Themeda triandra Renosterveld in the Heidelberg District

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Declaration

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and that I have not previously in its entirety or in part submitted it at any university for a degree.

Signature: .... Date: ....

Summary

This study investigated the composition of *Themeda triandra* Renosterveld in part of the Grootvadersbosch Conservancy and the effects of selected environmental and management variables to provide guidelines for promoting the presence of *Themeda triandra* in the veld.

The Zürich-Montpellier phytosociological method was used to determine the composition of the Renosterveld communities. The point quadrat method was used to determine the cover of *Themeda triandra* at three grass dominated sites and compare cover from one site with past cover measurements at the specific site. Ordination was used to examine the effects of the environmental and management variables on the plant communities.

Two community groups, five communities and five subcommunities were identified and described. The *Themeda triandra – Stoebe phyllostachys* Grassland Community Group consists of two communities of which one has two subcommunities. The *Themeda triandra – Elytropappus rhinocerotis* Shrubland Community Group consists of three communities of which one has three subcommunities.

The vegetation units described in this study have not been described previously in the literature. One community belongs to Silcrete Fynbos while another subcommunity is transitional between Renosterveld and thicket and gallery forest. The rest of the plant communities fit the definition for Renosterveld (the local Renosterveld type is Eastern Rûens Shale Renosterveld).

Cover of *Themeda triandra* did not differ significantly either between sites or between years. The comparison of *Themeda triandra* cover between years was done at a site that had been burnt between the last two sampling times yet the cover was not significantly different. This indicates that fire and other management practices did not have a negative impact on *Themeda triandra* at the site.

Unconstrained ordination of the dataset in which cover/abundance values were included, grouped the relevés by moisture and disturbance but the presence/absence dataset indicates that the two community groups have a slight transitional overlap. Constrained ordination of both datasets with a) soil variables and b) management variables, both showed a tendency to separate the relevés into community groups, that did not happen with topographic and vegetation variables. Ordination did not separate the community groups into their subdivisions.

The soil variables (both nutrients and texture) influence the vegetation structure and the community distribution.

Under the existing grazing management regime, fire at three to five year intervals promoted the dominance of *Themeda triandra* by affecting the structure of the plant communities, the abundance of

species other than *Themeda triandra,* and influencing which plant community is present. The use of fire as a management tool was regulated by the importance of the natural veld pastures to the farmers. The natural veld pastures are not suitable for dairy cattle in milk. Thus dairy farmers are less likely to burn the natural veld (no planned burns only chance fires) than those who farm with mutton or beef (planned burns on a three to five year interval).

Opsomming

Die studie het die samestelling van *Themeda triandra* Renosterveld in ’n deel van die Grootvadersbosch-Bewaria en die uitwerking van geselekteerde omgewings- en bestuursveranderlikes ondersoek om riglyne vir die bevordering van *Themeda triandra* in die veld daar te stel.

Die Zürich-Montpellier fitososiologiese metode is gebruik om die samestelling van die Renosterveldgemeenskappe te bepaal. Die puntkwadraat-metode is gebruik om ’n skatting van die dekking van *Themeda triandra* by drie gras-gedomineerde persele te bepaal en om ’n vergelyking te maak tussen die huidige en vorige dekking van ’n enkele perseel. Ordinasie is gebruik om die invloed van omgewings- en bestuursveranderlikes op die plantgemeenskappe te bepaal.

Twee gemeenskapsgroepe, vyf gemeenskappe en vyf subgemeenskappe is geïdentifiseer en gedefinieer. Die *Themeda triandra – Stoebe phyllostachys* Grasland-gemeenskapsgroep bestaan uit twee gemeenskappe waarvan een in twee subgemeenskappe onderverdeel is. Die *Themeda triandra – Elytropappus rhinocerotis* Struik-gemeenskapsgroep bestaan uit drie gemeenskappe waarvan een in drie subgemeenskappe onderverdeel is.

Die plantegroei-eenhede wat in die studie beskryf is, is nie voorheen in die literatuur beskryf nie. Een gemeenskap behoort aan Silkreet-fynbos en ’n ander subgemeenskap is ’n oorgangsfase tussen Renosterveld en struikbosveld of woud, terwyl die res van die plantgemeenskappe binne die definisie van Renosterveld val (die plaaslike Renosterveld tipe staan bekend as Oostelike Rûens Skalie-renosterveld).

Die bedekking van *Themeda triandra* het nie betekenisvol gevarieer tussen óf die verskillende lokaliteite óf die verskillende jare nie. Die vergelyking van *Themeda triandra*-bedekking oor tyd is onderneem in ’n gebied wat tussen opnames gebrand is. Die bedekking het nie betekenisvol verskil nie. Dit dui aan dat vuur en ander bestuurspraktyke nie ’n negatiewe invloed op *Themeda triandra* in hierdie gebied het nie.

Onbeperkte ordinasie van die datastel met die vergelyking van bedekking/volopheidwaardes, groepeer die relevés volgens vogtigheid en versteuring, terwyl die datastel ten opsigte van teenwoordigheid/afwesigheid aandui dat die twee gemeenskapsgroepe ’n effense oorgangs-oorvleueling het. Beperkte ordinasie van beide datastelle met a) grondveranderlikes en b) bestuursveranderlikes, toon albei ’n neiging om die gemeenskapsgroepe te skei, wat nie gebeur het met die topografiese- en plantegroeiveranderlikes nie. Ordinasie het nie die gemeenskapsgroepe onderverdeel in gemeenskappe of subgemeenskappe nie.

Die grondveranderlikes (beide voedingstowwe en tekstuur) beïnvloed die struktuur en die verspreiding van die plantegroei.

Met die bestaande weidingsbestuur bevorder brande met ’n interval van tussen drie tot vyf jaar die oorheersing van *Themeda triandra* deur die struktuur van die teenwoordige plantgemeenskap te beïnvloed, deur die getal van die verskillende plantsoorte te beïnvloed en selfs deur die plantgemeenskap se voorkoms te beïnvloed. Die waarde wat die boer aan die natuurlike veld as weiveld heg bepaal die mate waartoe hulle veldbrand gebruik as ’n deel van bestuur. Die natuurlike veld is nie geskik vir melkkoeie wat in die melkproduksiestadium is nie. Die melkboere is dus minder geneig om die natuurlike veld te brand (geen beplande brande nie net kans brande) as die boere wat met vleisbeeste of skape boer (beplande brande elke drie tot vyf jaar).

To my parents

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My family supplied emotional support and patiently helped me with the proofreading.

Structure of this thesis

This document is written in thesis-format with an introduction and literature review, methods, results, discussion and conclusions followed by sources of information (references and personal communication contact details) and appendices. The figure and table captions and references are provided following the latest South African Journal of Botany format.

Chapter 1 Introduction and Literature Review

1.1 Introduction

An analysis of historical literature of the incidence of mammals in the Cape Province of South Africa (Skead 1980), indicated that grasslands were far more widespread through the Winter Rainfall Region in the past (1600—1800's) than they are today. Determining the dynamics of the remaining *Themeda triandra* dominated patches of Renosterveld might indicate whether the present grasslands could have been more widespread and should provide a basis for restoration work through the region and give guidelines to facilitate management and retention of the natural vegetation.

Livestock grazes *Themeda triandra* preferentially in southern Africa (Danckwerts *et al.* 1983, Van Breda & Barnard 1991). Acocks termed it 'the staff of life to the grazing animal' as bread may be so regarded for humans (Zacharias 1990). This suggests that *Themeda triandra* is very important to farmers. A viable strategy for long term conservation of Renosterveld in the south coast is to persuade farmers to manage it as natural rangeland (Cowling *et al.* 1986), with conservation in this context defined as the retention of unploughed natural vegetation or maintenance of restored natural vegetation. One facet of this is to provide the farmers with information concerning the veld and the effects of management on it.

This project is planned to be complementary to a study (Milton & Krug 2000) on restoration of Renosterveld, in that it will provide information on one possible state the veld could be restored to in the South Coast Renosterveld. The aforementioned study aims to create a model with which to assess the efficiency of conservation and management strategies for restoration and make recommendations for enhancing them (Milton & Krug 2000).

Additionally, the project reported in this thesis will add an understanding of processes and information to the Botanical Society's study on conservation prioritisation based on the composition of Renosterveld patches in the Overberg (Von Hase *et al.* 2003). The flora and vegetation recorded from this site will be a valuable addition to their database.

1.2 Location of Study Area

The study area is located in the Overberg, or Rûens, of the South Western Cape Province, south of the Langeberg between Suurbraak and Heidelberg at Grootvadersbosch. The farms (Arkadia, Bergsig, D'Ou Gnu, Glen Etive, Grootvadersbosch[1] and Honeywood) are part of the Grootvadersbosch Conservancy.

The 1:500 000 map covering the area is Oudtshoorn SE35/20 (Trigonometrical Survey Office 1972). The relevant 1:50 000 maps are 3420BB Heidelberg (Kaap) (Chief Director Of Surveys & Mapping 1983a) and 3320DD Warmwaterberg (Chief Directorate: Surveys & Land Information 1985). Orthophoto maps do not exist for the grid squares 3320DD21 or 3320DD22. The orthophoto maps 3420BB1 Glen Etive (Chief Director Of Surveys & Mapping 1983b) and 33420BB2 Arkadia (Chief Director Of Surveys & Mapping 1983c) and electronic copies of Department of Water Affairs and Forestry (DWAF) aerial photographs (1999) covering all four orthophoto map areas were obtained from Surveys and Mapping, Mowbray, Cape Town.

1.3 Geology, Topography and Soils

The Fynbos Biome is subdivided into two physiographic elements: the Cape Folded Belt and the Coastal Forelands (Lambrechts 1979). The Coastal Forelands are split by Cape Hangklip into western and southern portions. The study area is located in the southern portion of the Coastal Forelands.

The site is in the Rûens immediately south of the Langeberg and south of the Grootvadersbosch Reserve. At this point the foreland slopes gradually from about 400 m towards the coastal plain (Lambrechts 1979, Malan *et al.* 1994). The Ruêns are formed by weathered Bokkeveld Group and Enon Formation rocks (Malan *et al.* 1994). The Grootvadersbosch hills on Bokkeveld Group shale separate the Kirkwood Formation of the Suurbraak and Heidelberg Valleys (Ellis 1973, Malan *et al.* 1994). The topography is undulating to rolling. Potberg at the coast is one of the discontinuous fold ridge remnants that characterize the Coastal Forelands (Lambrechts 1979).

The 1:250 000 soil map 3420 Riversdale (Coetsee 1993) indicates that the Ruêns, in which the study area is situated, occurs on the Devonian Bokkeveld Group, Bidouw Subgroup, described as shale and siltstone with occasional sandstone beds. The Ruêns includes high-level silcretes and ferricretes of the Tertiary, Grahamstown Silcrete Formation. Along the R322 road between Suurbraak and Heidelberg (on the edge of the Ruêns), the Kirkwood Formation of the Uitenhage Group (Cretaceous), consisting of reddish and greenish mudstone, sandstone with subordinate conglomerate lenses and greyish mudstone with tuff/bentonite layers, is present. Along the rivers, the Quaternary Bredasdorp Group is represented by the Strandveld Formation with light grey to pale red sandy soil (Coetsee 1993).

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[1] Groot Vaders Bosch is written as three words for both Mr K. Moodie's Farm and the conservancy but the reserve name, Mr A.J. Kruger's 'Estate' and the general area are one word, Grootvadersbosch. The official place names index recommends 'Grootvadersbosch' so this is the version of the name that will be used throughout the text for consistency.

Lambrechts & Schloms (1981) class the soils of the study area as shallow calcareous sands and loams and sedimentary lithosols. The soils of the study area are sedimentary lithosols. They are not calcareous.

The Glenrosa Form is the dominant soil form in the area. Ellis (1973) recorded the Glenrosa Form on Bergsig Farm and the Mispah Form adjacent to the study area. Cartref and Klapmuts Forms may be expected on the lower slopes in the area (pers. comm. Dr F. Ellis[2] 2005). The Mispah Form is mainly associated with silcretes here. Schloms *et al.* (1983) indicate that the Estcourt, Glenrosa, Sterkspruit and Swartland Forms are present in the study area. Both mountain and lowland soils were mapped on the farm Tradouw, west of the study area, by Kriel *et al.* (1997) and a report was drawn up by Lambrechts *et al.* (1997). The Cartref, Estcourt, Klapmuts, Sterkspruit and Tukulu Forms were found on the lowland areas of Tradouw that were not associated with moisture near the surface (Lambrechts *et al.* 1997, Kriel *et al.* 1997).

1.4 Climate

1.4.1 Introduction

The Mediterranean climate has seasonal and daily photoperiodicity. The high temperatures of summer coincide with low rainfall, producing a summer drought that is an important ecological factor for the vegetation. The rainfall is concentrated in the cold season (winter). The climate is further typified by the high variability of both annual and monthly rainfall. The climate is severe (Nahal 1981). Only the portion of the Fynbos Biome that lies west of Cape Agulhas has a true Mediterranean climate because east of Cape Agulhas the rainfall is not concentrated in the winter (Fuggle & Ashton 1979). Grootvadersbosch lies east of Cape Agulhas so it does not have a true Mediterranean climate.

The southern Cape is influenced by the warm Agulhas Current, which causes a humidity moisture gradient from the coast to the interior. The vapour pressure and surface layer moisture decreases with increasing distance from the Agulhas Current (Schulze 1980, Deacon *et al.* 1992). Across the Fynbos Biome there is a west to east evaporation and solar radiation gradient. The east has less evaporation and solar radiation and a lower temperature amplitude than the west (Deacon *et al.* 1992). Thus there is likely to be less water stress for vegetation in the east than in the west.

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[2] Contact details for all personal communications may be found under Personal Communications in Sources of Information.

The average annual evaporation from a Symons pan is 1397 mm and from a class 'A' pan, 1651 mm (Schulze 1980[3]).

The amount of solar radiation is much greater in summer (mean ~29 MJ m^{-2} d^{-1}) than in winter (mean < 11 MJ m^{-2} d^{-1})(Schulze & McGee 1978, Schulze 1997). In midsummer (22 Dec.), level ground receives the most solar radiation of all aspects. This means that level ground will be hotter than the slopes in summer. This pattern holds around the equinoxes (22 Mar./Sept.) and midwinter (21 June) except for the north, north-easterly and north-westerly aspects where the steeper slopes get more solar radiation (Schulze 1997).

The area south of the Langeberg Mountains has about ten days without sunshine annually. The average annual number of days with less than 10% of the possible sunshine is about thirty-five, while about 240 days a year have more than 50% of the possible sunshine of which about fifty days have more than 90% of the possible sunshine. The annual average of possible bright sunshine is about 60%. The area south of the Langeberg Mountains is cloudy by South African standards with four to five tenths of the sky be covered on annual average (Schulze 1980).

Thunder storms are rare being experienced on average only five days per year (Schulze 1980). Swellendam (station at 34°02' S; 20°27' E) has a lightning flash density of 0.32/km^2/yr which is low for the Fynbos Biome (Kruger 1979a). This means that there are about 416 ground strikes per year within 20 km of the flash counter in the Swellendam area. The Southern Cape is not very prone to thunderstorm activity (Kruger 1979a).

Summer mists reduce water loss (Deacon *et al.* 1992). Nagel estimates that on the coastal lowlands at about 32°S and 20°E the fog precipitation is equivalent to 300 mm a^{-1} (Schulze & McGee 1978, Schulze 1997). The study area is adjacent to this and probably has about the same amount of fog precipitation.

The annual surplus water available is less than 100 mm. This surplus occurs in winter. The annual water deficiency, 200—399 mm, occurs in summer (Schulze & McGee 1978). Grootvadersbosch is therefore generally very dry in summer and wet in winter.

The Köppen climate classification for the region is Bsk (arid zone, steppe climate, dry-hot with mean annual temperature below 18°C) (Schulze & McGee 1978). The link between the Köppen climate and vegetation is not very strong (Quézel 1981, Schulze & McGee 1978).

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[3] All averages from Schulze (1980) are read off maps. If the study area lies between to measures the midpoint is used. The same method is used for values from maps from Schulze & McGee (1978).

1.4.2 Wind

Winds along the coast tend to be parallel to the coast with an east-west axis on the south coast and may be strong especially in spring (Fuggle & Ashton 1979, Schulze 1980, Deacon *et al.* 1992). Inland from Cape Hangklip eastward the prevailing winds are roughly east and west, with easterly winds are most frequent in summer (Fuggle & Ashton 1979, Deacon *et al.* 1992). Hot berg (or foehn) winds start about the first week in March and last until August. The wind ends suddenly and is followed by rainy weather from the west (Ellis 1973). Berg winds may occur one to three times a month (Schulze 1980).

1.4.3 Precipitation

The eastern part of the Fynbos Biome receives rainfall throughout the year with a bimodal peak of rainfall at Swellendam and Mossel Bay, caused by the high number of ridging anticyclones and cut off low pressure cells that occur in spring and autumn, while Port Elizabeth has more evenly distributed rainfall (Fuggle & Ashton 1979, Deacon *et al.* 1992). The precipitation of South Africa is dominated by anticyclonic circulation patterns (Tyson 1978). The study area is in the region of transition between winter and summer rainfall. The rainfall south of the Langeberg is mainly cyclonic or orographic in origin (Schulze 1980). The southern Cape is affected by the sixteen to twenty year rainfall oscillations of the summer rainfall area but that the dominant oscillations in rainfall follow a weak ten to twelve year cycle (Tyson 1978).

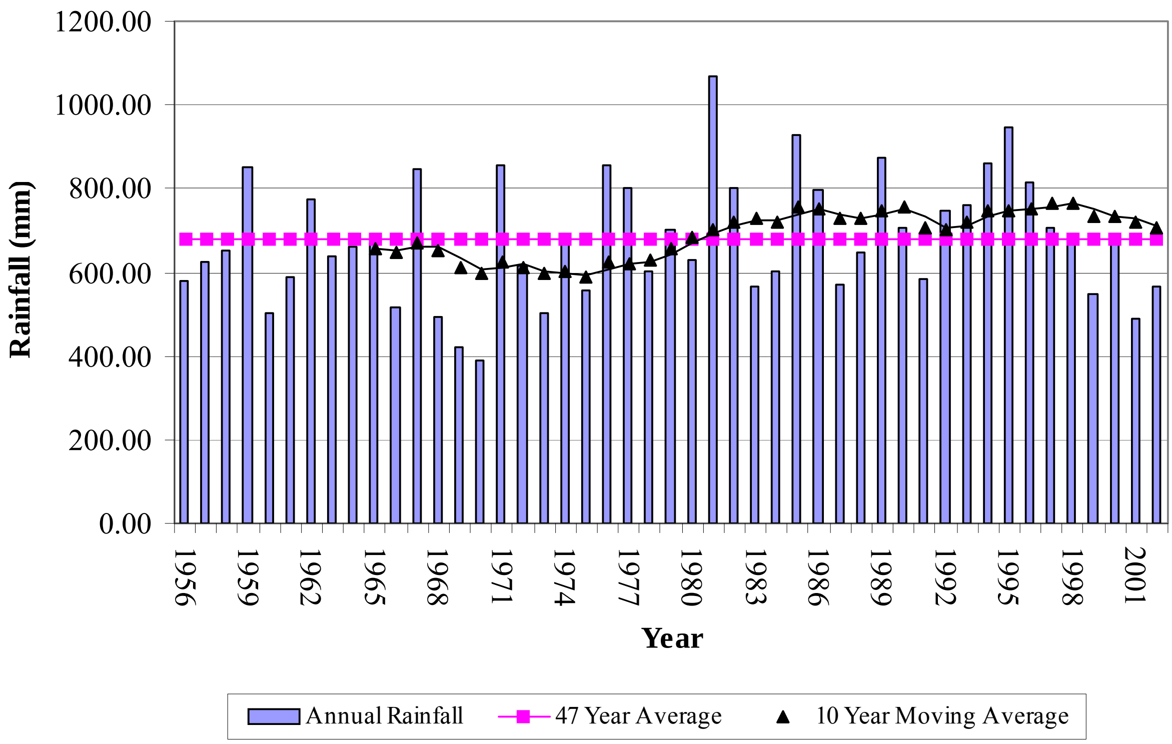

Figure 1.1: Annual Rainfall from 1956 to 2002 for the Grootvadersbosch Farmstead

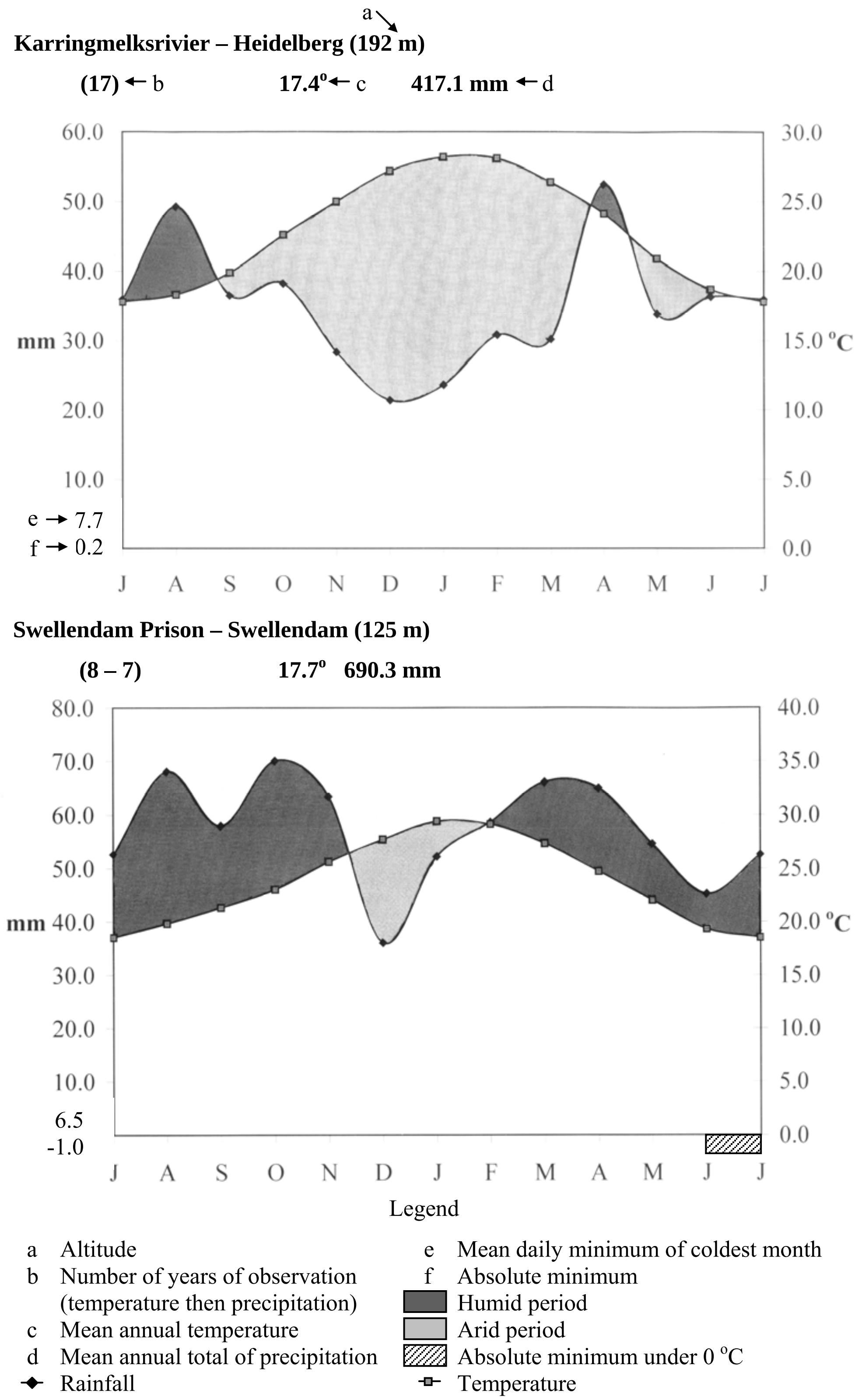

Figure 1.2: Walter-Leith Klima-diagrams for Karringmelksrivier and Swellendam. Data from Section Agrometeorology, Soil and Irrigation Research Institute (not dated)

Rainfall varies from less than 300 mm to upwards of 2 500 mm and is strongly affected by the topography and exposure to the prevailing winds (Fuggle & Ashton 1979). The rainfall extremes as percentages of the normal rainfall are 60% minimum and about 163% maximum. On average about eighty days have more than 0.25 mm of rain with about ten of these having more than 10 mm of rain (Schulze 1980).

Hail occurs infrequently and frost is very rare. Snow may occur once or twice a year on the Langeberg Mountains (Schulze 1980).

Swellendam Prison Weather Station (34°2'S; 20°27'E) at Swellendam is west of the study area and Karringmelksrivier Weather Station (34°8'S; 20°46'E) near Heidelberg is south of the study area (Section Agrometeorology not dated). Annual rainfall data from 1956 onwards and monthly rainfall data from 1960 onwards, are available from the Grootvadersbosch Farm homestead (see Appendix 1).

The annual rainfall pattern is illustrated in Figure 1.1. The ten-year moving average shows a dry cycle (less than the 45 year average) from 1967 to 1981 and a wet cycle (more than the 45 year average) from 1981 to 2002. The highest annual rainfall on record is in 1981 with 1 067 mm and the lowest recorded is 1970 with 391 mm. The monthly rainfall averages show a distinctive bimodal pattern with peaks in autumn and spring (Fig. 1.2).

1.4.4 Temperature

The mean annual temperature for the region in which the study area is located is 17°C. The mean annual range of temperature is 9°C. The mean summer maximum and winter minimum are 25°C and 8°C respectively (Schulze & McGee 1978). For January, the average maximum daily temperature is 26°C with extremes reaching 42°C and for July, 19°C with extremes reaching 32°C. For January, the average minimum daily temperature is 15°C with extremes reaching 4°C and for July, 7°C with extremes reaching -4°C (Schulze 1980).

Since 1948, temperature data have been collected at 8 am and 2 pm at weather stations in South Africa as standard practice (Weather Bureau 1986). The average monthly maximum temperature is shown in Figure 1.2. Table 1.1 shows the extreme maximum and minimum temperatures recorded for each month.

Table 1.1: Daily temperature extremes for each month from the Karringmelksrivier (1973—1989) and Swellendam Prison (1981—1989) Weather Stations[1]

Month	Karringmelksrivier		Swellendam Prison	
	Highest Temperature (°C)	Lowest Temperature (°C)	Highest Temperature (°C)	Lowest Temperature (°C)
January	41.2	10.3	41.0	10.0
February	43.0	9.2	42.5	7.6
March	39.3	7.0	38.8	6.2
April	38.0	6.0	37.4	3.1
May	34.6	4.0	34.0	2.2
June	31.0	1.3	30.2	-0.3
July	30.0	0.7	29.0	-1.0
August	32.0	0.2	32.0	0.0
September	35.0	2.0	33.8	0.8
October	38.2	4.0	38.6	2.8
November	40.0	6.5	38.1	5.5
December	42.0	7.0	40.0	7.4

[1] Information from Section Agrometeorology (not dated)

1.5 Palaeoecology and history of the area

1.5.1 Palaeoenvironment and vegetation

Deductions concerning palaeoecology are based on such sources of information as pollen and faunal remains (Avery 1983, Coetzee *et al.* 1983, Klein 1983). Archaeological sites of importance in unravelling palaeoecology include Noordhoek (in the southwestern Cape Province 200 km west of the study site) (Coetzee *et al.* 1983). Figure 1.3 highlights some of the environmental and vegetation changes from the Cretaceous Period to the Pleistogene Period.

1.5.2 Historical Evidence of the Nature of the Vegetation

Hendey (1983a) suggests that modern biota developed over approximately 20 million years (during the late Tertiary and Quaternary Sub-eras). In contrast, Coetzee *et al.* (1983) suggest that modern vegetation developed in the last 18 000 years B.P., after the last glacial maximum. It is probable that the above authors are considering different taxonomic levels in their estimates of the development of modern biota.

Pollen and charcoal are sources of information on palaeobotany. Pollen data are biased by the 'different production and transport qualities of various taxa' and charcoal is biased by the selection of firewood by prehistoric people (Scott *et al.* 1997).

Myr	Era	Sub-Era	Period	Epoch	Environment and vegetation
0.002					Open vegetation on the coastal lowlands
0.003				Holo-	S coast flats grassland + dense vegetation, hills shrubland
				cene	Environment not significantly different from historic
0.005					
0.007					S coast flats open grassland, hills shrub invasion reducing grass-like part
					Shrubs increased though grass still important
0.010					
0.013					Grass dom., dense veg. rivers, S coast flats, hills grass-like veg. + dense veg.
0.015					Clay and fauna show grass dom. lowlands, Cango Valley veg up density
0.018					
					Late Sub-era glacial shrubs & grass more = represent., trees & grass > now
0.030					Cango Valley vegetation became more arid
		Quarter-			Shrub prominence up interglacials, glacials shrubs prominent mountains
		nary	Pleisto-		Cango Valley hills open & grass-like veg., valleys more dense veg.
0.065			gene		Grassland with dense veg. S coast flats, hills open & grass-like veg.
0.080					Cango Valley open veg., dense near rivers, in valleys, hills grass-like veg.
					Colder intervals of interglacial favoured grasses
0.128				Pleisto-	
	Ceno-			cene	
	zoic				
0.5					
0.8					Grasses prominent, savanna
1.6					Vegetation combinations of woodland, savanna, shrubland and grassland
					Trees prominent western coastal lowlands
3.0				Plio-	Summer dry/winter wet starts, poles glaciated, atmospheric circulation ~ now
				cene	Temperate climate with frequent fires
5.3					Relationship modern vegetation clearer, gradient forest to grassland
7.0					Fynbos taxa more prominent, Poaceae well represented
			Neo-		
		Ter-	gene		
11.9		tiary			
				Mio-	Forest, woodland with grassy spaces & some dense undergrowth
				cene	Subtropical-tropical rainforest with Proteaceae and Restionaceae
24.6					
			Paleo-		Dry subtropical forest lowlands, sclerophyllous shrubs mountains
			gene		
65.0					Angiosperms prominent, southern Africa flora distinctive
	Meso-		Creta-		
113	zoic		ceous		Bisaccates similar to *Podocarpus*

Figure 1.3: Palaeoenvironment and vegetation with information from Deacon (1979a), Avery (1983), Coetzee *et al.* (1983), Deacon (1983a), Hendey (1983a, b) and Klein (1983). From small mammal remains, grass-like vegetation (either restioid or grassy) may be deduced but not the specific vegetation (Avery 1983). Myr = million years before present, veg. = vegetation, dom. = dominant, S = south, represent. = representation

Elytropappus rhinocerotis pollen was virtually absent in the Norga peat. Norga is about two kilometres west of Blanco in the George area. The peat samples dated from about 4 000 years B.P. Modern day

Renosterveld has an extremely high proportion of *Elytropappus rhinocerotis* in the pollen spectra (Scholtz 1986). Of pollen from about 32 000 years B.P. (late Pleistocene Epoch (Deacon 1983a)) at Boomplaas, 58 per cent was cf. *Elytropappus* and this increased to 78 per cent in the sample from about 20 000 years B.P. (late Pleistocene (Deacon 1983a)). Pollen samples from the early Holocene Epoch (about 10 000 years B.P.) had more species with a higher percentage of Poaceae (Deacon and Lancaster 1988). Based on the Boomplaas pollen data, the dominance of *Elytropappus* cannot in all cases be attributed to man (Scholtz 1986). It should be noted that Boomplaas Cave is not on the coastal lowlands but inland across the mountains, which may indicate different conditions to those of in the study area. The low relative abundance of *Elytropappus rhinocerotis* and the prominence of Poaceae ('grass pollen can generally not be distinguished below family level' (Scott *et al.* 1997)) in the Norga fossil pollen spectra support the view that Renosterveld was marginal to grassland in areas with sufficient moisture and that the prominence of *Elytropappus rhinocerotis* is due to overexploitation of the veld (Scholtz 1986).

In 1772, at Buffeljagsrivier about 10 km east of Swellendam, Thunberg noted that the grass increased and the plains started to look like meadows and the herds of cattle and flocks of sheep increased in size and frequency (Skead 1980). Sparrman noted deterioration in the veld condition, indicated by the increase in *Elytropappus rhinocerotis*, as early as 1775. The colonists acknowledged that their grazing practices were the cause of the deterioration. A farmer, who burnt *Elytropappus rhinocerotis* to get rid of it, found that it came up thicker than before (Sparrman 1971, Skead 1980).

1.5.3 Historical Incidence of Mammals in the Swellendam/Grootvadersbosch Region

Knowledge of the mammals historically occurring in an area allows deductions (based on diet and feeding habits) about the nature of the vegetation that occurred. Hendey (1983a) notes that the presence or absence of animals indicates changes in the environment and vegetation, for example, *Otocyon megalotis* (bat-eared fox) now occurs at Grootvadersbosch (pers. obs.) but is not recorded in the area in any of the journals analysed by Skead (1980). Historical records are difficult to decipher because of inadequate descriptions and the variety of names used to describe the different species. Many names were based on European animals familiar to the recording travellers. Groups such as bats are not recorded in sufficient detail to be identified in historical writings (Skead 1980). Klein (1983) supplies a list of large (>0.75 kg) mammals historically occurring in the Southern Cape. In this section, only those species mentioned in Skead (1980) as occurring in the Swellendam/Grootvadersbosch area with direct impacts on the Renosterveld are discussed.

The decline of *Panthera pardus* (leopard) (historically present (Skead 1980)) population may have led to increases in *Papio ursinus* (baboon) (Hendey 1983a) and *Hystrix africaeaustralis* (porcupine) populations. Baboons are omnivorous with a diet including grasses, seeds, fruit, pods, roots, bulbs, flowers, bark, shoots and leaves. Porcupines take bulbs, roots and tubers (Skinner & Smithers 1990). An increase in the population density of these animals might have changed the densities of certain geophytes in recent time.

The presence of grazing animals in the area at the time of European colonisation provides evidence that there was a substantial grass component in the vegetation at that time. The following grazers are known to have occurred in the region: *Syncerus caffer* (buffalo), *Equus zebra* (Cape mountain zebra), *Equus quagga* (quagga), *Damaliscus dorcas dorcas* (bontebok) and *Alcelaphus buselaphus* (red hartebeest) (Skead 1980, Skinner & Smithers 1990). The buffalo, that gave Buffeljagsrivier its name, had disappeared by 1819 (Skead 1980). Buffalo will as readily eat old grass as new growth after a burn but avoid trampled or overgrazed areas. Preferences include *Themeda triandra* and *Heteropogon contortus*. The Cape mountain zebra favour *Themeda triandra*, *Cymbopogon plurinodis* and *Heteropogon contortus* in that order and take the seed heads of *Eragrostis curvula* but will also take browse (including *Acacia karroo*) (Skinner & Smithers 1990). Bontebok include *Eragrostis capensis* in their diet. Red hartebeest will browse if need be but favour short grass including *Themeda triandra* and *Cynodon dactylon* (Skinner & Smithers 1990). Red hartebeest were locally abundant but not common throughout the Southern Cape (Klein 1983).

The presence of mixed feeders and browsers in the area in the 1600—1800's suggests that the vegetation included a shrubby component or comprised a grassland-shrubland mosaic. Mixed feeders and browsers reported by early travellers included *Diceros bicornis* (black rhinoceros) - extinct in the region by 1819, *Raphicerus campestris* (steenbuck), *Hippotragus leucophaeus* (blue antelope) (now extinct), *Philantomba monticola* (blue duiker) (possibly), *Antidorcas marsupialis* (springbuck) (possibly), *Sylvicapra grimmia* (grey duiker, common duiker), *Raphicerus melanotis* (Cape grysbok), *Oreotragus oreotragus* (klipspringer), *Pelea capreolus* (grey rhebuck) and *Tragelaphus scriptus* (bushbuck) (Skead 1980, Skinner & Smithers 1990).

1.5.4 History of Human Presence in Region

Knowledge of the past relies on artefacts and remains (Christopher 1982). The acid soils of the Fynbos Biome make stone artefacts more reliable indicators of human presence than fossils (Deacon 1992). There are stone artefacts (scrapers and hand axes) on the Grootvadersbosch Farm (pers. obs.). The fossil records nearest to the study area are those at the Boomplaas Cave (33°23'S 22°11'E) in the Cango Valley in the foothills of the Swartberg about four kilometres from the Cango Caves. Boomplaas Cave has Middle Stone Age remains (Deacon 1979b, Deacon 1983b, Deacon *et al.* 1983). Coastal archaeological sites, such as the Klasies River Mouth caves at the coast near Humansdorp and Herolds Bay, also provide valuable information (Deacon 1983b).

Swartkrans Cave, at Plettenberg Bay, contains deposits with burnt bones dating from about a million years B.P. indicating that the hominids of that time used fire (Brain & Sillen 1988).

Acheulian artefacts of the Early Stone Age (more than 200 000 years B.P., middle Pleistocene Epoch) occur extensively on the coastal platform and in intermontane valleys in the Fynbos Biome indicating a long history of human influence on the vegetation. The sites, usually situated in valley bottoms and near a water source, are mostly in the open air with only the stone artefacts preserved. The incorporation of Acheulian artefacts in colluvial deposits has resulted in the disturbance of the original context. There are more sites for the Middle Stone Age (late Pleistocene Epoch, about 125 000 years B.P.) than for the Earlier Stone Age in the Fynbos Biome. Human remains from the Middle Stone Age (more than 100 000 years B.P.) indicate that man was physically modern at that time. The vegetation of the Fynbos Biome has been subjected to some form of fire management for a minimum of 100 000 years B.P. (Deacon 1983b).

The people of the Later Stone Age (prior to 21 000 years B.P.) (late Pleistocene Epoch (Deacon 1983a)) were part of the pan-Bushman lifestyle in which little regional differentiation occurred in southern Africa (Christopher 1982, Deacon 1992). The hunter-gathers impacted the populations of their plant and animal food sources and possibly overexploited some of them. The use of fire affected the veld whether by design or accident (Hendey 1983a). Christopher (1982) considers the San (hunter gathers) and the Khoi (herders) were extremes of a continuum - i.e. closely related. The population apparently increased in the Holocene Epoch (from 10 000 years B.P.) as evidenced by the increase in the number of archaeological sites. The richer habitats of the southern Cape have large numbers of burial sites (Deacon 1992). The population increase would have resulted in increased pressure on the natural environment.

About 8 000 years ago, burning was used to manipulate the veld to ensure a good supply of geophytes and to attract game (Avery 1981). The herders also burned the veld to improve the grazing - a practice detrimental to shrubs and trees (Tansley 1982, Hendey 1983a). The fire was started after the area had been grazed, prior to leaving (Tansley 1982).

The hunter-gathers (San) gave way before the herders (Khoi) until they were confined to the desert areas (Christopher 1982). Herding became important in the Fynbos Biome about two thousand years ago and spread with the Khoi (Deacon 1992) and later with colonists from Europe. The archaeological site, De Kelders near Gansbaai, suggests that sheep preceded cattle by several hundred years (Deacon 1992). Dias bartered sheep and cattle from the natives at Mossel Bay in 1488 (Axelson 1973) indicating that both were present before Caucasian settlement. Notes in Van Riebeeck's journal indicate that the Khoi had livestock enough to create the potential for overgrazing of pastures (Hendey 1983a).

From the above, it is clear that the Fynbos Biome has been subject to management for thousands of years prior to the advent of European man. Fire management was applied and migratory grazing was practiced.

After colonial settlement in 1652, timber was in demand. The Afromontane Forest patches in the Swellendam area, particularly, were heavily exploited for the next century (Deacon 1992). Sparrman (1971) mentions the timber at Grootvadersbosch in the 1770's. Most of the valuable timber was removed before 1797, however, timber was still listed as one of the principal sources of revenue along with grain, butter, soap and dried fruit (Barrow 1968). The timber at Grootvadersbosch was of great botanical interest but the travellers found it difficult to identify the trees because they could find only a few species in flower. Sparrman noted in 1775, that the country around was 'extremely dry and arid' because of unusually low rainfall but the forest had attracted sufficient moisture to sustain itself during this drought period (Sparrman 1971, Skead 1980).

The first settlement in the Swellendam area was on loan places, which had uncertain tenure. In 1743, when Swellendam itself was founded, a free-hold conversion of 125 acres (50.5875 ha) around the farm house was allowed but few settlers made use of this free-hold. Swellendam became the seat of a magistrate in 1745 (Christopher 1976). The magisterial district of Swellendam stretched from the Breede River to the Camtoos River (*sic*) (now Gamtoos River) between the Swartberg and the sea (Barrow 1968). On 17 June 1795, the people of Swellendam deposed the magistrate because of poor governance and declared a republic. The republic lasted until the British came - about three months after declaration (Bulpin 1980). The British first took the Cape in September 1795 and withdrew in 1803 (Barrow 1807, 1847). Swellendam was a village comprising 20 to 30 cottages in 1798 (Barrow 1968). The first church was built in 1802 (Bulpin 1980). In about 1812, a missionary (Campbell) passing through Swellendam considered that the town had attractive buildings in a desert (Hulbert 1817). Swellendam was severely damaged by a fire in 1865. The town also had trouble with persistent drought (Bulpin 1980).

By 1760, the whole of the Fynbos Biome was within the area farmed by colonists. Land use was extensive, not intensive (Deacon 1992). By 1806, many of the graziers still did not hold any land title (Christopher 1976). Proximity to market meant that stock farming preceded cultivation on the frontier (Deacon 1992).

The British acquired the colony again in 1806. The British did not like the 'uncontrolled nature' of the loan-place system under which people avoided regulations on land hold and reduced the value of Crown Land by squatting on it. All of which resulted in reduced revenues for the Crown. Sir John Cradock, appointed governor in 1811, made the first move towards permanent policy. New regulations in 1813 allowed farms of 6 000 acres (2 428.2 ha) to be granted on a permanent rental. This initially resulted in an increase in squatting but also allowed farmers with grants to begin 'improving' their land. A second survey was carried out in 1828, which helped to resolve some of the problems. The second system allowed for variable rents according to grazing return (Christopher 1976).

Wheat growing extended the arable farming frontier after deciduous fruit and viticulture. Individual ownership of land led to land degradation that is most visible in Renosterveld (Deacon 1992).

Suurbraak started in 1809 as a station of the London Missionary Society. Heidelberg was planned in September 1855 when the Riversdale Church Council bought a piece of the farm Doornboom (owned by the Gous family since 1725) for the purpose of setting up a town. The first plots were sold in November 1855 (Bulpin 1980).

By 1855, there were between 12.9 and 25.6 livestock units per square mile (259.21 ha) in the Swellendam area and 0.5—1 per cent of the district was under cultivation (Christopher 1976).

The veld management changed after the advent of European settlement by changing the fire management and grazing all year round (non-migratory).

There is NO undisturbed vegetation left in the Cape because in even the most remote areas, the vegetation is impacted by the changes in fire frequency caused by man's use of fire, the introduction of alien species after 1652 and the decrease in the mammal populations (Hendey 1983a). The browsers would have maintained a more open shrub canopy allowing stands of grass for the grazers. The large mammals would have impacted nutrient cycling by dung deposition and carcass residues. The large mammals would have played a role in seed dispersal and the viability of seed requiring scarification by stomach acids. It is likely that grass was more abundant prior to the decline of the large mammals. Domestic animals are not an adequate replacement for the large mammals and tend to degrade the veld further. The continuous shrubland of the coastal lowlands is thought to be a result of human interference in local ecosystems (Hendey 1983a).

1.5.5 History of the Farms that were Sampled

The study site consists of the following farms in the Grootvadersbosch Conservancy between Suurbraak and Heidelberg: Arkadia, Bergsig, D'Ou Gnu, Glen Etive, Grootvadersbosch and Honeywood.

The site can be described as a series of drainage line valleys separated by hills. The hilltops are mostly under cultivation but the slopes still have natural vegetation.

Settlers have been on the land since the 1700's (the Grootvadersbosch farmhouse was built in 1735). The Moodie family has owned and farmed the land since the 1800's (pers. comm. Mr K. Moodie 2001—2003). Their farm was originally much more extensive than it is at present – probably including most of the farms in this study. The family still has two farms: Grootvadersbosch (Mr K. Moodie) and Honeywood (Mr J. Moodie).

An ancestor of the present Moodies, J.W.D. Moodie, whose brother had the family farm, wrote a book, 'Ten years in South Africa: including a particular description of the wild sports of that country' published 1835, that is one of the sources used by Skead (1980). He wrote about the period between 1819 and 1829. It is indicated that then, already, the family was 'old and established' (Skead 1980).

At the time the sampling was done for this study, the area was suffering from drought and some of the farmers were using the veld more heavily than normal to reduce the feed costs. The farming activities on the farms studied are sheep, cattle and dairy farming and bee keeping (see Appendix 6 for more detail).

1.6 Classification of Study Area on Vegetation Maps

Acocks's 1:1 500 000 map categorises the study area as Veld Type No. 70 (False Fynbos) and Veld Type No. 46 (Coastal Renosterveld) (Acocks 1947). False Fynbos (Veld Type No. 70) was incorporated in Mountain Fynbos (Acocks's Veld Type No. 69) by Taylor (1978). Cowling (1984) supported this and separated Grassy Fynbos from Mountain Fynbos. The portion of the study area categorised as False Fynbos (Veld Type No. 70) is presently a mosaic of Fynbos and Renosterveld.

The 1:250 000 'Vegetation of the Fynbos Biome' map (Moll & Bossi 1983) maps the study area as South Coast Renosterveld, whereas the 'Vegetation of South Africa, Lesotho and Swaziland' 1:1 000 000 map by Low & Rebelo (1996a) maps the study area as South & South-west Coast Renosterveld. More recently, Cowling & Heijnis (2001) 1:250 000 map the area as Riversdale (secondary Broad Habitat Unit (BHU)) Coastal Renosterveld (primary BHU) and Suurbraak (secondary BHU) Grassy Fynbos (primary BHU). The latest 'Vegetation map of South Africa, Lesotho and Swaziland' (Mucina & Rutherford 2004) describes the vegetation as Eastern Ruêns Shale Renosterveld, Ruêns Silcrete Renosterveld, Swellendam Silcrete Fynbos and Muscadel Alluvial Vegetation in and around the study area.

1.7 Renosterveld

1.7.1 Introduction

Rehman identified the flora of the South Western Cape as unique in 1880. The boundaries of the area were adjusted by Bolus in 1886 (Werger 1978). The Fynbos or Macchia Biome was one of five defined by Van der Schijff (1971). Fynbos is recognised as a vegetation unit by Taylor (1972a) though he does not use the term 'biome'.

Renosterveld is part of the Cape Floristic Region (CFR) (Goldblatt & Manning 2000) and the Fynbos Biome (Rutherford & Westfall 1994). The Fynbos Biome makes up the bulk of the CFR (Rutherford & Westfall 1994), but the CFR does not include the Fynbos and Renosterveld outliers toward the north and east (Low & Rebelo 1996b). Some differences exist as to which other biomes are part of the CFR. The most consistent listing is that the CFR contains four biomes: the Forest Biome, the Fynbos Biome, the Succulent Karoo Biome and the Thicket Biome (Cowling & Holmes 1992, Cowling & Richardson 1995, Goldblatt & Manning 2000). Low & Rebelo (1996b) consider the CFR to consist of five biomes with the fifth being the Nama Karoo Biome. Rutherford & Westfall (1994) do not recognise a Thicket Biome and Goldblatt (1997) lists Renosterveld as a fifth biome. Rutherford & Westfall (1994) include the Savanna Biome in the Oudtshoorn area in the CFR as a fifth biome. Most descriptions of vegetation in the CFR and Fynbos Biome deal with Fynbos vegetation and provide little information on Renosterveld.

The CFR has about 9 000 plant species with about 69% of the constituent species being endemic and five endemic families. The richness is comparable with the moist tropics but is less than the neotropics (Goldblatt & Manning 2000). Fynbos has more than 7 000 endemic species, while Renosterveld has about 1 000 endemic species (Low & Rebelo 1996b). The high proportion of the Restionaceae and the relatively low proportion of the Poaceae are considered diagnostic of the Fynbos Biome (Rutherford & Westfall 1994). The Poaceae become more dominant east of 23°E longitude (Cowling & Holmes 1992, Kruger 1979c, Rutherford & Westfall 1994). The Poaceae become more important in the fynbos as the soil fertility increases and as the proportion of summer rainfall increases (Kruger 1979c). The site of this project (at Grootvadersbosch) is east of 20°E longitude and is mostly dominated by *Themeda triandra* suggesting that the delimitation from only east of 23°E longitude is conservative.

Threats to the Fynbos Biome, and particularly to the Renosterveld component on more fertile, less stony soils include urbanization, alien plant invasion, misuse of fire and agriculture (Low & Rebelo 1996b).

1.7.2 Terminology and Definition

The spelling 'Renosterveld' is preferred to all other spelling variants as being the most correct (Afrikaans) and least likely to cause confusion (Boucher 1980). Cowling *et al.* (1988) and Rebelo *et al.* (1991) partially translate Renosterveld to Renoster Shrublands. This thesis uses 'Renosterveld' as recommended by Boucher (1980).

Renosterveld is not a heathland because ericoid shrubs do not have a constant presence (Taylor 1978). Renosterveld is a South African Mediterranean shrubland on base-rich soils (Cowling *et al.* 1986). Renosterveld may occur on acid soils and Fynbos may occur on 'base-rich' soils (Mucina & Rutherford 2004).

Tansley (1982) considers Coastal Renosterveld to be an ecotonal (transitional) vegetation type between Mountain Fynbos (Acocks' Veld Type No. 69) and Strandveld (Acocks' Veld Type No. 34) or Coastal Fynbos (Acocks' Veld Type No. 47). Boucher (1983) suggested that West Coast Renosterveld was derived from Mountain Fynbos. Boucher (1987) found West Coast Renosterveld to be Fynbos or Pseudofynbos. Boucher (1987) used the term 'Pseudofynbos' to refer to communities lacking in typical Fynbos taxa and/or typical Fynbos structure.

Cape Transitional Small-leaved Shrublands, which include Renosterveld, are defined as having (a) phytochorological spectra dominated by 'ecological and chorological transgressor species' that link the

Cape Region with adjacent phytochoria, especially the Karoo-Namib and Afromontane Regions with about a third of a sample of flora being Cape endemics; (b) lower regional endemism than Fynbos with endemics that do not belong to typical Cape genera (Cowling 1984, Moll *et al.* 1984); (c) small-leaved shrubland structure with heaths, restioid and proteoid growth forms almost absent and deciduous geophytes prominent in richness and grass dominating the 'field layer' (Cowling 1984, Moll *et al.* 1984, Rebelo 1996a); (d) an ecological distribution restricted to areas with at least 30% winter rain (Cowling 1984) and 250—600 mm average annual precipitation (rarely to 200 mm) on fine grained soils formed from Cretaceous mudstones and conglomerates, Klipheuwel Formation, Malmesbury and Cango Group phyllites, Bokkeveld Group shales, Cape Granites and the tillites and shales of the Karoo Supergroup (Taylor 1978, Kruger 1979b, Cowling 1984, Rebelo 1996a) that are usually more fertile than the soils Fynbos is found on (Taylor 1978, Boucher 1983, Cowling 1984, Moll *et al.* 1984, Cowling & Richardson 1995, Rebelo 1996a). The Cape Transitional Small-leaved Shrublands include Acocks's Veld Types Mountain Renosterveld (Veld Type No. 43), Coastal Renosterveld (Veld Type 46) and Karroid *Merxmuellera* Mountain Veld (Veld Type No. 60) (Cowling 1984). Cowling (1984) does not define Renosterveld within the Cape Transitional Small-leaved Shrublands.

Newton & Knight (2004) point out that Renosterveld is not ecologically homogenous and suggest that the definition for the Renosterveld is 'those parts of the country where renosterbos will grow' that have not been assigned to 'some other veld type'. Acocks, himself, did not map Mountain Renosterveld where he felt it had invaded other veld types (Acocks 1988).

1.7.3 Types

Table 1.2 shows the relationships between different categories of Renosterveld. Mountain Renosterveld (Acocks' Veld Type No. 43) is listed as a False Karoo Type because of its degenerate state, which Acocks considered to have been grassy formerly while he considers Coastal Renosterveld (Acocks' Veld Type 46), to be a Temperate and Transitional Forest and Scrub Type (Acocks 1988).

Cowling & Heijnis (2001) split Renosterveld into four primary BHU's, Fynbos/Renosterveld Mosaic, Coast Renosterveld, Inland Renosterveld and Mountain Complexes. The secondary BHU's for the Coast Renosterveld (the Renosterveld primary BHU relevant to the study area) are, Boland, Overberg, Riversdale and Swartland (Cowling & Heijnis 2001).

Table 1.2: Renosterveld types recognised from literature
The BHU's of Cowling & Heijnis (2001) were not included as these units are land class units and are not intended as vegetation units. Note that the groups containing the vegetation at Grootvadersbosch are identified using a bold font.

Author	**Renosterveld Types**					
Acocks (1947, 1988)	Mountain			**Coastal**		
Moll & Bossi (1983), Moll *et al.* (1984),			Central Mountain	West Coast	South West Coast	**South Coast**
Low & Rebelo (1996a, b)	North-western Moun-tain	Escarp-ment Moun-tain	Central Mountain	West Coast	**South & South-west Coast**	
Mucina & Rutherford (2004)	Namaqualand Granite	Roggeveld Shale	Breede Alluvium Breede Shale Central Mountain Ceres Shale Kango Matjiesfontein Shale Montagu Shale Nieuvoudtville Shale Robertson Granite Swartberg Shale Vanrhynsdorp Shale	Peninsula Shale Swartland Alluvium Swartland Shale Swartland Silcrete	Baviaanskloof Shale Central Ruêns Shale **Eastern Ruêns Shale** Humansdorp Shale Langkloof Shale Mossel Bay Shale **Ruêns Silcrete** Uniondale Shale Western Ruêns Shale	

1.7.4 Eastern Ruêns Shale Renosterveld

Descriptions of the map units for the 'Vegetation map of South Africa, Lesotho and Swaziland' (Mucina & Rutherford 2004) (including Eastern Shale Ruêns Renosterveld and Ruêns Silcrete Renosterveld) were not available at the time this study was in the process of completion (pers. comm. Prof. L. Mucina 2005) so the following description is derived from older classifications. It is possible to deduce that Eastern Shale Ruêns Renosterveld will occur primarily on shale derived soils and that Ruêns Silcrete Renosterveld will occur primarily on soils on silcrete.

South & South-west Coast Renosterveld is found on the south coastal plain, rolling country (Acocks 1988). The south coastal plain has more altitudinal variation than the west coast, the latter having altitudes of less than 300 m asl. (Taylor 1978).

Coastal Renosterveld in the southern block receives most of its rain in winter but some in summer (Acocks 1988). The rainfall peaks for South and South-west Coast Renosterveld are spring and autumn with increasing summer rainfall in the east (Rebelo 1996b). The annual rainfall is between 250—600 mm (rarely to 200 mm) with at least 30% falling in winter (Boucher 1983, Rebelo 1996a).

Coastal Renosterveld is found on shale and granite derived soils (Boucher 1983). In the Riversdale Area, the Renosterveld is primarily found on the Bokkeveld Group rocks (Malan *et al.* 1994). South & South-west Coast Renosterveld is found on soils derived from the Bokkeveld and Kango Group shales and the Uitenhage Group conglomerates (Rebelo 1996b). The soil pH (method of measurement unspecified) range for degraded Coastal Renosterveld in the Swellendam district was 5.2—6.8 (Joubert & Stindt 1979).

Renosterveld communities are considered secondary, with various different agencies deflecting the vegetation from its natural condition (Kruger 1979b), for example, Renosterveld may be considered to be an anthropogenically induced vegetation, replacing grassland and thicket due to overstocking, overgrazing and too frequent burning following European settlement, although this is not a universally accepted explanation (Deacon 1992, Rebelo 1996a).

Acocks (1988) thought that Coastal Renosterveld, dominated by *Elytropappus rhinocerotis* shrubs, replaced scrub (thicket). Scrub (thicket) is not supported by the historical writings, probably because the primary habitat requirement of the present thicket is deep well drained soil. Renosterveld is limited to shallow soils ‘often with poorly developed, clayey, impermeable subsoils’ (Cowling 1984).

The Coastal Renosterveld is typically shrub dominated (Boucher 1983). The South & South-west Coast Renosterveld is typically an open to mid-dense (25—75% canopy cover), cupressoid and small-leaved, low to mid-high shrubland with rare emergents (Moll *et al.* 1984, Rebelo 1996b). The Coastal Renosterveld is species rich, Acocks recorded 1 320 species in the southern block (Taylor 1978). Restionaceae are usually present but seldom dominant in Coastal Renosterveld (Boucher 1981).

Typical and dominant shrubs in South & South-west Coast Renosterveld include *Chaetacanthus setiger*, *Elytropappus rhinocerotis*, *Helichrysum anomalum*, *Hermannia flammea*, *Indigofera denudata*, *Oedera uniflora* (was *Relhania cuneata*) and *Oedera genistifolia* (was *Relhania genistifolia*) (Rebelo 1996b).

Grass is abundant in the understorey of Coastal Renosterveld (Specht 1979, Boucher & Moll 1981, Acocks 1988, Rebelo 1996a). *Themeda triandra* and other perennial grasses may become locally abundant in unploughed areas (Boucher 1981, 1983, Acocks 1988). The major distinguishing trait of South and South-west Coast Renosterveld is the high proportion of grasses relative to other Renosterveld types. The C_4 grasses are prominent. The grass species in South & South-west Coast Renosterveld include *Brachiaria serrata*, *Digitaria eriantha*, *Hyparrhenia hirta*, *Pentaschistis pallida*, *Sporobolus africanus* and *Themeda triandra* (Taylor 1978, Rebelo 1996b). The Coastal Renosterveld has a strong geophyte component especially from the Iridaceae, Liliaceae and Orchidaceae (Boucher 1983, Rebelo 1996a).

Fire or other disturbance leaves Coastal Renosterveld communities prone to invasion by Mediterranean herbs such as *Anagallis arvensis* and *Briza maxima* (Kruger & Bigalke 1984, Van Rooyen 2004). Vlok (1988) records the apparent displacement of indigenous herbs by alien herbs in Coastal Renosterveld and other veld types of the Fynbos Biome. However, he appears to infer a causal relationship in the correlation between increased alien herbs and decreased indigenous herbs. Correlation does not indicate causality (McCall 2001). Vlok's (1988) findings are the result of disturbance not displacement (Duvenhage 1993). Small scale disturbance assists alien grass establishment in West Coast Renosterveld (Van Rooyen 2004). In the West Coast Renosterveld near Stellenbosch, Duvenhage (1993) was unable to show either any displacement of indigenous herbs by alien herbs or any relationship between the time and distance from a source of alien herbs and the infestation levels of alien herbs in the natural vegetation. Duvenhage (1993) suggested that invasion levels of alien herbs need to reach a threshold before displacing indigenous herbs and that this threshold had not been reached near Stellenbosch. This suggestion is supported by Milton (2004) and Van Rooyen (2004) who note that alien species are inconspicuous for decades after arrival before increasing exponentially in distribution and abundance. Edge effects facilitated alien grass invasion at Elandsberg Private Nature Reserve and Jan Briers Louw Nature Reserve while deeper invasion into the natural vegetation was facilitated by fire and grazing (Van Rooyen 2004).

Road verges may serve as sources of alien grasses as these are sown and fertilised for vegetation reclamation (Vlok 1988). Nitrogen favours C_3 grasses over C_4 grasses. Increased nitrogen favours alien grasses in the Fynbos Biome as they do better with the elevated nitrogen and phosphate than the indigenous grasses do (Milton 2004, Van Rooyen 2004). Van Rooyen (2004) attributes the alien invasion at the edges of natural vegetation at Elandsberg Private Nature Reserve and Jan Briers Louw Nature Reserve to the fertiliser runoff from the adjacent lands. West Coast Renosterveld has more carbon and nitrogen than lands under wheat or clover but these lands have a lower C:N ratio than the natural vegetation (Mills 2003). A low soil C:N ratio, rather than increased nitrogen only, favours alien invasive grasses such as *Briza maxima* (Yelenik *et al.* 2002).

Almost all the Coastal Renosterveld has been transformed for growing cereals such as wheat and oats (Rutherford & Westfall 1994, Rebelo 1996b). In the Riversdale area intensive agriculture has now limited Renosterveld to river courses and other less accessible areas (Malan *et al.* 1994). In the east, the South & South-west Coast Renosterveld is extensive used for grazing (Rebelo 1996b). Joubert & Stindt (1979) judged the nutritive value of Coastal Renosterveld for grazing animals according to the standards of the time. Coastal Renosterveld was deficient in protein and phosphorus. Copper, manganese and zinc were deficient and the sodium content was below normal. Calcium was deficient in the dry season (Joubert & Stindt 1979).

Most of the reserves in the South Coast region have very little Renosterveld. The patch in the Bontebok National Park is the largest conserved area. Fire and grazing are important management tools (Rebelo 1996b). Conservation by farmers is needed because the value of the land and the small area of many remnants make formal conservation unfeasible. There is no significant difference in the composition of large and small remnants (Kemper *et al.* 1999). There are three possible reasons for this: many Renosterveld species resprout after fire and have long life spans or are wind pollinated hiding the effects of the relatively recent (c. 70 years) fragmentation; Renosterveld has a history of grazing disturbance that has already altered its nature and the rare species of the Renosterveld may be resistant to inbreeding and therefore not affected by fragmentation. This means that all remnants are worth conserving though large fragments are thought to be more stable (Kemper *et al.* 1999).

1.8 Fire in Renosterveld

Fire is an important driving force in the Fynbos Biome (Kruger 1979a; Cowling & Richardson 1995). In both the Western Cape and the Southern Cape, fires most frequently occur in summer and early autumn and least frequently in winter (Kruger 1979a, Van Wilgen 1987, Van Wilgen *et al.* 1992). The Western Cape has a higher frequency of fires in summer than does the Southern Cape and the Southern Cape has a higher frequency of fires in winter than does the Western Cape (Kruger 1979a).

The reproductive behaviour of several species (of flora and fauna) point to the dominant fire season being summer (Van Wilgen 1987). The peak period of flowering and seed set for most fynbos plants occurs in late winter and spring (Van Wilgen 1987, Van Wilgen *et al.* 1992). Fire stimulates flowering in some species, e.g. *Cyrtanthus* spp. and *Leucadendron salignum*. Fire stimulates seed germination by damaging the seed coat in hard seeds; by removing the vegetation layer resulting in greater fluctuation of soil temperatures or by exposure to smoke (Bond 1997).

The fire season (i.e. period with the greatest danger of fires) is about 2.5 months in the coastal areas. Changes in short, clearly defined fire seasons probably have more effect on the biota than changes in longer, less defined fire seasons (Van Wilgen 1987). Out of season fires affect the composition and structure of vegetation. The survival and regrowth of sprouters burnt during their growing season is reduced because defoliation occurs with depleted reserves which are further depleted by resprouting. Germination and establishment are greatest in winter and spring and are favoured by summer and autumn burns. Germination occurs after spring burns but the summer drought hampers establishment as do pathogens favoured by warm, moist spring conditions (Kruger & Bigalke 1984).

No data exist on the fuel properties of Renosterveld (Van Wilgen 1987). The Rutaceae have aromatic oils and the stems of the Restionaceae are usually covered in cuticular wax (Kruger & Bigalke 1984). The amount of energy per unit of fuel (heat of combustion) in *Themeda triandra* in the Eastern Cape for vegetative leafy material is 17 170 ± 16.7 $kJ\ kg^{-1}$ and for mature leaves/culms 17 727 ± 44.0 $kJ\ kg^{-1}$ (Trollope 1984, 1999).

Low rainfall areas dominated by *Elytropappus rhinocerotis* have a low biomass (available fuel) (Edwards 1984). The biomass may reach up to 1.5 m above the soil but is usually less than 0.75 m above the soil (Kruger & Bigalke 1984). Climate affects biomass production and utilization (e.g. grazing) alters the available biomass and its distribution (Edwards 1984).

Fire frequency depends on the fuel available, the presence of sources of ignition and weather conditions suitable for ignition and spread. Increasing vegetation post-fire age results in increased fuel and therefore an increased 'probability that a source of ignition will cause a fire'. For a spreading fire to occur, sufficient fuel and suitable weather conditions must occur with a source of ignition. 'The longer a fire burns, the higher the chances of the weather changing and thus extinguishing the fire' (Van Wilgen 1987).

Fire frequency in marginal zones (transitional) can be a critical determinant of the vegetation (Kruger & Bigalke 1984). Basal cover of Poaceae and Restionaceae was markedly reduced in 47 year old veld compared to four year old veld burnt on a six year rotation in the foothills of the Langeberg at Swellendam (Haynes & Kruger (1972) in Kruger & Bigalke (1984)).

Fire frequency influences the demography of seeding shrub populations; the relative abundance of different plant growth forms to the point where the community can change, a high frequency favours sprouters especially graminoid plants; spatial heterogeneity in the post-fire vegetation age and species diversity (Kruger & Bigalke 1984). Fire frequency is affected by feedback controls in the form of rates of biomass accumulation and fire intensity. In Fynbos, frequent fires result in low intensity burns with slow spread because not enough fuel has accumulated for an intense fire (Kruger & Bigalke 1984).

Late summer/early autumn weather is associated with high fire intensity in the Western Cape Province. Fire intensity may be manipulated by reducing fuel loads (by increasing fire frequency) or by selecting conditions that will result in the desired type of fire (Van Wilgen *et al.* 1992). Changes in fire intensity result in changes in the 'heat pulse' (Van Wilgen 1987) to the soil affecting the relative abundance of species with soil stored seedbanks (Pierce 1987, Van Wilgen 1987, Van Wilgen *et al.* 1992, Cilliers 2002). Fire intensity changes soil nutrient levels and microbial populations (Pierce 1987, Cilliers 2002).

The felling of alien trees supplies large amounts of dead fuel resulting in abnormally intense fires that harm the soil, fauna and flora (Van Wilgen *et al.* 1992, Cilliers 2002). Stands of alien trees also supply enough fuel to raise the fire intensity to levels that are harmful to the soil, fauna and flora (Cilliers 2002). The alien clearing burn on Honeywood farm had a detrimental effect on the environment.

1.9 *Themeda triandra*

Themeda triandra, belonging to the family Poaceae, subfamily Panicoideae and the tribe Andropogoneae (Gibbs Russell & Spies 1988), is a rhizomatous perennial C_4 tussock forming (= caespitose) grass (Gibbs Russell *et al.* 1990, Snyman *et al.* 1997, Van Breda & Barnard 1991, Zacharias 1990) that is highly palatable to ungulates (Coughenour *et al.* 1985, Edroma 1985). It has protean variability of form (Van Breda & Barnard 1991, Zacharias 1990). Culm height varies from 0.1—1.5 m. Leaves may be hairy and bluish-green or smooth, hairless and pale green (Van Breda & Barnard 1991). *Themeda triandra* has a fine root system (Edroma 1985). Each flowering unit consists of two male spikelets forming a basal involucre, a sessile perfect awned spikelet and two pedicelled male spikelets (Gluckmann 1951). The awned flowers (spikelets) are carried in triangular clumps in a false panicle (Gibbs Russell *et al.* 1990, Van Breda & Barnard 1991). The clumps are usually pendulous because the long stem of the panicle is normally flaccid (Van Breda & Barnard 1991).

Themeda triandra plants at a high altitude are small. In arid areas, *Themeda triandra* tends to have unbranched culms where in high rainfall areas, branched culms are the norm. A stoloniferous form occurs in Natal. Glaucousness is absent in the southern and south-western Cape (Gibbs Russell & Spies 1988). A variant of *Themeda triandra* found in Fynbos forms tillers from aerial shoots resulting in less self-shading (Bond 1997).

Themeda triandra is a widely distributed and often dominant grass in South Africa (Zacharias 1990) and elsewhere in Africa (described as Old World tropics and subtropics by Gibbs Russell *et al.* 1990) - e.g. Tanzania (Coughenour *et al.* 1985) and Uganda (Edroma. 1984) - and it also occurs in Australia (Walker *et al.* 1997, Morgan & Lunt 1999). It is known to occur in five different biomes in South Africa - the Grassland, Savanna, Nama Karoo, Succulent Karoo and Fynbos Biomes (Gibbs Russell *et al.* 1990, Rutherford & Westfall 1994, Van Oudtshoorn 1991).

The basic chromosome number of *Themeda triandra* is ten (Gluckmann 1951, Spies & Gibbs Russell 1988). Diploid to 11-ploid specimens are known but diploid, tetraploid and hexaploid individuals are most common. The presence of uneven polyploid levels and aneuploid specimens indicates difficulties in sexual reproduction. *Themeda triandra* is a facultative aposporic apomict (produces fertile asexual seeds). It has B chromosomes (Spies & Gibbs Russell 1988). B chromosomes harm the vigour and fertility of *Secale cereale* (rye) plants and other grass species (Jones & Pašakinskienė 2005).

The growing season for *Themeda triandra* is from early winter to late spring or early summer (Kruger 1981). The form of *Themeda triandra* near Humansdorp has two equally strong growth peaks: one in summer, the other in winter. The utilization of two seasons for growth is a possible reason for the dominance of C_4 grasses (*Themeda triandra* is dominant) over C_3 grasses in the area (Cowling 1983).

Flowering occurs from September to June (Gibbs Russell *et al.* 1990). Anthesis ('opening' of the flower) occurs at night and is inhibited by light. In perfect spikelets, the purple stigma emerged and feathered out first and then the filaments elongated until the anthers hung well below the stigma. The male flowers anthesed a few days after the perfect spikelet. The involucral pair of spikelets anthesed before or at the same time as the pedicelled spikelets (Gluckmann 1951).

The seed of *Themeda triandra* has a long awn (~ 25 mm) that is either purple or brown to reddish-brown which, after it has been shed, is the mechanism of trypanocarpy (Van Breda & Barnard 1991, Zacharias 1990). Acocks noted that a litter layer is necessary for the awn to be effective for trypanocarpy (Zacharias 1990). Each tussock of *Themeda triandra* produces a small quantity of large seed (in comparison to grasses in general) and the seed has no long distance dispersal mechanism (trypanocarpy is a short distance dispersal mechanism) (Mentis & Huntley 1982, O'Connor & Pickett 1992, Hendricks 2003). Wind dispersal of seed occurs. The density of the vegetation affects the dispersal distance with greater distances being covered where the vegetation is sparse (Hendricks 2003). *Themeda triandra* can compensate slightly for a loss of density of established plants by increasing the number of seeds per culm (O'Connor & Pickett 1992, Hendricks 2003). Rainfall influences the number of seeds produced – higher rainfall results in greater seed production (Hendricks 2003). The seeds require a 6—15 month period of after-ripening to break dormancy (Baxter *et al.* 1993).

The size of the soil borne seed bank of *Themeda triandra* is linked to the number of established individuals in the community. It is composed of seeds from the previous one or two seedings because the seeds have a limited lifespan of 2—3 years (O'Connor & Pickett 1992). Seeds are lost from the seedbank by grazing, deep burial, decay, germination and predation (Baxter *et al.* 1993, O'Connor & Pickett 1992). Rodents and ants (*Messor decipiens*) were observed as predators. *Themeda triandra* seeds may escape predation by lodging in cracks in the soil with the awns protruding (Capon & O'Connor 1990).

Smoke pretreatment of *Themeda triandra* seed increases germination and the rate of germination (Brown and Van Staden 1997). Smoke extracts did not stimulate germination of *Themeda triandra* seed from the Middelburg Region, Eastern Cape (Hendricks 2003).

Germination of imbibed *Themeda triandra* seeds exposed to plant derived smoke for 15 minutes was significantly increased. The stimulatory effect of the aqueous smoke extract increased with increased seed imbibition (Baxter *et al.* 1994). The concentration of aqueous smoke extracts altered the effects on germination. High concentrations of aqueous smoke extract were found to inhibit germination without harming the seed (Jäger *et al.* 1996, Brown & Van Staden 1997) suggesting that that the quantity (concentration) of smoke or the time of exposure to smoke might also affect the effectiveness in stimulating germination. Subsequent dilution of the highly concentrated smoke extract causes the germination of the seeds (Brown & Van Staden 1997).

Baxter *et al.* (1995) tested the effect of smoke from 27 grassland species from Cathedral Peak, Natal Drakensberg on the germination of *Themeda triandra* seed. *Themeda triandra* seed was not harmed by smoke from any of the tested species. Smoke from 18 species of the 27 species stimulated germination, but the effectiveness varied considerably (Baxter *et al.* 1995). The active stimulatory compound(s) of plant-derived smoke are widespread (Baxter *et al.* 1995, Brown & Van Staden 1997) implying that the compound(s) may originate from compounds common to many plant species. The active compound(s) in smoke appear to be breakdown products formed during combustion or heat treatment of plant material such as wet or dry leaves or stems, cellulose papers or agar (Brown & Van Staden 1997). The variation in the effectiveness of smoke from different species may be linked to interspecific differences. Alternately the temperature at which the smoke was generated could cause variation in the effectiveness. The active compounds have been obtained by dry-heating *Themeda triandra* leaf material at temperatures between 175^{o}C and 225^{o}C (Baxter *et al.* 1995).

Increasing temperatures result in increased germination and the availability of light also increases germination. Burying seed up to 3 cm results in increased germination. In the veld germination is better where there are cracks in the soil or stones that allow the seed to be buried (Hendricks 2003).

Many seedlings die after germination (O'Connor & Pickett 1992, O'Connor 1996). *Themeda triandra* seedlings are delicate and are easily trampled or shaded out (Mentis & Huntley 1982, Hendricks 2003). Soil compaction reduces seedling survival (Hendricks 2003). Seed availability is the most important factor affecting recruitment, followed by moisture and the rate of drying of the soil (O'Connor 1996, Hendricks 2003). Competition with established vegetation has a stronger impact during the latter part of the growing season than initially (O'Connor 1996).

In False Thornveld in the Eastern Cape, veld in a good condition (with especially abundant *Themeda triandra*, veld condition score 100 prior to drought) on stoneless soil was more affected by the 1982/1983 drought than veld that was in a moderate condition (veld condition score 60.4 prior to drought) on stony soil (good condition mortality, *Themeda triandra* - 57%, *Sporobolus fimbriatus* - 40% vs. moderate condition mortality, *Themeda triandra* - 30%, *Sporobolus fimbriatus* - 53%). One possible reason is that the healthy veld extracts more water than veld that is in a poorer condition (Danckwerts & Stuart-Hill 1988). However water availability may have been more important, in the stony soil the water penetrates about twice as deep as in the stoneless soil. *Themeda triandra* had at least double the root concentration at a soil depth of 200 to 400 mm that *Sporobolus fimbriatus* had whereas in the top 200 mm the root concentration was about equal. After the only reasonable spring rains, *Themeda triandra* had the advantage in obtaining water below 200 mm soil depth at the stony site. At the stoneless site, with equal chance to obtain water, the greater leaf area of *Themeda triandra* would result in *Themeda triandra* drying out more rapidly than *Sporobolus fimbriatus*. This possibly explained why, during the 1982/1983 drought, fewer *Themeda triandra* tussocks died at the stony site than *Sporobolus firmbriatus* and *vice versa* at the stoneless site (Danckwerts & Stuart-Hill 1988).

Leaf water content is lowest between one and three pm daily, when the transpiration rate is highest. Water content varies with rainfall but is high at the start of the season and decreases at the end of the season (Bot 1938).

Sensitivity to drought stress depends on phenology. The most important effects of drought are reduced leaf area and a slower growth rate. The decrease in leaf area depends on the duration and the frequency of stress (Snyman *et al.* 1997). Snyman *et al.* (1997) did a greenhouse study (with controlled temperatures and humidity) on the influence of water stress on the transpiration rate and water-use efficiency of *Themeda triandra*. In the absence of water stress, the transpiration rate and water-use efficiency of the vegetative and reproductive stages of *Themeda triandra* did not differ significantly. *Themeda triandra* showed a linear decrease in transpiration rate with an increase in water stress. In the reproductive phase of *Themeda triandra* subjected to increasing water stress, the water-use efficiency showed an increase initially then gradually decreased (Snyman *et al.* 1997).

Themeda triandra limits water stress by closing stomata. Stomatal behaviour is related to the relative humidity so the validity of study results is limited to the relative humidity present in the specific greenhouse study. *Themeda triandra* survives drought at a high water potential. At extremely low leaf water potential, *Themeda triandra* is dormant and can die if the period of stress is too long. *Themeda triandra* is adapted to maintain adult plants through drought rather than to reproduce after drought to recover population numbers (Snyman *et al.* 1997).

Themeda triandra is sensitive to frequent defoliation (= clipping or grazing). The rate of tiller production depends on the height and frequency of defoliation (Coughenour *et al.* 1985, Edroma 1985). *Themeda triandra* is not adversely affected by the loss of some apical meristems as there are shoot primordia at the base of the shoots (Edroma 1985). The loss of photosynthetic tissue and the reduction of leaf area resulted in the reduction of herbage, root dry mass, seed production and the number of subsequent tillers because carbohydrate reserves supply energy for growth after clipping (Coughenour *et al.* 1985, Edroma 1985).

In the Matopas, Zimbabwe, heavy grazing caused *Themeda triandra* to disappear from the veld within seven years. The veld was rested for eight years before *Themeda triandra* reappeared (O'Connor 1985). *Themeda triandra* may become locally extinct (i.e. be lost from the established vegetation and the seed bank) within 25 years (O'Connor & Pickett 1992). *Themeda triandra* may disappear from the veld if continuously grazed in the growing season (O'Connor 1985, Du Toit 1998). This loss is more likely when drought and heavy grazing occur in combination (O'Connor 1985, 1996).

Themeda triandra is quantitatively an important component of the ruminant's diet but is less favoured than some other species, especially when reproductive culms are present (Downing 1979, Van der Westhuizen *et al.* 1978, Danckwerts *et al.* 1983).

Under laboratory conditions, nitrogen supplementation stimulates growth in *Themeda triandra* (Coughenour *et al.* 1985). In the veld, fertilization with nitrogen leads to a decline in the dominance of *Themeda triandra* and may cause it to disappear from the veld (Mentis & Huntley 1982, O'Connor 1985). In the veld, *Themeda triandra* survives nitrogen fertilization better in the absence of phosphate fertilization. In combination, nitrogen and phosphate cause a decrease in the basal cover of *Themeda triandra* (O'Connor 1985). This suggests that competition causes the decline of *Themeda triandra* after nitrogen fertilization in natural veld.

Frequent defoliation of *Themeda triandra* prior to burning may not allow the accumulation of enough plant material to inhibit basal tillering. In such cases, a burn kills a large proportion of the apices of actively growing tillers. The gross accumulation rate decreases following the fire because new tillers grow more slowly than the mature but active tillers (Mentis & Tainton 1984).

Themeda triandra only started growing five weeks after an August burn in the highland sourveld of KwaZulu Natal (Summer Rainfall Region) so it was favoured by regular grazing for the first 6 weeks after the burn but grazing up to 8 weeks was detrimental to it (Bailey & Mappledoram 1983). Grazing after burning harmed *Themeda triandra* in Uganda (Edroma 1984).

Themeda triandra flowers in the second growing season after a fire because the tillers are biennial and the apices of tillers that will flower in a given growing season are elevated late in the previous growing season and are thus vulnerable to fire for a long period including the usual season for burning (Mentis & Tainton 1984).

Fire at the end of the dry season (winter in the Summer Rainfall Region) favours *Themeda triandra* possibly because the bases of this grass are fire resistant or because the conditions created by the fire are suitable for germination. Fire at the end of the dry season was more beneficial to the veld than fire at the beginning of the dry season (Edroma 1984). Burning in the wet season results in high *Themeda triandra* mortality not found if fires occur in winter or spring (O'Connor 1985). The amount of rainfall influences the effect of fire on *Themeda triandra*. With high rainfall, *Themeda triandra* thrives with fire; fire with low rainfall causes mortality of *Themeda triandra* plants (O'Connor 1985).

Themeda triandra becomes moribund (and may be lost from the veld) in the absence of fire and grazing in the Summer Rainfall Region of South Africa, in Zimbabwe and in Australia (O'Connor 1985, Morgan & Lunt 1999), however, a Winter Rainfall Region Fynbos form was able to survive in the absence of fire and grazing without becoming moribund (Bond 1997). The health of *Themeda triandra* declines after six years without fire and/or grazing. Fewer live tillers were found in a decreased number of tussocks. By eleven years after a fire and grazing, the canopy collapsed on itself forming a thick mulch on the ground and few live tussocks or tillers remained (Morgan & Lunt 1999). *Themeda triandra* survived in ungrazed macchia invaded Döhne Sourveld (South Africa) for up to twenty years without fire but the moribund tussocks consisted of fine, greatly elongated, weak stems

(Downing *et al.* 1978). A single fire in an area not burnt for 12 years did not immediately restore the grassland to the same state as frequently burned grassland (Morgan & Lunt 1999).

1.10 South African Pastures

Bonsma *et al.* (1952), West (1952, 1955), Scott (1955), Van der Westhuizen *et al.* (1978), Danckwerts *et al.* (1983), Mentis (1984), Danckwerts & Stuart-Hill (1988), Trollope (1990), Tainton *et al.* (1999) and Tainton & Danckwerts (1999) concentrate on veld management in the Summer Rainfall Region of South Africa but the extracted principles could be as applicable in the Winter Rainfall Region.

The goal of veld management is to maintain the veld at the 'best stage of succession for grazing', providing dense soil cover and 'the optimum production of the most nutritious grasses' (Scott 1955, West 1955). Veld management cannot be prescribed. It must be developed for each farm individually. The number of veld types with sufficient area to be fenced separately, the number and type of animal, topography, seasonal veld appearance and the availability of land for planted pastures should be considered in planning the management system. Grazing concentrates around water. No part of a pasture/ camp should be more than 0.8 km (0.5 miles) from water. Trampling at gates and along fences should be considered in the layout of camps, as should shade and shelter (Scott 1955).

Monitoring is an integral component of management. Monitoring may be defined as 'maintaining regular surveillance to test a null hypothesis of no change in' selected traits of a system that 'is vulnerable to impacts' of which the nature, timing and location may be unknown. The choice of field technique should consider both what is to be measured and how it is to be measured (Mentis 1984). Veld condition assessment (a form of monitoring) provides information to plan rest schedules and may be used to monitor the changes in veld condition and thus show how effectively the grazing and resting programmes applied are (Tainton & Danckwerts 1999).

Grazing may be applied either continuously or on a rotational basis. Continuous grazing does not allow for resting the veld and consequently has a lower stocking rate than rotational grazing. Rotational grazing has three primary objectives: controlling the grazing frequency, controlling the grazing intensity and reducing selective grazing (Tainton *et al.* 1999). Different grazing systems have been developed to force the use of undesirable species or to control the use of desirable species. Finances limit the number of camps in a rotational grazing system (Tainton *et al.* 1999).

Resting may be for the short term benefit of the animals or for the benefit of the veld with little short term gain for the animals, though this should provide increased forage production (see below) (Tainton & Danckwerts 1999). Rests aimed provide short term benefit to animals are to allow sufficient herbage to accumulate for the animals to have adequate intake when returned to graze. These rests may be long enough to allow the veld to recover between successive grazings (Tainton & Danckwerts 1999). Rest aimed at benefiting the veld is based on the resting of the veld at specific stages in the growth period over a number of seasons to promote plant vigour (West 1952, Scott 1955, West 1955, Tainton & Danckwerts 1999). The effectiveness of the rest to provide root carbohydrate stores is dependant on whether the veld has sufficient leaf area to produce an adequate supply of carbohydrates. If the veld growth is poor, this rest may need to start in the preceding season. Full season rests are also applied to benefit the veld (Tainton & Danckwerts 1999). Resting the veld during a drought is to prevent overgrazing or excessive trampling (Scott 1955).

For seedling establishment it is critical that the veld be rested during the transition from the tap root system of the seedling to the adventitious root system of the adult plant (Scott 1955). A rest programme to promote seedling establishment may include grazing after seed dispersal to assist in burying the seed and reduce the density of the canopy to allow light penetration. Such rest programmes improve botanical composition in lower rainfall areas of the Summer Rainfall Region. In high rainfall regions of the Summer Rainfall Region, rests to promote seeding are less effective and rests to promote tillering are advised (Tainton & Danckwerts 1999). Rests to promote seedling establishment are recommended after drought (Danckwerts & Stuart-Hill 1988, Tainton & Danckwerts 1999).

Burning to destroy the seedlings of undesirable plants, such as *Elytropappus rhinocerotis* and *Helichrysum* spp., may have positive results if the veld is rested immediately afterwards and grazing is carefully managed. Burns should not be carried out during the translocation of carbohydrate stores to the roots because this weakens the plants. Burning shortly after this period is not advised if the veld is to be grazed immediately because the growing leaves will draw the stores out of the roots and grazing will reduce the ability of the leaves to replenish the stores. Loss of species and ground cover follows. The loss of ground cover may cause the soil crusting causing increased runoff. Burning after the first good rains following the dry season is least harmful (Scott 1955, Trollope 1990). In Bushveld, burning after the first rains does not produce a hot enough fire to prevent bush encroachment so burning in anticipation of the first rains is preferred (West 1955). In the high rainfall grasslands of the Summer Rainfall Region, mowing may be used in place of burning (Scott 1955). For dry, summer rainfall Bushveld areas with a low carrying capacity, mowing is impractical and fire is a key tool (West 1955). Fire should be used when the grass is dormant or near dormant because this results in the minimum of damage to the grass sward (West 1952, 1955, Trollope 1990). Resting after fire allows the grass to replenish nutrient reserves (West 1952, 1955).

Cowling *et al.* (1986) used the phenology of *Elytropappus rhinocerotis* and *Metalasia muricata*, the main shrub invaders, and the phenology of *Themeda triandra*, the dominant grass, to recommend late summer to autumn (February to April) burns in South Coast Renosterveld (latest terminology, Humansdorp Shale Renosterveld) in the Humansdorp District. The shrub species show maximum growth and flower in late spring and summer (November to February) and set seed in late autumn to early winter so an autumn fire coincides with the end of the growth period with low root carbohydrate reserves thus minimising the ability to resprout and prevents the addition of seed to the soil seed bank. The shrub species have a juvenile period of three years so further burns should be carried out at three year intervals (Cowling *et al.* 1986). *Themeda triandra* in the Humansdorp District shows growth peaks in winter and summer and flowers from July to September with seed set between October and January. Burning in autumn coincides with a period of low soil moisture in the Humansdorp District, under which conditions the carbohydrate stores of *Themeda triandra* would be in the roots allowing for rapid growth after the rains come. *Themeda triandra* seed would not be lost and germination would be promoted so good recruitment should result from the favourable moisture conditions of the autumn/ winter and spring rains. The 'winter growing southern Cape form' of *Themeda triandra* may be a distinct ecotype that requires different management from those of the Summer Rainfall Region (Cowling *et al.* 1986). A two to four fire interval was most effective for clearing both lowland and highland Macchia in Döhne Sourveld and provided a vigorous sward suitable for water conservation (Trollope & Booysen 1971, Trollope 1973, Downing *et al.* 1978). Areas of marginal grassland and grassy Fynbos types (often *Themeda triandra* dominated) that have become dominated by *Elytropappus rhinocerotis* through mismanagement of grazing and burning may in many cases be regained by burning the veld at up to four year intervals and resting the veld from grazing (Kruger & Bigalke 1984).

The need for skilled management increases as the size of the animal decreases to compensate for the increasing grazing selectivity. Mixed grazing/browsing may be used to partially overcome the problems of selection. Sheep and cattle should be grazed together where both are farmed rather than the sheep being rotated behind the cattle (Owen-Smith 1999). Cattle graze selectively even when the grazing pressure is high (Danckwerts *et al.* 1983). Cattle graze an increasing variety of species the longer they occupy a camp (Owen-Smith 1999). Sheep are highly selective grazers that concentrate on the most palatable species (Van der Westhuizen *et al.* 1978). Sheep may be successfully pastured on both tall and short grass but they favour short grass. Sheep graze close to the ground and may uproot tufts of grass (Owen-Smith 1999).

The variety of animal affects the impact on the veld. Cows may take more or less browse in their diets depending on breed (Bonsma *et al.* 1952, Owen-Smith 1999). Of sheep breeds, Mutton Merinos are non-selective feeders (pers. comm. Dr V. Ferreira 2005).

1.11 Objectives and Critical Questions

The objectives of the present study are:

(a) to determine the composition of some *Themeda triandra* Renosterveld in the Ruêns area of the southern Cape;

(b) to map the plant communities identified in the study area;

(c) to determine whether there is any correlation between selected environmental factors and the occurrence of the communities within *Themeda triandra* Renosterveld and identify the key environmental factors associated with the occurrence of communities;

(d) to determine if there is any correlation between management practices and variations in the composition of *Themeda triandra* Renosterveld and the presence of *Themeda triandra* and identify the key management factors associated with the variations in the occurrence of communities and the presence of *Themeda triandra*.

The critical questions are:

(a) What variations exist in *Themeda triandra* Renosterveld Grassland communities in the study area?

(b) What measured environmental factors influence the occurrence of different communities within *Themeda triandra* Renosterveld?

(c) What management factors influence the occurrence of different communities within *Themeda triandra* Renosterveld?

Chapter 2 Materials and Methods

2.1 Introduction

Phytosociology, the study of vegetation, i.e. plant communities and their classification, is based on two features of plant communities: (1) non-random distribution of plants with distinct combinations of species repeated (= community unit theory (Werger 1973)) (Becking 1957, Rieley & Page 1990) – not accepted by the followers of the individualistic concept of the plant association promoted by Ramensky (Sobolev & Utekhin 1973) and Gleason (Whittaker 1973c,d); (2) the complex interaction between plants and their environment and between individual plants (Becking 1957, Rieley & Page 1990).

The individualistic concept developed by Gleason and Ramensky is based on two principles: (1) the principle of species individuality which states that each species is uniquely distributed according to how its own genetic makeup, physiological characteristics and population dynamics interact with the total range of environmental factors; (2) the principle of community continuity which states that communities usually intergrade continuously changing gradually along continuous environmental gradients (Werger 1973, Westhoff & De Smidt 1995). This concept leads to the analysis of vegetation in terms of gradients (e.g. environmental), which may be direct (i.e. constrained to a given environmental variable or set of variables) or indirect (i.e. seeking the patterns inherent in the data). Both direct and indirect gradient analysis have more than one approach of which, ordination is one example (Shimwell 1971, Whittaker 1973a).

Mucina (1997) suggested that the continuum versus discontinuum debates were confused by lack of clarity concerning whether the gradient arrangement of plant communities was theoretical or based on field situations. The observer's scale perception also impacts on the debate (Mucina 1997).

The subjective classification used by the Zürich-Montpellier School *et al.*, based on the community unit theory, is one approach in vegetation classification. The individualistic concept forms an alternative approach in vegetation classification. The Southampton School embodies a third approach in vegetation classification: statistical classification through cluster analysis. Studies done using methods from more than one trend agree on two points. The first is that the 'application of different methods initially linked to certain concepts about the nature of vegetation' gave 'similar and directly comparable or compatible results'. The second is that the so-called subjective techniques were the 'most efficient either in terms of effort expended or results obtained or both'. It is further noted that the judgement of success or suitability of the various methods of cluster analysis is tacitly partially subjective (Werger 1973).

Lepš & Šmilauer (2003) consider methods of classification and gradient analysis complementary. The choice of method depends on the purpose of the study (Lepš & Šmilauer 2003). Ewald (2003) considers gradient analysis an inherent part of the Central European Phytosociology (=Zürich-Montpellier) and considers gradient analysis complementary to the goal of the Zürich-Montpellier method. Relevés collected according to the Zürich-Montpellier method are suitable for gradient analysis (Whittaker 1973b).

The Zürich-Montpellier method meets three essential requirements. First, it is scientifically sound. Second, it supplies classification at an appropriate level and third, it is the 'most efficient and versatile among comparable approaches' (Werger 1973). The method is relatively easy to apply and rapid in execution and is applicable in any kind of vegetation and results from different areas are easily comparable (Goldsmith & Harrison 1976, Rieley & Page 1990). This method has been used in South Africa since 1969 (Werger 1973).

In the Cape shrublands, the Zürich-Montpellier method is considered to be a suitable method of vegetation analysis by (Boucher 1977, 1987) because it is both economical and practical, the definition of vegetation is better than that provided by other methods as the final group formation does not depend on the presence or absence of only one species, the units thus generated can be mapped, the vegetation is clearly linked to the environment and large datasets can be handled with ease (Boucher 1977, 1987). A structural classification, such as proposed by Campbell (1985, 1986), is less sensitive than a floristic classification, such as the Zürich-Montpellier method (Boucher 1987).

Following the Zürich-Montpellier method 'selected, representative, homogenous plots' of set size are sampled in the communities that form the vegetation of an area under survey. In the plot, all species are recorded and given a cover-abundance rating and certain other analytical characters are recorded (Werger 1973, 1974). The samples are tabulated and the vegetation units are extracted from the resulting table. The method consists of an analytical sampling phase and a synthetic phase (Werger 1974). A brief overview of the method is presented below. For more information on the Zürich-Montpellier method see Becking (1957), Whittaker (1973a), Werger (1973, 1974) and Schaminée *et al.* (1995a).

Ordination (gradient analysis) was used to determine how the Zürich-Montpellier communities are related along environmental gradients. Ordination is preferred to multiple regression for four reasons. Firstly, multiple regression requires that each species be analyzed separately – a potentially time consuming process. Individual species may occur too unpredictably to link the species to the environmental conditions by regression. Using patterns of species coincidence can overcome this difficulty. Secondly, neither qualitative data nor quantitative data containing many zero values for plots at which a species is absent satisfy the assumption of normal error distribution implicit in ordinary multiple regression. Thirdly, species and environmental relationships are generally non-linear. Finally, environmental variables can be highly correlated and so it may be impossible to separate their individual effects (Ter Braak 1987a,b). A brief overview of the method is presented below. For more information on ordination see Ter Braak (1987a,b), Hennekens *et al.* (1995), Ter Braak & Šmilauer (1998) and Lepš & Šmilauer (2003).

A frame was used to take point samples to gain a measure of basal cover (Kent & Coker 1992) in grass dominated stands. Point surveys do not result in complete floristic data and 'are more useful for the determination of vegetation gradients, the study of vegetation dynamics and veld condition assessment, than for vegetation classification' (Bredenkamp *et al.* 1991) so the method was not considered for classification. This method is used to assess the condition of the veld, an important issue for farmers. A brief overview of the method is presented below. For more information on point samples see Shimwell (1971), Mueller-Dombois & Ellenberg (1974) and Kent & Coker (1992)

2.2 Data Collection

2.2.1 Plot Sampling

Prior knowledge of the variation within an area is necessary for effective representative sampling for the Zürich-Montpellier method (Werger 1973). This may be gained from aerial photograph interpretation and/or pre-surveying the veld. Ensuring that reconnaissance routes, where possible, follow all the main environmental gradients enables the detection of the range of floristic variation, the general vegetation pattern and visible relations of the vegetation type with geology, topography and soil conditions (Westhoff & Van der Maarel 1973, Westfall 1992). Westfall (1992) suggests recording traits pertinent to planning the relevé locations and collecting voucher specimens during reconnaissance. Planning a study in this way facilitates the actual data collection. Reconnaissance for this study took the form of pre-surveying the veld during several days driving through and walking in the study area during which time voucher specimens were collected as suggested by Westfall (1992).

The subjective selection of sampling sites is common practice with the Zürich-Montpellier method (Werger 1974). Westhoff & De Smidt (1995) consider site selection to be 'intersubjective' (i.e. subjectivity based on the concensus of a group of researchers) because it is based on set rules concerning homogeneity and minimal area. Stratified subjective selection is the most efficient means of selecting possible representatives of an association especially in areas that have not been previously researched (Werger 1973, Westhoff & Van der Maarel 1973, Westhoff & De Smidt 1995). Stratification allows one to make sure that all vegetation units are sampled and allows even distribution of samples over all vegetation units (Westfall 1992). Stratification may be based on aerial photographs (large scale) or satellite imagery (small scale (e.g. 1:250 000)) because too many aerial photographs are required to be practical) combined with mapped nonvegetation factors such as geology and soil types (Westfall 1992, Westfall *et al.* 1996). The advantages of stratification joined to the flexibility of subjective selection facilitate meeting the criterion that stands be representative. Physiognomic-physiographic units for plot placement were not determined from either the 1:10 000 orthophotos, 3420BB1 Glen Etive (Chief Director of Surveys & Mapping 1983b) and 3420BB2 Arkadia (Chief Director of Surveys & Mapping 1983c), (because they were outdated (1983) and not representative of the vegetation at the time of this study) or more recent (DWAF 1999) aerial photographs which had not been obtained. Stratification based on visual variations in vegetation structure and species composition was used to select relatively homogenous stands for plot placement. Forested valley bottoms and wetland communities were not sampled because neither are the focus of this study and *Themeda triandra* was not observed at these sites during the reconnaissance survey. An initial survey of all the different communities on the slopes was limited to the portion of the Grootvadersbosch Farm that is south of the Suurbraak – Heidelberg (R322) road. The study was then expanded to include *Themeda triandra* Renosterveld vegetation on other farms. This study would have benefited from more planning in the placement of sample plots because the distribution of plots could have been improved.

Each stand selected for sampling should be representative of the vegetation of which it is part (Werger 1973). Westhoff *et al.* (1995) indicate three criteria for relevés to be representative. Firstly relevés should be homogeneous. Secondly relevés should be representative (i.e. typify the stand both floristically and structurally) (Werger 1973, 1974, Westhoff *et al.* 1995). Finally the relevé area should not be too large. Beyond a certain size, the increasing inaccuracy and the time investment are not balanced by the decreasing gains in information (Westhoff *et al.* 1995). To satisfy both the second and third criteria, the relevé size should be not more than marginally larger than the minimal area (Westhoff *et al.* 1995). Relevé size is a variable dependent on the community being analysed (Rieley & Page 1990).

A plant community is homogeneous if the individuals of the species used to characterize the community are homogeneously distributed - i.e. the possibility of finding an individual of the plant species within a test plot of a given size is the same in all parts of the area (Shimwell 1971). Westhoff *et al.* (1995) note that absolute homogeneity (all parts being the same) does not exist in vegetation. Species are naturally either randomly dispersed or clustered (Westhoff *et al.* 1995). The Zürich-Montpellier method requires floristic (pattern, dispersion - horizontal), structural (physiognomic, growth form and layering - vertical) and environmental homogeneity, which are usually assessed visually because the statistics to prove homogeneity are time-consuming and cumbersome (Werger 1973, 1974, Quézel 1981, Westhoff *et al.* 1995). Homogeneity of vegetation is linked to the scale of a study (Werger 1974) as the scale size increases, the impacts of the distribution of individual species become more important.

Several approaches to determining (analytical see Westhoff *et al.* (1995)) minimal area exist (Shimwell 1971, Werger 1972, Goldsmith & Harrison 1976, Buys *et al.* 1994, Westhoff *et al.* 1995). Minimal area requires that both floristic and structural data be considered (Werger 1972). A form of species-area curves was selected to estimate minimal area in this study.

In this study, the plot size for the Zürich-Montpellier method of vegetation analysis was initially to be determined by doing species-area curves in all the structural variants (to allow comparison at a later stage). The species-area curves were not done using the nested quadrats obtained by progressive doubling of quadrat size described by Mueller-Dombois & Ellenberg (1974), Kent & Coker (1992) and Westhoff *et al.* (1995), instead the curves started with ten plots of 1 x 1 m then nine successive increases of 10 x 1 m were applied until 100 m^2 was reached (Appendix 2). This was larger than the plot size expected from Buys *et al.* (1994) and an area for which homogenous stands could be found where homogenous stands of 1 000 m^2 were not available. A tangent as close as possible to the flattening of the curve was used to estimate the plot size rather than Werger's (1972) suggestion because that was based on curves covering 1 000 m^2. The largest plot size suggested from this tangent placement was 24 m^2 but 25 m^2 plots were eventually used because a 25 m^2 plot may be compared with other studies in Renosterveld. Most plots in this study were 5 x 5 m but six plots were 2.5 x 10 m because they were taken from the species-area curve sites.

I laid out 136 plots within subjectively chosen homogenous vegetation stands. Two plots were laid out per individual stand. Plots were subjectively located in areas supporting *Themeda triandra* to cover variations in slope, aspect and vegetation age with additional plots being located in areas where *Themeda triandra* was expected to occur, based on field observation, but where it was now absent. Each plot was marked by a 30 cm long metal stake placed in a northern corner. The corner marked was recorded on the field sheet. From the stake the plot extended up or down slope (depending on the aspect). For the plots on level ground the directions of the plot were recorded on the field sheet.

A complete floristic list for each plot was not possible as multiple visits to each plot were not practicable. Seasonal visits to the area were made to ensure as complete a floristic list as possible. This study was undertaken with very little prior knowledge of the flora.

The species were not recorded by layer, as was done for the vegetation of the Netherlands (Westhoff *et al.* 1995), nor were the layers recorded by growth form, as was recommended by Mucina *et al.* (2000), but the height and total cover of the different layers were recorded as they occurred. No attempt was made to identify cryptograms.

Mueller-Dombois & Ellenberg (1974) advocate using the published Braun-Blanquet scale of choice without modification to allow for comparison. Westhoff *et al.* (1995) note that several published modifications to the original Braun-Blanquet scale (including those used in this study) can be condensed into the original scale so that the data are still comparable. The Braun-Blanquet scale is quantitatively crude, even experts may make errors at the limit of the scale unit's value range (Mueller-Dombois & Ellenberg 1974). The suggested addition of quantitative traits to the codes up to scale level 2 could result in pseudoaccuracy (Westhoff *et al.* 1995). I estimated and recorded percentage cover/abundance per species per relevé using the modifications (the subdivision of scale '2' using the letters a, b and m) to the traditional Braun-Blanquet cover scale given in Westhoff & Van der Maarel (1973) and Werger (1974) and recorded in addition the species found in a 1 m band around the plot but not within it as 'O' (outside) in the manner used by Boucher (1987). The modifications to the traditional scale value '2' (numerous but < 5% cover or 5—25% cover independent of abundance) increased the information available.

The following data were also recorded for each sample plot: total vegetation cover per plot, non-soil cover per plot (this included gravel, stones and rock), exact location of the peg marking the plot (using a Garmin 3P GPS), altitude (estimated from an orthophoto and GPS readings), aspect (measured with a compass (in degrees) and corrected to true directions by adding 23^{o}, the deviation of magnetic north from true north), slope, biotic influences observed and soil depth. The soil samples from each horizon were collected with an auger and air-dried. The farmers supplied information on the names of the fields/camps.

The Zürich-Montpellier method is difficult to apply where the minimum area is too large to see cover or in grassland (as in this study) where different species have a relatively uniform appearance (Rieley & Page 1990).

2.2.2 Point Sampling for Cover Assessment

The Braun-Blanquet scale is quantitatively crude (Mueller-Dombois & Ellenberg 1974) and the scale is used to make estimates of canopy cover and abundance not basal cover determination. For this reason, point samples were used to obtain cover estimates in some grass dominated sites.

Using the point quadrat (or point intercept (Mueller-Dombois & Ellenberg 1974)) method of measuring cover, thin rods (or 'pins') are dropped through evenly spaced holes in a frame (or bridge or bench) (Kent & Coker 1992). The frame has two crosspieces with holes bored perpendicularly through them and the holes lined up perpendicularly to eliminate the parallax effect (Mueller-Dombois & Ellenberg 1974). The rod should be as thin as possible because increasing the diameter of the rod results in exaggerated cover estimates (Shimwell 1971, Kent & Coker 1992). The angle at which the point is dropped affects the likelihood of striking the vegetation (Shimwell 1971). Holding the frame vertically upright so that the point drops vertically is recommended for cover measurement though other angles have been used (Shimwell 1971, Mueller-Dombois & Ellenberg 1974, Goldsmith & Harrison 1976). The accuracy of a survey using a frame is increased by decreasing the number of points per frame (Tidmarsh & Havenga 1955). Mueller-Dombois & Ellenberg (1974) consider the size and intensity of the survey a guide to the number of points per frame with fewer points per frame being used to cover a larger area. A metre-length frame with ten holes set at ten centimetres intervals starting five centimetres from the edge was used with a rod of 2-3 mm in diameter. The rod was dropped perpendicular to the slope and ten points were collected per metre.

Every species the point of the rod touches is recorded (Mueller-Dombois & Ellenberg 1974, Kent & Coker 1992). 'Cover repetition' (i.e. the number of times the rod touches the same species in one descent) is more difficult to record than canopy and/or basal cover (Mueller-Dombois & Ellenberg 1974, Goldsmith & Harrison 1976). What a strike is should be clearly defined before the sampling commences (Tidmarsh & Havenga 1955). For this study, strikes were recorded when the rod touched any living plant part meaning that 'cover repetition' was also recorded. A first hit above the ground is termed a canopy strike and a strike on the lower stems or at the base of plants is a basal strike, in between strikes are termed subcanopy strikes. In the case of tussock grasses, a basal strike was noted if the rod struck within the basal circumference of the tussock. Basal misses were subdivided into bare soil, plant litter and stones.

Sampling should be random or systematic (Mueller-Dombois & Ellenberg 1974). In this study, points were collected in parallel rows of one hundred points set about ten to fifteen metres apart on grass dominated sites (the north east slope next to the field called 'Vleitjiesrug' and at two sites below the field called 'Dikkopskraal' on the Vleitjiesrug side).

The point quadrat method is time consuming (Shimwell 1971, Kent & Coker 1992). The pattern and structure of the vegetation affects the results. It is impractical to use this technique (the frame) in shrubby and/or tall vegetation (Kent & Coker 1992). The technique is best suited to grasslands (Shimwell 1971, Kent & Coker 1992). Mueller-Dombois & Ellenberg (1974) note that tools, such as the frame, have limited application but that the point intercept principle has a very wide application.

Hofmann & Ries (1990, 1992) found that their data supported the findings of Levy (1933) and Crocker & Tiver (1948) (quoted by Hofmann & Ries (1990, 1992) that a 300 to 500 point sample was sufficient to for vegetation analysis. For this study, information from five hundred points was collected per site. The data were then supplemented with point quadrat data collected by Stellenbosch University third year Botany classes in 1994 (480 points) and 1996 (800 points) at the site below Vleitjiesrug.

2.2.3 Management

Information about the management practices used on each of the different farms was collected during interviews with all the relevant farmers. Questions asked included the age of the vegetation, the number of times the various camps/sections had been burned since 1990 and grazing details including the type of livestock. If the farmer bought the farm after 1990, he was asked for contact details of the previous owner. Questions about the type of livestock, the fire management and grazing history were asked of previous owners of Bergsig and D'Ou Gnu during telephone interviews.

This information was collected for ordination analysis in conjunction with the relevé data.

2.2.4 Floristic Identification

All species in flower (including those not found in plots) were collected and sent for identification to the National Biodiversity Institute. Specimens were also taken of plants in the plots that were not in flower for matching purposes with others collected through the area, for possible later identification when a flowering specimen could be obtained. Flowering specimens were also collected at Brakkekuil Farm near Witsand as this area was originally intended to be part of the study but was later excluded because of the difficulties of distinguishing plants in the drought.

2.3 Data Analysis

2.3.1 Soil Analysis

All soil samples were sent to Bemlab, a commercial laboratory, for analysis. I carried out some additional analyses to facilitate comparison with other studies. The soil was prepared by passing it through a 2 mm diameter sieve to remove the non-soil particles.

Both pH_{KCl} and pH_{water} were measured. Bemlab measured pH_{KCl}. The $pH_{(water)}$ was measured according to the procedure outlined by the Non-affiliated Soil Analysis Work Committee (1990) using distilled water.

A 1:5 ratio of soil to distilled water was used to determine electrical conductivity (Mills 2003).

Bemlab analysed the cations (sodium, potassium, calcium and magnesium) by means of ICP and cation exchange capacity was calculated using ammonia saturation and an auto-analyser. Bemlab used the Walkley-Black method to determine the soil carbon content and the Bray II method to determine the phosphorus content of the soil.

Bemlab determined the five standard texture fractions (following the United States Department of Agriculture): coarse sand (2—0.5 mm diameter), medium sand (0.5—0.25 mm), fine sand (0.25—0.05 mm), silt (0.05—0.002 mm) and clay (< 0.002 mm) (Buol *et al.* 1997, FitzPatrick 1980).

2.3.2 Phytosociology

A relevé contains all the information (including abstract information such as altitude) concerning a plot (Moore 1962, Werger 1973). The Zürich-Montpellier method enters relevé information into a table (Mueller-Dombois & Ellenberg 1974, Werger 1974) for further processing. The relevé information may be obtained from a vegetation survey or from publications and databases (Schaminée *et al.* 1995b). Positive and negative associations of species are grouped together and relevés with similar species composition are grouped together (Werger 1973, 1974). Membership to a species group can be based on the restriction of a species to the general distribution range in the table of a group of associated species rather than exclusively by association with any individual species (Werger 1973). The program TWINSPAN (Hill 1979) provides an 'extremely good first approximation' of the table rearrangement that 'may be refined by the application of Braun-Blanquet procedures' (Bredenkamp *et al.* 1991). The 'process of rearranging' a table is 'largely objective' (Moore 1962, Werger 1973). The comparison of relevés in the table gives a quasi-objective test of homogeneity because heterogeneous stands have more species than the mean value of the community and/or many individual occurrences (Moore 1962). The advances in computer technology have facilitated the tabulation of data and table rearrangement. The floristic and environmental data collected during this study were entered in the computer program Excel in tabular form and then manually sorted to establish the coincidence between groups of species through the relevé set.

Werger (1973) notes different arguments concerning transitional relevés and fragmentary relevés. Transitional relevés can be handled in two ways: by retaining them in the table but ignoring them during classification or by removing them from the analysis (Schaminée *et al.* 1995b). Schaminée *et al.* (1995b) suggest that the purpose of the study should guide the choice of which option to follow. I agree with Ewald (2003), who is of the opinion that the removal of 'transitional' relevés from the final table compromises the data. All relevés are retained in the present study as the scale of the study does not allow syntaxonomical classification and such relevés could prove important when more data are available.

The results obtained from the rearranged table need to be checked in the field (Werger 1974). This field checking involves evaluating hypotheses concerning habitat links to communities generated (Werger 1973). Environmental and floristic data collected in each plot were analysed using ordination techniques to explain links between environmental conditions and communities and the communities were mapped (see Mapping) after the distribution of the resultant communities and their environmental correlates were tested by ground-truthing, while preparing the vegetation map. Some minor units were found to be inconsequential during this process.

Synoptic tables summarise the communities into single columns using constancy classes to denote for each species the percentage of relevés in each community in which the species is found (Westhoff & Van der Maarel 1973). Mucina *et al.* (2003) use percentages in place of constancy classes and add a column of weighted cover abundance values for each species in each community and another column to indicate the diagnostic value (character or differential) of each species and the communities for which this value applies. The synoptic table for this study (Table 3.1) uses the constancy classes found in Werger (1973) and Westhoff & Van der Maarel (1973).

Dominant species were identified using the definition of dominance supplied by Westhoff & Van der Maarel (1973) and Sieben (2003): a dominant species is a constant species (occurring in 60% or more of the relevés of the vegetation unit) with an average cover of more than 25%.

All subspecies were left out of the final table (Appendix 3). The subdivisions of the Braun-Blanquet scale '2' were listed as letters (m, a & b) (see the section on plot sampling for the choice of scale) in the phytosociological table because of spatial considerations.

The final Braun-Blanquet table is not the aim of the Zürich-Montpellier method. The table forms the basis for classification of syntaxa and for further studies such as vegetation dynamics (Werger 1973, Westhoff & Van der Maarel 1973). The table is a 'working hypothesis' to be tested by adding more data, mapping the vegetation units and checking the relationship between vegetation units and the environment (Westhoff & Van der Maarel 1973). Rearrangement of the table required by the addition of more relevés requires re-evaluation of the classification (Werger 1973). Two forms of classification are possible: formal syntaxonomical classification and local typology. The formal syntaxonomical classification aims to develop one general classification system for a large area, whereas a local typology aims to gain insight into the vegetation diversity of a limited area (Schaminée *et al.* 1995b). Ewald (2003) suggests that the question for phytosociologists should be 'how can plant species co-occurrence be understood?' rather than 'how is vegetation classified?' since the latter question is only a part of the former. The local typology generated in this study was used to assess the distribution of *Themeda triandra*, a palatable species of importance to farmers, in the natural vegetation and check the impacts of management in on the occurrence of this grass species.

Syntaxonomical classification is based on the presence and absence of diagnostic taxa and on the combinations of taxa (Westhoff & Van der Maarel 1973, Schaminée *et al.* 1995b). The diagnostic taxon may not be a species in idiotaxonomic terms (Schaminée *et al.* 1995b) though for this discussion, the term species will be used. Diagnostic species are identified by their fidelity. Fidelity is defined as the degree of bondage of species to vegetation types indicated by a scale from one to five found in Schaminée *et al.* (1995b). The criteria for determining fidelity are percentage presence, cover and comparison with the occurrence and classification of the species in published literature (Schaminée *et al.* 1995b). There are three types of diagnostic species: character species, differential species and constant companions. Character species normally occur in the stands of a specific syntaxon compared to their absence, less frequent occurrence or 'smaller total estimate' in stands of all other syntaxa of equal level (Westhoff & Van der Maarel 1973). Character species have categories defined according to the size of the area the study covers: local, regional and total. The geographic size ranges of categories for character species from different researchers do not always coincide (Werger 1973, Westhoff & Van der Maarel 1973, Schaminée *et al.* 1995b). Character species are a special case of differential species (Schaminée *et al.* 1995b, Westhoff & De Smidt 1995). Differential species are clearly more prominent in one syntaxon than in specific comparable syntaxa but are not limited to a single syntaxon (Westhoff & Van der Maarel 1973, Westhoff & De Smidt 1995). Fidelity classes three to five (3 - preferential character and preferential differential species, 4 – differential species or selective character species, 5 – exclusive character species) cover character and differential species (Schaminée *et al.* 1995b). Character and differential species can only be identified after comparison with all the syntaxonomical units for the entire area covered by the classification system (Mueller-Dombois & Ellenberg 1974, Schaminée *et al.* 1995b). Constant companion species (fidelity class 2, constant species) occur in most relevés of a syntaxon but do not fall in either of the preceding categories of diagnostic species (Westhoff & Van der Maarel 1973, Schaminée *et al.* 1995b). Fidelity class 1, residual species, covers all species not represented by the other classes (Schaminée *et al.* 1995b). Schaminée *et al.* (1995b) provide explicit quantitative guides to the fidelity classes. I used the definitions of fidelity listed above to determine the fidelity of species within the table of this present study to determine the diagnostic value of the species (differential or companion) used to describe the communities.

Four relevés are the absolute minimum required for adequate classification and characterization of a plant community but ten relevés are preferred (pers. comm. Dr C. Boucher 2001—2004, Westfall *et al.* 1996). At least ten relevés per syntaxonomic unit are required to identify differentiating taxa (Schaminée *et al.* 1995b). These considerations were applied in the classification of diagnostic taxa in this study.

In the syntaxonomical classification of communities, the association is the basic unit – it is not the smallest unit but it is required to understand smaller units (Braun-Blanquet 1932, Westhoff & Van der Maarel 1973). The association is defined as a plant community of certain floristic composition, of uniform habitat conditions and of uniform physiognomy (Becking 1957). The associations are defined by species combinations including character, differential and companion species (Westhoff & Van der Maarel 1973). The following are not classified as associations: residual communities (i.e. vegetation units that are species poor (unsaturated) and/or do not have character species) and derivative communities (i.e. vegetation units in which one or more alien species have displaced some or all of the diagnostic species) (Schaminée *et al.* 1995b, pers. comm. Prof. L. Mucina 2004). Mucina considers residual communities a 'non-concept' because the stands of an association are not usually saturated (pers. comm. Prof. L. Mucina 2004). The nomenclature for the syntaxa from subassociation to class is formalized (Schaminée *et al.* 1995b). For more information on nomenclature see Weber *et al.* (2000).

2.3.3 Mapping

The plant communities were mapped using MapInfo Professional 7.0 (MapInfo Corporation 2002), a GIS software package. DWAF (1999) aerial photographs of the study area were acquired from Surveys & Mapping in Mowbray, Cape Town. These raster images were opened with MapInfo and the projection was matched to eight GPS control points. The plots were then projected in the same coordinate system as the aerial photographs (Projection: Transverse Mercator; Ellipsoid: WGS 84 (World Geodetic System 1984); Datum: Hartbeesthoek 94 (Hartbeesthoek 1994, Longitude 21^{o})). A thematic map layer was created to show which plots belonged to each community and the communities were then drawn as a separate layer using the thematic layer as a guide. Human activity, in the form of homesteads and ploughed lands, etc., was drawn as a separate layer to allow the production of a continuous map and to ease visual discrimination of 'natural' (i.e. not expressly planted) vegetation. Both the natural vegetation and the cultivated lands layer were copied and simplified by grouping units to create an overview of the area.

The vegetation map was ground-truthed in November 2003 and corrected.

The area in hectares of each unit of the natural vegetation layer was calculated using MapInfo Professional 7.0 (MapInfo Corporation 2002) and the totals of each vegetation unit described in this study were calculated for each farm. This provides an underestimate of the extent of the natural vegetation. There are three sources of inaccuracy. The first is the impracticality of using a GPS to mark all the unit borders. The borders are drawn from the aerial photographs. The second is that the computer package did not have access to the contours so the area calculations are geometrically corrected not orthocorrected. The final source of inaccuracy is the precision with which the boundaries were manually drawn in the layer - the incorporation of natural vegetation on the boundaries is not absolutely precise.

2.3.4 Cover Assessment

The vegetation of the Vleitjiesrug site had been assessed prior to this study using the point quadrat method so the use of this method in the present study allowed a comparison of *Themeda triandra* cover over time. This incorporation of time justifies the inclusion of this exercise in this study.

Cover values for point quadrat data are expressed as percentages of the number of points (Shimwell 1971, Kent & Coker 1992) (see Appendices 8 and 9). If all strikes are counted, the total cover may be greater than one hundred percent (Shimwell 1971, Kent & Coker 1992).

Most of the species shared between the different point sampled sites occurred at too low a frequency for statistical analysis according to Shavelson (1981). Only *Themeda triandra* cover was sufficient for statistical analysis.

The non-parametric chi-squared (Π^2) test is used to compare observed values with expected values for data in the form of counts, i.e. frequency, proportion, probability or percentages, (Parker 1979, Shavelson 1981), which is why it was selected to test for differences in the cover of *Themeda triandra* between the different sites that were sampled with the point quadrat method and between the different years at the Vleitjiesrug site. The formula for the chi-squared test and the chi-squared probability table were found in Parker (1979). For the between sites comparisons, the data from the site next to Vleitjiesrug were used as the expected value. The data from the first site below Dikkopskraal were used as the expected value when comparing the two Dikkopskraal sites. For the comparisons of different years for the site next to Vleitjiesrug, the older data were treated as the expected value and the more recent data as the observed value.

2.3.5 Ordination

Ordination is defined as the arrangement of objects in one or more dimensional space which in phytosociology, may represent species, relevés or groups of relevés (Hennekens *et al.* 1995). There are two forms of ordination: constrained ordination (= direct gradient analysis) or unconstrained ordination (= indirect gradient analysis) (Hennekens *et al.* 1995).

Unconstrained ordination uses floristic composition and cover/abundance to arrange species and/or relevés according to axes derived from the internal variation of the data (Goldsmith *et al.* 1986, Hennekens *et al.* 1995). Constrained ordination relates species presence or abundance to environmental variables on the basis of species and environmental data from the same set of sample relevés (Ter Braak 1987b). Constrained ordination should be used in combination with unconstrained ordination to avoid possible inaccuracy caused by using too few or unimportant environmental variables in the constrained ordination that do not explain most of the variability of the species data (Lepš & Šmilauer 2003).

The Braun-Blanquet cover/abundance scale is not suitable for numerical analysis. The extremes of handling cover/abundance are: converting cover/abundance to either an ordinal scale or percentages and giving it weight and giving cover/abundance no weight thereby making presence/absence the focus (Hennekens *et al.* 1995). Emphasizing presence/absence gives good results if one is dealing with a heterogeneous series of relevés and/or species rich relevés (Hennekens *et al.* 1995) as this study does. For this study, both extremes were considered.

In this study, the program TURBO(VEG) (Hennekens 1996) was used to transform (to Cornell condensed format) the data for analysis using the CANOCO program (Ter Braak & Šmilauer 1998). The environmental and management information used for CCA is listed in Table 7.4a, Appendix 4. No transformations were used. No single relevé occurrences or temporarily visible species were included in the data transformed for CANOCO.

In ordination, the key question is the choice of species response model (Ter Braak 1987a, Lepš & Šmilauer 2003). The two models used in ordination are the linear response model and the unimodal response model (Lepš & Šmilauer 2003). The guide to choosing a response model supplied by Lepš & Šmilauer (2003 – p 50) indicated that unimodal ordination techniques were more suitable for this project.

The program CANOCO (Ter Braak & Šmilauer 1998) was used to apply Detrended Correspondence Analysis (DCA) (unconstrained with unimodal species response model) (see below for reasons for the selection of DCA) and Canonical Correspondence Analysis (CCA) (constrained with unimodal species response model) ordination to the full phytosociological dataset (including cover/abundance values) and as presence/absence (excluding cover/abundance values) to determine the ecological relationships between sample plots.

Both DCA and CCA are based on weighted averaging (Ter Braak 1987a, Lepš & Šmilauer 2003). For explanations of the mathematics of weighted averaging see Ter Braak (1987a), Kent & Coker (1992), Ter Braak & Šmilauer (1998) and Lepš & Šmilauer (2003). The principles of weighted averaging are the same for both constrained and unconstrained ordination but the identification of axes is different (Whittaker 1973b, Ter Braak 1987a).

Correspondence Analysis (CA) is a form of indirect gradient analysis (unconstrained ordination) in which the only input matrix is species x plots. CA has some problems (Ter Braak 1987b, Kent & Coker 1992). CA is strongly influenced by sites that are species poor and contain rare species – such aberrant sites are placed at the extreme ends of the first ordination axis, thereby relegating major vegetation trends to later axes (Ter Braak 1987b). The arch effect (or Guttman effect (Ter Braak & Šmilauer 1998)) occurs when the second axis is a quadratic function of the first axis containing no new information (Ter Braak 1987a, Kent & Coker 1992). Another problem is the axis compression effect - the species near the ends of the axis are closer together than those at the centre though they are in reality spaced at an equal distance (Kent & Coker 1992). Detrending, by segments or by polynomials, is used to minimise the arch effect. Detrending by segments does not have a 'convincing theoretical basis' (Lepš & Šmilauer 2003). Detrending by polynomials requires that the second axis be uncorrelated with both the first axis and the square of the first axis (Ter Braak 1987a). Detrending by polynomials was used in this study to attempt to eliminate the arch effect and gain meaningful information from the second axis.

In this study, DCA was run using detrending by 4th order polynomials in this project - the effects of detrending by 2nd, 3rd and 4th order polynomials were the same for the full (cover/abundance included) dataset. The other setting choices in CANOCO were inter-species distance and biplot. Outlying plots were noted then removed to enhance the resolution of the ordination.

CCA is a form of direct gradient analysis (constrained ordination). The input matrices are species x plots and environmental variables x plots. The axes are constrained to linear combinations of environmental variables (Kent & Coker 1992, Ter Braak 1987a, Ter Braak & Šmilauer 1998). CCA is only effective if good environmental data are available but is not affected by sites with aberrations in species composition unless the aberrations extend to the environmental variables (Ter Braak 1987b, Kent & Coker 1992).

In this study, the setting choices for CCA in CANOCO were inter-species distance and biplot. A first run of CCA with all the available environmental and management variables (64 variables) produced a data matrix too large for CanoDraw (Ter Braak & Šmilauer 1998) so the environmental variables were separated from the management variables. The environmental variables were split into soil variables and other variables (a combination of topographical and vegetation variables). The variables were run and then the log file was checked and superfluous variables – i.e. variables with a large inflation factor (Ter Braak & Šmilauer 1998) - were removed.

Hennekens *et al.* (1995) highlight the fact that computer programs (such as CANOCO) offer choices to the researcher and suggest that this makes the results as lacking in objectivity as for the Braun-Blanquet tabulation. Mucina (1997) suggests that numerical methods are 'more formal' in the sense of exactness, repeatability and 'liability to experiment on the data' rather than 'more objective'. 'Formality', as with 'objectivity', may be considered an advantage. Computer methods do have the advantage of being reproducible (Hennekens *et al.* 1995). This means that results may be more easily checked and criticised. To this end, the choices used in this study were listed.

The programs CanoDraw (Šmilauer 1990, 1992, Ter Braak & Šmilauer 1998) and CanoPost (Ter Braak & Šmilauer 1998) were used to display the ordination results graphically using the composite axes generated by CANOCO.

2.3.6 Floristic Identification and Comparison

Flowering specimens of species collected were sent to the National Biodiversity Institute at Kirstenbosch for identification. Since not all plants could be sent for identification (absence of flowers on some specimens), I have made tentative identifications of some non-flowering specimens by matching them to specimens in the Compton Herbarium. Appendix 3 contains a list of specimens identified and their collection numbers from both the Grootvadersbosch Conservancy and Brakkekuil Farm.

The floristic lists from Brakkekuil Farm near Witsand and the Grootvadersbosch Conservancy study site were compared quantitatively to get an indication of their degree of similarity. Both sites were sampled regularly one after the other.

Chapter 3 Results

3.1 Classification of Plant Communities

3.1.1 Introduction

This study identified two community groups using the Zürich-Montpellier method: the *Themeda triandra - Stoebe phyllostachys* Grassland Group (1) and the *Themeda triandra - Elytropappus rhinocerotis* Shrubland Group (2) (Table 3.1). The *Themeda triandra - Stoebe phyllostachys* Grassland Group is discussed first. Four relevés were not classified because they were fragmentary. They are placed on the right side of the phytosociological table (Appendix 4, Table 3.1).

The genera *Argyrolobium*, *Centella* and *Otholobium* and *Hermannia* subgenus *Mahernia* are under revision consequently species names for these taxa are either unavailable or tentative.

Sampling was undertaken over more than one season. The geophytic components were not always visible and certain grass species were not identifiable in all seasons due to the drought conditions at the time of sampling. The grass species are placed according to what the groundtruthing of the map showed to be their position. The geophytic species are placed in block J ‘Seasonally Identifiable Species’.

The physiognomic strata were found to be variable over the wider community range, thus some overlap in the description of the units occurs although individual stands were generally clearly layered.

The stratum dominants in the present study are not restricted to the definition of dominance used in this study because the strata are not always consistently present and these species are not automatically community dominants. The community dominants for this study did not always satisfy the definition of dominance used in this study. In cases where the definition of dominance could not be satisfied, the species occurring in the highest number of relevés with the highest possible cover were taken as dominant.

While the slope aspect of each unit is given in the description of the communities (using 16 categories), the units are not necessarily restricted to the listed aspects. Owing to the comparatively small scale of this study it has not been possible to define the distribution limits of most communities.

The scope of this study does not cover the wider distribution range of the vegetation type thus formal ranking of the units has not been done, although I suggest that my communities are probably at the association level.

The units are compared quantitively with published communities in Appendix 10.

Table 3.1 (page 1): Summarized Braun-Blanquet species data for the Grootvadersbosch Conservancy excluding single relevé occurrences

1.1.1 = *Themeda triandra - Centella* cf. *eriantha* Grassland Subcommunity, 1.1.2 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum, 1.2 = *Themeda triandra - Stoebe phyllostachys* Grassland Community, 2.1.1 = *Themeda triandra - Chrysanthemoides monilifera* Subcommunity, 2.1.2 = *Themeda triandra - Aspalathus nigra* Subcommunity, 2.1.3 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum, 2.2 = *Themeda triandra - Bobartia macrospatha* Herbland Community, 2.3 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community, 0 = unclassified relevés. I = present in 0—20% of unit's relevés, II = present in 20.1—40% of unit's relevés, III = present in 40.1—60% of unit's relevés, IV = present in 60.1—80% of unit's relevés, V = present in 80.1—100% of unit's relevés. * = Alien Species, ** = Collection number with the initials of the collector (G.R.Raitt) preceding it and + = Species not readily identifiable under drought conditions

Community	**1.1.1**	**1.1.2**	**1.2**	**2.1.1**	**2.1.2**	**2.1.3**	**2.2**	**2.3**	**0**
Species Block A: *Themeda triandra - Centella eriantha* Grassland Subcommunity									
Centella cf. *eriantha*	IV	.	.	.	.	.	.	.	.
Berkheya carduoides	II	.	.	.	.	.	.	.	.
Senecio crenatus	II	.	.	.	.	.	.	.	.
Aspalathus cf. *ternata*	II	.	.	.	.	.	.	.	.
*Acacia mearnsii**	I	.	.	.	.	.	.	.	.
*Pennisetum clandestinum**	I	.	.	.	.	.	.	.	.
Species Block B: *Themeda triandra - Senecio* sp. a (G.R.Raitt 710) Grassland Community									
Senecio sp. a (GRR 710**)	IV	IV	.	.	.	.	.	.	.
Ficinia tenuifolia	III	II	.	.	.	.	.	.	.
Osteospermum imbricatum	II	II	.	.	.	I	.	.	.
Monopsis unidentata	II	I	.	.	.	.	.	.	.
Aspalathus retroflexa	.	I	.	.	.	.	.	.	.
Species Block C: *Themeda triandra - Stoebe phyllostachys* Grassland Community Group									
Stoebe phyllostachys	III	III	III	.	.	I	I	.	.
Aspalathus angustifolia	II	II	III	.	.	.	.	.	.
Linum heterostylum	I	I	I	.	.	.	.	.	.
Senecio sp. b (GRR 51/22)	I	I	I	.	.	.	.	.	.
Muraltia satureioides	I	I	I	.	.	.	.	.	.
Pachycarpus dealbatus	.	I	I	.	.	.	.	.	.
Aspalathus sp. (GRR 123/14)	.	.	I	.	.	.	.	.	.
Species Block D: *Themeda triandra - Chrysanthemoides monilifera* Shrubland Subcommunity									
Chrysanthemoides monilifera	I	.	.	V	.	I	.	.	.
Muraltia collina	.	.	.	IV	.	.	.	.	.
Gymnosporia buxifolia	.	.	.	II	.	.	.	.	.
Clutia pulchella	.	.	.	I	.	.	.	.	.
Species Block E: *Themeda triandra - Aspalathus nigra* Shrubland Subcommunity									
Aspalathus nigra	.	.	.	III	V	.	.	.	.
Species Block F: *Themeda triandra - Argyrolobium* sp. a (G.R.Raitt 29) Shrubland Community									
Argyrolobium sp. a (GRR 29)	IV	IV	III	I	V	IV	.	.	IV
Eragrostis capensis	V	V	V	I	I	I	.	.	V
Phylica propinqua	III	III	III	III	II	I	.	.	III
Argyrolobium sp. b (GRR 842)	IV	III	II	II	III	I	.	.	II
Pelargonium candicans	III	IV	III	.	I	I	.	.	.
Tephrosia capensis	IV	II	III	.	II	I	.	.	II
Rhynchosia capensis	III	II	III	.	II	I	.	.	III
Euclea crispa	III	I	I	III	III	I	.	.	.
Hermannia flammea	I	I	.	I	IV	II	.	.	.
Otholobium sp. (GRR 45/4)	II	II	II	.	I	I	.	.	II
Athanasia juncea	.	I	I	II	II	II	.	.	II
Polygala hottentotta	III	II	I	.	.	I	.	.	.

Table 3.1 (page 2): Summarized Braun-Blanquet species data for the Grootvadersbosch Conservancy excluding single relevé occurrences

Community	**1.1.1**	**1.1.2**	**1.2**	**2.1.1**	**2.1.2**	**2.1.3**	**2.2**	**2.3**	**0**
Species Block F: *Themeda triandra - Argyrolobium* sp. a (G.R.Raitt 29) Community									
Koeleria capensis	II	III	III	.	.	I	.	.	III
Sutera hispida	I	.	I	I	IV	II	.	.	.
Centella cf. *affinis*	II	I	II	.	.	I	.	.	II
Aspalathus acuminata	I	I	II	.	I	I	.	.	III
Heteropogon contortus	II	I	II	.	.	I	.	.	II
Brachiaria serrata	I	I	II	.	.	I	.	.	III
Schizoglossum aschersonianum	.	I	I	I	.	I	.	.	II
Selago ciliata	I	I	II	.	.	I	.	.	II
Ruellia pilosa	I	I	I	.	.	I	.	.	.
Hermannia alnifolia	I	I	.	.	I	I	.	.	.
Gnidia squarrosa	.	I	.	I	I	I	.	.	II
Athrixia capensis	.	II	II	.	I	I	.	.	.
Scabiosa columbaria	.	.	I	.	II	.	.	.	.
Felicia hyssopifolia	I	I	I	.	I	.	.	.	.
Eragrostis racemosa[+]	I	I	II	.	.	.	.	.	.
Muraltia cf. *pillansii*	I	.	.	.	.	I	.	.	.
Helictotrichon hirtulum[+]	.	.	.	.	II	.	.	.	.
Festuca scabra[+]	I	I	.	.	.	I	.	.	.
Pentaschistis pallida[+]	.	.	.	.	.	I	.	.	.
Pelargonium pilosellifolium	.	I	.	.	.	I	.	.	.
Sporobolus africanus[+]	I	.	.	.	.	I	.	.	.
Tulbaghia capensis	.	.	.	.	.	I	.	.	.
Ruschia tenella	.	.	.	.	.	I	.	.	.
Helichrysum asperum	.	.	.	.	.	I	.	.	.
Aspalathus steudeliana	.	I	.	.	.	I	.	.	.
Passerina vulgaris	I	.	.	.	.	I	.	.	.
Species Block G: *Themeda triandra - Bobartia macrospatha* Community									
Bobartia macrospatha	.	.	.	.	.	.	V	.	.
Pelargonium sp. (GRR 13/38)	.	.	.	.	.	.	III	I	.
Tetraria bromoides	.	.	.	.	.	.	II	.	.
Leucadendron salignum	.	.	.	.	.	.	II	.	.
Linum thunbergii	.	.	.	.	.	.	II	.	.
Asteraceae sp. a (GRR 13/22)	.	.	.	.	.	.	II	.	.
Selago scabrida	.	.	.	.	.	I	II	.	.
Calopsis adpressa	.	.	.	.	.	.	II	.	.
Onixotis punctata	.	.	.	.	.	.	II	.	.
Cyperaceae spp.	.	.	.	.	.	.	II	.	.
Diospyros glabra	.	.	.	.	.	.	II	.	.
Clutia laxa	.	.	.	.	.	.	II	.	.
Species Block H: Species Common to Units 1.1.1, 1.1.2, 1.2, 2.1.1, 2.1.2, 2.1.3 & 2.2									
Indigofera porrecta	V	V	IV	III	V	III	II	.	V
Schoenoxiphium sparteum	V	V	V	III	III	II	II	.	IV
Aristea pusilla/*Aristea* sp. (GRR 120/41) Complex	III	V	IV	I	IV	II	II	.	III
Roella spicata	V	IV	III	.	I	II	II	.	II
Thesium junceum	III	IV	IV	I	III	I	II	.	II
Relhania pungens	.	III	II	I	II	IV	I	.	V
Asparagus capensis	II	I	I	V	II	III	I	.	IV
Helichrysum nudifolium	V	III	II	I	I	.	II	.	.
Aspalathus asparagoides	III	II	II	I	.	II	II	.	.
Aspalathus opaca	II	II	III	I	I	I	I	.	II

Table 3.1 (page 3): Summarized Braun-Blanquet species data for the Grootvadersbosch Conservancy excluding single relevé occurrences

Community	**1.1.1**	**1.1.2**	**1.2**	**2.1.1**	**2.1.2**	**2.1.3**	**2.2**	**2.3**	**0**
Species Block H: Species Common to Units 1.1.1, 1.1.2, 1.2, 2.1.1, 2.1.2, 2.1.3 & 2.2									
Berkheya herbacea	III	II	III	I	I	I	I	.	IV
Aspalathus millefolia	.	II	III	I	I	III	I	.	IV
Restio multiflorus	I	III	II	I	I	I	III	.	II
Tetraria cuspidata	II	III	III	.	.	I	I	.	II
Oxalis purpurea/*O. eckloniana* Complex	.	.	I	III	IV	I	IV	.	.
Gerbera piloselloides	III	I	I	I	I	.	II	.	.
Falckia repens	I	I	I	I	III	II	I	.	II
Pentaschistis curvifolia^{+}	I	I	I	I	I	I	IV	.	.
Hibiscus pusillus	I	.	.	I	I	III	I	.	.
Hermannia subgen. *Mahernia* (GRR 236)	.	I	I	II	I	I	II	.	.
Drosera cistiflora	.	.	I	I	I	I	III	.	.
Ledebouria ovalifolia	I	I	I	.	I	I	II	.	II
Drimia capensis	.	.	I	III	II	I	I	.	.
Arctotheca prostrata	.	I	.	I	I	I	II	.	III
Lobelia coronopifolia/*L. tomentosa*	I	I	I	.	.	I	II	.	.
Lanaria lanata	I	II	.	.	.	.	II	.	.
Knowltonia anemonoides	I	I	I	.	.	.	I	.	.
Corymbium africanum	.	.	I	.	.	I	II	.	.
Polygala meridionalis/*P. pottebergensis* Complex	.	I	I	.	I	I	I	.	.
Arctopus sp. (GRR 14/9)	I	I	.	.	.	I	II	.	.
Ehrharta calycina^{+}	II	.	.	.	.	.	.	.	.
Ehrharta capensis^{+}	I	I	.	.	.	.	.	.	.
Ehrharta bulbosa^{+}	I	I	.	.	.	.	.	.	.
Oedera capensis	.	I	I	.	.	I	I	.	.
Oxalis polyphylla	I	.	I	.	.	I	I	.	.
Tribolium uniolae^{+}	.	.	.	.	.	I	.	.	.
Erica cerinthoides	.	I	I	.	.	I	I	.	.
Tripteris tomentosa	I	.	.	I	.	.	I	.	.
Trachypogon spicatus^{+}	.	.	.	.	.	.	II	.	.
Cyclopia cf. *sessiliflora*	I	.	I	.	.	.	I	.	.
Species Block I: *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community Group									
Elytropappus rhinocerotis	.	.	.	III	III	V	IV	V	.
Lichens	.	.	.	II	III	II	IV	III	.
Gnidia laxa	I	I	.	II	IV	III	.	II	.
Oxalis pendulifolia/*O. ciliaris* Complex		.	I	II	IV	I	III	III	.
Rhus lucida	I	.	.	III	I	I	II	I	.
Oxalis pardalis	.	.	.	IV	I	I	III	II	.
Oxalis stellata	.	.	.	III	II	I	III	II	.
Euphorbia tuberosa	.	.	I	II	II	II	II	.	.
Oxalis cf. *heterophylla*	.	.	.	IV	III	I	II	.	.
Mohria caffrorum	.	I	.	II	II	.	II	.	.
Neodregea glassii	.	.	.	I	III	I	II	.	.
Pelargonium pinnatum	.	.	.	I	I	I	III	.	.
Melica racemosa^{+}	.	.	.	II	.	.	I	III	.
Rhus rosmarinifolia	.	.	.	II	I	.	II	.	.
Hermannia hyssopifolia	.	.	.	IV	I	.	I	.	.
Asparagus krebsianus	.	I	.	II	.	I	I	.	.
Berkheya rigida	.	.	.	.	I	I	.	II	.
Agathosma virgata	.	.	.	I	.	I	I	I	.
Heterolepis peduncularis	.	.	.	I	.	I	.	.	.

Table 3.1 (page 4): Summarized Braun-Blanquet species data for the Grootvadersbosch Conservancy excluding single relevé occurrences

Community	1.1.1	1.1.2	1.2	2.1.1	2.1.2	2.1.3	2.2	2.3	0
Species Block I: *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community Group									
Gazania krebsiana	.	.	.	.	.	I	.	.	.
Pelargonium caucalidifolium	.	.	.	.	I	.	II	.	.
Crassula capensis	.	.	.	I	.	.	II	.	.
Melinis nerviglumis+	.	.	.	.	.	.	I	II	.
Lichtensteinia latifolia	.	.	.	I	.	.	I	.	.
Printzia polifolia	.	.	.	I	.	.	I	.	.
Crassula saxifraga	.	.	.	.	I	.	I	.	.
Felicia aculeata	.	.	.	.	I	I	.	.	.
Thymelaeaceae sp. (GRR 116/10)	.	.	.	.	.	I	.	.	.
Hermannia cf. *saccifera*	.	.	.	.	.	I	.	.	.
Aristida diffusa+	.	.	.	.	.	I	.	.	.
Conyza scabrida	.	.	.	I	.	I	.	.	.
Aspalathus incompta	.	.	.	.	.	I	.	I	.
Karroochloa curva+	.	.	.	.	.	.	.	II	.
Holothrix mundii	.	.	.	.	.	.	.	II	.
Species Block J: Seasonally Identifiable Species									
Ornithogalum graminifolium	II	II	.	.	.	.	.	.	.
Ornithogalum dubium	.	III	I	.	.	I	.	.	.
Ornithogalum cf. *pilosum*	.	.	.	I	I	.	.	.	.
Watsonia laccata	.	.	.	.	I	.	.	.	.
Albuca viscosa	.	.	.	.	.	I	.	.	.
Moraea virgata	V	IV	IV	I	V	I	I	.	III
Eriospermum sp. a (GRR 4/48)	I	.	I	.	IV	.	II	.	.
Hypoxis setosa	I	I	I	.	.	.	I	.	II
Eriospermum proliferum	.	I	.	.	I	I	I	.	.
Haemanthus cf. *coccineus*	.	.	I	.	.	I	I	.	.
Babiana patula	.	.	.	I	III	I	I	I	.
Geissorhiza ovata	.	.	.	I	II	I	II	.	.
Cyphia volubilis	.	.	.	II	.	.	II	.	.
Eriospermum sp. b (GRR 26/29)	.	.	.	.	.	I	II	.	.
Tritoniopsis burchellii	.	.	.	.	.	.	II	.	.
Cyanella lutea	.	.	.	.	I	I	.	.	.
Hypoxis floccosa	.	.	.	.	.	I	.	I	.
Geophyte spp.	II	II	II	IV	IV	II	III	I	IV
Mosses	.	I	I	III	V	II	V	IV	II
Cyphia linarioides	.	.	I	.	.	I	.	I	.
Species Block K: Widespread Species									
Themeda triandra	V	V	V	III	V	IV	II	II	V
Hibiscus aethiopicus	V	V	V	V	V	V	IV	II	V
Gnidia sericea	V	V	V	III	III	III	III	III	III
Ficinia oligantha/*F. nigrescens* Complex	V	V	IV	III	IV	IV	III	I	III
Helichrysum patulum	V	IV	III	II	III	IV	IV	IV	II
Helichrysum cymosum	IV	III	III	II	IV	IV	V	IV	II
Metalasia densa/*M. acuta* Complex	V	IV	III	III	IV	IV	II	II	III
Erica peltata	IV	IV	III	III	II	IV	IV	III	II
Gnidia galpinii	III	V	III	II	IV	IV	III	II	III
Anthospermum aethiopicum	II	III	III	IV	V	IV	V	IV	II
Selago dolosa	III	III	II	I	V	III	II	IV	II
Hermannia flammula	II	III	II	III	V	IV	II	II	.
Otholobium cf. *spicatum*	V	III	I	V	V	I	II	II	.

Table 3.1 (page 5): Summarized Braun-Blanquet species data for the Grootvadersbosch Conservancy excluding single relevé occurrences

Community[1]	**1.1.1**	**1.1.2**	**1.2**	**2.1.1**	**2.1.2**	**2.1.3**	**2.2**	**2.3**	**0**
Species Block K: Widespread Species									
Athanasia trifurcata	II[2]	II	II	III	III	IV	II	IV	II
Aristida junciformis/Merxmuellera sp. Complex	III	IV	III	II	III	II	II	II	.
Anthospermum galioides	III	III	II	I	II	III	II	II	II
Euryops abrotanifolius	III	I	I	III	V	III	III	III	.
Erica leucopelta	.	I	II	III	III	II	V	III	II
Cliffortia filicaulis	III	II	II	II	II	I	II	II	.
Oxalis obtusa/*O. depressa* Complex	I	I	I	IV	IV	I	II	II	II
Oxalis cf. *lanata*	II	II	I	I	I	I	IV	II	.
Eragrostis curvula	II	I	I	II	II	I	.	IV	.
Wahlenbergia tenella	I	II	I	I	III	II	I	I	.
Poaceae spp.	I	II	I	III	II	II	V	II	.
Hyparrhenia hirta	I	I	I	I	I	II	I	III	.
Cynodon dactylon	.	I	I	I	II	III	I	III	.
Cymbopogon plurinodis	I	II	.	.	.	II	.	II	.
Ursinia discolor	II	I	I	.	.	I	.	I	.
Sonchus dregeanus	I	I		I	.	.	I	III	II
Euphorbia erythrina	I	.	I	I	.	.	II	I	.
Senecio rosmarinifolius	I	.	.	I	I	.	.	II	.
Cliffortia juniperina	I	.	.	.	.	.	I	I	.
*Anagallis arvensis**	I	.	.	.	.	.	.	I	.

3.1.2 *Themeda triandra - Stoebe phyllostachus* Grassland Community Group (1)

This community group includes two communities, of which one is further subdivided into two subcommunities. The proposed relationship of the community group follows:

Themeda triandra - Stoebe phyllostachys Grassland Community Group (1)

- *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Community (1.1)
  - *Themeda triandra - Centella* cf. *eriantha* Grassland Subcommunity (1.1.1)
  - *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum (1.1.2)
- *Themeda triandra - Stoebe phyllostachys* Grassland Community (1.2)

The 60 relevés that represent this community group are in community blocks 1.1.1, 1.1.2 and 1.2 of Appendix 3. The orthophoto map references in which this community group was recorded are, 3420BB1 Glen Etive (3420BB1) (Chief Director Of Surveys & Mapping 1983b), 3420BB2 Arkadia (3420BB2) (Chief Director Of Surveys & Mapping 1983c) and 3320DD22. Tables 3.2 and 3.3 show the area covered by this community group.

The average number of species per relevé is 34 (range = 19—50).

The characteristic species for the community group are: *Aspalathus angustifolia*, *Aspalathus* sp. (GRR 123/14), *Linum heterostylum*, *Muraltia satureioides*, *Pachycarpus dealbatus*, *Senecio* sp. b (GRR 51/22) and *Stoebe phyllostachys*. The dominant species is *Themeda triandra*. Species blocks C, F, H and K identify this community group. The vegetation, at the time of sampling, varied from young veld (up to two years old) to mature veld (about four years old) but 85% of the relevés was in young veld. Vegetation cover averaged 84% (range = 71—100%). The litter cover averaged 4% (range = < 0.5—15%).

Table 3.2: Area (ha) covered by the different phytosociological units as mapped

Tt = *Themeda triandra*, *Sp* = *Stoebe phyllostachus*, Com. = Community, *S* sp. = *Senecio* sp. (G.R.Raitt 710), *Ce* = *Centella* cf. *eriantha*, Subcom. = Subcommunity, Typ. = Typicum, *Er* = *Elytropappus rhinocerotis*, *A* sp. = *Argyrolobium* sp. (G.R.Raitt 29), *Cm* = *Chrysanthemoides monilifera*, *An* = *Aspalathus nigra*, *Bm* = *Bobartia macrospatha*, * = Subdivisions mapped. + Includes mosaics of subdivisions and any vegetation transitional between communities/subcommunities within the unit.

Phytosociological Unit	Single Unit (ha)	Mosaic (ha)	Total Certain (ha)	Uncon-firmed (ha)	Uncon-firmed Mosaic (ha)	Grand Total (ha)
Tt – *Sp* Com. Group*	197.705+	52.512	**250.217**	86.860+	185.289	**522.366**
Tt – *S* sp. Com.*	115.017+	72.433	**187.450**	22.766+	234.285	**444.501**
Tt – *Ce* Subcom.	54.149	14.748	**68.897**	1.673	47.878	**118.448**
Tt – *S* sp. Subcom. Typ.	60.868	57.685	**118.553**	20.785	187.023	**326.361**
Tt – *Sp* Com.	53.275	38.905	**92.180**	15.098	48.996	**156.274**
Tt – *Er* Com. Group*	810.284+	65.294	**875.578**	89.623+	185.289	**1150.490**
Tt – *A* sp. Com.*	648.859+	57.265	**706.124**	71.993+	188.904	**967.021**
Tt – *Cm* Subcom.	82.419	4.551	**86.970**	0.058	0.618	**87.646**
Tt – *An* Subcom.	80.612	24.596	**105.208**	1.000	0.130	**106.338**
Tt – *A* sp. Subcom. Typ.	485.826	27.916	**513.742**	70.329	189.368	**773.439**
Tt – *Bm* Com.	135.194	17.131	**152.325**	17.488	1.938	**171.751**
Tt – *Er* Com.	11.808	-	**11.808**	-	1.677	**13.485**

Table 3.3: Area (ha) covered by mosaics of plant communities, indeterminate vegetation and transitional vegetation as mapped

Tt = *Themeda triandra*, *Ce* = *Centella* cf. *eriantha*, Subcom. = Subcommunity, *S* sp. = *Senecio* sp. (G.R.Raitt 710), Typ. = Typicum, *Sp* = *Stoebe phyllostachus*, Com. = Community, *An* = *Aspalathus nigra*, *A* sp. = *Argyrolobium* sp. (G.R.Raitt 29), Indeter. = Indeterminate, *Cm* = *Chrysanthemoides monilifera*, *Bm* = *Bobartia macrospatha*, *Er* = *Elytropappus rhinocerotis*, Trans. = Transitional

Mosaic	**Mapped (ha)**	**Mapped as Unconfirmed (ha)**	**Total (ha)**
Tt – Ce Subcom. & *Tt – S* sp. Subcom. Typ.	-	0.308	0.308
Tt – Ce Subcom. & *Tt – Sp* Com.	11.339	47.570	58.909
Tt – Ce Subcom. & *Tt – An* Subcom.	1.384	-	1.384
Tt – Ce Subcom. & *Tt – A* sp. Subcom. Typ.	2.025	-	2.025
Tt – S sp. Subcom. Typ. & *Tt – Sp* Com.	18.074	1.426	19.500
Tt – S sp. Subcom. Typ. & *Tt – An* Subcom.	13.720	-	13.720
Tt – S sp. Subcom. Typ. & *Tt – A* sp. Subcom. Typ.	25.891	185.289	211.180
Tt – Sp Com. & *Tt – An* Subcom.	9.492	-	9.492
Indeter. possibly *Tt – Sp* Com.	5.580	-	5.580
Tt – Cm Subcom.& *Tt – A* sp. Subcom. Typ.	-	0.476	0.476
Tt – Cm Subcom. & *Tt – Bm* Com.	4.551	0.142	4.693
Tt – An Subcom.& *Tt – A* sp. Subcom. Typ.	-	0.130	0.130
Tt – A sp. Subcom. Typ. & *Tt – Bm* Com.	-	1.796	1.796
Tt – A sp. Subcom. Typ. & *Tt – Er* Com.	-	1.677	1.677
Trans. *Tt – A* sp. Subcom. Typ. & *Tt – Er* Com.	9.872	-	9.872
Indeter. possibly *Tt – A* sp. Subcom. Typ.	2.128	-	2.128
Tt – Bm Com. & Fynbos	12.580	-	12.580

This community group has light alien invasion. The woody aliens found in the relevés are *Acacia longifolia* and *Acacia mearnsii*. Herbaceous aliens *Anagallis arvensis* and *Pennisetum clandestinum* were found in the relevés and *Hibiscus trionum* was found in the area mapped to this Community Group.

Physiognomically, this community group consists of two to three strata. The two upper strata are not always distinct from each other. The number of strata is probably affected by the maturity of the vegetation. The tall shrub stratum, 0.4—1.4 m in height, with a projected cover of 2—50%, is dominated by *Otholobium* cf. *spicatum*. The middle stratum, 0.1—0.6 m in height, with a projected cover of 2—50% is dominated by one or more of the following species: *Aspalathus asparagoides*, *Erica peltata* and *Metalasia acuta* / *Metalasia densa*. The herbaceous stratum, up to 0.15 m tall, with a projected cover of 10—95%, is dominated by *Themeda triandra*.

This community group was found on the foothill slopes of the Langeberg. The altitude of the samples in this community group ranged from 240—368 m asl. The community group was recorded on slopes with any aspect except southerly. The average slope was 14.8^{o} (range = 5—25^{o}).

The under-lying geology in this community group is shale and the soil generally has a sandy loam texture (78% of samples). Soil depth averaged 200 mm (range = 88—411 mm). Tables 3.4 and 3.5 show the soil chemistry for this community group.

Table 3.4: Means and ranges of pH, electrical conductivity and cation exchange capacity for soils sampled in the 12 vegetation units of this study

Conductivity = Electrical conductivity, CEC = Cation Exchange Capacity, *Tt* = *Themeda triandra*, *Sp* = *Stoebe phyllostachus*, Com. = Community, *S* sp. = *Senecio* sp. (G.R.Raitt 710), *Ce* = *Centella* cf. *eriantha*, Subcom. = Subcommunity, Typ. = Typicum, *Er* = *Elytropappus rhinocerotis*, *A* sp. = *Argyrolobium* sp. (G.R.Raitt 29), *Cm* = *Chrysanthemoides monilifera*, *An* = *Aspalathus nigra*, *Bm* = *Bobartia macrospatha*

Vegetation Unit\Soil Variable	**pH_{KCl}**	**pH_{water}**	**Conductivity ($mS\ m^{-1}$)**	**CEC ($cmol_c\ kg^{-1}$)**
Tt – Sp Com. Group	4.5 4.2—5.0	5.9 5.4—6.4	3.0 1.5—15.1	10.2 6.3—15.8
Tt – S sp. Com.	4.5 4.2—5.0	5.9 5.4—6.4	3.1 1.5—15.1	10.2 6.7—15.8
Tt – Ce Subcom.	4.5 4.2—5.0	5.9 5.4—6.3	3.2 1.5—15.1	10.7 6.7—15.8
Tt – S sp. Subcom. Typ.	4.5 4.2—5.0	5.8 5.4—6.4	3.0 1.5—6.1	9.7 7.6—14.0
Tt – Sp Com.	4.6 4.4—4.9	5.9 5.5—6.4	2.8 1.6—5.3	10.1 6.3—14.3
Tt – Er Com. Group	4.7 3.9—5.2	5.9 4.9—7.1	4.5 1.3—17.4	10.6 4.4—18.6
Tt – A sp. Com.	4.7 4.3—5.2	5.9 5.1—6.6	5.0 2.1—17.4	11.2 4.4—18.6
Tt – Cm Subcom.	4.7 4.4—5.2	5.9 5.4—6.2	5.9 2.3—17.4	13.6 8.2—18.6
Tt – An Subcom.	4.9 4.6—5.2	6.1 5.7—6.6	4.1 2.6—6.0	11.9 10.0—16.5
Tt – A sp. Subcom. Typ.	4.7 4.3—5.2	5.9 5.1—6.5	5.0 2.1—16.6	10.2 4.4—15.2
Tt – Bm Com.	4.4 3.9—4.9	5.6 4.9—5.9	3.7 1.7—9.0	8.8 6.7—12.4
Tt – Er Com.	4.9 4.1—6.4	6.0 5.4—7.1	3.0 1.3—5.1	9.8 4.9—13.9

Table 3.5: Means and ranges of data for six elements in soil sampled in the 12 vegetation units of this study. The elements are measured in the form of exchangeable cations

Tt = *Themeda triandra*, *Sp* = *Stoebe phyllostachus*, Com. = Community, *S* sp. = *Senecio* sp. (G.R.Raitt 710), *Ce* = *Centella* cf. *eriantha*, Subcom. = Subcommunity, Typ. = Typicum, *Er* = *Elytropappus rhinocerotis*, *A* sp. = *Argyrolobium* sp. (G.R.Raitt 29), *Cm* = *Chrysanthemoides monilifera*, *An* = *Aspalathus nigra*, *Bm* = *Bobartia macrospatha*

Vegetation Unit\Soil Variable	**Sodium ($cmol_c$ kg^{-1})**	**Potassium ($cmol_c$ kg^{-1})**	**Calcium ($cmol_c$ kg^{-1})**	**Magnesium ($cmol_c$ kg^{-1})**	**Carbon (%)**	**Phosphorus (mg kg^{-1})**
Tt – Sp Com. Group	0.5 0.1—1.9	0.3 0.1—0.8	3.3 0.4—5.5	4.0 1.7—8.0	3.6 2.0—6.0	3.3 1.0—13.0
Tt – S sp. Com.	0.5 0.2—1.9	0.3 0.1—0.8	3.2 0.4—5.5	4.0 2.2—8.0	3.7 2.6—6.0	3.2 1.0—13.0
Tt – Ce Subcom.	0.6 0.2—1.9	0.3 0.1—0.6	3.2 1.2—5.5	4.3 2.2—8.0	3.9 2.6—5.8	2.7 1.0—7.0
Tt – S sp. Subcom. Typ	0.5 0.2—1.0	0.3 0.1—0.8	3.2 0.4—5.5	3.6 2.3—5.0	3.4 2.8—6.0	3.7 1.0—13.0
Tt – Sp Com.	0.4 0.1—0.9	0.3 0.1—0.5	3.5 2.3—5.2	3.9 1.7—6.8	3.5 2.0—5.2	3.7 1.0—6.0
Tt – Er Com. Group	0.6 0.1—2.2	0.4 0.1—1.1	3.8 1.1—10.7	4.0 1.1—8.6	3.4 1.6—6.0	6.5 1—24
Tt – A sp. Com.	0.7 0.1—2.2	0.4 0.1—1.1	3.6 1.4—6.7	4.7 1.1—8.6	3.4 1.8—5.5	6.0 2.0—15.0
Tt – Cm Subcom.	0.9 0.4—2.0	0.4 0.1—0.7	4.4 1.4—6.7	5.8 3.8—8.1	4.3 2.7—5.5	7.7 2.0—12.2
Tt – An Subcom.	0.7 0.3—1.4	0.5 0.3—1.1	3.9 3.4—4.6	5.3 3.1—8.6	3.1 2.8—3.4	4.8 3.0—7.0
Tt – A sp. Subcom. Typ	0.7 0.1—2.2	0.4 0.2—0.7	3.3 1.5—5.0	4.1 1.1—6.6	3.2 1.8—5.3	5.9 2.0—15.0
Tt – Bm Com.	0.5 0.1—0.9	0.3 0.1—0.5	2.8 1.3—4.5	2.8 1.4—4.6	3.4 2.6—5.4	5.4 1.0—9.0
Tt – Er Com.	0.2 0.1—0.3	0.2 0.1—0.4	5.9 1.1—10.7	2.1 1.1—3.1	3.4 1.6—6.0	10.3 2.0—24.0

3.1.2.1 *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Community (1.1)

This community includes two subcommunities. The proposed relationship of the community follows:

Themeda triandra - Stoebe phyllostachys Grassland Community Group (1)

- *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Community (1.1)
  - *Themeda triandra - Centella* cf. *eriantha* Grassland Subcommunity (1.1.1)
  - *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum (1.1.2)

The 43 relevés that represent this community are in community blocks 1.1.1 and 1.1.2 of Appendix 3. The orthophoto map references in which this community was recorded are, 3420BB1, 3420BB2 and 3320DD22. Tables 3.2 and 3.3 show the area covered by this community.

The average number of species per relevé is 35 (range = 24—50).

The characteristic species for the community are: *Aspalathus retroflexa*, *Ficinia tenuifolia*, *Monopsis unidentata*, *Osteospermum imbricatum* and *Senecio* sp. (GRR 710). The dominant species is *Themeda triandra*. Species blocks B, C, F, H and K identify this community. The vegetation, at the time of sampling, varied from young veld (up to two years old) to mature veld (about four years old) but 86% of the relevés was in young veld. Vegetation cover averaged 84% (range = 71—100%). Litter cover averaged 4% (range = < 0.5—15%).

This community has light alien invasion. The woody aliens found in the relevés are *Acacia longifolia* and *Acacia mearnsii*. Herbaceous aliens *Anagallis arvensis* and *Pennisetum clandestinum* were found in the relevés.

Physiognomically, this community consists of two or three strata. The two upper strata are not always distinct from each other. The number of strata is probably affected by the maturity of the vegetation. The tall shrub stratum, 0.4—1.4 in height, with a projected cover of 2—50%, is dominated by *Otholobium* cf. *spicatum* and/or *Senecio* sp. (GRR 710). The short shrub stratum, 0.1—0.6 m in height, with a projected cover of 2—50%, is dominated by one or more of the following species: *Aspalathus asparagoides*, *Erica peltata* and *Metalasia acuta* / *Metalasia densa*. The herbaceous stratum, up to 0.15 m tall, with a projected cover of 10—95%, is dominated by *Themeda triandra* and occasionally *Eragrostis capensis*.

This community was found on the foothill slopes of the Langeberg. The altitude of the samples in this community ranged from 240—368 m asl. The community was recorded on slopes with a north, north north-east, north-east, east north-east, east, east south-east, south-east, south south-east, south south-west, west north-west, northwest or north north-west aspect. The average slope was 14.4^{o} (range = 5—25^{o}).

The under-lying geology in this community is shale and the soil generally has a sandy loam texture (77% of samples). Soil depth averaged 209 mm (range = 96—411 mm). Tables 3.4 and 3.5 show the soil chemistry for this community.

3.1.2.1.1 *Themeda triandra - Centella* cf. *eriantha* Subcommunity (1.1.1)

Themeda triandra - Stoebe phyllostachys Grassland Community Group (1)

Themeda triandra - Senecio sp. (G.R.Raitt 710) Grassland Community (1.1)

Themeda triandra - Centella cf. *eriantha* Grassland Subcommunity (1.1.1)

The 22 relevés that represent this subcommunity are in community block 1.1.1 of Appendix 3. The type relevé, 73, is located at 34.00238^{o}S and 20.81842^{o}E. The orthophoto map references in which this subcommunity was recorded are, 3420BB2 and 3320DD22. Tables 3.2 and 3.3 show the area covered by this subcommunity. Figure 3.1 gives an idea of the appearance of this subcommunity.

Figure 3.1: Example of vegetation belonging to the *Themeda triandra - Centella* cf. *eriantha* Subcommunity

The average number of species per relevé is 36 (range = 24—50).

The characteristic species for the subcommunity are: *Aspalathus* cf. *ternata*, *Berkheya carduoides*, *Centella* cf. *eriantha* and *Senecio crenatus*. The dominant species is *Themeda triandra*. Species blocks A, B, C, F, H and K identify this subcommunity. The vegetation, at the time of sampling, varied from young veld (up to one year old) to mature veld (about four years old) but 73% of the relevés was in young veld. Vegetation cover averaged 88% (range = 74—100%). Litter cover averaged 4% (range = < 0.5—15%).

This subcommunity has light alien invasion. The woody aliens found in the relevés are *Acacia longifolia* and *Acacia mearnsii*. Herbaceous aliens *Anagallis arvensis* and *Pennisetum clandestinum* were found in the relevés. While the alien species *Acacia mearnsii* and *Pennisetum clandestinum* appear in species block A in Table 3.1, the distribution of these species is not limited to this subcommunity.

Physiognomically, this subcommunity consists of two or three strata. The number of strata is affected by the maturity of the vegetation - the tall shrub stratum is most prominent in the mature vegetation. Where present, the tall shrub stratum, 0.4—1.4 in height, with a projected cover of 10—50%, is dominated by one or more of the following species: *Otholobium* cf. *spicatum*, *Senecio crenatus* and *Senecio* sp. (GRR 710). The short shrub stratum, 0.1—0.6 m in height, with a projected cover of 10—50%, is dominated by one or more of the following species: *Aspalathus asparagoides*, *Erica peltata* and *Metalasia acuta* / *Metalasia densa*. The herbaceous stratum, up to 0.15 m tall, with a projected cover of 10—95%, is dominated by *Eragrostis capensis* and/or *Themeda triandra*.

This subcommunity was found on the foothill slopes of the Langeberg. The altitude of the samples in this subcommunity ranged from 240—368 m asl. The subcommunity was found on slopes with a north-west, north north-west, north, north north-east, north-east, east north-east, east, east south-east, south-east or south south-east aspect. The average slope was 13^{o} (range = 5—23^{o}).

The under-lying geology in this subcommunity is shale and the soil generally has a sandy loam texture (77% of samples). Soil depth averaged 255 mm (range = 153—411 mm). Tables 3.4 and 3.5 show the soil chemistry for this subcommunity.

3.1.2.1.2 *Themeda triandra* - *Senecio* sp. (G.R.Raitt 710) Subcommunity Typicum (1.1.2)

Themeda triandra - *Stoebe phyllostachys* Grassland Community Group (1)

Themeda triandra - *Senecio* sp. (G.R.Raitt 710) Grassland Community (1.1)

Themeda triandra - *Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum (1.1.2)

The 21 relevés that represent this subcommunity typicum are in community block 1.1.2 of Appendix 3. The type relevé, 76, is located at 34.00171^{o}S and 20.81677^{o}E. The orthophoto map references in which this subcommunity typicum was recorded are, 3420BB1, 3420BB2 and 3320DD22. Tables 3.2 and 3.3 show the area covered by this subcommunity. Figure 3.2 gives an idea of the appearance of this subcommunity.

The average number of species per relevé is 34 (range = 26—49).

The characteristic species for the subcommunity typicum are: *Aspalathus retroflexa*, *Ficinia tenuifolia*, *Monopsis unidentata*, *Osteospermum imbricatum* and *Senecio* sp. (GRR 710) in the absence of species block A. The dominant species is *Themeda triandra*. Species blocks B, C, F, H and K identify this subcommunity. The vegetation, at the time of sampling, was young (up to two years old). Vegetation cover averaged 79% (range = 71—89%). Litter cover averaged 4% (range = < 0.5—10%).

This subcommunity may have light alien invasion. No alien species were recorded in the relevés.

Physiognomically, this subcommunity typicum consists of two or three strata. The tall shrub stratum is seldom identifiable. Where present, the tall shrub stratum, 0.4—1 m in height, with a projected cover of 2—10%, is dominated by *Otholobium* cf. *spicatum* and/or *Senecio* sp. (GRR 710). The short shrub

Figure 3.2: Example of vegetation from the *Themeda triandra* - *Senecio* sp. (G.R.Raitt 710) Subcommunity Typicum

stratum, 0.1—0.5 m in height, with a projected cover of 2—50%, is dominated by one or more of the following species: *Aspalathus asparagoides*, *Erica peltata*, *Metalasia acuta* / *Metalasia densa* and *Relhania pungens*. The herbaceous stratum, up to 0.15 m tall, with a projected cover of ≤ 50%—85%, is dominated by *Aristida junciformis* / *Merxmuellera* sp., *Eragrostis capensis* and/or *Themeda triandra*.

This community typicum was found on the foothill slopes of the Langeberg. The altitude of the samples in this community ranged from 255—358 m asl. The community typicum was recorded on slopes with a west north-west, north-west, north, north north-east, north-east, east north-east, east south-east, south-east, south south-east or south south-west aspect. The average slope was 15.3^{o} (range = 10—25^{o}).

The under-lying geology in this subcommunity is shale and the soil generally has a sandy loam texture (76% of samples). Soil depth averaged 160 mm (range = 96—244 mm). Tables 3.4 and 3.5 show the soil chemistry for this subcommunity.

3.1.2.2 *Themeda triandra - Stoebe phyllostachus* Grassland Community (1.2)

This community is the community typicum for the community group. The proposed relationship of the community follows:

Themeda triandra - Stoebe phyllostachys Grassland Community Group (1)

Themeda triandra - Stoebe phyllostachys Grassland Community (1.2)

The seventeen relevés that represent this community are in community block 1.2 of Appendix 3. The type relevé, 95, is located at 34.00501^{o}S and 20.81313^{o}E. The orthophoto map references in which this community was recorded are, 3420BB1, 3420BB2 and 3320DD22. Tables 3.2 and 3.3 show the area covered by this community. Figure 3.3 gives an idea of the appearance of this subcommunity.

The average number of species per relevé is 30 (range = 19—40).

The community group typicum is characterized by the absence of characteristic species. The dominant species is *Themeda triandra*. Species blocks C, F, H and K identify this community. The vegetation, at the time of sampling, varied from young veld (up to two years old) to mature veld (about four years old) but 82% of the relevés was in young vegetation. Vegetation cover averaged 83% (range = 75—97%). Litter cover averaged 4% (range = < 0.5—15%).

This community may have light alien invasion. No alien species were recorded in the relevés.

Physiognomically, this subcommunity consists of two or occasionally three strata. Where present, the tall shrub stratum, 0.5—1.2 m in height, with a projected cover of 2%, is dominated by *Otholobium* cf. *spicatum*. The short shrub stratum, 0.1—0.6 m in height, with a projected cover of 2—50%, is dominated by one or more of the following species: *Aspalathus asparagoides*, *Erica peltata*, *Metalasia acuta* / *Metalasia densa*, and *Stoebe phyllostachys*. The herbaceous stratum, up to 0.15 m tall, with a projected cover of ≤ 50—95%, is dominated by *Themeda triandra*.

This community group typicum was found on the foothill slopes of the Langeberg. The altitude of the samples in this community ranged from 260—361 m asl. The community group typicum was recorded on slopes with a north, north-east, east north-east, south south-east, south south-west, south-west, west south-west, west, northwest or north north-west aspect. The average slope was 15.8^o (range = 9.5—25^o).

Figure 3.3: Example of vegetation belonging to the *Themeda triandra - Stoebe phyllostachus* Grassland Community

The under-lying geology in this community is shale and the soil generally has a sandy loam texture (82% of samples). Soil depth averaged 176 mm (range = 88—384 mm). Tables 3.4 and 3.5 show the soil chemistry for this community.

3.1.3 *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community Group (2)

This community group includes three communities, of which one is further subdivided into three subcommunities. The proposed relationship of the community group follows:

Themeda triandra - Elytropappus rhinocerotis Shrubland Community Group (2)

- *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Community (2.1)
  - *Themeda triandra - Chrysanthemoides monilifera* Subcommunity (2.1.1)
  - *Themeda triandra - Aspalathus nigra* Subcommunity (2.1.2)
  - *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum (2.1.3)
- *Themeda triandra - Bobartia macrospatha* Herbland Community (2.2)
- *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community (2.3)

The 72 relevés that represent this community group are in community blocks 2.1.1, 2.1.2, 2.1.3, 2.2 and 2.3 of Appendix 3. The orthophoto map references in which this community group was recorded are, 3420BB1, 3420BB2 and 3320DD22. Tables 3.2 and 3.3 show the area covered by this community group.

The number of species per relevé ranges from nine to fifty-five. The average number of species per relevé is 32 (range = 9—55).

The characteristic species for the community group are: *Agathosma virgata*, *Aristida diffusa*, *Aspalathus incompta*, *Asparagus krebsianus*, *Berkheya rigida*, *Conyza scabrida*, *Elytropappus rhinocerotis*, *Euphorbia tuberosa*, *Felicia aculeata*, *Gazania krebsiana*, *Gnidia laxa*, *Hermannia hyssopifolia*, *Hermannia* cf. *saccifera*, *Heterolepis peduncularis*, *Karroochloa curva*, *Lichtensteinia latifolia*, *Melica racemosa*, *Melinis nerviglumis*, *Mohria caffrorum*, *Neodregea glassii*, *Pelargonium caucalidifolium*, *Printzia polifolia*, *Rhus lucida* and *Rhus rosmarinifolia*. The community group has no clearly dominant species. Each community appears to have unique dominants listed under the relevant communities. Species blocks I and K identify this community group. The vegetation, at the time of sampling, varied from young veld (one to two years old) to old veld (eleven or more years old) but 71% of the relevés were in mature vegetation (four to six years old). Vegetation cover averaged 88% (range = 54—99%). Litter cover averaged 10% (range = < 0.5—98%).

This community group has light alien invasion. The woody aliens found in the area mapped to the Community Group are *Acacia mearnsii* and *Pinus* sp. Herbaceous alien *Anagallis arvensis* was found in the relevés.

Physiognomically, this community group consists of two or four strata. The tall shrub and short shrub strata are not always distinct from each other. The number of strata is probably affected by the maturity of the vegetation. The emergent shrub stratum, 0.5—4 m in height, with a projected cover of 2—99%, is dominated by *Otholobium* cf. *spicatum* but the greatest cover for this stratum occurred in old veld in which this stratum was dominated by *Erica peltata*. The tall shrub stratum, 0.2—2 m in height, with a projected cover of 2—50%, does not have consistent dominance throughout by any one species. One or more of the following species may dominate it: *Chrysanthemoides monilifera*, *Elytropappus rhinocerotis* and *Metalasia acuta* / *Metalasia densa*. The short shrub stratum, 0.1—1.2 m in height, with a projected cover of 2—50%, does not have consistent dominance throughout by any one species. One or more of the following species may dominate it: *Cliffortia filicaulis*, *Erica peltata*, *Helichrysum patulum*, *Hyparrhenia hirta* and *Relhania pungens*. The herbaceous stratum, up to 0.2 m tall, with a projected cover of 10—85%, does not have consistent dominance throughout by any one species. One or more of the following species may dominate it: *Bobartia macrospatha*, *Cynodon dactylon*, *Pentaschistis curvifolia* and *Themeda triandra*.

This community group was found on the foothill tops and foothill slopes of the Langeberg. The altitude of the samples in this community group ranged from 252—370 m asl. The community group was recorded on slopes with no aspect or any aspect except north north-east and west south-west. The average slope was 13.9^{o} (range = 1—23^{o}).

The under-lying geology in this community group is shale, mudstone and silcrete/ferricrete. The soil generally has a sandy loam texture (50% of samples). Soil depth averaged 209 mm (range = 77—453 mm). Tables 3.4 and 3.5 show the soil chemistry for this community group.

3.1.3.1 *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Community (2.1)

This community includes three subcommunities. The proposed relationship of the community follows:

Themeda triandra - Elytropappus rhinocerotis Shrubland Community Group (2)

- *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Community (2.1)
  - *Themeda triandra - Chrysanthemoides monilifera* Subcommunity (2.1.1)
  - *Themeda triandra - Aspalathus nigra* Subcommunity (2.1.2)
  - *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum (2.1.3)

The 50 relevés that represent this community are in community blocks 2.1.1, 2.1.2 and 2.1.3 of Appendix 3. The orthophoto map references in which this community was recorded are, 3420BB1 and 3420BB2. Tables 3.2 and 3.3 show the area covered by this community.

The average number of species per relevé is 33 (range = 15—55).

The community is characterized by the absence of characteristic species. The dominant species is *Themeda triandra*. Species blocks F, H, I and K identify this community. The vegetation, at the time of sampling, varied from young veld (one to two years old) to old veld (eleven or more years old) but 60% of the relevés were in mature vegetation (four to six years old). Vegetation cover averaged 86% (range = 54 – 99%). Litter cover averaged 13% (range = < 0.5 – 98%).

This community has light alien invasion. The woody aliens found in the area mapped to the Community Group are *Acacia mearnsii* and *Pinus* sp. No alien species were recorded in the relevés.

Physiognomically, this community consists of two to four strata. Where present, the emergent shrub stratum, 0.5—4 m in height, with a projected cover of 2—99%, is dominated by *Otholobium* cf. *spicatum*. The tall shrub stratum, 0.2—2 m in height, with a projected cover of 2—95%, does not have consistent dominance throughout by any one species. One or more of the following species may dominate it: *Chrysanthemoides monilifera*, *Elytropappus rhinocerotis* and *Metalasia acuta* / *Metalasia densa*. The short shrub stratum, 0.1—1.2 m in height, with a projected cover of 2—75%, does not have consistent dominance throughout by any one species. One or more of the following species may dominate it: *Aspalathus nigra*, *Erica peltata*, *Muraltia collina* and *Relhania pungens*. The herbaceous stratum, up to 0.2 m tall, with a projected cover of 2—85%, is dominated by *Themeda triandra*.

This community was found on the foothill slopes of the Langeberg. The altitude of the samples in this community ranged from 255—346 m asl. The community was recorded on slopes with a north, north-east, east north-east, east, east south-east, south-east, south south-east, south, south south-west, west, west north-west, northwest or north north-west aspect. The average slope was 15.2^o (range = 7—23^o).

The under-lying geology in this community is generally shale with occasional mudstone and silcrete/ferricrete. The soil generally has a sandy loam texture (48% of samples) or a sandy clay loam texture (24% of samples). Soil depth averaged 213 mm (range = 77—453 mm). Tables 3.4 and 3.5 show the soil chemistry for this community.

3.1.3.1.1 *Themeda triandra - Chrysanthemoides monilifera* Shrubland Subcommunity (2.1.1)

Themeda triandra - Elytropappus rhinocerotis Shrubland Community Group (2)

Themeda triandra - Argyrolobium sp. (G.R.Raitt 29) Community (2.1)

Themeda triandra - Chrysanthemoides monilifera Subcommunity (2.1.1)

The ten relevés that represent this subcommunity are in community block 2.1.1 of Appendix 3. The type relevé, 20, is located at 34.04747^{o}S and 20.78139^{o}E. The orthophoto map references in which this subcommunity was recorded are, 3420BB1 and 3420BB2. Tables 3.2 and 3.3 show the area covered by this subcommunity. Figure 3.4 gives an idea of the appearance of this subcommunity.

The average number of species per relevé is 34 (range = 20—44).

The characteristic species for the subcommunity are: *Chrysanthemoides monilifera*, *Clutia pulchella*, *Gymnosporia buxifolia* and *Muraltia collina*. The dominant species is *Muraltia collina* but in some relevés *Chrysanthemoides monilifera* is more prominent. Species blocks D, E, F, H, I and K identify this subcommunity. The vegetation, at the time of sampling, was mature (four to six years old). Vegetation cover averaged 93% (range = 81—99%). Litter cover averaged 37% (range = 1—96%). The relevés dominated by *Chrysanthemoides monilifera* have more than 70% litter cover, while the relevés dominated by *Muraltia collina* have less than 5% litter cover.

This subcommunity may have light alien invasion. No alien species were recorded in the relevés.

Physiognomically, this subcommunity consists of two to four strata. Where present, the emergent shrub stratum, 1.2—4 m in height, with a projected cover of 2—10%, is dominated by *Otholobium* cf. *spicatum* and/or *Chrysanthemoides monilifera* (the latter only where *Muraltia collina* is dominant) or in the case of relevé six, *Gynosporia buxifolia* and *Rhamnus prinoides*. The tall shrub stratum, 1—2 m in height, with a projected cover of ≤ 50—95%, is dominated by *Chrysanthemoides monilifera* and is characteristic of the stands in which *Chrysanthemoides monilifera* is dominant. The short shrub stratum, 0.3—1.2 m in height, with a projected cover of 10—95%, is dominated by *Muraltia collina*. The herbaceous stratum, up to 0.2 m tall, with a projected cover of 2—10%, is dominated by *Pentaschistis curvifolia* and/or *Themeda triandra*.

Figure 3.4: Example of vegetation belonging to the *Themeda triandra - Chrysanthemoides monilifera* Shrubland Subcommunity

This subcommunity was found on the foothill slopes of the Langeberg often on drainage lines. The altitude of the samples in this subcommunity ranged from 310—330 m asl. The subcommunity was recorded on slopes with an east north-east, east south-east, south-east or south south-east aspect. The average slope was 19.2^{o} (range = 16—23^{o}).

The under-lying geology in this subcommunity is generally shale with occasional mudstone and silcrete/ferricrete. The soil generally has a sandy loam texture (40% of samples) or a sandy clay loam texture (30% of samples). Soil depth averaged 261 mm (range = 132—390 mm). Tables 3.4 and 3.5 show the soil chemistry for this subcommunity.

3.1.3.1.2 *Themeda triandra - Aspalathus nigra* Shrubland Subcommunity (2.1.2)

Themeda triandra - Elytropappus rhinocerotis Shrubland Community Group (2)

Themeda triandra - Argyrolobium sp. (G.R.Raitt 29) Community (2.1)

Themeda triandra - Aspalathus nigra Subcommunity (2.1.2)

The ten relevés that represent this subcommunity are in community block 2.1.2 of Appendix 3. The type relevé, 2, is located at 34.03962^{o}S and 20.78530^{o}E. The orthophoto map references in which this subcommunity was recorded are, 3420BB1 and 3420BB2. Tables 3.2 and 3.3 show the area covered by this community. Figure 3.5 gives an idea of the appearance of this subcommunity.

The average number of species per relevé is 42 (range = 30—55).

The characteristic species for the subcommunity is *Aspalathus nigra* in the absence of species block D. The dominant species is *Themeda triandra*. Species blocks E, F, H, I and K identify this subcommunity. The vegetation, at the time of sampling, was mature (five to six years old). Vegetation cover averaged 90% (range = 80—98%). Litter cover averaged 1% (range = < 1—2.5%).

This subcommunity may have light alien invasion. No alien species were recorded in the relevés.

Physiognomically, this subcommunity consists of two or three strata. Either of the upper strata may be absent. The emergent shrub stratum, 0.5—2 m in height, with a projected cover of 2—50%, is dominated by *Anthospermum aethiopicum* and/or *Otholobium* cf. *spicatum*. The short shrub stratum 0.25—0.45 m in height, with a projected cover of 2—50%, is dominated by one or more of the following species: *Aspalathus nigra*, *Euryops abrotanifolius*, *Metalasia acuta* / *Metalasia densa* and occasionally *Relhania pungens*. The herbaceous stratum, up to 0.2 m tall, with a projected cover of ≤ 50—85%, is dominated by *Themeda triandra*.

This subcommunity was found on the foothill slopes of the Langeberg. The altitude of the samples in this subcommunity ranged from 295—323 m asl. The subcommunity was recorded on slopes with a north-east, east north-east, east south-east, south-east, south south-east or south aspect. The average slope was 16.1^{o} (range = 12—22^{o}).

Figure 3.5: Example of vegetation belonging to the *Themeda triandra - Aspalathus nigra* Shrubland Subcommunity

The under-lying geology in this subcommunity is generally shale with occasional mudstone and silcrete/ferricrete. The soil generally has a sandy loam texture (50% of samples). Soil depth averaged 321 mm (range = 143—453 mm). Tables 3.4 and 3.5 show the soil chemistry for this subcommunity.

3.1.3.1.3 *Themeda triandra* - *Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum (2.1.3)

Themeda triandra - *Elytropappus rhinocerotis* Shrubland Community Group (2)

Themeda triandra - *Argyrolobium* sp. (G.R.Raitt 29) Community (2.1)

Themeda triandra - *Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum (2.1.3)

The thirty relevés that represent this subcommunity typicum are in community block 2.1.3 of Appendix 3. The type relevé, 102, is located at 34.03846^{o}S and 20.79287^{o}E. The orthophoto map references in which this subcommunity typicum was recorded are, 3420BB1 and 3420BB2. Tables 3.2 and 3.3 show the area covered by this subcommunity. Figure 3.6 gives an idea of the appearance of this subcommunity.

The average number of species per relevé is 30 (range = 15—43).

The subcommunity typicum lacks characteristic species. The dominant species is *Themeda triandra*. Species blocks F, H, I and K identify this subcommunity. The vegetation, at the time of sampling, varied from young veld (one to two years old, 23% of samples) to old veld (eleven or more years old, 43% of samples). Vegetation cover averaged 83% (range = 54—99%). Litter cover averaged 10% (range = < 0.5 – 98%). Litter cover increased with increasing post-fire vegetation age.

This subcommunity has light alien invasion. The woody aliens found in the area mapped to the subcommunity are *Acacia mearnsii* and *Pinus* sp. No alien species were recorded in the relevés.

Physiognomically, this subcommunity typicum consists of two to four strata. Where present, the emergent shrub stratum 0.5—2 m in height, with a projected cover of 10—99%, is dominated by one or more of the following species: *Anthospermum aethiopicum*, *Erica peltata* (old veld) and *Otholobium* cf. *spicatum*. The tall shrub stratum, 0.2—1.1 m in height, with a projected cover of 10—50%, is dominated by one or more of the following species: *Elytropappus rhinocerotis*, *Hyparrhenia hirta* and *Metalasia acuta* / *Metalasia densa*. The short shrub stratum, 0.1—0.5 m in height, with a projected cover of 10—75%, is dominated by *Erica peltata* and/or *Relhania pungens*. The herbaceous stratum, up to 0.2 m tall, with a projected cover of 10—65%, is dominated by *Themeda triandra*. Other species, such as *Cliffortia filicaulis*, may also become dominant in some stands. Groundtruthing the map showed that *Cliffortia filicaulis* was dominant in old veld of this subcommunity typicum transitional/adjacent to Fynbos nearer the mountains with a probable higher rainfall. The aforementioned old veld tended to be depauperate.

Figure 3.6: Example of vegetation belonging to the *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum

This subcommunity typicum was found on the foothill slopes of the Langeberg. The altitude of the samples in this subcommunity ranged from 255—346 m asl. The subcommunity typicum was recorded on slopes with a north, north-east, east north-east, east, east south-east, south-east, south south-west, west, west north-west, northwest or north north-west aspect. The average slope was 13.5^{o} (range = 7—23^{o}).

The under-lying geology in this subcommunity is generally shale with occasional mudstone and silcrete/ferricrete. The soil generally has a sandy loam texture (50% of samples). Soil depth averaged 161 mm (range = 77—265 mm). Tables 3.4 and 3.5 show the soil chemistry for this subcommunity.

3.1.3.2 *Themeda triandra - Bobartia macrospatha* Community (2.2)

The proposed relationship of the community follows:

Themeda triandra - Elytropappus rhinocerotis Shrubland Community Group (2)

Themeda triandra - Bobartia macrospatha Community (2.2)

The thirteen relevés that represent this community are in community block 2.2 of Appendix 3. The type relevé, 17, is located at 34.04822^{o}S and 20.77896^{o}E. The orthophoto map references in which this community was recorded are, 3420BB1, 3420BB2 and 3320DD22. Tables 3.2 and 3.3 show the area covered by this community. Figure 3.7 gives an idea of the appearance of this subcommunity.

The average number of species per relevé is 36 (range = 28—42).

Figure 3.7: Example of vegetation belonging to the *Themeda triandra - Bobartia macrospatha* Community

The characteristic species for the community are: *Bobartia macrospatha*, *Calopsis adpressa*, *Clutia laxa*, *Diospyros glabra*, Asteraceae sp. (GRR 13/22), *Leucadendron salignum*, *Linum thunbergii*, *Onixotis punctata*, *Pelargonium* sp. (GRR 13/38), *Selago scabrida* and *Tetraria bromoides*. The dominant species is *Bobartia macrospatha* though the cover is less than the definition for dominance used in this study. Species blocks G, H, I and K identify this community. The vegetation, at the time of sampling, was mature (four to six years old). A relevé had been brush cut two years before sampling. Vegetation cover averaged 91% (range = 76—99%). Litter cover averaged 1% (range = < 0.5—2%). This community may be Fynbos.

This community may have light alien invasion. No alien species were recorded in the relevés.

Physiognomically, this community consists of one to three strata. The tall shrub stratum is rarely present. The tall shrub stratum, 1—2 m in height, with a projected cover of 2—50%, is dominated by one or more of the following species: *Anthospermum aethiopicum*, *Otholobium* cf. *spicatum* and *Printzia polifolia*. The short shrub stratum, 0.4—0.7 m in height, with a projected cover of 2—50% is dominated by one or more of the following species: *Elytropappus rhinocerotis*, *Gnidia sericea*, *Helichrysum cymosum*, *Helichrysum patulum* and *Hyparrhenia hirta*. The herbaceous stratum, up to 0.35 m tall, with a projected cover of ≤ 50—65%, is dominated by one or more of the following species: *Bobartia macrospatha*, *Corymbium africanum* and *Pentaschistis curvifolia*.

This community was found on some tops and slopes of the foothills of the Langeberg. The altitude of the samples in this community ranged from 331—370 m asl. The community was recorded on slopes with an east, east south-east, south-east, south south-west, south-west or no aspect. The average slope was 13.8^{o} (range = 1—20^{o}).

The under-lying geology in this community is generally silcrete/ferricrete with occasional mudstone and shale. The soil generally has a sandy loam texture (46% of samples) or a loam texture (46% of samples). Soil depth averaged 214 mm (range = 117—307 mm). Tables 3.4 and 3.5 show the soil chemistry for this community.

3.1.3.3 *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community (2.3)

This community is the community typicum for the community group. The proposed relationship of the community follows:

Themeda triandra - Elytropappus rhinocerotis Shrubland Community Group (2)

Themeda triandra - Elytropappus rhinocerotis Shrubland Community (2.3)

The nine relevés that represent this community are in community block 2.3 of Appendix 3. The type relevé, 84, is located at 34.04741^{o}S and 20.77714^{o}E. The orthophoto map references in which this community was recorded are, 3420BB1 and 3420BB2. Tables 3.2 and 3.3 show the area covered by this community. Figure 3.8 gives an idea of the appearance of this subcommunity.

The average number of species per relevé is 19 (range = 9—26).

The community group typicum is characterized by the absence of characteristic species. The dominant species is *Helichrysum patulum*. Species blocks I and K identify this community. The vegetation, at the time of sampling, was mature (four to six years old) except for one relevé that had old vegetation (twelve years old). Two relevés had been brush cut two years before sampling. Vegetation cover averaged 94% (range = 79—99%). Litter cover averaged 5% (range = 1—10%).

This community has light alien invasion. The herbaceous alien *Anagallis arvensis* was found in the relevés.

Physiognomically, this subcommunity consists of two or three strata. The emergent shrub stratum, 0.7—3 m in height, with a projected cover of 10—75%, is dominated by *Anthospermum aethiopicum* and/or *Otholobium* cf. *spicatum*. The tall shrub stratum, 0.3—1.2 m in height, with a projected cover of ≤ 50—85% is dominated by *Cliffortia filicaulis*, *Helichrysum patulum* and *Metalasia acuta* / *Metalasia densa*. The herbaceous stratum, up to 0.3 m tall, with a projected cover of 10—50%, may be dominated by one or more of the following species: *Cynodon dactylon*, *Karroochloa curva* and/or *Melica racemosa*.

Figure 3.8: Example of vegetation belonging to the *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community

This community group typicum was found on some tops and slopes of the foothills of the Langeberg. The altitude of the samples in this community ranged from 252—370 m asl.. The community group typicum was recorded on slopes with a south, south south-east, north or no aspect. The average slope was 7.1^{o} (range = 1—15^{o}).

The under-lying geology in this community is shale, mudstone and silcrete/ferricrete. The soil generally has a sandy loam texture (67% of samples). Soil depth averaged 179 mm (range = 102—241 mm). Tables 3.4 and 3.5 show the soil chemistry for this community.

3.2 Mapping

The images presented here (Fig. 3.9) and in Appendix 5 are sections taken from combinations of layers created in MapInfo Professional 7.0 (MapInfo Corporation 2002). The details concerning the layers created form Appendix 5.

The area covered and probably covered by the plant communities described above or combinations of the said plant communities was calculated using MapInfo Professional 7.0 (MapInfo Corporation 2002). Tables 3.6 – 3.8 show the area covered by each subcommunity and community, mosaic and possible mosaic on each farm.

The legend units were grouped to create the overview map. Map units were ground-truthed to assess boundaries that were unclear or to clarify the identity of suspect units, using the vegetation classification produced from the initial sampling of the area. The mapping units applied are described below.

Cultivated lands were marked to complete the map surface. This category includes visible old lands and all other deliberate transformation by humans.

'Denuded Area' included erosion surfaces and areas burned to clear *Acacia mearnsii* stands. The latter were included in this category because the regeneration after six months was almost nonexistent.

'Woody or Alien Vegetation' covers the riverine woodland and the aliens that cluster along the drainage lines. *Acacia mearnsii* and *Pennisetum clandestinum* are the most prominent aliens. Other woody aliens include *Populus* sp., *Eucalyptus* sp. and *Pinus* sp.

Some vegetation was neither sampled (observations of similar areas suggested *Themeda triandra* would not occur there) nor checked during the groundtruthing. This is termed 'Unsampled Area' to allow continuous mapping.

'Mapped Indigenous Vegetation' refers to the communities described in Section 3.1.

'Area Excluded from Study' covers Fynbos, natural vegetation not matching any of the described communities that was not found during sampling and stands (mostly in drainage lines) dominated by *Cliffortia filicaulis* without clear affinities to any described subcommunity or community.

'Combinations of Other Units' indicate where two or more units co-occur.

Areas marked 'Classification Not Confirmed' are probable units not checked during groundtruthing.

Table 3.6: Area (ha) covered by transitional vegetation and mosaics of plant communities found on each of the farms in this study

Mosaic\Farm	**Arkadia**	**Bergsig**	**D'Ou Gnu**	**Glen Etive**	**Groot-vaders-bosch**	**Honey-wood**
Trans.[1] Tt[2] – A sp.[3] Subcom.[4] Typ.[5] & Tt – Er[6] Com.[7]	-	-	-	-	9.872	-
Tt – Ce[8] Subcom. & Tt – Sp[9] Com.	-	-	-	-	-	11.339
Tt – Ce Subcom. & Tt – An[10] Subcom.	-	-	1.384	-	-	-
Tt – Ce Subcom. & Tt – A sp. Subcom. Typ.	-	-	1.456	-	-	0.570
Tt – S sp.[11] Subcom. Typ. & Tt – Sp Com.	9.884	-	0.705	-	-	7.485
Subcoms. Tt – S sp. Typ. & Tt – An	0.935	3.843	8.942	-	-	-
Subcoms.Typ. Tt – S sp. & Tt – A sp.	4.393	3.098	10.506	-	1.837	6.057
Tt – Sp Com. & Tt – An Subcom.	3.209	-	6.283	-	-	-
Tt – Cm[12] Subcom. & Tt – Bm[13] Com.	-	-	-	-	4.551	-
Tt – Bm Com. & Fynbos	-	-	12.580	-	-	-

[1] Transitional
[2] *Themeda triandra*
[3] *Argyrolobium* sp. (G.R.Raitt 29)
[4] Subcommunity
[5] Typicum
[6] *Elytropappus rhinocerotis*
[7] Community
[8] *Centella* cf. *eriantha*
[9] *Stoebe phyllostachus*
[10] *Aspalathus nigra*
[11] *Senecio* sp. (G.R.Raitt 710)
[12] *Chrysanthemoides monilifera*
[13] *Bobartia macrospatha*

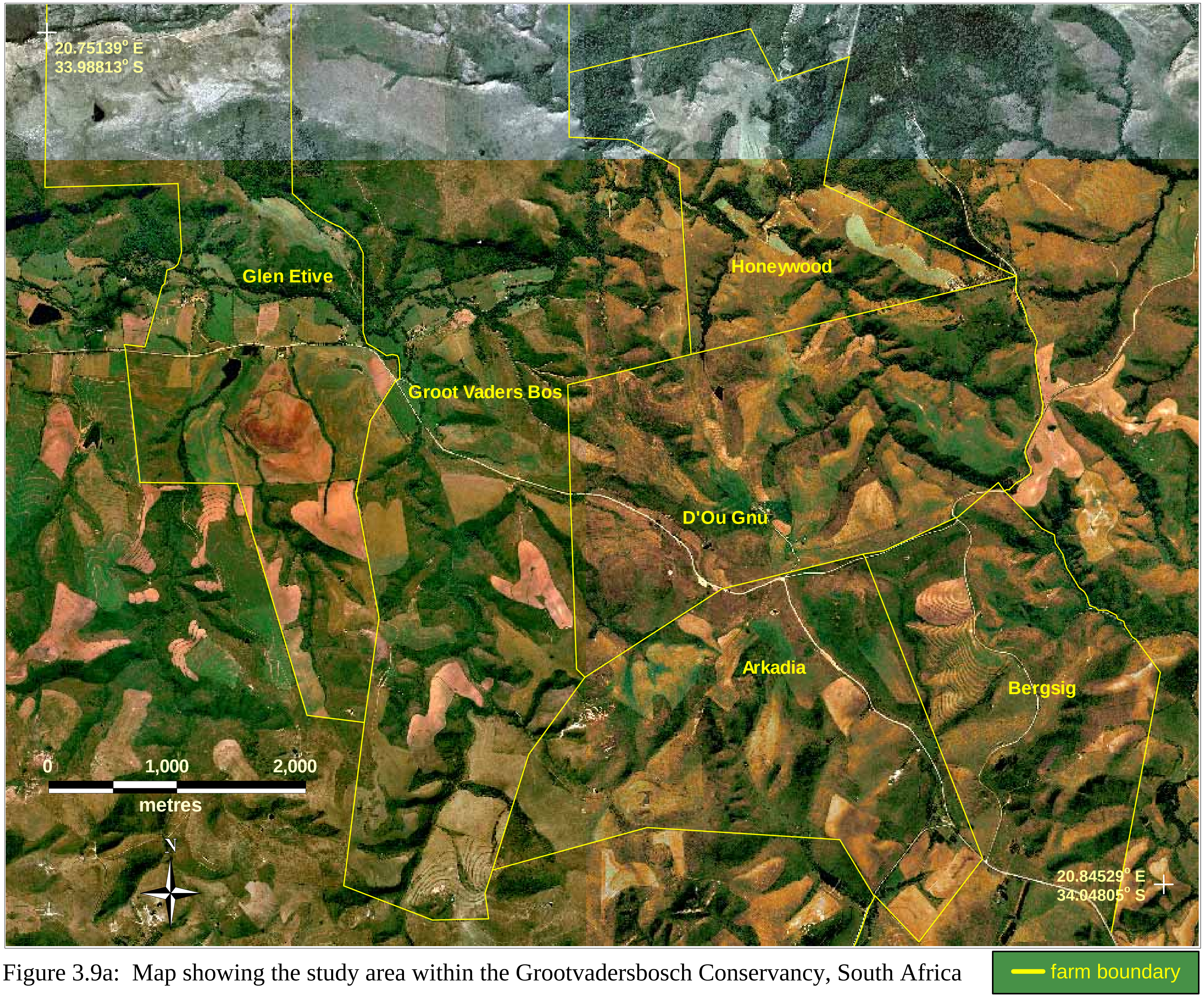

Figure 3.9a: Map showing the study area within the Grootvadersbosch Conservancy, South Africa

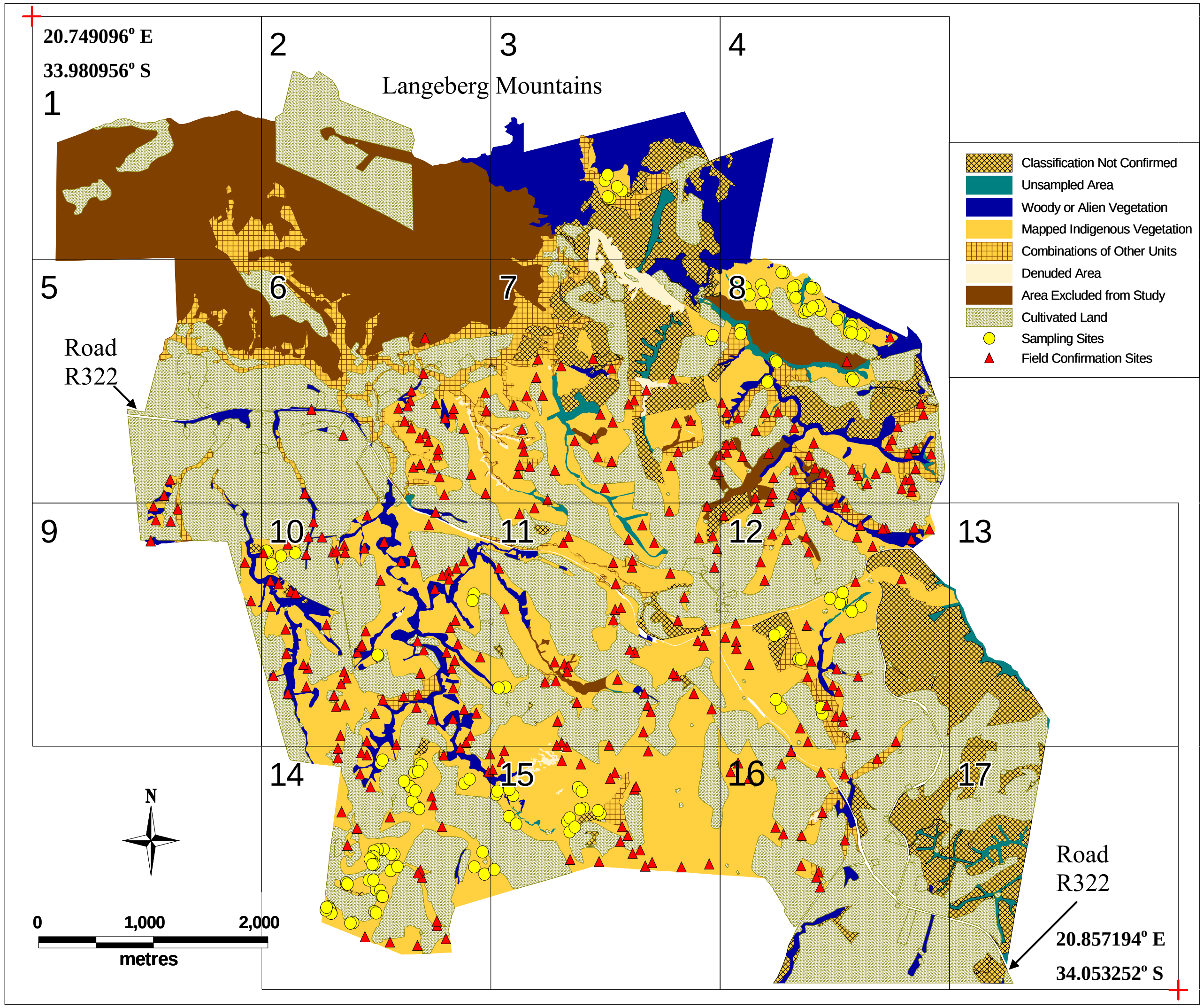

Figure 3.9b: Overview of the vegetation of the study area within the Grootvadersbosch Conservancy, South Africa indicating the distribution of detailed vegetation maps (Appendix 5)

Table 3.7: Area (ha) covered by indeterminate vegetation and possible mosaics of plant communities found on each of the farms in this study

Possible Mosaic\Farm	Arkadia	Bergsig	D'Ou Gnu	Glen Etive	Groot-vaders-bosch	Honey-wood
Indeterminate	1.117	-	0.407	-	-	-
Indeterminate possibly *Tt*[1] – *Sp*[2] Com.[3]	-	-	5.580	-	-	-
Indeterminate possibly *Tt* – *A* sp.[4] Subcom.[5] Typ.[6]	-	-	2.128	-	-	-
Tt – *Ce*[7] Subcom. & *Tt* – *S* sp.[8] Subcom. Typ.	-	-	-	-	-	0.308
Tt – *Ce* Subcom. & *Tt* – *Sp* Com.	-	-	-	-	0.834	46.736
Tt – *S* sp. Subcom. Typ. & *Tt* – *Sp* Com.	-	-	-	-	-	1.426
Subcoms.Typ. *Tt* – *S* sp. & *Tt* – *A* sp.	2.054	111.717	6.058	-	35.360	30.099
Tt – *Cm*[9] Subcom.& *Tt* – *A* sp. Subcom. Typ.	-	-	-	-	0.476	-
Tt – *Cm* Subcom. & *Tt* – *Bm*[10] Com.	-	-	0.142	-	-	-
Tt – *An*[11] Subcom.& *Tt* – *A* sp. Subcom. Typ.	-	-	-	-	0.130	-
Tt – *A* sp. Subcom. Typ. & *Tt* – *Bm* Com.	0.695	-	-	0.704	0.397	-
Tt – *A* sp. Subcom. Typ. & *Tt* – *Er*[12] Com.	0.714	-	-	0.963	-	-

[1] *Themeda triandra*
[2] *Stoebe phyllostachus*
[3] Community
[4] *Argyrolobium* sp. (G.R.Raitt 29)
[5] Subcommunity
[6] Typicum
[7] *Centella* cf. *eriantha*
[8] *Senecio* sp. (G.R.Raitt 710)
[9] *Chrysanthemoides monilifera*
[10] *Bobartia macrospatha*
[11] *Aspalathus nigra*
[12] *Elytropappus rhinocerotis*

Table 3.8: Area (ha) and probable area covered by the plant communities and subcommunities found on each of the farms in this study

Phytosociological unit\Farm	Arkadia	Bergsig	D'Ou Gnu	Glen Etive	Groot-vaders-bosch	Honey-wood
Tt[1] – *S* sp.[2] Com.[3]	24.427	7.069	39.013	-	2.170	42.339
Probably *Tt* – *S* sp. Com.	8.943	10.338	1.673	-	-	1.504
Tt – *Ce*[4] Subcom.[5]	9.369	-	12.111	-	-	32.643
Probably *Tt* – *Ce* Subcom.	-	-	1.673	-	-	-
Tt – *S* sp. Subcom. Typ.[6]	15.031	7.069	26.902	-	2.170	9.696
Probably *Tt* – *S* sp. Subcom. Typ.	8.943	10.338	-	-	-	1.504
Tt – *Sp*[7] Com.	30.228	9.911	3.208	-	-	9.927
Probably *Tt* – *Sp* Com.	-	-	-	-	-	9.518
Tt – *A* sp.[8] Com.	163.889	13.645	135.910	59.021	276.392	-
Probably *Tt* – *A* sp. Com.	2.121	38.956	7.668	-	9.824	10.690
Tt – *Cm*[9] Subcom.	1.611	1.240	-	0.048	79.520	-
Probably *Tt* – *Cm* Subcom.	-	-	0.058	-	-	-
Tt – *An*[10] Subcom.	6.640	-	23.092	9.737	41.143	-
Probably *Tt* – *An* Subcom.	-	-	-	-	1.000	-
Tt – *A* sp. Subcom. Typ.	155.638	12.405	112.818	49.236	155.730	-
Probably *Tt* – *A* sp. Subcom. Typ.	2.121	38.956	7.610	-	8.824	10.690
Tt – *Bm*[11] Com.	83.566	10.687	4.198	3.564	30.527	2.652
Probably *Tt* – *Bm* Com.	-	17.488	-	-	-	-
Tt – *Er*[12] Com.	0.794	6.214	-	0.542	4.258	-

[1] *Themeda triandra*
[2] *Senecio* sp. (G.R.Raitt 710)
[3] Community
[4] *Centella* cf. *eriantha*
[5] Subcommunity
[6] Typicum
[7] *Stoebe phyllostachus*
[8] *Argyrolobium* sp. (G.R.Raitt 29)
[9] *Chrysanthemoides monilifera*
[10] *Aspalathus nigra*
[11] *Bobartia macrospatha*
[12] *Elytropappus rhinocerotis*

3.3 Cover Assessment

Analysing the cover of *Themeda triandra* using the chi-squared test showed no significant differences between the different sites (Table 3.9) or, for the Vleijtiesrug site, for the different years (Table 3.10). Table 3.9 includes the Braun-Blanquet cover-abundance scores for the two plots from the each different site. Further statistical comparison of the methods is not possible, as they did not cover the same area.

Table 3.9: *Themeda triandra* cover for the different sites from descending point samples and Braun-Blanquet plots. None of the cover values differ significantly according to the chi-squared test (See Appendix 7)

Site	Vleitjiesrug	Dikkopskraal 1	Dikkopskraal 2
Total Cover Assessment	28.2 %	77.8 %	73.2 %
Phytosociological Cover (1st plot)	50 – 75 % (4)	> 75 % (5)	> 75 % (5)
Phytosociological Cover (2nd plot)	25 – 50 % (3)	> 75 % (5)	> 75 % (5)
Canopy Cover	19.0 %	70.2 %	70.4 %
Basal Cover	11.8 %	27.6 %	18.4 %

Table 3.10: *Themeda triandra* cover, determined using the point quadrat method, for the Vleitjiesrug site over time (See Appendix 8)

Vleitjiesrug	**2001**	**1996**	**1994**
Canopy Cover	19.0 %	53.13 %	50.0 %
Basal Cover	11.8 %	16.63 %	10.6 %

3.4 Management

Questions related to grazing yielded extremely general answers (except for Mr M. Prinsloo of Bergsig) that were not readily quantifiable. For ordination purposes the relevés were marked as grazed or ungrazed. At the time the sampling was done for this study, the area was suffering from drought and some of the farmers were using the veld more heavily than normal to reduce the feed bills. The management data are shown in Table 3.11.

Table 3.11: Management information for the farms sampled during this study. For more information see Appendix 6

Farm	**Use natural veld**	**Fire regime**	**Brush cutting regime**	**Livestock present 2003**	**# owners 1990—2003**	**Past livestock***
Arkadia	Yes	3 yr	None	Mutton Merino sheep	2	Mutton Merino sheep & cattle
Bergsig	Yes	None	1.5—2 yr	Mutton Merino sheep	3	Merino then Mutton & Duni Merino sheep
D'Ou Gnu	Yes	Chance	None	Mutton Merino sheep	4	Duni Merino sheep & Hereford cattle then Aberdeen Angus cattle then Nguni cattle
Glen Etive	No	Chance	None	Jersey cattle	1	Jersey cattle
Groot-vaders-bosch	Yes	Chance	None	Jersey cattle	2	Jersey cattle & sheep
Honeywood	Yes	4—5 yr	On gentle slopes prior to burning	Hereford cattle, bees	1	Hereford cattle & sheep

* Past livestock pastured on the natural veld

3.5 Ordination of Relevé Data

The ordination images are presented in terms of the communities identified using the Zurich-Montpellier method. The figures show the first two axes of the ordination.

3.5.1 Full Phytosociological Dataset

3.5.1.1 Detrended Correspondence Analysis of Full Dataset

Detrended Correspondence Analysis of all plots with the full phytosociological dataset produced a first axis apparently corresponding to the dominance of woody species (Fig. 3.10a). The extreme outlier, plot 6, is strongly dominated by woodland species. This may indicate a moisture gradient rather than a structural gradient because plot 6 is situated on a drainage line.

The second axis appears to correspond to management actions that disturb the soil. The extreme group (relevés 85, 86, 87, 88, 93 & 94) are plots where the slope had been disturbed at some time, possibly when contour berms were built on the slope. The next grouping (relevés 13, 39, 40, 83, 84, 97 & 98), with the exception of relevé 13, are relevés that were placed in areas that had been ploughed and left to return to natural vegetation. Relevé 13 is situated in natural vegetation on a rocky hilltop between the returning natural vegetation of relevés 83, 84, 97 & 98 and a ploughed field and may show edge effects.

Table 3.12 supplies the statistics for the first four axes of DCA applied to the full phytosociological dataset. Removal of plot six makes the outlying groups more distinct but does not change the pattern of the ordination diagram (Fig. 3.10b).

Table 3.12: Statistics for the first four axes of Detrended Correspondence Analysis applied to the full phytosociological dataset. The total variance of species data is expressed by the sum of all the eigenvalues viz. 8.534

Axes	**1**	**2**	**3**	**4**
Eigenvalues	0.715	0.618	0.429	0.323
Cumulative % variance of species data explained	8.4	15.6	20.7	24.4

3.5.1.2 Canonical Correspondence Analysis of Full Dataset

Removing relevés during the CANOCO analysis procedure changes the correlation matrix. Environmental variables correlated to one axis with all the relevés may be correlated to another axis when some relevés are removed.

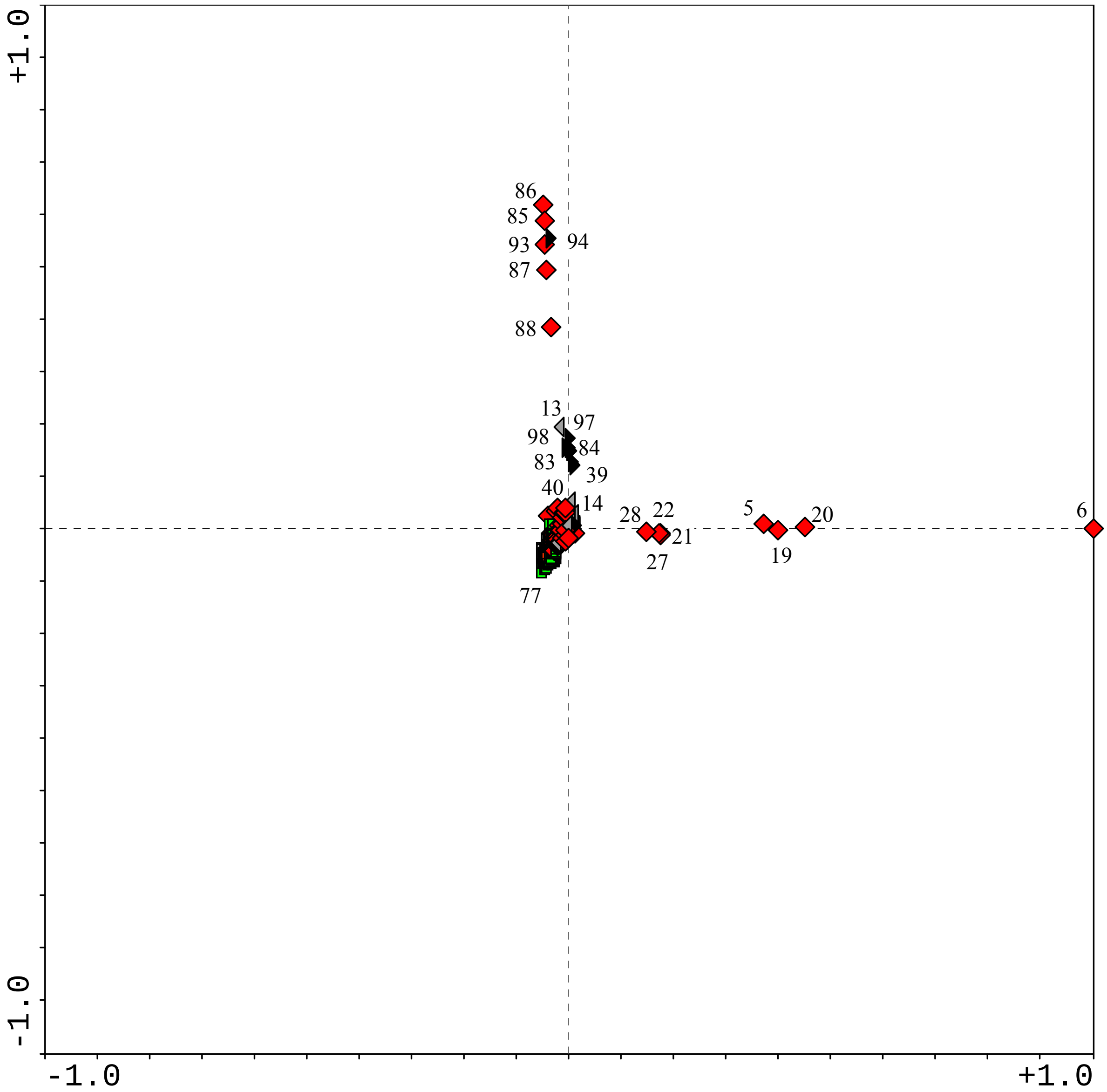

Figure 3.10a: Detrended Correspondence Analysis with seasonal species and single occurrences excluded. ▯ *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Community, □ *Themeda triandra - Stoebe phyllostachus* Grassland Community, ◆ *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Shrubland Community, ◀ *Themeda triandra - Bobartia macrospatha* Herbland Community, ▶ *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community, ● Unclassified relevés

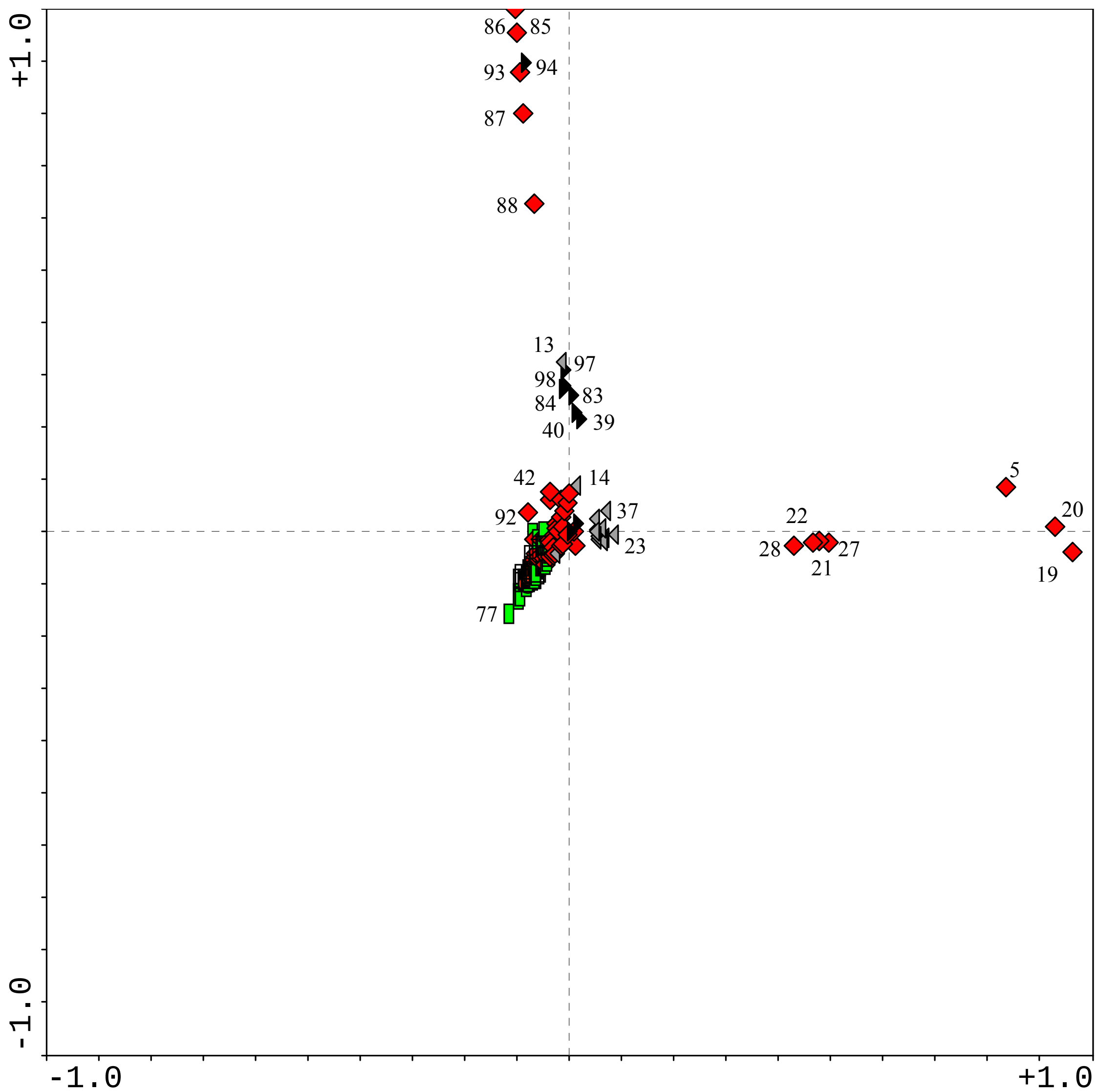

Figure 3.10b: Detrended Correspondence Analysis with seasonal species and single occurrences excluded with Plot 6 removed. *Themeda triandra* - *Senecio* sp. (G.R.Raitt 710) Grassland Community, *Themeda triandra* - *Stoebe phyllostachus* Grassland Community, *Themeda triandra* - *Argyrolobium* sp. (G.R.Raitt 29) Shrubland Community, *Themeda triandra* - *Bobartia macrospatha* Herbland Community, *Themeda triandra* - *Elytropappus rhinocerotis* Shrubland Community, Unclassified relevés

3.5.1.2.1 Environmental and Vegetation Variables

Not all environmental variables affect the vegetation directly, for example aspect and altitude affect temperature and moisture thus indirectly influencing the vegetation. Environmental variables may also influence each other.

Canonical Correspondence Analysis (CCA) of the topographical and vegetation variables (Fig. 3.11) showed little resemblance to the pattern reflected by DCA (Fig. 3.10). There is also no contribution to explain the community classification. Litter cover has the strongest correlation to the first axis. Gravel (non-soil) cover forms the strongest correlation to the second axis. High gravel cover may be linked to the occurrence of silcrete especially on the hill tops hence the aspect nominal variable flat being near the gravel cover and the second axis. The statistics for the first four axes for topographical and vegetation variables are shown in Table 3.13.

The soil variables (Fig. 3.12) also failed to resemble the pattern of the DCA (Fig. 3.10). The soil variables show a tendency to separate into the community groups. The tendency to separate community groups also reflects a structural trend to separate grassy and shrubby vegetation. The statistics for the first four axes for soil variables are shown in Table 3.14.

Table 3.13: Statistics for the first four axes of Canonical Correspondence Analysis applied to the full phytosociological dataset with topographical and vegetation environmental variables. The total variance of species data is expressed by the sum of all the unconstrained eigenvalues viz. 8.534, while the sum of all constrained eigenvalues is 2.927

Axes	**1**	**2**	**3**	**4**
Eigenvalues	0.556	0.386	0.326	0.249
Correlation between species & environmental axes	0.913	0.864	0.805	0.752
Cumulative % variance of species data explained	6.5	11.0	14.9	17.8
Cumulative % variance of species-environmental data explained	19.0	32.2	43.3	51.8

Table 3.14: Statistics for the first four axes of Canonical Correspondence Analysis applied to the full phytosociological dataset with soil environmental variables. The total variance of species data is expressed by the sum of all the unconstrained eigenvalues viz. 8.534, while the sum of all constrained eigenvalues is 2.062

Axes	**1**	**2**	**3**	**4**
Eigenvalues	0.410	0.396	0.228	0.207
Correlation between species & environmental axes	0.869	0.783	0.726	0.680
Cumulative % variance of species data explained	4.8	9.4	12.1	14.5
Cumulative % variance of species-environmental data explained	19.9	39.1	50.2	60.2

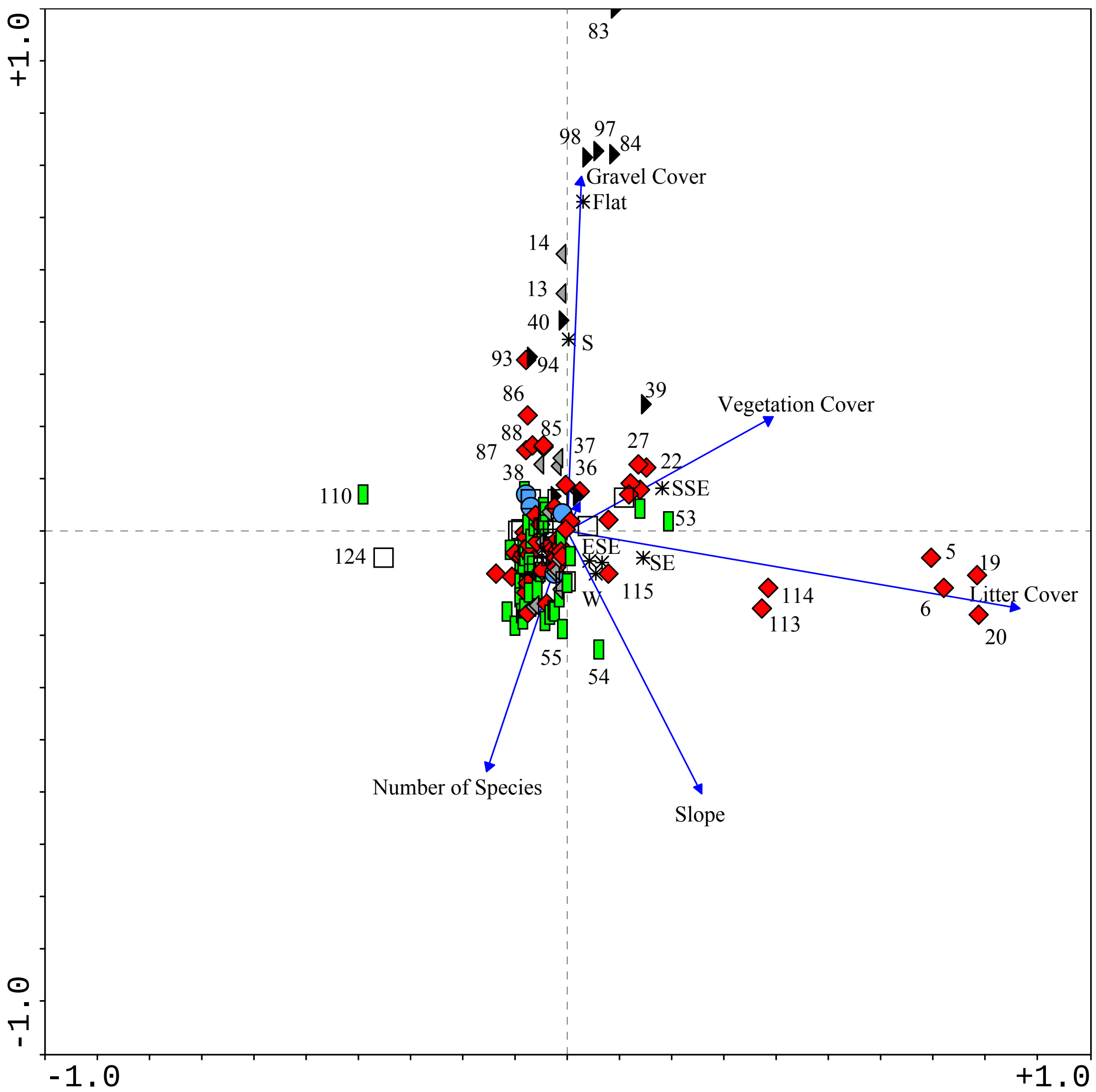

Figure 3.11a: Canonical Correspondence Analysis with seasonal species and single occurrences excluded with topographical and vegetation environmental variables. ▮ *Themeda triandra – Senecio* sp. (G.R.Raitt 710) Grassland Community, □ *Themeda triandra – Stoebe phyllostachys* Grassland Community, ◆ *Themeda triandra – Argyrolobium* sp. (G.R.Raitt 29) Shrubland Community, ◁ *Themeda triandra – Bobartia macrospatha* Herbland Community, ▶ *Themeda triandra – Elytropappus rhinocerotis* Shrubland Community, ● Unclassified relevés

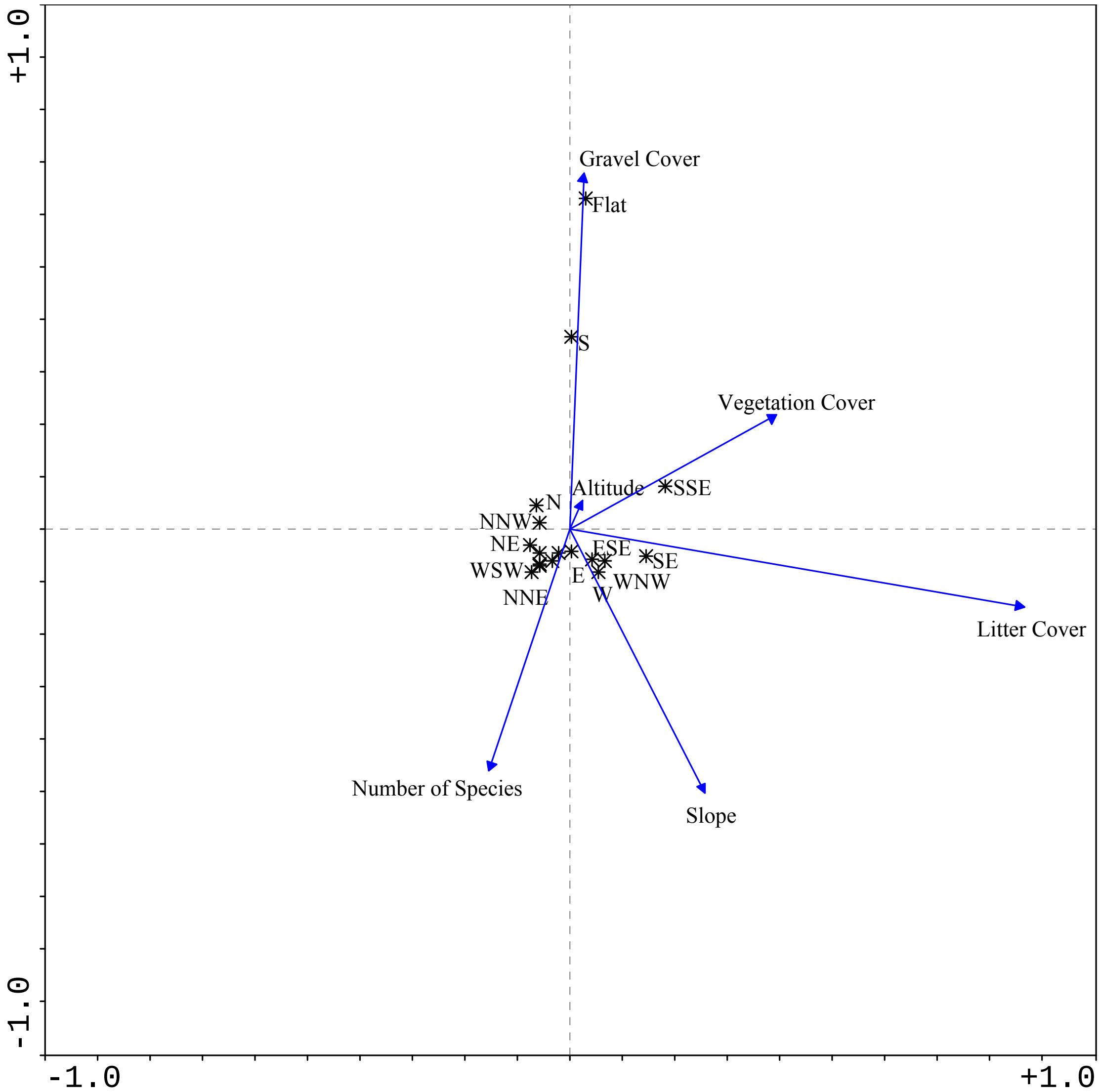

Figure 3.11b: Environmental variables for Canonical Correspondence Analysis with seasonal species and single occurrences excluded with topographical and vegetation environmental variables

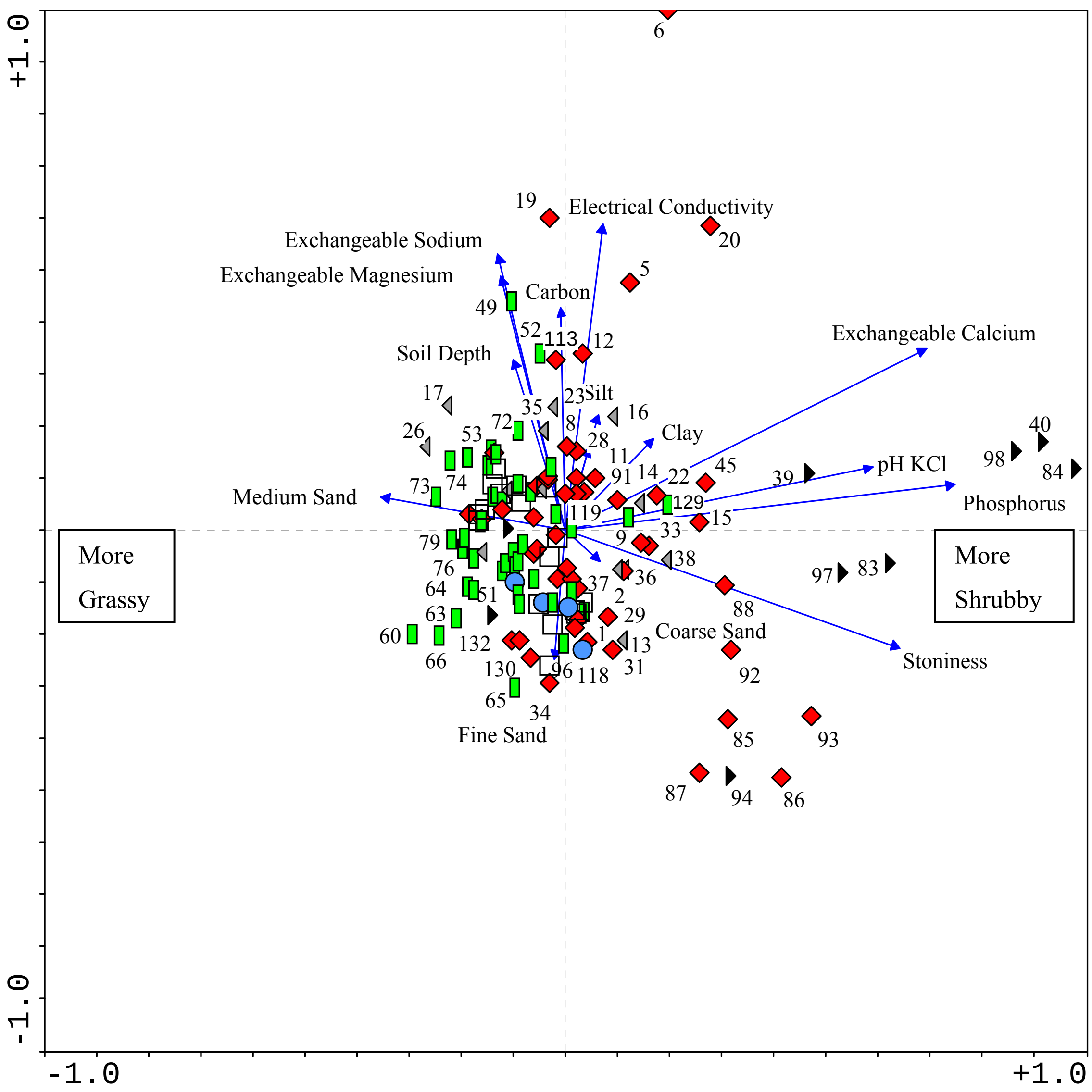

Figure 3.12a: Canonical Correspondence Analysis with seasonal species and single occurrences excluded with soil environmental variables. *Themeda triandra* – *Senecio* sp. (G.R.Raitt 710) Grassland Community, *Themeda triandra* – *Stoebe phyllostachys* Grassland Community, *Themeda triandra* – *Argyrolobium* sp. (G.R.Raitt 29) Shrubland Community, *Themeda triandra* – *Bobartia macrospatha* Herbland Community, *Themeda triandra* – *Elytropappus rhinocerotis* Shrubland Community, Unclassified relevés

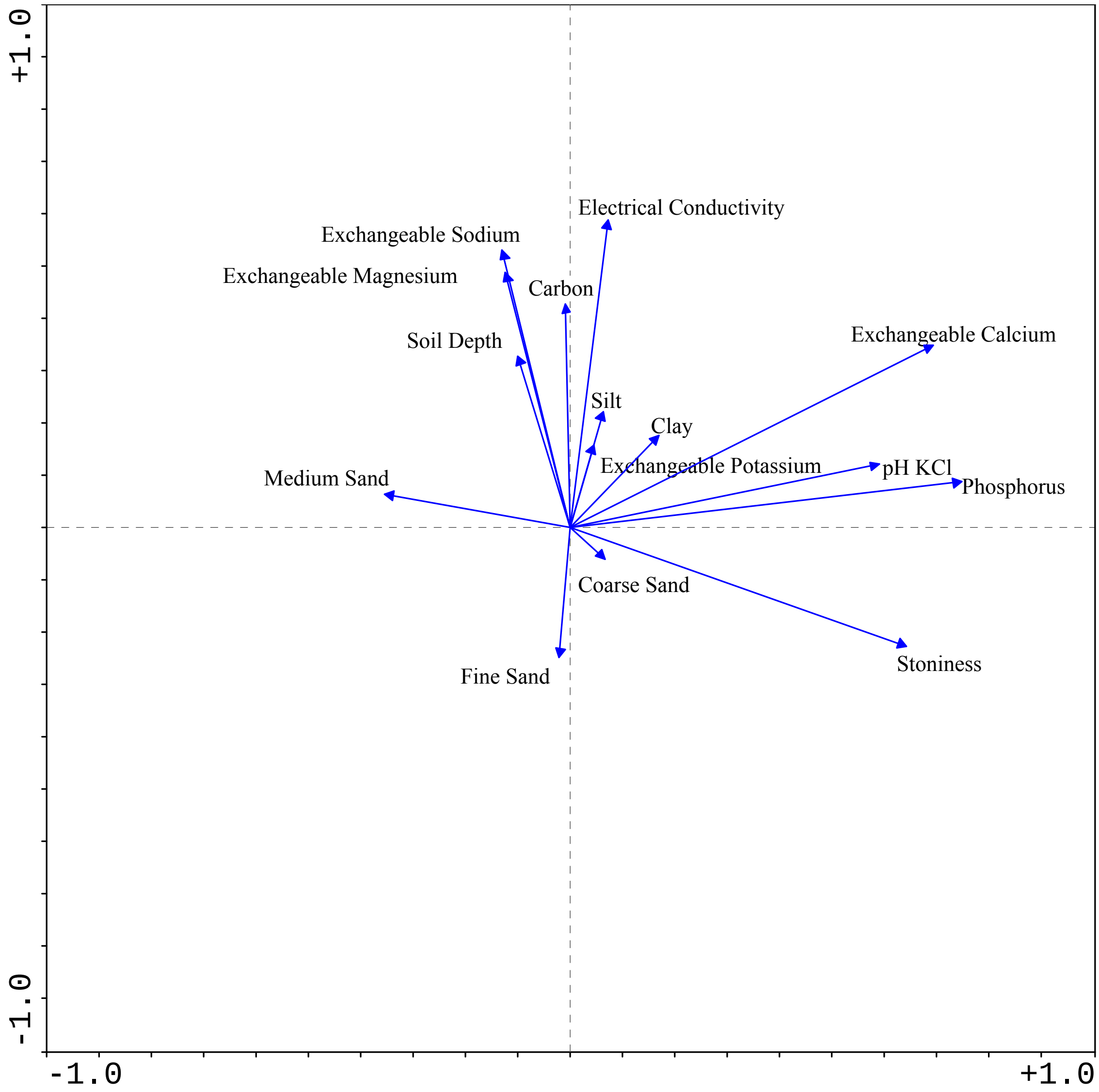

Figure 3.12b: Environmental variables for Canonical Correspondence Analysis with seasonal species and single occurrences excluded with soil environmental variables

3.5.1.2.2 Management variables

Management variables are interrelated. For example, the number of fires since 1990 is linked to the post-fire vegetation age. Increased post-fire vegetation age may be correlated to an increase in shrubby vegetation so that increased time since burning is likely to reflect a decrease in the grazing potential of the vegetation. The nominal variables for Jersey cattle and ungrazed veld are close together. This may be because one of the dairy farmers only pastures 'dry' cows or juveniles on natural veld because the cultivated pasture combined with supplements gives a greater yield of milk than the natural veld (pers. comm. Mr K. Moodie 2001—2003) and the other dairy farmer has not used the natural veld since 1990 (pers. comm. Mr P.W. Groenewald 2003).

Canonical Correspondence Analysis (CCA) of the management variables (Fig. 3.13) did not elucidate the DCA (Fig. 3.10) but showed a tendency to separate the community groups. The tendency to separate community groups also reflects a structural trend to separate grassy and shrubby vegetation. The statistics for the first four axes for management variables are shown in Table 3.15.

Table 3.15: Statistics for the first four axes of Canonical Correspondence Analysis applied to the full phytosociological dataset with management variables. The total variance of species data is expressed by the sum of all the unconstrained eigenvalues viz. 8.534, while the sum of all constrained eigenvalues is 1.682

Axes	**1**	**2**	**3**	**4**
Eigenvalues	0.496	0.379	0.225	0.200
Correlation between species & environmental axes	0.894	0.895	0.773	0.715
Cumulative % variance of species data explained	5.8	10.3	12.9	15.2
Cumulative % variance of species-environmental data explained	29.5	52.0	65.3	77.2

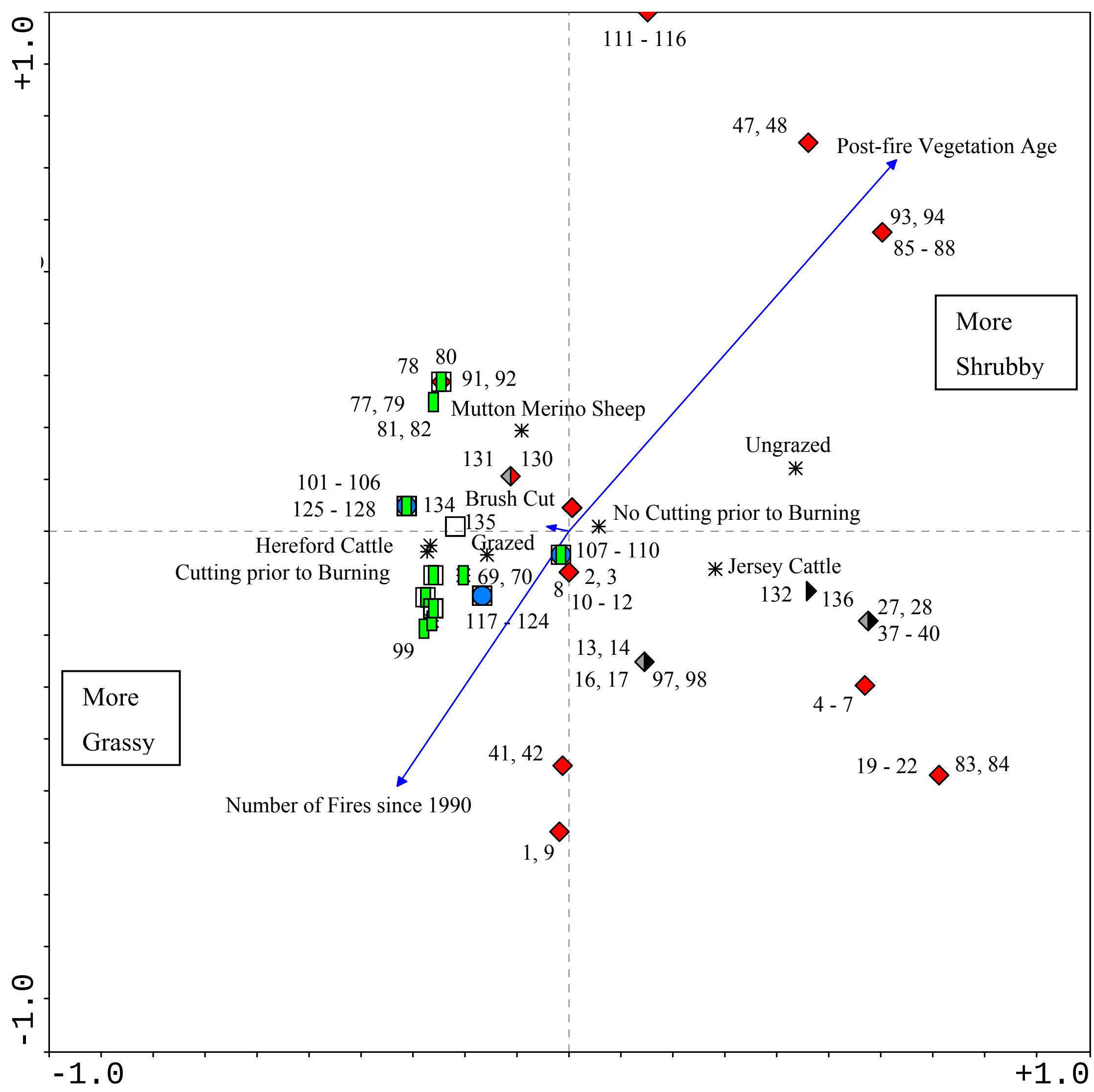

Figure 3.13a: Canonical Correspondence Analysis with seasonal species and single occurrences excluded with management variables. Brush cut refers to cutting without burning. Cutting prior to burning indicates the use of both brush cutting and burning. ▮ *Themeda triandra – Senecio* sp. (G.R.Raitt 710) Grassland Community, □ *Themeda triandra – Stoebe phyllostachys* Grassland Community, ◆ *Themeda triandra – Argyrolobium* sp. (G.R.Raitt 29) Shrubland Community, ◀ *Themeda triandra – Bobartia macrospatha* Herbland Community, ▶ *Themeda triandra – Elytropappus rhinocerotis* Shrubland Community, ● Unclassified relevés

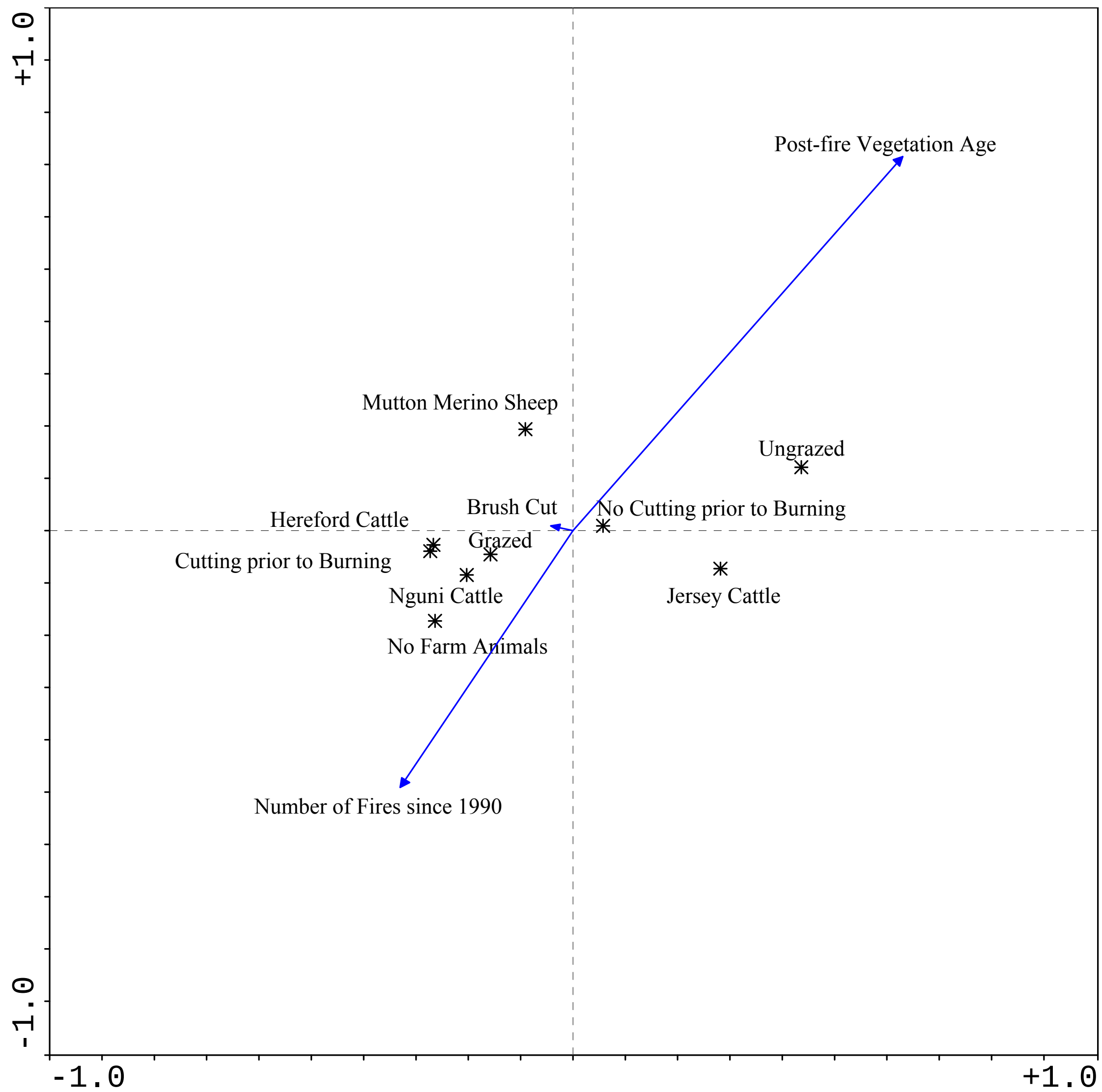

Figure 3.13b: Management variables for Canonical Correspondence Analysis with seasonal species and single occurrences excluded with management variables. Brush cut refers to cutting without burning. Cutting prior to burning indicates the use of both brush cutting and burning

3.5.2 Presence/Absence Dataset

3.5.2.1 Detrended Correspondence Analysis

Detrended Correspondence Analysis (DCA) of presence/absence data for all plots indicated that all the plots are closely related but the community groups are identifiable though slightly overlapped (Fig. 3.14). The tendency to separate community groups also reflects a structural trend to separate grassy and shrubby vegetation. Removing relevés 16, 17, 23, 24, 25 and 26 showed that the community groups are identifiable (Fig. 3.15). In Figure 3.15, relevés 92 and 103 are situated with the community group that they do not belong to. Relevé 103 is a depauperate relevé and has none of the species characterizing the *Themeda triandra – Elytropappus rhinocerotis* Community Group, many of the species shared by the two community groups and only one species characterizing the *Themeda triandra – Stoebe phyllostachys* Community Group (*Senecio* sp. b (GRR 51/22)). Further removal of plots 5, 6, 19, 20, 21, 22, 27 & 28 increased the separation of the community groups and inverted the second axis (Fig. 3.16). Relevé 92 is still not with the community group it belongs to. This relevé has five or more per cent cover of *Elytropappus rhinocerotis* which resulted in the relevé being classified as part of the *Themeda triandra – Elytropappus rhinocerotis* Community Group and a rare occurrence of *Osteospermum imbricatum* which belongs to the *Themeda triandra – Stoebe phyllostachys* Community Group. See Table 3.1 for the relationships between the communities and community groups.

Table 3.16 supplies the statistics for the first four axes of DCA applied to the full presence/absence dataset. The total variance in the species data is less than with the full phytosociological dataset and the first four axes explain less of the variance than with the full phytosociological dataset (Table 3.12). Ter Braak & Šmilauer (1998) note that axes with small eigenvalues may still be meaningful because species data are redundant.

Table 3.16: Statistics for the first four axes of Detrended Correspondence Analysis applied to the presence/absence dataset. The total variance of species data is expressed by the sum of all the eigenvalues viz. 5.218

Axes	**1**	**2**	**3**	**4**
Eigenvalues	0.377	0.213	0.185	0.150
Cumulative % variance of species data explained	7.2	11.3	14.9	17.7

3.5.2.2 Canonical Correspondence Analysis

All Canonical Correspondence Analysis of the complete (no relevés removed) presence/absence dataset produced small eigenvalues for the first axis (< 0.3). Removal of some relevés occasionally resulted in a first axis eigenvalue slightly above three tenths.

(a)

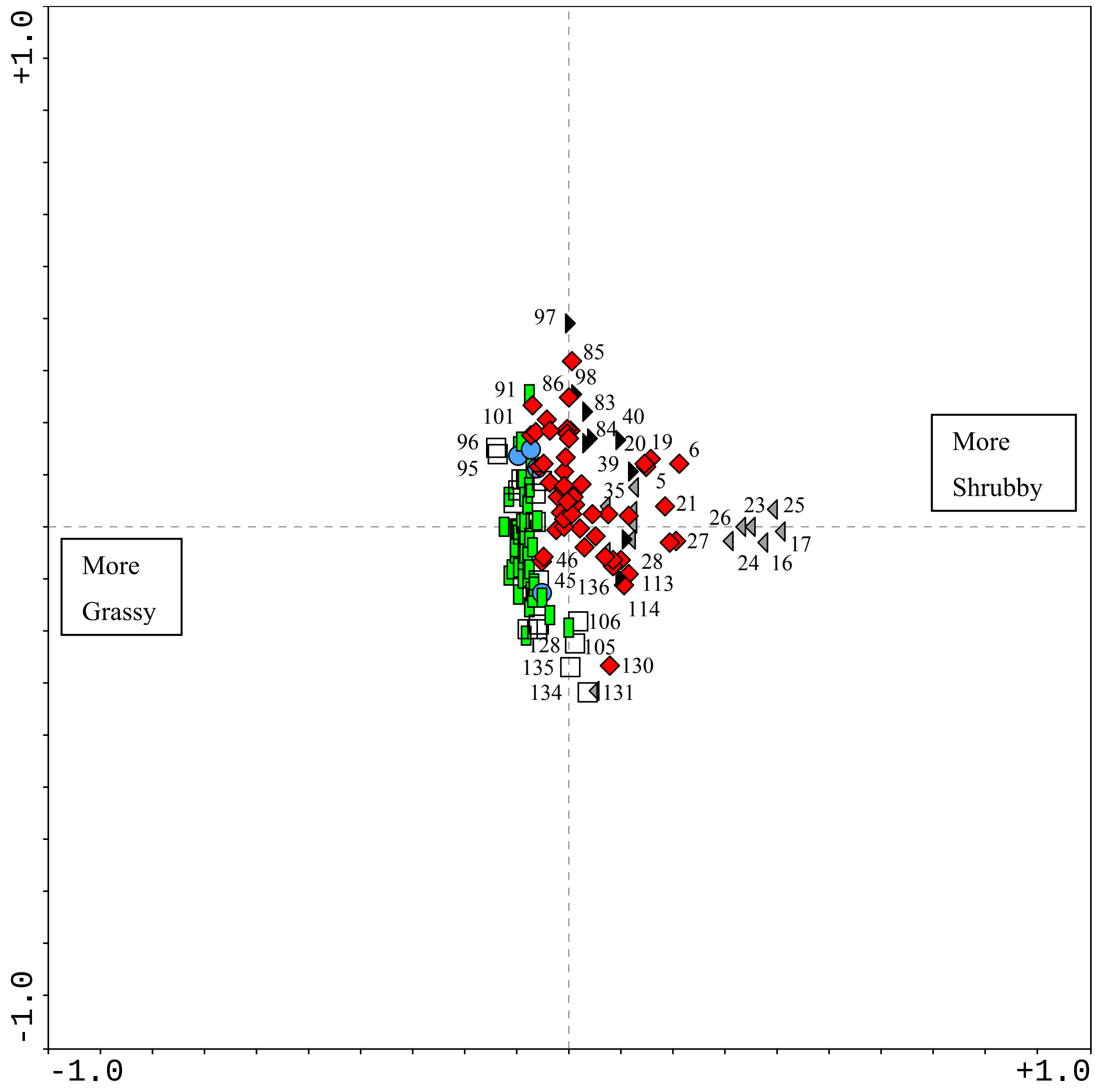

Figure 3.14: Detrended Correspondence Analysis of presence/absence data with seasonal species and single occurrences excluded. *Themeda triandra – Senecio* sp. (G.R.Raitt 710) Grassland Community, *Themeda triandra – Stoebe phyllostachys* Grassland Community, *Themeda triandra – Argyrolobium* sp. (G.R.Raitt 29) Shrubland Community, *Themeda triandra – Bobartia macrospatha* Herbland Community, *Themeda triandra – Elytropappus rhinocerotis* Shrubland Community, Unclassified relevés

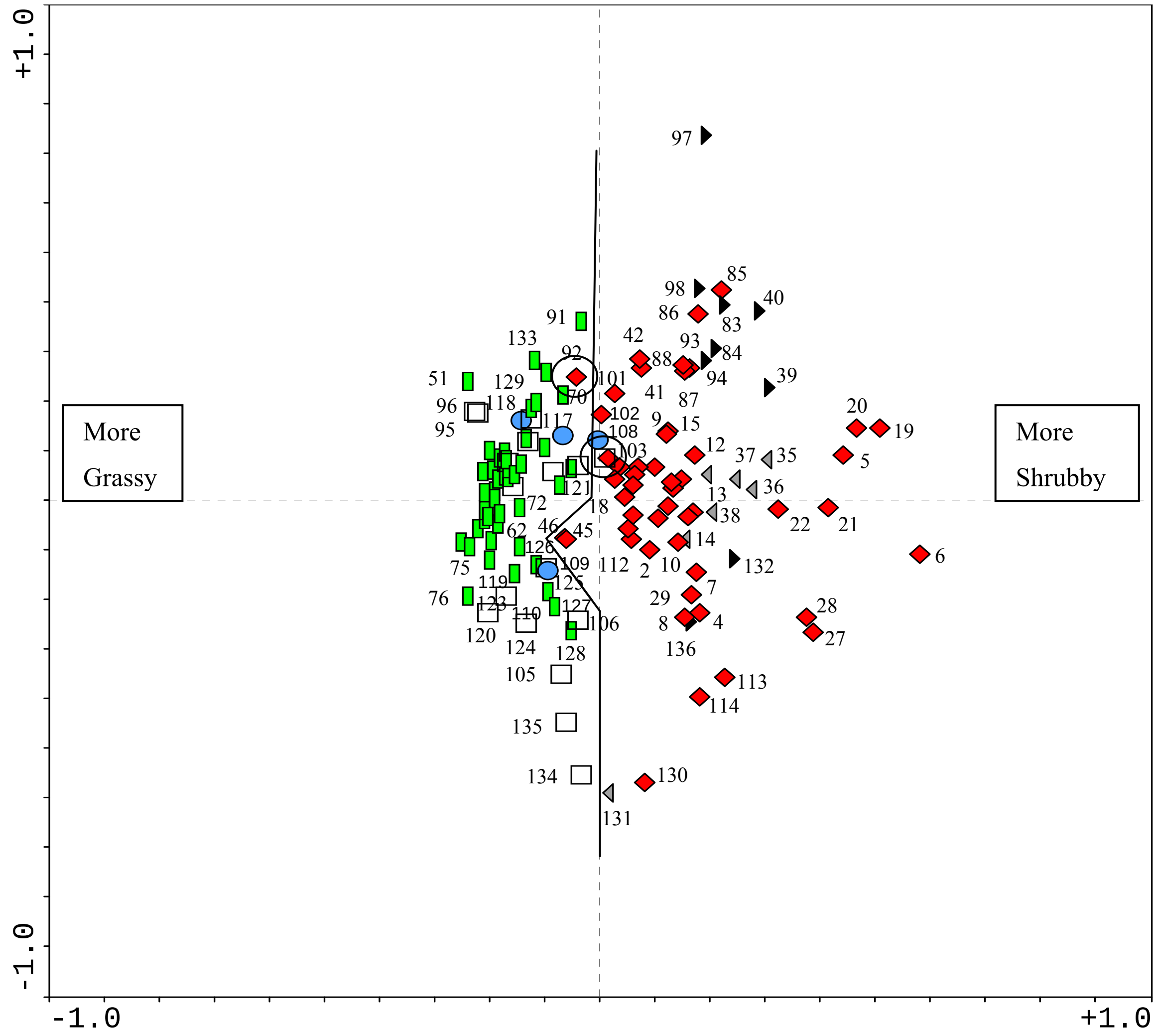

Figure 3.15: Detrended Correspondence Analysis of presence/absence data with seasonal species and single occurrences excluded with plots 16, 17, 23, 24, 25 & 26 (about half of one community) removed. *Themeda triandra – Senecio* sp. (G.R.Raitt 710) Grassland Community, *Themeda triandra – Stoebe phyllostachys* Grassland Community, *Themeda triandra – Argyrolobium* sp. (G.R.Raitt 29) Shrubland Community, *Themeda triandra – Bobartia macrospatha* Herbland Community, *Themeda triandra – Elytropappus rhinocerotis* Shrubland Community, Unclassified relevés

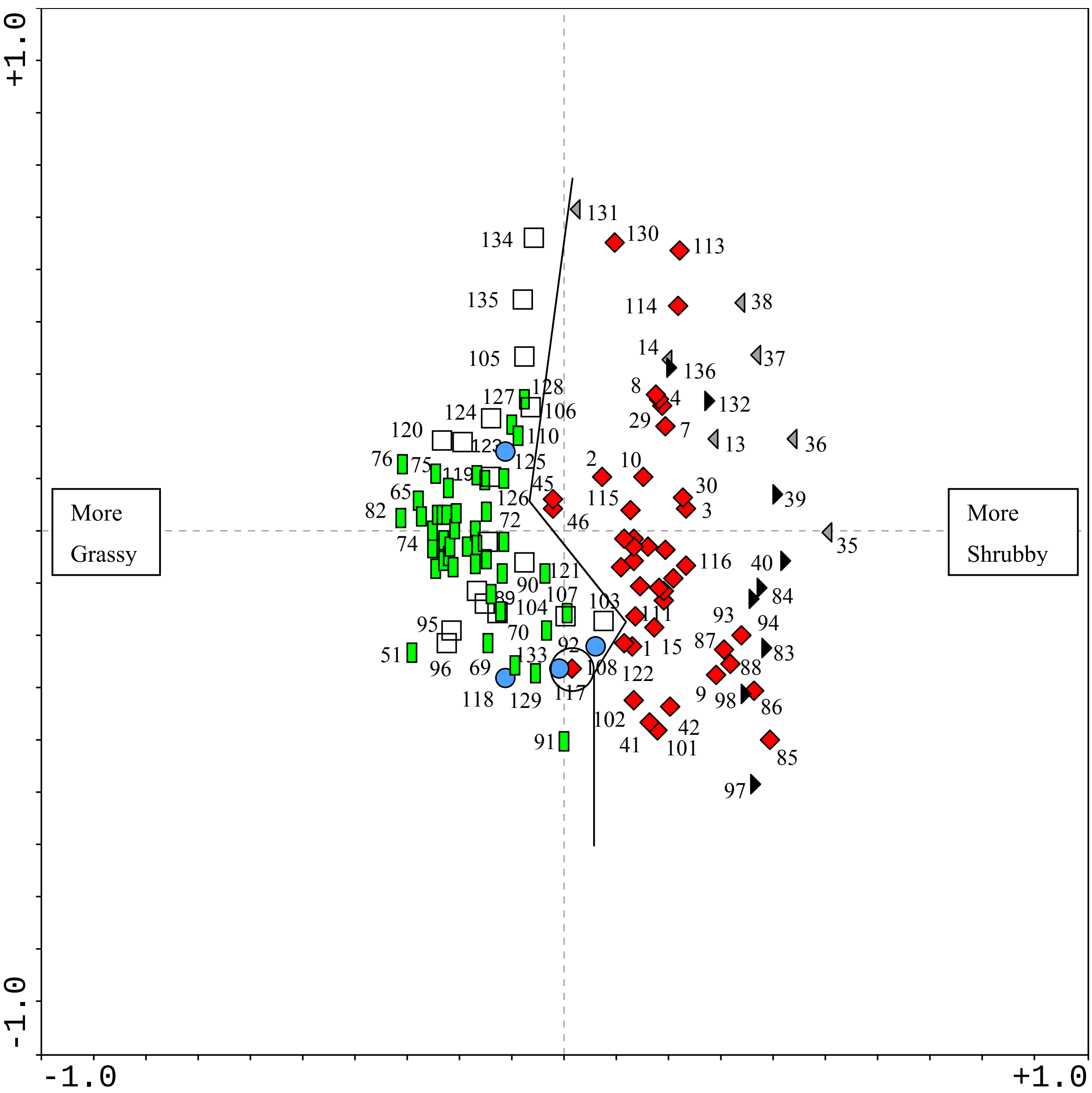

Figure 3.16: Detrended Correspondence Analysis of presence/absence data with seasonal species and single occurrences excluded. Plots 16, 17, 23, 24, 25 & 26 (about half of one community) and plots 5, 6, 19, 20, 21, 22, 27 & 28 (most of one subcommunity) were removed. ▮ *Themeda triandra – Senecio* sp. (G.R.Raitt 710) Grassland Community, □ *Themeda triandra – Stoebe phyllostachys* Grassland Community, ◆ *Themeda triandra – Argyrolobium* sp. (G.R.Raitt 29) Shrubland Community, ◀ *Themeda triandra – Bobartia macrospatha* Herbland Community, ▶ *Themeda triandra – Elytropappus rhinocerotis* Shrubland Community, ● Unclassified relevés

3.5.2.2.1 Environmental and Vegetation Variables

See section 3.4.1.2.1 for comment on the environmental variables.

The topographical and vegetation variables data (Fig. 3.17) did not reflect the DCA separation of the community groups (Figs. 3.14, 3.15 & 3.16), nor did this change after removing plots with undue influence on the calculations (inflation factor > 14 in the log file (Lepš & Šmilauer 2003)). The statistics for the first four axes for topographical and vegetation variables are shown in Table 3.17.

The separation between the community groups in DCA (Figs. 3.14, 3.15 & 3.16) is partially supported by the trend towards separating the community groups shown by the soil variables data (Fig 3.18) but there is no single measured variable that accounts for either axis. The tendency to separate community groups also reflects a structural trend to separate grassy and shrubby vegetation. The statistics for the first four axes for soil variables are shown in Table 3.18.

Table 3.17: Statistics for the first four axes of Canonical Correspondence Analysis applied to the presence/absence dataset with topographical and vegetation environmental variables. The total variance of species data is expressed by the sum of all the unconstrained eigenvalues viz. 5.218, while the sum of all constrained eigenvalues is 1.568

Axes	**1**	**2**	**3**	**4**
Eigenvalues	0.272	0.197	0.144	0.111
Correlation between species & environmental axes	0.891	0.884	0.829	0.879
Cumulative % variance of species data explained	5.2	9.0	11.7	13.9
Cumulative % variance of species-environmental data explained	17.3	29.9	39.1	46.1

Table 3.18: Statistics for the first four axes of Canonical Correspondence Analysis applied to the presence/absence dataset with soil environmental variables. The total variance of species data is expressed by the sum of all the unconstrained eigenvalues viz. 5.218, while the sum of all constrained eigenvalues is 1.096

Axes	**1**	**2**	**3**	**4**
Eigenvalues	0.216	0.169	0.116	0.103
Correlation between species & environmental axes	0.869	0.732	0.790	0.812
Cumulative % variance of species data explained	4.1	7.4	9.6	11.6
Cumulative % variance of species-environmental data explained	19.7	35.1	45.7	55.2

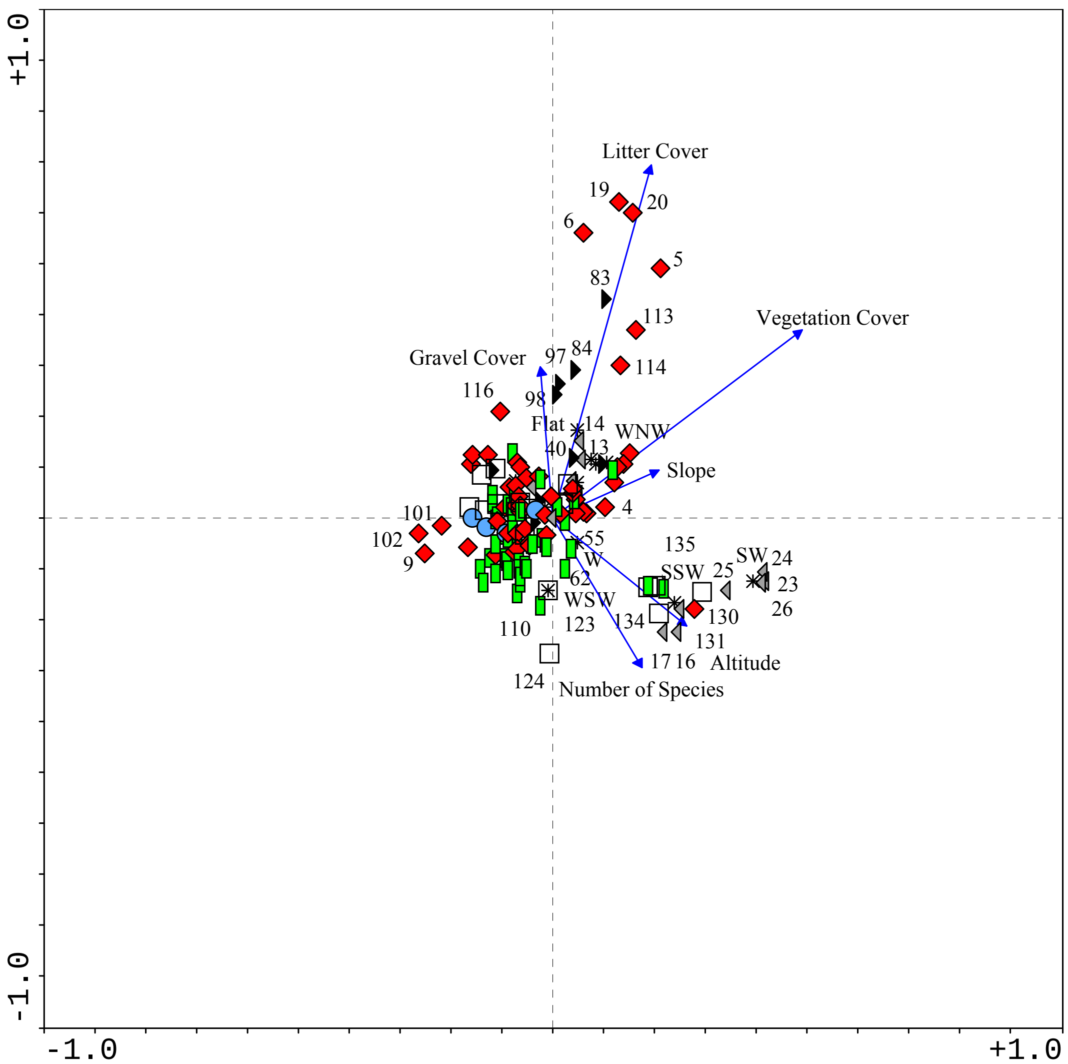

Figure 3.17a: Canonical Correspondence Analysis of presence/absence data with seasonal species and single occurrences excluded with topographical and vegetation environmental variables. ▮ *Themeda triandra – Senecio* sp. (G.R.Raitt 710) Grassland Community, □ *Themeda triandra – Stoebe phyllostachys* Grassland Community, ◆ *Themeda triandra – Argyrolobium* sp. (G.R.Raitt 29) Shrubland Community, ◀ *Themeda triandra – Bobartia macrospatha* Herbland Community, ▶ *Themeda triandra – Elytropappus rhinocerotis* Shrubland Community, ● Unclassified relevés

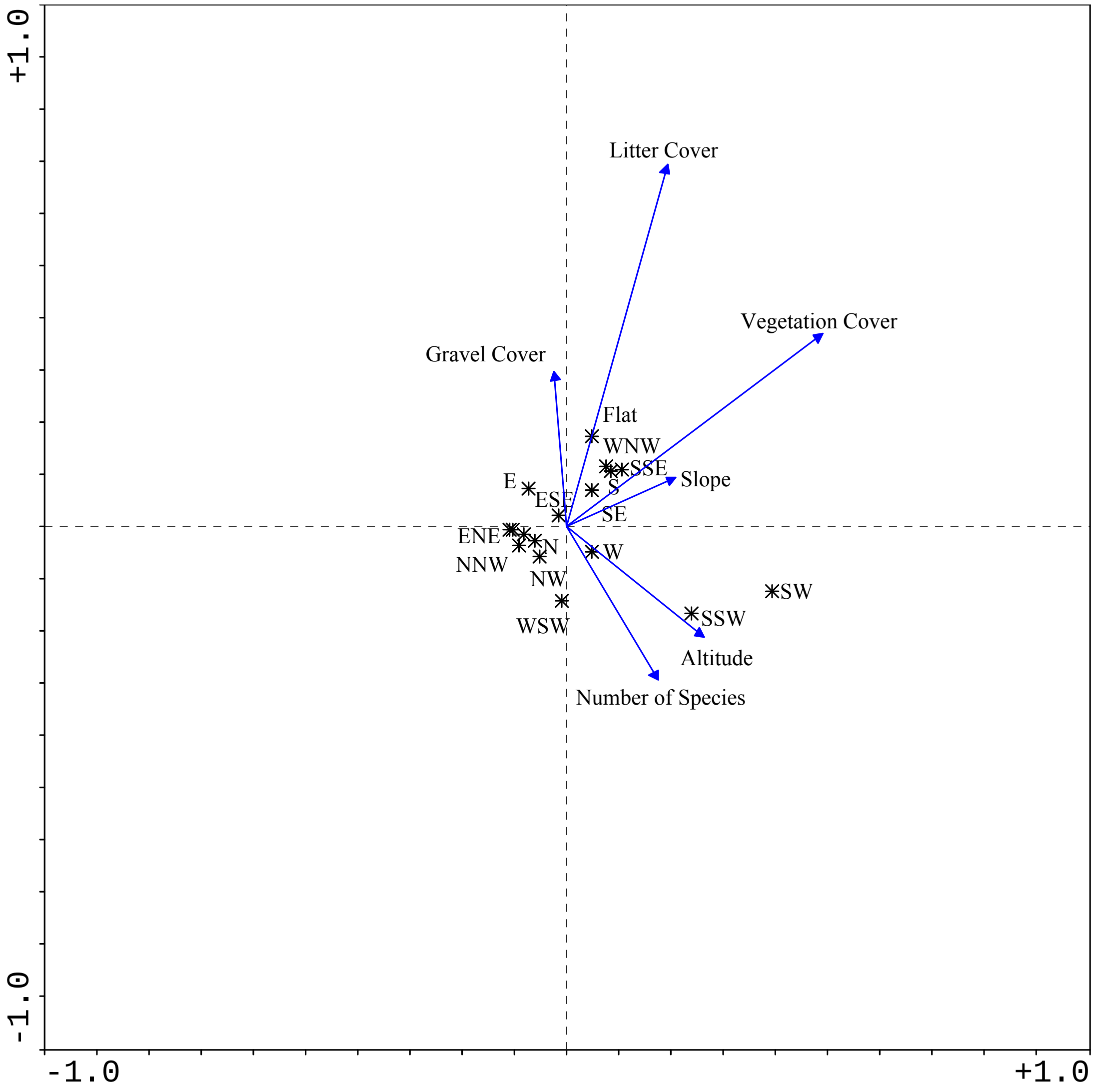

Figure 3.17b: Environmental variables for Canonical Correspondence Analysis of presence/absence data with seasonal species and single occurrences excluded with topographical and vegetation environmental variables

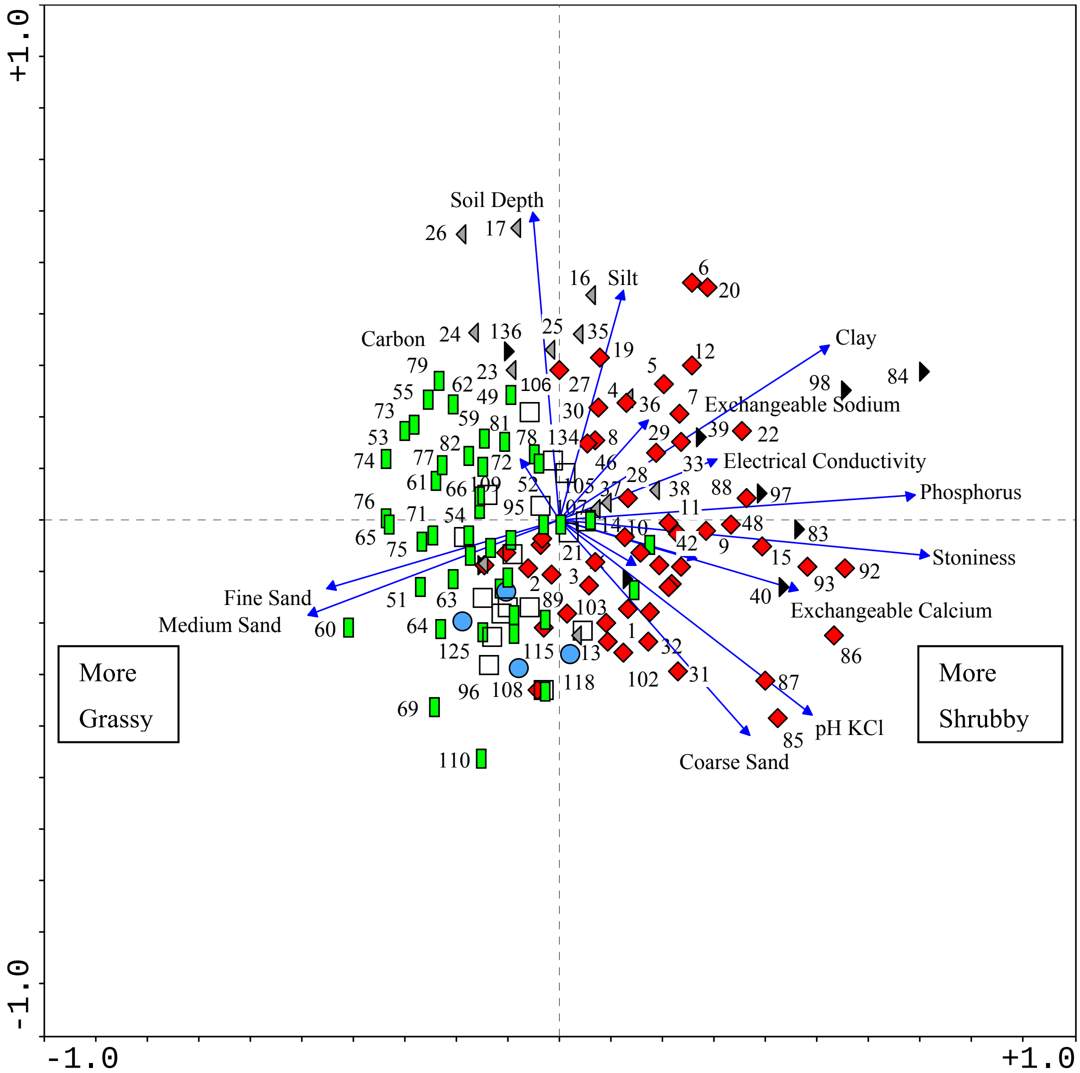

Figure 3.18a: Canonical Correspondence Analysis of presence/absence data with seasonal species and single occurrences excluded with soil environmental variables. ▯ *Themeda triandra* – *Senecio* sp. (G.R.Raitt 710) Grassland Community, □ *Themeda triandra* – *Stoebe phyllostachys* Grassland Community, ◆ *Themeda triandra* – *Argyrolobium* sp. (G.R.Raitt 29) Shrubland Community, ◀ *Themeda triandra* – *Bobartia macrospatha* Herbland Community, ▶ *Themeda triandra* – *Elytropappus rhinocerotis* Shrubland Community, ● Unclassified relevés

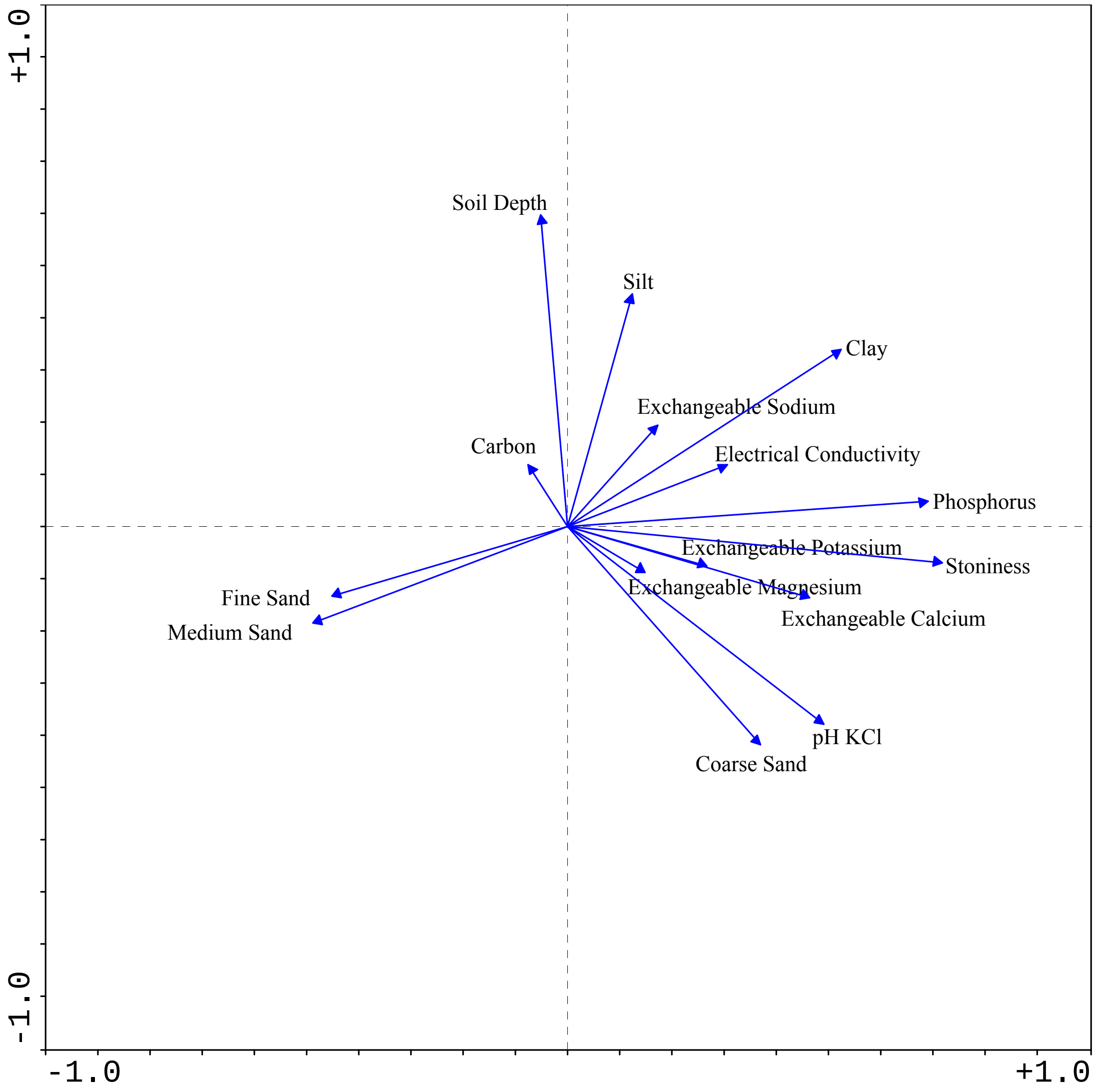

Figure 3.18b: Environmental variables for Canonical Correspondence Analysis of presence/absence data with seasonal species and single occurrences excluded with soil environmental variables

3.5.2.2.2 Management variables

The references to interrelationship between the management variables found in section 3.4.1.2.2 also apply here.

Canonical Correspondence Analysis (CCA) of the management variables (Fig. 3.19) showed a tendency to separate the community groups. The tendency to separate community groups also reflects a structural trend to separate grassy and shrubby vegetation. Fire management seems to be the strongest factor causing this tendency to separate community groups and vegetation structure. This may in part reflect the comparative ease with which fire management information could be obtained and quantified compared to grazing management information. The statistics for the first four axes for management variables are shown in Table 3.19.

Table 3.19: Statistics for the first four axes of Canonical Correspondence Analysis applied to the presence/absence dataset with management variables. The total variance of species data is expressed by the sum of all the unconstrained eigenvalues viz. 5.218, while the sum of all constrained eigenvalues is 0.887

Axes	**1**	**2**	**3**	**4**
Eigenvalues	0.297	0.135	0.094	0.089
Correlation between species & environmental axes	0.942	0.893	0.786	0.809
Cumulative % variance of species data explained	5.7	8.3	10.1	11.8
Cumulative % variance of species-environmental data explained	33.5	48.8	59.4	69.4

3.6 Comparison of the Flora of the Grootvadersbosch Conservancy with Brakkekuil Farm

Table 3.20 shows the quantitative comparison between the Brakkekuil Farm and the Grootvadersbosch Conservancy.

Table 3.20: Quantitative comparison of partial floristic lists from Brakkekuil Farm and the Grootvadersbosch Conservancy study site

Locality	**Brakkekuil Farm**	**Grootvadersbosch Conservancy**
Total of listed species	112	287
Shared species	26	
Shared species with different subtaxa	4	
Unique Species	82	257

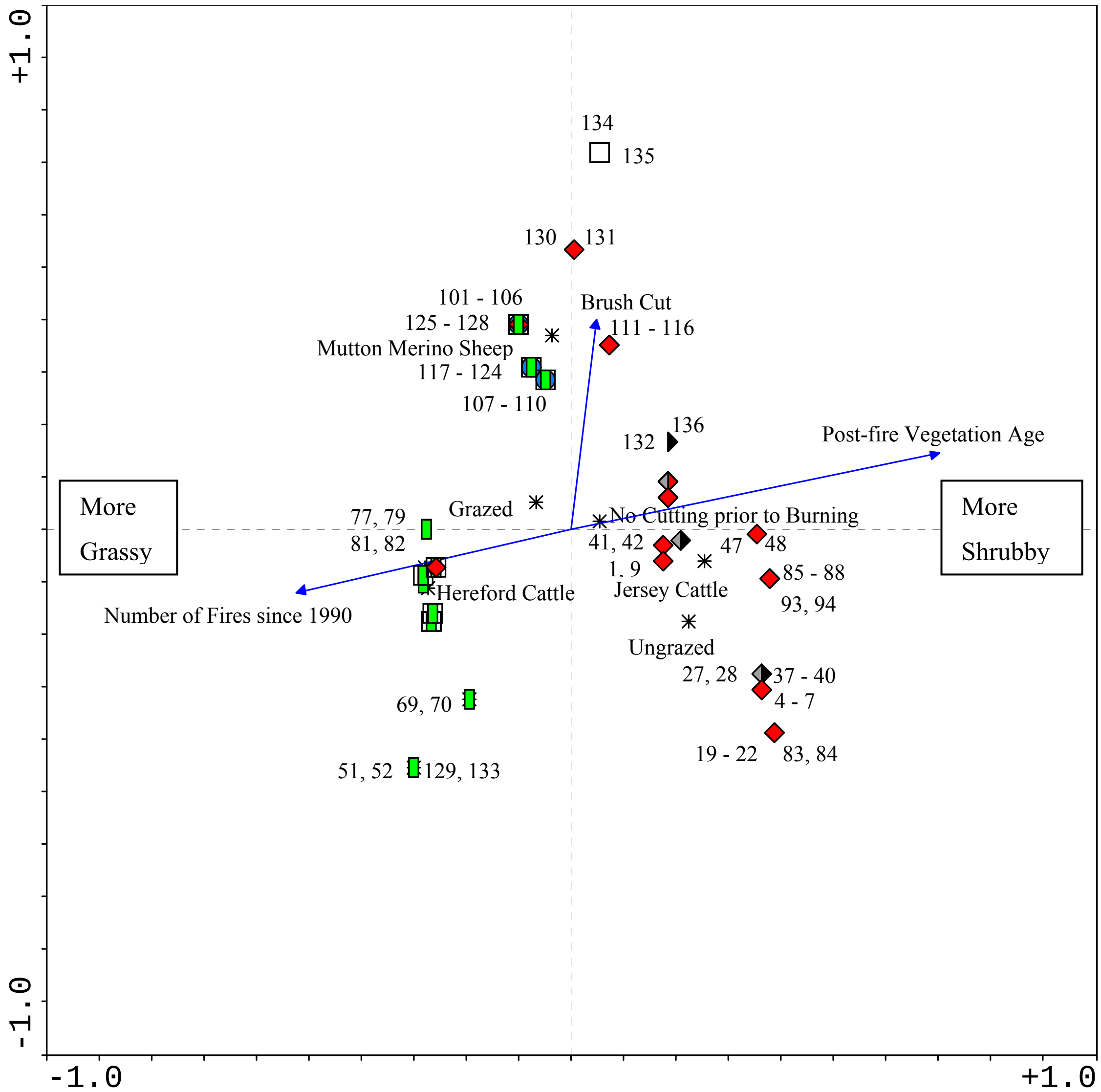

Figure 3.19a: Canonical Correspondence Analysis of presence/absence data with seasonal species and single occurrences excluded with management variables. Brush cut refers to cutting without burning. Cutting prior to burning indicates the use of both brush cutting and burning. ▯ *Themeda triandra – Senecio* sp. (G.R.Raitt 710) Grassland Community, □ *Themeda triandra – Stoebe phyllostachys* Grassland Community, ◆ *Themeda triandra – Argyrolobium* sp. (G.R.Raitt 29) Shrubland Community, ◀ *Themeda triandra – Bobartia macrospatha* Herbland Community, ▶ *Themeda triandra – Elytropappus rhinocerotis* Shrubland Community, ● Unclassified relevés

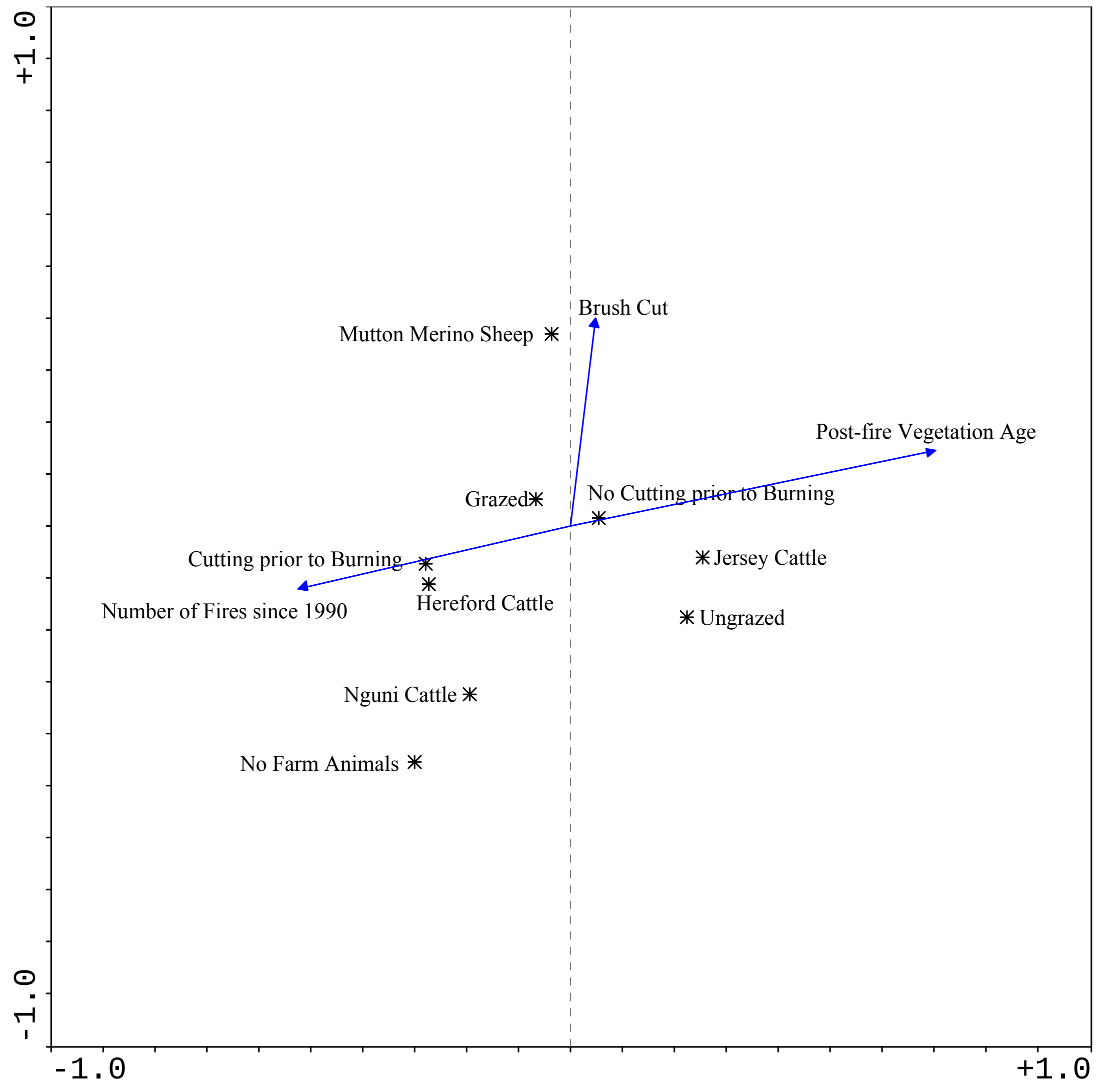

Figure 3.19b: Management variables for Canonical Correspondence Analysis of presence/absence data with seasonal species and single occurrences excluded with management variables. Brush cut refers to cutting without burning. Cutting prior to burning indicates the use of both brush cutting and burning

Chapter 4 Discussion

4.1 Methods

4.1.1 Zürich-Montpellier Method

4.1.1.1 Plot Sampling

The use of species composition to determine minimal area using species-area curves is widely discussed in the literature, however, minimal area is not objectively determined from species-area curves (Shimwell 1971, Werger 1972, Mueller-Dombois & Ellenberg 1974, Kent & Coker 1992, Westhoff *et al.* 1995). The choice of position on the curve constituting minimal area is more or less arbitrary (Westhoff *et al.* 1995), though Werger (1972) suggests a standardized method based on curves covering a 1 000 m^2. The use of nested quadrats with the large areas incorporating the smaller areas means that the results are statistically dependent. For statistical validity, the minimal area would have to be calculated from many species-area curves, which is impractical (Westhoff *et al.* 1995). Species-area curves, while not objective, do provide a guide to the selection of relevé size. For comparative purposes, the relevé size of other studies in the same vegetation type should be considered.

Once the relevé size is selected according to the minimal area within a structural vegetation type, the relevé size should be used consistently in that vegetation within the survey. While relevé size has to meet criteria, the plot shape is not specified (Werger 1974) though a rectangular shape is preferable (Westhoff & Van der Maarel 1973). Goldsmith & Harrison (1976) note that changing the plot shape causes negligible differences in the results. In this study, the chosen plot size resulted in only four of 136 plots not being classified (plots 108, 117, 118 and 125), and variation of shape did not result in different classification.

The number of relevés for a survey is not fixed but is linked to the scale of the survey (Werger 1974). Ground-truthing for mapping showed that the 136 plots laid out in this study largely covered the variation in the area.

Westfall *et al.* (1996) and Mucina *et al.* (2000) list categories of information that should be included in a relevé suggesting standards for data collection to increase the comparability of relevés from different studies. The overall categories were successfully used in this study but the subdivisions were not always practicable – e.g. the cryptogram layer in the category 'data on vegetation' from Mucina *et al.* (2000). Mucina *et al.*'s (2000) categories were set up for Europe so the subdivisions of the category 'geographic coordinates' differed from those in use in South Africa.

Goldsmith & Harrison (1976) consider prior knowledge of the flora of the study area necessary for the effective use of vegetation analysis based on floristics. Prior knowledge of the flora of an area may be an advantage but is not essential to the practice of the Zurich-Montpellier method (pers. comm. Dr C.

Boucher[4] 2001). Boucher (1987) notes that delays in species identification do not prevent distinction between species in the field. Field distinction of species, aided by a field herbarium, prior to identification was found to be adequate in this study. Species complexes were used in cases where field distinction did not work e.g. *Metalasia*.

Ideally a complete floristic list should be recorded for each plot but this is difficult to achieve because geophytes and therophytes are not visible in all seasons or all years. A complete list therefore requires multiple visits that are not always possible (Werger 1974, Westfall *et al.* 1996) as with this study where financial constraints meant that specimen collection trips were limited to one per season when no plot sampling was being done. Perennial plants, which are better indicators of habitat than ephemerals and more readily identifiable, are therefore used in cases where multiple visits are not possible (Werger 1974, Westfall *et al.* 1996). This study took place during a drought, negatively affecting the behavior of particularly the ephemeral species. Perennial species were thus the focus of the classification for this study as recommended by Werger (1974) and Westfall *et al.* (1996). The quality of the species list in the Braun-Blanquet table depends on the taxonomic knowledge available. South Africa still has taxonomic work to complete. At the time this study was carried out the genera *Argyrolobium*, *Centella* and *Otholobium* and the subgenus *Mahernia* of *Hermannia* were under revision so the species names were not readily available though some names were tentatively assigned. Expert assistance did not always result in species names and some inaccuracies were also found in the identifications received from the National Biodiversity Institute. Identification of a diagnostic *Senecio* sp. was not possible.

4.1.1.2 Phytosociology

All plant communities in this study included more than four relevés (the absolute minimum required for adequate classification (Westfall *et al.* 1996)). Four weak relevés were retained to the right of the table and were not classifiable because they lacked character and differential species.

The nomenclature was not formalised in this study because the scale was considered that of a local typology rather than suitable for formal syntaxonomical classification.

4.1.2 Management

Little Renosterveld remains and much of this is in private ownership. Anecdotal evidence is admittedly weak but many farmers do not keep formal records to allow for better data collection. Only one farmer mentioned written evidence of management actions and this evidence was in a private diary and not open to public scrutiny. The farmers' management impacts upon the vegetation and therefore

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[4] Contact details for all personal communications may be found under Personal Communications in Sources of Information.

requires documentation. Of the anecdotal information, grazing data is very imprecise. Data on fire management is more reliable as most farmers have a policy (though unwritten) on burning and can calculate the approximate dates of burns. The anecdoctal information gained provided useful hypotheses for future testing.

4.1.3 Ordination

Økland (2003) recommends partitioning environmental and management variables. This allows the variables to be ranked in importance, which could not be done by the method used in the present study. Økland's (2003) method would be advantageous for future work.

4.2 Fynbos or Renosterveld?

The *Themeda triandra – Bobartia macrospatha* Herbland Community is associated with silcrete and contains proteoid (*Leucadendron salignum*), restioid (*Calopsis adpressa*), ericoid (e.g. *Erica versicolor*) and geophytic (e.g. *Tritoniopsis burchellii*) elements. This community is classified as Fynbos and should be termed Swellendam Silcrete Fynbos (definition not yet published following the nomenclature used in the 'Vegetation map of South Africa, Lesotho and Swaziland' (Mucina & Rutherford 2004)), a Grassy Fynbos type as Tony Rebelo contends (pers. comm. Dr A.G. Rebelo 2003).

The other units found in this study lack proteoid elements. The lack of proteoid elements does not exclude vegetation from the Fynbos (Moll *et al.* 1984). The presence of *Erica cerinthoides*, *Erica peltata* and *Erica versicolor* accords with that observed by Muir (1929) in Renosterveld. The units are not excluded from the definition of Cape Transitional Small-leaved Shrublands (Cowling 1984, Moll *et al.* 1984) as, in general I consider them to be Renosterveld rather than Fynbos because the veld is a small-leaved shrubland (including Asteraceous and other species as well as ericoid species) to shrubby grassland, found on shale derived soils.

Due to the variable restioid cover, individual stands of the *Themeda triandra – Argyrolobium* sp. (G.R.Raitt 29) Community may be classified as Fynbos or Cape Transitional Small-leaved Shrublands (Renosterveld) according to (Moll *et al.* 1984). Again, here it is considered to be Renosterveld for the same reasons presented above.

The *Themeda triandra – Chrysanthemoides monilifera* Shrubland Subcommunity is transitional containing species belonging to both thicket and gallery forest and not Fynbos or Renosterveld.

4.3 Phytosociology

4.3.1 Have the communities from this study been described previously?

The communities from this study were compared with Renosterveld and Grassy Fynbos communities from Muir (1929), Jordaan (1964), Grobler & Marais (1967), Taylor (1972b), Cowling (1984), Boucher (1987), Cowling *et al.* (1988) and Rebelo *et al.* (1991). For Cowling *et al.* (1988) and Rebelo *et al.* (1991), Mesotrophic Asteraceous Fynbos has been included in the comparison because Rebelo *et al.* (1991) indicate that Moll *et al.* (1984) classified this unit as South Coast Renosterveld. For quantitative comparisons between this study and the aforementioned studies see Appendix 10.

None of the communities matched Muir's (1929) description of Renosterveld in the Riversdale Area (Appendix 10, Table 7.10.1a-f). The *Aloe* Scrub, described by Muir (1929) from west of Heidelberg, was not found in this study, however, some *Aloe* species were present in the Grootvadersbosch study area but did not occur in any relevés. During groundtruthing for the map, I observed that *Aloe* cf. *ferox* and *Rhus lucida*, form a scrub subcommunity within the *Themeda triandra – Argyrolobium* sp. Shrubland Community. *Grewia occidentalis* and *Gymnosporia buxifolia* (species characteristic of Muir's (1929) *Aloe* Scrub), occur as part of the *Themeda triandra – Chrysanthemoides monilifera* Shrubland Subcommunity of the *Themeda triandra – Argyrolobium* sp. (G.R.Raitt 29) Shrubland Community, were associated with drainage lines in this study but no *Aloe* species were found with them.

The number of species listed for the vegetation of the Bredasdorp and Caledon Districts as described by Jordaan (1964) was inadequate for comparison to the communities found in the present study (Appendix 10, Table 7.10.2a-c). The 'heiveld' and 'plampersveld', dominated by *Corymbium* spp. and *Bobartia* spp. (Jordaan 1964), are by description similar to the *Themeda triandra – Bobartia macrospatha* Community found in this study.

None of the communities in the present study match those found in the Bontebok National Park (Appendix 10, Table 7.10.3a-f). *Themeda triandra* was not confined to a single community in the Bontebok National Park (Grobler & Marais 1967, Taylor 1972b). Nine of the thirteen communities described by Grobler & Marais (1967) contain *Themeda triandra*. Taylor (1972b) adds two communities in the section of the Bontebok National Park added after 1967, to those found by Grobler & Marais (1967), but lists only one species name making comparison based on species composition impossible. Both the *Themeda triandra* dominated floodplain vegetation (Community 14 in Taylor (1972b)) and the marshy graminoid flats (Community 15 in Taylor (1972b)) are very unlikely to be any of the communities described in the present study which is located in drier terrain.

The communities of the present study did not match those of Cowling (1984) (neither the Grassy Fynbos nor the South Coast Renosterveld communities) for the Humansdorp Region (Appendix 10, Table 7.10.4a-f). Of the species present in Cowling (1984) and the Grootvadersbosch Conservancy, *Brachiaria serrata*, *Helichrysum nudifolium*, *Hermannia flammea*, cf. *Pentaschistis pallida* (was *Pentaschistis angustifolia* see Appendix 10) and *Trachypogon spicatus* are listed as diagnostic for both Grassy Fynbos and South Coast Renosterveld; *Gerbera piloselloides* is listed as diagnostic for Grassy Fynbos but is also present in South Coast Renosterveld; *Anthospermum aethiopicum*, *Helictotrichon hirtulum*, *Sporobolus africanus* and *Themeda triandra* are listed as diagnostic for South Coast Renosterveld but are present in Grassy Fynbos; *Ehrharta calycina*, *Heteropogon contortus* and *Rhus rosmarinifolia* are diagnostic for Grassy Fynbos and *Eragrostis capensis* is diagnostic for South Coast Renosterveld. *Rhus* species (including *Rhus lucida*) and *Olea europaea* form scattered patches in Coastal Renosterveld (Boucher and Moll 1981, Cowling 1984). Cowling (1984) indicates that the shallow-rooted thicket species, *Euclea crispa* is occasionally associated with Renosterveld and this was found in the present study.

None of the communities found in this study match those described by Boucher (1987) as Coastal Renosterveld on the western coastal foreland of the Western Cape, South Africa (Appendix 10, Table 7.10.5a-f).

The exclusion of species with less than ten per cent cover meant that only four species (of which only two species were found in this study) were recorded for the Renosterveld Shrubland and eight species for the Mesotrophic Asteraceous Fynbos, identified by Cowling *et al.* (1988) using Campbell's (1985) structural approach on the Agulhas Plain (Appendix 10, Table 7.10.6a-c). Floristic comparison to the communities found in the present study is therefore impossible but the studies are unlikely to match. In the present study, most of the species recorded had less than ten per cent cover. Cowling *et al.*'s (1988) communities may be related to those of the *Themeda triandra – Elytropappus rhinocerotis* Shrubland Community Group described in the present study.

The exclusion of species with less than ten per cent cover meant that few species (twelve) (of which only four species were noted in this study, two in the relevés and two during the mapping) were recorded for the Renosterveld Shrubland, seven species for the Grassy Fynbos and twenty-two species for the Mesotrophic Asteraceous Fynbos, identified by Rebelo *et al.* (1991) using Campbell's (1985) structural approach on the Riversdale Plain (Appendix 10, Table 7.10.7a-c). Floristic comparison to the communities found in the present study is therefore impossible but the studies are unlikely to match. The description of Renoster Shrubland given by Rebelo *et al.* (1991) indicated that grasses were not prominent which suggests that the vegetation does not match any of the communities found in this study. *Oedera genistifolia* (was *Relhania genistifolia*, a dominant in the Renosterveld Shrubland of Rebelo *et al.* (1991)) is rare in the area covered by this study although it is dominant in specific areas on the Stellenbosch University Farm, Brakkekuil near the Breede River estuary.

On the basis of the quantitative comparisons, I conclude that none of the communities identified in this study have been described previously.

4.3.2 Literature on Other Vegetation Types near Grootvadersbosch

McDonald (1995) worked in the Langeberg Mountains, which though adjacent to this study site, support Afromontane Forest and Sandstone Fynbos, not Renosterveld. The indigenous forest communities in the Grootvadersbosch Reserve have been described by Taylor (1955).

4.3.3 General Comments

One visit to a site does not result in a comprehensive list of species. Relevé 4 was visited twice and this has contributed to it having the longest list of species. Additional records from the other samples might have resulted in more species being listed in them as well because some species are seasonally visible. The phytosociological table is based on species that can be perennially identified (see Werger 1974 and Westfall *et al.* 1996). An association may have subassociations of different geophytes that will not be identified without a complete floristic list for each relevé.

The *Themeda triandra – Elytropappus rhinocerotis* Shrubland Community is the result of disturbance in the form of ploughing or putting in berms. This study was not directly concerned with restoration or the succession of old lands, so it is probable that other communities resulting from disturbance also exist in the area.

The *Themeda triandra – Elytropappus rhinocerotis* Shrubland Community was the only community in which *Elytropappus rhinocerotis* was dominant. This suggests that the existing disturbance regimes of fire and grazing do not favour *Elytropappus rhinocerotis* above either other shrubs or grasses but that soil disturbance does favour *Elytropappus rhinocerotis*. This agrees with Boucher's (1987) observations that erosion (soil disturbance), which causes in increased aridity, results in the dominance of pioneers such as *Elytropappus rhinocerotis*. Overgrazing and ploughing may result in erosion.

Conservation includes preserving vegetation as well as species diversity. The communities described in this study represent variations in the vegetation to be conserved. The value of these units for conservation in terms of irreplaceability is increased by their classification as Renosterveld, of which little is conserved.

4.4 Phytogeography

4.4.1 Alien species

Acacia mearnsii and *Pinus* sp. are most visible along the watercourses and drainage lines though not limited to such. Other woody aliens found included *Acacia longifolia*, *Eucalyptus* sp. and *Populus* sp.

Pennisetum clandestinum, used to 'stabilise' drainage lines and planted for pastures and lawns, has spread into the natural vegetation in places. *Anagallis arvensis*, common on rocky cultivated lands, has spread into the natural vegetation in places. Other herbaceous aliens found in the veld included *Briza* *maxima*, *Bromus* sp., *Echium* cf. *plantagineum*, *Hibiscus trionum*, *Medicago polymorpha* and *Oxalis corniculata*.

Goldblatt & Manning (2000) list *Eragrostis racemosa* (scattered throughout the natural vegetation of the study area) and *Rumex acetosella* (found in relevé 71 of the *Themeda triandra* - *Centella* cf. *eriantha* Grassland Subcommunity) as alien to the Cape Floristic Region.

4.4.2 Indigenous species

Muir's (1929) overall description of Renosterveld placed *Elytropappus rhinocerotis* far more prominently than the species was found to be in the present study area. Muir (1929) also explicitly describes the vegetation of the Riversdale Area as a shrubland with limited grass (either *Cynodon dactylon* or *Themeda triandra* (called "*Themeda Forskalii*"), while the study area is a mixture of *Themeda triandra* dominated grassland and shrubland. Muir (1929) suggests that the dominance of *Elytropappus rhinocerotis* in the Riversdale Area is the result of human disturbance. Thunberg noted, in 1772 coming from Swellendam direction, that the grass increased and the plains started to look like meadows at Buffeljagsrivier, about 10 km east of Swellendam (Skead 1980). In 1929, the people of the Klein Karoo still referred to the country south of the mountains as 'grasveld' (grassland) (Muir 1929). *Hyparrhenia hirta* migrated into the study area from further east according to Muir (1929). This latter less palatable species has become widespread in the study area. This study is adjacent to the Langeberg and the presence of *Erica peltata* matches Muir's (1929) observation of its distribution within Renosterveld.

Not everyone considers *Themeda triandra* to be a natural part of the vegetation of the Southern Cape, either classified as Fynbos or Renosterveld, which suggests that *Themeda triandra* is a recent invader. An alternative view is that *Themeda triandra* is a relic from before the Fynbos/Renosterveld vegetation developed in the region. Genetic studies could be used to test whether the presence of *Themeda triandra* is a recent phenomenon or not by testing the genetic variation within the populations. Little variation implies a recent invasion where high variation implies a longer presence in the area. *Themeda triandra* is polyploid (Spies & Gibbs Russell 1988) and therefore is probably very adaptable.

4.5 Cover Assessment

The subjective cover estimate of *Themeda triandra* using the Zürich-Montpellier technique was of a similar order to the cover of *Themeda triandra* recorded using descending point samples (Table 3.9).

Comparison of the point quadrat data between the sites showed no significant differences in the canopy or basal cover of *Themeda triandra* though the Vleitjiesrug site was burned in February 2000 (one year post-fire at the time of sampling) and the Dikkopskraal sites were last burned in 1996 (five years post-fire at the time of sampling).

Comparison of the point quadrat data between years for the Vleitjiesrug site showed no significant differences in the canopy or basal cover of *Themeda triandra*. This suggests that the fire in February 2000 did not harm the vegetation.

4.6 Management

4.6.1 Grazing

In this study, each farmer uses the natural pastures differently. Mr M. Prinsloo (Bergsig) puts the sheep on natural pasture to mate. Mr H.J. Wessels (Arkadia) uses both planted pastures and natural veld for pasturing sheep. He uses the veld condition as a guide to removing the sheep so that the animals do not lose condition. Mr J. Moodie (Honeywood) lets all the cattle range freely over his farm. Mr K. Moodie (Grootvadersbosch) uses the veld for dry and juvenile cows when the planted pastures are unavailable. Mr P.W. Groenewald (Glen Etive) does not use the natural veld for grazing.

The type of animal farmed affects the intensity of management required to maintain the veld (Owen-Smith 1999). Cattle damage the veld less than sheep do because sheep take the grass off closer to the ground than cattle do and may uproot tufts of grass (Owen-Smith 1999, pers. comm. Dr V. Ferreira 2005) leaving less leaf area for photosynthesis and thus increasing the recovery time needed by the plant. Different breeds of animal also impact the veld differently (Bonsma *et al.* 1952, Owen-Smith 1999). Of sheep breeds, Mutton Merino sheep are non-selective grazers (pers. comm. Dr V. Ferreira 2005) and will utilise more of the veld and therefore have less impact on the more palatable species than other sheep breeds within a given grazing period.

Sheep prefer shorter grass than cattle do (Owen-Smith 1999, pers. comm. Mr H.J. Wessels, Arkadia 2002—2003). This means that sheep farmers try to maintain short grass pastures either by burning or brush cutting. Fire and/or brush cutting are used to create open vegetation that the animals are able to utilize because sheep and cattle do not utilise dense vegetation (pers. comms. Mr K. Moodie, Grootvadersbosch 2001—2003, Mr M. Prinsloo, Bergsig 2002—2003 and Mr H.J. Wessels, Arkadia 2002—2003). Sheep do not move through dense vegetation to get to pasture (pers. comm. Mr M. Prinsloo, Bergsig 2002—2003). This implies that patches of grassy veld isolated by dense vegetation do not get grazed.

The reproductive structures of *Themeda triandra* are more fibrous than the non-reproductive portions and therefore reduce (but **not** eliminate) the preference for *Themeda triandra* shown by the cattle during late spring (November) and in summer (December to February) and autumn (March to May) where dry reproductive culms are present (Danckwerts *et al.* 1983). Allowing *Themeda triandra* to reproduce is necessary for the long term sustainability of the veld. Mr H.J. Wessels (Arkadia) burns his veld (in autumn) before use after a heavy *Themeda triandra* seed set (pers. comm. Mr H.J. Wessels 2002—2003). This removes the less nutritious old fruiting culms after seed dispersal has taken place.

Strategic resting in a rotational grazing system benefits the veld (Tainton & Danckwerts 1999). For resting to be effective, the veld should be rested during, the growing period (to allow the grass to replenish nutrient reserves), set seed and increase the dry matter on the veld (West 1952, Scott 1955, Tainton & Danckwerts 1999). Danckwerts & Stuart-Hill (1988) recommend resting veld after a drought to allow the plants to recover from the unfavourable conditions.

Insufficient information was assimilated over a sufficiently long time interval to draw statistically defensible conclusions concerning grazing. It seems probable that continuous heavy grazing will reduce palatable species and promote unpalatables species but further research is necessary to determine the effects of grazing on this particular vegetation.

4.6.2 Fire and Brush Cutting

Fire history has a cumulative effect so the effects of changes are not immediately visible. Fire management requires awareness of long term impacts and thus requires long term monitoring.

Fire has several desirable effects. Burning removes the fibrous portions of the plants that are unpalatable to animals (Edroma 1984). Burning encourages grass - *Themeda triandra* bases are fire resistant (Edroma 1984). Fire is used to control bush encroachment (West 1952, Downing *et al.* 1978).

Fire should be used with caution, as misuse is harmful. Fire should be used when the grass is dormant or near dormant (West 1952). Burning after the first good rain following the dry season is good for the grass but, in Bushveld, not for controlling bush encroachment (West 1952). The farmers in the study area burn after the first good rain in autumn and achieve a grassy sward so it seems that suppresion of the shrubs does not require as hot a fire as is needed to control bush encroachment in the Bushveld. Grass production is only increased by burning if there is adequate rainfall. If the rainfall is inadequate, burning is detrimental (Edroma 1984).

Fire as a means of alien clearance requires careful use. The areas cleared in this way on Honeywood show very poor recovery of natural vegetation. The soil was almost completely bare six months after the September fire (2001) though the natural veld that had been burnt in the same fire had recovered (pers. obs.). The alien trees supply a higher fuel load than the natural vegetation resulting in a hotter fire, which allows heat to penetrate deeper into the soil and alters the soil characteristics. The increased fire intensity reduces or even eradicates the soil seedbanks of both indigenous and exotic plant species (Cilliers 2002).

The farmers (and some of their predecessors) using fire in this study all favour a three to five year fire cycle (pers. comms. Mrs C. Kluyts 2004—2005, Mr J. Moodie 2002—2003, Mr A. Rademan 2004—2005 and Mr H.J. Wessels 2002—2003). The carrying capacity of the veld is severely reduced if it is not burnt (pers. comm. Mr A. Rademan 2004—2005). Burning is usually carried out in autumn after the first rains (pers. comms. Mrs C. Kluyts 2004—2005 and Mr H.J. Wessels 2002—2003). Burning has to be done after 2 pm to avoid changes in wind direction and thus control the spread of the fire (pers. comms. Mrs C. Kluyts 2004—2005 and Mr H.J. Wessels 2002—2003).

Thus an autumn fire at an interval of three to five years, under the existing grazing management, promotes *Themeda triandra* rich veld (by both influencing the plant community present (Fig. 4.1) and the structure of the plant community - by affecting both shrub size and the number of shrubs present (Fig. 4.2)) as is best for grazing purposes. This is within the three to ten year interval indicated for Coastal Renosterveld by many plant species and the life cycle of the Geometric Tortoise (Rebelo 1995).

Cowling *et al.* (1986) recommend a three year fire interval for clearing *Elytropappus rhinocerotis*, while Kruger & Bigalke (1984) recommend a fire interval of four years or less combined with resting the veld from grazing to clear *Elytropappus rhinocerotis* from degraded veld. The three to five year interval most used in the present study maintains grass dominance but there is not enough information to judge whether or not a five year interval would clear *Elytropappus rhinocerotis*.

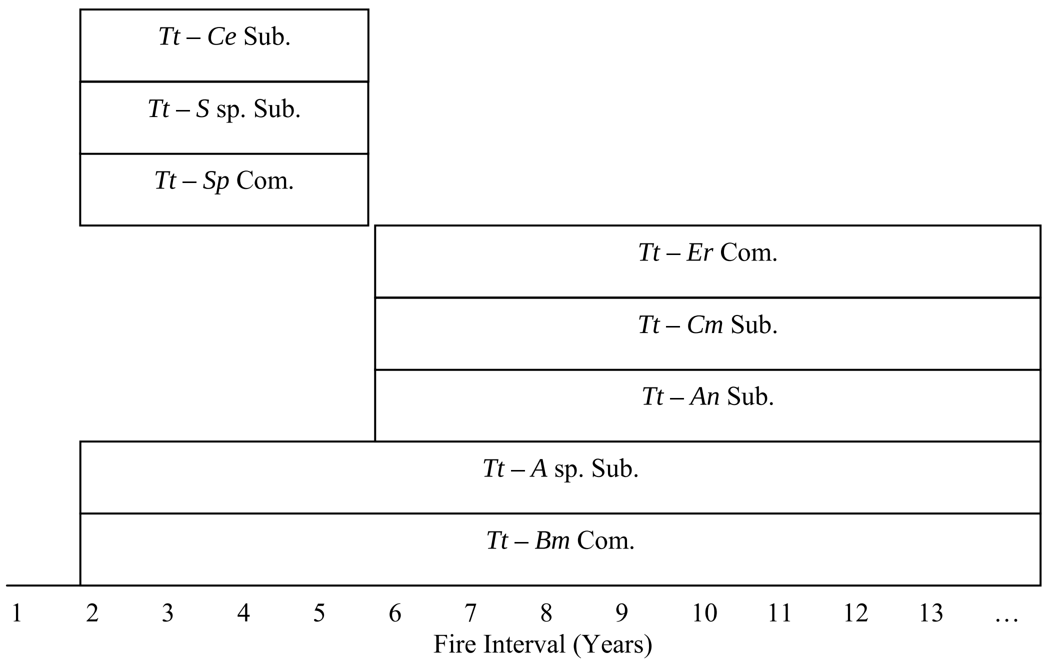

Figure 4.1: Possible relationships between the plant communities and fire interval
Tt – Ce Subcom. = *Themeda triandra – Centella eriantha* Grassland Subcommunity, *Tt – S* sp. Subcom. Typ. = *Themeda triandra – Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum, *Tt – Sp* Com. = *Themeda triandra – Stoebe phyllostachys* Grassland Community, *Tt – Er* Com. = *Themeda triandra – Elytropappus rhinocerotis* Shrubland Community, *Tt – An* Subcom. = *Themeda triandra – Aspalathus nigra* Shrubland Subcommunity, *Tt – Cm* Subcom. = *Themeda triandra – Chrysanthemoides monilifera* Shrubland Subcommunity, *Tt – A* sp. Subcom. Typ. = *Themeda triandra – Argyrolobium* sp. (G.R.Raitt 29) Shrubland Subcommunity Typicum, *Tt – Bm* Com. = *Themeda triandra – Bobartia macrospatha* Herbland Community

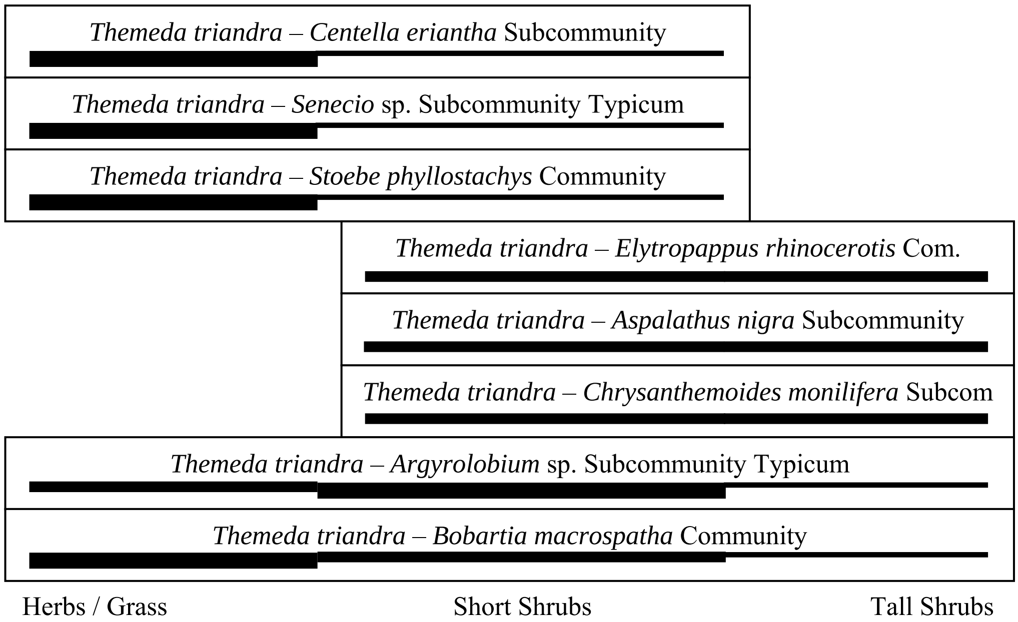

Figure 4.2: Structural variation of the plant communities found in this study
The lines in the blocks indicate proportionate occurrence of each structural variant Com. = Community, Subcom = Subcommunity

The model in which spring fires result in Renosterveld and autumn fires in Grassy 'Renosterveld' presented by Rebelo (1995 – Figure 3) is unlikely to be natural given that Rebelo (1995) indicates that natural fires occur in late summer or autumn – not spring. Spring fires are probably the result of human interference and may promote Renoster**bos** (*Elytropappus rhinocerotis*) but not Renoster**veld**.

Fire at an interval greater than ten years resulted in a loss of grassiness and species richness in the Grootvadersbosch area. Thus the existing fire and grazing regimes contribute to the retention of floristic diversity especially considering that the farms are patch burnt and that each fire will miss some patches of vegetation.

The three to five year fire interval with an autumn burn and grazing appear to benefit C_3 grasses (e.g. *Eragrostis capensis* and *Trachypogon spicatus*), C_4 grasses (*Themeda triandra*), forbs and geophytes more than an increased fire interval and decreased grazing would. Shrubs are favoured by a longer fire interval and decreased grazing.

By altering the structure of the vegetation (Fig. 4.2), fire alters the grazing value. The relative grazing value of the veld for the *Themeda triandra – Centella eriantha* Grassland Subcommunity, the *Themeda triandra – Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum and the *Themeda triandra – Stoebe phyllostachys* Grassland Community is high in the grassy state and moderate in the short shrub state (see Fig. 4.2). The *Themeda triandra – Argyrolobium* sp. (G.R.Raitt 29) Shrubland Subcommunity Typicum has a high grazing value in the grassy state, a variable grazing value in the short shrub state (depending on the shrub density) and limited or no grazing value in the tall shrub state. The *Themeda triandra – Aspalathus nigra* Shrubland Subcommunity provides moderate grazing in both shrub states depending on the shrub density. The *Themeda triandra – Chrysanthemoides monilifera* Shrubland Subcommunity, *Themeda triandra – Bobartia macrospatha* Herbland Community and *Themeda triandra – Elytropappus rhinocerotis* Shrubland Community have no or very limited grazing value.

Mr Mike Gregor, manager of Elandsberg Farm and Private Nature Reserve, Porterville Area of the Western Cape Lowlands, found that brush cutting increased the dominance of shrubs including *Elytropappus rhinocerotis* on the brush cut land although there are no data records of the brush cutting experiment on the farm (pers. comm. Mr M. Gregor 2003). Mr Prinsloo (Bergsig) had used brush cutting for two years at the time of sampling and no deductions could be made yet as to the effect on the vegetation.

In West Coast Strandveld, brush cutting benefited Restionaceae at Silverstroomstrand, while regular patch burning favoured 'broad-leaved sclerophyllous shrubs' (Boucher 1984, pers. comm. Dr C. Boucher 2005). Rotational patch burning increased the carrying capacity of West Coast Strandveld on Buffelsrivier Farm. The carrying capacity of West Coast Strandveld initially increased after brush cutting Buck Bay Farm but decreased over time such that annual brush cutting was necessary to stimulate the volume of young growth of edible Restionaceae (pers. comm. Dr C. Boucher 2005).

More relevés on Glen Etive and more relevés with vegetation that is only brush cut, e.g. Camp 18 of Bergsig, would provide a clearer picture of the effects of fire and brush cutting on the vegetation of the area. Camp 18 of Bergsig was not sampled because this study was conducted in a period of drought and the camp was heavily grazed so that the grass species were unidentifiable. Further research could determine the effects of different treatments on the plant communities.

4.6.3 Restoration

The observations in this section are not backed by data from this study but are discussed because my observations indicate that tilling destroys the natural vegetation and the limited area still covered by Renosterveld makes restoration an important means of increasing the area of Renosterveld. The anecdotal information may be used to form hypotheses concerning restoration that may be tested.

Mr K. Meyer inherited the farm 'Burchell', east of the study area between Uniondale and Knysna. The farm was then dominated by *Themeda triandra*. The *Themeda triandra* was lost due to subsequent management actions. Between 1955 and 1976 there were twelve camps in which the cattle were regularly shifted. In 1976, it was decided to restore the farm to a *Themeda triandra* dominated state. Mr K. Meyer has successfully restored his farm by applying block burns between 1976 and 1980 and then leaving the veld for two to three years before applying light grazing between 1980 and 1992. The veld has not been utilized since 1992 but has had two unexpected fires, the last of which came in 1997/1998. The fully restored, *Themeda triandra* dominated farm is presently used for walking and driving along the ten kilometre section of W.J. Burchell's original road that is on the farm. Mr K. Meyer has photographic slides of the successful restoration process but no documentation (pers. comm. Mr K. Meyer 2002).

I have observed that tilling removes *Themeda triandra* veld and simultaneously changes the soil nutrient status. On Arkadia, Mr H.J. Wessels has a piece of recently ploughed land on which *Themeda triandra* is coming back. He has burned this land but not grazed it (pers. comm. Mr H.J. Wessels 2002—2003). Mr J. Moodie (Honeywood) has a field on a hilltop last ploughed about 30 years ago on which *Themeda triandra* is not yet re-established. He has burned and grazed this land (pers. comm. Mr J. Moodie 2002—2003). This land has a ridge around the field as a result of ploughing, which may contribute to the poor reestablishment of *Themeda triandra* by hampering seed dispersal from the natural vegetation below this ridge (pers. obs.).

It appears that fire benefits the return of *Themeda triandra* to ploughed or degraded lands but not if these lands are grazed prior to the establishment of *Themeda triandra*.

4.7 Environmental and management determinants of community composition

While constrained ordination arranges relevés according to environmental variables, Whittaker (1973b) notes that one or more axes may represent time (either disturbance time or successional time).

Considering the interpretation of the statistical output of Canonical Correspondence Analysis (from CANOCO), Ter Braak & Šmilauer (1998) warn against assuming that the high values of species-environmental variance are significant.

Correlation is not a direct indication of how much of the variability of Y is associated with X. A correlation (r) of 0.5 ($r^2 = 0.25$) means that twenty-five % of the variability of Y is associated with X. Correlation does not indicate causality (Shavelson 1981, McCall 2001).

The Canonical Correspondence Analysis (CCA) showed that while the community groups are distinguishable, their environmental parameters overlap.

Both soil variables and management variables showed a tendency to split the community groups. It is possible that management causes the vegetation to change and this in turn affects the soil. Alternately, the management may affect the soil directly and the soil cause changes in the vegetation. A third possibility is that both soil and management variables act independently on the vegetation. Further research is required to determine the mechanism(s) controlling which community group is present.

Soil variables (both nutrients and texture) were shown to have an impact on which community group was present, but the causal relationship between the soil and the community is not clear.

The management ordination results show that the use of fire as a management tool directly affects which community group is present (Figs. 3.23 & 3.29). Fire also affects the physiognomy of the plant community present – the three to five year fire interval with an autumn burn favours the dominance of grass. This supports the prediction of Cowling *et al.* (1986) that a three year fire interval with an autumn fire favours grass (see above).

The management data do not cover a fire interval of less than two years so no conclusions can be made concerning very frequent fire. The existing data suggests that a fire interval of two to about six years is beneficial to *Themeda triandra* dominance. After longer than about six years the shrub component increases and the grass cover decreases.

The management ordination results reflect the value of the veld for the different types of farming. For the farmers concerned with meat and/or wool production, the veld is important grazing so they manage the veld for grazing by planned burning and/or brush cutting that results in grass dominated veld. The dairy farmers get a greater yield of milk from planted pastures and supplements than from the natural veld (pers. comm. Mr K. Moodie 2001—2003). The natural pasture is not as important to dairy farmers so burning and/or brush cutting are less important management practices to them than to those who produce meat and/or wool. The veld on the dairy farms was shrub dominated with grass dominated patches in places.

4.8 Comparison of the Flora of the Grootvadersbosch Conservancy with Brakkekuil Farm

Though the flora of Brakkekuil Farm differs from that of the Grootvadersbosch Conservancy, despite both areas supporting dense stands of *Themeda triandra*, it should be remembered that neither list was complete. The lack of similarity between the Grootvadersbosch Conservancy study site and Brakkekuil Farm highlights the local nature of the plant communities identified in this study.

The Grootvadersbosch Conservancy study site covers a larger area than Brakkekuil Farm. Limited funds restricted formal identification of specimens for especially the Brakkekuil list, which was not too serious for the vegetation analysis as this was not pursued on this property.

Brakkekuil Farm seems to have more succulent plants. The rainfall at Brakkekuil Farm is lower than that adjacent to the mountains (Grootvadersbosch).

Brakkekuil Farm has distinct heuweltjies (evenly distributed raised patches locally associated with termitaria) not found in the Grootvadersbosch Conservancy. At Brakkekuil Farm the heuweltjies are associated with scrub.

Chapter 5 Conclusions

5.1 Have the critical questions been answered and the objectives achieved?

Answering the first critical question, "What variations exist in *Themeda triandra* Renosterveld Grassland communities in the study area?" covers objectives (a) and (b) of the present study viz. (a) to determine the composition of some *Themeda triandra* Renosterveld in the Ruêns area of the southern Cape and (b) to map the plant communities identified in the study area.

The vegetation was classified floristically into five subcommunities, five communities and two community groups, which were mapped. Observations made during the process suggest that more extensive sampling may show more variations in the vegetation. The units identified have not been described in the literature and represent a considerable contribution to the vegetation knowledge available for this area.

Most sampling was done in autumn so the geophytic component of the communities in the Braun-Blanquet Table is not comprehensive. It is probable that the drought affected the flowering and therefore identification of geophytes negatively. The floristic list (Appendix 3) recorded is incomplete.

Answering the second critical question, "What measured environmental factors influence the occurrence of different communities within *Themeda triandra* Renosterveld?" covers objective (c) viz. to determine whether there is any correlation between selected environmental factors and the occurrence of the communities within *Themeda triandra* Renosterveld and identify the key environmental factors associated with the occurrence of communities.

The soil variables measured (both nutrients and texture) showed a definite impact on the vegetation (both structure and community present). Phosphorus and exchangeable calcium were the nutrients with the largest effect on which community was present and stoniness and the sand fractions were the textural features that had the strongest impact on which community was present. More research is needed to determine how the variables interact and by what mechanisms the soil variables impact on the vegetation.

Answering the final critical question, "What management factors influence the occurrence of different communities within *Themeda triandra* Renosterveld?" covers objective (d) viz. to determine if there is any correlation between management practices and variations in the composition of *Themeda triandra* Renosterveld and the presence of *Themeda triandra* and identify the key management factors associated with the variations in the occurrence of communities and the presence of *Themeda triandra*.

Fire frequency influenced the vegetation structure and the plant communities present. A higher fire frequency resulted in grass dominance. Long intervals (greater than ten years) without fire resulted in a reduction in species richness. A few shrub species became dominant and the grass cover decreased.

This suggests that the three to five year fire interval found to be the most frequently used in this study is compatible with the preservation of a grass dominated community that is floristically diverse. More research is required to determine the effects of burns at an interval of less than two years because the farmers imply that such high frequencies result in changes to the vegetation composition that are detrimental in terms of grazing. Further research is needed to determine the impacts of grazing regimes on the vegetation.

5.2 Impacts of This Study

This study cannot fully answer the question of how widely grassland was previously distributed since there is insufficient information on grazing and the impacts of natural herbivores. However, given that the Fynbos Biome has been subjected to some form of fire management for a minimum of 100 000 years B.P. (Deacon 1983b), the use and effects of fire can contribute to the explanation of grass distribution. The three to five year autumn burn fire regime observed in this study would result in grass dominance in a wider area than that of this study, though even without fire, Brakkekuil Farm has a field that is open shrubland with a thick understorey of *Themeda triandra* and other grasses (pers. obs.) suggesting that even without fire, certain areas would have been grass dominated. While information about the fire frequency used by the Khoi is not part of this thesis, it may be deduced that the frequency would have been such as to promote grass for grazing by their livestock or to concentrate game for hunting purposes, or fire would have been of limited use to them.

Information from this study has already been applied on a restoration project in the general area of the study, confirming the value of this study as a basis for such work.

This study indicates that fire on a three to five year autumn burn regime is beneficial to the veld and also provides increased *Themeda triandra* dominance suitable for pastures. While this is true, there is insufficient evidence available to cause all farmers to regard the natural veld as good pasture because the carrying capacity of natural veld is lower than that of planted pastures (pers. comm. Mr H.J. Wessels) and the veld is not nutritious enough to produce high milk yields (pers. comm. Mr K. Moodie). However, it may be used to sell the retention of some natural pasture in the grazing system as the health of stock is better on natural patures (pers. comm. Mr H.J. Wessels). The information in this thesis will aid those farmers who desire to manage the natural veld for sustainable use.

Themeda triandra is a fire climax grass. It is removed by tilling and is slow to return to a previously tilled field (pers. comm. Mr J. Moodie 2002—2003). If the natural vegetation is left for prolonged periods without fire and the shrubs become dense, the *Themeda triandra* declines in density and health in the natural veld (pers. obs.).

The study site is adjacent to, but outside of, the border of the area covered by (Von Hase *et al.* 2003). The floristic list and vegetation data provided by this study extend their database. The importance of fire as a determinant of floristic composition in the Overberg is also highlighted in this study.

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Appendices

Appendix 1: Rainfall data (mm) from the Grootvadersbosch homestead. Ave. = average

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1956													580.45
1957													624.03
1958													653.75
1959													851.85
1960	27.69	30.99	55.88	56.64	0.00	60.45	36.83	22.10	32.77	17.02	66.55	97.28	504.19
1961	77.22	32.77	13.97	37.85	73.91	35.56	23.37	146.56	55.12	37.34	44.45	12.70	590.80
1962	29.97	45.21	74.93	66.55	24.13	31.75	28.19	254.00	27.94	70.36	109.73	9.65	772.41
1963	60.96	8.89	150.88	58.93	96.27	29.46	45.72	32.51	2.54	77.47	38.10	35.05	636.78
1964	0.00	120.90	79.25	23.37	22.86	92.96	21.59	64.01	69.34	65.53	96.27	4.32	660.40
1965	44.20	49.78	30.23	50.55	25.65	95.76	40.64	43.94	8.89	138.18	103.63	40.13	671.58
1966	54.10	48.77	22.86	34.29	71.88	16.00	29.46	115.32	85.85	26.92	0.00	8.89	514.35
1967	10.16	28.70	54.36	263.65	87.38	75.95	37.08	62.99	73.41	45.47	87.63	18.03	844.80
1968	0.00	6.35	48.77	26.16	26.92	147.57	0.00	64.01	67.82	38.10	64.26	5.59	495.55
1969	21.34	42.67	42.16	24.13	21.59	82.30	44.96	51.82	34.54	44.96	11.43	0.00	421.89
1970	5.59	111.51	14.99	12.95	19.56	36.83	22.61	40.64	10.16	43.94	28.70	43.69	391.16
1971	41.15	91.44	50.80	117.09	84.84	36.07	121.92	88.14	34.54	22.86	113.28	53.34	855.47
1972	8.89	86.36	54.61	15.75	135.89	24.89	17.27	87.63	69.34	9.14	68.33	39.12	617.22
1973	32.51	16.00	3.81	62.74	53.85	24.38	53.34	63.50	51.31	45.47	40.64	55.88	503.43
1974	69.85	106.93	58.67	45.72	102.11	20.07	20.57	138.68	61.21	44.96	17.27	0.00	686.05
1975	36.58	38.61	0.00	17.27	56.39	48.77	78.23	48.26	97.79	13.72	74.68	46.48	556.77
1976	40.13	67.56	93.47	42.42	100.84	80.01	61.98	44.45	52.32	163.07	94.49	16.26	857.00
1977	8.13	137.16	64.01	45.72	133.35	58.93	32.00	48.77	67.31	56.39	72.39	79.50	803.66
1978	24.38	16.76	22.86	77.72	44.45	23.62	60.96	53.59	60.45	99.06	31.50	88.65	604.01
1979	36.83	19.05	87.12	21.34	92.71	44.20	110.49	54.86	116.59	45.72	31.50	41.91	702.31
1980	84.07	8.89	16.00	36.07	31.75	60.96	36.58	41.66	66.55	76.20	83.31	89.41	631.44
1981	200.66	87.38	125.22	136.14	83.31	56.39	55.88	143.76	56.90	37.59	20.32	63.50	1067.05
1982	42.93	42.42	109.73	200.91	11.68	41.15	83.06	21.59	158.50	20.07	45.47	25.65	803.15
1983	7.87	62.23	15.75	28.70	48.01	55.37	82.04	35.05	103.38	45.47	36.58	43.43	563.88
1984	28.70	59.44	103.89	44.45	33.53	15.75	69.60	37.59	18.80	101.85	36.58	54.36	604.52
1985	103.89	82.04	32.51	98.81	19.56	48.51	117.86	26.67	16.26	175.26	96.01	109.73	927.10
1986	49.53	63.25	54.36	33.53	9.91	34.54	36.58	262.38	41.40	114.81	64.26	31.50	796.04
1987	23.37	33.53	44.96	119.63	6.86	64.01	42.16	95.50	74.68	16.76	0.00	47.24	568.71
1988	25.65	38.61	67.31	139.45	39.62	57.40	48.51	51.56	61.21	44.45	14.73	57.40	645.92
1989	71.12	29.72	55.37	155.45	18.80	54.36	57.40	66.29	53.34	169.16	99.06	44.45	874.52
1990	17.00	80.00	42.00	155.00	53.00	72.00	9.00	53.00	54.00	83.00	22.00	67.00	707.00
1991	77.00	7.00	29.00	24.00	52.00	50.00	29.00	33.00	28.00	179.00	27.00	49.00	584.00
1992	70.00	49.00	56.00	28.00	50.00	109.00	70.00	24.00	55.00	180.00	40.00	14.00	745.00
1993	29.00	55.00	33.00	207.00	92.00	31.00	57.00	35.00	62.00	15.00	31.00	116.00	763.00
1994	35.00	72.00	88.00	76.00	35.00	46.00	74.00	119.00	52.00	74.00	19.00	169.00	859.00
1995	57.00	70.00	105.00	86.00	98.00	48.00	50.00	42.00	55.00	60.00	130.00	144.00	945.00
1996	39.00	30.00	96.00	21.00	16.00	20.00	76.00	15.00	88.00	163.00	217.00	35.00	816.00
1997	10.00	77.00	64.00	66.00	97.00	35.00	100.00	104.00	27.00	30.00	71.00	24.00	705.00
1998	42.00	54.00	67.00	96.00	41.00	36.00	40.00	31.00	24.00	19.00	116.00	106.00	672.00
1999	49.00	54.00	51.00	66.00	60.00	19.00	31.00	44.00	45.00	87.00	26.00	15.00	547.00
2000	109.00	28.00	165.00	34.00	49.00	16.00	30.00	47.00	39.00	51.00	53.00	62.00	683.00
2001	39.00	25.00	43.00	49.00	12.00	10.00	37.00	106.00	51.00	24.00	78.00	13.00	487.00
2002	76.00	36.00	8.00	49.00	65.00	53.00	55.00	55.00	73.00	8.00	40.00	47.00	565.00
Ave.	44.57	52.35	58.04	70.95	53.43	48.81	50.58	70.14	55.42	66.98	59.56	49.40	680.01

Appendix 2: Species-Area Curves from the Grootvadersbosch Farm

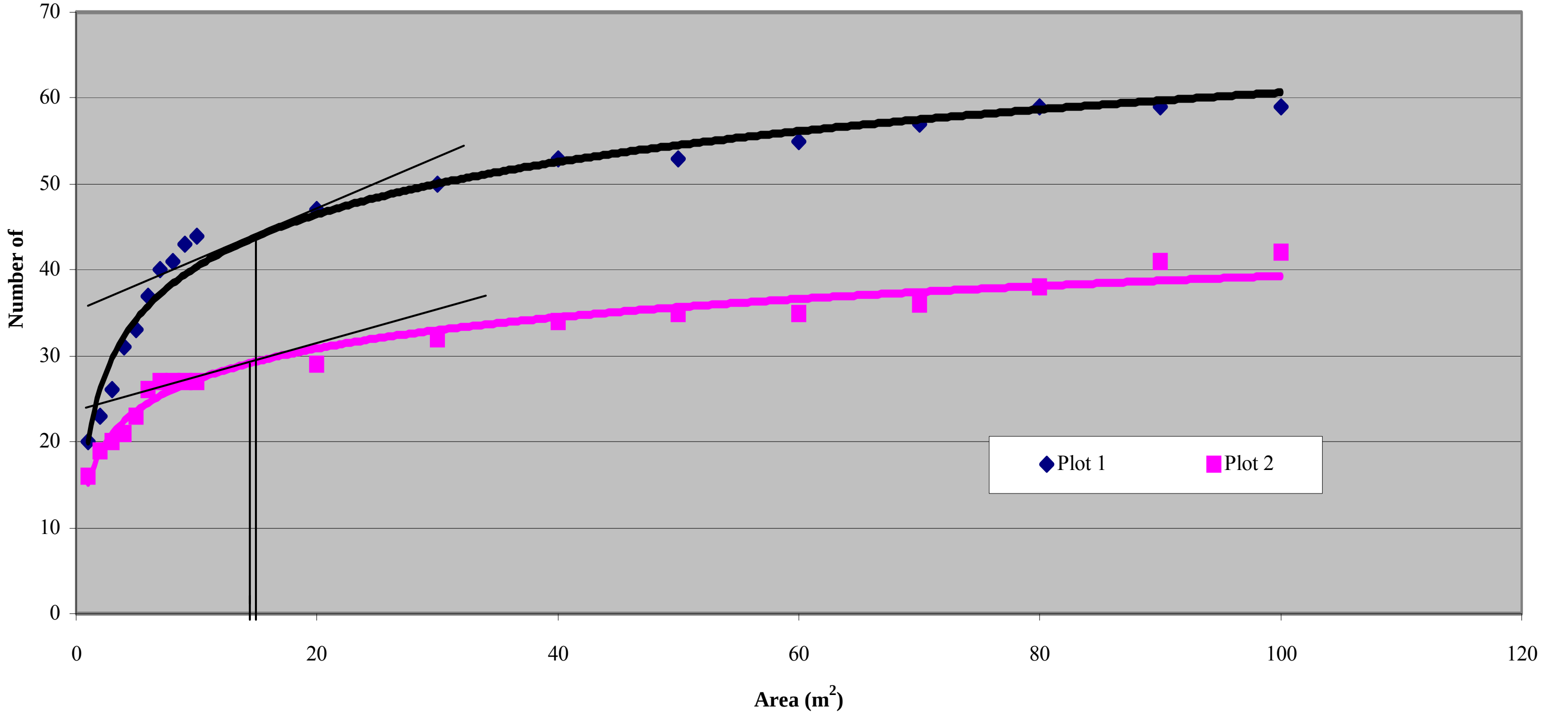

Figure 7.2.1: Species-area curves in grassy vegetation. The plots one and two for the Braun-Blanquet survey were done at the same sites

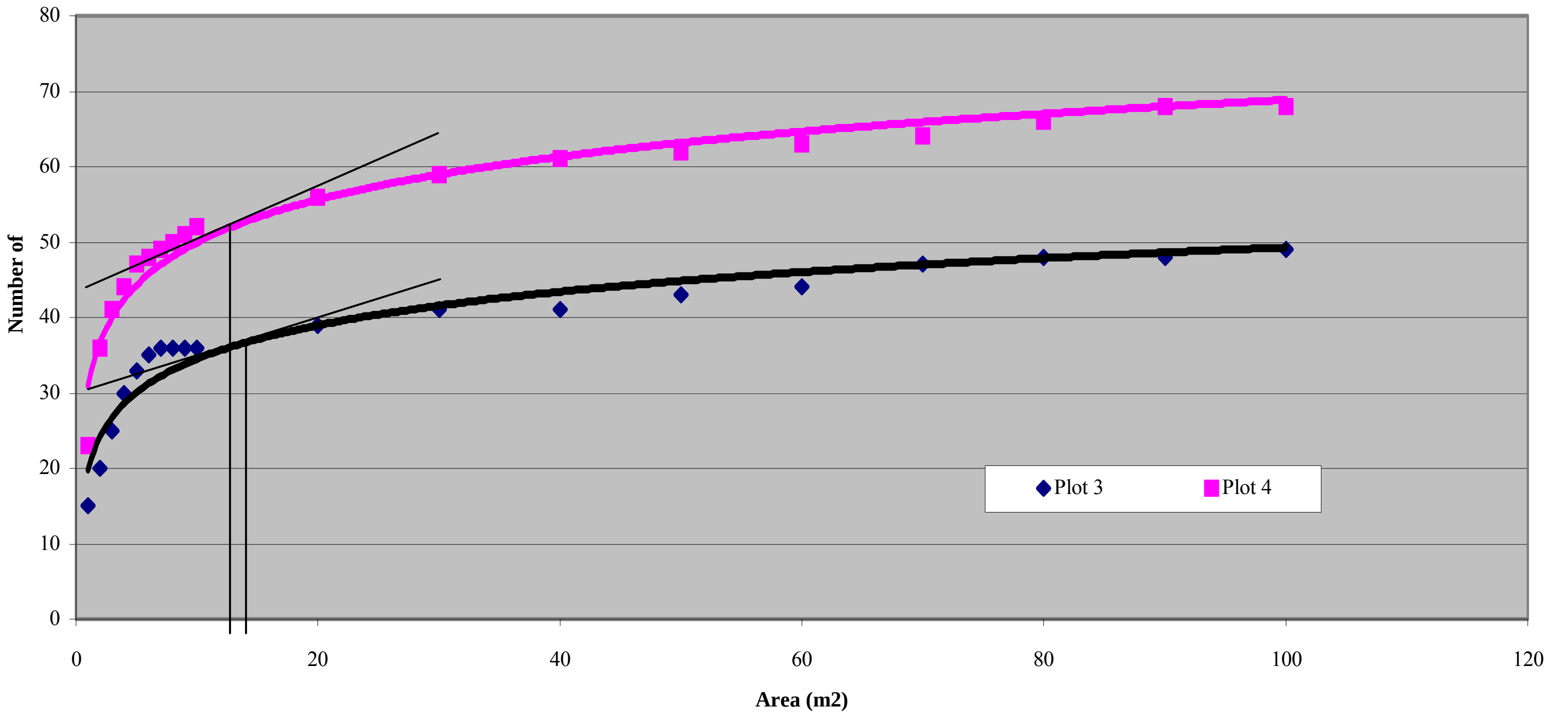

Figure 7.2.2: Species-area curves in short shrub vegetation. The plots three and four for the Braun-Blanquet survey were done at the same sites

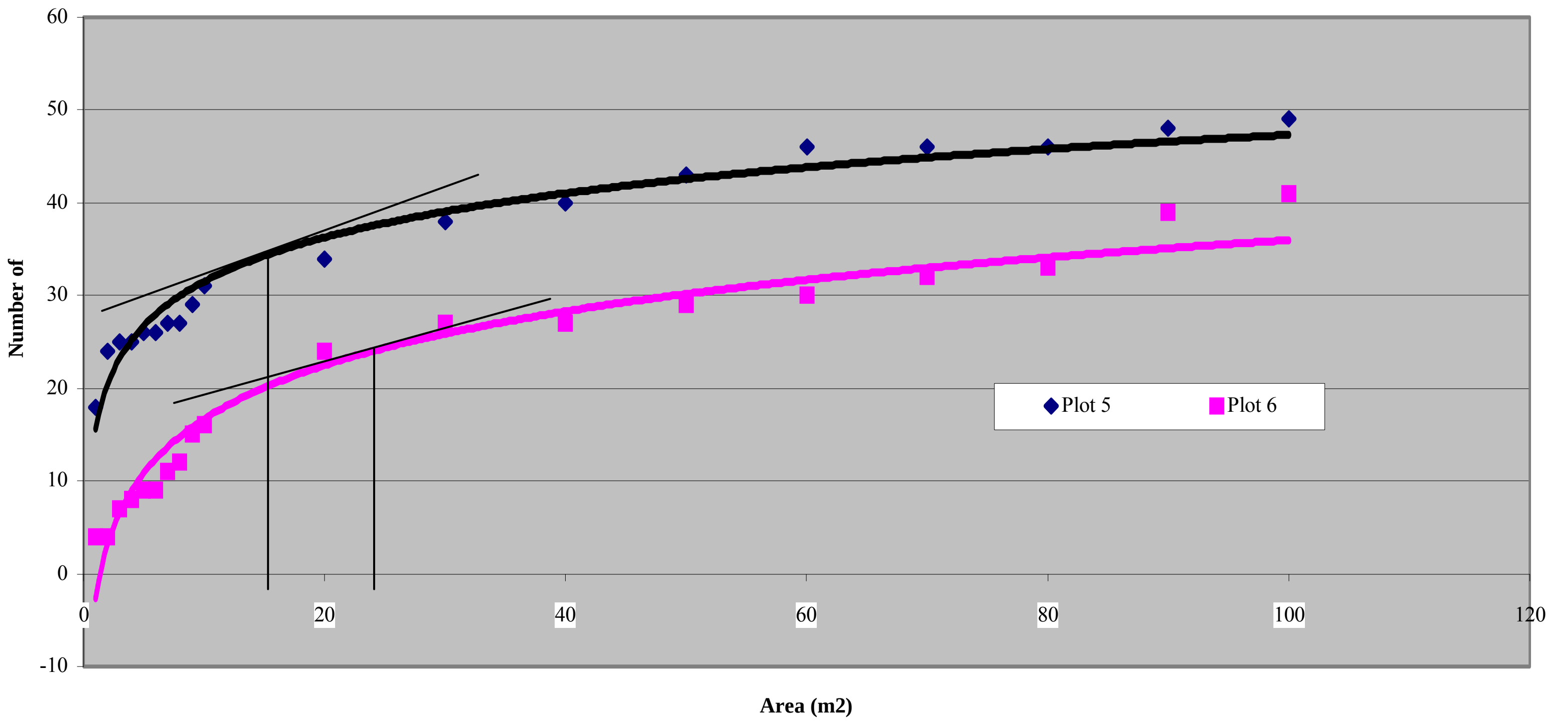

Figure 7.2.3: Species-area curves in tall shrub vegetation. The plots five and six for the Braun-Blanquet survey were done at the same sites

Appendix 3: Floristic lists for the Grootvadersbosch Conservancy and Brakkekuil Farm

Both lists include species that were observed but not collected and/or identified – possibly because the plants were not flowering. Some tentative identifications were made by the author of the non-flowering specimens by matching to herbarium specimens. The lists are partially augmented by other people's identifications or lists.

Partial floristic list for the Grootvadersbosch Conservancy arranged, where possible, according to Goldblatt & Manning (2000).

Name	Collection Number	Releve Found	Life Form
Pteridophytes			
Anemiaceae			
Mohria caffrorum (L.) Desv.	GRR 4/26		Hemicryptophyte
Monocotyledons			
Alliaceae			
Tulbaghia capensis L.	GRR 32		Cryptophyte
Amaryllidaceae			
Haemanthus cf. *coccineus* L.	-	14	Cryptophyte
Asparagaceae			
Asparagus ovatus Salter	GRR 6/0/1		Chamaephyte
Asparagus capensis L.	GRR 151t		Chamaephyte
Asparagus krebsianus (Kunth) Jessop	GRR 5/29		Chamaephyte
Asphodelaceae			
Bulbine foleyi E.Phillips	GRR 900t		Cryptophyte
Haworthia sp.	GRR 329t		Hemicryptophyte
Colchicaceae			
Neodregea glassii C.H. Wright	GRR 62t		Cryptophyte
Onixotis punctata (L.) Mabberley	GRR 128t		Cryptophyte
Convallariaceae			
Eriospermum sp. a	GRR 4/48		Cryptophyte
Eriospermum sp. b	GRR 26/29		Cryptophyte
Eriospermum proliferum Baker	GRR 15/24		Cryptophyte
Cyperaceae			
Ficinia nigrescens (Schrad.) J.Raynal	GRR 107t		Hemicryptophyte
Ficinia oligantha (Steud.) J.Raynal	GRR 17		Hemicryptophyte
Ficinia tenuifolia Kunth	GRR 847t		Hemicryptophyte
Ficinia trichodes (Schrad.) Benth. & Hook.f.	GRR 140t		Hemicryptophyte
Schoenoxiphium sparteum (Wahlenb.) C.B.Cl.	GRR 68t		Hemicryptophyte
Tetraria bromoides (Lam.) Pfeiffer	GRR 100t		Hemicryptophyte
Tetraria cuspidata C.B.Cl.	GRR 72t		Hemicryptophyte
Hyacinthaceae			
Albuca viscosa L.f.	GRR 461t		Cryptophyte
Drimia capensis (Burm.f.) Wijnands	GRR 696t		Cryptophyte
Lachenalia sp.	GRR 74/32		Cryptophyte
Lachenalia orchioides (L.) Aiton	GRR 154t		Cryptophyte
Ledebouria ovalifolia (Schrad.) Jessop	GRR 911t		Cryptophyte

* Alien Species
[+] Species not found during this study

Name	Collection Number	Releve Found	Life Form
Monocotyledons			
Hyacinthaceae			
Ornithogalum juncifolium Jacq.	GRR 4		Cryptophyte
Ornithogalum graminifolium Thunb.	GRR 726t		Cryptophyte
Ornithogalum dubium Houtt.	GRR 707t		Cryptophyte
Ornithogalum pilosum L.f. ssp. *pilosum*	GRR 719t		Cryptophyte
Ornithogalum cf. pilosum L.f.	GRR 10/26		Cryptophyte
Hypoxidaceae			
Hypoxis floccosa Baker	GRR 796t		Cryptophyte
Hypoxis setosa Baker	GRR 945t		Cryptophyte
Spiloxene flaccida (Nel) Garside	GRR 146t		Cryptophyte
Iridaceae			
Aristea sp.	GRR 120/41		Cryptophyte
Aristea pusilla (Thunb.) Ker-Gawl.	GRR 506t		Cryptophyte
Babiana patula N.E.Br.	GRR 155t		Cryptophyte
Bobartia macrospatha Baker	GRR 89t		Cryptophyte
Freesia sparmannii (Thunb.) N.E.Br.	GRR 519t		Cryptophyte
Geissorhiza ramosa Ker-Gawl. ex Klatt	GRR 317t		Cryptophyte
Geissorhiza foliosa Klatt	GRR 529t		Cryptophyte
Geissorhiza ovata (Burm.f.) Aschers. & Graebn.	GRR 313t		Cryptophyte
Gladiolus tristis L.	GRR 171t		Cryptophyte
Gladiolus bilineatus G.J.Lewis	GRR 972t		Cryptophyte
Gladiolus stellatus G.J.Lewis	GRR 459t		Cryptophyte
Ixia orientalis L.Bolus	GRR 320t		Cryptophyte
Moraea virgata Jacq.	GRR 684t		Cryptophyte
Moraea bulbillifera (Lewis) Goldblatt	GRR 319t		Cryptophyte
Moraea tripetala (L.f.) Ker-Gawl.	GRR 129t		Cryptophyte
Moraea unguiculata Ker-Gawl.	GRR 161t		Cryptophyte
Tritoniopsis burchellii (N.E.Br.) Goldblatt	GRR 895t		Cryptophyte
Watsonia laccata (Jacq.) Ker-Gawl.	GRR 284t		Cryptophyte
Lanariaceae			
Lanaria lanata (L.) T.Durand & Schinz	GRR 878t		Hemicryptophyte
Orchidaceae			
Holothrix mundii Sond.	GRR 39/24		Cryptophyte
Poaceae			
Aristida diffusa Trin.	GRR 101/32t		Hemicryptophyte
Aristida junciformis Trin. & Rupr.	GRR 12		Hemicryptophyte
Brachiaria serrata (Thunb.) Stapf.	GRR 781t		Hemicryptophyte
Cymbopogon pospischilii (K.Schum.) C.E. Hubb.	GRR 500t		Hemicryptophyte
Cynodon dactylon (L.) Pers	GRR 94t		Hemicryptophyte
Digitaria argyrograpta (Nees) Stapf	GRR 65t		Hemicryptophyte
Ehrharta delicatula (Nees) Stapf	GRR 542t		Hemicryptophyte
Ehrharta bulbosa J.E.Sm.	GRR 865t		Hemicryptophyte
Ehrharta capensis Thunb.	GRR 864t		Hemicryptophyte
Ehrharta calycina J.E.Sm.	GRR 152t		Hemicryptophyte
Eragrostis capensis (Thunb.) Trin.	GRR 16		Hemicryptophyte
Eragrostis curvula (Schrad.) Nees	GRR 71t		Hemicryptophyte

* Alien Species
+ Species not found during this study

Name	Collection Number	Releve Found	Life Form
Monocotyledons			
Poaceae			
Eragrostis racemosa (Thunb.) Steud.	GRR 816t		Hemicryptophyte
Festuca scabra Vahl	GRR 863t		Hemicryptophyte
Helictotrichon hirtulum (Steud.) Schweich	GRR 69t		Hemicryptophyte
Hyparrhenia hirta (L.) Stapf	GRR 74t		Hemicryptophyte
Karroochloa curva (Nees) Conert & Tuerpe	GRR 906t		Hemicryptophyte
Koeleria capensis (Steud.) Nees	GRR 70t		Hemicryptophyte
Melica racemosa Thunb.	GRR 905t		Hemicryptophyte
Melinis nerviglumis (Franch.) Zizka	GRR 85t		Hemicryptophyte
Merxmuellera sp.			Hemicryptophyte
Pennisetum clandestinum Chiov.*		71	Hemicryptophyte
Pentaschistis pallida (Thunb.) H.P.Linder	GRR 789t		Hemicryptophyte
Pentaschistis curvifolia (Schrad.) Stapf	GRR 483t		Hemicryptophyte
Setaria sphacelata (Schumach.) Moss	GRR 850t		Hemicryptophyte
Sporobolus africanus (Poir.) Robyns & Tournay	GRR 922t		Hemicryptophyte
Themeda triandra Forssk.	GRR 292t		Hemicryptophyte
Trachypogon spicatus (L.f.) Kuntze	GRR 139t		Hemicryptophyte
Tribolium uniolae (L.f.) Renvoize	GRR 782t		Hemicryptophyte
Restionaceae			
Restionaceae sp.	GRR 16/28		Hemicryptophyte
Calopsis adpressa Esterhuysen	GRR 84t		Hemicryptophyte
Restio multiflorus Spreng.	GRR 21		Hemicryptophyte
Tecophilaeaceae			
Cyanella lutea L.f.	GRR 493t		Cryptophyte
Eudicotyledons			
Acanthaceae			
Ruellia pilosa L.f.	GRR 25		Hemicryptophyte
Aizoaceae			
Ruschia tenella (Haw.) Schwantes	GRR 1/0/2		Phanerophyte
Anacardiaceae			
Rhus lucida L.	GRR 75t		Phanerophyte
Rhus rosmarinifolia Vahl	GRR 61t		Phanerophyte
Apiaceae			
Arctopus sp.	GRR 14/9		Cryptophyte
Lichtensteinia latifolia Eckl. & Zeyh.	GRR 105t		Hemicryptophyte
Apocynaceae			
Asclepias crispa P.J.Bergius	GRR 65/32		Chamaephyte
Microloma tenuifolium (L.) K.Schum.	GRR 82t		Liana
Pachycarpus dealbatus E.Mey.	GRR 917t		Chamaephyte
Schizoglossum aschersonianum Schltr.	GRR 178t		Chamaephyte
Araliaceae			
Centella cf. *eriantha* (A.Rich.) Drude	GRR 49/41		Hemicryptophyte
Centella cf. *affinis*	GRR 52t		Hemicryptophyte
Asteraceae			
Asteraceae sp. a	GRR 13/22		Hemicryptophyte
Asteraceae sp. b	GRR 37/36		Chamaephyte

* Alien Species
[+] Species not found during this study

Name	Collection Number	Releve Found	Life Form
Eudicotyledons			
Asteraceae			
Arctotheca prostrata (Salisb.) Britten	GRR 553t		Hemicryptophyte
Arctotis acaulis L.	GRR 327t		Hemicryptophyte
Athanasia juncea DC.	GRR 9		Phanerophyte
Athanasia trifurcata (L.) L.	GRR 22		Phanerophyte
Athrixia capensis Ker Gawl.	GRR 691t		Chamaephyte
Berkheya carduoides (Less.) Hutch.	GRR 944t		Phanerophyte
Berkheya herbacea (L.f.) Druce	GRR 79t		Chamaephyte
Berkheya rigida (Thunb.) Bolus & Wolley-Dod ex Adamson & T.M.Salter	GRR 481t		Phanerophyte
Chrysanthemoides monilifera (l.) T.Norl. ssp. *monilifera*	GRR 54t		Phanerophyte
Conyza scabrida DC.	GRR 690t		Phanerophyte
Conyza albida Spreng.	GRR 15		Chamaephyte
Corymbium africanum L.	GRR 16/31		Hemicryptophyte
Cymbopappus adenosolen (Harv.) B.Nord.	GRR 805t		Phanerophyte
Elytropappus rhinocerotis (L.f.) Less.	GRR 58t		Phanerophyte
Euryops abrotanifolius (L.) DC.	GRR 53t		Phanerophyte
Felicia aculeata Grau	GRR 60t		Chamaephyte
Felicia hyssopifolia (Berg) Nees ssp. *polyphylla* (Harv.) Grau	GRR 5		Phanerophyte
Gazania krebsiana Less. ssp. *krebsiana*	GRR 532t		Hemicryptophyte
Gerbera piloselloides (L.) Cass.	GRR 508t		Hemicryptophyte
Helichrysum nudifolium (L.) Less.	GRR 325t		Phanerophyte
Helichrysum nudifolium (L.) Less. var. *nudifolium*	GRR 709t		Chamaephyte
Helichrysum asperum (Thunb.) Hilliard & Burtt var. *albidum* (DC.) Hilliard	GRR 783t		Chamaephyte
Helichrysum cymosum (L.) D.Don ssp. *cymosum*	GRR 18		Phanerophyte
Helichrysum patulum (L.) D.Don	GRR 76t		Phanerophyte
Helichrysum teretifolium (L.) Less.	GRR 331t		Chamaephyte
Heterolepis peduncularis DC.	GRR 99t		Chamaephyte
Metalasia acuta Karis	GRR 14b		Phanerophyte
Metalasia densa (Lam.) Karis	GRR 14a		Phanerophyte
Oedera capensis (L.) Druce	GRR 513t		Chamaephyte
Oedera genistifolia (L.) Anderb. & Bremer	GRR 324t		Phanerophyte
Oedera squarrosa (L.) Anderb. & Bremer	GRR 322t		Phanerophyte
Osteospermum imbricatum L. ssp. *imbricatum*	GRR 514t		
Printzia polifolia (L.) Hutch.	GRR 86t		Phanerophyte
Pseudognaphalium undulatum (L.) Hilliard & B.L.Burtt	GRR 974t		Chamaephyte
Relhania pungens L'Herit. ssp. *pungens*	GRR 7		Chamaephyte
Senecio sp. a	GRR 710t		Phanerophyte
Senecio sp. b	GRR 51/22		Chamaephyte
Senecio deltoideus Less.	GRR 55t		Liana
Senecio rosmarinifolius L.f.	GRR 686t		Phanerophyte
Senecio crenatus Thunb.	GRR 714t		Phanerophyte
Senecio lineatus (L.f.) DC.	GRR 857t		Phanerophyte
Sonchus dregeanus DC.	GRR 505t		Hemicryptophyte
Stoebe phyllostachys (DC.) Sch.Bip.	GRR 885t		Chamaephyte

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Name	Collection Number	Releve Found	Life Form
Eudicotyledons			
Asteraceae			
Tripteris tomentosa (L.f.) Less.	GRR 458t		Chamaephyte
Ursinia discolor (Less.) N.E.Br.	GRR 874t		Chamaephyte
Boraginaceae			
Echium cf. *plantagineum* L.	-	84	Phanerophyte
Brassicaceae			
Heliophila subulata Burch. ex DC.	GRR 30		Chamaephyte
Lepidium cf. *desertorum* Eckl. & Zeyh.	GRR 968t		Chamaephyte
Bruniaceae			
Brunia sp.			Phanerophyte
Campanulaceae			
Cyphia sp.	GRR 123/5		Cryptophyte
Cyphia linarioides C.Presl	GRR 983t		Cryptophyte
Cyphia volubilis (Burm.f.) Willd.	GRR 126t		Cryptophyte
Lobelia coronopifolia L./*L. tomentosa* L.f.	GRR 66t		Chamaephyte
Lobelia cf. *erinus* L.	GRR 534t		Chamaephyte
Monopsis unidentata (Dryand.) E.Wimm.	GRR 856		Phanerophyte
Roella spicata L.f.	GRR 1		Chamaephyte
Wahlenbergia tenella (L.f.) Lammers	GRR 11		Chamaephyte
Caryophyllaceae			
Dianthus sp.	GRR 321t		Chamaephyte
Dianthus cf. *caespitosus* Thunb.	GRR 637t		Chamaephyte
Silene undulata Ait.	GRR 151t		Phanerophyte
Celastraceae			
Gymnosporia buxifolia (L.) Szyszyl.	GRR 543t		Phanerophyte
Convolvulaceae			
Convolvulus sp.	GRR 941t		Hemicryptophyte
Convolvulus capensis Burm.f.	GRR 509t		Hemicryptophyte
Falckia repens L.f.	GRR 167t		Hemicryptophyte
Crassulaceae			
Crassula capensis (L.) Baill.	GRR 16/20	16	Cryptophyte
Crassula saxifraga Harv.	GRR 23/27		Cryptophyte
Dipsacaceae			
Cephalaria humilis (Thunb.) Roem. & Schultes	GRR 943t		Phanerophyte
Scabiosa columbaria L.	GRR 713t		Chamaephyte
Droseraceae			
Drosera cistiflora L.	GRR 311t		Chamaephyte
Ebenaceae			
Diospyros glabra (L.) De Winter	GRR 37/26	37	Phanerophyte
Euclea crispa (Thunb.) Guerke var. *ovata* (Burch.) de Winter	GRR 915t		Phanerophyte
Ericaceae			
Erica cerinthoides L.	GRR 59t		Phanerophyte
Erica leucopelta Tausch	GRR 56t		Phanerophyte
Erica peltata Andr.	GRR 28		Phanerophyte
Erica pseudocalycina Compton	GRR 489t		Chamaephyte
Erica versicolor Andr.	GRR 84t		Phanerophyte

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Name	Collection Number	Releve Found	Life Form
Eudicotyledons			
Euphorbiaceae			
Clutia laxa Eckl. & Zeyh.	GRR 141t		Phanerophyte
Clutia pulchella L.	GRR 281t		Phanerophyte
Euphorbia tuberosa L.	GRR 64t		Cryptophyte
Euphorbia erythrina Link.	GRR 98t		Phanerophyte
Fabaceae			
Acacia mearnsii De Wild.*	-	51	Phanerophyte
Acacia longifolia (Andrews) Willd.*	-	51	Phanerophyte
Argyrolobium sp. a	GRR 29		Chamaephyte
Argyrolobium sp. b	GRR 102t		Chamaephyte
Aspalathus sp.	GRR 123/14		Phanerophyte
Aspalathus alpestris (Benth.) Dahlgren	GRR 20		Phanerophyte
Aspalathus angustifolia (Lam.) R.Dahlgren ssp *angustifolia*	GRR 511t		Chamaephyte
Aspalathus nigra L.	GRR 166t		Phanerophyte
Aspalathus cf. *ternata* (Thunb.) Druce	GRR 58/26		Phanerophyte
Aspalathus acuminata Lam. ssp. *acuminata*	GRR 10		Chamaephyte
Aspalathus opaca Eckl. & Zeyh. ssp. *pappeana* (Harv.) Dahlgren	GRR 135t		Phanerophyte
Aspalathus asparagoides L.f. ssp. *asparagoides*	GRR 103t		Phanerophyte
Aspalathus incompta Thunb.	GRR 565t		Phanerophyte
Aspalathus millefolia Dahlgren	GRR 132t		Phanerophyte
Aspalathus retroflexa L. ssp. *retroflexa*	GRR 898t		Phanerophyte
Aspalathus spinescens Thunb.+			Phanerophyte
Aspalathus steudeliana Brongn.	GRR 172t		Phanerophyte
Cyclopia cf. *sessiliflora* Eckl. & Zeyh.	GRR 127t		Phanerophyte
*Lessertia frutescens (*L.) Goldblatt & J.C.Manning	GRR 85/3		Phanerophyte
Indigofera porrecta Eckl. & Zeyh.	GRR 67t		Chamaephyte
Lotononis umbellata (L.) Benth.	GRR 175t		Chamaephyte
Medicago polymorpha L.*	GRR 504t		Hemicryptophyte
Medicago sp.*+			Hemicryptophyte
Otholobium cf. *spicatum* (L.) C.H.Stirt.	GRR 245t		Phanerophyte
Otholobium sp.	GRR 43/14		Chamaephyte
Podalyria cf. *myrtillifolia* Eckl. & Zeyh.	GRR 657t		Phanerophyte
Psoralea cf. *monophylla* (L.) C.H. Stirton (genus under revision)	GRR 926t		Chamaephyte
Rhynchosia capensis (Burm.f.) Schinz	GRR 73t		Cryptophyte
Tephrosia capensis (Jacq.) Pers.	GRR 34		Chamaephyte
Gentianaceae			
Sebaea aurea (L.f.) Roem. & Schult.	GRR 528t		Therophyte
Sebaea grisebachiana Schinz.	GRR 285t		Therophyte
Geraniaceae			
Monsonia emarginata (L.f.) L'Hér.	GRR 980t		Chamaephyte
Pelargonium sp.	GRR 13/38		Chamaephyte
Pelargonium pilosellifolium (Eckl. & Zeyh.) Steud.	GRR 923t		Cryptophyte
Pelargonium pinnatum (L.) L'Herit.	GRR 3		Cryptophyte
Pelargonium crispum (P.J.Bergius) L'Hér.	GRR 154t		Phanerophyte
Pelargonium candicans Spreng.	GRR 2		Chamaephyte
Pelargonium caucalidifolium Schltr.	GRR 491t		Chamaephyte

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Name	Collection Number	Releve Found	Life Form
Eudicotyledons			
Lamiaceae			
Leonotis ocymifolia (Burm.f.) Iwarsson var. *ocymifolia*	GRR 724t		Phanerophyte
Linaceae			
Linum africanum L.	GRR 901t		Chamaephyte
Linum heterostylum C.M.Rogers	GRR 886t		Chamaephyte
Linum thunbergii Eckl. & Zeyh.	GRR 666t		Chamaephyte
Malvaceae			
Grewia occidentalis L.	GRR 689t		Phanerophyte
Hermannia subgen. *Mahernia*	GRR 105t		Chamaephyte
Hermannia cf. *saccifera* (Turcz.) K.Schum.	GRR 102/7		Chamaephyte
Hermannia flammea Jacq.	GRR 8b		Chamaephyte
Hermannia flammula Harv.	GRR 8a		Chamaephyte
Hermannia holosericea Jacq.	GRR 87/16		Phanerophyte
Hermannia hyssopifolia L.	GRR 101t		Phanerophyte
Hermannia alnifolia L.	GRR 159t		Chamaephyte
Hibiscus aethiopicus L.	GRR 682t		Hemicryptophyte
Hibiscus pusillus Thunb.	GRR 133t		Hemicryptophyte
Hibiscus trionum L.*	GRR 882t		Hemicryptophyte
Oleaceae			
Olea europaea L. ssp. *africana* (Mill.) P.S.Green	GRR 6/12	6	Phanerophyte
Oxalidaceae			
Oxalis corniculata L.*	GRR 525t		Cryptophyte
Oxalis stellata Eckl. & Zeyh.	GRR 909t		Cryptophyte
Oxalis cf. *heterophylla* DC.	GRR 4/16		Cryptophyte
Oxalis cf. *lanata* L.f.	GRR 858t		Cryptophyte
Oxalis obtusa Jacq.	GRR 26		Cryptophyte
Oxalis pendulifolia Salter	GRR 33		Cryptophyte
Oxalis pardalis Sond.	GRR 63t		Cryptophyte
Oxalis polyphylla Jacq.	GRR 953t		Cryptophyte
Oxalis depressa Eckl. & Zeyh.	GRR 27		Cryptophyte
Oxalis ciliaris Jacq.	GRR 128t		Cryptophyte
Oxalis eckloniana C.Presl	GRR 981t		Cryptophyte
Oxalis purpurea L.	GRR 92t		Cryptophyte
Polygalaceae			
Muraltia ericifolia DC.	GRR 122/7		Phanerophyte
Muraltia heisteria (L.) DC.	GRR 77t		Phanerophyte
Muraltia satureioides DC.	GRR 808t		Phanerophyte
Muraltia collina Levyns	GRR 87t		Phanerophyte
Muraltia cf. *pillansii* Levyns	GRR 798t		Chamaephyte
Muraltia macroceras DC.	GRR 100t		Phanerophyte
Polygala hottentotta C.Presl	GRR 162t		Chamaephyte
Polygala meridionalis Levyns	GRR 31		Chamaephyte
Polygala pottebergensis Levyns	GRR 137t		Chamaephyte
Polygonaceae			
Rumex acetosella L. ssp. *angiocarpus* (Murb.) Murb.	GRR 924t		Chamaephyte

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Name	Collection Number	Releve Found	Life Form
Eudicotyledons			
Primulaceae			
Anagallis arvensis L.*	GRR 487t		Chamaephyte
Proteaceae			
Leucadendron sp.			Phanerophyte
Leucadendron salignum Berg.	GRR 123t		Phanerophyte
Ranunculaceae			
Knowltonia anemonoides H.Rasm. ssp. *tenuis* H.Rasm.	GRR 855t		Chamaephyte
Rhamnaceae			
Phylica mairei Pillans	GRR 960at		Chamaephyte
Phylica propinqua Sond.	GRR 6		Chamaephyte
Phylica rubra Willd. ex Roem. & Schult.	GRR 960bt		Phanerophyte
Rhamnus prinoides L'Herit	GRR 81t		Phanerophyte
Rosaceae			
Cliffortia filicaulis Schlechtd.	GRR 90t		Phanerophyte
Cliffortia juniperina L.f.	GRR 457t		Phanerophyte
Rubiaceae			
Anthospermum aethiopicum L.	GRR 283t		Phanerophyte
Anthospermum galioides Reichenb.f. ssp. *galioides*	GRR 306t		Chamaephyte
Rutaceae			
Agathosma virgata Bartl. & Wendl.	GRR 164t		Phanerophyte
Santalaceae			
Thesium strictum Berg.	GRR 139t		Vascular Semi-parasite
Thesium diversifolium Sond.	GRR 460t		Vascular Semi-parasite
Thesium junceum Bernh.	GRR 93t		Vascular Semi-parasite
Scrophulariaceae			
Dischisma sp.+			Chamaephyte
Freylinia undulata Benth.	GRR 173t		Phanerophyte
Jamesbrittenia aspalathoides (Benth.) Hilliard	GRR 88t		Chamaephyte
Nemesia affinis Benth.	GRR 91t		Therophyte
Pseudoselago outeniquensis Hilliard	GRR 889t		Therophyte
Selago scabrida Thunb.	GRR 137t		Chamaephyte
Selago seticaulis Hilliard	GRR 19b		Chamaephyte
Selago ciliata L.f	GRR 19a		Phanerophyte
Selago dolosa Hilliard	GRR 13		Phanerophyte
Sutera hispida (Thunb.) Druce	GRR 157t		Chamaephyte
Thymelaeaceae			
Thymelaeaceae sp.	GRR 116/10		Chamaephyte
Gnidia laxa (L.f.) Gilg	GRR 35		Phanerophyte
Gnidia sericea L.	GRR 57t		Phanerophyte
Gnidia squarrosa (L.) Druce	GRR 143t		Phanerophyte
Gnidia galpinii C.H.Wright	GRR 295t		Phanerophyte
Passerina vulgaris Thoday	GRR 91/10		Phanerophyte

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Partial floristic list for Brakkekuil Farm arranged, where possible, according to Goldblatt & Manning (2000).

Name	Collection Number	Main Life Form
Monocotyledons		
Amaryllidaceae		
Crossyne guttata (L.) D. & U. Mull.-Doblies	GRR 946t	Cryptophyte
Gethyllis afra L.	GRR 730t	Cryptophyte
Asparagaceae		
Asparagus capensis L. var. *capensis*	GRR 48	Chamaephyte
Asphodelaceae		
Bulbine frutescens (L.) Willd.	GRR 37	Hemicryptophyte
Bulbine lagopus (Thunb.) N.E.Br.	GRR 372t	Cryptophyte
Bulbine cf. *filifolia* Baker	GRR 570t	Hemicryptophyte
Haworthia marginata (Lam.) Stearn+		Hemicryptophyte
Trachyandra muricata (L.f.) Kunth	GRR 394t	Hemicryptophyte
Commelinaceae		
Commelina sp.	GRR 38	Chamaephyte
Commelina africana L. var. *africana*	GRR 604t	Chamaephyte
Hyacinthaceae		
Dipcadi brevifolium (Thunb.) Fourc.	GRR 629t	Cryptophyte
Drimia capensis (Burm.f.) Wijnands	GRR 839t	Cryptophyte
Drimia exuviata (Jacq.) Jessop	GRR 595t	Cryptophyte
Massonia echinata L.f.	GRR 123t	Cryptophyte
Ornithogalum suaveolens Jacq.	GRR 351t	Cryptophyte
Hypoxidaceae		
Hypoxis floccosa Baker	GRR 23	Cryptophyte
Iridaceae		
Gladiolus teretifolius Goldblatt & M.P.de Vos	GRR 361t	Cryptophyte
Ixia micrandra Baker	GRR 345t	Cryptophyte
Moraea collina Thunb.	GRR 590t	Cryptophyte
Moraea setifolia (L.f.) Druce	GRR 632t	Cryptophyte
Tritonia deusta (Aiton) Ker-Gawl.	GRR 568t	Cryptophyte
Watsonia aletroides (Burm.f.) Ker-Gawl.	GRR 567t	Cryptophyte
Orchidaceae		
Holothrix mundii Sond.	GRR 450t	Cryptophyte
Poaceae		
Chloris gayana Kunth*	GRR 36	Hemicryptophyte
Cynodon dactylon (L.) Pers	GRR 612	Hemicryptophyte
Digitaria eriantha Steud.	GRR 116t	Hemicryptophyte
Ehrharta capensis Thunb.	GRR 594t	Hemicryptophyte
Karoochloa purpurea (L.f.) Conert & Tuerpe	GRR 340t	Hemicryptophyte
Koeleria capensis (Steud.) Nees	GRR 109t	Hemicryptophyte
Themeda triandra Forssk.	GRR 401t	Hemicryptophyte
Tribolium echinatum (Thunb.) Renvoize	GRR 429t	Hemicryptophyte
Restionaceae		
Ischyrolepis capensis (L.) H.P.Linder	GRR 121t	Hemicryptophyte
Tecophilaeaceae		
Cyanella lutea L.f.	GRR 362t	Cryptophyte

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Eudicotyledons		
Acanthaceae		
Blepharis integrifolia (L.f.) E.Mey. ex Schinz	GRR 346t	Chamaephyte
Aizoaceae		
Antimima sp.	GRR 356t	Chamaephyte
Cephalophyllum subulatoides (Haw.) N.E.Br.	GRR 403t	Chamaephyte
Drosanthemum praecultum (N.E.Br.) Schwantes	GRR 597t	Chamaephyte
Galenia africana L.	GRR 778t	Phanerophyte
Lampranthus rustii (A.Berger) N.E.Br.	GRR 334t	Chamaephyte
Lampranthus ernestii (L.Bolus) L.Bolus	GRR 587t	Chamaephyte
Pharnaceum dichotomum L.f.	GRR 430t	Chamaephyte
Ruschia tenella (Haw.) Schwantes	GRR 39	Phanerophyte
Trichodiadema sp.	GRR 436	Chamaephyte
Trichodiadema cf. *calvatum* L.Bolus	GRR 50	Chamaephyte
Anacardiaceae		
Rhus angustifolia L.	GRR 700t	Phanerophyte
Rhus lucida L.	GRR 118t	Phanerophyte
Apocynaceae		
Carissa bispinosa (L.) Desf. ex Brenan	GRR 113	Phanerophyte
Microloma sagittatum (L.) R.Br.	GRR 49	Liana
Asteraceae		
Chrysanthemoides monilifera (l.) T.Norl.	GRR 381t	Phanerophyte
Chrysocoma ciliata L.	GRR 404at	Phanerophyte
Elytropappus rhinocerotis (L.f.) Less.	GRR 110t	Phanerophyte
Eriocephalus africanus L.	GRR 338t	Phanerophyte
Gorteria personata L. ssp. *gracilis* Roessler	GRR 392t	Chamaephyte
Helichrysum imbricatum (L.) Less.	GRR 598t	Chamaephyte
Oedera genistifolia (L.) Anderb. & Bremer	GRR 336t	Phanerophyte
Oligocarpus calendulaceus (L.f.) Less.	GRR 390t	Chamaephyte
Pentzia incana (Thunb.) Kuntze	GRR 404bt	Phanerophyte
Pteronia incana (Burm.) DC.	GRR 386t	Phanerophyte
Rhynchopsidium sessiliflorum (L.f.) DC.	GRR 360t	Chamaephyte
Senecio burchellii DC.	GRR 391t	Chamaephyte
Senecio pinifolius (L.) Lam.	GRR 40	Chamaephyte
Ursinia nana DC. ssp. *nana*	GRR 447t	Chamaephyte
Boraginaceae		
Lobostemon echioides Lehm.	GRR 42	Phanerophyte
Brassicaceae		
Heliophila cf. *meyeri* Sonder var. *minor* Marais	GRR 431t	Chamaephyte
Caryophyllaceae		
Petrorhagia prolifera (L.) Ball & Heywood*	GRR 613t	Chamaephyte
Convolvulaceae		
Falckia repens L.f.	GRR 347t	Hemicryptophyte
Crassulaceae		
Cotyledon orbiculata L. var. *spuria* (L.) Toelken	GRR 762t	Phanerophyte
Crassula capensis (L.) Baill. var. albertiniae (Schönl.) Toelken	GRR 44	Cryptophyte
Crassula saxifraga Harv.	GRR 984t	Cryptophyte

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Name	Collection Number	Main Life Form
Eudicotyledons		
Crassulaceae		
Crassula nudicaulis L. var. *nudicaulis*	GRR 601t	Chamaephyte
Crassula pubescens Thunb. ssp. *pubescens*	GRR 411t	Chamaephyte
Crassula ciliata L.	GRR 734t	Chamaephyte
Crassula acutifolia Lam.	GRR 832t	Chamaephyte
Cucurbitaceae		
Kedrostis nana (Lam.) Cogn. var. *zeyheri* A.Meeuse	GRR 43	Liana
Euphorbiaceae		
Euphorbia tuberosa L.	GRR 124t	Cryptophyte
Euphorbia arceuthobioides Boiss.	GRR 358t	Chamaephyte
Euphorbia clandestina Jacq.	GRR 837t	Phanerophyte
Euphorbia cf. *juglans* Compton	GRR 357t	Chamaephyte
Fabaceae		
Aspalathus nigra L.	GRR 395t	Phanerophyte
Aspalathus acuminata Lam.	GRR 771t	Chamaephyte
Aspalathus campestris R.Dahlgren	GRR 822t	Chamaephyte
Aspalathus spinosa L. ssp. *spinosa*	GRR 838t	Chamaephyte
Crotalaria excisa (Thunb.) Baker f.	GRR 405t	Chamaephyte
Indigofera porrecta Eckl. & Zeyh.	GRR 369t	Chamaephyte
Geraniaceae		
Pelargonium sp. Undescribed	GRR 756t	Cryptophyte
Pelargonium triste (L.) L'Hér.	GRR 379t	Cryptophyte
Pelargonium proliferum (Burm.f.) Steud.	GRR 819t	Cryptophyte
Pelargonium peltatum (L.) L'Hér.	GRR 115t	Phanerophyte
Pelargonium cf. *abrotanifolium* (L.f.) Jacq.	GRR 24	Chamaephyte
Pelargonium abrotanifolium (L.f.) Jacq.	GRR 51	Chamaephyte
Pelargonium caucalidifolium Schltr.	GRR 419t	Chamaephyte
Malvaceae		
Hermannia cf. *saccifera* (Turcz.) K.Schum.	GRR 349t	Chamaephyte
Hermannia cf. *pinnata L.*	GRR 410t	Chamaephyte
Hermannia diversistipula C.Presl ex Harv. var. *graciliflora* I.Verdoorn	GRR 393t	Phanerophyte
Hermannia cuneifolia Jacq. var. *cuneifolia*	GRR 335t	Phanerophyte
Hibiscus pusillus Thunb.	GRR 46	Hemicryptophyte
Oxalidaceae		
Oxalis obtusa Jacq.	GRR 413t	Cryptophyte
Oxalis ciliaris Jacq.	GRR 120t	Cryptophyte
Polygalaceae		
Nylandtia spinosa (L.) Dumort.	GRR 47	Chamaephyte
Primulaceae		
Anagallis arvensis L.*	GRR 389t	Chamaephyte
Santalaceae		
Thesium nigromontanum Sond.	GRR 451t	Vascular Semi-parasite
Scrophulariaceae		
Diascia grantiana MS	GRR 343t	Therophyte
Freylinia undulata Benth.	GRR 359t	Phanerophyte
Hebenstretia sp.	GRR 416t	Chamaephyte

* Alien Species

[+] Species not found during this study

Name	Collection Number	Main Life Form
Eudicotyledons		
Scrophulariaceae		
Hemimeris racemosa (Houtt.) Merrill was *H. montana* L.f.	GRR 427t	Therophyte
Jamesbrittenia aspalathoides (Benth.) Hilliard	GRR 45	Chamaephyte
Lyperia violacea (Jaroscz) Benth.	GRR 428t	Chamaephyte
Selago aspera Choisy	GRR 575t	Chamaephyte
Selago ramosissima Rolfe	GRR 385t	Chamaephyte
Selago dolosa Hilliard	GRR 41	Phanerophyte
Sutera hispida (Thunb.) Druce	GRR 339t	Chamaephyte
Zaluzianskya sp.	-	Therophyte
Thymelaeaceae		
Gnidia ericoides C.H.Wright	GRR 402t	Chamaephyte

* Alien Species
\+ Species not found during this study

Appendix 4: Full Braun-Blanquet Table for Grootvadersbosch Conservancy

Table 7.4a: Entire non-floristic releve data set

Releve #	49	51	52	53	54	55	56	58	60	65	69	70	71	72	73	74	77	78	79	81	82	91
Farm Name	Honeywood	Reserve	Reserve	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood	D'Ou Gnu	D'Ou Gnu	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood
Date	23.01.2002	23.01.2002/4.02.2002	4.02.2002	5.02.2002	5.02.2002	5.02.2002	5.02.2002	6.02.2002	7.02.2002	8.02.2002	11.02.2002	11.02.2002	11.02.2002	12.02.2002	12.02.2002	12.02.2002	13.02.2002	13.02.2002	13.02.2002	13.02.2002	18.03.2002	20.03.2002
Latitude South (decimal degrees)	34.00287	34.00126	34.00120	34.00104	34.00172	34.00116	34.00192	34.00470	34.00406	34.00303	34.00785	34.00805	34.00098	34.00143	34.00238	34.00243	33.99454	33.99442	33.99397	33.99322	33.99279	34.00809
Longitude East (decimal degrees)	20.82347	20.82289	20.82260	20.82117	20.82083	20.82088	20.82111	20.82726	20.82635	20.82192	20.82635	20.82655	20.81785	20.81810	20.81842	20.81789	20.80362	20.80340	20.80473	20.80312	20.80338	20.81850
Soil Sample Number	49	51	52	53	54	55	56	58	60	65	69	70	71	72	73	74	77	78	79	81	82	91
% Cover Litter*	7	2	10	12	15	5	3.5	3.5	3.5	1	1.5	1	1	1.5	3	2	< 0.5	3	0.5	< 0.5	0.5	1
% Cover Vegetation*	89.0	74.0	89.0	90.0	82.0	81.0	79.0	87.0	86.0	84.0	89.0	83.0	93.0	87.0	84.0	85.0	100.0	99.5	99.5	99.0	97.0	88.0
% Cover Soil	15.5	30	13	15	20	19	24	15	15	17.5	13	18	9	14	17	17.5	0	0.5	1	1.5	5	13
% Cover Gravel - Rock*	< 0.5	< 0.5	< 0.5	0	0	0	0	<0.05	<0.05	< 0.5	0	<0.01	0	0	< 0.5	0	0	0	0	0	0	< 1
Number of species*	43	43	38	42	48	50	44	34	30	33	38	33	37	36	41	36	30	31	32	27	32	24
Post-fire Vegetation Age (yrs)*	1	1	1	1	1	1	1	1	1	1	0.5	0.5	1	1	1	1	4	4	4	4	4	4
Number of fires from 1990 on*	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Releve #	59	61	62	63	64	66	67	68	75	76	89	99	107	110	119	121	126	127	128	129	133
Farm Name	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood	Arkadia	Arkadia	Arkadia	Arkadia	Arkadia	Arkadia	Arkadia	Reserve	Reserve
Date	6.02.2002	7.02.2002	7.02.2002	7.02.2002	7.02.2002	8.02.2002	8.02.2002	8.02.2002	12.02.2002	12.02.2002	20.03.2002	2.04.2002	4.04.2002	5.04.2002	10.04.2002	10.04.2002	11.04.2002	11.04.2002	11.04.2002	14.05.2002	16.05.2002
Latitude South (decimal degrees)	34.00389	34.00336	34.00357	34.00448	34.00455	34.00282	34.00287	34.00261	34.00112	34.00171	34.00657	34.00426	34.04149	34.03992	34.02870	34.03278	34.03848	34.03974	34.03981	34.00007	34.00005
Longitude East (decimal degrees)	20.82645	20.82519	20.82503	20.82619	20.82641	20.82207	20.82231	20.82272	20.81639	20.81677	20.81918	20.81590	20.79969	20.80236	20.82133	20.82359	20.80084	20.80100	20.80068	20.82000	20.81981
Soil Sample Number	59	61	62	63	64	66	67	68	75	76	89	99	107	110	119	121	126	127	128	129	133
% Cover Litter*	4	6	1.5	4	3.5	2	1	1.5	1.5	3	1	1	6	10	9	4	9	6	7	< 0.5	1
% Cover Vegetation*	85.0	81.0	81.0	77.0	79.0	78.0	71.0	74.0	78.0	89.0	80.0	80.0	83.0	82.0	78.0	73.0	78.0	77.0	77.0	82.0	82.0
% Cover Soil	16	20	20	23	21.5	23	29	27	23	13	20	21	19	21	23	27	23	24	24	19	20
% Cover Gravel - Rock*	< 0.5	<0.05	0	< 0.5	< 0.5	<0.01	4	4.5	< 0.5	0	< 1	< 0.5	< 0.5	< 0.5	1.5	2	< 1	1	< 1	6	6
Number of species*	30	39	49	39	30	27	31	39	46	40	36	37	28	26	38	29	30	27	33	30	32
Post-fire Vegetation Age (yrs)*	1	1	1	1	1	1	1	1	1	1	0.5	0.5	2	2	1	1	2	2	2	1	1
Number of fires from 1990 on*	2	2	2	2	2	2	2	2	2	2	2	2	3	3	2	2	1	1	1	2	2

Releve #	50	57	80	90	95	96	100	103	104	105	106	109	120	123	124
Farm Name	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood	Honeywood	Arkadia	Arkadia	Arkadia	Arkadia	Arkadia	Arkadia	Arkadia	Arkadia
Date	23.01.2002	6.02.2002	13.02.2002	20.03.2002	21.03.2002	21.03.2002	2.04.2002	3.04.2002	3.04.2002	4.04.2002	4.04.2002/15.09.2003	4.04.2002	10.04.2002	10.04.2002	10.04.2002
Latitude South (decimal degrees)	34.00252	34.00457	33.99368	34.00669	34.00501	34.00471	34.00459	34.03834	34.03879	34.04072	34.04045	34.04016	34.02871	34.03233	34.03171
Longitude East (decimal degrees)	20.82327	20.82759	20.80429	20.81932	20.81313	20.81330	20.81592	20.79400	20.79436	20.79948	20.79970	20.80259	20.82157	20.81970	20.81918
Soil Sample Number	50	57	80	90	95	96	100	103	104	105	106	109	120	123	124
% Cover Litter*	4	4.5	0	2	< 0.5	< 0.5	< 0.5	15	11	1.5	3	7	6	8	5
% Cover Vegetation*	91.0	89.0	97.0	76.0	87.0	80.0	79.0	80.0	78.0	78.0	77.0	95.0	75.0	80.0	76.0
% Cover Soil	10	13	5	24	14	21	22	22	24	24	25	9	25	21	25
% Cover Gravel - Rock*	< 0.01	0	1	< 0.5	< 0.5	< 1	< 0.5	< 1	< 0.5	2	< 1	0	2	< 1	< 1
Number of species*	35	27	32	40	25	24	27	26	32	28	30	19	37	32	39
Post-fire Vegetation Age (yrs)*	1	1	4	0.5	0.5	0.5	0.5	2	2	2	2	2	1	1	1
Number of fires from 1990 on*	2	2	2	2	2	2	2	1	1	1	1	3	2	2	2

Table 7.4b: Complete floristic data set

Unit	1.1.1																						1.1.2																					1.2														
Releve #	49	51	52	53	54	55	56	58	60	65	69	70	71	72	73	74	77	78	79	81	82	91	59	61	62	63	64	66	67	68	75	76	89	99	107	110	119	121	126	127	128	129	133	50	57	80	90	95	96	100	103	104	105	106	109	120	123	124
Species Block A: *Themeda triandra* - *Centella eriantha* Grassland Subcommunity																																																										
Centella cf. *eriantha*	o	+	.	+	+	+	.	o	+	1	.	.	m	o	1	+	5	a	1	m	m	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berkheya carduoides	.	.	.	.	.	.	+	.	.	.	1	+	.	.	.	.	.	+	.	o	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio crenatus	.	1	+	r	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aspalathus cf. *ternata*	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	1	o	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Acacia mearnsii *	.	+	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pennisetum clandestinum *	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species Block B: *Themeda triandra* - *Senecio* sp. a (GRR 710) Grassland Community																																																									
Senecio sp. a (GRR 710**)	+	+	+	+	m	+	+	+	.	+	r	.	m	+	+	.	.	.	.	+	.	.	.	o	+	+	+	+	r	+	+	+	o	+	.	.	.	r	.	r	r	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ficinia tenuifolia	.	+	+	+	.	+	+	.	.	.	+	.	+	+	+	.	r	.	.	.	.	.	.	+	.	.	+	.	o	.	1	.	.	+	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Osteospermum imbricatum	+	.	.	.	.	r	.	.	.	.	.	.	.	.	+	1	.	.	+	.	+	.	r	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	+	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Monopsis unidentata	.	.	.	+	+	+	.	.	.	.	.	.	r	+	+	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aspalathus retroflexa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species Block C: *Themeda triandra* - *Stoebe phyllostachys* Grassland Community Group																																																									
Stoebe phyllostachys	+	.	+	+	+	+	+	.	.	+	.	.	+	.	+	1	.	.	.	.	.	.	.	1	+	.	.	1	1	+	+	+	.	.	.	.	+	.	.	1	1	.	.	.	.	.	+	+	.	r	.	.	a	b	.	+	+	+
Aspalathus angustifolia	.	.	.	.	.	+	.	.	.	m	.	.	r	.	1	+	.	.	+	.	1	.	.	.	.	1	.	.	.	.	+	+	.	.	.	+	.	.	.	o	.	.	.	+	.	+	.	.	.	.	.	.	.	.	+	+	o	+
Linum heterostylum	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	+	.	.	.	.	+	r	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	o	+
Senecio sp. b (GRR 51/22)	.	+	r	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	r	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+	r	.	.	.	.	.	.
Muraltia satureioides	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pachycarpus dealbatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	r	.	.	.	.	.	.	.	.	.	.	.	.	.
Aspalathus sp. (GRR 123/14)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1
Species Block D: *Themeda triandra* - *Chrysanthemoides monilifera* Shrubland Subcommunity																																																									
Chrysanthemoides monilifera	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Muraltia collina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gymnosporia buxifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clutia pulchella	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species Block E: *Themeda triandra* - *Aspalathus nigra* Shrubland Subcommunity																																																									
Aspalathus nigra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species Block F: *Themeda triandra* - *Argyrolobium* sp. a (GRR 29) Shrubland Community																																																									
Argyrolobium sp. a (GRR 29)	1	.	.	.	r	.	.	+	+	.	+	+	+	+	+	o	1	+	r	.	.	+	1	r	+	+	+	.	.	o	+	+	+	+	o	o	+	+	.	.	.	+	.	+	+	+	1	+	+	+	+	+	.	.	o	.	.	.
Eragrostis capensis	1	1	+	+	a	1	m	a	b	4	1	+	b	m	+	a	5	5	a	1	a	.	m	a	1	a	1	4	1	1	+	1	+	1	a	+	1	+	1	+	+	.	.	+	1	1	+	m	+	1	.	r	o	.	+	a	+	1
Phylica propinqua	+	o	m	1	1	m	m	o	.	.	+	.	.	.	o	+	.	.	+	.	.	.	+	1	1	.	.	.	.	.	+	+	r	.	.	.	+	.	o	+	+	.	o	o	r	+	+	.	.	+	.	.	.	r	.	+	.	.
Argyrolobium sp. b (GRR 842)	1	r	+	+	+	+	+	.	+	+	.	.	.	r	+	1	.	.	+	.	+	.	+	+	+	+	.	+	r	.	+	+	.	.	.	.	+	.	+	+	.	.	.	+	.	.	.	.	.	.	.	.	+	+	.	m	+	+
Pelargonium candicans	+	1	+	.	+	+	+	r	.	.	+	+	.	.	r	.	.	.	.	.	.	.	.	+	+	+	.	.	o	+	+	.	r	.	.	.	1	+	r	.	+	+	m	o	.	.	+	.	.	.	+	+	.	r	.	r	m	1
Tephrosia capensis	1	m	a	.	+	+	+	m	+	.	1	1	.	.	r	.	+	+	+	.	+	a	1	.	.	+	+	.	.	o	.	.	1	+	.	.	.	.	.	.	.	+	1	1	m	1	1	+	+	.	.	o	.	.	+	.	.	.
Rhynchosia capensis	r	+	+	.	r	.	.	1	+	.	+	+	.	.	.	.	+	m	.	+	+	+	.	.	.	1	+	.	.	.	.	.	1	o	.	.	.	.	.	.	.	1	+	+	1	1	1	1	+	1	.	.	.	.	.	.	.	.
Euclea crispa	.	m	+	.	+	.	+	.	.	.	.	1	.	.	.	.	.	+	.	+	+	1	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+	1	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.
Hermannia flammea	.	.	.	.	.	.	.	.	.	.	1	+	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Otholobium sp. (GRR 45/4)	.	.	.	.	.	.	.	.	.	.	.	+	1	a	m	m	m	+	.	.	m	.	.	.	.	.	.	.	.	.	.	o	+	+	.	+	.	.	o	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	+	.	.	.

Appendix 5: Detailed Vegetation Maps of the Study Area

Legend for Community Map Units 1—17

+ Geographic Reference Point with Longitude and Latitude Above or Below.

Mapped Indigenous Vegetation

- *Themeda triandra – Centella eriantha* Subcommunity (a)
- *Themeda triandra – Senecio* sp. (G.R.Raitt 710) Subcommunity Typicum (b)
- *Themeda triandra – Stoebe phyllostachys* Community (c)
- *Themeda triandra – Chrysanthemoides monilifera* Subcommunity (d)
- *Themeda triandra – Aspalathus nigra* Subcommunity (e)
- *Themeda triandra – Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum (f)
- *Themeda triandra – Bobartia macrospatha* Community (g)
- *Themeda triandra – Elytropappus rhinocerotis* Community (h)
- Indeterminate (k)
- Transitional between Communities f and h

Area Excluded from This Study

- Fynbos (n)
- Unclassified (o)
- Dominated by *Clffortia filicaulis* (p)
- Dominated by *Clffortia filicaulis* but possilbly f (r)
- Dominated by *Clffortia filicaulis* but possilbly k (s)

Unsampled Area

- Unsampled Area (t)

Woody or Alien Vegetation

- Indigenous Woodland/Forest (u)
- Alien Woodland (w)
- Alien Grasses/Shrubs (x)

Denuded Area

- Erosion Surface (y)
- Area Denuded by Burning Aliens (z)

Cultivated Land

- Cultivated Land

Classification Not Confirmed

- Possibly *Themeda triandra – Centella eriantha* Subcommunity (a)
- Possibly *Themeda triandra – Senecio* sp. (G.R.R. 710) Subcommunity Typicum (b)
- Possibly *Themeda triandra – Stoebe phyllostachys* Community (c)
- Possibly *Themeda triandra – Chrysanthemoides monilifera* Subcommunity (d)
- Possibly *Themeda triandra – Aspalathus nigra* Subcommunity (e)
- Possibly *Themeda triandra – Argyrolobium* sp. (G.R.R. 29) Subcommunity Typ. (f)
- Possibly *Themeda triandra – Bobartia macrospatha* Community (g)
- Possibly Fynbos
- Possibly Either Unit or Subcommunity Complex of a and b
- Possibly Either Unit or Subcommunity/Community Complex of a and c
- Possibly Either Unit or Subcommunity/Community Complex of b and c
- Possibly Either Unit or Subcommunity Complex of b and f
- Indeterminate but possibly c
- Possibly Either Unit or Subcommunity Complex of d and f
- Possibly Either Unit or Subcommunity/Community Complex of d and g
- Possibly Either Unit or Subcommunity Complex of e and f
- Possibly Either Unit or Subcommunity/Community Complex of f and g
- Possibly Either Unit or Community Complex of f and h
- Indeterminate but possibly f

Combinations of Other Units

- Subcommunity Complex of a and e
- Subcommunity Complex of b and e
- Community/Subcommunity Complex of c and e
- Subcommunity/Community Complex of a and c
- Subcommunity/Community Complex of b and c
- Subcommunity Complex of a and f
- Subcommunity Complex of b and f
- Subcommunity/Community Complex of d and g
- Community Complex of g and n
- Community Complex of n and u
- Community Complex of t and u
- Community Complex of u and w
- Community Complex of w and x plus Erosion Surface

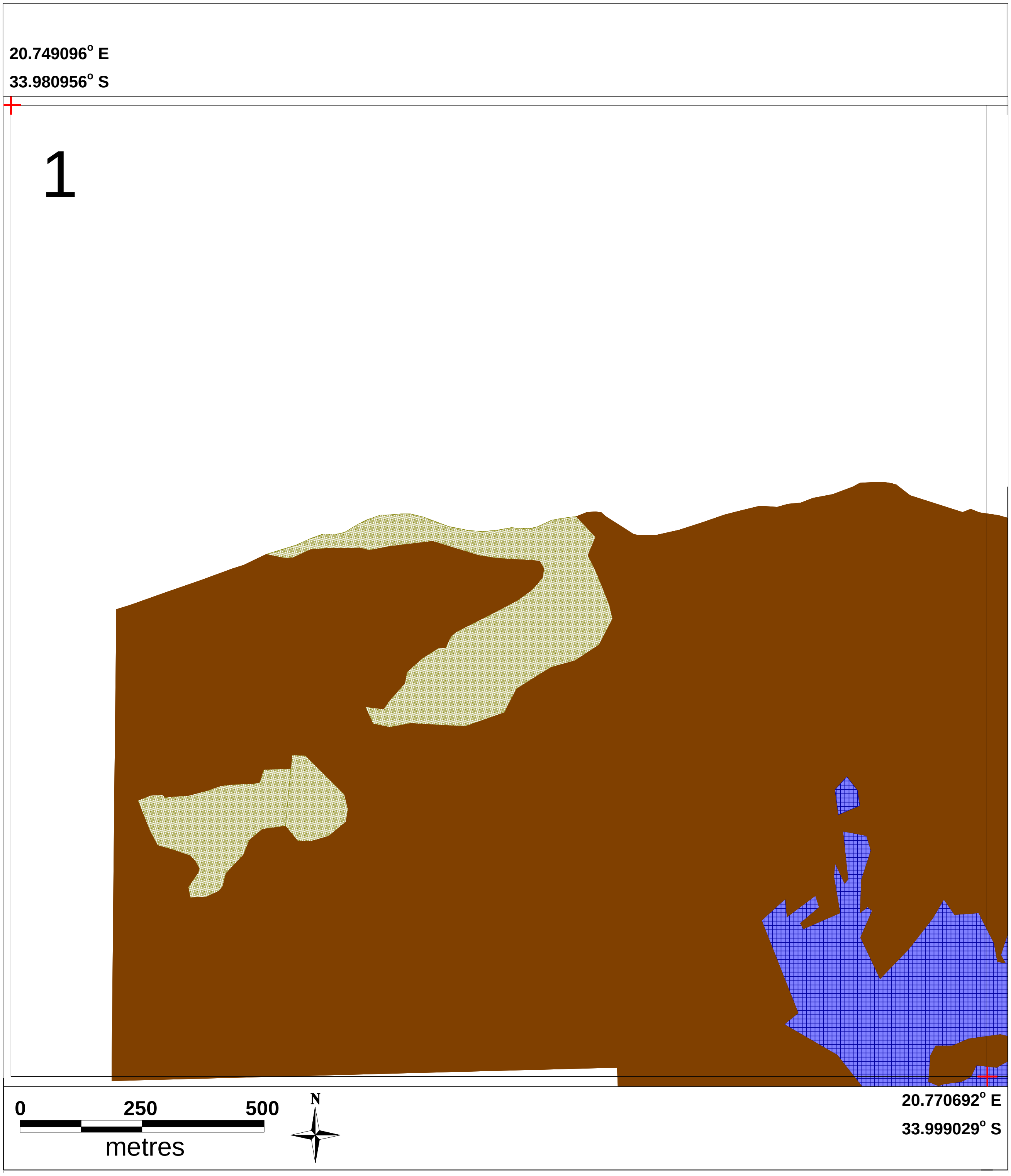

Figure 7.5.1: Vegetation map for map unit 1 of the study area within the Grootvadersbosch Conservancy, South Africa (see Figure 3.9)

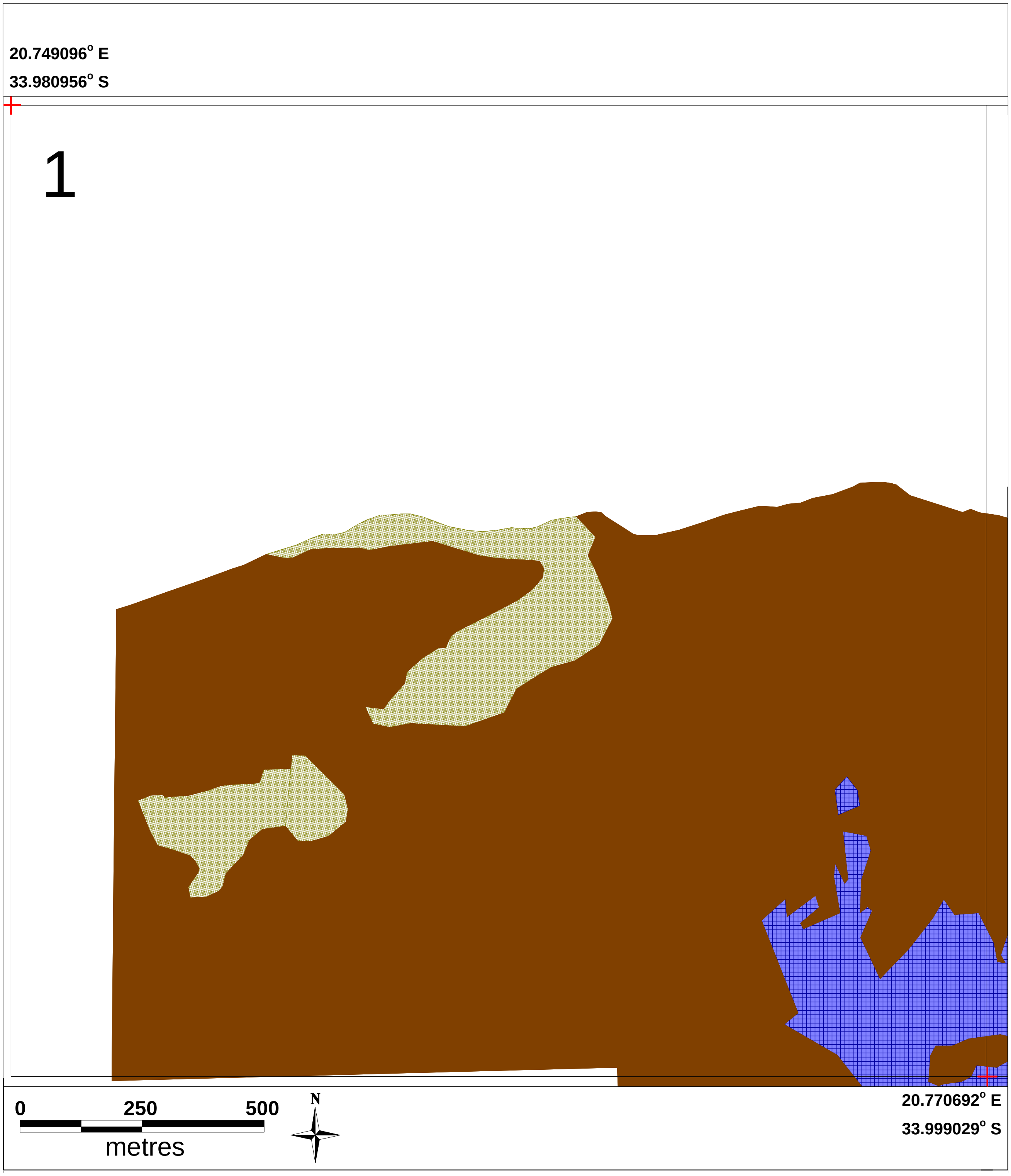

Figure 7.5.1: Vegetation map for map unit 1 of the study area within the Grootvadersbosch Conservancy, South Africa (see Figure 3.9)

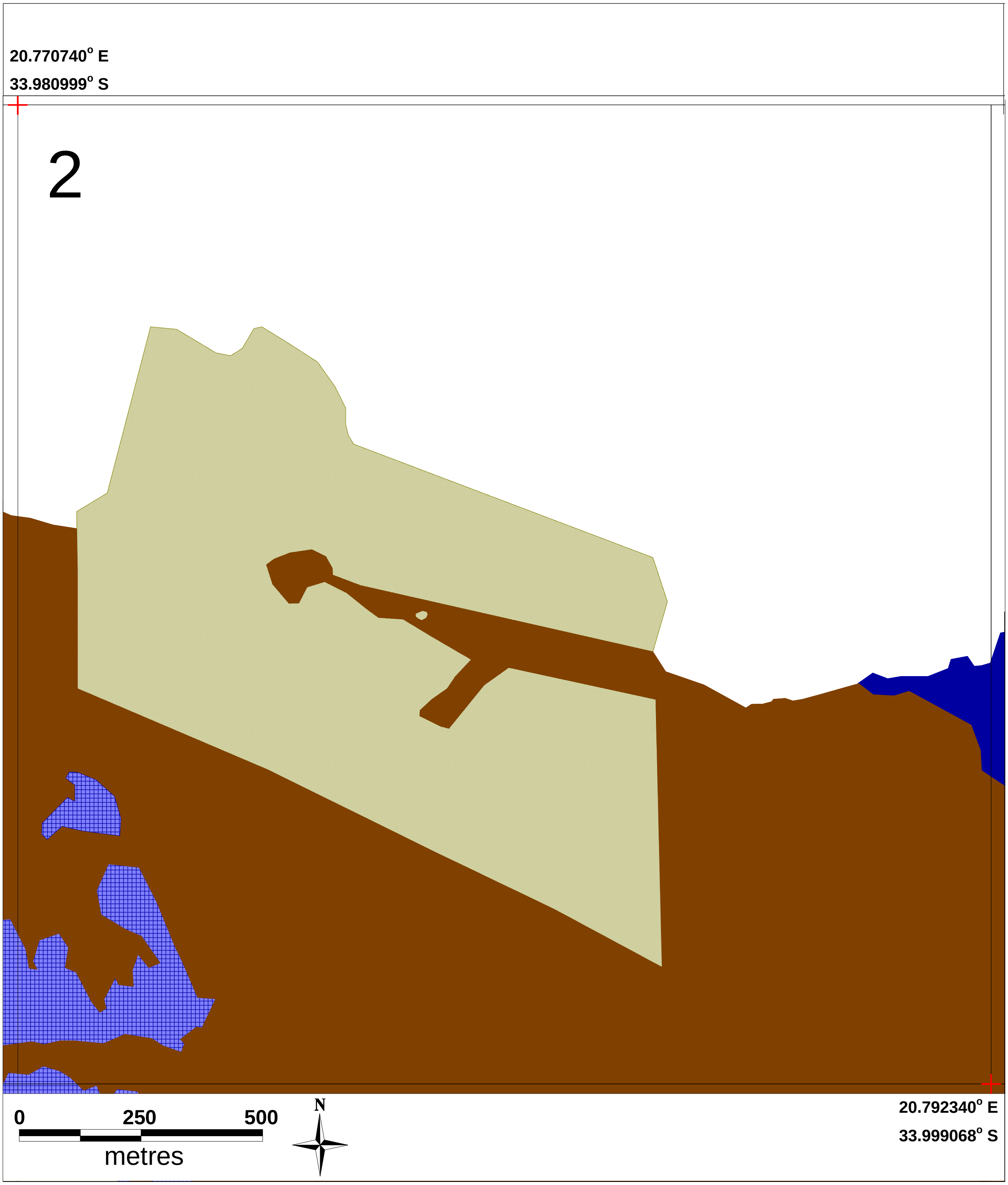

Figure 7.5.2: Vegetation map for map unit 2 of the study area within the Grootvadersbosch Conservancy, South Africa (see Figure 3.9)

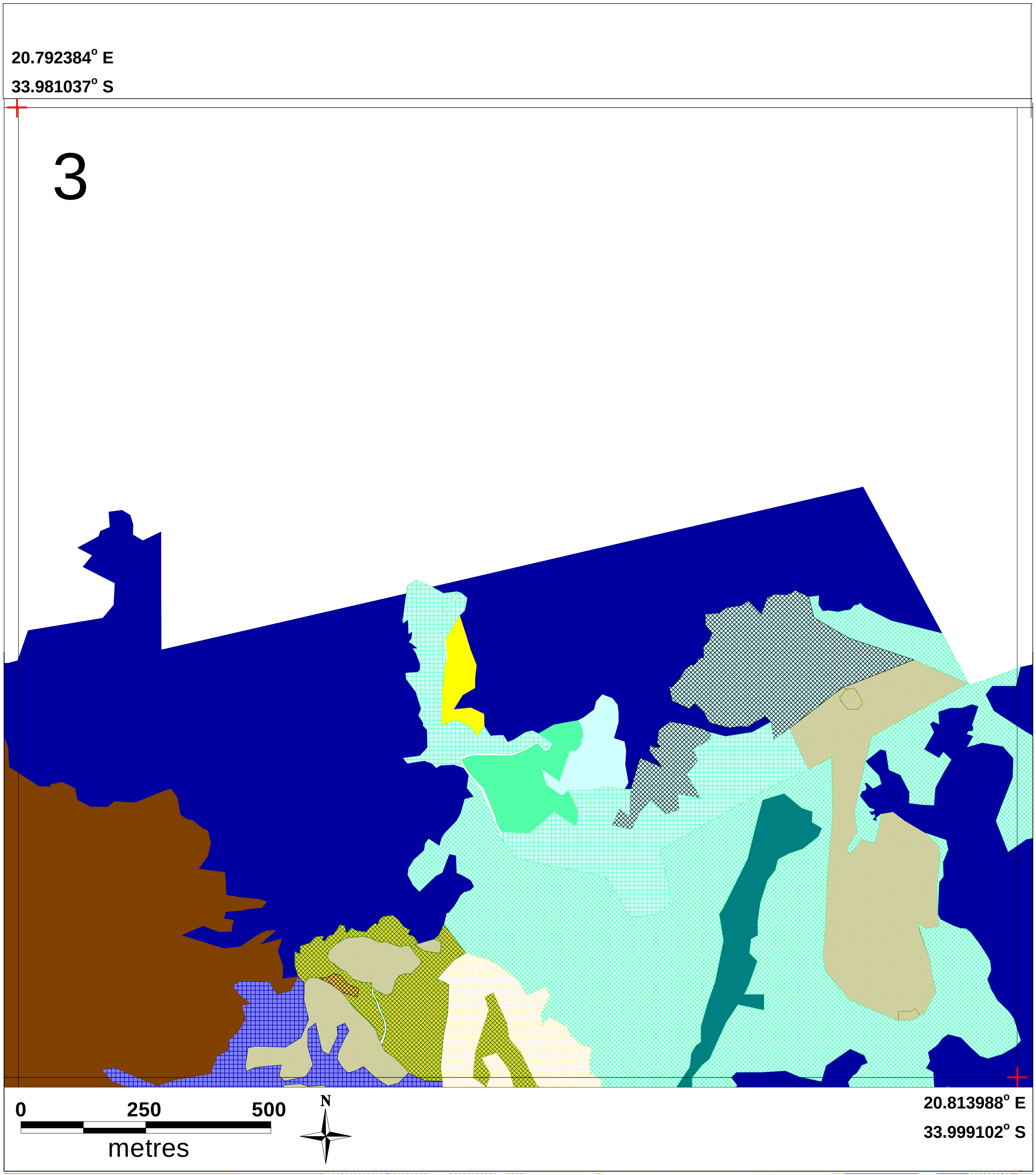

Figure 7.5.3: Vegetation map for map unit 3 of the study area within the Grootvadersbosch Conservancy, South Africa (see Figure 3.9)

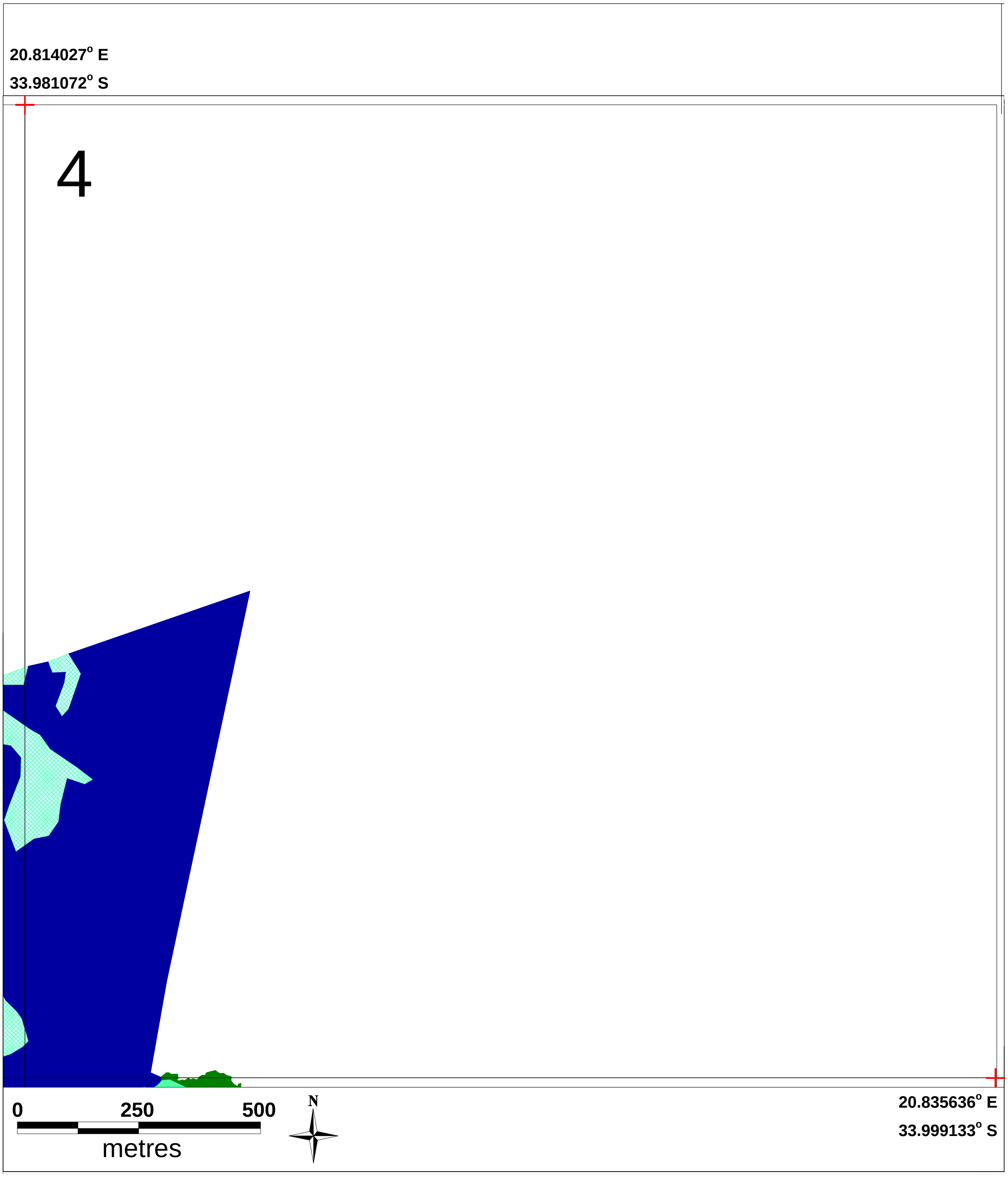

Figure 7.5.4: Vegetation map for map unit 4 of the study area within the Grootvadersbosch Conservancy, South Africa (see Figure 3.9)

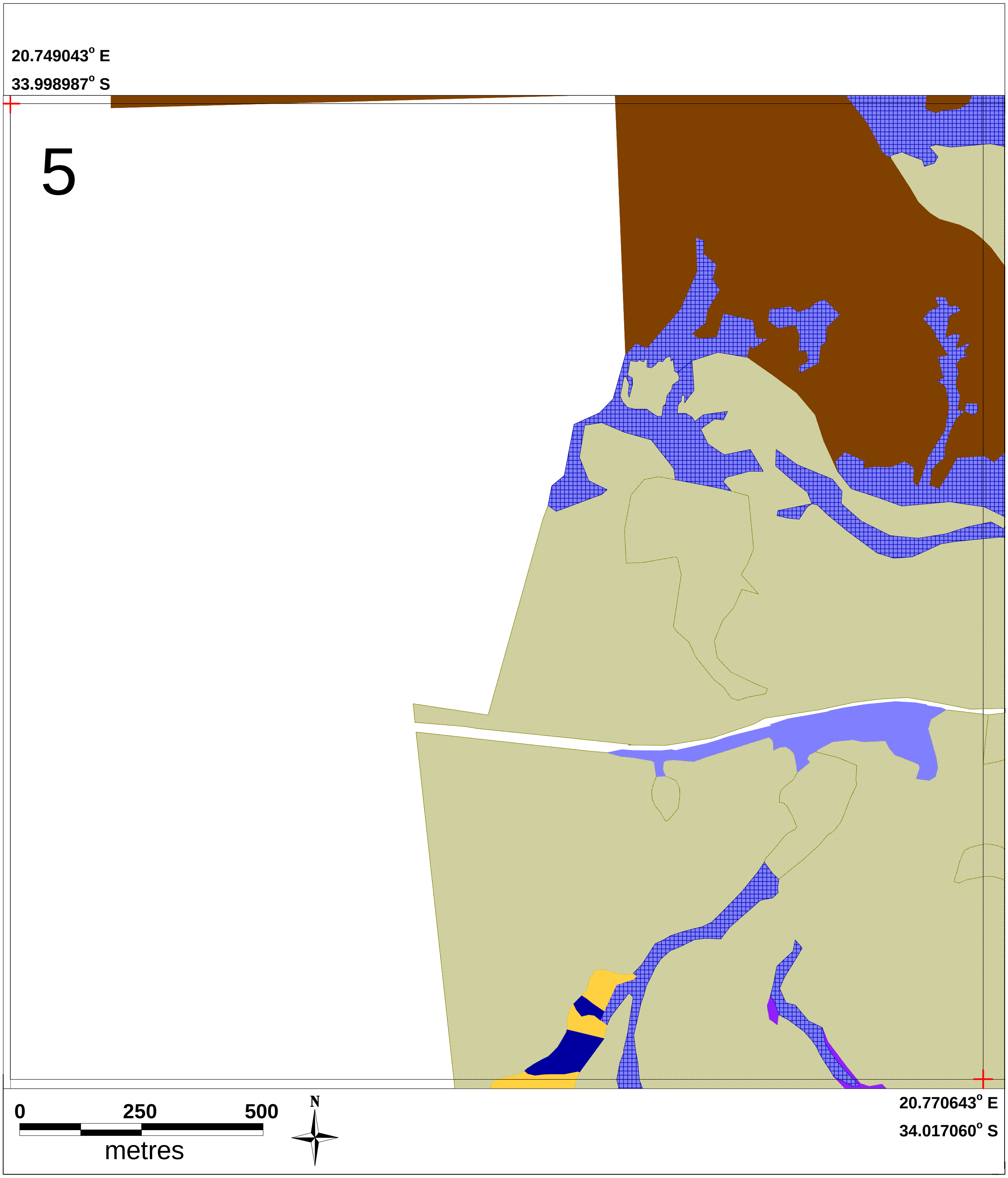

Figure 7.5.5: Vegetation map for map unit 5 of the study area within the Grootvadersbosch Conservancy, South Africa (see Figure 3.9)

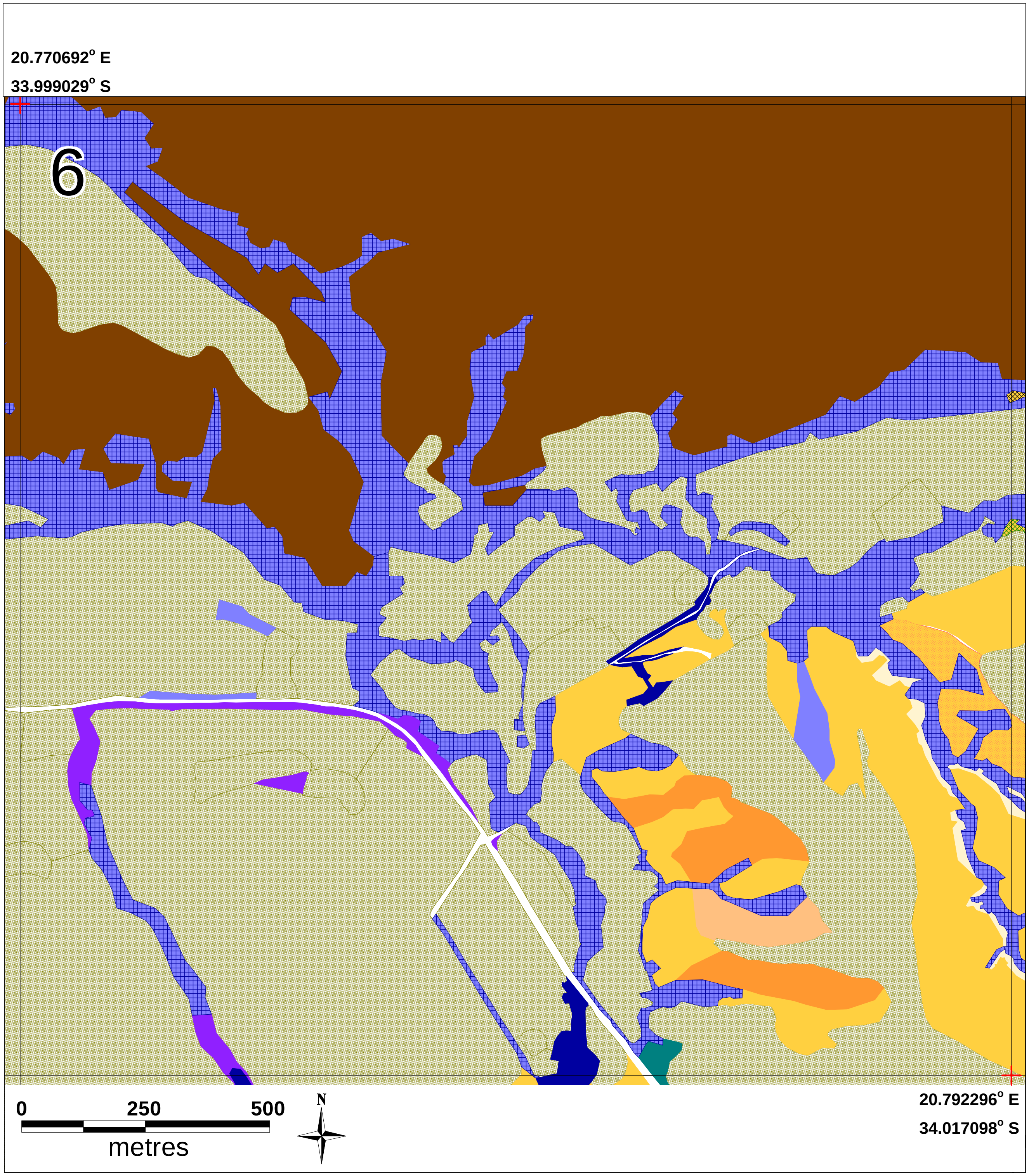

Figure 7.5.6: Vegetation map for map unit 6 of the study area within the Grootvadersbosch Conservancy, South Africa (see Figure 3.9)

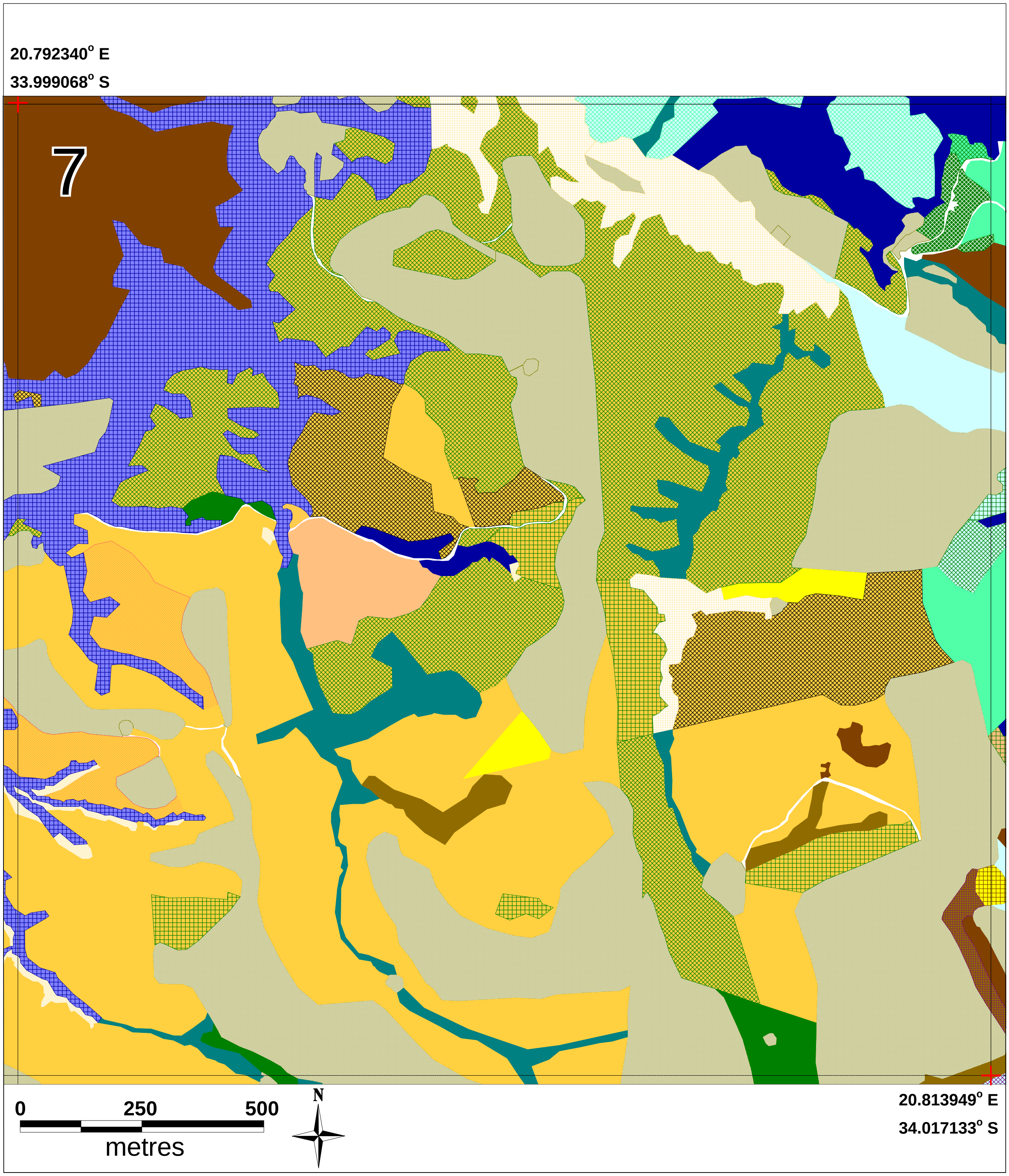

Figure 7.5.7: Vegetation map for map unit 7 of the study area within the Grootvadersbosch Conservancy, South Africa (see Figure 3.9)

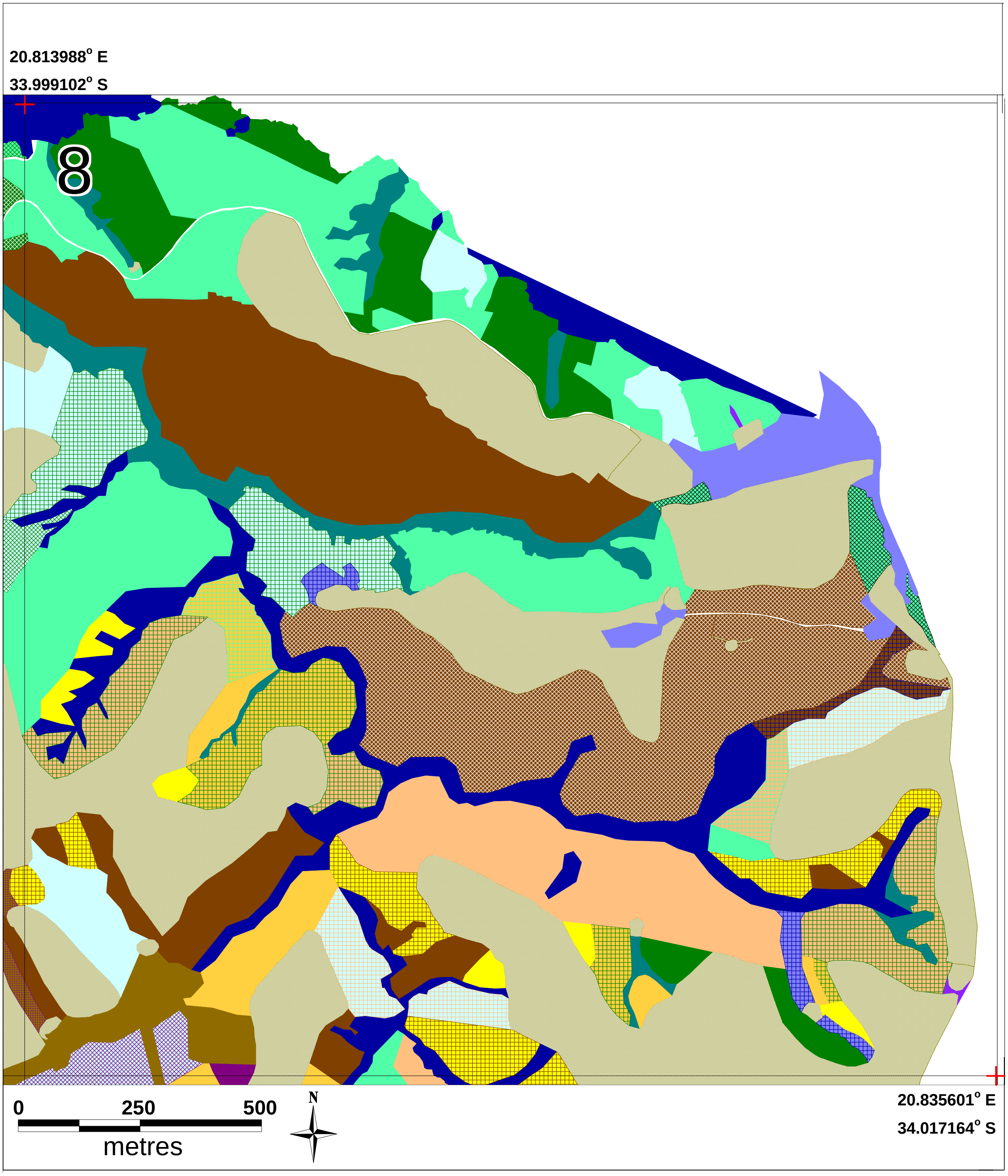

Figure 7.5.8: Vegetation map for map unit 8 of the study area within the Grootvadersbosch Conservancy, South Africa (see Figure 3.9)

Figure 7.5.9: Vegetation map for map unit 9 of the study area within the Grootvadersbosch Conservancy, South Africa (see Figure 3.9)

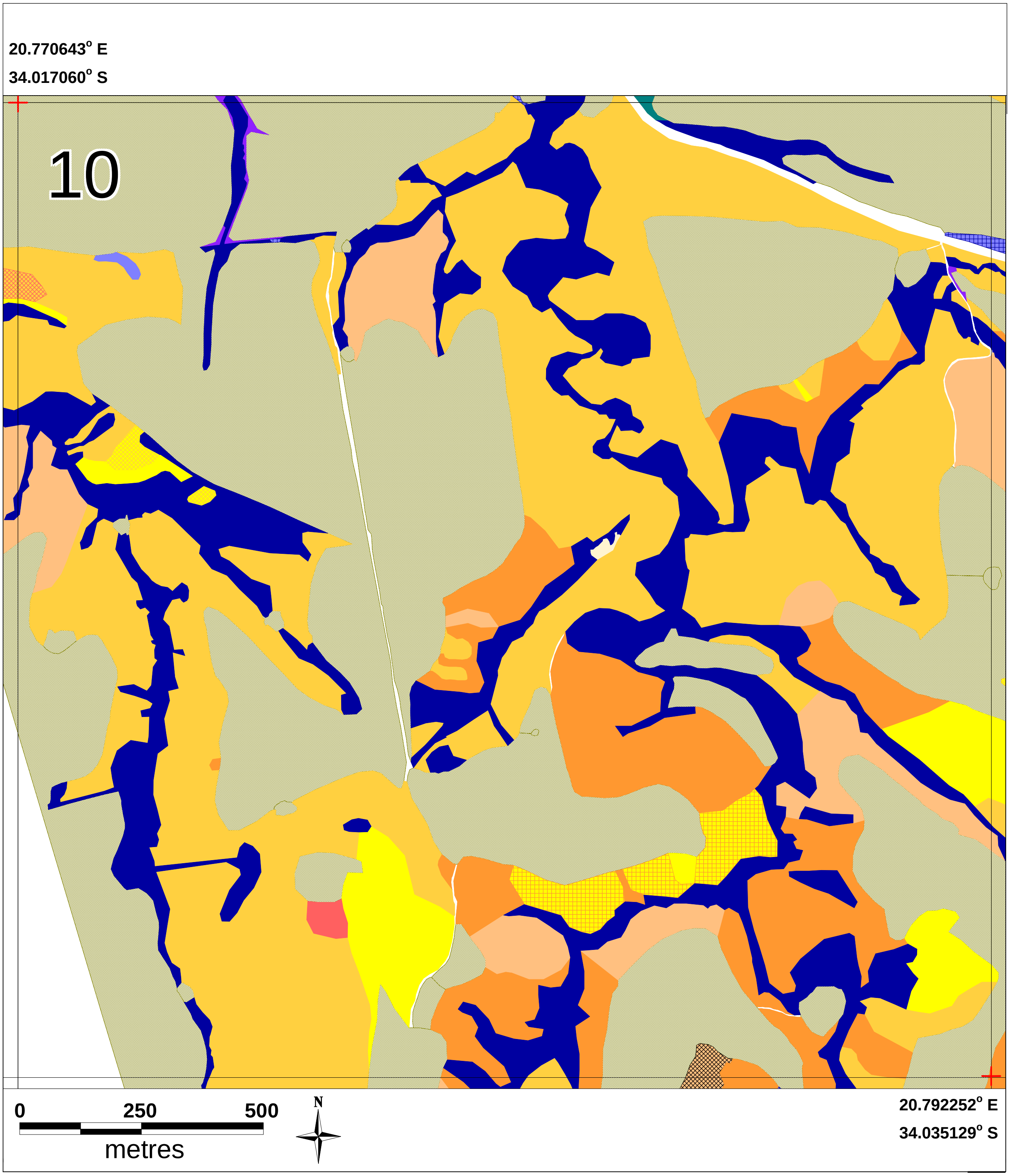

Figure 7.5.10: Vegetation map for map unit 10 of the study area within the Grootvadersbosch Conservancy, South Africa (see Figure 3.9)

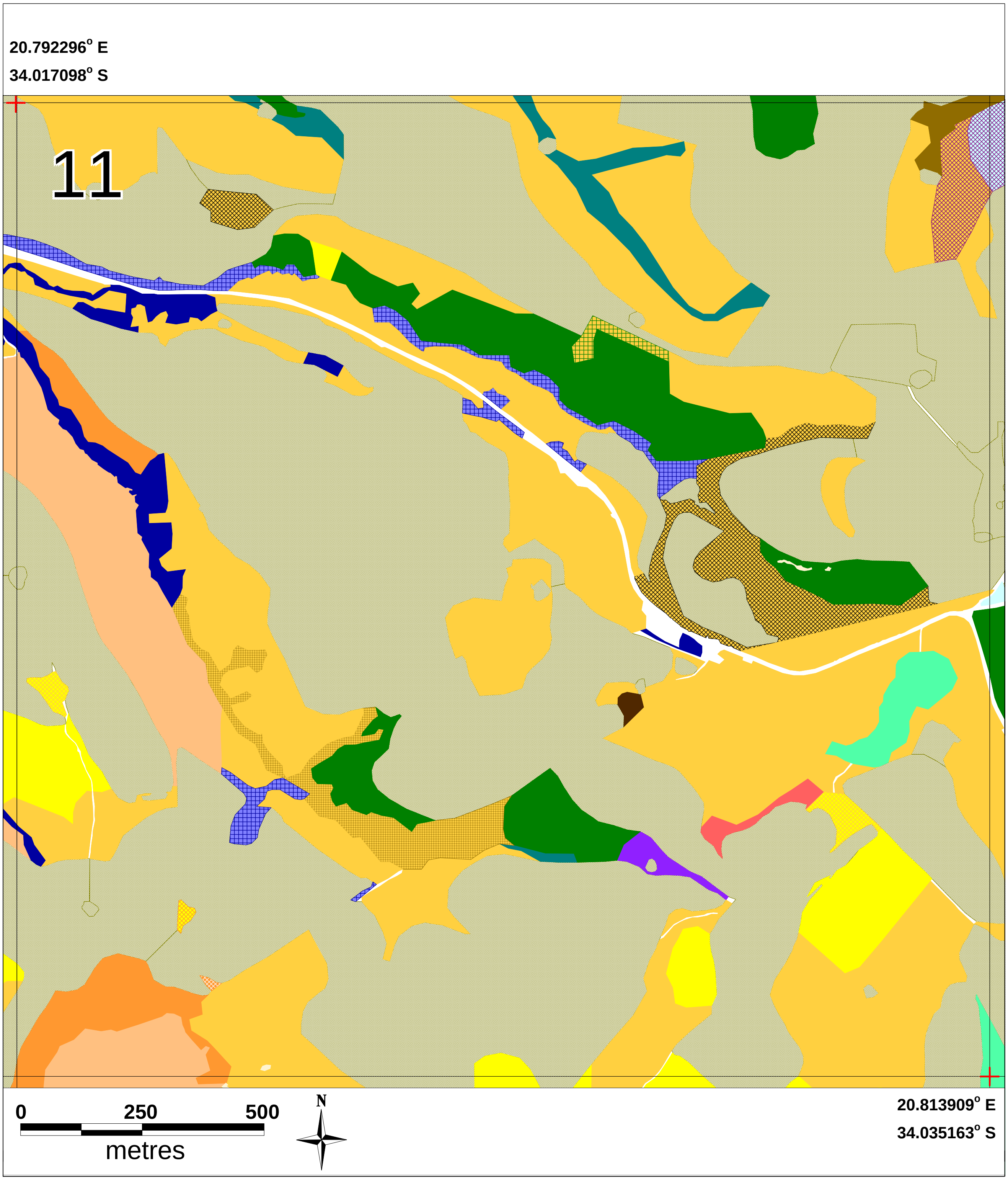

Figure 7.5.11: Vegetation map for map unit 11 of the study area within the Grootvadersbosch Conservancy, South Africa (see Figure 3.9)

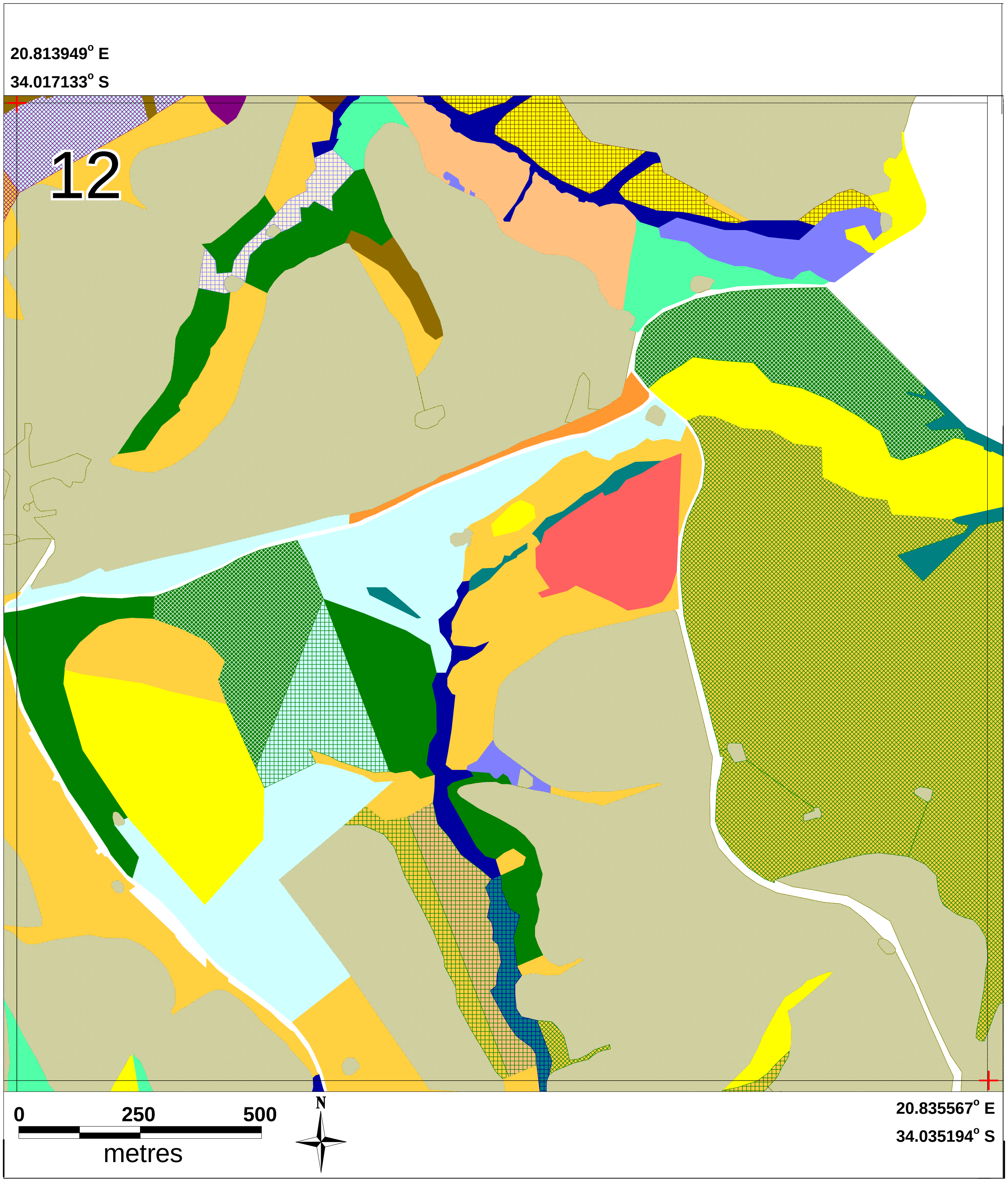

Figure 7.5.12: Vegetation map for map unit 12 of the study area within the Grootvadersbosch Conservancy, South Africa (see Figure 3.9)

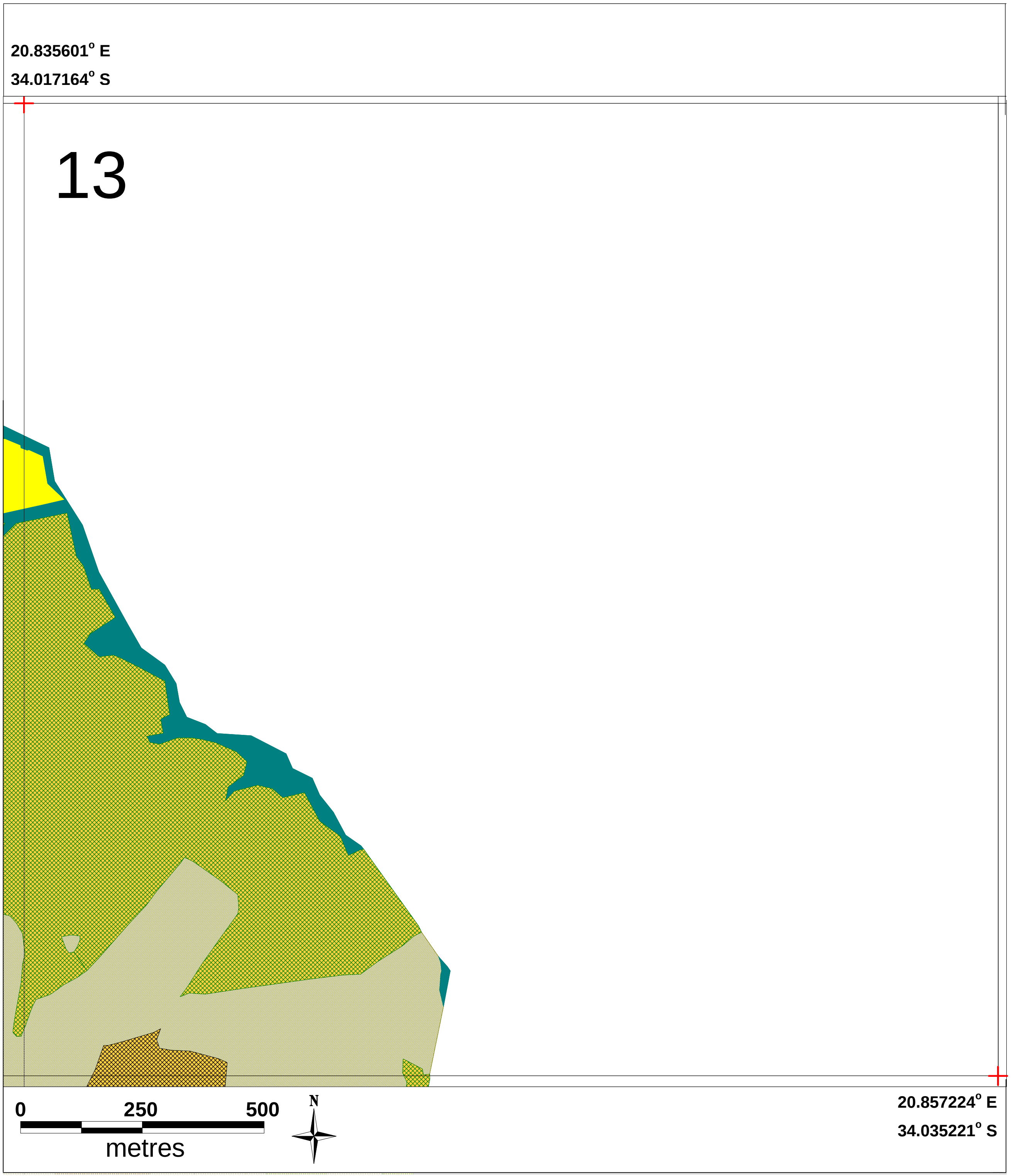

Figure 7.5.13: Vegetation map for map unit 13 of the study area within the Grootvadersbosch Conservancy, South Africa (see Figure 3.9)

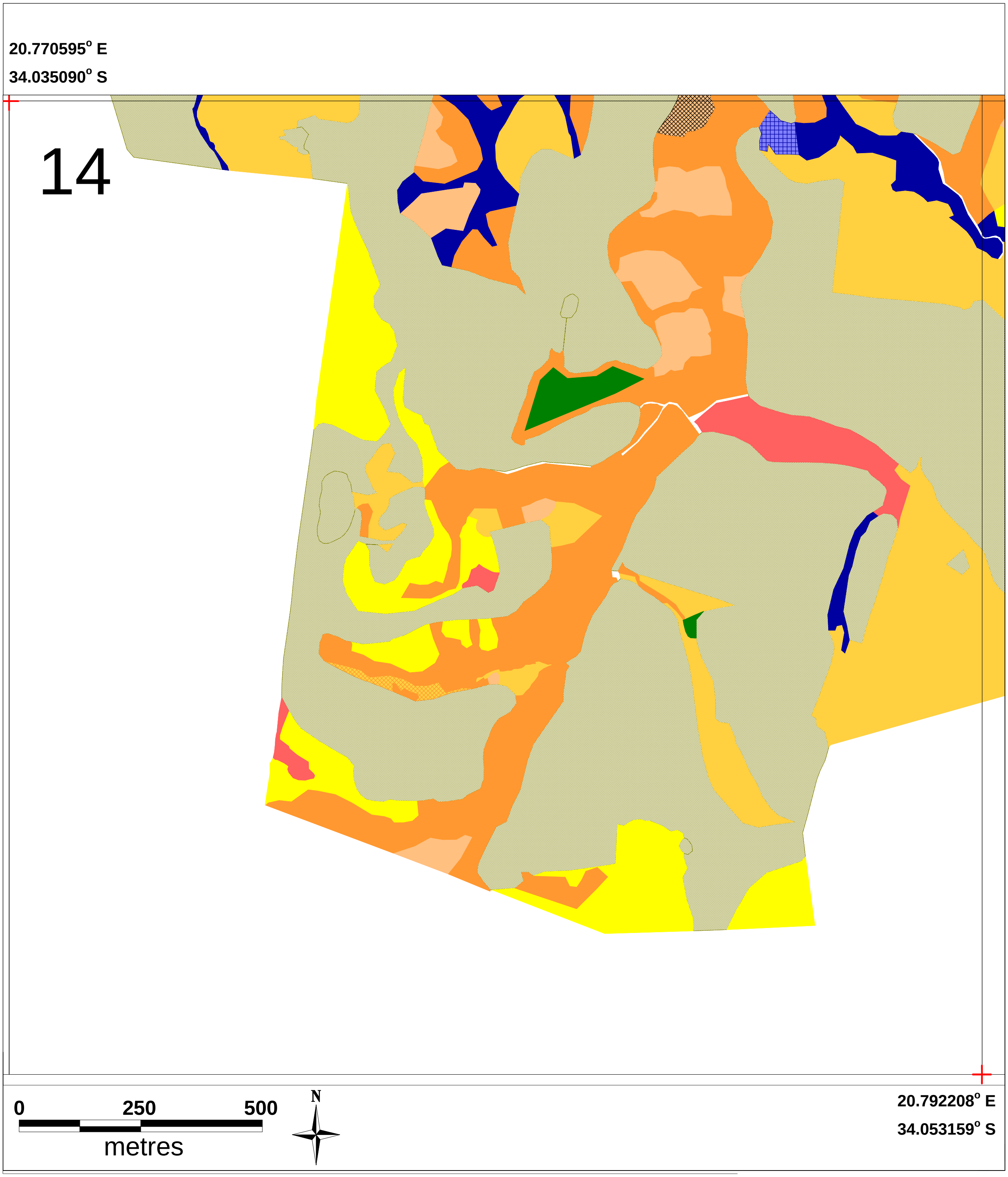

Figure 7.5.14: Vegetation map for map unit 14 of the study area within the Grootvadersbosch Conservancy, South Africa (see Figure 3.9)

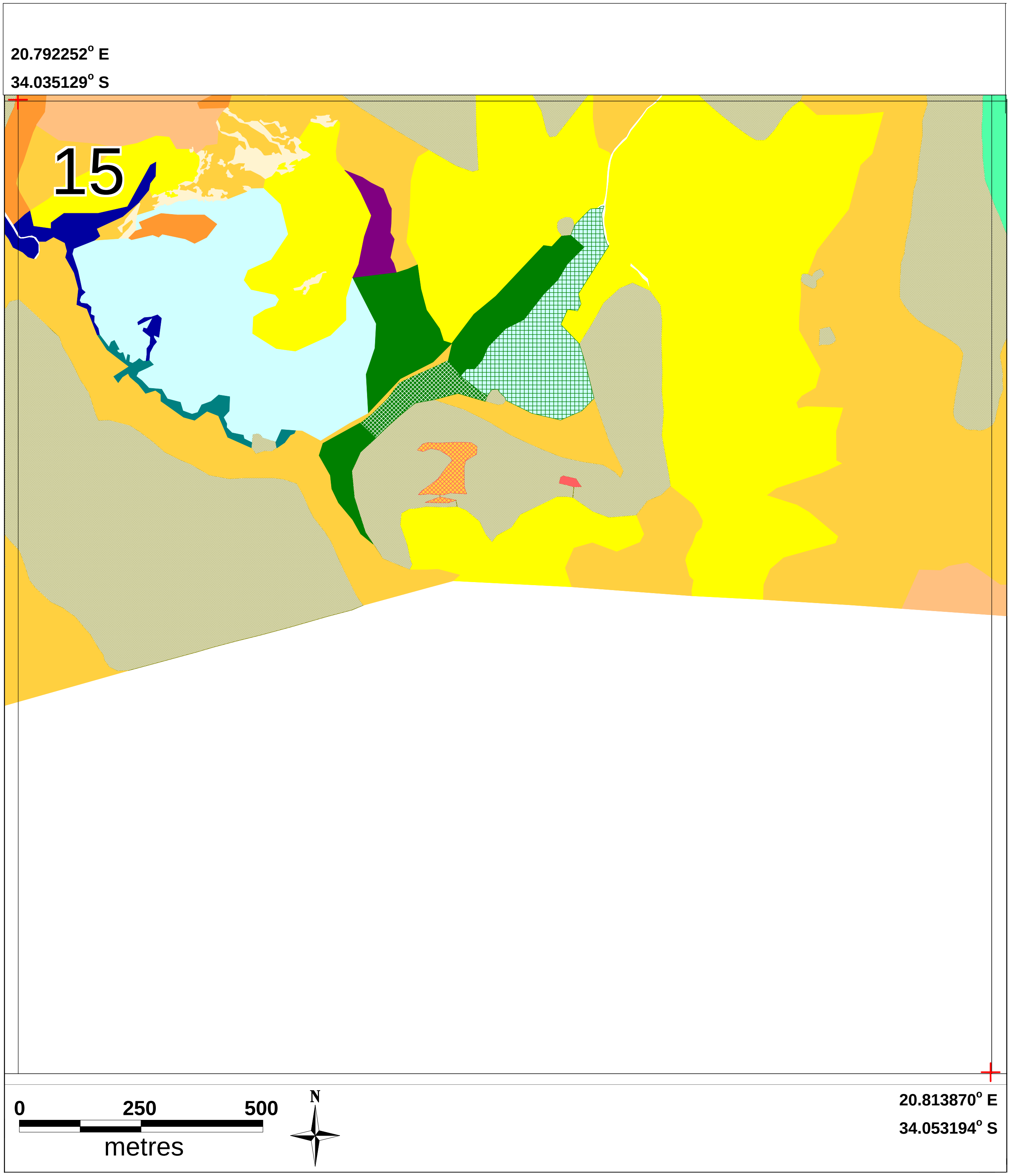

Figure 7.5.15: Vegetation map for map unit 15 of the study area within the Grootvadersbosch Conservancy, South Africa (see Figure 3.9)

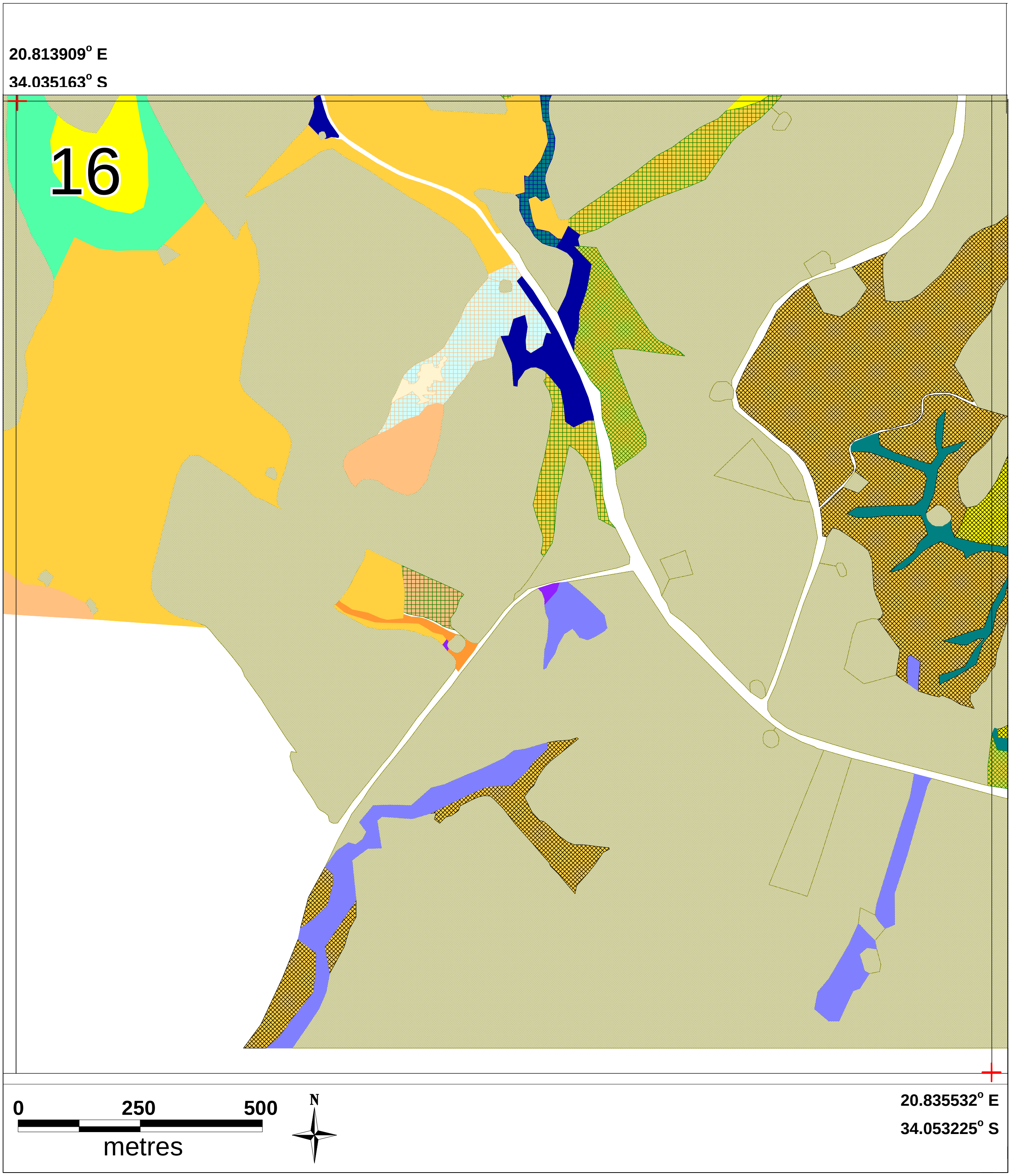

Figure 7.5.16: Vegetation map for map unit 16 of the study area within the Grootvadersbosch Conservancy, South Africa (see Figure 3.9)

Figure 7.5.17: Vegetation map for map unit 17 of the study area within the Grootvadersbosch Conservancy, South Africa (see Figure 3.9)

Appendix 6: Metadata for GIS layers created in MapInfo.

GIS Metadata for South Coast Renosterveld Plots

File name: South_Coast_Renosterveld_Plots

Address: Botany and Zoology Department, Stellenbosch University.

Description: Relevé details

Data Origin: G.R. Raitt's Masters Thesis, Stellenbosch University.

Availability: Data freely available with permission from the author. Obtainable from Dr R. Knight, Department of Biodiversity and Conservation Biology, University of the Western Cape. Tel. (021) 959-3940 Email rknight@uwc.ac.za

Projection: Transverse Mercator

Ellipsoid: WGS 84 (World Geodetic System 1984)

Datum: Hartbeesthoek 94 (Hartbeesthoek 1994, Longitude 21^{o})

Units: Metres.

Notes: Graphic projection of coordinates collected with a Garmin GPS.

Completed February 2004

Coordinates from marked Northern corner of relevés. Data collected 2001 and 2002.

Attribute Fields:

Field Name	**Field Type**	**Description**
X	Integer	Longitude
Y	Integer	Latitude projected x-1 for southern hemisphere
Plot_id	Integer	Relevé number in Braun-Blanquet Table
Classification	Character	Coded community group, community and subcommunity
Unit_Name	Character	Name of classification unit in Braun-Blanquet Table
Community	Character	Name of community in Braun-Blanquet Table
Community Group	Character	Name of community group in Braun-Blanquet Table

Revision History:

GIS Metadata for Plant Communities

File name: Plant_communities

Address: Botany and Zoology Department, Stellenbosch University.

Description: Layer of mapped Braun-Blanquet units and other natural units.

Data Origin: G.R. Raitt's Masters Thesis, Stellenbosch University.

Availability: Data freely available with permission from the author. Obtainable from Dr R. Knight, Department of Biodiversity and Conservation Biology, University of the Western Cape. Tel. (021) 959-3940 Email rknight@uwc.ac.za

Projection: Transverse Mercator

Ellipsoid: WGS 84 (World Geodetic System 1984)

Datum: Hartbeesthoek 94 (Hartbeesthoek 1994, Longitude 21^{o})

Units: Metres.

Notes: On screen digitizing from DWAF aerial photos (1999) of 3320DD21, 3320DD22, 3420BB1 and 3420BB2. Resolution between 0.84 and 0.85 metres.

Data collection in 2001 and 2002. Groundtruthed November 2003.

Completed March 2004.

Attribute Fields:

Field Name	Field Type	Description
ID	Integer	Computer generated ID unintelligible to user which may be assigned a number by the user as in this case
Map_Unit	Interger	Numerical code for classifying units
Area	Decimal	Area of unit in hectares – assumes flat surface
Labels	Character	Letter code classifying units for use in black and white presentation
Farm	Character	Abbreviated farm name
Unit_Name	Character	Name of classification unit in Braun-Blanquet Table
Community	Character	Name of community in Braun-Blanquet Table
Community Group	Character	Name of community group in Braun-Blanquet Table

Revision History:

GIS Metadata for Ploughed Lands

File name: Ploughed_Lands

Address: Botany and Zoology Department, Stellenbosch University.

Description: Land transformed by human activity

Data Origin: G.R. Raitt's Masters Thesis, Stellenbosch University.

Availability: Data freely available with permission from the author. Obtainable from Dr R. Knight, Department of Biodiversity and Conservation Biology, University of the Western Cape. Tel. (021) 959-3940 Email rknight@uwc.ac.za

Projection: Transverse Mercator

Ellipsoid: WGS 84 (World Geodetic System 1984)

Datum: Hartbeesthoek 94 (Hartbeesthoek 1994, Longitude 21^{o})

Units: Metres.

Notes: On screen digitizing from DWAF aerial photos (1999) of 3320DD21, 3320DD22, 3420BB1 and 3420BB2. Resolution between 0.84 and 0.85 metres.

Completed February 2004.

Fill layer for Plant Communities covering farmed extent on the coastal side of the mountains for all four aerial photos.

Attribute Fields:

Field Name	**Field Type**	**Description**
ID	Integer	Computer generated ID unintelligible to user which may be assigned a number by the user
Map_Unit	Integer	Numerical code for classifying units
Unit_Name	Character	Description of the unit

Revision History:

GIS Metadata for Used Lands

File name: Used_Lands

Address: Botany and Zoology Department, Stellenbosch University.

Description: Land transformed by human activity

Data Origin: G.R. Raitt's Masters Thesis, Stellenbosch University.

Availability: Data freely available with permission from the author. Obtainable from Dr R. Knight, Department of Biodiversity and Conservation Biology, University of the Western Cape. Tel. (021) 959-3940 Email rknight@uwc.ac.za

Projection: Transverse Mercator

Ellipsoid: WGS 84 (World Geodetic System 1984)

Datum: Hartbeesthoek 94 (Hartbeesthoek 1994, Longitude 21^{o})

Units: Metres.

Notes: Copied from Ploughed_Lands which was created by on screen digitizing from DWAF aerial photos (1999) of 3320DD21, 3320DD22, 3420BB1 and 3420BB2. Resolution between 0.84 and 0.85 metres. Modified to fit study area.

Completed March 2004.

Fill layer for Plant Communities.

Attribute Fields:

Field Name	**Field Type**	**Description**
ID	Integer	Computer generated ID unintelligible to user which may be assigned a number by the user
Map_Unit	Integer	Numerical code for classifying units
Unit_Name	Character	Description of the unit

Revision History:

GIS Metadata for Farm Boundaries

File name: Farm_Boundaries

Address: Botany and Zoology Department, Stellenbosch University.

Description: Farm boundaries as confirmed by the farmers

Data Origin: G.R. Raitt's Masters Thesis, Stellenbosch University.

Availability: Data freely available with permission from the author. Obtainable from Dr R. Knight, Department of Biodiversity and Conservation Biology, University of the Western Cape. Tel. (021) 959-3940 Email rknight@uwc.ac.za

Projection: Transverse Mercator

Ellipsoid: WGS 84 (World Geodetic System 1984)

Datum: Hartbeesthoek 94 (Hartbeesthoek 1994, Longitude 21^{o})

Units: Metres.

Notes: Demarcation of farms involved in the study.

On screen digitizing from DWAF aerial photos (1999) of 3320DD21, 3320DD22, 3420BB1 and 3420BB2. Resolution between 0.84 and 0.85 metres. Groundtruthed November 2003 by consulting the farmers.

Completed February 2004.

Attribute Fields:

Field Name	**Field Type**	**Description**
ID	Integer	Computer generated ID unintelligible to user which may be assigned a number by the user
Type	Character	Official status of the boundary

Revision History:

GIS Metadata for Check Points

File name: Check_points

Address: Botany and Zoology Department, Stellenbosch University.

Description: Points at which the plant community was confirmed.

Data Origin: G.R. Raitt's Masters Thesis, Stellenbosch University.

Availability: Data freely available with permission from the author. Obtainable from Dr R. Knight, Department of Biodiversity and Conservation Biology, University of the Western Cape. Tel. (021) 959-3940 Email rknight@uwc.ac.za

Projection: Transverse Mercator

Ellipsoid: WGS 84 (World Geodetic System 1984)

Datum: Hartbeesthoek 94 (Hartbeesthoek 1994, Longitude 21^{o})

Units: Metres.

Notes: Points checked when Plant_communities layer was groundtruthed in November 2003 and observations made during data collection in 2001 and 2002.

On screen digitizing from DWAF aerial photos (1999) of 3320DD21, 3320DD22, 3420BB1 and 3420BB2. Resolution between 0.84 and 0.85 metres.

Completed February 2004.

Attribute Fields:

Field Name	**Field Type**	**Description**
ID	Integer	Computer generated ID unintelligible to user which may be assigned a number by the user as in this case
Community_Unit	Character	Name of classification unit in Braun-Blanquet Table

Revision History:

GIS Metadata for Plant Communities for Overview

File name: Plant_communities_for_overview

Address: Botany and Zoology Department, Stellenbosch University.

Description: Layer of grouped natural units.

Data Origin: G.R. Raitt's Masters Thesis, Stellenbosch University.

Availability: Data freely available with permission from the author. Obtainable from Dr R. Knight, Department of Biodiversity and Conservation Biology, University of the Western Cape. Tel. (021) 959-3940 Email rknight@uwc.ac.za

Projection: Transverse Mercator

Ellipsoid: WGS 84 (World Geodetic System 1984)

Datum: Hartbeesthoek 94 (Hartbeesthoek 1994, Longitude 21^{o})

Units: Metres.

Notes: Data grouped for overall view of the area. More detailed information is present in the table. Layer was copied from Plant communities. The latter was created by on screen digitizing from DWAF aerial photos (1999) of 3320DD21, 3320DD22, 3420BB1 and 3420BB2. Resolution between 0.84 and 0.85 metres.

Data collection in 2001 and 2002. Groundtruthed November 2003.

Completed March 2004.

Attribute Fields:

Field Name	Field Type	Description
ID	Integer	Computer generated ID unintelligible to user which may be assigned a number by the user
Map_Unit	Interger	Numerical code for classifying units
Labels	Character	Letter code classifying units for use in black and white presentation
Unit_Name	Character	Name of classification unit in Braun-Blanquet Table
Community	Character	Name of community in Braun-Blanquet Table
Community Group	Character	Name of community group in Braun-Blanquet Table

Revision History:

GIS Metadata for Simplified Used Lands

File name: Simplified_Used_Lands

Address: Botany and Zoology Department, Stellenbosch University.

Description: Simplified version of Used_Lands with all units of the same appearance

Data Origin: G.R. Raitt's Masters Thesis, Stellenbosch University.

Availability: Data freely available with permission from the author. Obtainable from Dr R. Knight, Department of Biodiversity and Conservation Biology, University of the Western Cape. Tel. (021) 959-3940 Email rknight@uwc.ac.za

Projection: Transverse Mercator

Ellipsoid: WGS 84 (World Geodetic System 1984)

Datum: Hartbeesthoek 94 (Hartbeesthoek 1994, Longitude 21^{o})

Units: Metres.

Notes: Simplified copy of Used_Lands with all units of the same appearance because the detail is not relevant to the study. Corrected as alterations were made to the Used_Lands layer. The Used_Lands layer was copied from the Ploughed_Lands layer which was created by on screen digitizing from DWAF aerial photos (1999) of 3320DD21, 3320DD22, 3420BB1 and 3420BB2. Resolution between 0.84 and 0.85 metres.

Completed March 2004.

Fill layer for Plant Communities and Plant Communities for Overview.

Attribute Fields:

Field Name	**Field Type**	**Description**
ID	Integer	Computer generated ID unintelligible to user which may be assigned a number by the user
Map_Unit	Integer	Numerical code for classifying units
Unit_Name	Character	Description of the unit

Revision History:

Appendix 7: Detailed Management Results

Mr H.J. Wessels owned Arkadia since about 1992. He favours a three year burn cycle but first burned the piece next to the indent of Vleitjiersrug, Grootvadersbosch Farm in 2000. The end of the farm Arkadia, adjacent to Grootvadersbosch Farm has never been burnt because it is situated on the borders of two other farms. The Mutton Merino sheep are only put on the veld after a fire when the vegetation has grown out so that sufficient food is available. The availability of sufficient feed after a burn depends on the rain. The natural veld is used as grazing when the planted pastures are not available. The stocking rate and duration of stocking depend on the condition of the veld – the sheep are on as long as there is food. The farm had cattle previously but these were removed because of problems with tick borne disease (Ricketsiosis = heartwater or 'hartwater') (pers. comm. Mr H.J. Wessels[5] 2002—2003). Mr H.J. Wessels sold Arkadia to Mr I. Harper in March 2004 (pers. comm. Mr I. Harper 2005).

Mr M. Prinsloo owned Bergsig from about 1999 (he sold the farm in October 2004). He brush cuts the natural vegetation to encourage regrowth for grazing rather than burning. He runs about two hundred to two hundred and fifty Mutton Merino sheep on camp 19 for about six to seven weeks ending January (start mid December) and October (start mid September) for breeding. The ewes are on for two weeks prior to the rams entry and 35 days with rams. The natural veld of camps 18 and 19 was also used during the drought (pers. comm. Mr M. Prinsloo 2002—2003). Prior to Mr Prinsloo, Mr W.P. Louw owned the farm (pers. comm. Mr M. Prinsloo2002—2003). He bought Bergsig in 1993 from Mr A. Rademan. He farmed with Mutton and Duni Merino sheep and beef cattle. He burned the sampled camp about 1994 and 1997/1998 - about a three to four year cycle (pers. comm. Mr W.P. Louw 2004—2005). Prior to 1993, Bergsig was owned by Mr A. Rademan (pers. comm. Mr W.P. Louw 2004—2005). Mr A. Rademan bought the farm in 1990/1991. He farmed with Merino sheep. He burned the sampled field (Camp 19) in 1991 (pers. comm. Mr A. Rademan).

Mr P.W. Groenewald of Glen Etive runs Jersey cattle (pers. comm. Mr P.W. Groenewald 2003). He put in berms on the sampled area prior to 1983 (Orthophoto 3420BB1 (Chief Director of Surveys and Mapping 1983)). The sampled area was burned in 1990 but no planned burns have been carried out since. The natural veld has not been grazed since 2001. Prior to 2001, young cows were put on the veld from January to April (pers. comm. Mr P.W. Groenewald 2003).

Mr K. Moodie took over from his father on the farm, Grootvadersbosch, in about 1991. The Grootvadersbosch Farm has had wheat and sheep on it previously but is now strictly a dairy farm. Most of the fires on Grootvadersbosch Farm have escaped from adjacent farms. The veld is not grazed for at least six months after a burn and then only if the amount of grass is judged sufficient. The

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[5] Contact details for all personal communications may be found under Personal Communications in Sources of Information.

natural vegetation that is not immediately adjacent to fields is divided into three camps that are grazed at a low intensity by dry cows and young cows once or twice a year from late summer/autumn through winter and into spring at which time planted pastures are again available. The veld adjacent to planted pastures is utilised by the cattle on the pasture (pers. comm. Mr K. Moodie 2001—2003).

Mr A. Kruger bought Moodies Hoogte from Mr A. Rademan in 1998 and changed the name to the Grootvadersbosch Estate (the farm name was sold in 2003 to Mr P. Scott and the name was changed to D'Ou Gnu based on information about the history of the farm (pers. comm. Mr A.J. Kruger 2004—2005 & Mr K. Moodie 2001—2003)). No planned burns were carried out but the sampled area was burnt in September in 2001, together with part of Honeywood to clear aliens. The farm carried Duni Merino sheep, Jersey cattle and Nguni cattle. The Nguni cattle were pastured on the natural vegetation. The animals were pastured according to the availability of feed (pers. comm. Mr A.J. Kruger 2004—2005, son of Mr A. Kruger). Mr A. Rademan bought Moodies Hoogte from Mrs C. Kluyts in 1995. He carried out a planned burn in 1996 planning a three year burn cycle. He farmed with Merino sheep, Jersey cattle and Aberdeen Angus cattle. The Aberdeen Angus cattle were pastured on the natural veld (pers. comm. Mr A. Rademan 2004—2005). Mrs C. Kluyts farmed with Jersey cattle, Duni Merino sheep and Hereford cattle. The sheep and Hereford cattle were pastured on the indigenous veld. Livestock was allowed to graze the veld from about August after a February/March burn. Mrs C. Kluyts burned on a three to four year cycle but could not remember which years the sampled area had been burned (pers. comm. Mrs C. Kluyts 2004—2005). For the purposes of ordination Mr J. Moodie's recollections were used, as Honeywood is immediately adjacent to the sampled part of D'Ou Gnu. It is probable that there was at least one, maybe two, more fires than are indicated by his anecdotal information. The present owner, Mr P. Scott, runs Mutton Merino sheep (pers. comm. Mr P. Scott 2003).

Mr J. Moodie of Honeywood keeps bees and eighty Hereford cattle that have free range (i.e. the grazing is not managed systematically) on the veld though, previously, there were two camps and prior to that four camps. Fires are carried out on a four to five year cycle. He brush cuts gentle slopes prior to burning. He decreased the number of cattle from one hundred and sixty and sold his two hundred sheep in 2000, during the drought, to eliminate the need to plant pastures. Prior to 1989, when Mr J. Moodie took over, his father ran cattle on the farm (pers. comm. Mr J. Moodie 2002—2003).

Appendix 8. Comparison of point quadrat data for cover assessment from the different sites, Vleitjiesrug, Dikkopskraal 1 and Dikkopskraal 2.

Table 7.8.1a: Comparison of the total cover between sites

Species	Vleitjiesrug	Dikkopskraal 1	Dikkopskraal 2
Themeda triandra	28.2%	77.8%	73.2%
Ficinia oligantha	1.8%	0.6%	1.0%
Moss	0.2%	5.8%	5.6%
Heteropogon contortus	7.8%		0.2%
Poaceae spp.	1.6%		0.2%
Cynodon dactylon	1.8%		
Argyrolobium sp. (G.R.Raitt 29)	1.2%		
Digitaria argyrograpta	0.8%		
Restio multiflorus	0.6%		
Roella spicata	0.6%		
Aristida junciformis	0.4%		
Hermannia flammea	0.4%		
Aspalathus millefolia	0.4%		
Anthospermum galioides	0.4%		
Anthospermum aethiopicum	0.4%		
Centella cf. *affinis*	0.4%		
Gazania krebsiana	0.4%		
Hermannia flammula	0.2%		
Erica peltata	0.2%		
Gnidia sericea	0.2%		
Relhania pungens	0.2%		
Euryops abrotanifolius	0.2%		
Aspalathus steudeliana	0.2%		
Selago dolosa	0.2%		
Hibiscus aethiopicus	0.4%	0.2%	
Aristea pusilla	0.4%	0.2%	
Geophytic spp.	0.2%	2.2%	
Oxalis cf. *lanata*		2.2%	
Schoenosciphium sparteum		1.6%	
Helichrysum patulum		0.6%	
Indigofera porrecta		0.6%	
Moraea virgata		0.4%	
Eragrostis curvula		0.4%	
Tephrosia capensis		0.4%	
Ornithogalum cf. *pilosum*		0.4%	
Thesium junceum		0.2%	
Otholobium cf. *spicatum*		0.2%	
Erica leucopelta		0.2%	
Felicia hyssopifolia		0.2%	
Oxalis purpurea		1.2%	0.2%
Aspalathus nigra		0.4%	0.6%
Wahlenbergia tenella			0.6%
Euclea crispa var. *ovata*			0.4%
Spiloxene flaccida			0.4%
Oxalis stellata			0.2%
Total Cover	49.8%	95.8%	82.6%

Table 7.8.1a (cont.): Comparison of the total cover between sites

Species	Vleitjiesrug	Dikkopskraal 1	Dikkopskraal 2
Total Number of Points with Cover	48.6%	84.8%	78.0%
Bare Soil	41.0%	8.8%	8.6%
Gravel	2.2%	0.4%	0.6%
Litter	8.2%	6.0%	12.8%
Total Number of Species	28	23	11
Unique Species	22	17	4
Vleitjiesrug & Dikkopskraal 1	24	19	
Vleitjiesrug & Dikkopskraal 2	23		6
Dikkopskraal 1 & 2		18	6

Table 7.8.1b: Chi^2 and p values for the total cover of *Themeda triandra* and the number of species recorded compared between sites

	Chi^2 V & D1	**p Values V & D1**
Themeda triandra	0.872	> 0.1*
Total Number of Species	0.893	> 0.1
	Chi^2 V & D2	**p Values V & D2**
Themeda triandra	0.718	> 0.1
Total Number of Species	10.321	< 0.01
	Chi^2 D1 & D2	**p Values D1 & D2**
Themeda triandra	0.003	> 0.9
Total Number of Species	6.261	< 0.05

* p values of <0.05 are significant, thus the differences in *Themeda triandra* cover are not significant but two of the differences in the number of species recorded are significant.

Table 7.8.2a: Comparison of the canopy cover between sites

Species	Vleitjiesrug	Dikkopskraal 1	Dikkopskraal 2
Themeda triandra	19.0%	70.2%	70.4%
Ficinia oligantha	1.0%	0.4%	0.8%
Heteropogon contortus	6.4%		
Poaceae spp.	1.4%		
Cynodon dactylon	1.4%		
Argyrolobium sp. (G.R.Raitt 29)	1.2%		
Restio multiflorus	0.6%		
Roella spicata	0.6%		
Anthospermum galioides	0.4%		
Anthospermum aethiopicum	0.4%		
Aristida junciformis	0.4%		
Hermannia flammea	0.4%		
Aspalathus millefolia	0.4%		
Hibiscus aethiopicus	0.4%		
Centella cf. *affinis*	0.4%		
Gazania krebsiana	0.4%		
Aristea pusilla	0.4%		
Digitaria argyrograpta	0.2%		
Hermannia flammula	0.2%		
Erica peltata	0.2%		
Gnidia sericea	0.2%		
Relhania pungens	0.2%		
Euryops abrotanifolius	0.2%		
Aspalathus steudeliana	0.2%		
Geophytic spp.	0.2%	1.0%	
Schoenosciphium sparteum		1.6%	
Oxalis cf. *lanata*		0.6%	
Helichrysum patulum		0.4%	
Moraea virgata		0.4%	
Indigofera porrecta		0.4%	
Oxalis purpurea		0.4%	
Eragrostis curvula		0.4%	
Erica leucopelta		0.2%	
Ornithogalum cf. *pilosum*		0.2%	
Tephrosia capensis		0.2%	
Thesium junceum		0.2%	
Otholobium cf. *spicatum*		0.2%	
Aspalathus nigra		0.4%	0.6%
Wahlenbergia tenella			0.6%
Euclea crispa var. *ovata*			0.4%
Spiloxene flaccida			0.4%
Oxalis stellata			0.2%
Total Cover	36.8%	77.2%	73.4%
Plant Litter	0.4%	1.8%	1.6%
Cow Dung	0.2%		0.2%
No Canopy	62.6%	21.0%	24.8%
Total Number of Species	26	19	7
Unique Species	24	16	4
Vleitjiesrug & Dikkopskraal 1	24	17	

Table 7.8.2a (cont.): Comparison of the canopy cover between sites

Species	Vleitjiesrug	Dikkopskraal 1	Dikkopskraal 2
Vleitjiesrug & Dikkopskraal 2	24		5
Dikkopskraal 1 & 2		16	4

Table 7.8.2b: Chi^2 and p values for the canopy cover of *Themeda triandra* and the number of species recorded compared between sites

	Chi^2 V & D1	**p Values V & D1**
Themeda triandra	1.380	> 0.1*
Total Number of Species	1.885	> 0.1
	Chi^2 V & D2	**p Values V & D2**
Themeda triandra	1.391	> 0.1
Total Number of Species	13.885	< 0.001
	Chi^2 D1 & D2	**p Values D1 & D2**
Themeda triandra	0.000	> 0.9
Total Number of Species	7.579	< 0.01

* p values of <0.05 are significant, thus the differences in *Themeda triandra* cover are not significant but two of the differences in the number of species recorded are significant.

Table 7.8.3a: Comparison of the subcanopy cover between sites

Species	Vleitjiesrug	Dikkopskraal 1	Dikkopskraal 2
Themeda triandra	1.0%	19.4%	14.0%
Cynodon dactylon	0.4%		
Digitaria argyrograpta	0.2%		
Poaceae sp.	0.2%		
Heteropogon contortus	0.2%		
Selago dolosa	0.2%		
Oxalis cf. *lanata*		1.2%	
Geophytic sp.		1.0%	
Oxalis purpurea		0.6%	
Helichrysum patulum		0.2%	
Tephrosia capensis		0.2%	
Aristea pusilla		0.2%	
Hibiscus aethiopicus		0.2%	
Felicia hyssopifolia		0.2%	
Wahlenbergia tenella			0.4%
Ficinia oligantha			0.2%
Total Plant Cover	2.2%	23.2%	14.6%
Plant Litter	0.2%	0.4%	0.6%
No Subcanopy	97.6%	78.8%	85.6%
Subcanopy	2.4%	21.2%	14.4%
Total Number of Species	6	9	3
Unique Species	5	8	2
Vleitjiesrug & Dikkopskraal 1	5	8	
Vleitjiesrug & Dikkopskraal 2	5		2
Dikkopskraal 1 & 2		8	2

Table 7.8.3b: Chi^2 and p values for the subcanopy cover of *Themeda triandra* and the number of species recorded compared between sites

	Chi^2 V & D1	p Values V & D1
Themeda triandra	3.386	> 0.05*
Total Number of Species	1.500	> 0.1
	Chi^2 V & D2	**p Values V & D2**
Themeda triandra	1.690	> 0.1
Total Number of Species	1.500	> 0.1
	Chi^2 D1 & D2	**p Values D1 & D2**
Themeda triandra	0.015	> 0.9
Total Number of Species	4.000	< 0.05

* p values of <0.05 are significant, thus the differences in *Themeda triandra* cover are not significant but the difference in the number of species recorded between the Dikkopskraal sites is significant.

Table 7.8.4a: Comparison of the basal cover between sites

Species	Vleitjiesrug	Dikkopskraal 1	Dikkopskraal 2
Themeda triandra	11.8%	27.6%	18.4%
Ficinia oligantha	1.2%	0.2%	0.4%
Moss	0.2%	5.8%	5.6%
Heteropogon contortus	2.6%		0.2%
Poaceae spp.	0.4%		0.2%
Cynodon dactylon	0.6%		
Digitaria argyrograpta	0.4%		
Restio multiflorus	0.2%		
Indigofera porrecta		0.2%	
Oxalis cf. *lanata*		0.2%	
Geophytic sp.		0.2%	
Ornithogalum cf. *pilosum*		0.2%	
Oxalis purpurea		0.4%	0.2%
Total Cover	17.4%	34.4%	24.8%
Plant Litter	9.6%	18.6%	32.2%
Cow Dung	1.2%		
Rat Dung			0.2%
Antelope Dung			0.4%
Bare Soil	68.0%	45.8%	41.4%
Gravel	3.2%	0.8%	0.6%
Old Termite Mound	0.6%		
Soil Tunnel			0.2%
Total Number of Species	8	8	6
Unique Species	4	4	1
Vleitjiesrug & Dikkopskraal 1	5	5	
Vleitjiesrug & Dikkopskraal 2	4		2
Dikkopskraal 1 & 2		4	2

Table 7.8.4b: Chi^2 and p values for the basal cover of *Themeda triandra* and the number of species recorded compared between sites

	Chi^2 V & D1	**p Values V & D1**
Themeda triandra	0.212	> 0.5*
Total Number of Species	0.000	> 0.9
	Chi^2 V & D2	**p Values V & D2**
Themeda triandra	0.037	> 0.5
Total Number of Species	0.500	> 0.1
	Chi^2 D1 & D2	**p Values D1 & D2**
Themeda triandra	0.031	> 0.5
Total Number of Species	0.500	> 0.1

* p values of <0.05 are significant, thus neither the differences in *Themeda triandra* cover nor the differences in the number of species recorded are significant.

Appendix 9. Comparison of point quadrat data for cover assessment from the Vleitjiesrug site for the years 1994, 1996 & 2001.

Table 7.9.1a: Comparison of the canopy cover data from Vleitjiesrug. Entities that may be related are blocked

Species	2001 Site 1	1994 Site 1	1996 Site 1
Themeda triandra	19.0%	50.0%	53.13%
Relhania pungens	0.2%	5.2%	2.38%
Poaceae spp.	1.4%		
Pentaschistis sp.		12.5%	
Pentaschistis curvifolia			0.50%
Eragrostis capensis			2.75%
Hermannia sp.		2.5%	
Hermannia flammea	0.4%		
Hermannia flammula	0.2%		0.75%
Gazania sp.			0.25%
Gazania krebsiana	0.4%		
Anthospermum aethiopicum	0.4%		0.25%
Erica peltata	0.2%		1.50%
Euryops abrotanifolius	0.2%		1.50%
Heteropogon contortus	6.4%		
Cynodon dactylon	1.4%		
Argyrolobium sp. (G.R.Raitt 29)	1.2%		
Restio multiflorus	0.6%		
Roella spicata	0.6%		
Anthospermum galioides	0.4%		
Aristea pusilla	0.4%		
Centella cf. *affinis*	0.4%		
Hibiscus aethiopicus	0.4%		
Digitaria argyrograpta	0.2%		
Geophytic sp.	0.2%		
Gnidia sericea	0.2%		
Aristida junciformis	0.4%	5.0%	
Aspalathus sp.		9.8%	
Aspalathus millefolia	0.4%		
Aspalathus steudeliana	0.2%		
Ficinia sp.		3.3%	
Ficinia oligantha	1.0%		
Aspalathus spinescens probably *Aspalathus acuminata*			3.13%
Elytropappus rhinocerotis			3.13%
Helichrysum cymosum			0.88%
Metalasia acuta			0.88%
Gnidia galpinii			0.38%
Hibiscus trionum			0.25%
Dischisma sp.			0.13%
Plant Litter	0.4%		
Cow Dung	0.2%		
Total Cover	37.4%	88.3%	71.75%
No Canopy	62.6%	11.7%	28.25%
Total Number of Species	26	7	16

Table 7.9.1b: Chi^2 and p values for canopy cover of *Themeda triandra* and the number of species recorded compared between years from Vleitjiesrug

	Chi^2 1994/2001	p Values 1994/2001
Themeda triandra	0.1922	> 0.5*
Total Number of Species	51.5714286	< 0.001
	Chi^2 1994/1996	**p Values 1994/1996**
Themeda triandra	0.00195313	> 0.9
Total Number of Species	11.5714286	< 0.001
	Chi^2 1996/2001	**p Values 1996/2001**
Themeda triandra	0.21920294	> 0.5
Total Number of Species	6.25	<0.05

* p values of <0.05 are significant, thus the differences in *Themeda triandra* cover are not significant but the differences in the number of species recorded are significant.

Table 7.9.2a: Comparison of the basal cover data from Vleitjiesrug. Entities that may be related are blocked

% Cover	2001 Site 1	1994 Site 1	1996 Site 1
Themeda triandra	11.8%	10.6%	16.63%
Heteropogon contortus	2.6%		
Ficinia oligantha	1.2%		
Cynodon dactylon	0.6%		
Digitaria argyrograpta	0.4%		
Moss	0.2%		
Restio multiflorus	0.2%		
Poaceae sp.	0.4%		
Pentaschistis sp.		4.4%	
Aspalathus sp.		2.7%	
Eragrostis capensis			0.88%
Elytropappus rhinocerotis			0.63%
Aspalathus spinescens			0.50%
Euryops abrotanifolius			0.50%
Helichrysum cymosum			0.25%
Hermannia flammula			0.25%
Relhania pungens			0.25%
Erica peltata			0.13%
Gazania sp.			0.13%
Metalasia acuta			0.13%
Plant Litter	9.6%		
Cow Dung	1.2%		
Total Cover	28.2%	17.7%	20.25%
Bare Soil	68.0%	82.3%	79.75%
Gravel	3.2%		
Old Termite Mound	0.6%		
Total Number of Species	8	3	11

Table 7.9.2b: Chi^2 and p values for basal cover of *Themeda triandra* and the number of species recorded compared between years from Vleitjiesrug

	Chi^2 1994/2001	p Values 1994/2001
Themeda triandra	0.00135849	> 0.9*
Total Number of Species	8.33333333	< 0.01
	Chi^2 1994/1996	**p Values 1994/1996**
Themeda triandra	0.03424587	> 0.5
Total Number of Species	21.3333333	< 0.001
	Chi^2 1996/2001	**p Values 1996/2001**
Themeda triandra	0.01400338	> 0.9
Total Number of Species	0.81818182	> 0.1

* p values of <0.05 are significant, thus the differences in *Themeda triandra* cover are not significant but the two of the differences in the number of species recorded are significant.

Appendix 10: Quantitative Comparison with Published Communities

There are many difficulties in comparing other studies with this one. They include differences in methodology, incomplete species lists and uncertainties due to changes in the names of taxa.

Despite all the problems in comparing, it is clear from the following that this vegetation is distinct from that previously described.

Of all the studies compared to the present one, only Boucher (1987) uses the Zürich-Montpellier methodology. Cowling (1984) used TWINSPAN without reference to the Zürich-Montpellier methodology. The aforementioned two studies have published noticeably more comprehensive species lists for their communities than any of the other studies here compared to the present study.

The Coastal Renosterveld subassociations and associations from Boucher (1987) are compared with this study, not the higher syntaxa.

Jordaan (1964) uses only a common name, 'Olifantsgras' (Elephant Grass) to identify one of the species for his Renosterbosveld Communities. This common name refers to *Hyparrhenia collina*, which does not occur in the area according to Gibbs Russell *et al.* (1990). It is likely that Jordaan's (1964) Elephant Grass was a *Hyparrhenia* species.

The updating of the species name for *Pentaschistis angustifolia* depends on which subspecies is present, one of the possible updated names being *Pentaschistis pallida*. No subspecies are listed in the literature so this species is considered a possible shared species. *Heterolepis penduncularis* from Muir (1929) could not be found to update but could be *Heterolepis peduncularis* so this is considered a possible shared species. *Ornithogalum minuatum* from Cowling (1984) could not be found to update but *Ornithogalum miniatum* becomes *Ornithogalum dubium* so this is considered a possible shared species.

The studies are compared in order of publication: Muir (1929) in Table 7.10.1 a—f, Jordaan (1964) in Table 7.10.2 a—c, Grobler and Marais (1967) and Taylor (1972b) in Table 7.10.3 a—f, Cowling (1984) in Table 7.10.4 a—f, Boucher (1987) in Table 7.10.5 a—f, Cowling *et al.* (1988) in Table 7.10.6 a—c and Rebelo *et al.* (1991) in Table 7.10.7 a—c. The Table letter designations are:

Letter	Designation
a	Quantitative comparison with the Subcommunities described in this study
b	Quantitative comparison with the Communities described in this study
c	Quantitative comparison with the Community Groups described in this study
d	Quantitative comparison of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating with the Subcommunities ofthis study
e	Quantitative comparison of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating with the Communities described in this study
f	Quantitative comparison of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating with the Community Groups of this study

Table 7.10.1a: Quantitative comparison of Muir's (1929) Renosterveld units with the Subcommunities described in this study

	Total Species for Units of This Study	122			112			104			104			147		
Unit Total Species[2]	**Unit For Muir (1929) / This Study**[1]	**1.1.1**			**1.1.2**			**2.1.1**			**2.1.2**			**2.1.3**		
		Tot.[3]	**dif.**[4] **both**	**dif. one**[5]	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
219	Renosterveld Proper	12	0	8	13	0	10	12	0	6	12	0	6	20	5	9
44	Aloe Scrub	2	0	0	2	0	0	6	1	0	5	0	1	4	0	0
11	Bokkeveld Shale	3	0	0	2	0	0	3	0	0	3	0	0	4	0	1
11	Bokkeveld Shale Adjacent Langeberg	1	0	0	2	0	0	2	0	0	2	0	0	3	0	0
30	Uitenhage Group in Valley	0	0	0	1	0	0	2	0	0	3	0	0	4	1	0
26	Uitenhage Group on Hill	3	0	2	3	0	2	4	0	2	4	0	2	4	1	1
9	Melilite Basalt	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0
69	Witteberg Series	3	0	2	3	0	0	6	0	2	4	0	1	5	0	1
22	High and Rocky River Valley	1	0	1	1	0	1	2	0	2	2	0	2	1	0	1
13	Low River Valley	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0

1 1.1.1 = *Themeda triandra - Centella* cf. *eriantha* Grassland Subcommunity, 1.1.2 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum, 2.1.1 = *Themeda triandra - Chrysanthemoides monilifera* Subcommunity, 2.1.2 = *Themeda triandra - Aspalathus nigra* Subcommunity, 2.1.3 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum

2 Total number of species listed for each published unit

3 Total number of species shared by the units compared

4 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

5 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

Table 7.10.1b: Quantitative comparison of Muir's (1929) vegetation units with the Communities described in this study

	Total Species for Units of This Study	140			106			175			120			56		
Unit	**Unit For Muir (1929) / This Study[1]**	**1.1**			**1.2**			**2.1**			**2.2**			**2.3**		
Total Species[2]		**Tot.[3]**	**dif.[4] both**	**dif. one[5]**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
219	Renosterveld Proper	17	0	12	12	1	8	25	6	12	11	0	6	8	1	5
44	Aloe Scrub	3	0	0	2	0	0	6	0	1	6	0	2	3	0	2
11	Bokkeveld Shale	3	0	0	2	0	0	4	0	1	3	0	0	2	0	1
11	Bokkeveld Shale Adjacent Langeberg	2	0	0	2	0	0	3	0	0	5	0	0	2	0	1
30	Uitenhage Group in Valley	1	0	0	1	0	0	4	1	0	2	0	0	2	0	1
26	Uitenhage Group on Hill	3	0	2	2	0	1	4	1	1	4	0	2	2	0	2
9	Melilite Basalt	0	0	0	0	0	0	1	0	0	1	0	0	1	0	1
69	Witteberg Series	5	0	2	4	0	1	8	0	3	9	0	3	3	0	1
22	High and Rocky River Valley	1	0	1	1	0	1	2	0	2	1	0	1	1	0	1
13	Low River Valley	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0

[1] 1.1 = *Themeda triandra* - *Senecio* sp. (G.R.Raitt 710) Grassland Community, 1.2 = *Themeda triandra* - *Stoebe phyllostachys* Grassland Community, 2.1 = *Themeda triandra* - *Argyrolobium* sp. (G.R.Raitt 29) Community, 2.2 = *Themeda triandra* - *Bobartia macrospatha* Herbland Community, 2.3 = *Themeda triandra* - *Elytropappus rhinocerotis* Shrubland Community

[2] Total number of species listed for each published unit

[3] Total number of species shared by the units compared

[4] Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

[5] Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

Table 7.10.1c: Quantitative comparison of Muir's (1929) vegetation units with the Community Groups described in this study

	Total Species for Units of This Study	149			115		
Unit Total Species[2]	**Unit For Muir (1929)** / **This Study**[1]	**1**			**2**		
		Tot.[3]	**dif. both**[4]	**dif. one**[5]	**Tot.**	**dif. both**	**dif. one**
219	Renosterveld Proper	19	1	13	15	2	9
44	Aloe Scrub	3	0	0	5	1	2
11	Bokkeveld Shale	3	0	0	2	0	1
11	Bokkeveld Shale Adjacent Langeberg	2	0	0	3	0	1
30	Uitenhage Group in Valley	1	0	0	3	0	1
26	Uitenhage Group on Hill	3	0	2	2	0	2
9	Melilite Basalt	0	0	0	1	0	1
69	Witteberg Series	5	0	0	6	1	1
22	High and Rocky River Valley	1	0	1	2	0	2
13	Low River Valley	0	0	0	1	0	0

[1] 1 = *Themeda triandra - Stoebe phyllostachys* Grassland Community Group, 2 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community Group

[2] Total number of species listed for each published unit

[3] Total number of species shared by the units compared

[4] Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

[5] Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

Table 7.10.1d: Quantitative comparison of Muir's (1929) Renosterveld units and the Subcommunities described in this study, of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating

	Total Species for Units of This Study		122			112			104			104			147		
Unit Total Species[2]	**Unit For Muir (1929)**	**This Study[1]**	**1.1.1**			**1.1.2**			**2.1.1**			**2.1.2**			**2.1.3**		
			Tot.[3]	**dif.[4] both**	**dif. one[5]**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
219	Renosterveld Proper	Diff. s.t.[6]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?[7]	0	0	0	0	0	0	1	0	1	0	0	0	2	0	2
44	Aloe Scrub	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Bokkeveld Shale	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Bokkeveld Shale Adjacent Langeberg	Diff. s.t.	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	Uitenhage Group in Valley	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	Uitenhage Group on Hill	Diff. s.t.	1	0	0	1	0	0	1	0	0	1	0	0	1	0	1
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Melilite Basalt	Diff. s.t.	1	0	0	1	0	0	1	0	0	1	0	0	1	0	1
		Same sp.?	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1
69	Witteberg Series	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
22	High and Rocky River Valley	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Low River Valley	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[1] 1.1.1 = *Themeda triandra* - *Centella* cf. *eriantha* Grassland Subcommunity, 1.1.2 = *Themeda triandra* - *Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum, 2.1.1 = *Themeda triandra* - *Chrysanthemoides monilifera* Subcommunity, 2.1.2 = *Themeda triandra* - *Aspalathus nigra* Subcommunity, 2.1.3 = *Themeda triandra* - *Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum

[2] Total number of species listed for each published unit.

[3] Total number of species shared by the units compared

[4] Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

[5] Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

[6] Different subtaxa of the same species

[7] Uncertain name updating of what is possibly the same species

Table 7.10.1e: Quantitative comparison of Muir's (1929) Renosterveld units and the Communities described in this study, of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating

	Total Species for Units of This Study		140			106			175			120			56		
Unit Total Species[2]	**Unit For Muir (1929)**	**This Study**[1]	**1.1**			**1.2**			**2.1**			**2.2**			**2.3**		
			Tot.[3]	**dif.**[4] **both**	**dif. one**[5]	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
219	Renosterveld Proper	Diff. s.t.[6]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?[7]	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0
44	Aloe Scrub	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Bokkeveld Shale	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Bokkeveld Shale Adjacent Langeberg	Diff. s.t.	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	Uitenhage Group in Valley	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	Uitenhage Group on Hill	Diff. s.t.	1	0	0	1	0	0	1	0	1	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Melilite Basalt	Diff. s.t.	1	0	0	1	0	0	1	0	1	0	0	0	0	0	0
		Same sp.?	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1
69	Witteberg Series	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
22	High and Rocky River Valley	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Low River Valley	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1 1.1 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Community, 1.2 = *Themeda triandra - Stoebe phyllostachys* Grassland Community, 2.1 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Community, 2.2 = *Themeda triandra - Bobartia macrospatha* Herbland Community, 2.3 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community

2 Total number of species listed for each published unit

3 Total number of species shared by the units compared

4 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

5 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

6 Different subtaxa of the same species

7 Uncertain name updating of what is possibly the same species

Table 7.10.1f: Quantitative comparison of Muir's (1929) Renosterveld units and the Community Groups described in this study, of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating

	Total Species for Units of This Study		149			115		
Unit Total Species[2]	**Unit For Muir (1929)**	**This Study[1]**	**1**			**2**		
			Tot.[3]	**dif. both[4]**	**dif. one[5]**	**Tot.**	**dif. both**	**dif. one**
219	Renosterveld Proper	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	1	1	0
44	Aloe Scrub	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
11	Bokkeveld Shale	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
11	Bokkeveld Shale Adjacent Langeberg	Diff. s.t.	1	0	1	1	0	1
		Same sp.?	0	0	0	0	0	0
30	Uitenhage Group in Valley	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
26	Uitenhage Group on Hill	Diff. s.t.	1	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
9	Melilite Basalt	Diff. s.t.	1	0	0	0	0	0
		Same sp.?	1	0	1	1	0	1
69	Witteberg Series	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
22	High and Rocky River Valley	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
13	Low River Valley	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0

1 1 = *Themeda triandra - Stoebe phyllostachys* Grassland Community Group, 2 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community Group
2 Total number of species listed for each published unit
3 Total number of species shared by the units compared
4 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared
5 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both
6 Different subtaxa of the same species
7 Uncertain name updating of what is possibly the same species

Table 7.10.2a: Quantitative comparison of Jordaan's (1964) vegetation units with the Subcommunities described in this study

	Total Species for Units of This Study	122			112			104			104			147		
Unit Total Species[2]	**Unit For Jordaan (1964) / This Study[1]**	**1.1.1**			**1.1.2**			**2.1.1**			**2.1.2**			**2.1.3**		
		Tot.[3]	**dif.[4] both**	**dif. one[5]**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
5	Mountain Renosterbosveld	1	0	1	0	0	0	1	0	1	1	0	1	2	1	1
2	Heiveld	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0
3 to 4	Renosterbosveld Communities	1	0	1	1	0	1	2	0	1	2	0	1	2	0	1
1	Plamperveld	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[1] 1.1.1 = *Themeda triandra - Centella* cf. *eriantha* Grassland Subcommunity, 1.1.2 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum, 2.1.1 = *Themeda triandra - Chrysanthemoides monilifera* Subcommunity, 2.1.2 = *Themeda triandra - Aspalathus nigra* Subcommunity, 2.1.3 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum

[2] Total number of species listed for each published unit

[3] Total number of species shared by the units compared

[4] Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

[5] Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

Table 7.10.2b: Quantitative comparison of Jordaan's (1964) vegetation units with the Communities described in this study

	Total Species for Units of This Study	140			106			175			120			56		
Unit Total Species[2]	**Unit For Jordaan (1964) / This Study[1]**	**1.1**			**1.2**			**2.1**			**2.2**			**2.3**		
		Tot.[3]	**dif.[4] both**	**dif. one[5]**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
5	Mountain Renosterbosveld	1	0	1	0	0	0	2	1	1	2	0	1	1	0	1
2	Heiveld	1	0	1	0	0	0	0	0	0	1	0	1	0	0	0
3 to 4	Renosterbosveld Communities	1	0	1	1	0	1	2	0	1	2	0	1	2	0	2
1	Plamperveld	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[1] 1.1 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Community, 1.2 = *Themeda triandra - Stoebe phyllostachys* Grassland Community, 2.1 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Community, 2.2 = *Themeda triandra - Bobartia macrospatha* Herbland Community, 2.3 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community

[2] Total number of species listed for each published unit

[3] Total number of species shared by the units compared

[4] Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

[5] Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

Table 7.10.2c: Quantitative comparison of Jordaan's (1964) vegetation units with the Community Groups described in this study

	Total Species for Units of This Study	149			115		
Unit Total Species[2]	**Unit For Jordaan (1964)** / **This Study**[1]	**1**			**2**		
		Tot.[3]	**dif. both**[4]	**dif. one**[5]	**Tot.**	**dif. both**	**dif. one**
5	Mountain Renosterbosveld	1	0	1	1	0	1
2	Heiveld	1	0	1	0	0	0
3 to4	Renosterbosveld Communities	1	0	1	2	0	2
1	Plamperveld	0	0	0	0	0	0

[1] 1 = *Themeda triandra - Stoebe phyllostachys* Grassland Community Group, 2 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community Group

[2] Total number of species listed for each published unit

[3] Total number of species shared by the units compared

[4] Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

[5] Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

Table 7.10.3a: Quantitative comparison of Grobler and Marais's (1967) and Taylor's (1972b) vegetation units with the Subcommunities described in this study

	Total Species for Units of This Study	122			112			104			104			147		
Unit	**Unit For This Study[1]**	**1.1.1**			**1.1.2**			**2.1.1**			**2.1.2**			**2.1.3**		
Total Species[2]	**Grobler and Marais (1967) & Taylor (1972b)**	**Tot.[3]**	**dif.[4] both**	**dif. one[5]**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
12	*Leucadendron – Lanaria* Community	3	0	0	3	0	0	2	0	0	2	0	0	2	0	1
10	*Cliffortia ruscifolia* Community	2	0	0	0	0	0	2	0	0	1	0	0	3	0	1
15	*Protea repens* Community	4	0	0	3	0	0	4	0	0	4	0	0	6	0	1
11	*Leucadendron – Pelargonium* Com.[6]	1	0	0	1	0	0	2	0	0	2	0	0	2	0	0
8	*Erica diaphana* Community	1	0	0	1	0	0	2	0	0	2	0	0	2	0	0
8	*Leucadendron* Community of Plain	2	0	0	2	0	0	2	0	0	2	0	0	2	0	1
12	Renosterbos Community of Plain	3	0	0	3	0	0	5	0	0	5	0	0	6	0	0
10	Renosterbos Community of Slopes	3	0	0	2	0	0	2	0	0	2	0	0	3	0	0
4	Short Renosterbos – *Themeda* Com.	2	0	0	2	0	0	3	0	0	3	0	0	3	0	0
7	*Olea – Chilianthus* Community	2	0	0	1	0	0	4	0	0	3	0	0	3	0	0
8	*Aloe ferox* Community	2	0	0	2	0	0	5	0	0	4	0	0	4	0	0
12	*Acacia karroo* Community	1	0	0	1	0	0	3	0	0	2	0	0	2	0	0
8	*Podocarpus* Community	1	0	0	0	0	0	1	0	0	1	0	0	1	0	0
1	Com. 14, *Themeda triandra* Floodplain	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
0	Community 15, Graminoid Flats	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1 1.1.1 = *Themeda triandra* - *Centella* cf. *eriantha* Grassland Subcommunity, 1.1.2 = *Themeda triandra* - *Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum, 2.1.1 = *Themeda triandra* - *Chrysanthemoides monilifera* Subcommunity, 2.1.2 = *Themeda triandra* - *Aspalathus nigra* Subcommunity, 2.1.3 = *Themeda triandra* - *Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum

2 Total number of species listed for each published unit

3 Total number of species shared by the units compared

4 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

5 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

6 Com. = Community

Table 7.10.3b: Quantitative comparison of Grobler and Marais's (1967) and Taylor's (1972b) vegetation units with the Communities described in this study

	Total Species for Units of This Study	140			106			175			120			56		
Unit Total Species[2]	**Unit For This Study**[1] **Grobler and Marais (1967) & Taylor (1972b)**	**1.1**			**1.2**			**2.1**			**2.2**			**2.3**		
		Tot.[3]	**dif.**[4] **both**	**dif. one**[5]	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
12	*Leucadendron – Lanaria* Community	3	0	0	2	0	0	2	0	1	3	0	1	1	0	0
10	*Cliffortia ruscifolia* Community	2	0	0	0	0	0	4	0	1	3	0	0	1	0	1
15	*Protea repens* Community	4	0	0	4	0	0	6	0	1	5	0	1	3	0	1
11	*Leucadendron – Pelargonium* Com.[6]	1	0	0	1	0	0	2	0	0	3	0	1	2	0	1
8	*Erica diaphana* Community	1	0	0	1	0	0	2	0	0	3	0	1	2	0	1
8	*Leucadendron* Community of Plain	2	0	0	2	0	0	2	0	1	2	0	1	1	0	0
12	Renosterbos Community of Plain	4	0	0	4	0	0	6	0	0	5	0	0	5	0	2
10	Renosterbos Community of Slopes	3	0	0	1	0	0	3	0	0	4	0	0	2	0	1
4	Short Renosterbos – *Themeda* Com.	2	0	0	2	0	0	3	0	0	2	0	0	3	0	1
7	*Olea – Chilianthus* Community	2	0	0	1	0	0	4	0	0	3	0	0	3	0	2
8	*Aloe ferox* Community	3	0	0	2	0	0	5	0	0	3	0	0	4	0	2
12	*Acacia karroo* Community	2	0	0	1	0	0	3	0	0	2	0	0	2	0	1
8	*Podocarpus* Community	1	0	0	0	0	0	1	0	0	1	0	0	1	0	1
1	Com. 14, *Themeda triandra* Floodplain	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
0	Community 15, Graminoid Flats	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1 1.1 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Community, 1.2 = *Themeda triandra - Stoebe phyllostachys* Grassland Community, 2.1 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Community, 2.2 = *Themeda triandra - Bobartia macrospatha* Herbland Community, 2.3 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community

2 Total number of species listed for each published unit

3 Total number of species shared by the units compared

4 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

5 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

6 Com. = Community

Table 7.10.3c: Quantitative comparison of Grobler and Marais's (1967) and Taylor's (1972b) vegetation units with the Community Groups described in this study

	Total Species for Units of This Study	149			115		
Unit Total Species[2]	**Unit For Grobler and Marais (1967) & Taylor (1972b)** / **This Study**[1]	**1**			**2**		
		Tot.[3]	**dif. both**[4]	**dif. one**[5]	**Tot.**	**dif. both**	**dif. one**
12	*Leucadendron – Lanaria* Community	2	0	0	1	0	0
10	*Cliffortia ruscifolia* Community	2	0	0	2	0	1
15	*Protea repens* Community	5	0	0	3	0	1
11	*Leucadendron – Pelargonium* Community	1	0	0	2	0	1
8	*Protea repens* Community	1	0	0	2	0	1
8	*Leucadendron* Community of Plain	2	0	0	1	0	0
12	Renosterbos Community of Plain	5	0	0	5	0	2
10	Renosterbos Community of Slopes	3	0	0	2	0	1
4	Short Renosterbos – *Themeda* Community	2	0	0	3	0	1
7	*Olea – Chilianthus* Community	2	0	0	4	0	2
8	*Aloe ferox* Community	3	0	0	5	0	2
12	*Acacia karroo* Community	2	0	0	3	0	1
8	*Podocarpus* Community	1	0	0	1	0	1
1	Com.[6] 14, *Themeda triandra* Floodplain	1	0	0	1	0	0
0	Community 15, Graminoid Flats	0	0	0	0	0	0

[1] 1 = *Themeda triandra - Stoebe phyllostachys* Grassland Community Group, 2 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community Group
[2] Total number of species listed for each published unit
[3] Total number of species shared by the units compared
[4] Differential (dif.) species (that distinguish the different units from others) shared by both the units compared
[5] Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both
[6] Com. = Community

Table 7.10.3d: Quantitative comparison of Grobler and Marais's (1967) and Taylor's (1972b) vegetation units and the Subcommunities described in this study, of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating

	Total Species for Units of This Study		122			112			104			104			147		
Unit Total Species[2]	**Unit For Grobler and Marais (1967) & Taylor (1972b)**	**This Study[1]**	**1.1.1**			**1.1.2**			**2.1.1**			**2.1.2**			**2.1.3**		
			Tot.[3]	**dif.[4] both**	**dif. one[5]**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
12	*Leucadendron – Lanaria* Community	Diff. s.t.[6]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?[7]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	*Cliffortia ruscifolia* Community	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
15	*Protea repens* Community	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	*Leucadendron – Pelargonium* Community	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	*Erica diaphana* Community	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	*Leucadendron* Community of Plain	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Renosterbos Community of Plain	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Renosterbos Community of Slopes	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Short Renosterbos – *Themeda* Community	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	*Olea – Chilianthus* Community	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[1] 1.1.1 = *Themeda triandra - Centella* cf. *eriantha* Grassland Subcommunity, 1.1.2 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum, 2.1.1 = *Themeda triandra - Chrysanthemoides monilifera* Subcommunity, 2.1.2 = *Themeda triandra - Aspalathus nigra* Subcommunity, 2.1.3 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum

[2] Total number of species listed for each published unit

[3] Total number of species shared by the units compared

[4] Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

[5] Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

[6] Different subtaxa of the same species

[7] Uncertain name updating of what is possibly the same species

Table 7.10.3d Continued: Quantitative comparison of Grobler and Marais's (1967) and Taylor's (1972b) vegetation units and the Subcommunities described in this study of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating

	Total Species for Units of This Study		122			112			104			104			147		
Unit Total Species[2]	**Unit For Grobler and Marais (1967) & Taylor (1972b)**	**This Study**[1]	**1.1.1**			**1.1.2**			**2.1.1**			**2.1.2**			**2.1.3**		
			Tot.[3]	**dif.**[4] **both**	**dif. one**[5]	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
8	*Aloe ferox* Community	Diff. s.t.[6]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?[7]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	*Acacia karroo* Community	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	*Podocarpus* Community	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	Community 14, *Themeda triandra* Floodplain	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	Community 15, Graminoid Flats	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[1] 1.1.1 = *Themeda triandra - Centella* cf. *eriantha* Grassland Subcommunity, 1.1.2 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum, 2.1.1 = *Themeda triandra - Chrysanthemoides monilifera* Subcommunity, 2.1.2 = *Themeda triandra - Aspalathus nigra* Subcommunity, 2.1.3 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum

[2] Total number of species listed for each published unit

[3] Total number of species shared by the units compared

[4] Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

[5] Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

[6] Different subtaxa of the same species

[7] Uncertain name updating of what is possibly the same species

Table 7.10.3e: Quantitative comparison of Grobler and Marais's (1967) and Taylor's (1972b) vegetation units and the Communities described in this study, of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating

	Total Species for Units of This Study		140			106			175			120			56		
Unit Total Species[2]	**Unit For Grobler and Marais (1967) & Taylor (1972b)**	**This Study[1]**	**1.1**			**1.2**			**2.1**			**2.2**			**2.3**		
			Tot.[3]	**dif.[4] both**	**dif. one[5]**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
12	*Leucadendron – Lanaria* Community	Diff. s.t.[6]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?[7]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	*Cliffortia ruscifolia* Community	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
15	*Protea repens* Community	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	*Leucadendron – Pelargonium* Community	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	*Erica diaphana* Community	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	*Leucadendron* Community of Plain	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Renosterbos Community of Plain	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Renosterbos Community of Slopes	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Short Renosterbos – *Themeda* Community	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	*Olea – Chilianthus* Community	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1 1.1 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Community, 1.2 = *Themeda triandra - Stoebe phyllostachys* Grassland Community, 2.1 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Community, 2.2 = *Themeda triandra - Bobartia macrospatha* Herbland Community, 2.3 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community

2 Total number of species listed for each published unit

3 Total number of species shared by the units compared

4 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

5 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

6 Different subtaxa of the same species

7 Uncertain name updating of what is possibly the same species

Table 7.10.3e Continued: Quantitative comparison of Grobler and Marais's (1967) and Taylor's (1972b) vegetation units and the Communities described in this study, of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating

	Total Species for Units of This Study		140			106			175			120			56		
Unit Total Species[2]	**Unit For Grobler and Marais (1967) & Taylor (1972b)**	**This Study[1]**	**1.1**			**1.2**			**2.1**			**2.2**			**2.3**		
			Tot.[3]	**dif.[4] both**	**dif. one[5]**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
8	*Aloe ferox* Community	Diff. s.t.[6]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?[7]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	*Acacia karroo* Community	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	*Podocarpus* Community	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	Community 14, *Themeda triandra* Floodplain	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	Community 15, Graminoid Flats	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[1] 1.1 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Community, 1.2 = *Themeda triandra - Stoebe phyllostachys* Grassland Community, 2.1 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Community, 2.2 = *Themeda triandra - Bobartia macrospatha* Herbland Community, 2.3 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community

[2] Total number of species listed for each published unit

[3] Total number of species shared by the units compared

[4] Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

[5] Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

[6] Different subtaxa of the same species

[7] Uncertain name updating of what is possibly the same species

Table 7.10.3f: Quantitative comparison of Grobler and Marais's (1967) and Taylor's (1972b) vegetation units and the Community Groups described in this study, of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating

	Total Species for Units of This Study		149			115		
Unit Total Species[2]	**Unit For Grobler and Marais (1967) & Taylor (1972b)**	**This Study[1]**	**1**			**2**		
			Tot.[3]	**dif.[4] both**	**dif. one[5]**	**Tot.**	**dif. both**	**dif. one**
12	*Leucadendron – Lanaria* Community	Diff. s.t.[6]	0	0	0	0	0	0
		Same sp.?[7]	0	0	0	0	0	0
10	*Cliffortia ruscifolia* Community	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	1	0	0	1	0	0
15	*Protea repens* Community	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
11	*Leucadendron – Pelargonium* Community	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
8	*Erica diaphana* Community	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
8	*Leucadendron* Community of Plain	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
12	Renosterbos Community of Plain	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
10	Renosterbos Community of Slopes	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
4	Short Renosterbos – *Themeda* Community	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
7	*Olea – Chilianthus* Community	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
8	*Aloe ferox* Community	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
12	*Acacia karroo* Community	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
8	*Podocarpus* Community	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
1	Community 14, *Themeda triandra* Floodplain	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
0	Community 15, Graminoid Flats	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0

[1] 1 = *Themeda triandra - Stoebe phyllostachys* Grassland Community Group, 2 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community Group
[2] Total number of species listed for each published unit
[3] Total number of species shared by the units compared
[4] Differential (dif.) species (that distinguish the different units from others) shared by both the units compared
[5] Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both
[6] Different subtaxa of the same species
[7] Uncertain name updating of what is possibly the same species

Table 7.10.4a: Quantitative comparison of Cowling's (1984) vegetation units with the Subcommunities described in this study

	Total Species for Units of This Study	122			112			104			104			147		
Unit Total Species[2]	**Unit For Cowling (1984)**[3] / **This Study**[1]	**1.1.1**			**1.1.2**			**2.1.1**			**2.1.2**			**2.1.3**		
		Tot.[4]	**dif.**[5] **both**	**dif. one**[6]	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
41	Grassy Fynbos A	7	0	0	7	0	0	7	0	0	7	0	0	8	0	2
74	Grassy Fynbos B	16	0	1	13	0	0	11	0	0	12	0	0	14	0	3
61	Grassy Fynbos C	11	0	1	9	0	0	9	0	0	9	0	0	10	0	2
42	Grassy Fynbos D	6	0	0	6	0	0	5	0	0	5	0	0	7	0	0
56	Grassy Fynbos E	11	0	1	9	0	0	7	0	0	8	0	0	14	0	4
54	South Coast Renosterveld A	14	0	1	12	0	1	12	0	0	14	0	0	16	0	6
62	South Coast Renosterveld B	14	0	0	12	0	0	13	0	0	15	0	0	17	0	6
61	South Coast Renosterveld C	9	0	1	8	0	1	9	0	1	9	0	1	11	0	6
39	South Coast Renosterveld D	8	0	0	7	0	0	7	0	0	9	0	0	10	0	5

1 1.1.1 = *Themeda triandra - Centella* cf. *eriantha* Grassland Subcommunity, 1.1.2 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum, 2.1.1 = *Themeda triandra - Chrysanthemoides monilifera* Subcommunity, 2.1.2 = *Themeda triandra - Aspalathus nigra* Subcommunity, 2.1.3 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum

2 Total number of species listed for each published unit

3 Grassy Fynbos A = *Themeda triandra – Passerina pendula* Hankey Dry Grassy Fynbos, Grassy Fynbos B = *Erica pectinifolia – Trachypogon spicatus* Humansdorp Grassy Fynbos, Grassy Fynbos C = *Protea neriifolia – Clutia alaternoides* Humansdorp Grassy Fynbos, Grassy Fynbos D= *Thamnochortus glaber – Erica diaphana* Tsitsikamma Grassy Fynbos, Grassy Fynbos E = *Thamnochortus fruticosus – Tristachya leucothrix* Tsitsikamma Restioid Grassland, South Coast Renosterveld A = *Themeda triandra – Cliffortia linearifolia* Humansdorp False Fynbos, South Coast Renosterveld B = *Elytropappus rhinocerotis – Metalasia muricata* Humansdorp Coast Renosterveld, South Coast Renosterveld C = *Elytropappus rhinocerotis – Eustachys paspaloides* Hankey Coast Renosterveld, South Coast Renosterveld D = *Elytropappus rhinocerotis - Oedera genistifolia* Humansdorp Coast Renosterveld

4 Total number of species shared by the units compared

5 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

6 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

Table 7.10.4b: Quantitative comparison of Cowling's (1984) vegetation units with the Communities described in this study

	Total Species for Units of This Study	140			106			175			120			56		
Unit Total Species[2]	**Unit For Cowling (1984)**[3] / **This Study**[1]	**1.1**			**1.2**			**2.1**			**2.2**			**2.3**		
		Tot.[4]	**dif.**[5] **both**	**dif. one**[6]	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
41	Grassy Fynbos A	7	0	0	6	0	0	10	0	2	9	0	1	4	0	1
74	Grassy Fynbos B	16	0	0	12	0	1	18	0	4	16	0	1	6	0	2
61	Grassy Fynbos C	10	0	0	7	0	0	12	0	2	12	0	1	5	0	2
42	Grassy Fynbos D	6	0	0	5	0	0	7	0	0	10	0	1	5	0	1
56	Grassy Fynbos E	12	0	1	9	0	1	16	1	5	11	0	0	5	0	1
54	South Coast Renosterveld A	15	0	1	15	0	1	19	0	7	13	0	0	4	0	1
62	South Coast Renosterveld B	15	0	0	14	0	0	19	0	7	12	0	0	7	0	1
61	South Coast Renosterveld C	10	0	1	7	0	1	12	0	6	8	0	2	4	0	2
39	South Coast Renosterveld D	9	0	0	6	0	0	11	0	6	5	0	0	4	0	1

1 1.1 = *Themeda triandra* - *Senecio* sp. (G.R.Raitt 710) Grassland Community, 1.2 = *Themeda triandra* - *Stoebe phyllostachys* Grassland Community, 2.1 = *Themeda triandra* - *Argyrolobium* sp. (G.R.Raitt 29) Community, 2.2 = *Themeda triandra* - *Bobartia macrospatha* Herbland Community, 2.3 = *Themeda triandra* - *Elytropappus rhinocerotis* Shrubland Community

2 Total number of species listed for each published unit

3 Grassy Fynbos A = *Themeda triandra – Passerina pendula* Hankey Dry Grassy Fynbos, Grassy Fynbos B = *Erica pectinifolia – Trachypogon spicatus* Humansdorp Grassy Fynbos, Grassy Fynbos C = *Protea neriifolia – Clutia alaternoides* Humansdorp Grassy Fynbos, Grassy Fynbos D= *Thamnochortus glaber – Erica diaphana* Tsitsikamma Grassy Fynbos, Grassy Fynbos E = *Thamnochortus fruticosus – Tristachya leucothrix* Tsitsikamma Restioid Grassland, South Coast Renosterveld A = *Themeda triandra – Cliffortia linearifolia* Humansdorp False Fynbos, South Coast Renosterveld B = *Elytropappus rhinocerotis – Metalasia muricata* Humansdorp Coast Renosterveld, South Coast Renosterveld C = *Elytropappus rhinocerotis – Eustachys paspaloides* Hankey Coast Renosterveld, South Coast Renosterveld D = *Elytropappus rhinocerotis - Oedera genistifolia* Humansdorp Coast Renosterveld

4 Total number of species shared by the units compared

5 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

6 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

Table 7.10.4c: Quantitative comparison of Cowling's (1984) vegetation units with the Community Groups described in this study

	Total Species for Units of This Study	149			115		
Unit Total Species[2]	**Unit For Cowling (1984)**[3] / **This Study**[1]	**1**			**2**		
		Tot.[4]	**dif. both**[5]	**dif. one**[6]	**Tot.**	**dif. both**	**dif. one**
41	Grassy Fynbos A	7	0	0	5	0	2
74	Grassy Fynbos B	16	0	1	7	0	3
61	Grassy Fynbos C	10	0	0	6	0	3
42	Grassy Fynbos D	6	0	0	5	0	1
56	Grassy Fynbos E	12	0	2	7	1	2
54	South Coast Renosterveld A	17	0	1	4	0	1
62	South Coast Renosterveld B	17	0	0	4	0	1
61	South Coast Renosterveld C	10	0	1	4	0	2
39	South Coast Renosterveld D	9	0	0	4	0	1

[1] 1 = *Themeda triandra - Stoebe phyllostachys* Grassland Community Group, 2 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community Group

[2] Total number of species listed for each published unit

[3] Grassy Fynbos A = *Themeda triandra – Passerina pendula* Hankey Dry Grassy Fynbos, Grassy Fynbos B = *Erica pectinifolia – Trachypogon spicatus* Humansdorp Grassy Fynbos, Grassy Fynbos C = *Protea neriifolia – Clutia alaternoides* Humansdorp Grassy Fynbos, Grassy Fynbos D= *Thamnochortus glaber – Erica diaphana* Tsitsikamma Grassy Fynbos, Grassy Fynbos E = *Thamnochortus fruticosus – Tristachya leucothrix* Tsitsikamma Restioid Grassland, South Coast Renosterveld A = *Themeda triandra – Cliffortia linearifolia* Humansdorp False Fynbos, South Coast Renosterveld B = *Elytropappus rhinocerotis – Metalasia muricata* Humansdorp Coast Renosterveld, South Coast Renosterveld C = *Elytropappus rhinocerotis – Eustachys paspaloides* Hankey Coast Renosterveld, South Coast Renosterveld D = *Elytropappus rhinocerotis - Oedera genistifolia* Humansdorp Coast Renosterveld

[4] Total number of species shared by the units compared

[5] Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

[6] Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

Table 7.10.4d: Quantitative comparison of Cowling's (1984) vegetation units and the Subcommunities described in this study, of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating

	Total Species for Units of This Study		122			112			104			104			147		
Unit Total Species[2]	**Unit For Cowling (1984)**[3]	**This Study**[1]	**1.1.1**			**1.1.2**			**2.1.1**			**2.1.2**			**2.1.3**		
			Tot.[4]	**dif.**[5] **both**	**dif. one**[6]	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
41	Grassy Fynbos A	Diff. s.t.[7]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?[8]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
74	Grassy Fynbos B	Diff. s.t.	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
61	Grassy Fynbos C	Diff. s.t.	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
42	Grassy Fynbos D	Diff. s.t.	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	Grassy Fynbos E	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1

1 1.1.1 = *Themeda triandra - Centella* cf. *eriantha* Grassland Subcommunity, 1.1.2 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum, 2.1.1 = *Themeda triandra - Chrysanthemoides monilifera* Subcommunity, 2.1.2 = *Themeda triandra - Aspalathus nigra* Subcommunity, 2.1.3 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum

2 Total number of species listed for each published unit

3 Grassy Fynbos A = *Themeda triandra – Passerina pendula* Hankey Dry Grassy Fynbos, Grassy Fynbos B = *Erica pectinifolia – Trachypogon spicatus* Humansdorp Grassy Fynbos, Grassy Fynbos C = *Protea neriifolia – Clutia alaternoides* Humansdorp Grassy Fynbos, Grassy Fynbos D= *Thamnochortus glaber – Erica diaphana* Tsitsikamma Grassy Fynbos, Grassy Fynbos E = *Thamnochortus fruticosus – Tristachya leucothrix* Tsitsikamma Restioid Grassland, South Coast Renosterveld A = *Themeda triandra – Cliffortia linearifolia* Humansdorp False Fynbos, South Coast Renosterveld B = *Elytropappus rhinocerotis – Metalasia muricata* Humansdorp Coast Renosterveld, South Coast Renosterveld C = *Elytropappus rhinocerotis – Eustachys paspaloides* Hankey Coast Renosterveld, South Coast Renosterveld D = *Elytropappus rhinocerotis - Oedera genistifolia* Humansdorp Coast Renosterveld

4 Total number of species shared by the units compared

5 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

6 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

7 Different subtaxa of the same species

8 Uncertain name updating of what is possibly the same species

Table 7.10.4d Continued: Quantitative comparison of Cowling's (1984) vegetation units and the Subcommunities described in this study, of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating

	Total Species for Units of This Study		122			112			104			104			147		
Unit Total Species[2]	**Unit For Cowling (1984)**[3]	**This Study**[1]	**1.1.1**			**1.1.2**			**2.1.1**			**2.1.2**			**2.1.3**		
			Tot.[4]	**dif.**[5] **both**	**dif. one**[6]	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
54	South Coast Renosterveld A	Diff. s.t.[7]	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
		Same sp.?[8]	0	0	0	1	0	0	0	0	0	0	0	0	2	0	1
62	South Coast Renosterveld B	Diff. s.t.	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
		Same sp.?	0	0	0	1	0	0	0	0	0	0	0	0	2	0	1
61	South Coast Renosterveld C	Diff. s.t.	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
39	South Coast Renosterveld D	Diff. s.t.	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1

1 1.1.1 = *Themeda triandra - Centella* cf. *eriantha* Grassland Subcommunity, 1.1.2 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum, 2.1.1 = *Themeda triandra - Chrysanthemoides monilifera* Subcommunity, 2.1.2 = *Themeda triandra - Aspalathus nigra* Subcommunity, 2.1.3 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum

2 Total number of species listed for each published unit

3 Grassy Fynbos A = *Themeda triandra – Passerina pendula* Hankey Dry Grassy Fynbos, Grassy Fynbos B = *Erica pectinifolia – Trachypogon spicatus* Humansdorp Grassy Fynbos, Grassy Fynbos C = *Protea neriifolia – Clutia alaternoides* Humansdorp Grassy Fynbos, Grassy Fynbos D= *Thamnochortus glaber – Erica diaphana* Tsitsikamma Grassy Fynbos, Grassy Fynbos E = *Thamnochortus fruticosus – Tristachya leucothrix* Tsitsikamma Restioid Grassland, South Coast Renosterveld A = *Themeda triandra – Cliffortia linearifolia* Humansdorp False Fynbos, South Coast Renosterveld B = *Elytropappus rhinocerotis – Metalasia muricata* Humansdorp Coast Renosterveld, South Coast Renosterveld C = *Elytropappus rhinocerotis – Eustachys paspaloides* Hankey Coast Renosterveld, South Coast Renosterveld D = *Elytropappus rhinocerotis - Oedera genistifolia* Humansdorp Coast Renosterveld

4 Total number of species shared by the units compared

5 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

6 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

7 Different subtaxa of the same species

8 Uncertain name updating of what is possibly the same species

Table 7.10.4e: Quantitative comparison of Cowling's (1984) vegetation units and the Communities described in this study, of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating

	Total Species for Units of This Study		140			106			175			120			56		
Unit Total Species[2]	**Unit For Cowling (1984)**[3]	**This Study**[1]	**1.1**			**1.2**			**2.1**			**2.2**			**2.3**		
			Tot.[4]	**dif.**[5] **both**	**dif. one**[6]	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
41	Grassy Fynbos A	Diff. s.t.[7]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?[8]	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
74	Grassy Fynbos B	Diff. s.t.	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
61	Grassy Fynbos C	Diff. s.t.	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
42	Grassy Fynbos D	Diff. s.t.	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	Grassy Fynbos E	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0

1 1.1 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Community, 1.2 = *Themeda triandra - Stoebe phyllostachys* Grassland Community, 2.1 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Community, 2.2 = *Themeda triandra - Bobartia macrospatha* Herbland Community, 2.3 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community

2 Total number of species listed for each published unit

3 Grassy Fynbos A = *Themeda triandra – Passerina pendula* Hankey Dry Grassy Fynbos, Grassy Fynbos B = *Erica pectinifolia – Trachypogon spicatus* Humansdorp Grassy Fynbos, Grassy Fynbos C = *Protea neriifolia – Clutia alaternoides* Humansdorp Grassy Fynbos, Grassy Fynbos D= *Thamnochortus glaber – Erica diaphana* Tsitsikamma Grassy Fynbos, Grassy Fynbos E = *Thamnochortus fruticosus – Tristachya leucothrix* Tsitsikamma Restioid Grassland, South Coast Renosterveld A = *Themeda triandra – Cliffortia linearifolia* Humansdorp False Fynbos, South Coast Renosterveld B = *Elytropappus rhinocerotis – Metalasia muricata* Humansdorp Coast Renosterveld, South Coast Renosterveld C = *Elytropappus rhinocerotis – Eustachys paspaloides* Hankey Coast Renosterveld, South Coast Renosterveld D = *Elytropappus rhinocerotis - Oedera genistifolia* Humansdorp Coast Renosterveld

4 Total number of species shared by the units compared

5 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

6 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

7 Different subtaxa of the same species

8 Uncertain name updating of what is possibly the same species

Table 7.10.4e Continued: Quantitative comparison of Cowling's (1984) vegetation units and the Communities described in this study, of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating

	Total Species for Units of This Study		140			106			175			120			56		
Unit Total Species[2]	**Unit For Cowling (1984)**[3]	**This Study**[1]	**1.1**			**1.2**			**2.1**			**2.2**			**2.3**		
			Tot.[4]	**dif.**[5] **both**	**dif. one**[6]	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
54	South Coast Renosterveld A	Diff. s.t.[7]	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
		Same sp.?[8]	1	0	0	1	0	0	2	0	1	0	0	0	0	0	0
62	South Coast Renosterveld B	Diff. s.t.	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
		Same sp.?	1	0	0	1	0	0	2	0	1	0	0	0	0	0	0
61	South Coast Renosterveld C	Diff. s.t.	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
39	South Coast Renosterveld D	Diff. s.t.	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0

1 1.1 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Community, 1.2 = *Themeda triandra - Stoebe phyllostachys* Grassland Community, 2.1 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Community, 2.2 = *Themeda triandra - Bobartia macrospatha* Herbland Community, 2.3 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community

2 Total number of species listed for each published unit

3 Grassy Fynbos A = *Themeda triandra – Passerina pendula* Hankey Dry Grassy Fynbos, Grassy Fynbos B = *Erica pectinifolia – Trachypogon spicatus* Humansdorp Grassy Fynbos, Grassy Fynbos C = *Protea neriifolia – Clutia alaternoides* Humansdorp Grassy Fynbos, Grassy Fynbos D= *Thamnochortus glaber – Erica diaphana* Tsitsikamma Grassy Fynbos, Grassy Fynbos E = *Thamnochortus fruticosus – Tristachya leucothrix* Tsitsikamma Restioid Grassland, South Coast Renosterveld A = *Themeda triandra – Cliffortia linearifolia* Humansdorp False Fynbos, South Coast Renosterveld B = *Elytropappus rhinocerotis – Metalasia muricata* Humansdorp Coast Renosterveld, South Coast Renosterveld C = *Elytropappus rhinocerotis – Eustachys paspaloides* Hankey Coast Renosterveld, South Coast Renosterveld D = *Elytropappus rhinocerotis - Oedera genistifolia* Humansdorp Coast Renosterveld

4 Total number of species shared by the units compared

5 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

6 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

7 Different subtaxa of the same species

8 Uncertain name updating of what is possibly the same species

Table 7.10.4f: Quantitative comparison of Cowling's (1984) vegetation units and the Community Groups described in this study, of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating

	Total Species for Units of This Study		149			115		
Unit Total Species[2]	**Unit For Cowling (1984)**[3]	**This Study**[1]	**1**			**2**		
			Tot.[4]	**dif.**[5] **both**	**dif. one**[6]	**Tot.**	**dif. both**	**dif. one**
41	Grassy Fynbos A	Diff. s.t.[7]	0	0	0	0	0	0
		Same sp.?[8]	0	0	0	0	0	0
74	Grassy Fynbos B	Diff. s.t.	1	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0
61	Grassy Fynbos C	Diff. s.t.	1	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0
42	Grassy Fynbos D	Diff. s.t.	1	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
56	Grassy Fynbos E	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
54	South Coast Renosterveld A	Diff. s.t.	1	0	0	1	0	0
		Same sp.?	1	0	0	1	0	0
62	South Coast Renosterveld B	Diff. s.t.	1	0	0	1	0	0
		Same sp.?	1	0	0	1	0	0
61	South Coast Renosterveld C	Diff. s.t.	1	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0
39	South Coast Renosterveld D	Diff. s.t.	1	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0

1 1 = *Themeda triandra - Stoebe phyllostachys* Grassland Community Group, 2 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community Group

2 Total number of species listed for each published unit

3 Grassy Fynbos A = *Themeda triandra – Passerina pendula* Hankey Dry Grassy Fynbos, Grassy Fynbos B = *Erica pectinifolia – Trachypogon spicatus* Humansdorp Grassy Fynbos, Grassy Fynbos C = *Protea neriifolia – Clutia alaternoides* Humansdorp Grassy Fynbos, Grassy Fynbos D= *Thamnochortus glaber – Erica diaphana* Tsitsikamma Grassy Fynbos, Grassy Fynbos E = *Thamnochortus fruticosus – Tristachya leucothrix* Tsitsikamma Restioid Grassland, South Coast Renosterveld A = *Themeda triandra – Cliffortia linearifolia* Humansdorp False Fynbos, South Coast Renosterveld B = *Elytropappus rhinocerotis – Metalasia muricata* Humansdorp Coast Renosterveld, South Coast Renosterveld C = *Elytropappus rhinocerotis – Eustachys paspaloides* Hankey Coast Renosterveld, South Coast Renosterveld D = *Elytropappus rhinocerotis - Oedera genistifolia* Humansdorp Coast Renosterveld

4 Total number of species shared by the units compared

5 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

6 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

7 Different subtaxa of the same species

8 Uncertain name updating of what is possibly the same species

Table 7.10.5a: Quantitative comparison of Boucher's (1987) vegetation units with the Subcommunities described in this study

	Total Species for Units of This Study	122			112			104			104			147		
Unit Total Species[2]	**Unit For Boucher (1987)**[3] / **This Study**[1]	**1.1.1**			**1.1.2**			**2.1.1**			**2.1.2**			**2.1.3**		
		Tot.[4]	**dif.**[5] **both**	**dif. one**[6]	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
82	Community 33	9	0	2	6	0	1	9	0	1	8	0	1	9	0	2
97	Community 34	8	0	0	7	0	0	10	0	1	9	0	0	12	0	2
187	Community 35	14	0	1	9	0	0	15	0	1	12	0	0	19	1	3
145	Community 36	7	0	1	5	0	0	12	0	3	9	0	1	8	0	1
161	Community 37	12	0	0	9	0	0	17	0	1	14	0	0	14	0	1
91	Community 38	6	0	0	5	0	0	12	0	2	10	0	0	8	0	1
174	Communities 37—38	12	0	0	9	0	0	18	0	2	15	0	0	15	0	1
156	Community 39	12	0	0	10	0	0	17	0	1	15	0	0	17	0	3
111	Community 40	10	0	1	9	0	1	13	0	2	13	0	2	12	1	3
92	Community 41	11	0	0	8	0	0	12	0	1	12	0	0	13	0	4
106	Community 42	8	0	0	7	0	0	14	0	0	13	0	0	11	0	1
144	Community 43	7	0	0	6	0	0	14	0	0	11	0	0	12	0	2
127	Community 44	6	0	0	5	0	0	11	0	0	11	0	0	10	0	1
208	Communities 42—44	9	0	0	8	0	0	16	0	0	14	0	0	14	0	2
88	Community 45	4	0	0	1	0	0	7	0	0	6	0	0	7	0	1
99	Community 46	5	0	0	4	0	0	7	0	0	7	0	0	9	0	1
99	Community 47	8	0	0	6	0	0	11	0	0	8	0	0	9	0	1
121	Community 48	11	0	1	10	0	0	12	0	0	10	0	0	13	0	1

1 1.1.1 = *Themeda triandra - Centella* cf. *eriantha* Grassland Subcommunity, 1.1.2 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum, 2.1.1 = *Themeda triandra - Chrysanthemoides monilifera* Subcommunity, 2.1.2 = *Themeda triandra - Aspalathus nigra* Subcommunity, 2.1.3 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum

2 Total number of species listed for each published unit

3 Units according to Table 20 in Boucher (1987). Communities 37, 38, 42—44 are subassociations and so grouped to give the two associations (37&38, 43—44). The other communities are associations.

4 Total number of species shared by the units compared

5 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

6 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

Table 7.10.5b: Quantitative comparison of Boucher's (1987) vegetation units with the Communities described in this study

	Total Species for Units of This Study	140			106			175			120			56		
Unit Total Species[2]	**Unit For Boucher (1987)**[3] **This Study**[1]	**1.1**			**1.2**			**2.1**			**2.2**			**2.3**		
		Tot.[4]	**dif.**[5] **both**	**dif. one**[6]	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
82	Community 33	9	0	1	6	0	1	11	0	2	11	0	2	6	0	2
97	Community 34	8	0	0	6	0	0	15	0	2	10	0	0	5	0	2
187	Community 35	14	0	0	10	0	0	24	1	3	18	0	3	9	0	2
145	Community 36	8	0	0	6	0	0	14	0	2	11	0	2	7	1	0
161	Community 37	13	0	0	10	0	0	22	0	2	19	1	2	10	0	2
91	Community 38	6	0	0	6	0	0	15	0	3	13	0	2	6	0	1
174	Communities 37—38	13	0	0	11	0	0	23	0	3	19	0	2	11	0	2
156	Community 39	14	0	0	12	0	0	23	0	4	19	0	2	11	0	2
111	Community 40	11	0	1	8	0	1	19	1	5	13	0	1	7	0	1
92	Community 41	12	0	0	8	0	0	18	0	5	13	0	1	7	0	1
106	Community 42	9	0	0	9	0	0	16	0	2	16	0	2	8	0	1
144	Community 43	8	0	0	8	0	0	17	0	2	13	0	0	5	0	1
127	Community 44	6	0	0	8	0	0	14	0	3	13	0	0	5	0	1
208	Communities 42—44	10	0	0	10	0	0	20	0	3	18	0	2	7	0	1
88	Community 45	4	0	0	5	0	0	11	0	2	9	0	0	2	0	1
99	Community 46	5	0	0	5	0	0	10	0	1	9	0	1	5	0	1
99	Community 47	7	0	0	5	0	0	14	0	1	12	0	2	5	0	1
121	Community 48	13	0	1	9	0	0	16	0	2	15	0	3	10	0	2

[1] 1.1 = *Themeda triandra* - *Senecio* sp. (G.R.Raitt 710) Grassland Community, 1.2 = *Themeda triandra* - *Stoebe phyllostachys* Grassland Community, 2.1 = *Themeda triandra* - *Argyrolobium* sp. (G.R.Raitt 29) Community, 2.2 = *Themeda triandra* - *Bobartia macrospatha* Herbland Community, 2.3 = *Themeda triandra* - *Elytropappus rhinocerotis* Shrubland Community

[2] Total number of species listed for each published unit

[3] Units according to Table 20 in Boucher (1987). Communities 37, 38, 42—44 are subassociations and so grouped to give the two associations (37&38, 43—44). The other communities are associations.

[4] Total number of species shared by the units compared

[5] Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

[6] Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

Table 7.10.5c: Quantitative comparison of Boucher's (1987) vegetation units with the Community Groups described in this study

	Total Species for Units of This Study	149			115		
Unit Total Species[2]	**Unit For Boucher (1987)**[3] **This Study**[1]	**1**			**2**		
		Tot.[4]	**dif. both**[5]	**dif. one**[6]	**Tot.**	**dif. both**	**dif. one**
82	Community 33	10	0	1	10	0	4
97	Community 34	10	0	0	11	0	5
187	Community 35	15	0	0	16	0	5
145	Community 36	9	0	0	13	1	3
161	Community 37	14	0	0	18	0	6
91	Community 38	8	0	0	12	0	6
174	Communities 37—38	15	0	0	18	0	7
156	Community 39	16	0	0	16	0	6
111	Community 40	12	0	1	13	1	5
92	Community 41	13	0	0	11	0	3
106	Community 42	12	0	0	13	0	5
144	Community 43	10	0	0	11	0	5
127	Community 44	9	0	0	10	0	4
208	Communities 42—44	13	0	0	14	0	4
88	Community 45	7	0	0	6	0	3
99	Community 46	6	0	0	8	0	2
99	Community 47	7	0	0	10	0	4
121	Community 48	13	0	1	12	0	3

1 1 = *Themeda triandra - Stoebe phyllostachys* Grassland Community Group, 2 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community Group

2 Total number of species listed for each published unit

3 Units according to Table 20 in Boucher (1987). Communities 37, 38, 42—44 are subassociations and so grouped to give the two associations (37&38, 43—44). The other communities are associations.

4 Total number of species shared by the units compared

5 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

6 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

Table 7.10.5d: Quantitative comparison of Boucher's (1987) vegetation units and the Subcommunities described in this study, of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating

	Total Species for Units of This Study		122			112			104			104			147		
Unit Total Species[2]	**Unit For Boucher (1987)**[3]	**This Study**[1]	**1.1.1**			**1.1.2**			**2.1.1**			**2.1.2**			**2.1.3**		
			Tot.[4]	**dif.**[5] **both**	**dif. one**[6]	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
82	Community 33	Diff. s.t.[7]	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
		Same sp.?[8]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
97	Community 34	Diff. s.t.	2	0	0	2	0	0	1	0	0	2	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
187	Community 35	Diff. s.t.	1	0	0	1	0	0	1	0	0	1	0	0	2	0	1
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
145	Community 36	Diff. s.t.	3	0	0	2	0	0	3	0	0	2	0	0	3	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
161	Community 37	Diff. s.t.	3	0	0	2	0	0	3	0	0	2	0	0	3	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	Community 38	Diff. s.t.	3	0	0	2	0	0	3	0	0	2	0	0	3	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
174	Communities 37—38	Diff. s.t.	4	0	0	3	0	0	4	0	0	3	0	0	4	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
156	Community 39	Diff. s.t.	3	0	0	2	0	0	3	0	0	2	0	0	3	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
111	Community 40	Diff. s.t.	4	0	0	3	0	0	4	0	0	3	0	0	4	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1 1.1.1 = *Themeda triandra - Centella* cf. *eriantha* Grassland Subcommunity, 1.1.2 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum, 2.1.1 = *Themeda triandra - Chrysanthemoides monilifera* Subcommunity, 2.1.2 = *Themeda triandra - Aspalathus nigra* Subcommunity, 2.1.3 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum

2 Total number of species listed for each published unit

3 Units according to Table 20 in Boucher (1987). Communities 37, 38, 42—44 are subassociations and so grouped to give the two associations (37&38, 43—44). The other communities are associations.

4 Total number of species shared by the units compared

5 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

6 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

7 Different subtaxa of the same species

8 Uncertain name updating of what is possibly the same species

Table 7.10.5d Continued: Quantitative comparison of Boucher's (1987) vegetation units and the Subcommunities described in this study, of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating

	Total Species for Units of This Study		122			112			104			104			147		
Unit Total Species[2]	**Unit For Boucher (1987)[3]**	**This Study[1]**	**1.1.1**			**1.1.2**			**2.1.1**			**2.1.2**			**2.1.3**		
			Tot.[4]	**dif.[5] both**	**dif. one[6]**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
92	Community 41	Diff. s.t.[7]	3	0	0	2	0	0	3	0	0	2	0	0	3	0	0
		Same sp.?[8]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
106	Community 42	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
144	Community 43	Diff. s.t.	2	0	0	2	0	0	2	0	0	2	0	0	2	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
127	Community 44	Diff. s.t.	3	0	0	3	0	0	2	0	0	3	0	0	3	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
208	Communities 42—44	Diff. s.t.	3	0	0	3	0	0	2	0	0	3	0	0	3	0	1
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
88	Community 45	Diff. s.t.	3	0	0	3	0	0	3	0	0	3	0	0	3	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99	Community 46	Diff. s.t.	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99	Community 47	Diff. s.t.	2	0	0	2	0	0	2	0	0	2	0	0	2	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
121	Community 48	Diff. s.t.	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0

1 1.1.1 = *Themeda triandra - Centella* cf. *eriantha* Grassland Subcommunity, 1.1.2 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum, 2.1.1 = *Themeda triandra - Chrysanthemoides monilifera* Subcommunity, 2.1.2 = *Themeda triandra - Aspalathus nigra* Subcommunity, 2.1.3 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum

2 Total number of species listed for each published unit

3 Units according to Table 20 in Boucher (1987). Communities 37, 38, 42—44 are subassociations and so grouped to give the two associations (37&38, 43—44). The other communities are associations.

4 Total number of species shared by the units compared

5 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

6 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

7 Different subtaxa of the same species

8 Uncertain name updating of what is possibly the same species

Table 7.10.5e: Quantitative comparison of Boucher's (1987) vegetation units and the Communities described in this study, of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating

	Total Species for Units of This Study		140			106			175			120			56		
Unit Total Species[2]	**Unit For Boucher (1987)**[3]	**This Study**[1]	**1.1**			**1.2**			**2.1**			**2.2**			**2.3**		
			Tot.[4]	**dif.**[5] **both**	**dif. one**[6]	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
82	Community 33	Diff. s.t.[7]	1	0	0	1	0	0	1	0	0	1	0	0	0	0	0
		Same sp.?[8]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
97	Community 34	Diff. s.t.	2	0	0	2	0	0	2	0	1	1	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
187	Community 35	Diff. s.t.	1	0	0	1	0	0	2	0	1	1	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
145	Community 36	Diff. s.t.	3	0	0	2	0	0	3	0	0	2	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
161	Community 37	Diff. s.t.	3	0	0	2	0	0	3	0	0	2	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	Community 38	Diff. s.t.	3	0	0	2	0	0	3	0	0	2	0	0	2	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
174	Communities 37—38	Diff. s.t.	4	0	0	3	0	0	4	0	0	3	0	0	2	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
156	Community 39	Diff. s.t.	3	0	0	2	0	0	3	0	0	2	0	0	2	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
111	Community 40	Diff. s.t.	4	0	0	3	0	0	4	0	0	3	0	0	2	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1 1.1 = *Themeda triandra* - *Senecio* sp. (G.R.Raitt 710) Grassland Community, 1.2 = *Themeda triandra* - *Stoebe phyllostachys* Grassland Community, 2.1 = *Themeda triandra* - *Argyrolobium* sp. (G.R.Raitt 29) Community, 2.2 = *Themeda triandra* - *Bobartia macrospatha* Herbland Community, 2.3 = *Themeda triandra* - *Elytropappus rhinocerotis* Shrubland Community

2 Total number of species listed for each published unit

3 Units according to Table 20 in Boucher (1987). Communities 37, 38, 42—44 are subassociations and so grouped to give the two associations (37&38, 43—44). The other communities are associations.

4 Total number of species shared by the units compared

5 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

6 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

7 Different subtaxa of the same species

8 Uncertain name updating of what is possibly the same species

Table 7.10.5e Continued: Quantitative comparison of Boucher's (1987) vegetation units and the Communities described in this study, of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating

	Total Species for Units of This Study		140			106			175			120			56		
Unit Total Species[2]	**Unit For Boucher (1987)[3]**	**This Study[1]**	**1.1**			**1.2**			**2.1**			**2.2**			**2.3**		
			Tot.[4]	**dif.[5] both**	**dif. one[6]**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
92	Community 41	Diff. s.t.[7]	3	0	0	2	0	0	3	0	0	2	0	0	2	0	0
		Same sp.?[8]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
106	Community 42	Diff. s.t.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
144	Community 43	Diff. s.t.	2	0	0	2	0	0	2	0	0	2	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
127	Community 44	Diff. s.t.	3	0	0	3	0	0	4	0	0	2	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
208	Communities 42—44	Diff. s.t.	3	0	0	3	0	0	4	0	2	2	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
88	Community 45	Diff. s.t.	3	0	0	3	0	0	3	0	0	3	0	0	2	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99	Community 46	Diff. s.t.	1	0	0	1	0	0	1	0	0	1	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99	Community 47	Diff. s.t.	2	0	0	2	0	0	2	0	0	2	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
121	Community 48	Diff. s.t.	1	0	0	1	0	0	1	0	0	1	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0

1 1.1 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Community, 1.2 = *Themeda triandra - Stoebe phyllostachys* Grassland Community, 2.1 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Community, 2.2 = *Themeda triandra - Bobartia macrospatha* Herbland Community, 2.3 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community

2 Total number of species listed for each published unit

3 Units according to Table 20 in Boucher (1987). Communities 37, 38, 42—44 are subassociations and so grouped to give the two associations (37&38, 43—44). The other communities are associations.

4 Total number of species shared by the units compared

5 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

6 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

7 Different subtaxa of the same species

8 Uncertain name updating of what is possibly the same species

Table 7.10.5f: Quantitative comparison of Boucher's (1987) vegetation units and the Community Groups described in this study, of numbers of shared species with different subtaxa and possibly shared species with uncertain name updating

	Total Species for Units of This Study		149			115		
Unit Total Species[2]	**Unit For Boucher (1987)**[3]	**This Study**[1]	**1** **Tot.**[4]	**dif.**[5] **both**	**dif. one**[6]	**2** **Tot.**	**dif. both**	**dif. one**
82	Community 33	Diff. s.t.[7]	1	0	0	0	0	0
		Same sp.?[8]	0	0	0	0	0	0
97	Community 34	Diff. s.t.	2	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
187	Community 35	Diff. s.t.	1	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
145	Community 36	Diff. s.t.	3	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0
161	Community 37	Diff. s.t.	3	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0
91	Community 38	Diff. s.t.	3	0	0	2	0	0
		Same sp.?	0	0	0	0	0	0
174	Communities 37—38	Diff. s.t.	4	0	0	2	0	0
		Same sp.?	0	0	0	0	0	0
156	Community 39	Diff. s.t.	3	0	0	2	0	0
		Same sp.?	0	0	0	0	0	0
111	Community 40	Diff. s.t.	4	0	0	2	0	0
		Same sp.?	0	0	0	0	0	0
92	Community 41	Diff. s.t.	3	0	0	2	0	0
		Same sp.?	0	0	0	0	0	0
106	Community 42	Diff. s.t.	0	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
144	Community 43	Diff. s.t.	2	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0
127	Community 44	Diff. s.t.	3	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0
208	Communities 42—44	Diff. s.t.	3	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0
88	Community 45	Diff. s.t.	3	0	0	2	0	0
		Same sp.?	0	0	0	0	0	0
99	Community 46	Diff. s.t.	1	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0
99	Community 47	Diff. s.t.	2	0	0	1	0	0
		Same sp.?	0	0	0	0	0	0
121	Community 48	Diff. s.t.	1	0	0	0	0	0
		Same sp.?	0	0	0	0	0	0

1 1 = *Themeda triandra - Stoebe phyllostachys* Grassland Community Group, 2 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community Group
2 Total number of species listed for each published unit
3 Units according to Table 20 in Boucher (1987). Communities 37, 38, 42—44 are subassociations and so grouped to give the two associations (37&38, 43—44). The other communities are associations.
4 Total number of species shared by the units compared
5 Differential (dif.) species (that distinguish the different units from others) shared by both the units compared
6 Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both
7 Different subtaxa of the same species
8 Uncertain name updating of what is possibly the same species

Table 7.10.6a: Quantitative comparison of Cowling *et al.*'s (1988) vegetation units with the Subcommunities described in this study

	Total Species for Units of This Study	122			112			104			104			147		
Unit	**Unit For This Study[1]**	**1.1.1**			**1.1.2**			**2.1.1**			**2.1.2**			**2.1.3**		
Total Species[2]	**Cowling *et al.* (1988)**	**Tot.[3]**	**dif.[4] both**	**dif. one[5]**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
4	Renoster Shrubland	1	0	0	1	0	0	2	0	0	2	0	0	2	0	0
8	Mesotrophic Asteraceous Fynbos	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0

[1] 1.1.1 = *Themeda triandra* - *Centella* cf. *eriantha* Grassland Subcommunity, 1.1.2 = *Themeda triandra* - *Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum, 2.1.1 = *Themeda triandra* - *Chrysanthemoides monilifera* Subcommunity, 2.1.2 = *Themeda triandra* - *Aspalathus nigra* Subcommunity, 2.1.3 = *Themeda triandra* - *Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum

[2] Total number of species listed for each published unit

[3] Total number of species shared by the units compared

[4] Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

[5] Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

Table 7.10.6b: Quantitative comparison of Cowling *et al.*'s (1988) vegetation units with the Communities described in this study

	Total Species for Units of This Study	140			106			175			120			56		
Unit	**Unit For This Study[1]**	**1.1**			**1.2**			**2.1**			**2.2**			**2.3**		
Total Species[2]	**Cowling *et al.* (1988)**	**Tot.[3]**	**dif.[4] both**	**dif. one[5]**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
4	Renoster Shrubland	1	0	0	1	0	0	2	0	0	2	0	0	2	0	1
8	Mesotrophic Asteraceous Fynbos	0	0	0	0	0	0	1	0	0	1	0	0	1	0	1

[1] 1.1 = *Themeda triandra* - *Senecio* sp. (G.R.Raitt 710) Grassland Community, 1.2 = *Themeda triandra* - *Stoebe phyllostachys* Grassland Community, 2.1 = *Themeda triandra* - *Argyrolobium* sp. (G.R.Raitt 29) Community, 2.2 = *Themeda triandra* - *Bobartia macrospatha* Herbland Community, 2.3 = *Themeda triandra* - *Elytropappus rhinocerotis* Shrubland Community

[2] Total number of species listed for each published unit

[3] Total number of species shared by the units compared

[4] Differential (dif.) species (that distinguish the different units from others) shared by both the units compared

[5] Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

Table 7.10.6c: Quantitative comparison of Cowling *et al.*'s (1988) vegetation units with the Community Groups described in this study

	Total Species for Units of This Study	149			115		
Unit Total Species[2]	**Unit For Cowling *et al.* (1988)** / **This Study**[1]	**1**			**2**		
		Tot.[3]	**dif. both**[4]	**dif. one**[5]	**Tot.**	**dif. both**	**dif. one**
4	Renoster Shrubland	1	0	0	2	0	1
8	Mesotrophic Asteraceous Fynbos	0	0	0	1	0	1

[1] 1 = *Themeda triandra - Stoebe phyllostachys* Grassland Community Group, 2 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community Group
[2] Total number of species listed for each published unit
[3] Total number of species shared by the units compared
[4] Differential (dif.) species (that distinguish the different units from others) shared by both the units compared
[5] Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

Table 7.10.7a: Quantitative comparison of Rebelo *et al.*'s (1991) vegetation units with the Subcommunities described in this study

	Total Species for Units of This Study	122			112			104			104			147		
Unit Total Species[2]	**Unit For Rebelo *et al.* (1991)** / **This Study**[1]	**1.1.1**			**1.1.2**			**2.1.1**			**2.1.2**			**2.1.3**		
		Tot.[3]	**dif.**[4] **both**	**dif. one**[5]	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
12	Renoster Shrubland	0	0	0	1	0	0	2	0	0	2	0	0	2	0	0
7	Grassy Fynbos	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
22	Mesotrophic Asteraceous Fynbos	2	0	0	2	0	0	3	0	0	3	0	0	3	0	0

[1] 1.1.1 = *Themeda triandra - Centella* cf. *eriantha* Grassland Subcommunity, 1.1.2 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Subcommunity Typicum, 2.1.1 = *Themeda triandra - Chrysanthemoides monilifera* Subcommunity, 2.1.2 = *Themeda triandra - Aspalathus nigra* Subcommunity, 2.1.3 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Subcommunity Typicum
[2] Total number of species listed for each published unit
[3] Total number of species shared by the units compared
[4] Differential (dif.) species (that distinguish the different units from others) shared by both the units compared
[5] Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

Table 7.10.7b: Quantitative comparison of Rebelo *et al.*'s (1991) vegetation units with the Communities described in this study

	Total Species for Units of This Study	140			106			175			120			56		
Unit Total Species[2]	**Unit For Rebelo *et al.* (1991) / This Study**[1]	**1.1**			**1.2**			**2.1**			**2.2**			**2.3**		
		Tot.[3]	**dif.**[4] **both**	**dif. one**[5]	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**	**Tot.**	**dif. both**	**dif. one**
12	Renoster Shrubland	1	0	0	1	0	0	2	0	0	2	0	0	2	0	1
7	Grassy Fynbos	1	0	0	1	0	0	1	0	0	3	0	1	1	0	0
22	Mesotrophic Asteraceous Fynbos	2	0	0	2	0	0	3	0	0	6	1	1	3	0	1

[1] 1.1 = *Themeda triandra - Senecio* sp. (G.R.Raitt 710) Grassland Community, 1.2 = *Themeda triandra - Stoebe phyllostachys* Grassland Community, 2.1 = *Themeda triandra - Argyrolobium* sp. (G.R.Raitt 29) Community, 2.2 = *Themeda triandra - Bobartia macrospatha* Herbland Community, 2.3 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community
[2] Total number of species listed for each published unit
[3] Total number of species shared by the units compared
[4] Differential (dif.) species (that distinguish the different units from others) shared by both the units compared
[5] Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both

Table 7.10.7c: Quantitative comparison of Rebelo *et al.*'s (1991) vegetation units with the Community Groups described in this study

	Total Species for Units of This Study	149			115		
Unit Total Species[2]	**Unit For Rebelo *et al.* (1991) / This Study**[1]	**1**			**2**		
		Tot.[3]	**dif. both**[4]	**dif. one**[5]	**Tot.**	**dif. both**	**dif. one**
12	Renoster Shrubland	1	0	0	2	0	1
7	Grassy Fynbos	1	0	0	2	0	0
22	Mesotrophic Asteraceous Fynbos	2	0	0	4	0	1

[1] 1 = *Themeda triandra - Stoebe phyllostachys* Grassland Community Group, 2 = *Themeda triandra - Elytropappus rhinocerotis* Shrubland Community Group
[2] Total number of species listed for each published unit
[3] Total number of species shared by the units compared
[4] Differential (dif.) species (that distinguish the different units from others) shared by both the units compared
[5] Differential (dif.) species (that distinguish the different units from others) belonging to either one of the two units compared but not both