BREYTENBACH P J J

DIE FITOSOSIOLOGIE VAN DIE VILLIERS-GROOTVLEI-OMGEWING

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DIE FITOSOSIOLOGIE VAN DIE VILLIERS-GROOTVLEI-OMGEWING

deur

Philippus Johannes Jacobus Breytenbach

Voorgelê ter vervulling van 'n deel van die
vereistes vir die graad

MAGISTER SCIENTIAE

in die Fakulteit Natuurwetenskappe
Universiteit van Pretoria
PRETORIA

Leier : Prof. G.K. Theron
Medeleier : Prof. G.J. Bredenkamp

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Opgedra aan Hanlie

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Die fitososiologie van die Villiers-Grootvlei-omgewing.

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UITTREKSEL

Die plantegroei van die Villiers-Grootvlei-omgewing is geklassifiseer deur gebruik te maak van die Braun-Blanquet prosedures. Die data is eerstens geklassifiseer deur die politetiese verdeling van TWINSPAN waarna dit verfyn is. Die studiegebied is gestratifiseer deur gebruik te maak van landtipes en geologie. Daar is afsonderlike fitososiologiese tabelle vir die Ib-, Ba-, Bb- en Ea-landtipe daargestel. Al die plantgemeenskappe is beskryf en ekologies geïnterpreteer. 'n Sinoptiese tabel van die plantgemeenskappe is saamgestel om die hierargiese verwantskappe tussen die plantgemeenskappe aan te toon. Die omgewing-plantegroei interaksies is met behulp van DECORANA aangetoon.

The phytosociology of the Villiers-Grootvlei area.

by

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Magister Scientiae

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ABSTRACT

The vegetation of the Villiers-Grootvlei area was classified using Braun-Branquet procedures. The polythetic divisive program TWINSPAN was used for a first classification which was then refined. Land Types and geology were criteria used to stratify the study area. Separate phytosociological tables were generated for the Ib, Ba, Bb and Ea Land Types. The plant communities were described and interpreted ecologically. A synoptic table showing the hierarchical relathionship among plant communities was compiled. The habitat-vegetation interactions were indicated by means of DECORANA ordination.

INHOUDSOPGAWE

HOOFSTUK 1

INLEIDING

Waar grasse voorkom as die klimaksplantegroei, word die veld beskou as natuurlike grasvelde. Hierdie natuurlike grasvelde word aangetref oor die grootste gedeelte van die Oranje-Vrystaat, die binneland van Natal en die suidelike deel van Transvaal. Die natuurlike grasvelde word as klimaksplantegroei behou deur 'n kombinasie van klimaat en veldbrande wat verhoed dat bosindringing plaasvind (Bayer, in Meredith 1955). Die tipe grasveld, natuurlik tot enige streek, sal grootliks bepaal word deur die heersende klimaat van daardie betrokke streek (Bayer, in Meredith 1955). Van al die hulpbronne van Suid-Afrika is natuurlike weiding of -veld een van die waardevolste soos gesien kan word uit die volgende statistieke. Van die totale oppervlakte van Suid-Afrika (122 miljoen ha) word ongeveer 84% gebruik vir landbou. Van die totale 122 miljoen ha ontvang 66% van die oppervlakte minder as 600 mm gemiddelde jaarlikse reënval, wat beskou word as die vereiste minimum vir droëland gewasproduksie in Suid-Afrika (Anon. 1978 en Hall 1952). Hiermee saam is 'n groot gedeelte van die hoër reënvalgebied bergagtig en klipperig (Hall 1952) en is sodoende nie geskik vir gewasverbouing nie. Die ongeveer 103 miljoen ha grond wat vir landbou gebruik word kan soos volg onderverdeel word (Anon. 1978):

natuurlike weiding	83 262 000 ha (81%)
gewasverbouing en bosbou	18 502 000 ha (18%)
aangeplante weiding	932 000 ha (0,9%)

Hierdie syfers illustreer dat die grootste gedeelte (81%) van die

landbougrond gebruik word vir natuurlike weiding of veld en deur korrekte en effektiewe bestuur kan dit 'n groot bydrae lewer tot die landbou-ekonomie. Stapleton het dit pertinent gestel dat die gewas wat die werêld se landbouvooruitgang bepaal sonder twyfel die natuurlike weiding is (Hall 1952).

Daar bestaan 'n lang geskiedenis van veldwanbestuur in Suid-Afrika. Hall (1934) bespreek die uitgebreide probleme van oorbeweiding, te hoë veegetalle en die onoordeelkundige gebruik van veldbrande. Acocks (Ongepubl.) berig van semi-woestyntoestande wat in sekere gebiede van die land voorkom as gevolg van die tekort aan behoorlike veldbestuur en die praktyk van aanhoudende selektiewe beweiding. Veldtoestande in die Hoëveldstreek is geensins 'n uitsondering op die situasie wat hierbo geskets is nie.

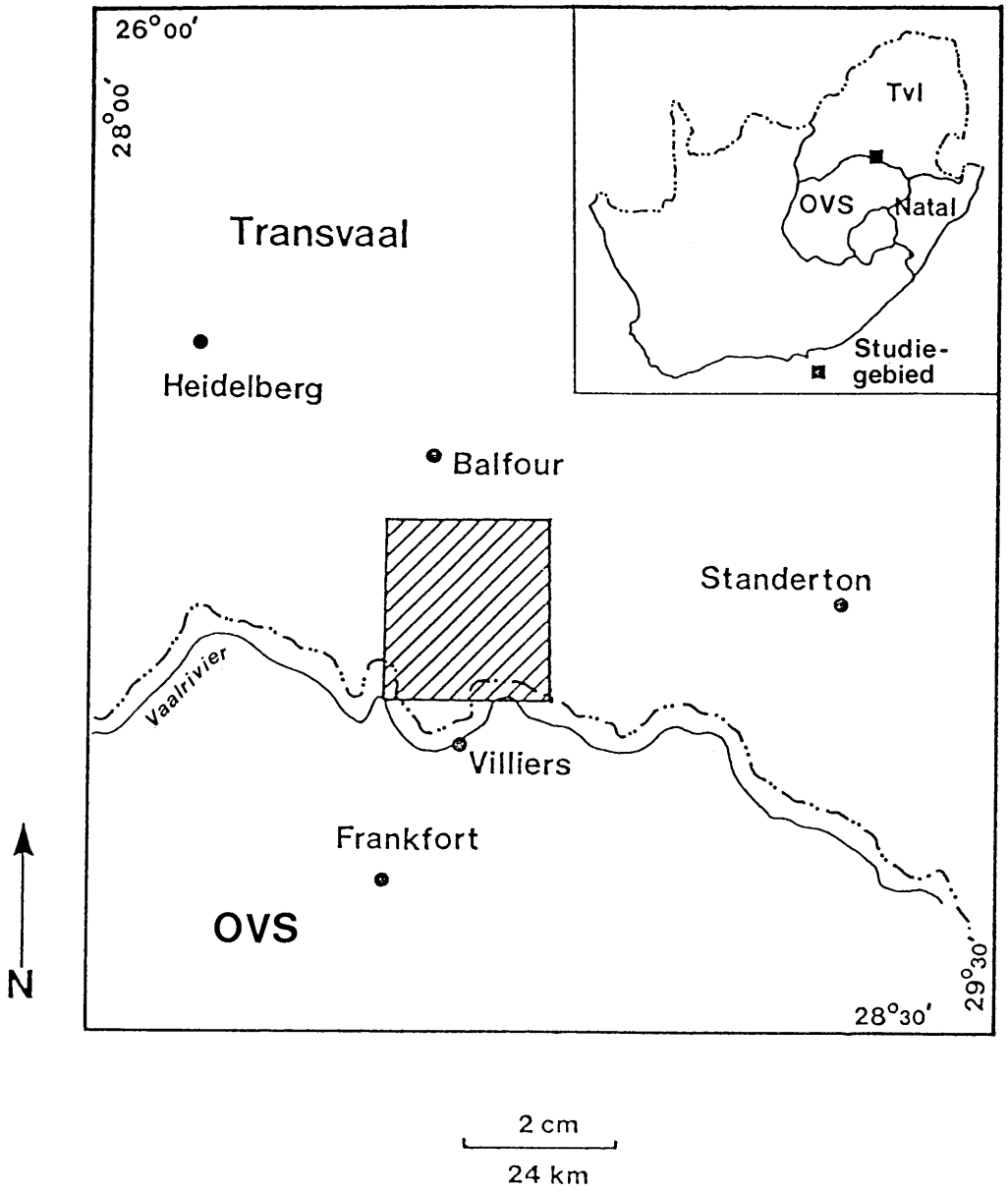
Die Hoëveldstreek, met Potchefstroom as hoofkwartier, vorm die sentrale hoogland van die Republiek. Die Streek beslaan 'n oppervlakte van 11,5 miljoen hektaar waarvan 5 713 870 ha (49,6%) onder bewerking is en 5 471 194 ha (47%) natuurlike weiding is (Landbou-ontwikkelingsprogram: Hoëveldstreek 1986). Die natuurlike veld in die Hoëveldstreek kom vandag hoofsaaklik voor waar die grond te vlak, klipperig, steil, kleierig of te swak gedreineer is, of weens uiterste klimaat ongeskik is vir kontantgewasverbouing. Die huidige toestand van die veld kan as swak bestempel word as gevolg van 'n algemene gebrekkige kennis en belangstelling in die beheer en benutting van die veld en 'n ooroptimisme oor die weidingkapasiteit van die veld. Aanduidings van die algemene agteruitgang van die veld word weerspieël deur die voorkoms van een of meer van die volgende verskynsels op die meeste van die plase in die Streek:

- die verdwyning van smaaklike grasse uit die veldsamestelling in so 'n mate dat hulle nog net op wenakkers en padreserwes aangetref word bv. *Digitaria eriantha, Panicum maximum, P. coloratum, Eustachys paspaloides* en *Brachiaria nigropedata*;

- die vermeerdering en/of indringing van ongewenste plante in die veld, byvoorbeeld onsmaaklike grasse soos *Elionurus muticus, Aristida* spp. en *Eragrostis plana*, die die verdigting van bome en struike soos *Acacia karroo* en *Asparagus* spp. en karoo-agtige bossies soos *Felicia* spp., *Pentzia* spp. , *Chrysocoma* spp. en *Stoebe vulgaris*;

- die voorkoms van kaal kolle (Landbou-ontwikkelings-program: Hoëveldstreek 1986).

Die herstel en die sinvolle benutting van die veld as 'n natuurlike hulpbron behoort dus baie aandag te geniet, nie net uit 'n navorsingsoogpunt nie maar ook ten opsigte van voorligting aan die boere (Landbou-ontwikkelingsprogram: Hoëveldstreek 1986). In die " Witskrif oor Landboubeleid " (1984) word verwys na die agteruitgang van natuurlike weiveld en word gewaarsku dat onoordeelkundige praktyke en oorontginning van die natuurlike hulpbronne sal lei tot 'n verlaging in die lewensstandaard en lewenskwaliteite van die bevolking. Dit is dus noodsaaklik dat 'n doelgerigde weidingstrategie onverwyld toegepas word om veldagteruitgang te stuit en om die potensiaal van die weiveld van die RSA te ontwikkel. Die breë doelstelling van die Nasionale Weidingstrategie is om natuurlike en aangeplante weidings in die RSA op so 'n wyse te benut, ontwikkel en bestuur dat die grootste volgehoue voordeel vir die huidige geslag verkry word,



Figuur 1.1 Die ligging van die studiegebied (gebaseer op die 2628 DC GROOTVLEI 1:50 000 topokadastrale kaart)

terwyl die produksiepotensiaal behoue bly om die behoeftes en strewes van toekomstige geslagte te bevredig.

Die enigste veldtipe-indeling van die Hoëveldstreek wat tans beskikbaar is, is dié van Acocks (1988). Hierdie veldtipe-indeling is op 'n breë skaal (1 : 1 500 000) en dit is duidelik dat die grense, veral in die grasveld, slegs by benadering aangedui is. Daar bestaan dus 'n behoefte aan 'n meer gedetailleerde plantegroeikartering van die Hoëveldstreek met assosiasies van veldtipes met bepaalde grond-klimaat kombinasies (Landbou-ontwikkelingsprogram: Hoëveldstreek 1986). Die doel van 'n plantkundige opname is om plantegroei te beskryf, die omvang daarvan te bepaal en dit te klassifiseer en interpreteer in die lig van heersende omgewingsfaktore. Plantegroei-ekologiese opnames analiseer dus die plantegroeihulpbron van die land en verklaar hoe daardie plantegroei voortbestaan onder die heersende omgewingsfaktore (Edwards 1979).

Die studiegebied is geleë tussen 26°45' en 27°00' suiderbreedte en 28°30' en 28°45' oosterlengte en beslaan ongeveer 690 km² (70 000 ha) in die omgewing van Grootvlei, Transvaal, asmede 'n beperkte terrein aangrensend by Villiers in die noordelike Oranje Vrystaat. Met betrekking tot die Hoëveldstreek is die studiegebied geleë in die noord-oostelike gedeelte van die streek (Figuur 1.1)

Die doel van hierdie studie is om die floristiese samestelling, struktuur en omgewingsinteraksies van hierdie grasveld en skyngrasveld (Bankenveld) te bestudeer om die plantegroei-omgewing interaksies te verstaan en te organiseer in 'n sisteem met maksimale voorspelbaarheid voor oë. So 'n klassifikasie en

ekologiese interpretasie van die plantegroei sou kon dien as die ekologiese basis wat vir omgewingsbeplanning , veldbestuur en bewaring gebruik kan word. Hierdie studiegebied is gekies om as 'n sleutelgebied te dien vir doeltreffende ekstrapolering na die omliggende gebiede en te dien as 'n skakel tussen die westelike en oostelike dele van die Grasveldbioom.

Hierdie verhandeling bestaan uit 'n versameling bydraes oor die fitososiologie van die onderskeie landtipes in die studiegebied. Hierdie benadering is in lyn met vorige suksesvolle studies in ander dele van die Grasveldbioom, met die oog op 'n fitososiologiese en sintaksonomiese sintese van die plantegroei van die Grasveldbioom. Die bydraes is in die vorm van manuskripte wat aanvaar is of voorgelê is vir publikasie in verskeie wetenskaplike tydskrifte. Hoewel die besonderhede oor die studiegebied, metodes, resultate, bespreking en literatuurverwysings in die individuele manuskripte weergegee word, word saaklike hoofstukke oor 'n oorsig oor vorige plantegroei beskrywings, biotiese faktore, benadering en metodes, en ook 'n algemene bespreking en samevattende literatuurlys afsonderlik aangebied. Die manuskripte toon sekere stylistiese inkonsekwentheid en sekere aspekte word telkens herhaal. Dit is toe te skryf aan die verskille in styl en uitleg wat verskillende tydskrifte vereis, en ook dat elke manuskrip as 'n eenheid beskou moet word.

HOOFSTUK 2.

'N OORSIG OOR VORIGE PLANTEGROEI STUDIES IN DIE GEBIED

Die eerste weergawe van breë plantegroeitipes in Suid-Afrika was deur Bews (1916a) wat opgevolg is deur 'n tweede weergawe oor grasse en grasvelde van Suid-Afrika (Bews 1916b). Twintig jaar later het Pole-Evans (1936) 'n algemene plantegroeikaart van Suid-Afrika daargestel waarop hy die grense van die plantegroeitipes geografies aangedui het. Adamson (1938) en Pentz (1949) het soortgelyke kaarte daargestel maar het verskillende kriteria vir die definiëring van die plantegroeitipes gebruik. In 1953 het Acocks die plantegroei van Suid-Afrika in 70 veldtipes geklassifiseer. Van hierdie 70 veldtipes is daar 13 suiwer grasveldtipes en agt skyngrasveldtipes geïdentifiseer. In 1975 en 1988 is hersiene uitgawes van Acocks se werk gepubliseer.

Volgens Acocks se indeling (1988) kom daar vyf veldtipes in die Villiers-Grootvlei-omgewing voor waarvan vier suiwer grasveldtipes en een 'n skyngrasveldtipe is. Die grasveldtipes is *Cymbopogon-Themeda* Veld (Veldtipe 48), *Themeda* Turfveld of Turf Hoëveld (Veldtipe 52), Gemengde Hoëveld na *Cymbopogon-Themeda* Veld oorgang (Veldtipe 53) en Bankenveld na Turf Hoëveld oorgang (Veldtipe 55). Bankenveld (Veldtipe 61) is 'n skyngrasveldtipe.

Die meeste gebiede waar studies in die grasveld onderneem is se lokaliteite is as gevolg van gerief naby groot studie-sentrums geleë (Tainton 1984). Die keuse van studiegebiede het amper nooit die maksimale ekstrapolering of toepasbaarheid van die resultate in aanmerking geneem nie. Daar is ook geen werklike poging aangewend om vorige studies se plantegroei-eenhede te

bestudeer en sodoende daardie klassifikasie te verfyn nie (Tainton 1984).

Geen plantegroei opname is al in hierdie spesifieke studiegebied gedoen nie, alhoewel resente studies in ander gebiede van die grasveld gedoen is (bv. Scheepers 1975; Bredenkamp 1975; Morris 1976; Van Wyk 1983; du Preez 1987; Bezuidenhout 1988; Bloem 1988; Turner 1989; Kooij 1990). Die werk van Bredenkamp (1975, 1976, 1977, 1978, 1980) op die Suikerbosrand-natuurresevaat is veral van toepassing op die hoërliggende gedeeltes van die Bankenveld in hierdie studiegebied, veral op areas wat deur die Ventersdorp-lawa beslaan word.

HOOFSTUK 3.

BIOTIESE FAKTORE

Vuur

Veldbrande het algemeen in die studiegebied voorgekom maar was hoofsaaklik ongeluksvure. Daar word algemeen aanvaar dat vuur 'n natuurlike faktor is wat die spesiesamestelling van die grasveld bepaal (Hall 1984). Vuur is verantwoordelik vir die verwydering van oortollige dooie plantmateriaal en die onderdrukking van bosindringing (Coupland 1979). Uit studies van Tainton (1981) blyk dit dat die veld agteruitgaan as dit vir lang periodes onbenut gelaat word. Tydens die studie is waargeneem dat die basale bedekking van gras asook die voorkoms van kruide afneem tydens lang periodes van onbenutting. Die praktyk van herhaaldelike brand gevolg deur swaar beweiding deur skape en beeste verlaag ook die lewenskragtigheid en voedingswaarde van die veld (Batchelor 1984b).

Mens

Die Hoëveldstreek beslaan 'n oppervlakte van 11,5 miljoen hektaar waarvan 5 713 870 ha (49,6%) onder bewerking is en 5 471 194 ha (47%) wat natuurlike weiding is (Landbou-ontwikkelingsprogram: Hoëveldstreek 1986). Dit verteenwoordig ongeveer 11,3% van die Republiek se landbougrond waarop nagenoeg 22% van die produsente boer. Tans is die Streek se bydrae tot die totale waarde van veekundige produkte 14,5%. Van die totale natuurlike veld in die Hoëveldstreek is slegs 6% in 'n goeie toestand teenoor 16-50% wat in 'n swak tot baie swak toestand is (Landbou-

ontwikkelingsprogram: Hoëveldstreek 1986). In die studiegebied word daar hoofsaaklik gekonsentreer op gemengde boerdery praktyke. Produkte wat geproduseer word sluit in vleis, wol, melk, mielies, sonneblom, koring, graansorghum en in 'n mindere mate aartappels.

Mynbouaktiwiteite kom nog hoofsaaklik in die Grootvlei-omgewing voor. Hierdie aktiwiteite het 'n groot invloed op die onmiddelike plantegroei in die omgewing deurdat die myne 'n invloed op die grondwater het. Afloopwater van die mynhope het ook die Ph-vlak van die water in die nabygeleë vleie, spruite en damme in die omgewing laat daal. Die lugbesoedeling van die Grootvlei-kragstasie het ook dalk 'n invloed op die plantegroei in die omgewing. Versteuring van die plantegroei in die Bankenveld is by uitgewerkte goudmyne in die Hexrivier-omgewing sigbaar. Die toestand van die veld in hierdie gebiede is baie swak en word oorheers deur onwenslike indringer en uitheemse spesies soos *Stoebe vulgaris, Acacia mearnsii, Aristida* spp. en 'n *Opuntia* sp.. Sekere mynmaatskappye doen tans 'n opname en versamel geologiese monsters in die studiegebied wat 'n aanduiding van moontlike nuwe mynbou-aktiwiteite in die gebied is.

Indringer plante

Verskeie uitheemse bome en struike word in die studiegebied aangetref. Die oorgrote meerderheid van hierdie plantsoorte is as windskerms op plase of as sierplante in tuine aangeplant. Saadverspreiding deur voëls en ander diere sowel as deur wind is verantwoordelik vir die voorkoms van hierdie plantsoorte in die natuurlike veld. Die vermeerdering van sekere van die plantsoorte het al ernstige afmetings aangeneem soos *Sesbania sesban* wat vir verskeie veevrektes verantwoordelik is. Ander uitheemse bome en

struike wat in die studiegebied voorkom is onder andere *Acacia dealbata, A. mearnsii, Pinus* spp., *Eucalyptus* spp., *Cotoneaster pannosa* en 'n *Opuntia* sp..

Diere

Die volgende dierspesies is in die studiegebied aangetref:

Voëls

Slegs die skaarser spesies word hier aangetoon. Die spesies is volgens Sinclair (1987) gerangskik:

Platalea alba	Lepelaar
Scopus umbretta	Hamerkop
Plectopterus gambensis	Wildemakou
Alopochen aegyptiacus	Kolgans
Dendrocygna viduata	Nonnetjie-eend
Anthropoides paradisea	Bloukraanvoël
Sagittarius serpentarius	Sekretarisvoël
Tyto capensis	Grasuil
Asio capensis	Vlei-uil

Reptiele

Die spesies is volgens Branch (1988) gerangskik:

Pelomedusa subrufa	Helmwaterskilpad
Psammophylax rhombeatus	Gevlekte skaapsteker
Psammophylax tritaeniatus	Gestreepte skaapsteker
Dasypeltis scabra	Gewone eiervreter
Dasypeltis inorata	Suidelike bruin eiervreter
Hemachatus haemachatus	Rinkhals
Cordylus vittifer	Transvaalse gordelakkedis
Agama aculeata	Grondkoggelmander
Varanus niloticus	Waterlikkewaan

Soogdiere

Die spesies is volgens Smithers (1983) gerangskik:

Lepus capensis	Vlakhaas
Hystix africaeaustralis	Ystervark
Xerus inauris	Waaierstertgrondeekhoring
Canis mesomelas	Rooijakkals
Ictonyx striatus	Stinkmuishond
Genetta genetta	Kleinkolmuskejaatkat
Suricata suricatta	Stokstertmeerkat
Procavia capensis	Klipdassie
Damaliscus dorcas phillipsi	Blesbok
Sylvicapra grimmia	Gewone duiker
Raphicerus campestris	Steenbok
Antidorcas marsupiales	Springbok
Pelea capreolus	Vaalribbok

HOOFSTUK 4.

BENADERINGS EN METODES VAN OPNAMES EN DATAVERWERKING

Fitososiologiese benadering

In die studie is gebruik gemaak van die Zürich-Montpellier fitososiologiese benadering (Braun-Blanquet 1932; Werger 1974) om die plantegroeigemeenskappe in die studiegebied te definieer en te beskryf, aangesien dit die mees populêre en aanvaarbaarste metode is wat tans in Suid-Afrika gebruik word (Bredenkamp 1975; Van Rooyen 1978). Die Afdeling Weiveld-ekologie by die Navorsingssentrum vir Weiding is 'n voorstaander van dié benadering. Die suksesvolle afhandeling van ander studies in die Grasveld-bioom (Bredenkamp 1975, 1982; Deall 1985; Bezuidenhout 1988; Bloem 1989; Turner 1989; Kooij 1990) met behulp van hierdie metode, het bygedra tot die verkose benadering. Een van die grootste voordele van die Zürich-Montpellier-benadering is die aanpasbaarheid of buigsaamheid daarvan wat die klassifikasie van plantgemeenskappe baie vergemaklik.

Die prosedure word in twee fases onderverdeel:

1. Analitiese fase

Gedurende hierdie fase is die studiegebied fisies verken en is lugfoto's (skaal 1:50 000) saam met die Geologiekaart (2628 DC Grootvlei) en die Landtipekaart (2628 Oosrand) gebruik om die studiegebied te stratifieer en opnamepunte se spesifieke lokaliteite vas te stel. Die plantegroei is deur middel van persele gemonster deur gebruik te maak van gestratifieerde

ewekansige verspreiding van opnamepunte.

1.1 Verkenning

Verkenning van die studiegebied is gedoen gedurende die groeiseisoen van 1987/88. Tydens die verkenning is vertroud geraak met die algemene voorkoms en kenmerke van die landskap en plantegroei. Planteksemplare van spesies is versamel en na die Nasionale Herbarium in Pretoria(1) gestuur vir identifikasie. Daar is klem gelê op die identifikasie van grasspesies in die veld op grond van hulle vegetatiewe kenmerke en tydens die verkenning is daar geëksperimenteer met die grassleutel soos opgestel deur Turner(2) (pers.med.). Geologiese monsters met hulle spesifieke lokaliteite is so veel as moontlik geneem om toekomstige werklas te verminder. Hierdie monsters is deur die personeel van Geologiese Opnames(3) geidentifiseer.

1.2 Strategie en Prosedure van Monsterneming

1.2.1 Grootte en vorm van monsterpersele

Grasveld

Die plantegroei is gemonster deur gebruik te maak van 'n ewekansige gestratifiseerde sub-kwadraatmetode. Tydens die verkenning is die sub-kwadraatmetode (Turner 1989) prakties met 'n enkele vierkantige kwadraatmetode vergelyk. Die vergelyking is in die grasveld sowel as die Bankenveld gedoen en in albei gevalle is dieselfde resultaat verkry. Die resultaat

(1) Nasionale Botaniese Instituut Privaatsak x101 Pretoria 0001.
(2) Walt Hof Nr.2, Cragg Str. 169, Queenswood 0186.
(3) Geologiese Opnames Privaatsak x112 Pretoria 0001.

het aangetoon dat 'n baie groot enkele kwadraat nodig is om dieselfde floristiese inligting te verkry as wat met die sub-kwadraatmetode verkry word. Dit was duidelik dat met die sub-kwadraatmetode meer inligting verkry word in terme van tyd en energie besteding. Hierdie resultate is ook verkry deur Oosting (1956) en Turner (1989). 'n Nadeel van die metode is dat die plantegroei van die sub-kwadrate heterogeen mag wees sonder dat die navorser dit dadelik agterkom.

Die vorm van die sub-kwadrate is reghoekig met die sye in die verhouding van een tot twee, aangesien dit meer effektief as vierkantige kwadrate is (Oosting 1956; Cain & Castro 1959). By reghoekige sub-kwadrate kom minder variasie in die plantegroei voor as tussen vierkantige kwadrate (Greig-Smith 1983). Die spesifieke afmetings van die sub-kwadrate wat gebruik is, was 3 m by 1,5 m.

Bankenveld

Weens die voorkoms van bome en struike in die gebied is besluit om reghoekige monsterpersele van 20 m by 10 m (200 m^2) te gebruik. Dit stem ooreen met wat onder andere deur Bredenkamp (1975) gebruik is.

In die vleigebiede is van 4 m by 4 m (16 m^2) persele gebruik gemaak wat ooreenstem die perseelgrootte wat deur Bloem (1988) in Die Verlorenvalei-natuurreservaat gebruik is.

1.2.2 Aantal en verspreiding van monsterpersele

Grasveld

Die hoeveelheid monsterpersele per karteringseenheid is 'n pragmatiese besluit wat bepaal word deur die tyd wat beskikbaar is en benodig word om die persele te monster. Die hoeveelheid sub-kwadrate per monsterperseel is bepaal deur gebruik te maak van inligting/area/tyd doeltreffendheids-verhoudings. Die patroon van die plantegroei sal die hoeveelheid sub-kwadrate bepaal. Sub-kwadrate is uitgeplaas totdat daar minder as 10% toename in nuwe spesies verkry is. 'n Minimum van drie sub-kwadrate per monstereenheid is gehandhaaf tydens die studie. Die minimum grootte van 'n monsterperseel was dus 13,5 m^2. Daar is 132 persele in die grasveld uitgeplaas (ongeveer een perseel per 38 ha). Die opnamepunte is met behulp van ewekansige syfers, wat deur 'n rekenaar verkry is, objektief uitgeplaas.

Bankenveld

Die oppervlakte van die gebied sowel as die tyd beskikbaar het die aantal monsterpersele wat uitgeplaas is bepaal. Vyftig persele is beskou as voldoende om die verskillende plantegroei-eenhede uit te wys. Hierdie persele is gestratifiseerd subjektief uitgeplaas. Whittaker (1956) het subjektiewe plasing van monsterpersele gekritiseer in teenstelling met Werger (1973) en Bredenkamp (1982) wat hierdie metode van uitplasing van persele sterk aanbeveel .

Vleigebiede

Hierdie gebied is in oppervlakte baie kleiner as die Bankenveld en die grasveld. Dit was dus nodig om soveel as moontlik van die natter gebiede te monster om 'n duidelike beeld van die verskillende plantegroeitipes of sones te verkry. Vier en veertig persele is subjektief in hierdie gebied uitgeplaas.

1.2.3 Monsterperseeldata

Velddata is op die Navorsingsentrum vir Weiding se Ec.2 vorm aangeteken. Data van alle sub-kwadrate van een opnamepunt in die grasveld en van alle opnamepunte in die Bankenveld en vleigebiede is soos volg op 'n vorm aangeteken:

1.2.4 Lokaliteitsdata

Die lokaliteit van elke opnamepunt is, in terme van sy geografiese koördinate so wel as sy kwartgraad ruitverwysing, akkuraat bepaal en aangeteken.

1.2.5 Floristiese data

Alle spesies wat in elke submonster voorkom is aangeteken. 'n Verwysingseksemplaar vir alle spesies wat voorkom is versamel vir verwysingsdoeleindes. Die spesies wat nie deur die navorser geïdentifiseer kon word nie, is na die Nasionale Herbarium in Pretoria gestuur vir identifikasie. Alle verwysingseksemplare word in die Nasionale Herbarium(4) gehuisves en is in 'n naamlys aangehaal (Myburgh et al. (in prep.)).

(4) Nasionale Botaniese Instituut Privaatsak x101 Pretoria 0001

Struktuur data

Bedekkinggetalsterktewaarde

Die skaal van Braun-Blanquet vir bedekkinggetalsterktewaardes (Werger 1974) is in hierdie studie gebruik om die relatiewe belangrikheid van elke spesie in 'n gemeenskap te bepaal. Die Braun-Blanquet-skaal is soos volg:

r - 'n Enkele individu met 'n bedekking van minder as een persent van die perseel.

\+ - Meer as een individu met 'n bedekking van minder as een persent van die perseel.

1 - Volop met 'n bedekking van een tot vyf persent van die perseel.

2 - Enige aantal individue met 'n bedekking van meer as vyf tot 25 persent van die perseel.

3 - Enige aantal individue met 'n bedekking van meer as 25 tot 50 persent van die perseel.

4 - Enige aantal individue met 'n bedekking van meer as 50 tot 75 persent van die perseel.

5 - Enige aantal individue met 'n bedekking van meer as 75 persent van die perseel.

Die basale bedekking, met uitsondering van die Bankenveld waar die kroonbedekking bepaal is, is gemeet aangesien die plantegroei oor die algemeen kort gewei was.

1.2.6 Habitatdata

Die volgende habitatdata is by elke opnamepunt aangeteken:

Hoogte bo seespieël

Die hoogte bo seespieël van elke opnamepunt is van die 1:50 000 topokadastrale kaart (2628DC GROOTVLEI) van die studiegebied afgelees. Die hoogte is aangedui in meter bo seevlak.

Geologie

Waar geen monsters geneem is nie is die 1:250 000 Geologiese kaart van die gebied (2628 OOS RAND) gebruik om die tipe rots af te lei. Die volgende klasse is onderskei:

Klas 1 - R, Rh, Rt, Rg, Rb, Rjo (Kwartsiet, skalie, tilliet)

Klas 2 - Rk (Basaltiese lawa, agglomeraat, tuf)

Klas 3 - Qw (Eoliese sand)

Klas 4 - Pv (Sandsteen en skalie)

Klas 5 - Jd (Doleriet)

Klas 6 - Vdi (Diabaas)

Geomorfologie

Geomorfologie is slegs aangeteken in die geval van die Bankenveld en vleigebiede:

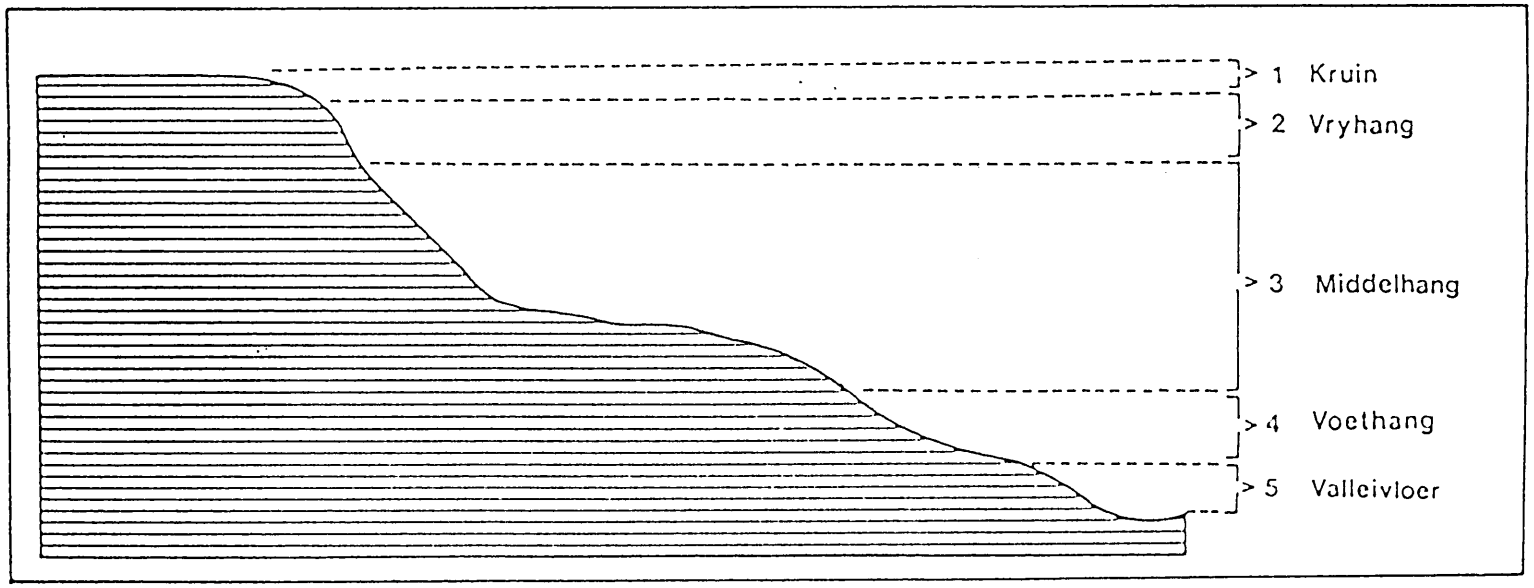
1 - Konkaaf

2 - Konveks

3 - Plat

Topografiese posisie

Die topografiese posisie is bepaal volgens die terreinmorfologiese eenheidsindeling (Scheepers et al. 1984) soos geillustreer in Figuur 4.1:



FIGUUR 4.1 Terrein-morfologiese eenhede (Scheepers, Smit & Ludick 1984) wat die onderskeie topografiese posisies in die studiegebied aandui.

Kruin - 1

Vryhang - 2

Middelhang - 3

Voethang - 4

Valleivloer - 5

Aspek

Die aspek is die rigting waarin glooiings front en is met behulp van 'n kompas bepaal. Ware Noord is verkry deur die inklinasiehoek van 17,4° Wes in berekening te bring. Die volgende afkortings is gebruik :

N - Noord	S - Suid
NO - Noordoos	SW - Suidwes
O - Oos	W - Wes
SO - Suidoos	NW - Noordwes

Grond

Grondvorm

Die grondvorm is aan die hand van die binomiese sisteem van grondklassifikasie (McVicar et al. 1977) bepaal. Daar is met behulp van 'n handgrondboor by al die persele van die grasveld en die vleigebiede tot op 'n diepte van 1 200 mm of tot op 'n beperkende laag geboor. Die Bankenveld het oor die algemeen 'n baie hoë persentasie klipbedekking. Daar is dus nie grondvorms bepaal vir die verskillende persele nie. Die gronddata is verkry van die 1 : 50 000 2628 DC Grootvlei Bodemkaart (1978). Die

volgende grondklasse is onderskei:

Rooi leem- en kleigronde	- 1
Geel leem- en kleigronde	- 2
Geel en grys growwe sand	- 3
Donker kleie	- 4
Dupleks gronde	- 5
Gestratifiseerde alluvium, rots, litosols	- 6

Gronddiepte

Gronddiepte is bepaal vir al die persele in die grasveld en die vleigebiede. Gronddiepte is bepaal tot 1 200 mm of tot op 'n beperkende laag soos byvoorbeeld rots.

Grondkonsistensie

Die grondkonsistensie (Anoniem 1988)is slegs by die persele in die vleigebiede aangeteken. Die volgende klasse is onderskei :

Los	- 1
Effens hard	- 2
Hard	- 3
Baie hard	- 4

Grondtekstuur

Die grondtekstuur is bepaal volgens die worsmetode (Loxton 1966).

Die volgende klasse is onderskei:

0 - 10%	Sand	(Sa)
>10 - 15%	Leemsand	(LmSa)
>15 - 20%	Sandleem	(SaLm)
>20 - 35%	Sandkleileem	(SaKlLm)
>35 - 55%	Sandklei	(SaKl)
>55%	Klei	(Kl)

Helling

Die helling by elke opnamepunt is gemeet in grade met die hulp van 'n Suunto optiese klinometer. Die helling is altyd loodreg met die aspek gemeet.

2. Sintetiese fase

Die gegewens wat in die veld versamel is, is in 'n tabelvorm opgestel. Die tabel bestaan uit kolomme en rye wat onderskeidelik die relevés en spesies verteenwoordig (Werger 1974). Die bedekkings-getalsterktewaardes van die spesies wat in die relevés aangetref is, verteenwoordig die matriks van die tabel.

'n TWINSPAN-klassifikasie (Hill 1979b) is as eerste verdeling op die data uitgevoer. Die produk van hierdie eerste verdeling is in 'n tabelvorm opgestel en is verder verfyn deur gebruik te maak van Braun-Blanquet-prosedures (Werger 1974) en die PHYTOTAB rekenaarprogrampaket (Westfall et al. 1982). Die proses waarvolgens spesies en relevés in 'n plantsosiologiese tabel gerangskik word, word deur Ellenberg (1956) beskou as 'n objektiewe tegniek (Bredenkamp 1982).

Die plantegroei-eenhede wat verkry is, is met spesifieke habitatsdata geassosieer deur gebruik te maak van die DECORANA ordeningsprogram (Hill 1979a).

In die plantsosiologiese tabelle word die volgende gegewens aangedui (Bredenkamp 1982):

(a) Die spesies wat in die onderskeie plantgemeenskappe teenwoordig is.

(b) Die bedekkings-getalsterktewaardes van elke spesie in elk van die plantgemeenskappe.

(c) Die onderlinge verwantskap tussen die gemeenskappe.

Afsonderlike fitososiologiese tabelle is vir elke landtipe in die studiegebied opgestel. 'n Sinoptiese tabel van alle plantgemeenskappe wat in die studiegebied verkry is, is opgestel om die verwantskappe tussen die gemeenskappe aan te toon. Die name van die dominante plantspesies is vir die benaming van die gemeenskappe gebruik. Met dominant word bedoel die plantspesies met die hoogste frekwensie en bedekking in die gemeenskap.

HOOFSTUK 5.

THE PHYTOSOCIOLOGY OF THE VILLIERS-GROOTVLEI AREA, SOUTH AFRICA. 1. PHYSICAL ENVIRONMENT AND THE PLANT COMMUNITIES OF THE Bb LAND TYPE.

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Keywords: Villiers-Grootvlei area, climate, geology, Braun-Blanquet, classification, ordination

ABSTRACT

The physiography, geology and climate of the Villiers-Grootvlei area are described. The vegetation of the Bb Land Type is classified, by means of the Braun-Blanquet method, in three communities. One of the communities is divided in four sub-communities. The communities are related to spesific environmental conditions.

UITTREKSEL

Die fisiografie, geologie en klimaat van die Villiers-Grootvlei area is beskryf. Die plantegroei van die Bb-landtipe is deur middel van die Braun-Blanquet metode geklassifiseer in drie gemeenskappe. Een van die gemeenskappe is verder onderverdeel in vier sub-gemeenskappe. Die gemeenskappe is gekoppel aan spesifieke omgewingstoestande.

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INTRODUCTION

The term grassland is well established, is effectively descriptive and is preferred to the vernacular grassveld, because of the former's local and international acceptance. The Grassland Biome is found mainly on the high central plateau of South Africa, inland areas of the seabord of Natal and mountain areas of the south eastern Cape Province. The area of the biome is 343 000 km² or 16,5% of South Africa (Rutherford & Westfall 1986).

The Grassland Biome is an important region for maize, wheat and other agricultural produce such as meat, wool and dairy products. The "White Paper on Agriculture policy" (1984) refers to the decline of the natural pasturage and warns that indiscriminate land-use practices and the over-exploitation of the natural resources may lead to a decrease in the living standards (and quality) of the population. The veld type description of Acocks (1988) is the only available vegetation classification of the Highveld Region. This classification was of a rather generalised nature and therefore a more detailed description and mapping of the vegetation of the Highveld Region according to the association of vegetation with distinct soil-climate combinations is a necessity (Landbou-ontwikkelingsprogram: Hoëveldstreek 1986).

The aim of the study is to describe, measure and classify the vegetation of the Villiers-Grootvlei area, and to relate the vegetation to factors governing it's behaviour and it's interactions with the environment (Edwards 1972; 1979), to organize it in a system with maximum predictability. This specific study area was chosen as a key area for effective

extrapolation to the surrounding areas and as a link between the western and eastern parts of the Grassland Biome. In this report the classification of the Bb Land Type together with a general discussion of the physical environment of the study area is given.

STUDY AREA

The 2628DC GROOTVLEI Topocadastral map (1:50 000) (1978 - Government Printer, Pretoria) was used as the basemap.

The study area is situated between latitudes 26°45'S and 27°00'S, and between longitudes 28°30'E and 28°45'E and occupies an area of ± 690 km² (70 000 ha) in the vicinity of Grootvlei, southern Transvaal, and a small area adjacent to Villiers in the northern Orange Free State (Figure 1).

PHYSIOGRAPHY

Geology

The dominant parent material or combination of materials influence the texture, i.e. clay- or sand percentage, the effective depth and the base status of the soil derived from it. These soil characters influence the species composition of the vegetation (Landbou-ontwikkelingsprogram: Hoëveldstreek 1986).

The geology of the study area is characterised by the Karoo Sequence, Ventersdorp Supergroup and the Witwatersrand Supergroup (Figure 2). The Ecca Group of the Karoo Sequence occurs in the

southern and eastern parts while the Ventersdorp Supergroup and Witwatersrand Supergroup occur in the central and northern parts of the study area (SACS 1980) (Figure 2; Table 1).

Shales and sandstone of the Middle Ecca sediments form a gently undulating landscape with a moderately thick soil mantle. Dolerite intrusions as dykes and sheets are prominent in the south-western part of the study area.

The Ventersdorp Supergroup comprises andesitic to basaltic lavas together with quartzites, shales and cherts (Du Toit 1954; SACS 1980) and forms the hilliest part of the landscape. Isolated remnants of the Witwatersrand Supergroup occur along the western margins of the Ventersdorp Supergroup. The Witwatersrand Supergroup comprises quartzites, shales, conglomerates, andesetic lavas and tillite (Du Toit 1954; SACS 1980). The arable land on the Ventersdorp Supergroup and Witwatersrand Supergroup is limited to pediment slopes where the soils usually exhibit well developed rubble layers. A thick mantle of Quaternary aeolian Vaal River Sand occurs on a strip of land on the Orange Free State banks of the Vaal river. This may be of the same kind as the late Upper Pleistocene garnet-bearing, river border dunes described by Harmse (1963).

Geomorphology and topography

Kruger (1983) classified the Republic of South Africa on terms of broad terrain patterns. Two terrain units namely Terrain unit 7 and Terrain unit 10 are located in the study area. Terrain unit 7 is defined as the Southern Inland Flats and Terrain unit 10 as the Pre-Karoo Area.

Kruger (1983) also classified the Republic of South Africa in

terms of terrain morphological classes. Two terrain morphological classes namely Class 3 and Class 18 occur in the study area. Class 3 is described as gently undulating flats with a low relief of 0-130 m. Class 18 is defined as hilly and lowlands with a low to high relief of >130-450 m (Kruger 1983). Eighty percent of the area of Class 3 has slopes of less than 5% while 20-50% of the area of Class 18 has slopes of less than 5% (Kruger 1983). The north-eastern area and part of the central area of the study area represents Class 18 while the rest of the study area is covered by Class 3.

The study area is part of the gently undulating Highveld plateau, an early Tertiary erosion surface that has suffered some dissection by later erosion cycles (Van der Bank et al. 1978). The east-west ridges of erosion-resistant Ventersdorp rocks and the hilly country in their vicinity comprise somewhat less of the study area than the pediplain (King 1963) on the softer Ecca sediments. A few circular pans, which seldom contains much water, occur on the Ecca pediplain. Large alluvial flats, such as the one at Springfield Collieries, Grootvlei, are probably the result of aggregation. In the south, northerly winds have removed sand from the Vaal River and deposited it as a distinctive left bank feature.

The study area varies from 1 500 m to 1 834 m above mean sea level with the highest point of 1 834 m approximately 1 km east of Korporaalskop in the north-eastern part of the study area.

LAND TYPES

According to MacVicar et al. (1974), a Land Type is an area that can be demarcated on a 1:250 000 scale map, with a specific degree of uniformity in macroclimate, terrain and soil pattern. Five Land Types namely Ea, Ib, Ba, Bb and Ca occur in the study area (Figure 3). The Land Types with their associated vegetation are fully discussed by the Land Type Survey Staff (1984) and by (Breytenbach et al. 1992. 1,2,3,4).

CLIMATE

According to Schulze (1965) the primary factors that control the climate of any given area are (i) latitude, which defines the quantity of solar radiation (ii) position in terms of distribution of land and sea (iii) altitude (iv) general circulation of the atmosphere and it's interferences (v) sea currents (vi) general nature of the topography (vii) orientation in relation to mountains and hills and (viii) vegetation cover.

Grootvlei is situated in the Cwb-zone of Köppen's (1900, in Schulze & McGee 1978) system for climatological classification. According to this system the Cwb climate can be described as:

C: a warm temperate climate where the coldest month has a mean temperature between 18°C and -3°C

w: the dry season occurs during winter

b: the warmest month has a mean temperature below 22°C, but at least four months have mean temperatures above 10°C

(after Köppen &Geiger 1936, in Schulze & McGee 1978).

According to Poynton's Thermal Regions (1971, in Schulze & McGee

1978) the study area falls into Region 5. The region can be described as a cold-temperate zone with an effectiveness index of 520 mm to 997 mm. Moderate frost occurs and the approximate mean monthly minimum temperature for the coldest month lies between -5°C and 0°C.

The details of the nine weather stations in the Highveld Region from which the climatic data was obtained is given in Table 2.

TEMPERATURE

Photothermal units

According to the map for photothermal units above 10°C as compiled by the Sub-division:Agricultural Meteorology of the Soil and Irrigation Research Institute (1975) the study area is divided as follows. From March to October the north-eastern part is situated in the 15 000 to 19 999 photothermal units above 10°C zone and the rest of the study area is situated in the 20 000 to 24 999 photothermal units above 10°C zone. From April to September the study area receives 1 to 5 000 photothermal units above 10°C except for a small area in the south-west, receiving 5 001 to 10 000 photothermal units above 10°C.

Air temperature

Since there is no weather station in the study area the air temperature data of Villiers, Heidelberg and Standerton weather stations are used in the discussion (Table 3).

The mean daily maximum temperature fluctuates between 17,2°C in July at Standerton to 27,9°C in January at Villiers and the mean

daily minimum temperature varies between -2,7°C in June to 14,2°C in January, as recorded at Villiers (Table 3). The mean monthly temperature varies from 7,5°C in June to 21,1°C in January as recorded at Villiers. The extreme maximum temperature of 37,4°C (1989-12-31) and the extreme minimum temperature of -12,8°C were recorded at Standerton (Table 4).
According to Table 3 September to March are the warmer and April to August are the colder months of the year in the study area.

RAINFALL

With the use of Principal Component Analysis (PCA) and simple linkage analysis, Olivier & Van Rensburg (1987) divided the south-eastern Transvaal into the western, central and eastern homogeneous rainfall regions. The rainfall shows a decline from the north-east to the south-west of the area. Grootvlei is situated in the western part which is characterised by intermediate rainfall of 550-650 mm per year (Olivier & Van Rensburg 1987).

The short-term rainfall statistics for the nine weather stations are given in Table 5.

The highest mean yearly rainfall of 799,1 mm and the lowest mean yearly rainfall of 604,5 mm were measured at Greylingstad and Wittebank respectively (Table 5). The highest mean monthly rainfall of 363,5 mm was measured in December at Villiers (Table 6). The extreme maximum rainfall within 24 hours is 106 mm as measured at Standerton (1980-01-22).

SOLAR RADIATION, SUNSHINE DURATION AND CLOUD COVER

Solar radiation

In the study area the incoming radiation during winter varied from 150 to 160 units per day while incoming radiation during summer varied from 230 to 240 units, where one unit is equal to 100 000 J.m².day (South Africa Weather Bureau 1968).

Sunshine duration

Information on sunshine duration is only available for Villiers weather station over a period of 10 years (1977-1987). The mean daily hours sunshine is the highest during December to February and also during August while the lowest is from March to November with the exception of August. The lowest mean hours sunshine of 7,9 occurs during March and the highest mean hours sunshine of 8,9 occurs during December (Table 7).

Cloud cover

No information on cloud cover is available for the study area. The discussion on cloud cover is based on information from the Standerton weather station over a period of six years. The cloud cover is measured at 08:00, 14:00 and 20:00 and is indicated on a scale of 0 to 8 (Table 8). The highest mean cloud cover at 08:00 is obtained from November to April, at 14:00 from October to April and at 20:00 from November to February. The lowest mean cloud cover occurs during winter and specifically from June to July when the cloud cover declines from 08:00 to 20:00.

THUNDER, HAIL, SNOW AND MIST

Thunder

The average number of days per year with thunder is 45,8 which occurs mainly during October to March. In January there is an average of 7,4 days with thunder compared with 0,4 days during June (Table 9).

Hail

The average number of days with hail per year is 4,4 which occurs mainly during October to December. The highest average number of days with hail in one month is 0,8 during October and during June no hail has ever been recorded (Table 9).

Snow

The average number of days with snow per year is 0,9. Snow has only been recorded from April to September with the highest average number of days with snow of 0,3, recorded during July (Table 9).

Mist

The average number of days with mist per year is 44, which occurs mainly from March to August. The highest average number of days with mist namely 7,8 occurs during May compared to 0,2 during December (Table 9).

RELATIVE HUMIDITY

The data from the Standerton and Villiers weather stations over a period of 33 years (1951-1984) and 9 years (1978-1987) respectively is used in the discussion.

The higest mean maximum percentage relative humidity as recorded at Villiers, occurs from November to April, compared to January to July at Standerton.

SUMMARY

The rainfall and temperature data of the weather stations is summarised in Walter climate diagrams (Figure 4).

METHODS

In the study the ZÜrich-Montpellier phytosociological approach (Braun-Blanquet 1932; Werger 1974) was used to define and describe the different plant communities as it is the most popular and acceptable method in use in South Africa (Bredenkamp 1975; Van Rooyen 1978; Deall 1985; Kooij 1990). The Rangeland Ecology Section of the Grassland Research Centre is an advocator of this approach and the fact that other studies in the Grassland Biome (Bredenkamp 1975; Deall 1985; Bezuidenhout 1988; Turner 1989; Bloem 1989; Kooij 1990) were done with this approach contribute, to it's selection.

The vegetation is sampled with the use of random stratified sub-quadrats. The study area was stratified by means of geology and

Land Types. Experiments during the reconnaissance phase in the study area showed that more information was obtained with the sub-quadrat method in terms of time and energy spent, than a single square quadrat. A stratified random method was used for the placement of sample plots. The sub-quadrats are rectangular with the sides in proportion of one to two, since this is more effective than square quadrats (Oosting 1956; Cain & Castro 1959). The sub-quadrats used were 3 m in length and 1,5 m in width (Turner 1989). Sub-quadrats are repeatedly placed until the increase in new species is less than 10%. During the study a minimum of three sub-quadrats per relevé was maintained (a minimum area of 13,5 m^2). The relevés were placed by using random numbers which have been generated by computer. In each relevé floristic composition , using the Braun-Blanquet cover-abundance scale (Werger 1974). Taxon names (Myburgh et al. in prep.) conform to those of Gibbs Russell et al. (1985 & 1987).

Data analysis was carried out using TWINSPAN (Hill 1979b) for the first set of relevé and species sequences and thereafter the table was refined using Braun-Blanquet procedures (Behr & Bredenkamp 1988; Bredenkamp, Joubert & Bezuidenhout 1989) and the PHYTOTAB program package (Westfall et al. 1982). The data was ordinated by using Detrended Correspondence Analysis (DECORANA) (Hill 1979a).

The Bb Land Type occupy 9 800 ha of the total study area (Figure 5). The dominant soils of the Bb Land Type are of the Avalon, Glencoe, Longlands, Hutton, Wasbank, Rensburg and Bonheim Forms. The predominantly geology of the area is shale, sandstone and grit of the Ecca Group, Karoo Sequence. The dominant terrain

units of the area are terrain unit 3 (60% of the area) within the slope class 1-3% and terrain unit 1 (30% of the area) within the slope class 1-2% (Land Type Survey Staff 1985). The average rainfall of the Bb Land Type is 666,2 mm (Land Type Survey Staff 1985). The area of the Bb Land Type as well as the time available determined the number of relevés. Relevés were compiled in 19 stratified random sample plots.

RESULTS

The vegetation of the Bb Land Type (Table 10) can be described as a *Themeda triandra-Eragrostis curvula* Grassland with *Eragrostis curvula, Themeda triandra, Cynodon dactylon* and *Aristida congesta* as the most common species, with high abundance cover values (Species Group H, Table 10). An average of 11 species was recorded per relevé. The presence of pioneer species such as *Cynodon dactylon* and *Aristida congesta* suggests that the veld has been over-grazed (Landbou-ontwikkelingsprogram: Hoëveldstreek 1986).

This grassland is situated on deep (>900 mm) sandy soils of the Avalon soil form and also shallower (<300 mm) loam and clayey soils to deep (>300 mm) loam and clayey soils of the Clovelly, Pinedene, Westleigh, Mispah, Arcadia and Rensburg soil forms (MacVicar et al. 1977). The grassland occurs at an altitude of 1 520 m to 1 600 m above mean sea level on slopes with an inclination of 0-3° and on terrain units 3, 4 and 5 (Figure 6 ; 7). The percentage above-ground rock varies between 0% to 20%. Shrubs and trees are absent in this grassland.

CLASSIFICATION

The grassland is divided into three main plant communities (Table 10; Figure 7):

1.1 the high-lying *Cynodon dactylon-Pogonarthria squarrosa* Grassland on deep (>900mm) sandy soils;

1.2 the *Themeda triandra-Aristida sciurus* Grassland on shallow (<300mm) rocky soils;

1.3 the low-lying *Eragrostis curvula-Eragrostis plana* Grassland on the floodplains.

The *Eragrostis curvula-Eragrostis plana* Grassland is divided into the following sub-communities:

1.3.1 *Eragrostis plana-Setaria nigrirostris* Grassland

1.3.2 *Eragrostis plana-Digitaria ternata* Grassland

1.3.3 *Eragrostis plana-Elionurus muticus* Grassland

1.3.4 *Eragrostis plana-Commelina africana* Grassland

Description of plant communities

1.1 The *Cynodon dactylon-Pogonarthria squarrosa* Grassland

The *Cynodon dactylon-Pogonarthria squarrosa* Grassland is situated on deep (>900 mm) sandy soils (0-6% clay) of the Avalon soil form (MacVicar et al. 1977) with sandstone (Qw) as the parent material (Figure 6). This grassland occurs at an altitude of 1 540 m above mean sea level on slopes with an inclination of 0-1° on terrain unit 1 (Figure 7), near a non-perennial circular pan (Figure 6). Above-ground rock is absent in this community. An average of eight species was recorded per relevé.

The plant community is characterised by the occurrence of the

conspicious diagnostic species *Pogonarthria squarrosa, Trichoneura grandiglumis, Solanum panduriforme* and *Cyperus rigidifolius* (Species group A, Table 10). Other grasses include *Cynodon dactylon, Aristida congesta* and *Eragrostis curvula.* The mean basal cover of the herbaceous layer is 4%.

1.2 The *Themeda triandra-Aristida sciurus* Grassland

The *Themeda triandra-Aristida sciurus* Grassland is associated with outcrops of dolerite dykes which occur in the study area (Figure 6). The soils of this community mostly represent the Arcadia form (MacVicar et al. 1977). The depth of the soil varies between 150 mm and 300 mm and the above-ground rock between 10% and 20% (Figure 6). This grassland occurs at an altitude of 1 520- 1 540 m above mean sea level and mainly on the concave terrain unit 3 (Figure 7) on slopes with an inclination of 1-3°. An average of 13 species was recorded per relevé.
The diagnostic species are *Aristida bipartita, Aristida sciurus, Cymbopogon plurinodes, Heteropogon contortus, Hyparrhenia hirta, Chenopodium schraderanum, Garuleum woodii, Crabbea acaulis, C. hirsuta, Abildgaardia ovata, Bulbostylis contexta* and a *Hypoxis* sp. (Species group B, Table 10). *Cynodon dactylon, Eragrostis curvula, Themeda triandra* and *Aristida congesta* are dominant grasses in the community. The presence of *Aristida* species and *Cynodon dactylon* suggests either over-grazing or another form of disturbance of the veld (Landbou-ontwikkelingsprogram: Hoëveldstreek 1986). *Hyparrhenia hirta* occurs on localised disturbed patches between the above-ground rocks. The mean basal cover of the herbaceous layer is 7%.

1.3 The *Eragrostis curvula-Eragrostis plana* Grassland

The *Eragrostis curvula-Eragrostis plana* Grassland is situated at an altitude of 1 520 m to 1 600 m above mean sea level on terrain units 3, 4 and 5 and slopes with a inclination of 0-2°. The soils of this community represent the Clovelly, Pinedene, Westleigh, Mispah, Arcadia and Rensburg forms (MacVicar et al. 1977) with a soil depth that varies from 200 mm to 1 000 mm.

The *Eragrostis curvula-Eragrostis plana* Grassland is characterised by the occurrence of *Eragrostis plana* and *Berkheya pinnatifida* (Species group C, Table 10). *Eragrostis plana, Eragrostis curvula, Themeda triandra, Elionurus muticus, Cynodon dactylon* and *Berkheya pinnatifida* are dominant species (Table 10).

1.3.1 The *Eragrostis plana-Setaria nigrirostris* Grassland

The habitat of the *Eragrostis plana-Setaria nigrirostris* Grassland differs from the other two sub-communities because here the soils are shallower (<300 mm), the clay content is lower and the position in the landscape leads to better drained soils (Figure 6). The soils of the community are predominantly of the Clovelly form (MacVicar et al. 1977) with a clay content of 25-35%. The above-ground rock cover varies between 5% and 10% (Figure 6). The community is situated at an altitude of 1 600 m above mean sea level on slopes with an inclination of 1-2°. An average of 12 species was recorded per sample plot.

The diagnostic species of the community are *Helichrysum rugulosum, Paspalum dilatatum, Sporobolus africanus, Setaria*

nigrirostris and *Hermannia depressa* (Species group D, Table 10). *Eragrostis curvula, Themeda triandra* and *Cynodon dactylon* are dominant grasses. *Aristida congesta* and *Cynodon dactylon* occur in localised disturbed areas. The short grazed *Themeda triandra* and the ungrazed *Eragrostis plana* indicate selective grazing. This selective grazing together with termite activity result in degradation of the veld. The mean basal cover of the herbaceous layer is 9%.

1.3.2 The *Eragrostis plana-Digitaria ternata* Grassland

The *Eragrostis plana-Digitaria ternata* Grassland is situated on black vertic soils of the Arcadia soil form (MacVicar et al. 1977) with a clay content of more than 55% and an average soil depth of 730 mm. No above-ground rock occurs in the community (Figure 6). The community occurs at an altitude of 1 520 m to 1 550 m above mean sea level on terrain unit 4 (Figure 7) on slopes with an inclination of 0-1° (Figure 6). An average of 13 species was recorded per sample plot.

The community is characterised by the diagnostic species *Digitaria ternata, Solanum supinum, Urochloa panicoides, Tagetus minuta, Schkuhria pinnata, Digitaria eriantha, Asclepias multicaulis, Microchloa caffra, Anthericum cooperi* and *Berkheya setifera* (Species group E, Table 10). *Eragrostis curvula, Themeda triandra* and *Cynodon dactylon* are dominant grasses in the community. Generally the veld is selectively grazed with *Themeda triandra* extensively grazed and *Eragrostis plana* ungrazed. In the over-grazed areas the dicotyledonous forb *Berkheya pinnatifida* is conspiciously present. The mean basal cover of the herbaceous layer is 10%.

1.3.3 The *Eragrostis plana-Elionurus muticus* Grassland

The *Eragrostis plana-Elionurus muticus* Grassland is situated on dolerite (Jd) (Figure 6) that erodes to a vertic clayey soil of the Arcadia and Rensburg soil forms (MacVicar et al. 1977). Shallow rocky soils are also present in this community. The community is situated at an altitude of 1 540 m to 1 560 m above mean sea level on terrain unit 4 (Figure 7) on slopes with an inclination of 0-2° (Figure 6). An average of nine species was recorded per sample plot.

The diagnostic species of the community are *Elionurus muticus, Eragrostis racemosa, Brachiaria serrata, Felicia fascicularis, Aptosimum indivisum, Chaetacanthus costatus, Evolvulus alsinoides, Dicoma anomala, Pentzia globosa, P. incana, Cyperus tenax* and *Ledebouria* sp. (Species group F, Table 10). *Eragrostis curvula, E. plana* and *Themeda triandra* are dominant grass species in the community with *Berkheya pinnatifida* as the most prominent dicotyledonous forb. Very few dicotyledonous forbs occur where dead plant material accumulates, resulting in uncovered ground between tufts of grass. In areas where there is less accumulation of dead plant material, more forbs occur and the basal cover of the grasses is higher. The mean basal cover of the herbaceous layer is 12%.

1.3.4 The *Eragrostis plana-Commelina africana* Grassland

The *Eragrostis plana-Commelina africana* Grassland is situated on clayey soils (generally gleyed) and are of the Rensburg, Pinedene

and Westleigh soil forms (MacVicar et al. 1977). The clay content of the soil is more than 55% with an average soil depth of 550 mm. The community is associated with sandstone and shale and is situated at an altitude of 1 540 m above mean sea level on terrain units 4 and 5 (Figure 7) on slopes with an inclination of 0-2° (Figure 6). No above-ground rock is present in the community. An average of eight species was recorded per sample plot.

The community is characterised by the diagnostic species *Setaria pallide-fusca, Brachiaria serrata, Asclepias eminens, Commelina africana, Chamaesyce inequilatera, Oxalis obliquifolia, Pseudognaphalium luteo-album, Kohautia amatymbica, Verbena bonariensis, Linum thunbergii, Walafrida densiflora* and *Mariscus* sp. (Species group G, Table 10). *Eragrostis curvula* and *Eragrostis plana* are dominant grasses in the community. Other grasses in the community are *Themeda triandra* and *Cynodon dactylon*. The condition of the veld varies from good where *Themeda triandra* has a high basal cover, to poor where *Themeda triandra* has a low basal cover and disturbed open spaces where only *Cynodon dactylon* occurs. *Hyparrhenia hirta* can also be found on localised disturbed areas. In areas where dead plant material accumulates the occurrence of forbs is very low. The mean basal cover of the herbaceous layer is 8%

ORDINATION

The data was ordinated by using Detrended Correspondence Analysis (DECORANA) (Hill 1979). In the scatter diagram a distinct separation between the different communities of the Bb Land Type can be observed (Figure 8). The first and second axes of the

ordination were used for the illustration of the plant communities and environmental interactions. The first axes is responsable for 77% (Eigen value of 0,770) and axes two for 43,2% (Eigen value of 0,432) of the variation in the data set . The relevès of the *Cynodon dactylon-Pogonarthria squarrosa* Grassland (A) are separated from the other communities on the basis of the drainage of the soils. This community is situated on terrain unit 1 (Figure 7). The relevès of the *Themeda triandra-Aristida sciurus* Grassland (B) on terrain unit 3 (Figure 7) is seperated from the relevès of the *Eragrostis curvula-Eragrostis plana* Grassland (C) on terrain units 4 and 5 (Figure 7) on the basis of a soil drainage gradient with the exception of one relevè (Figures 6; 8).

CONCLUSION

According to Watts (1971) in Schulze & McGee (1978) there are four factors that potentially confine the growth of plants namely climate, topography, soil and biotic factors. A knowledge of the physical environment is essential in order to understand and interpret the vegetation-environment relationships.

The vegetation of the Bb Land Type is classified in three main communities and one community is divided in four sub-communities. The communities are mainly divided along a soil drainage gradient and this is confirmed by the DECORANA ordination. These plant communities combined with similar plant communities in the Ea, Ca, Ba and Ib Land Types (Breytenbach et al. b, c, d (in prep.)) in the study area, form management units.

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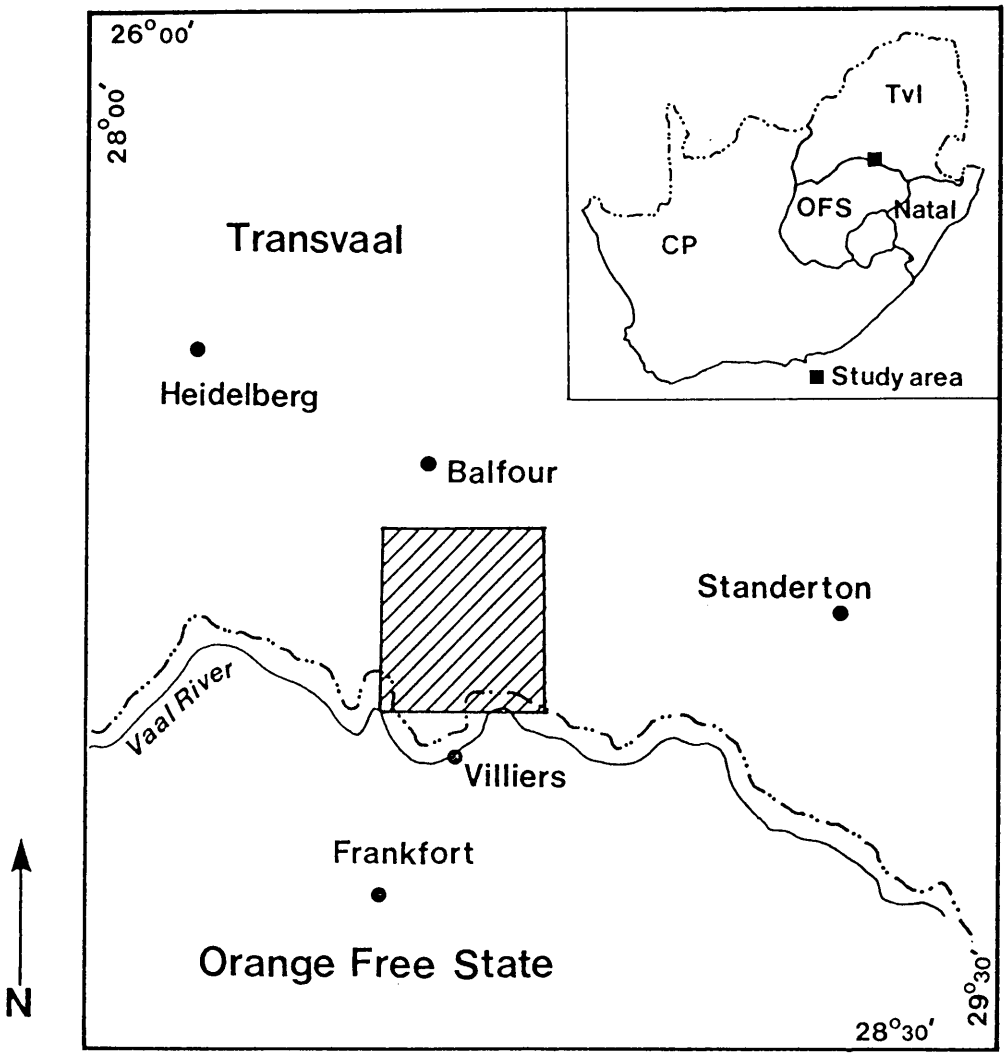


Figure 1. The location of the study area, based on the 2628 DC GROOTVLEI 1:50 000 Topocadastral map (Government Printer, Pretoria 1978).

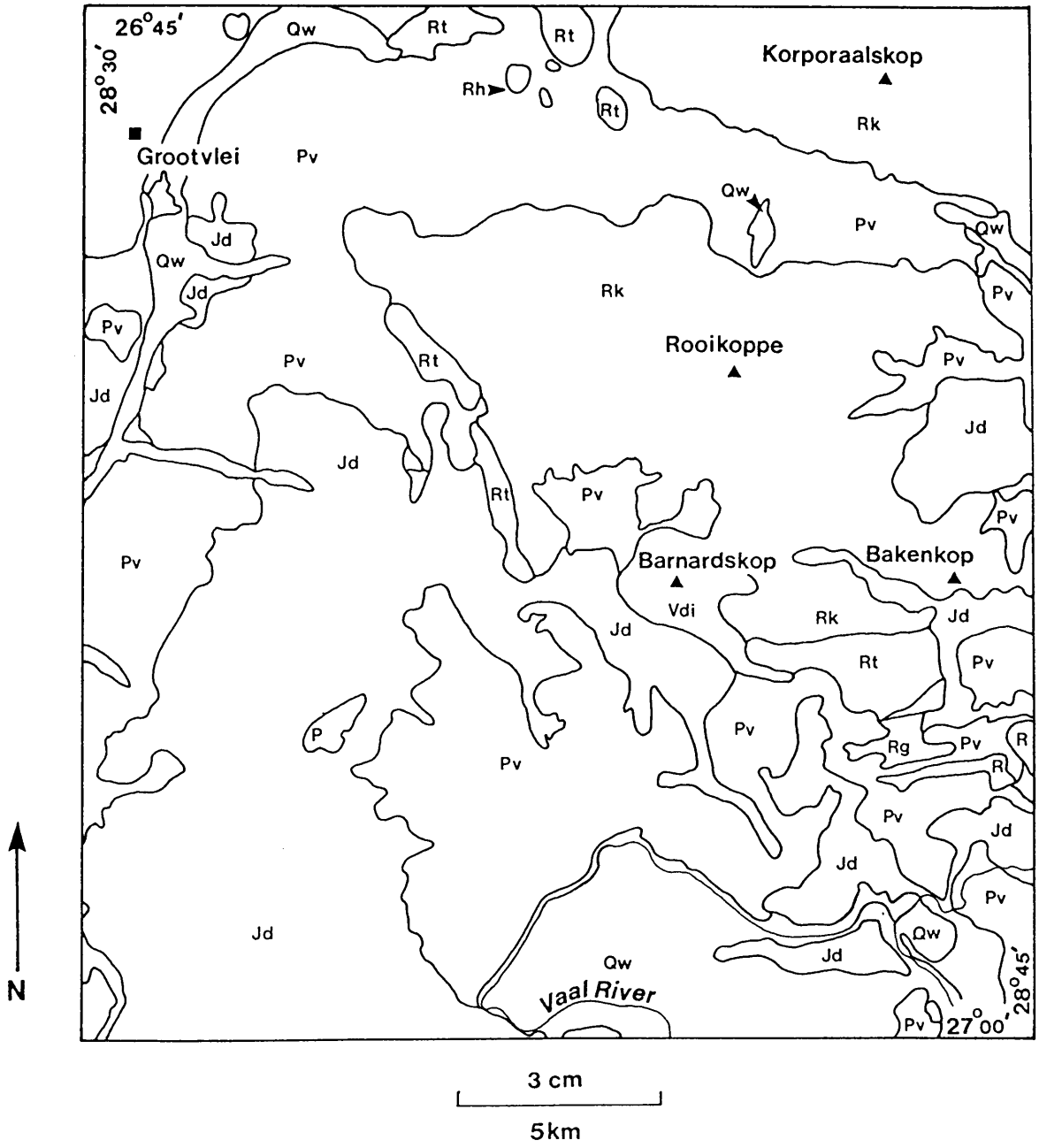


Figure 2. Map of the study area with the geological formations based on the 1:250 000 2628 EAST RAND geological map (Department of Mineral and Energy Affairs 1986).
(See table 1. for explanation of simbols)

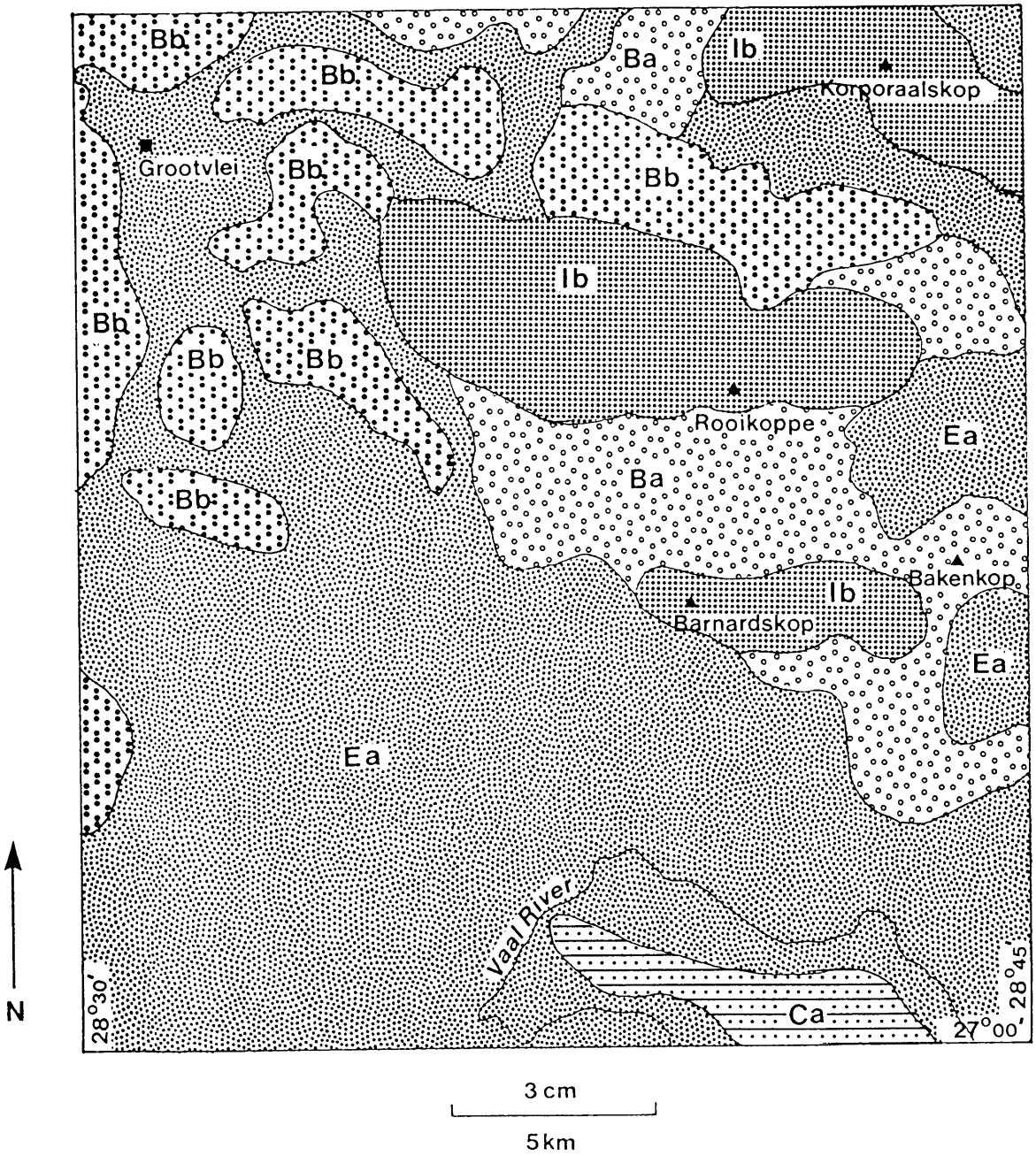


Figure 3. A map of the Land types of the study area based on the Land type series map 2628DC EAST RAND (1979).

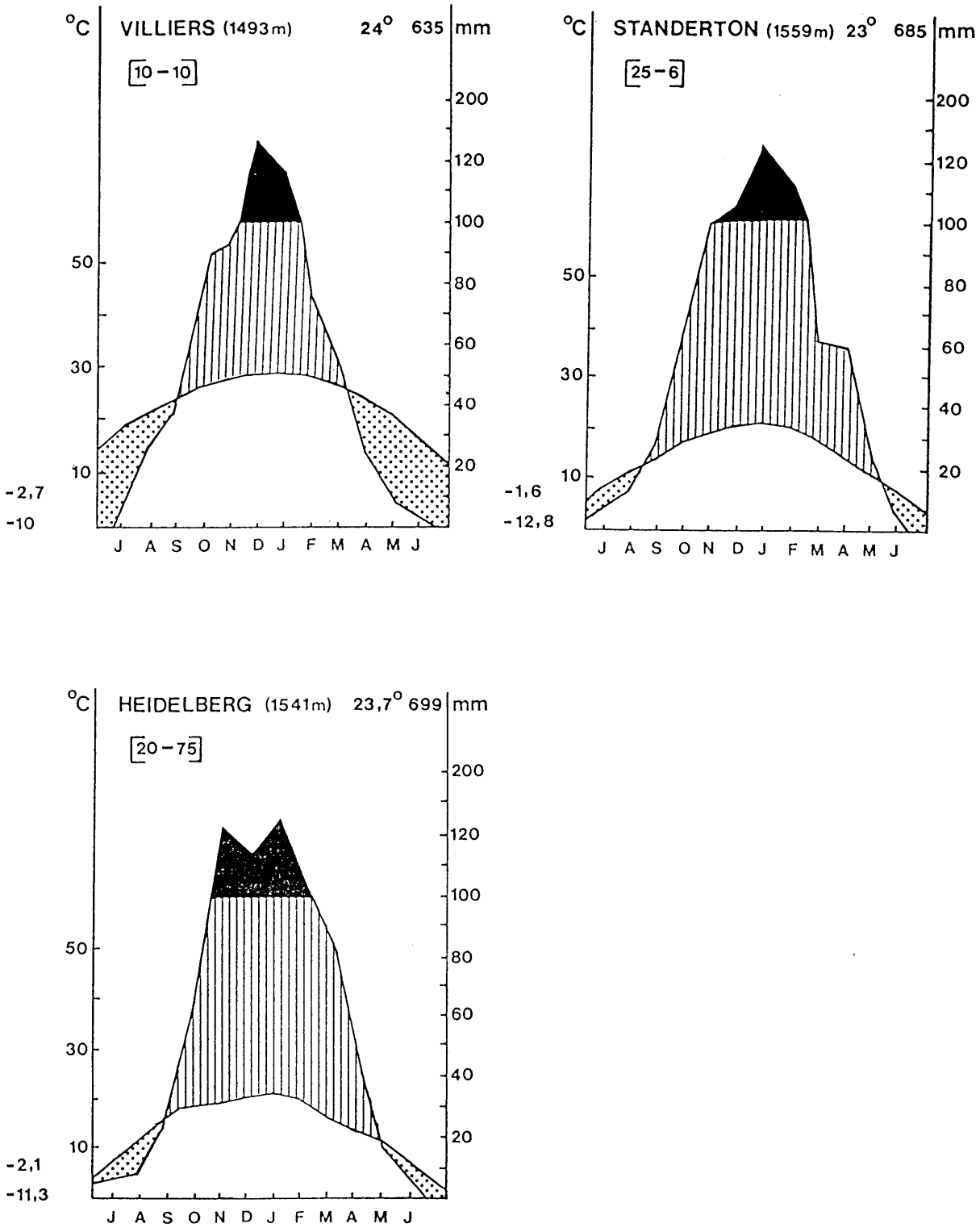


Figure 4. Climatic diagrams for the study area according to Walter (1963)

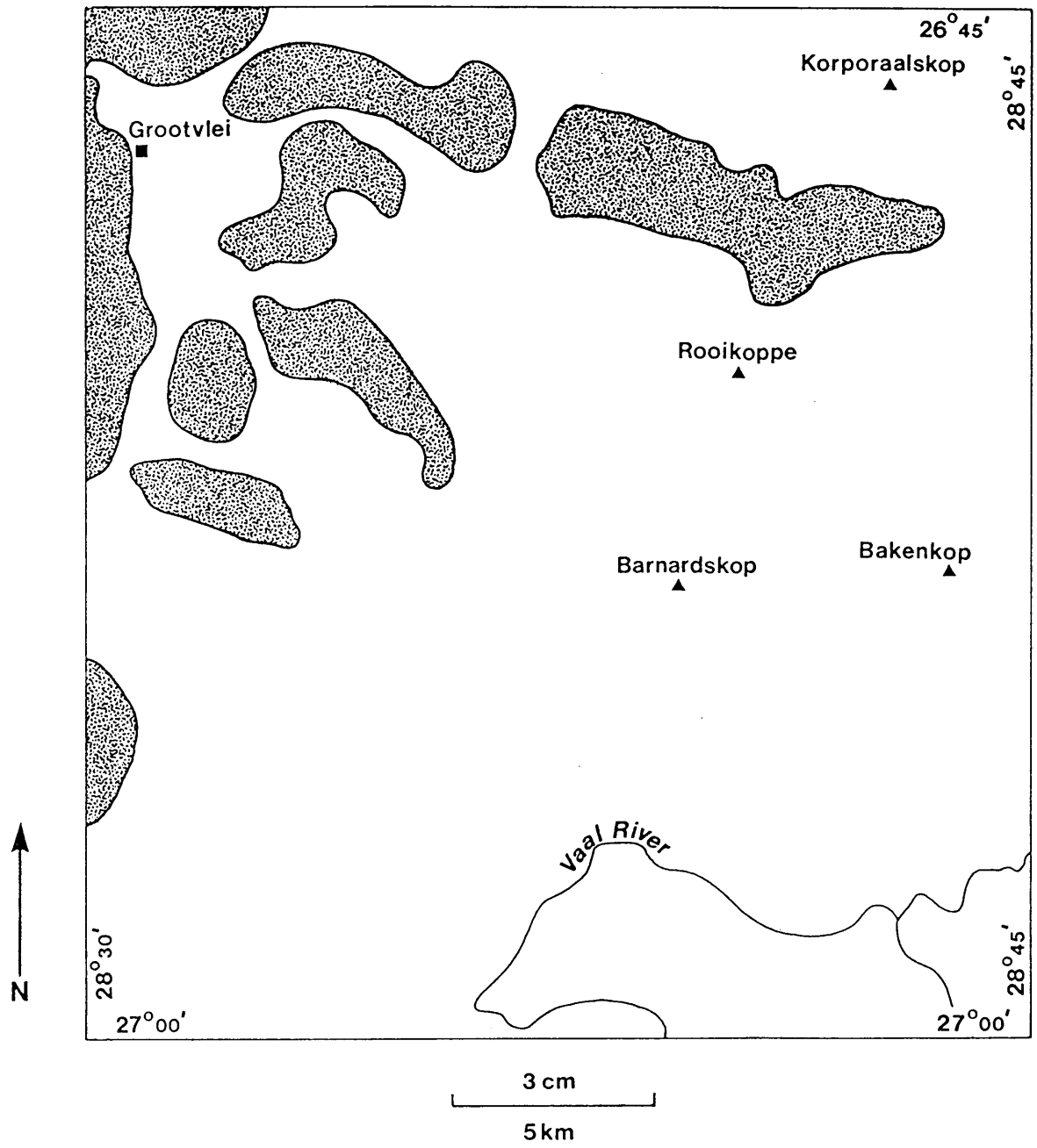


Figure 5. The location of the Bb Land Type in the study area (Land Type Survey Staff 1984)

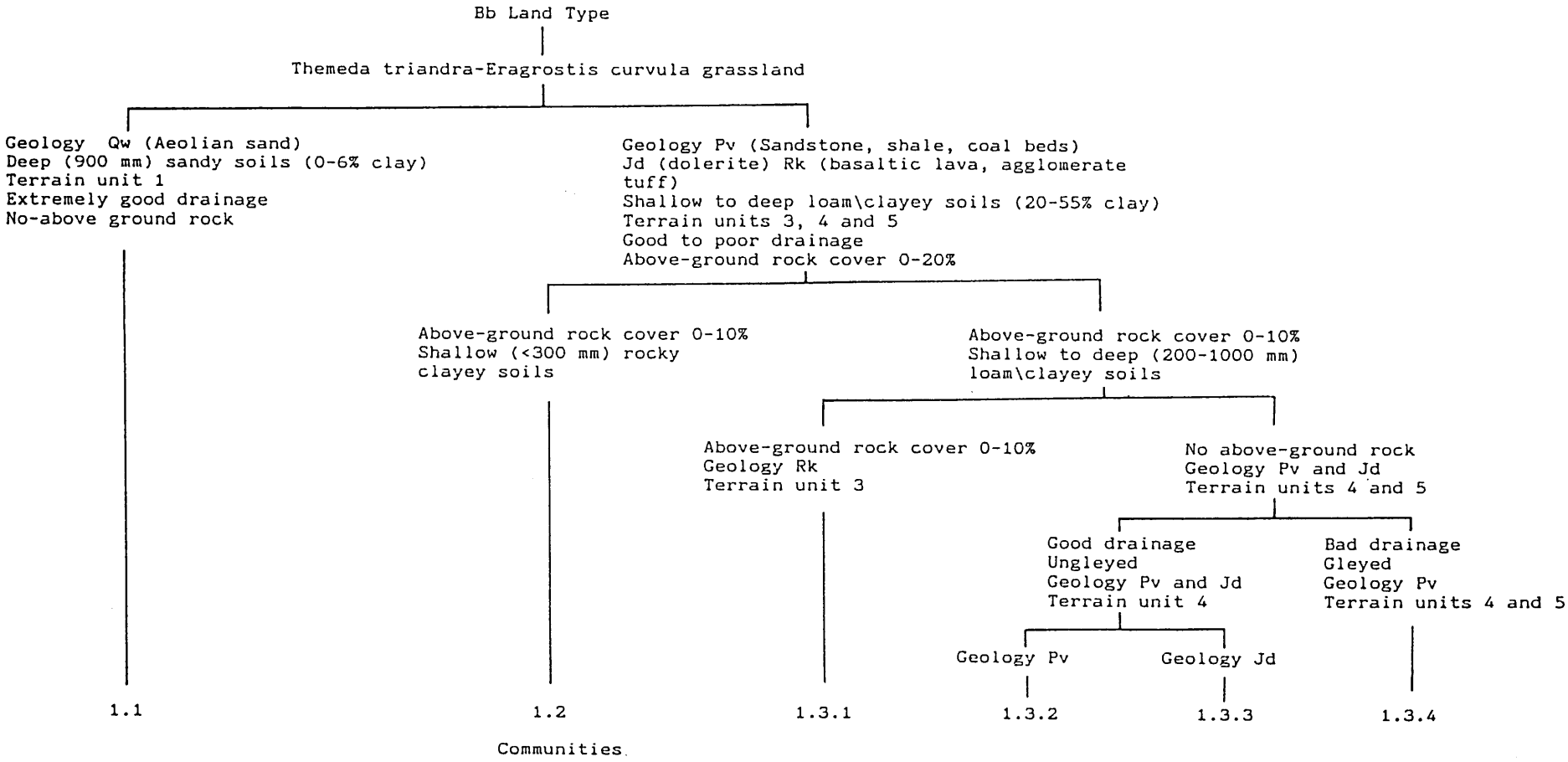


Figure 6. Dendrogram to illustrate the habitat relationships of the communities in the Bb Land Type (see text for community names).

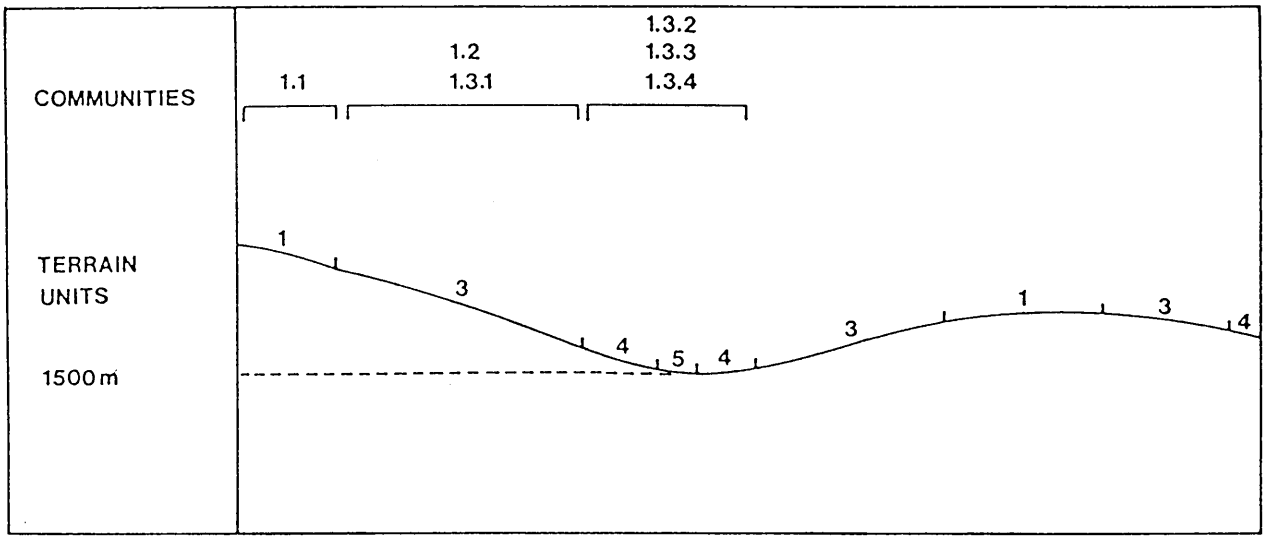


Figure 7. The location of the communities in the Bb Land Type on topographical types (see text for community names)

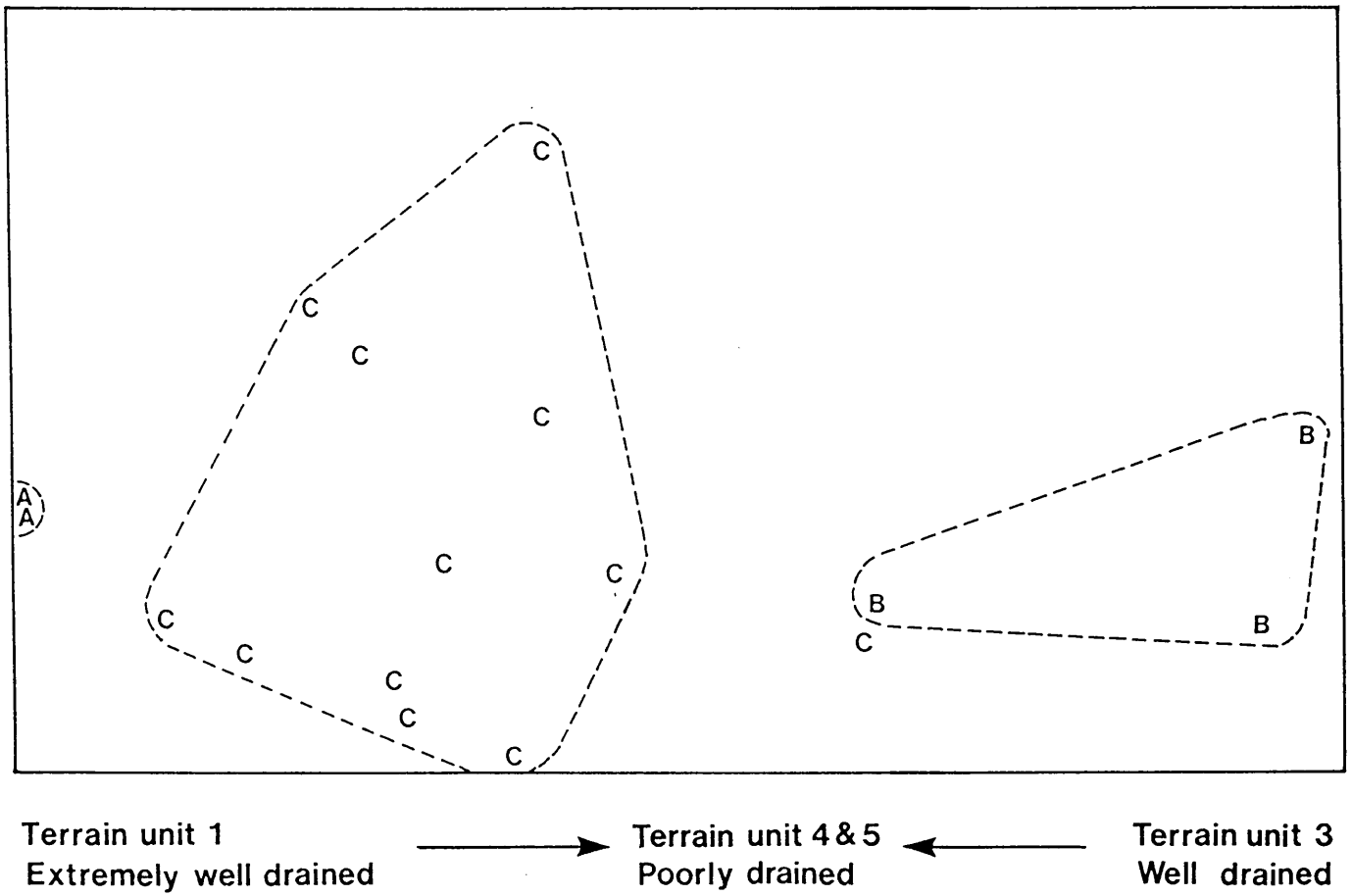
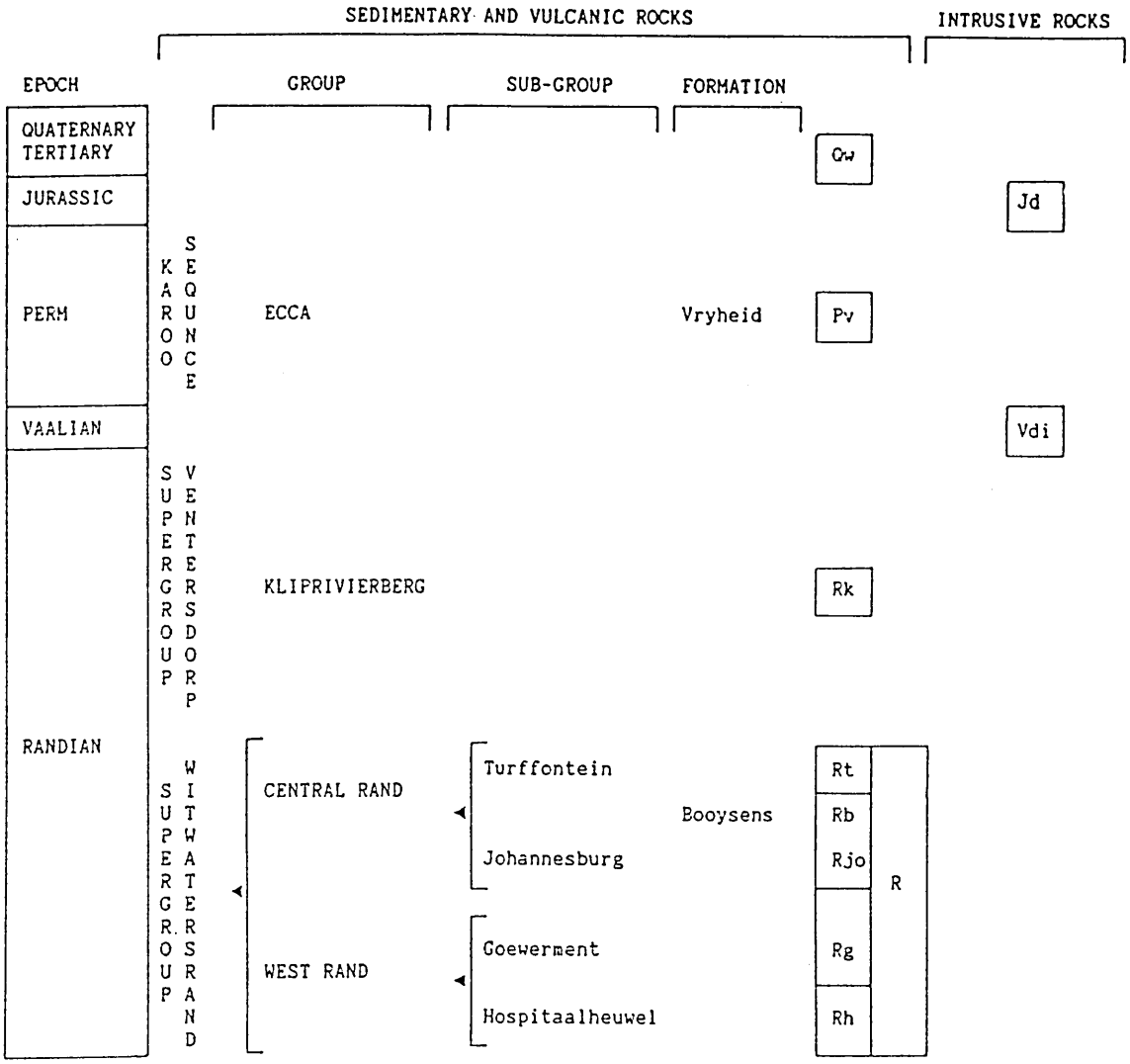


Figure 8. The Decorana ordination of the vegetation of the Bb Land Type in the Villiers-Grootvlei area.
A - *Cynodon dactylon-Pogonarthria squarrosa* Grassland
B - *Themeda triandra-Aristida sciurus* Grassland
C - *Eragrostis curvula-Commelina africana* Grassland

Table 1. Chronostratigraphic and litostratigraphic divisions in the Grootvlei area, southern Transvaal (adapted from SACS 1980)



LEGEND

Qw - Aeolian sand

Jd - Dolerite

Pv - Sandstone, shale, coal beds

Vdi - Diabase

R - Undifferentiated Witwatersrand quartzite, shale

Rk - Basaltic lava, agglomerate, tuff

Rt - Quartzite, conglomerate, sandy shale

Rb - Shale

Rjo - Quartzite, conglomerate

Rg - Quartzite, greywacke, conglomerate, shale, tillite

Rh - Shale (partly ferruginous), quartzite: banded ironstone

Table 2. Details of the nine weather stations in the Highveld Region from which the climatic data was obtained (Weather Bureau 1965, 1986; Soil and Irrigation Research Institute, Private Bag x79, Pretoria 0001)

Weather station	Latitude	Longitude	Altitude in meters	Observation period (years) Temperature\Rainfall (°C)	(mm)
Villiers (Koöperasie) (404/152)	27°02'	28°37'	1 493	10	10
Heidelberg (0476/660 A1)	26°30'	28°21'	1 541	20	75
Standerton (0441/416 A0)	26°56'	29°14'	1 559	25	6
Barnardskop (440/263)	26°53'	28°39'	1 585	0	8
Beerlaagte (439/769)	26°49'	28°26'	1 615	0	45
Grootvlei (440/ 18)	26°48'	28°31'	1 539	0	42
Greylingstad (SAR) (440/435)	26°45'	28°45'	1 588	0	46
Greylingstad (440/464)	26°44'	28°46'	1 588	0	9
Wittebank (440/449)	26°59'	28°45'	1 524	0	37

Table 3. Longterm temperature data (°C) as recorded at Villiers (V), Heidelberg (H) and Standerton (S) (see Table 2)

	Mean daily max. temp.			Mean daily min. temp.			Mean daily temp.			Highest monthly max. temp.			Highest monthly min. temp.			Lowest monthly max. temp.			Lowest monthly min. temp.		
Month	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S	V	H	S
J	27,9	27,7	26,8	14,2	13,9	13,6	21,1	20,8	20,2	33,5	32,7	31,6	-	-	16,7	-	-	19,3	9,5	11,7	8,9
F	27,8	26,8	26,0	14,0	13,1	13,0	20,9	19,9	19,5	32,8	30,8	30,5	-	-	16,4	-	-	19,6	9,8	9,2	8,4
M	26,8	25,4	25,1	11,5	11,5	11,2	19,2	18,5	18,2	31,5	29,9	29,7	-	-	15,6	-	-	18,0	5,8	6,6	5,3
A	24,4	23,4	22,3	7,4	7,1	7,2	16,0	15,3	14,7	29,4	27,6	26,7	-	-	12,4	-	-	15,3	0,8	1,1	1,2
M	21,6	20,5	19,9	1,9	2,1	2,5	11,8	11,3	11,1	26,4	24,6	24,6	-	-	8,9	-	-	13,1	-3,7	-4,4	-3,5
J	17,8	17,7	17,2	-2,7	-2,0	-1,6	7,5	7,8	7,8	22,3	21,9	21,6	-	-	6,0	-	-	10,4	-8,0	-7,5	-6,9
J	18,0	17,6	17,6	-2,4	-2,1	-1,6	7,8	7,7	8,0	22,6	22,6	22,1	-	-	5,1	-	-	10,3	-7,7	-7,4	-6,6
A	20,8	20,8	20,6	1,6	1,0	1,1	11,2	10,9	10,8	26,3	26,5	26,1	-	-	8,7	-	-	12,0	-5,8	-5,3	-5,4
S	23,5	23,9	24,3	6,7	5,8	5,7	15,2	14,8	15,0	30,6	32,0	30,3	-	-	11,8	-	-	13,1	-0,9	-0,9	-1,9
O	25,4	26,6	25,1	9,7	10,3	9,3	17,6	18,5	17,1	31,4	32,5	31,7	-	-	14,6	-	-	14,8	2,2	3,9	2,6
N	26,7	27,6	26,4	12,3	11,9	11,5	19,2	19,2	18,3	32,2	32,3	30,9	-	-	15,6	-	-	15,7	7,0	6,1	6,1
D	27,5	27,6	26,4	13,3	13,4	12,9	20,4	20,5	19,7	32,6	32,3	31,6	-	-	16,2	-	-	18,2	8,8	9,4	8,3
Year	24,0	23,7	23,0	7,2	7,2	7,1	15,6	15,1	15,0	29,3	28,9	28,1	-	-	12,3	-	-	14,9	1,4	1,9	2,2

Table 4. Absolute temperatures (°C) as recorded at Standerton and Heidelberg (see Table 2) (Weather Bureau 1986)

Months	Absolute maximum daily temp.				Absolute minimum daily temp.			
	Standerton		Heidelberg		Standerton		Heidelberg	
	°C	Date	°C	Date	°C	Date	°C	Date
J	37,2	5-01-29	36,6	5-01-29	2,5	5-01-60	5,7	21-01-36
F	35,2	15-02-84	36,1	3-02-14	3,3	20-02-24	3,3	28-01-28
M	34,0	3-03-84	33,9	17-03-15	0,6	15-03-30	1,9	31-03-37
A	31,7	1-04-33	30,7	1-04-33	-5,3	30-04-17	-3,7	28-04-39
M	30,0	3-05-33	28,4	11-05-37	-10,6	31-05-18	-8,7	31-05-18
J	25,0	1-06-32	25,8	3-06-41	-12,8	11-06-07	-11,1	26-06-12
J	26,1	31-07-40	25,0	24-07-40	-12,8	18-07-13	-11,3	25-07-21
A	29,9	30-08-22	29,0	27-08-31	-11,7	16-08-13	-10,6	6-08-26
S	34,4	30-09-23	34,4	30-09-23	-7,8	16-09-30	-10,7	2-09-31
O	35,2	21-10-61	35,1	18-10-05	-3,8	1-10-13	-1,2	5-10-36
N	34,4	6-11-68	37,1	24-11-41	-1,1	25-11-12	1,3	3-11-41
D	37,4	31-12-82	36,7	25-12-25	2,2	8-12-07	2,2	1-12-44

Table 5. The mean annual rainfall (mm) for nine stations on the the Highveld (Weather Bureau 1986; Soil and Irrigation Research Institute, Private Bag x79, Pretoria 0001)

Station	Mean annual rainfall
Villiers	635,0
Heidelberg	699,7
Standerton	705,0
Barnardskop	655,3
Beerlaagte	628,1
Grootvlei	632,7
Greylingstad (SAR)	699,3
Greylingstad	799,1
Wittebank	604,5

Table 6. The highest monthly maximum, minimum and average rainfall (mm) as recorded at Villiers, Heidelberg and Standerton (see Table 2) (Weather Bureau 1986, Soil and Irrigation Research Institute, Private Bag, x79, Pretoria 0001)

Station	Mean rainfall per year		J	F	M	A	M	J	J	A	S	O	N	D
		Max.	168,5	188,0	88,0	38,5	25,5	13,0	17,5	73,0	133,0	160,5	152,0	363,5
Villiers	635,0	Min.	48,5	4,0	12,0	0,0	0,0	0,0	0,0	0,0	4,0	8,0	45,0	46,0
		Av.	114,8	74,5	52,0	21,2	6,5	3,8	4,1	21,1	35,7	86,7	90,9	123,7
		Max.	305,6	273,1	291,2	178,5	147,5	71,7	63,8	68,3	91,2	152,7	461,1	243,1
Heidelberg	699,7	Min.	24,4	1,4	9,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	11,3	8,0
		Av.	122,2	100,2	81,7	40,4	18,6	6,3	7,3	7,5	21,7	63,1	119,2	111,5
		Max.	269,0	279,0	133,0	156,0	70,0	42,0	57,0	88,0	66,0	141,0	254,0	302,0
Standerton	705,0	Min.	38,0	12,0	2,0	1,0	0,0	0,0	0,0	0,0	1,0	24,0	26,0	28,0
		Av.	115,0	102,0	61,0	48,0	16,0	7,0	9,0	13,0	25,0	76,0	116,0	117,0

Table 7. Average sunshine duration (hours) as recorded at Villiers (see Table 2) (Soil and Irrigation Research Institute , Private bag x79, Pretoria 0001)

Month	J	F	M	A	M	J	J	A	S	O	N	D
Average sunshine duration (h)	8,6	8,6	7,9	8,0	8,5	8,4	8,4	8,6	8,2	8,3	8,4	8,9

Table 8. The average cloud cover (0-8 scale) as recorded at Standerton (see Table 2) (Weather Bureau 1986)

Time	Average per year	Month J	F	M	A	M	J	J	A	S	O	N	D
08:00	3,5	4,6	4,6	4,5	4,1	2,8	2,5	2,3	2,4	2,6	3,4	4,3	4,3
14:00	3,4	4,9	4,6	4,5	3,8	2,4	1,7	1,3	1,7	2,9	4,1	5,0	4,6
20:00	2,7	4,7	3,8	3,5	2,6	1,3	0,8	0,7	1,1	2,1	3,3	4,4	4,2

Table 9. The average number of days per month with thunder, hail, snow and mist for Standerton weather station over a period of 33 years (Weather bureau 1986)

Month	Annual average	J	F	M	A	M	J	J	A	S	O	N	D
Thunder	45,8	7,4	4,6	4,8	2,5	0,8	0,4	0,6	1,7	2,9	6,4	7,0	6,7
Hail	4,4	0,4	0,2	0,6	0,3	0,2	0,0	0,1	0,3	0,1	0,8	0,7	0,7
Snow	0,9	0,0	0,0	0,0	0,1	0,1	0,2	0,3	0,1	0,1	0,0	0,0	0,0
Mist	44,0	1,1	3,1	5,9	5,3	7,8	6,4	7,1	4,0	1,7	1,0	0,4	0,2

Table 10. Phytosociological table of the Bb Land Type in the Villiers-Grootvlei area.

Community numbers	1.1	1.2	1.3			
			1.3.1	1.3.2	1.3.3	1.3.4
Releve numbers	01 70 89	000 333 765	11 01 60	011 710 918	0000 6566 2901	00000 77766 32167
Species group A						
Cyperus rigidus	11					
Pogonarthria squarrosa	11					
Trichoneura grandiglumis	11					
Solanum panduriforme	R	+|	+			
Species group B						
Aristida bipartita		11+				
Aristida sciurus		22				
Cymbopogon plurinodes		1+				
Heteropogon contortus		11				
Chenopodium schraderanum		RR				
Garuleum woodii		RR				
Crabbea acaulis		+ R		+		
Aristida 266		2				
Abildgaardia ovata		+				
Hyparrhenia hirta		+				
Setaria 351		R				
Species 230		21				
Bulbostylis contexta		++	+			
Hypoxis species		+				
Brachiaria species		R				
Crabbea hirsuta		R				
Species 287		R				
Species group C						
Eragrostis plana	1	22	221	1 22	334 1	
Berkheya pinnatifida		1+	R+1	1 RR	R	
Species group D						
Helichrysum rugulosum		1+				
Paspalum dilatatum		11			1	
Sporobolus africanus		11				
Setaria nigrirostris		1	1		1	
Hermannia depressa		++		+	R	
Species group E						
Digitaria ternata			111			
Solanum supinum		R	11			
Urochloa panicoides			11			
Tagetus minuta			11		R1	
Schkuhria pinnata			++			
Digitaria eriantha			+			
Asclepias multicaulis			R		R	
Microchloa caffra			++			
Anthericum cooperi			R			
Berkheya setifera			R			
Species group F						
Elionurus muticus	+			111		
Eragrostis racemosa				1 1		
Felicia fascicularis				+1		
Ledebouria species				R+		
Aptosimum indivisum	+			RR		
Chaetacanthus costatus				+ +		
Evolvulus alsinoides				+		
Dicoma anomala				R		
Pentzia globosa				1		
Cyperus tenax				+		
Pentzia incana				R		
Brachiaria serrata		+	+ 1	+ +		
Species group G						
Species 411					R+R	
Commelina africana	R				+1	
Setaria pallide-fusca					++	
Chamaesyce inequilatera					1R	
Oxalis obliquifolia					1 1	
Pseudognaphalium luteo-album					+	
Kohautia amatymbica					1R	
Mariscus species					1	
Verbena bonariensis					+	
Species 416					R	
Halafrida densiflora					R	
Species group H						
Eragrostis curvula	11	1+1	11	11	2222	12233
Themeda triandra		+22	11	123 1121		211
Cynodon dactylon	21	1	21	311		11+ 1
Aristida congesta	11	+ +		2	.	

HOOFSTUK 6.

THE PHYTOSOCIOLOGY OF THE VILLIERS-GROOTVLEI AREA, SOUTH AFRICA. 2. THE PLANT COMMUNITIES OF THE Ib LAND TYPE.

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Keywords: Braun-Blanquet, classification, ordination, plant communities, Villiers-Grootvlei area.

ABSTRACT

The vegetation of the Ib Land Type is classified, by means of the Braun-Blanquet method, in six communities. One of the communities is divided in two sub-communities. The communities are related to spesific environmental conditions.

UITTREKSEL

Die plantegroei van die Ib-landtipe is deur middel van die Braun-Blanquet metode in ses gemeenskappe geklassifiseer. Een van die gemeenskappe is verder onderverdeel in twee sub-gemeenskappe. Die gemeenskappe is gekoppel aan spesifieke omgewings toestande.

INTRODUCTION

The recovery and wise utilisation of the veld as a natural resource ought to receive careful attention, not just from a research view point but also in terms of agricultural extension

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(Landbou-ontwikkelingsprogram: Hoëveldstreek 1986). The Whitepaper on Agricultural Policy (1984) refers to the decline of the natural pasturage and warns that indiscriminate land-use practices and the over-exploitation of the natural resources may lead to a decrease in the living standards of the population.
The veld type description of Acocks (1988) is the only classification that is available for the Highveld Region. This classification was of a rather generalised nature and therefore a more detail mapping of the Highveld Region according to the association of veld types with distinct soil-climate combinations is a necessity (Landbou-ontwikkelingsprogram: Hoëveldstreek 1986).

The aim of the study is to describe, measure and classify the vegetation of the Grootvlei district, southern Transvaal, and to study the way the vegetation functions with respect to factors governing it's behaviour and it's interactions with the environment (Edwards 1972; 1979) and to organize it in a predictable system with maximum predictability. This spesific study area was chosen as a key area for effective extrapolation to the surrounding areas and as a link between the western and eastern parts of the Grassland Biome. Previously the classification of the Bb Land Type (Breytenbach et al. a. (in prep.)) was given while in this publication report is given on the Ib Land Type.

STUDY AREA

The 2628DC GROOTVLEI topocadastral map (1:50 000) was used as the basemap for the study.
The study area is situated between latitudes 26°45'S and 27°00'S

and between longitudes28°30'E and 28°45'E and occupies an area of ± 690 km² (70 000 ha) in the vicinity of Grootvlei, southern Transvaal, and a small area adjacent to Villiers in the northern Orange Free State (Figure 1).
A detail description of the physical environment of the study area is given by Breytenbach et al. (a. in prep.).

METHODS

In the study the Zürich-Montpellier phytosociological approach (Braun-Blanquet 1932; Werger 1974) and the PHYTOTAB program package (Westfall et al. 1982) was used to define and describe the different plant communities as it is the most popular and acceptable method in use in South Africa (Bredenkamp 1975: Van Rooyen 1978). The Rangeland Ecology Section of the Grassland Research Centre is an advocator of this approach and the fact that other studies in the Grassland Biome (Bredenkamp 1975; Deall 1985; Bezuidenhout 1988; Turner 1989; Bloem 1989; Kooij 1990) were done with this approach contribute to it's selection.

The vegetation is sampled with the use of random stratified sub-quadrats. Experiments during the reconnaissance phase of the study area showed that more information is obtained with the sub-quadrat method, in terms of time and energy spent, than a single square quadrat. A stratified random method was used for the placement of relevés. The sub-quadrats are rectangular with the sides in the proportion of one to two, since this is more effective than square quadrats (Oosting 1956; Cain & Castro 1959). The sub-quadrats that were used were 3m in length and 1,5m in width (Turner 1989). Sub-quadrats are placed until there is less than 10% increase in new species. During the study a minimum

of three sub-quadrats per relevé is maintained (a minimum area of 13,5m²). The relevés are objectively placed with the help of random numbers which are generated by a computer.
The species names used are given by Myburgh et al. (in prep.) and are arranged according to Gibbs Russell et al. (1985; 1987).

The area of the Ib Land Type is 9 800 ha of the total study area (Figure 2). The dominant soils of the Ib Land Type are of the Avalon, Hutton, Shortlands and Bonheim Forms. The predominant geology of the area is Ventersdorp lava, breccia and tuff. The dominant terrain units of the area are terrain unit 3 (40% of the area) within the slope class 12-50%, terrain unit 1 (30% of the area) within the slope class 0-12% and terrain unit 4 (20% of the area) within the slope class 6-12% (Land Type Survey Staff 1985). The average rainfall of the Ib Land Type is 689,2 mm (Land Type Survey Staff 1985). The area of the Ib Land Type as well as the time available determined the number of relevés. Relevés were compiled in 41 stratified random sample plots.

RESULTS

Classification

The vegetation of the Ib land type is divided in three main vegetation types namely, a high-lying grassland (11% of the area), a high-lying shrubland (54% of the area) and a lower grassland (35% of the area) (Figure 3 and 4). The high-lying grassland (Species group A, Table 1) occur on shallow (50 mm) rocky soils and the lower grassland (Species groups K and L, Table 1) on deep (975 mm) clayey soils. The two grassland communities are characterised by the absence of shrubs and trees.

The high lying shrubland (Species group I, Table 1) occurs on shallow soils and has a high above-ground rock cover (60%) on steep slopes (25x). Species group N (Table 1) depicts the general species of this land type and an average of 30 species per relevé was recorded.

The vegetation of the Ib land type is grouped into six communities and two sub-communities namely (Figure 3; Table 1):

1.1 The *Loudetia simplex-Eragrostis curvula* Grassland

1.2 The *Euclea crispa-Aloe davyana* Shrubland

1.3 The *Diospyros lycioides-Heteromorpha trifoliata* Shrubland

1.4 The *Diospyros lycioides-Leonotis microphylla* Shrubland

1.5 The *Diospyros lycioides-Trachypogon spicatus* Shrubland

1.6 The *Eragrostis plana-Eragrostis curvula* Grassland

1.6.1 The *Eragrostis plana-Cynodon dactylon* Grassland

1.6.2 The *Eragrostis plana-Indigofera* species Grassland

1.1 The *Loudetia simplex-Eragrostis curvula* Grassland

The *Loudetia simplex-Eragrostis curvula* Grassland is situated mainly on soils of the Mispah form (MacVicar et al. 1977) with a clay content of 15-25% and an average soil depth of 50 mm (Figure 3). The parent material is Undifferentiated Witwatersrand quartzite and shale (R) with sandstone (Pv). The community is situated at an altitude of 1 590 m to 1 640 m above mean sea level on slopes with an inclination of 1-3° on terrain unit 3 (Figure 3 and 4). The above ground rock cover in the community varied between 0% to 30% (Figure 3). An average of 23 species per relevé was recorded.

The community is characterised by the diagnostic species *Loudetia simplex, Diheteropogon filifolius, Harpochloa falx, Euryops*

transvaalensis, Solanum panduriforme, Khadia acutipetala and *Gazania krebsiana* (Species group A, Table 1). Dominant grasses in the community are *Aristida junciformis* (Species group C, Table 1), *Aristida congesta, Tristachya leucothrix, Eragrostis curvula, E. racemosa, Brachiaria serrata, Heteropogon contortus, Themeda triandra* and *Elionurus muticus* (Species group N, Table 1). *Aristida junciformis, A. congesta, Cynodon dactylon* and *Stoebe vulgaris* are prominent on disturbed and trampled areas in the community. The occurrence of *Loudetia simplex*, the dominant grass in the community, is proof of the unpalatibility of the veld. *Diheteropogon filifolius, Khadia acutipetala* and *Euryops transvaalensis* are characteristic of the rocky hills of the Ib Land Type. No shrubs or trees occur in the community. The mean crown cover of the herbaceous layer was 55%.

1.2 The *Euclea crispa-Aloe davyana* Shrubland

The *Euclea crispa-Aloe davyana* Shrubland is situated mainly on shallow (<300 mm) rocky soils of the Mispah form (MacVicar et al. 1977) with dolorite (Jd) as the parent material (Figure 3). Basaltic lava, agglomerate and tuff (Rk) also occur in the community. The community is situated at an altitude of 1 620 m to 1 660 m above mean sea level mainly on north facing slopes with an inclination of 11-20° on terrain unit 3 (Figure 3 and 4). The above ground rock cover in the community varied between 31% and 60% (Figure 3). An average of 33 species per relevé was recorded.

The community is characterised by the diagnostic species *Aloe davyana, Hypoxis argentea, H. obtusa, Ipomoea obscura, Rhynchosia totta, Elephantorrhiza elephantina, Ledebouria ovatifolia, Barleria obtusa* and *Pavonia transvaalensis* (Species group B,

Table 1). *Aristida junciformis* (Species group C, Table 1) is a mutual species of the *Loudetia simplex-Eragrostis curvula* Grassland and the *Euclea crispa-Aloe davyana* Shrubland. The species of Species groups E, I, M and N (Table 1) occur generally in the community. The dominant grasses in the community are *Aristida junciformis, Eragrostis curvula, Heteropogon contortus, Elionurus muticus, Themeda triandra* and *Brachiaria serrata* (Table 1). Dominant shrubs in the community are *Euclea crispa, Diospyros lycioides, Aloe transvaalensis, Rhoicissus tridentata* and *Rhus rigida* (Table 1). *Canthium gilfillanii, Ehretia rigida, Maytenus heterophylla* and *Diospyros whyteana* are the dominant trees in the community with *Canthium gilfillanii* having the highest crown cover. *Aristida junciformis* is present were trampling due to overgrazing has occurred. The mean crown cover for the community was 44%.

1.3 The *Diospyros lycioides-Heteromorpha trifoliata* Shrubland

The *Diospyros lycioides-Heteromorpha trifoliata* Shrubland occurs on shallow (<300 mm) soils of the Mispah form (MacVicar et al. 1977) with basaltic lava, agglomerate, tuff (Rk) and diabase (Vdi) as the parent material (Figure 3). The community is situated at an altitude of 1 640 m to 1 760 m above mean sea level on slopes with an inclination of 1-25° on terrain units 1 and 3 (Figure 3 and 4). The above ground rock cover in the community varied between 16% and 60% (Figure 3). An average of 33 species per relevé was recorded.

The community is characterised by the diagnostic species *Heteromorpha trifoliata, Zanthoxylum capense, Clutia hirsuta, Schkuhria pinnata, Teucrium trifidum, Lippia scaberrima* and *Ehrharta erecta* (Species group D, Table 1). Species of Species

groups E, H, I, M and N are common in the community. The dominant trees in the community are *Ehretia rigida, Rhus pyroides, Ziziphus mucronata, Cussonia paniculata, Maytenus heterophylla* and *Diospyros whyteana* (Table 1). Dominant shrubs of the community are *Diospyros lycioides, Aloe transvaalensis, Felicia filifolia, Rhus discolor, R. rigida, Rhoicissus tridentata* and *Euclea crispa* (Table 1). The dominant grasses in the community are *Hyparrhenia hirta, Digitaria eriantha, Rhynchelytrum repens, Cymbopogon excavatus, Heteropogon contortus, Eragrostis curvula, Themeda triandra, Elionurus muticus, Brachiaria serrata* and *Aristida congesta* (Table 1). Prominent forbs in the community are *Garuleum woodii, Tagetes minuta, Cheilanthes eckloniana, C. hirta, Pellaea calomelanos, Bidens pilosa* and *Ipomoea crassipes* (Table 1). Dense stands of *Bidens pilosa* and *Tagetus minuta* occur in areas of severe disturbance. Single specimens of *Opuntia* sp. also occur in this community. All the relevés in the community have open ground with very little or no vegetation, possibly due to heavy grazing. In some of the relevés the effect of rock rabbit (*Procavia capensis*) and porcupine (*Hystrix africae-australis*) activities on the vegetation was evident. The mean crown cover of the community was 58%.

1.4 The *Diospyros lycioides-Diheteropogon amplectans* Shrubland

The *Diospyros lycioides-Diheteropogon amplectans* Shrubland occurs on shallow (<300 mm) soils of the Mispah form (MacVicar et al. 1977) with basaltic lava, agglomerate, tuff (Rk) and diabase (Vdi) as the parent material (Figure 3). The community is situated at an altitude of 1 600 m to 1 740 m above mean sea level on slopes with an inclination of 2-7° on terrain units 1 and 3 (Figure 3 and 4). The above ground rock cover in the

community varied between 31% and 60% (Figure 3). An average of 43 species per relevé was recorded.

The community is characterised by the diagnostic species *Diheteropogon amplectans, Leonotis microphylla* and *Asclepias fruticosa* (Species group F, Table 1). Species of Species groups G, H, I and M are common in this community (Table 1). The dominant trees in the community are *Rhus pyroides, Celtis africana, Maytenus heterophylla* and *Canthium gilfillanii* (Table 1). Dominant shrubs in the community are *Diospyros lycioides, Rhus discolor* and *Rhus rigida* (Table 1). Dominant grasses in the community are *Trachypogon spicatus, Hyparrhenia hirta, Setaria nigrirostris, Eragrostis curvula, Heteropogon contortus, Themeda triandra, Elionurus muticus* and *Brachiaria serrata* (Table 1). Prominent forbs in the community are *Acalypha caperonioides, Berkheya setifera* and *Ipomoea crassipes* (Table 1). The mean crown cover of the community was 69%.

1.5 The *Diospyros lycioides-Diheteropogon amplectens* Shrubland

The *Diospyros lycioides-Diheteropogon amplectens* Shrubland occurs mainly on shallow (<300 mm) soils of the Mispah form (MacVicar et al. 1977) with basaltic lava, agglomerate and tuff (Rk) as the parent material (Figure 3). The community is situated at an altitude of 1 640 m to 1 680 m above mean sea level, mainly on southern and south-western slopes with an inclination of 8-17° and on terrain unit 3 (Figure 3 and 4). The above ground rock cover varied between 16% and 45%. An average of 40 species per relevé was recorded.

This community is not characterised by spesific diagnostic species but rather by the presence of the species in Species group G (Table 1) and the absence of the species in Species group

F (Table 1). Species of Species groups H, I, M and N (Table 1) also occur in the community. Dominant grasses in the community are *Trachypogon spicatus, Cymbopogon excavatus, Themeda triandra, Tristachya leucothrix, Elionurus muticus* and *Heteropogon contortus* (Table 1). Prominent forbs in the community are *Helichrysum rugulosum, Athrixia elata, Berkheya setifera, Crabbea acaulis* and *Cheilanthes hirta* (Table 1). Dominant shrubs of the community are *Diospyros lycioides, Rhus discolor, R. rigida, Myrsine africana* and *Euclea crispa* (Table 1). *Rhus zeyheri, R. whyteana* and *Canthium gilfillanii* are noteworthy trees in the community (Table 1). The mean crown cover of the community was 70%.

1.6 The *Eragrostis plana-Eragrostis curvula* Grassland

The *Eragrostis plana-Eragrostis curvula* Grassland occurs mainly on yellow and red loam and clayey soils of the Hutton, Bainsvley, Westleigh and Pinedene forms (MacVicar et al. 1977) and also on the dark clayey soils of the Arcadia and Rensburg forms (MacVicar et al. 1977) (Figure 3). The parent material of the soils is undifferentiated Witwatersrand quartzite, shale (R), sandstone (Pv) and diabase (Vdi) while basaltic lava, agglomerate, tuff (Rk) and dolerite (Jd) also occur in the community (Figure 3). The community is situated at an altitude of 1 580 m to 1 680 m above mean sea level on slopes with an inclination of 0-3° on terrain units 1, 3, 4 and 5 (Figure 3 and 4). The above ground rock cover in the community varied from 0% to 20%. An average of 20 species per relevé was recorded.

Eragrostis plana (Species group J, Table 1) with a high cover value characterised this community being the only diagnostic species for the community.. Species groups K, L, M and N

(Table 1) also occur in this community. The mean basal cover of the community is 9%.

The *Eragrostis plana-Eragrostis curvula* Grassland is divided in two sub-communities namely:

1.6.1 the *Eragrostis plana-Cynodon dactylon* Grassland on terrain units 1, 3 and 4 with undifferentiated Witwatersrand quartzite, shale, and sandstone as the dominant geology;

1.6.2 the *Eragrostis plana-Indigofera* species Grassland on terrain units 4 and 5 with diabase as the dominant geology.

1.6.1 The *Eragrostis plana-Cynodon dactylon* Grassland

The *Eragrostis plana-Cynodon dactylon* Grassland occurs mainly on yellow and red loam and clayey soils of the Hutton and Bainsvley forms (MacVicar et al. 1977) (Figure 3). In the community there are single occurrences of soils that are of the Avalon, Westleigh, Pinedene, Mispah and Arcadia forms (MacVicar et al. 1977). The parent material of the soils are mainly undifferentiated Witwatersrand quartzite, shale (R) and sandstone (Pv) with single occurrence of basaltic lava, agglomerate, tuff (Rk) and dolerite (Jd) (Figure 3). The mean soil depth in the community was 360 mm with an above ground rock cover that varied between 0% and 20% (Figure 3). The community is situated at an altitude of 1 580 m to 1 680 m above mean sea level on slopes with an inclination of 1-3° on terrain units 1, 3 and 4 (Figure 3 and 4). The average number of species recorded per relevé was 20.

The community is characterised by the diagnostic species *Cynodon dactylon, Berkheya pinnatifida, Trichoneura grandiglumis, Chamaesyce inequilatera, Helichrysum aureo-nitens, Crassula lanceolata, Microchloa caffra, Cyanotis speciosa, Eragrostis*

capensis, Chloris virgata and *Dianthus basuticus* (Species group K, Table 1). Species groups M and N (Table 1) also occur in this community. Dominant grasses in the community are *Eragrostis plana, E. racemosa, Themeda triandra, Heteropogon contortus* and *Aristida congesta* (Table 1). Prominent forbs in the community are *Hermannia depressa, Crabbea acaulis* and *Trifolium africanum* (Table 1). In the community there are single occurrences of shrubs and trees such as *Diospyros lycioides, Rhus rigida* and *Canthium gilfillanii*. Localized disturbed areas are characterised by the occurrence of *Aristida congesta, Stoebe vulgaris, Cynodon dactylon* and *Chloris virgata*. The mean basal cover of the community was 9%.

1.6.2 The *Eragrostis plana-Indigofera* species Grassland

The *Eragrostis plana-Indigofera* species Grassland occurs on black clayey soils (>55% clay) of the Arcadia and Rensburg forms (MacVicar et al. 1977) with dolerite (Jd) and diabase (Vdi) as the parent material (Figure 3). In the community there are single occurrences of soils of the Avalon form (MacVicar et al. 1977) with basaltic lava, agglomerate and tuff as the parent material. The mean soil depth in the community was 975 mm with an above ground rock cover that varied between 0% and 10% (Figure 3). The community is situated at an altitude of 1 580 m to 1 620 m above mean sea level on slopes with an inclination of 0-2° on terrain units 4 and 5 (Figure 3 and 4). An average of 19 species per relevé was recorded.
The community is characterised by the diagnostic species *Convolvulus sagittatus* and a *Indigofera* species (Species group L, Table 1). The dominant grasses in the community are *Eragrostis plana, E. curvula, Themeda triandra, Setaria sphacelata* and

Elionurus muticus (Table 1). Prominent forbs in the community are *Vernonia oligocephala* and *Trifolium africanum*. No trees and shrubs are present in the community. The mean basal cover of the community is 8%.

ORDINATION

The data was ordinated by using Detrended Correspondence Analysis (DECORANA) (Hill 1979). The first and second axes of the ordination were used for the illustration of the plant communities and environmental interactions. The first axes is responsable for 68,1% (Eigen value of 0,681) and axes two for 62,0% (Eigen value of 0,620) of the variation in the data set. On the scatter diagram of the ordination (Figure 5) there is a distinct separation between the different communities with the exception of the *Diospyros lycioides-Trachypogon spicatus* Shrubland (E). The communities are separated in the *Eucleacrispa-Aloe davyana* Shrubland (B), *Diospyros lycioides-Heteromorpha trifoliata* Shrubland (C), *Diospyros lycioides-Leonotis microphylla* Shrubland (D) on steep slopes, a high above-ground rock cover and are high-lying. The *Loudetia simplex-Eragrostis curvula* Grassland (A), *Diospyros lycioides-Trachypogon spicatus* Shrubland, *Eragrostis plana-Eragrostis curvula* Grassland (F) occur on less steep slopes, a lower above-ground rock cover and low-lying (Figure 5).

CONCLUSION

The vegetation of the Ib Land Type is classified in six main communities and one community is divided in two sub-communities. The communities are mainly divided along a soil drainage and an

altitude gradient which is confirmed by the DECORANA ordination. These plant communities combined with similar plant communities in the Ea, Ca, Bb and Ba Land Types (Breytenbach et al. a, c, d (in prep.)) in the study area, form management units.

ACKNOWLEDGEMENTS

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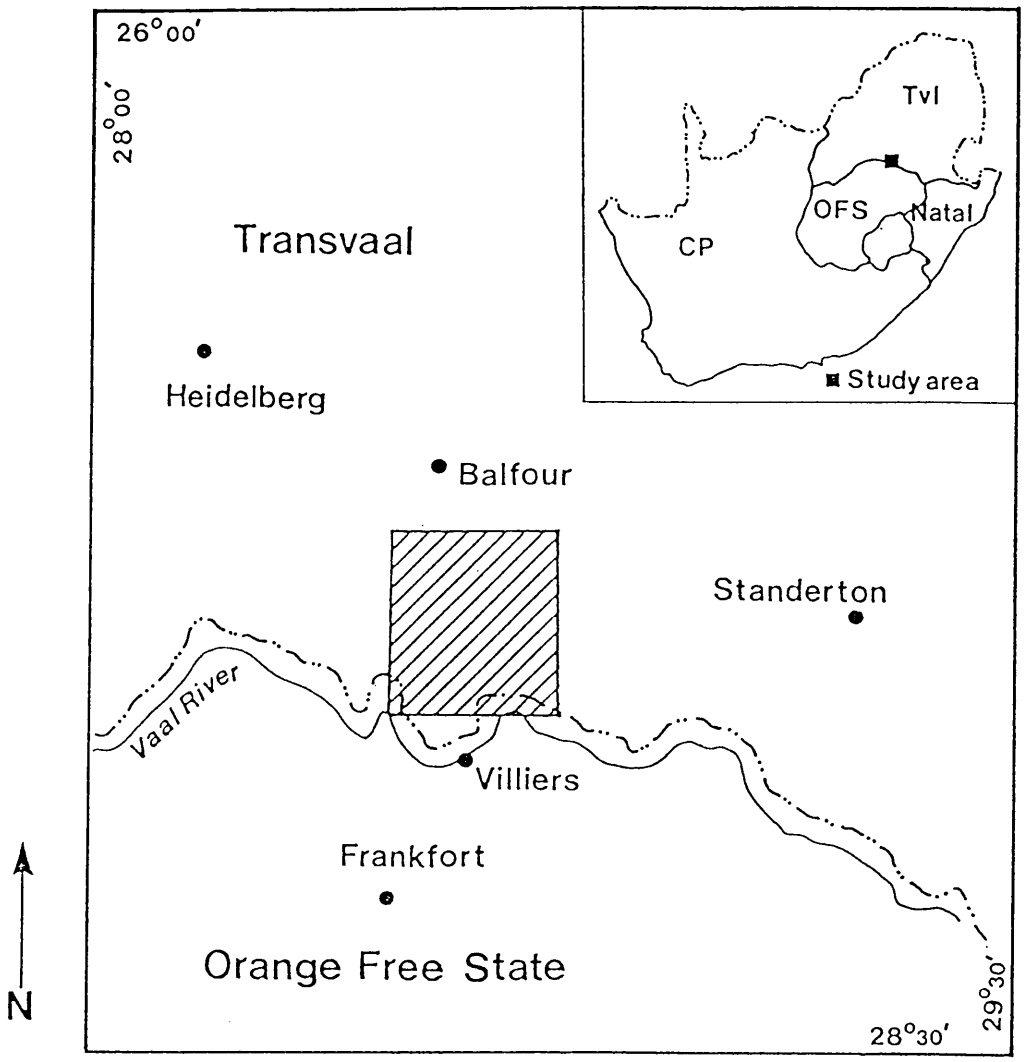

Figure 1. The location of the study area, based on the 2628 DC GROOTVLEI 1:50 000 Topocadastral map (Government Printer, Pretoria 1978).

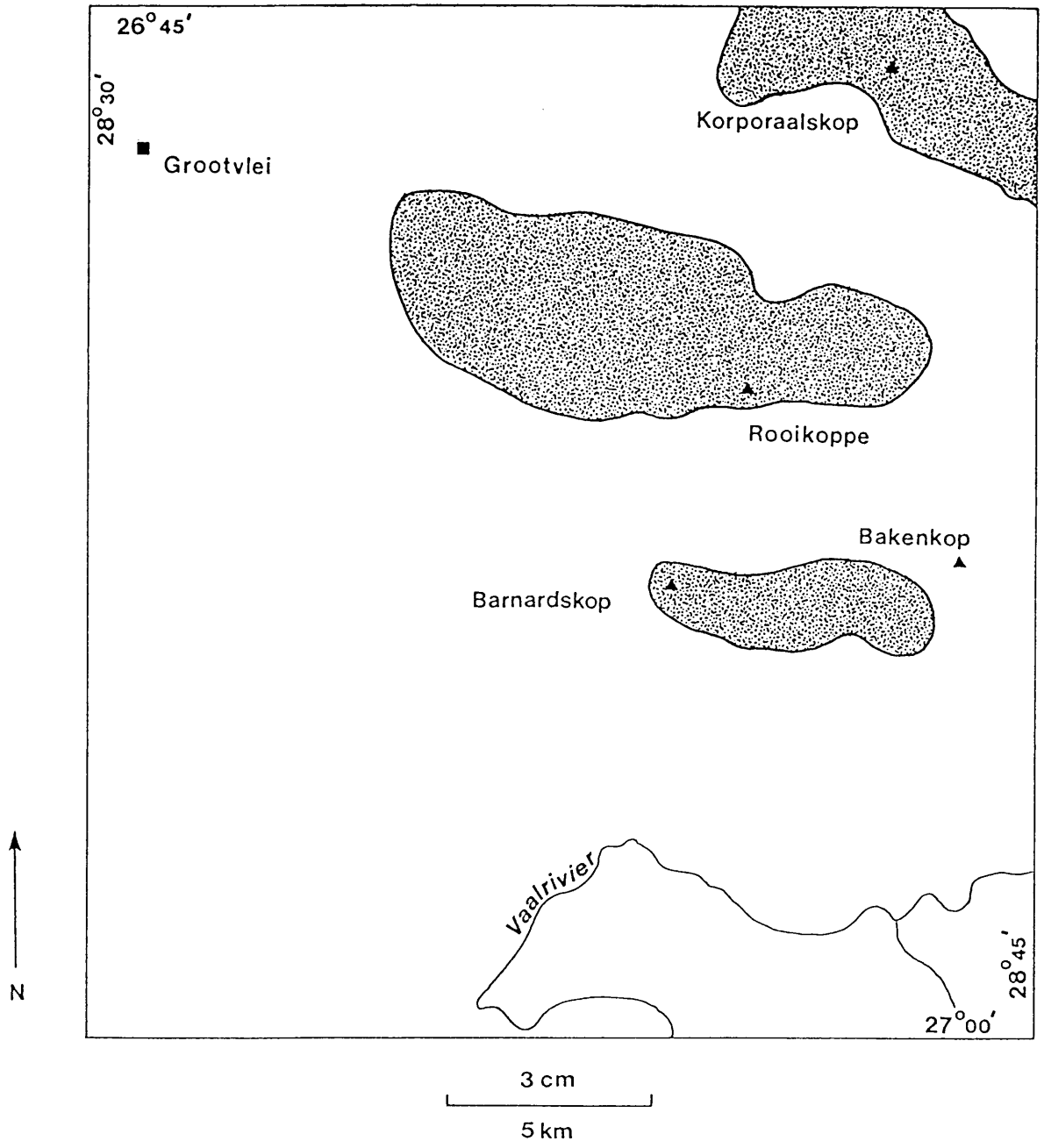

Figure 2. The location of the Ib Land Type in the study area (Land Type Survey Staff 1984)

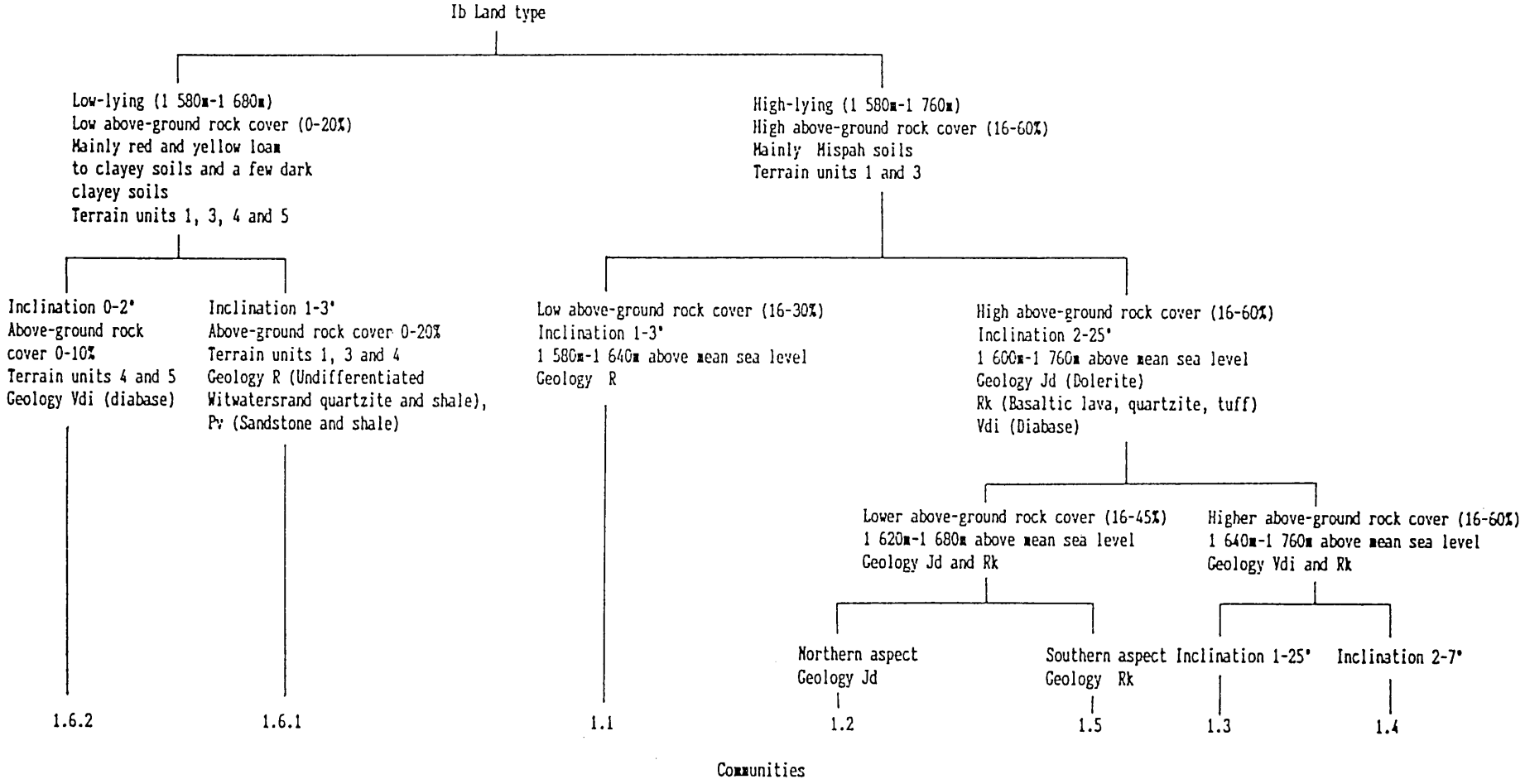

Figure 3. Dendrogram to illustrate the habitat relationships of the communities in the Ib Land Type (see text for community names)

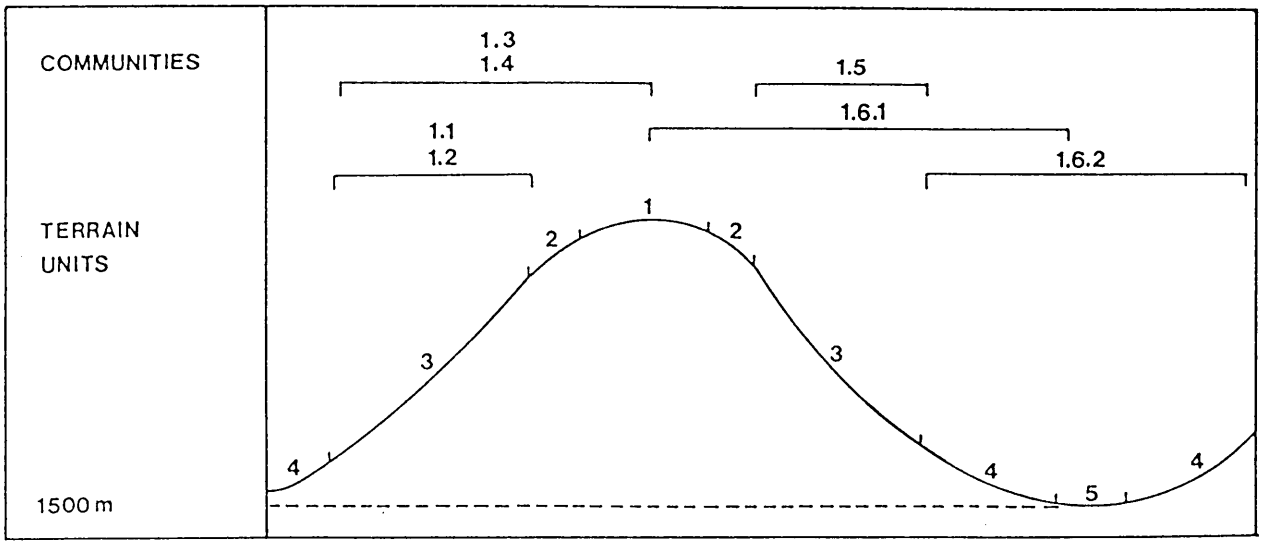

Figure 4. The location of the communities in the Ib Land Type on topographical types (see text for community names)

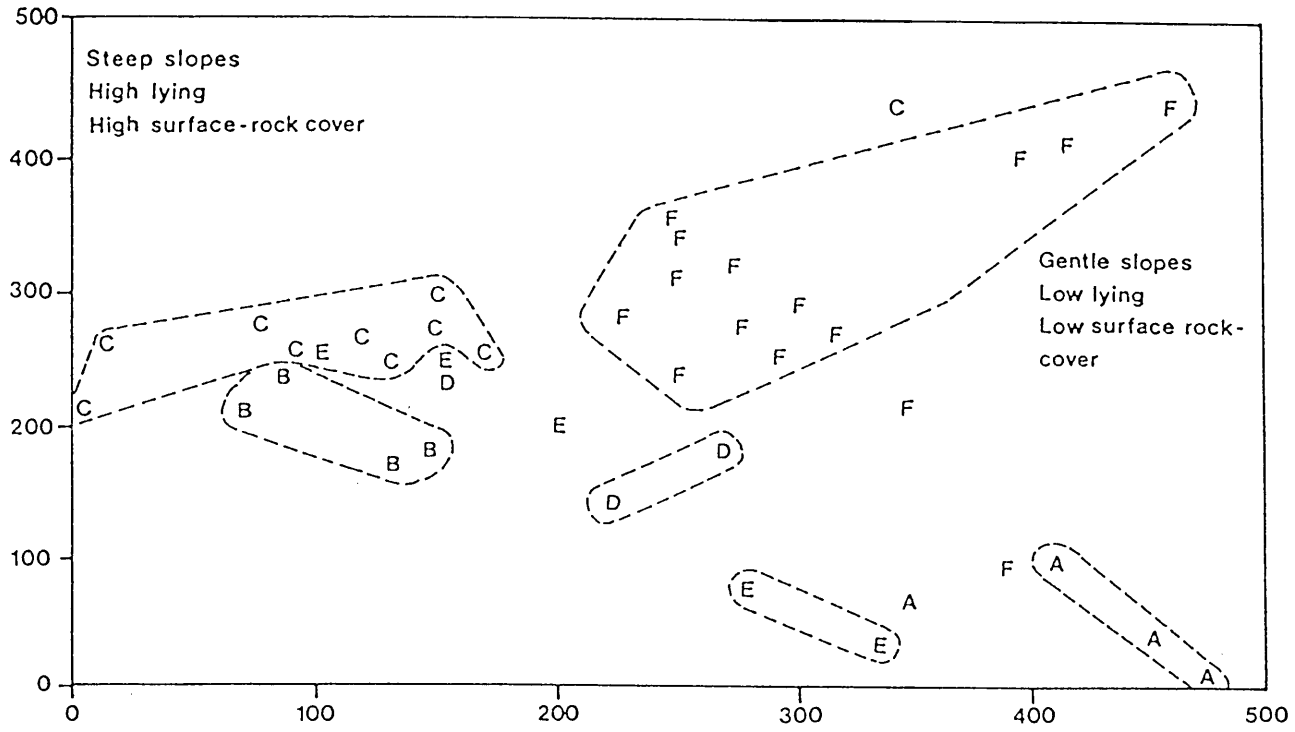

Figure 5. The DECORANA ordination of the vegetation of the Ib Land Type in the Villiers-Grootvlei area, South Africa.
A - *Loudetia simplex-Eragrostis curvula* Grassland
B - *Euclea crispa-Aloe davyana* Shrubland
C - *Diospyros lycioides-Heteromorpha trifoliata* Shrubland
D - *Diospyros lycioides-Leonotis microphylla* Shrubland
E - *Diospyros lycioides-Trachypogon spicatus* Shrubland
F - *Eragrostis plana- Indigofera* species Grassland

Table 1. Phytosociological table of the Ib Land Type in the Villiers-Grootvlei area, South Africa.

COMMUNITY NUMBER	1.1	1.2	1.3	1.4	1.5	1.6	1.6.1	1.6.2
RELEVE NUMBER	2201 1122 7644	2222 2225 7680	2222222202 4323314394 8805635911	222 144 994	22222 44211 32358	00000202100 72775471139 75567744736		0011 3401 4316
SPECIES GROUP A								
Loudetia simplex	3112							
Euryops transvaalensis	++2+						+	
Solanum panduriforme	+++		+	+			+	
Diheteropogon filifolius	32							
Harpochloa falx	11				11		+	
Khadia acutipetala	+1					+		
Gazania krebsiana	++						R	
Species group B								
Aloe davyana		332+	+	1				
Hypoxis argentea		1+1	R	R				
Ipomoea obscura		11 +	+ +					
Rhynchosia totta		+ ++		+	R		+ +	+
Elephantorrhiza elephantina		+1						
Ledebouria ovatifolia	+	11						
Barleria obtusa		2 1	+ 2					
Hypoxis obtusa		+ +						
Pavonia transvaalensis		+ 1						
Species group C								
Aristida junciformis	112	322					1	
Species group D								
Heteromorpha trifoliata			2+ 11		2			
Schkuhria pinnata		+	+R ++				++	
Teucrium trifidum			+1+ 1		R			
Ehrharta erecta			1 1 +		1			
Zanthoxylum capense			2 1+	R				
Lippia scabberima			1 +	+				
Clutia hirsuta			12					
Species group E								
Aloe transvaalensis		222+	113+1+ 1	1	+			R
Ehretia rigida		32+	+1 R3					
Haemanthus humilus		++	+ + RR +					
Kalanchoe thyrsiflora		R +	R R					

```
Species group F

Asclepias fruticosa              |    |    |     R    |+R+|     |           |    |
Leonotis microphylla             |    |    |          |111|     |           |    |
Diheteropogon amplectans         |   1|    |          |2 +|     |           |    |

Species group G

Trachypogon spicatus             |1   |  2 |          |+12| 13++|           |    |
Helichrysum rugulosum            |    |    | R        |+++|1 +++|    + 2    |    |
Acalypha caperonioides           |    |    |          |11 |+1++ |   ++      |    |
Dicoma anomala                   | ++ |    |          |1 R| ++  |           |    |
Gladiolus species                |    |    |          | ++| 2+  |           |    |
Helichrysum nudifolium           |    |    |      +   |+  | + ++|R     R    |  + |
Athrixia elata                   |    |    |         +|  2| 4+R |           |    |
Rhus zeyheri                     |    |    |         1| R |1R  +|           |    |
Haplocarpha scaposa              |    |    |          |R1 |   + |           |+   |
Lactuca species                  |    |    |          |R  |+ +  |           |    |
Schistostephium crataegifc       |    |    |          | + |++   |           |    |

Species group H

Rhus pyroides                    |    |    |+1 2 +++  | +1|3  +1|           |    |
Rhus discolor                    |    |    | +   +1 11|+ 1|3+ 11|           |    |
Hyparrhenia hirta                |    | +  |1+21 1    |221|   +2|      +    |1   |
Plectranthus madagascari         |    |  1 | +++ 1   +| 1 | +1++|           |    |
Berkheya setifera                |    |    | +     ++ |21+|++21 | 1  11   + | +  |
Setaria nigrirostris             |+R  |    | +    + 1 | +4|11 11|    1  1   |    |
Ziziphus mucronata               |    |    |321    11 | 1+|1   +|           |    |
Conyza podocephala               |    |    | ++   2 ++| ++|1 +  |  R        |  R |
Indigofera obscura               |++  |  R | +    R + |  R|+R+++|         R |    |
Garuleum woodii                  |    |    |1+    + +1|  1|21   |           |+   |
Myrsine africana                 |    |    | +   ++2  |  +|2  RR|           |    |
Celtis africana                  |    | R  | R+ R+R   | 1 |3   R|           |    |
Tagetus minuta                   |R   |   +|+R   + 1 +| ++|     |   +  1    |    |
Argyrolobium velutinum           |    |+ R |  +    + +| + |+++R |     +     |    |
Protasparagus setaceus           |    |    | R     RR | + |  R++|           |    |
Cussonia paniculata              |    |   R|+1     R1 | R+|+    |           |    |
Cheilanthes eckloniana           |    |    |  + + +  2|   |++  +|           |    |
Felicia filifolia                |    |    | 1  1  1 +| + |   + |           |    |
Digitaria eriantha               |    |    |  1+     +|   |    +|      1    |    |

Species group I

Diospyros lycioides              |    |211 | 2221212+ |122|1 +11|    2 1    |    |
Pellaea calomenalos              |    |111+|+R+R+ 1 +2|R+ |R R++|    +      |    |
Rhus rigida                      |    | +R1|111R + ++ |+1+|+R+ R|    +      |    |
Rhynchelytrum repens             |    |111 |2 ++++  11|+++|  ++ |           |    |
Cheilanthes hirta                |    |+ ++|+ ++1 1 +2| + |+R++1|           |    |
Maytenus heterophylla            |    | 11+|22  1+RR 4| 11|1  R+|           |    |
Rhoicissus tridentata            |    |12 2|211412 +11|  +|R   1|           |    |
Euclea crispa                    |    | 313|31 R11411R|  +|2   +|           |    |
Bidens pilosa                    |R   | +++|1R++3 11 +| + |+   +|      +    |    |
Commelina africana               |++  |+++ |+ +++   1+|++ |   ++|     R+    |    |
Cymbopogon excavatus             |    |  ++|    2++ +2| 2 |21+1+|    +      |    |
Ipomoea crassipes                |    |+ + |1+ 1+ +  1|+ 1| +   |           |+   |
Diospyros whyteana               |    | R  |  12121 +R|  +|1 +1 |           |    |
Canthium gilfillanii             |    |1 24| +   1    |  1|2  1 |    2      |    |
                                 |    |  + |1  R+    + | 1 |     |    1      |    |
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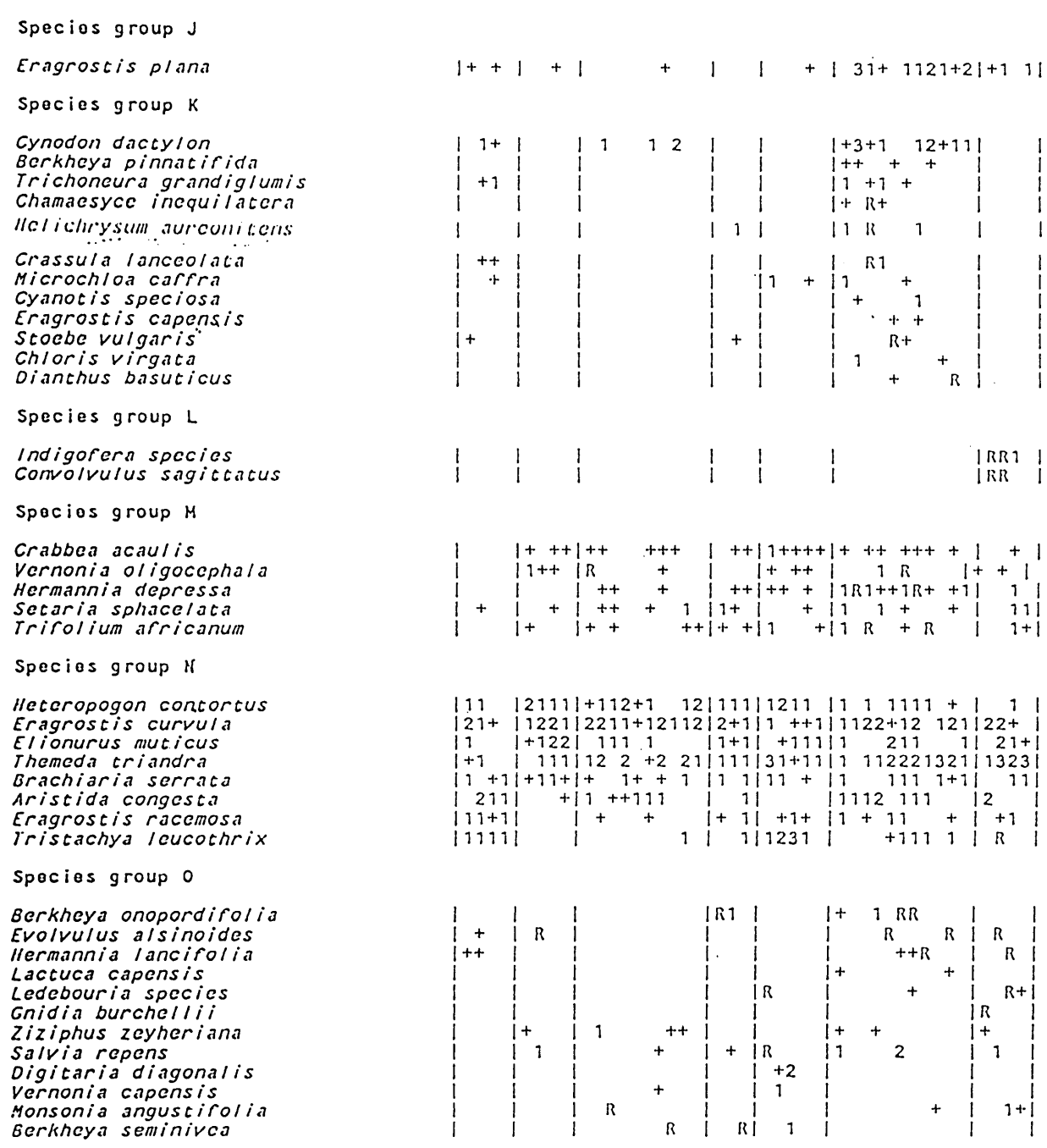

Aristida transvaalensis		+	1	+			
Berkheya radula					2		
Chaetacanthus species					+		
Helichrysum lepidissimum					+		
Monsonia attenuata					+		
Cotoneaster pannosus					R		
Dianthus mooiensis				+			
Helichrysum melanacme					+		
Nidorella anomala					+		
Opuntia species				R			
Sebaea leiostyla					+		
Solanum incanum				R			
Acacia karroo			4				
Aristida canescens			+				
Aristida stipitata			+				
Artemisia afra			3		+		
Asplenium splendens			R				
Clematis oweniae			+				
Crassula alba			+				
Hyparrhenia species			+				
Pellaea species			2				
Protasparagus laricinus			+				
Senecio oxyriifolius			+				
Zinnia peruviana			+				
Pseudognaphalium luteo-album						1	1
Acalypha angustifolia							1
Alectra sessiliflora							R
Chaetacanthus burchellii							R
Setaria incrassata						+	2
Stipagrostis zeyheri							+
Sutera aurantiaca							+
Urginea species						+	R
Aristida adscensionis	+					1	
Helichrysum callicomum	+						
Helichrysum cerastioides	+						
Helichrysum species	+					+	
Limeum viscosum	R						
Monocymbium cerisiiforme	R						
Panicum coloratum	1						
Panicum natalense	R						
Shizachyrium sanguineum	1						
Solanum supinum	+					R	
Sporobolus pectinatus	1						
Aristida diffusa			+			1	1
Bulbostylis contexta						+	
Chenopodium schraderanum						+	
Conyza bonariensis						R	+
Cucumis hirsutus						R	
Eragrostis gummiflua						1	
Euphorbia striata						R	
Helichrysum coriaceum						R	
Hyparrhenia anamesa						1	+
Ipomoea bathycolpos						+	
Paspalum dilatatum						1	
Scabiosa columbaria						+	R
Setaria pallide-fusca						1	1

Senecio coronatus						R						R													R																	R	
Urochloa panicoides			R															1														+											
Cymbopogon plurinodes											1																												1		+			
Oxalis obliquifolia																		+										1						R					+			+	
Felicia fascicularis	R						+										+																+			+							
Helichrysum pilosellum																										R								R									
Polygala hottentotta			R																							+																	
Aristida mollissima																					1													2									
Digitaria ternata																			+																1									
Alternanthera pungens																																							R				
Andropogon schirensis																																						+					
Aptosimum indivisum																														+													
Tephrosia longipes																							R																R			
Gomphrena celosioides												+											R												R							
Crassula swaziensis						R																																					
Crassula setulosa					R								+																														
Malva verticillata								+			1																																
Pachycarpus rigidus					R		+																				R																
Clematis brachiata																			2				R																				

HOOFSTUK 7.

THE PHYTOSOCIOLOGY OF THE VILLIERS-GROOTVLEI AREA, SOUTH AFRICA. 3. THE PLANT COMMUNITIES OF THE Ba LAND TYPE.

P.J.J BREYTENBACH*, W.J. MYBURGH*, G.K. THERON**, G.J. BREDENKAMP**

Keywords: Braun-Blanquet, classification, ordination, plant communities, Villiers-Grootvlei area.

ABSTRACT

The vegetation of the Ba Land Type is classified, by means of the Braun-Blanquet method, in nine communities. One of the communities is divided in two sub-communities. The communities are related to spesific environmental conditions.

UITTREKSEL

Die plantegroei van die Ba-landtipe is deur middel van die Braun-Blanquet metode in nege gemeenskappe geklassifiseer. Een van die gemeenskappe is verder onderverdeel in twee sub-gemeenskappe. Die gemeenskappe is gekoppel aan spesifieke omgewings toestande.

INTRODUCTION

The recovery and wise utilisation of the veld as a natural resource ought to receive careful attention, not just from a research view point but also in terms of agricultural extension (Landbou-ontwikkelingsprogram: Hoëveldstreek 1986). The

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Whitepaper on Agricultural Policy (1984) refers to the decline of the natural pasturage and warns that indiscriminate land-use practices and the over-exploitation of the natural resources may lead to a decrease in the living standards of the population.
The veld type description of Acocks (1988) is the only classification that is available for the Highveld Region. This classification was of a rather generalised nature and therefore a more detail mapping of the Highveld Region according to the association of veld types with distinct soil-climate combinations is a necessity (Landbou-ontwikkelingsprogram: Hoëveldstreek 1986).

The aim of the study is to describe, measure and classify the vegetation of the Grootvlei area, southern Transvaal, and to study the way the vegetation functions with respect to factors governing it's behaviour and it's interactions with the environment (Edwards 1972; 1979) and to organize it in a system with maximum predictability. This spesific study area was chosen as a key area for effective extrapolation to the surrounding areas and as a link between the western and eastern parts of the Grassland Biome. Previously the classification of the Bb and Ib Land Types (Breytenbach et al. a, b (in prep.)) was given while in this publication report is given on the Ba Land Type.

STUDY AREA

The 2628DC GROOTVLEI topocadastral map (1:50 000) was used as the basemap for the study.
The study area lies between latitudes 26°45'S and 27°00'S and between 28°30'E and 28°45'E and occupies an area of approximately 690 km² (70 000 ha) in the vicinity of Grootvlei,

southern Transvaal, and a small area adjacent to Villiers in the northern Orange Free State (Figure 1).
A detail description of the physical environment of the study area is given by Breytenbach et al. a. (in prep.).

METHODS

In the study the Zürich-Montpellier phytosociological approach (Braun-Blanquet 1932; Werger 1974) and the PHYTOTAB program package (Westfall et al. 1982) was used to define and describe the different plant communities as it is the most popular and acceptable method in use in South Africa (Bredenkamp 1975: Van Rooyen 1978). The Rangeland Ecology Section of the Grassland Research Centre is an advocator of this approach and the fact that other studies in the Grassland Biome (Bredenkamp 1975; Deall 1985; Bezuidenhout 1988; Turner 1989; Bloem 1989; Kooij 1990) were done with this approach contribute to it's selection.

The vegetation is sampled with the use of random stratified sub-quadrats. Experiments during the reconnaissance phase of the study area showed that more information is obtained with the sub-quadrat method, in terms of time and energy spent, than a single square quadrat. A stratified random method was used for the placement of relevés. The sub-quadrats are rectangular with the sides in the proportion of one to two, since this is more effective than square quadrats (Oosting 1956; Cain & Castro 1959). The sub-quadrats that were used were 3 m in length and 1,5 m in width (Turner 1989). Sub-quadrats are placed until there is less than 10% increase in new species. During the study a minimum of three sub-quadrats per relevé is maintained (a minimum area of 13,5m²). The relevés are objectively placed with the help

of random numbers which are generated by a computer.
The species names used are given by Myburgh et al. (in prep.) and is arranged according to Gibbs Russell et al. (1985; 1987).

The Ba Land Type occupy 9 800 ha of the total study area (Figure 2). The dominant soils of the Ba Land Type are of the Avalon, Hutton, Wasbank, Rensburg, Bainsvlei, Swartland and Bonheim Forms. The predominant geology of the area is andesitic to dacitic lava, tuff, chert, agglomerate and quartzite of the Ventersdorp Supergroup. The dominant terrain units of the area are terrain unit 3 (65% of the area) within the slope class 3-8% and terrain unit 1 (20% of the area) within the slope class 0-8% (Land Type Survey Staff 1985). The average rainfall of the Bb Land Type is 704,0 mm (Land Type Survey Staff 1985). The area of the Ba Land Type as well as the time available determined the number of relevès. Relevès were compiled in 46 stratified random sample plots.

RESULTS

Classification

The vegetation of the Ba land type can be described as a *Themeda triandra-Eragrostis curvula* Grassland with *Themeda triandra, Eragrostis curvula, Cynodon dactylon, Eragrostis plana, Setaria sphacelata* and *Brachiaria serrata* as the common species (Species group Q, Table 1). An average of 24 species per relevè was recorded. The grassland occurs on red and yellow soils of the Clovelly, Glencoe, Avalon, Hutton, Bainsvley and Shortlands forms, on brown to dark brown soils of the Valsrivier and Katspruit forms, on dark clayey soils of the Arcadia and Rensburg

forms and on soils of the Mispah form (MacVicar et al. 1977). The soil depth of the red and yellow soils varied between 110 mm (Hutton) and 1 200 mm (Clovelly), of the brown to dark brown soils from 300 mm (Valsrivier) to 400 mm (Katspruit) and of the dark clayey soils from 200 mm (Arcadia) to 1 200 mm (Rensburg). The percentage clay in the soils varied between 0-10% (Clovelly) and more than 55% (Arcadia and Rensburg). This grassland is situated at an altitude of 1 540 m to 1 650 m above mean sea level on slopes with an inclination of 0-16° on terrain units 1, 3, 4 and 5 (Figure 4). The above ground rock cover varied between 0% and 45%. Various shrubs and trees occur in this grassland.

The *Themeda triandra-Eragrostis curvula* Grassland is divided in nine communities and two sub-communities namely (Table 1; Figure 3):

1.1 *Eragrostis plana-Falkia oblonga* Grassland

1.2 *Eragrostis plana-Setaria pallide-fusca* Grassland

1.3 *Themeda triandra-Urginea* sp. Grassland

1.4 *Themeda triandra-Setaria nigrirostris* Grassland

1.5 *Themeda triandra-Aristida mollissima* Grassland

1.6 *Diospyros lycioides-Eragrostis curvula* Shrubland

1.6.1 *Diospyros lycioides-Euclea crispa* Shrubland

1.6.2 *Diospyros lycioides-Digitaria tricholaenoides* Shrubland

1.7 *Eragrostis curvula-Hyparrhenia hirta* Grassland

1.8 *Eragrostis curvula-Harpochloa falx* Grassland

1.9 *Themeda triandra-Elionurus muticus* Grassland

1.1 The *Eragrostis plana-Falkia oblonga* Grassland

The *Eragrostis plana-Falkia oblonga* Grassland occurs mainly on black clayey soils of the Arcadia and Rensburg forms (MacVicar et

al. 1977) with undifferentiated Witwatersrand quartzite, shale, basaltic lava, agglomerate and tuff as the parent material (Figure 3). This community is situated at an altitude of 1 580 m above mean sea level on slopes with an inclination of 1-2° on terrain units 4 and 5 (Figure 4). No above ground rock occurs in this community. The average number of species per relevé was 15.

The community is characterised by the diagnostic species *Falkia oblonga*, *Digitaria ternata* and *Panicum coloratum* (Species group A, Table 1). Dominant grasses in the community are *Eragrostis plana*, *Cynodon dactylon*, *Eragrostis curvula* and *Themeda triandra* (Table 1). Other forbs in the community are *Haplocarpha lyrata*, *Trifolium africanum*, *Felicia fascicularis* and *Berkheya pinnatifida* (Table 1). Less prominent forbs and grasses in the community are *Salvia repens*, *Bidens pilosa*, *Conyza podocephala*, *Haplocarpha scaposa*, *Abildgaardia ovata*, *Setaria nigrirostris*, *Cymbopogon excavatus*, *Microchloa caffra*, *Digitaria eriantha*, *Aristida diffusa* and *Eragrostis gummiflua* (Table 1). *Berkheya pinnatifida* and *Eragrostis plana* are characteristically found in areas where the soils are waterlogged. No shrubs or trees occur in the community. The mean basal cover of the herbaceous layer was 11%.

1.2 The *Eragrostis curvula-Setaria pallide-fusca* Grassland

The *Eragrostis curvula-Setaria pallide-fusca* Grassland occurs on shallow (<300 mm) sandy clayey loam (21-35% clay) and clayey (>55% clay) soils of the Valsrivier and Arcadia forms (MacVicar et al. 1977) with sandstone and shale (Pv) as the parent material (Figure 3). The community is situated at an altitude of 1 540 m to 1 580 m above mean sea level on slopes with an

inclination of 0-1° on terrain units 4 and 5 (Figure 3 and 4). No above ground rock was found in this community. An average of 14 species per relevé was recorded.

The community is characterised by the diagnostic species *Setaria pallide-fusca* and *Urochloa panicoides* (Species group B, Table 1). Dominant grasses in the community were *Eragrostis curvula, E. plana, Cynodon dactylon* and *Themeda triandra* (Table 1). Other prominent forbs in the community were *Schkuhria pinnata, Oxalis obliquifolia* and *Tagetes minuta* (Table 1). Less dominant grasses in the community were *Sporobolus africanus, Panicum coloratum, Aristida congesta* and *Hyparrhenia hirta* (Table 1). The occurrence of *Aristida congesta, Cynodon dactylon, Tagetes minuta* and *Gomphrena celosioides* suggest mismanagement or some other disturbance of the veld (Landbou-ontwikkelings- program: Hoëveldstreek 1986). No shrubs or trees occur in this community. The mean basal cover of the herbaceous layer was 14%.

1.3 The *Themeda triandra-Urginea* sp. Grassland

The *Themeda triandra-Urginea* sp. Grassland occurs mainly on black clayey (>55% clay) soils of the Arcadia form (MacVicar et al. 1977) with diabase (Vdi) as the parent material (Figure 3). Occasionally the community was found on soils of the Hutton, Bainsvley and Avalon forms (MacVicar et al. 1977) with a clay content that varied from 15% to 35% and with undifferentiated Witwatersrand quartzite, shale, greywacke and tillite as the parent material. The community is situated at an altitude of 1 580 m to 1 600 m above mean sea level on slopes with an inclination of 1-2° on terrain unit 4 (Figure 3 and 4). The above ground rock cover varied between 0% and 5%. An average of 19 species per relevé was recorded.

The community is characterised by the diagnostic species *Urginea* sp., *Evolvulus alsinoides, Indigofera* sp., *Convolvulus sagittatus, Salvia repens, Crabbea hirsuta, Rhynchosia totta, Cyperus margaritaceus, Hypoxis iridifolia* and *Eragrostis capensis* (Species group C, Table 1). Dominant grasses in the community were *Themeda triandra, Eragrostis curvula, E. plana, Cynodon dactylon, Setaria sphacelata, Brachiaria serrata, Elionurus muticus, Heteropogon contortus* and *Eragrostis racemosa* (Table 1). Localized trampled and disturbed areas are characterised by the occurrence of *Cynodon dactylon, Stoebe vulgaris* and several *Aristida* species. No shrubs or trees occur in this community. The mean basal cover of the herbaceous layer was 7%.

1.4 The *Themeda triandra-Setaria nigrirostris* Grassland

The *Themeda triandra-Setaria nigrirostris* Grassland occurs mainly on soils of the Mispah form (MacVicar et al. 1977) with a clay content that varied between 35% and 55% (Figure 3). Soils of the Hutton, Glencoe and Shortlands forms (MacVicar et al. 1977) with a soil depth that varied from 110 mm to 650 mm and a clay content that varied between 15% and 55% are also present in the community. The soils are derived from basaltic lava, agglomerate, tuff (Rk), dolerite (Jd) and quartzite (R). The community is situated at an altitude of 1 560 m to 1 650 m above mean sea level on slopes with an inclination of 1-3° on terrain units 1 and 3 (Figure 3 and 4). The above ground rock cover of the community varied between 0% and 30%. An average of 25 species per relevé was recorded.

The community is characterised by the diagnostic species *Setaria nigrirostris, Hypoxis argentea, Acalypha angustata, Haplocarpha lyrata, Cassia biensis* and *Sporobolus africanus* (Species group D,

Table 1). Dominant grasses in the community are *Themeda triandra, Eragrostis curvula, Elionurus muticus, Heteropogon contortus, Setaria sphacelata, Trachypogon spicatus, Tristachya leucothrix, Brachiaria serrata* and *Cynodon dactylon* (Table 1). Prominent forbs in the community are *Helichrysum nudifolium, H. rugulosum, Crabbea acaulis* and *Hermannia depressa* (Table 1). Areas with shallow (<300 mm) soils and areas that were burnt the previous season are characterised by the occurrence of *Tristachya leucothrix* and *Trachypogon spicatus*. Species of Species groups F, K, M, P and Q also occur in the community. Localized disturbed areas are characterised by *Cynodon dactylon, Stoebe vulgaris, Ziziphus zeyheriana* and several *Aristida* species. No shrubs and trees occur in the community although in the adjacent plant communities trees such as *Maytenus heterophylla* and shrubs like *Diospyros lycioides* and *Rhus rigida* do occur. The mean basal cover of the herbaceous layer was 9%.

1.5 The *Themeda triandra-Aristida mollissima* Grassland

The *Themeda triandra-Aristida mollissima* Grassland occurs mainly on soils of the Mispah form (MacVicar et al. 1977) with sandstone and shale (Pv) as the parent material (Figure 3). Soils of the Hutton form (MacVicar et al. 1977) with a soil depth of 420 mm and a clay content that varied between 25% and 35% on dolerite (Jd) also occur in the community. Outcrops of basalt, basaltic breccia and quartzite are also present in the community. The community is situated at an altitude of 1 560 m to 1 620 m above mean sea level on slopes with an inclination of 1-3° on terrain unit 3 (Figure 3 and 4). The above ground rock cover in the community varied between 0% and 30%. An average of 32 species per relevé was recorded.

The community is characterised by the diagnostic species *Aristida mollissima, Cymbopogon plurinodes, Hermannia lancifolia, Euryops transvaalensis* and *Berkheya onopordifolia* (Species group E, Table 1). Dominant grasses in the community were *Themeda triandra, Eragrostis curvula, Elionurus muticus, Heteropogon contortus* and *Brachiaria serrata* (Table 1). Prominent forbs in the community were *Crabbea acaulis, Helichrysum rugulosum, Dicoma anomala* and *Hermannia depressa* (Table 1). Species group F (Table 1) represents the common species for the *Themeda triandra-Setaria nigrirostris* Grassland and the *Themeda triandra-Aristida mollissima* Grassland. Species of Species groups J, K, M, P and Q (Table 1) are also present in the community. Localized disturbed areas in the community are characterised by the occurrence of *Stoebe vulgaris, Ziziphus zeyheriana* and *Cynodon dactylon.* The tree *Canthium gilfillanii* the shrubs *Rhus rigida* and *Diospyros lycioides* are widely scattered in the more rocky areas of the community. The mean crown cover of the community was 50%.

1.6 The *Diospyros lycioides-Eragrostis curvula* Shrubland

The *Diospyros lycioides-Eragrostis curvula* Shrubland occurs mainly on soils of the Mispah form (MacVicar et al. 1977) derived predominantly from basaltic lava, agglomerate and tuff (Rk) (Figure 3). Undifferentiated Witwatersrand quartzite, shale (R), quartzite, banded ironstone (Rh) and dolerite (Jd) are also present in the community. The community is situated at an altitude of 1 560 m to 1 680 m above mean sea level on slopes with an inclination of 1-16° on terrain units 1 and 3 (Figure 3 and 4). The above ground rock cover in the community varied from 16% to more than 60%. An average of 38 species per relevé was recorded.

The community is characterised by the diagnostic species *Diospyros lycioides, Maytenus heterophylla, Cheilanthes hirta, Argyrolobium velutinum, Aloe transvaalensis, Asclepias fruticosa, Plectranthus madagascariensis* and *Pachycarpus rigidus* (Species group G, Table 1). Species of Species groups H, I, J, K, L, M, P and Q (Table 1) are also present in the community. Species group J (Table 1) indicates the relationship between the *Diospyros lycioides-Eragrostis curvula* Shrubland and the *Themeda triandra-Aristida mollissima* Grassland. Dominant grasses in the community were *Eragrostis curvula, Themeda triandra, Cymbopogon excavatus, Hyparrhenia hirta, Elionurus muticus* and *Heteropogon contortus* (Table 1). Prominent forbs in the community were *Berkheya setifera, Crabbea acaulis, Ziziphus zeyheriana, Chaetacanthus costatus, Helichrysum rugulosum* and *Conyza podocephala* (Table 1). The mean crown cover of the community was 55%.

The *Diospyros lycioides-Eragrostis curvula* Shrubland is divided in two sub-communities (Table 1) namely:

1.6.1 The high-lying *Diospyros lycioides-Euclea crispa* Shrubland

1.6.2 The low-lying *Diospyros lycioides-Digitaria tricholaenoides* Shrubland

1.6.1 The *Diospyros lycioides-Euclea crispa* Shrubland

The *Diospyros lycioides-Euclea crispa* Shrubland occurs mainly on soils of the Mispah form (MacVicar et al. 1977) with basaltic lava, agglomerate and tuff (Rk) as the parent material (Figure 3). Undifferentiated Witwatersrand quartzite, shale (R), quartzite and banded ironstone (Rh) are also present in the community. The community is situated at an altitude of 1 580 m to 1 680 m above mean sea level mainly on northern slopes with an

inclination of 1-16° on terrain units 1 and 3 (Figure 3 and 4). The above ground rock cover varied between 31% and 60% (Figure 3). An average of 36 species per relevé was recorded.

The community is characterised by the diagnostic species *Canthium gilfillanii, Ehretia rigida, Cussonia paniculata, Diospyros whyteana, Euclea crispa, Protasparagus setaceus, Rhoicissus tridentata, Pavonia transvaalensis, Berkheya seminifera, Lippia rehmannii, Ipomoea obscura, Teucrium trifidum, Haemanthus humilis, Crassula setulosa, Aloe davyana, Kalanchoe thyrsiflora, Digitaria tricholaenoides* and *Pellaea calomelanos* (Species group H, Table 1). Dominant grasses in the community were *Eragrostis curvula, Elionurus muticus, Heteropogon contortus, Themeda triandra, Cymbopogon excavatus* and *Hyparrhenia hirta* (Table 1). Prominent forbs in the community were *Crabbea acaulis, Conyza podocephala, Commelina africana* and *Helichrysum rugulosum* (Table 1). Dominant shrubs and trees in the community were *Diospyros lycioides, Rhus rigida, Maytenus heterophylla, Euclea crispa, Canthium gilfillanii* and *Aloe davyana* (Table 1). Localized disturbed areas are characterised by the occurrence of *Ziziphus zeyheriana, Stoebe vulgaris, Aristida* species and *Opuntia* sp.. The mean crown cover of the community was 47%.

1.6.2 The *Diospyros lycioides-Digitaria tricholaenoides* Shrubland

The *Diospyros lycioides-Digitaria tricholaenoides* Shrubland occurs mainly on soils of the Mispah form (MacVicar et al. 1977) with basaltic lava, agglomerate, tuff (Rk) and dolerite (Jd) as the predominantly parent material (Figure 3). The community is situated at an altitude of 1 560 m to 1 640 m above mean sea level mainly on southern slopes with an inclination of 2-4° on terrain unit 3 (Figure 3 and 4). The above ground rock cover in

the community varied between 16% and 45% (Figure 3). An average of 41 species per relevé was recorded.

The community is characterised by the diagnostic species *Helichrysum krausii, Lactuca* sp., *Cheilanthus eckloniana, Ipomoea crassipes, Digitaria tricholaenoides, Bidens pilosa* and *Ledebouria ovatifolia* (Species group I, Table 1). Dominant grasses in the community were *Eragrostis curvula, Themeda triandra, Cynodon dactylon, Brachiaria serrata, Cymbopogon excavatus, Trachypogon spicatus, Elionurus muticus, Heteropogon contortus, Eragrostis racemosa, Aristida congesta* and *Hyparrhenia hirta* (Table 1). Prominent forbs in the community were *Crabbea acaulis, Vernonia oligocephala, Chaetacanthus costatus, Ziziphus zeyheriana, Helichrysum rugulosum, Commelina africana* and *Hermannia depressa* (Table 1). Dominant shrubs and trees in the community were *Diospyros lycioides, Rhus rigida, Maytenus heterophylla* and *Aloe transvaalensis* (Table 1). The mean crown cover of the community was 64%.

1.7 The *Eragrostis curvula-Hyparrhenia hirta* Grassland

The *Eragrostis curvula-Hyparrhenia hirta* Grassland occurs mainly on soils of the Mispah form (MacVicar et al. 1977) derived from undifferentiated Witwatersrand quartzite, shale (R) and banded ironstone (Rh) (Figure 3). Soils of the Avalon and Hutton forms (MacVicar et al. 1977) with a clay content that varied between 25% and 55% and parent material that consists of dolerite (Jd), sandstone and shale (Pv) and a soil depth that varied between 800 mm and 1 200 mm are also present in the community. The community is situated at an altitude of 1 540 m to 1 580 m above mean sea level on slopes with an inclination of 1-4° on terrain unit 3 (Figure 3 and 4). The above ground rock cover in

the community varied between 0% and 45%. An average of 25 species per relevé was recorded.

The community is characterised by the occurrence of *Hyparrhenia hirta, Conyza podocephala* and *Felicia fascicularis* (Species group L, Table 1) and also by the occurrence of *Helichrysum rugulosum, Commelina africana, Aristida congesta* and *Dicoma anomala* (Species group M, Table 1) and the absence of species of Species groups D, E, F, G, H, I, J and K (Table 1). The community is also characterised by the presence of species of Species group O and the absence of species of Species group N (Table 1). Dominant grasses in the community were *Eragrostis curvula, E. plana, Themeda triandra, Setaria sphacelata, Cynodon dactylon, Heteropogon contortus* and *Trichoneura grandiglumis* (Table 1). Prominent forbs in the community were *Hermannia depressa* and *Ledebouria* sp. (Table 1). Single occurrences of *Diospyros lycioides* are to be found in the community. Localized disturbed areas are characterised by *Stoebe vulgaris, Ziziphus zeyheriana, Cynodon dactylon* and several *Aristida* species. A few selectively grazed areas are characterised by short grazed *Themeda triandra* and ungrazed *Hyparrhenia hirta* and *Aristida* species. The mean basal cover of the herbaceous layer was 6%.

1.8 The *Eragrostis curvula-Harpochloa falx* Grassland

The *Eragrostis curvula-Harpochloa falx* Grassland occurs on soils of the Mispah form (MacVicar et al. 1977) derived from undifferentiated Witwatersrand quartzite and shale (Rk) (Figure 3). The soil depth varied from 100 mm to 150 mm with a clay content of between 15% and 20%. The community is situated at an altitude of 1 600 m above mean sea level on slopes with an inclination of 1-2° on terrain units 1 and 3 (Figure 3 and 4).

The above-ground rock cover varied between 0% and 15%. An average of 16 species per relevé was recorded.

The community is characterised by the diagnostic species *Harpochloa falx* and *Ledebouria* sp. (Species group N, Table 1). Species of Species groups O, P and Q (Table 1) are also present in the community. Dominant grasses in the community were *Eragrostis curvula, Themeda triandra, Aristida junciformis, Trichoneura grandiglumis, Elionurus muticus, Heteropogon contortus* and *Cynodon dactylon* (Table 1). Prominent forbs in the community were *Solanum panduriforme* and *Crabbea acaulis* (Table 1). There are no shrubs or trees in this community. The occurrence of *Aristida junciformis, A. congesta* and *Cynodon dactylon* is an indication of some sort of disturbance of the veld. *Aristida congesta* and *Cynodon dactylon* are dominant in the vicinity of termitaria. The mean basal cover of the herbaceous layer was 8%.

1.9 The *Themeda triandra-Elionurus muticus* Grassland

The *Themeda triandra-Elionurus muticus* Grassland occurs on soils of the Clovelly, Katspruit, Mispah, Arcadia and Rensburg forms (MacVicar et al. 1977) with a clay content that varied from 21% to more than 55% (Figure 3). The soil depth in the community varied between 100 mm and 1 200 mm and the parent material consists of quartzite, greywacke, conglomerate, shale, tillite (Rg), basaltic lava, agglomerate, tuff (Rk), undifferentiated Witwatersrand quartzite (R), diabase (Vdi) and dolerite (Jd). The community is situated at an altitude of 1 580 m to 1 620 m above mean sea level on slopes with an inclination of 1-3° on terrain units 3 and 4 (Figure 3). In general there is no above-ground rock cover but in two relevés there is a 15% above ground rock

cover. An average of 15 species per relevé was recorded.

The community is characterised by the presence of the species *Elionurus muticus, Heteropogon contortus, Eragrostis racemosa* and *Hermannia depressa* (Species group P, Table 1) and the absence of species of Species groups A to O (Table 1). Dominant grasses in the community were *Themeda triandra, Eragrostis curvula, E. plana, Cynodon dactylon, Setaria sphacelata, S. nigrirostris, Brachiaria serrata* and *Trichoneura grandiglumis* (Table 1). Prominent forbs in the community were *Stoebe vulgaris* and *Ledebouria* sp. (Table 1). Localized disturbed areas are characterised by the occurrence of *Stoebe vulgaris, Cynodon dactylon, Aristida diffusa, A. congesta* and *Ziziphus zeyheriana*. There are less forbs in this community than any other community in the Ba land type. The mean basal cover of the herbaceous layer was 10%.

ORDINATION

The data was ordinated by using Detrended Correspondence Analysis (DECORANA) (Hill 1979). The first and second axis of the ordination were used for the illustration of the plant communities and environmental interactions. The first axis is responsable for 72,3% (Eigen value of 0,723) and axis two for 46,1% (Eigen value of 0,461) of the variation in the data set. On the scatter diagram of the ordination there is a distinct seperation between the high-lying community (F) and the low-lying communities (A, B, C) (Figure 5). Communities D, E, G, H and I are positioned on a gradient that consists of altitude, above-ground rock cover, slope and soil drainage (persentage clay content of the soil) (Figure 5). There is no seperation between communities D, E and I (Figure 5) on the scatter diagram that

suggests that the seperation factor of these communities was not recorded during the study.

CONCLUSION

The vegetation of the Ba Land Type is classified in nine main communities and one community is divided in two sub-communities. The communities are mainly divided along a soil drainage gradient and this is confirmed by the DECORANA ordination. These plant communities combined with similar plant communities in the Ea, Ca, Bb and Ib Land Types (Breytenbach et al. a, b, d (in prep.)) in the study area, form management units.

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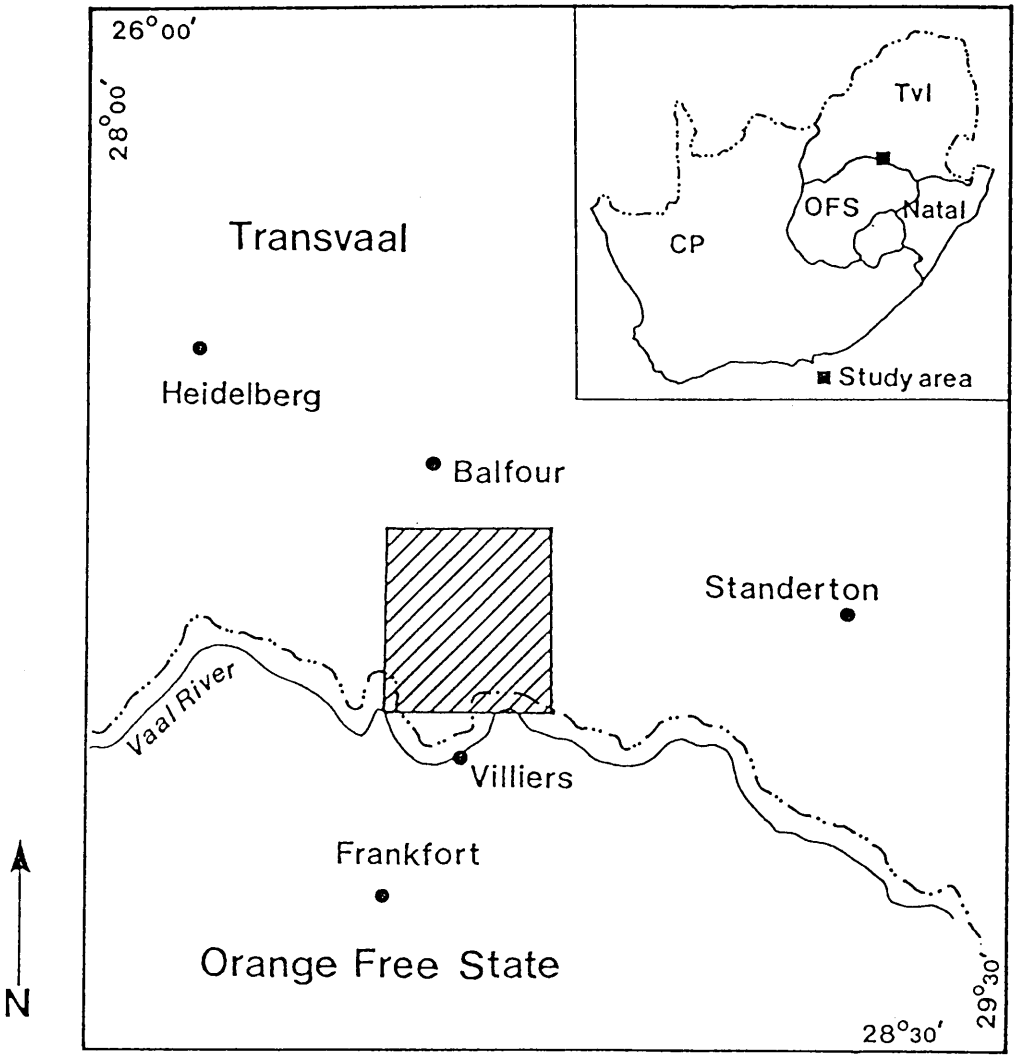


Figure 1. The location of the study area, based on the 2628 DC GROOTVLEI 1:50 000 Topocadastral map (Government Printer, Pretoria 1978).

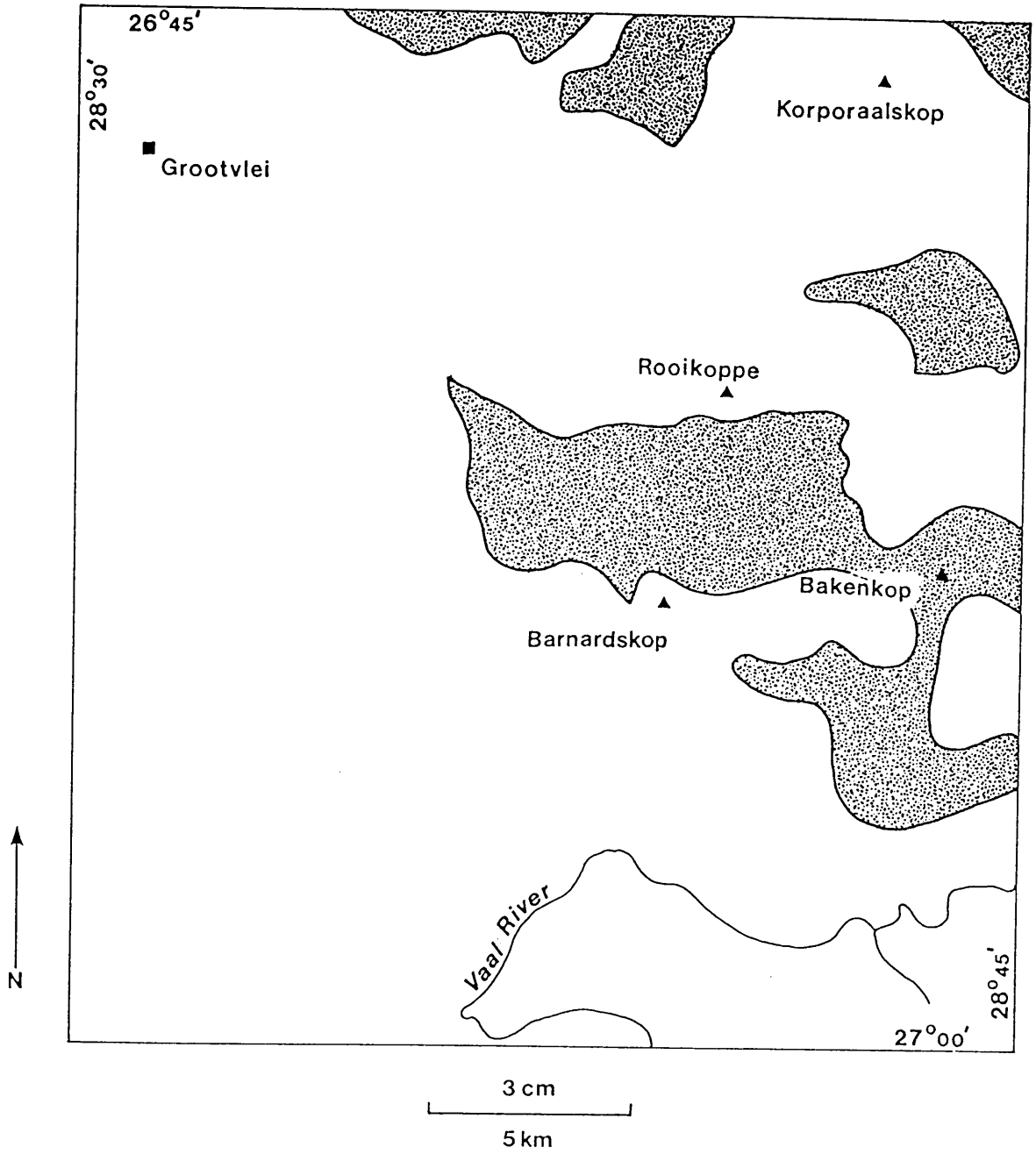


Figure 2. The location of the Ba Land Type in the study area (Land Type Survey Staff 1984)

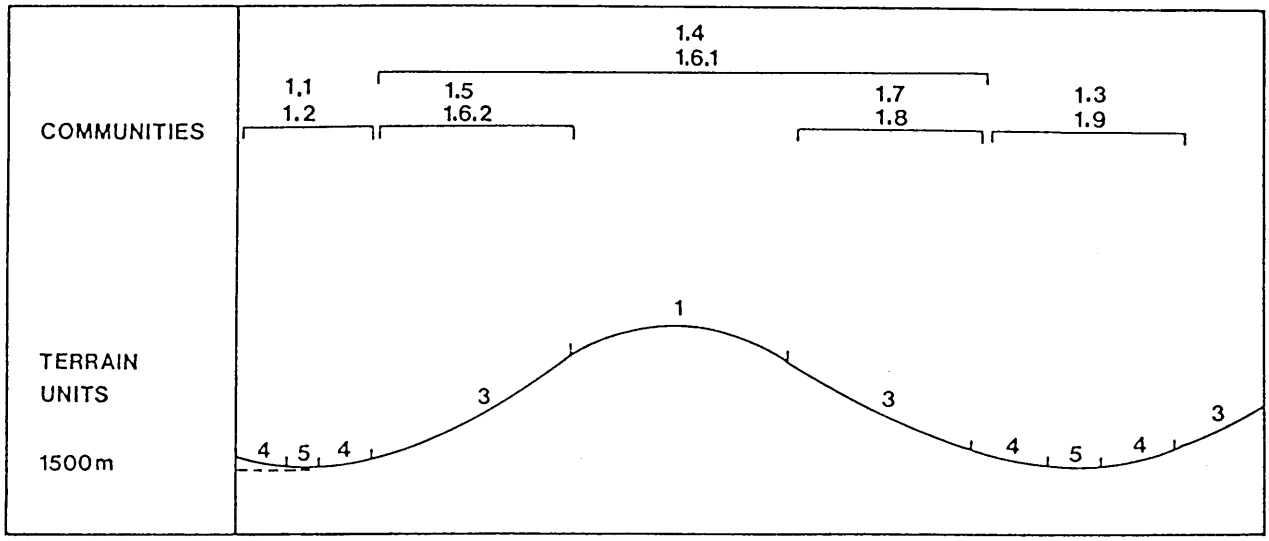


Figure 3. The location of the communities in the Ba Land Type on topographical types (see text for community names)

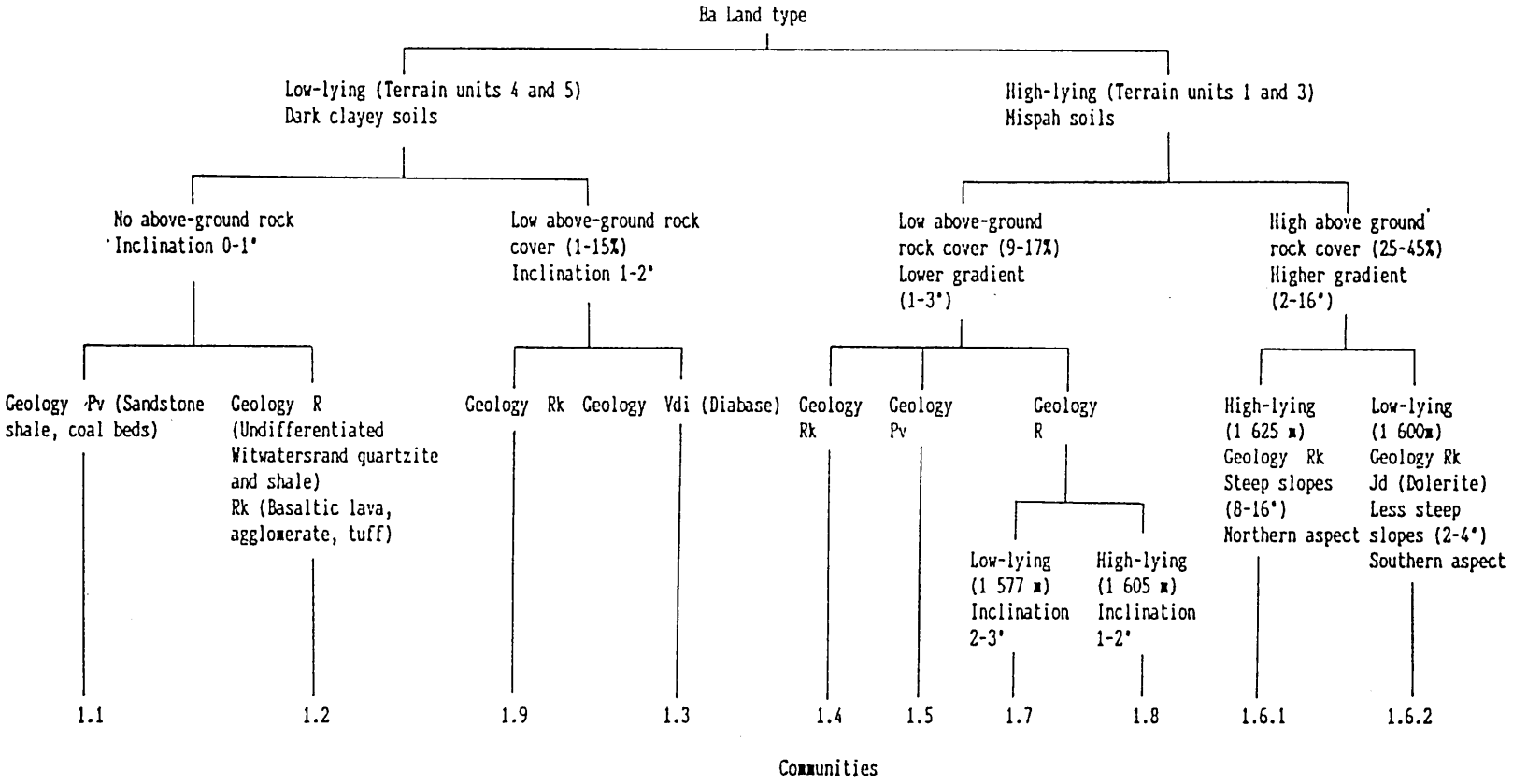


Figure 4. Dendrogram to illustrate the habitat relationships of the communities in the Ba Land Type (see text for community names)

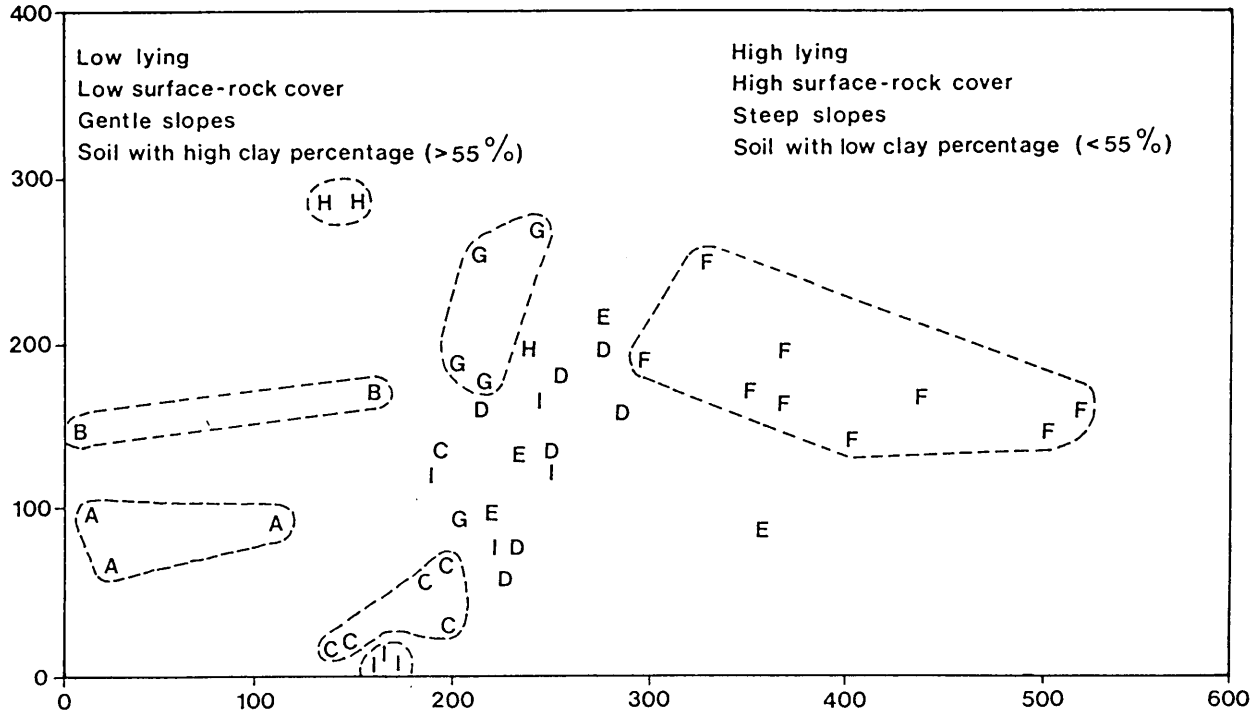


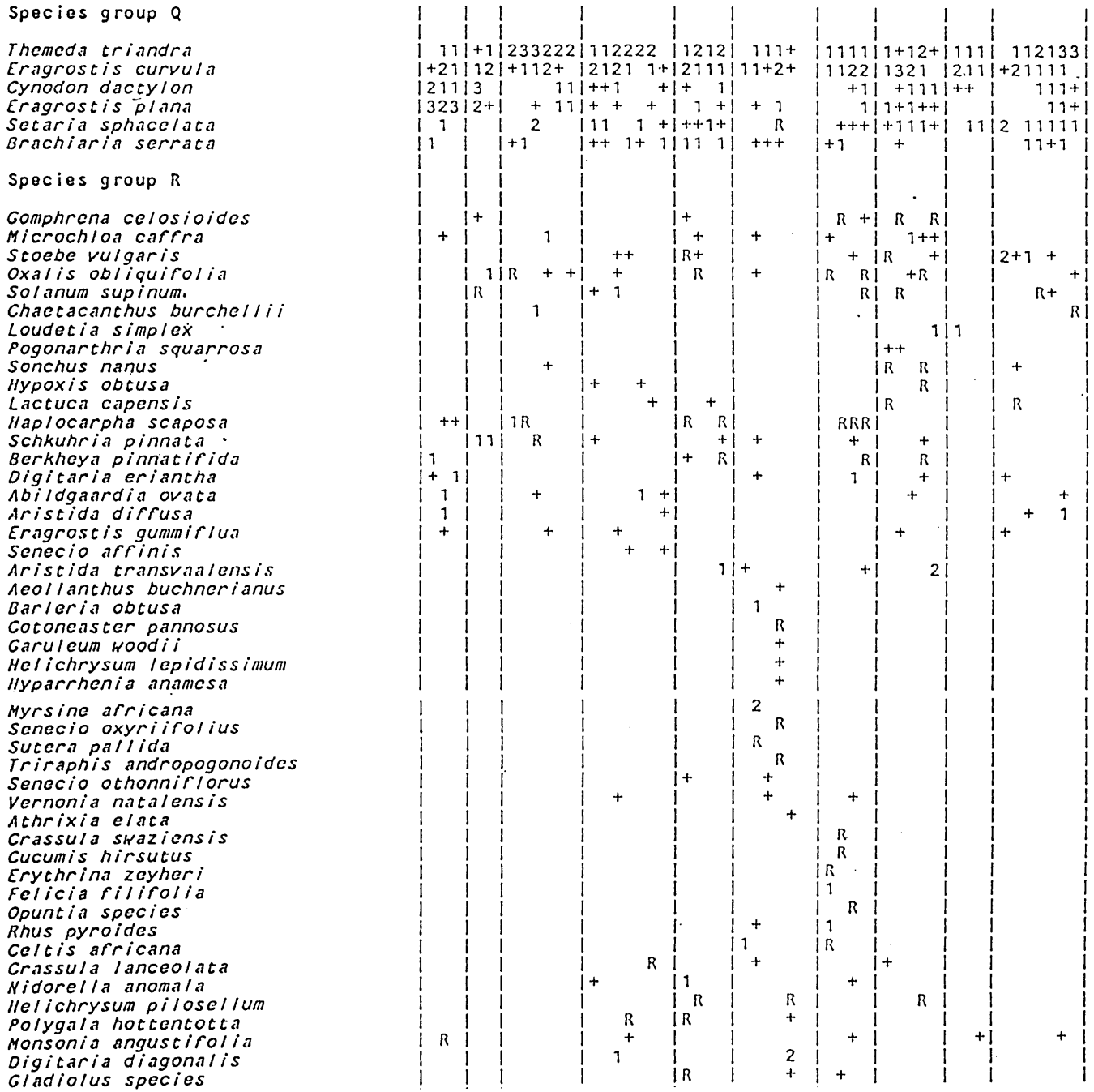
Figure 5. The ordination of the vegetation of the Ba Land Type in the Grootvlei-area southern Transvaal, South Africa
A - *Eragrostis plana-Falkia oblonga* grassland
B - *Eragrostis plana-Setaria pallide-fusca* grassland
C - *Themeda triandra-Urginea* species grassland
D - *Themeda triandra-Setaria nigrirostris* grassland
E - *Themeda triandra-Aristida mollissima* grassland
F - *Diospyros lycioides-Eragrostis curvula* shrubland
G - *Eragrostis curvula-Hyparrhenia hirta* grassland
H - *Eragrostis curvula-Harpochloa falx* grassland
I - *Themeda triandra-Elionurus muticus* grassland

Table 1. Phytosociological table of the Ba Land Type in the Villiers-Grootvlei area, South Africa.

Community number	1										
	1.1	1.2	1.3	1.4	1.5	1.6		1.7	1.8	1.9	
						1.6.1	1.6.2				
Releve numbers	010	01	000000	2121101	2202	22222	2222	00122	001	0010010	
	808	82	441544	0100222	3420	33212	3232	23201	881	5518812	
	471	21	453467	9315263	1778	04913	3425	90972	789	5685658	
Species group A											
Falkia oblongata	111										
Digitaria ternata	1+										
Panicum coloratum	++	1			1						
Species group B											
Setaria pallide-fusca		21	1+ 1								
Urochloa panicoides		21									
Species group C											
Urginea species			11+R1R								
Evolvulus alsinoides			R R +R	+	+						
Indigofera species			RRR R							+	
Convolvulus sagittatus			R RR							R	
Salvia repens	+		RR R		2		+				
Eragrostis capensis			++ 1							1	
Crabbea hirsuta			R +R	+							
Rhynchosia totta			+R+		+	+					
Cyperus margaritaceus			11								
Species 280			+1								
Hypoxis iridifolia			R +								
Species group D											
Setaria nigrirostris	1			1111			1		+	11 1	
Hypoxis argentea				++ +		R					
Acalypha angustifolia			R	+ 1 1							
Haplocarpha lyrata	+R			R +						+	
Cassia biensis				1+					R		
Sporobolus africanus				+ +							

Species group E										
Aristida mollissima					+2 1		+			
Cymbopogon plurinodis			1	+	+ 1+					+
Hermannia lancifolia				+	R+				+	
Euryops transvaalensis				R	++			+		
Berkheya onopordifolia					+R					
Species group F										
Helichrysum nudifolium				R1+ R R	+ ++		R+			
Trifolium africanum	R +		R	R + +	++			+		+ +
Senecio coronatus				R +	+ +			+		
Species group G										
Diospyros lycioides					12	2222+	2131	R		
Rhus rigida					+	111++	2+R1			
Tagetus minuta		1+		R		R+R	+ ++			
Maytenus heterophylla						2 2	+11+			
Rhynchelytrum repens					+	1 21+	++			
Cheilanthes hirta						+ ++	+ ++			
Argyrolobium velutinum					+	+ +	+++			
Aloe transvaalensis						+ +R	R1			
Asclepias fruticosa						R1 +	R +			
Plectracanthus madagascariensis						1 1	+ +			
Pachycarpus rigidus				R		R	RR			
Species group H										
Euclea crispa						312	R			
Canthium gilfillanii					2	222	+			
Haemanthus humilis						+11+	1			
Pellaea calomenalos					+	+ ++R	+			
Ehretia rigida						2R2				
Pavonia transvaalensis						+1+				
Berkheya seminivea						+ 1				
Protasparagus setaceus						R R				
Crassula setulosa						+ 2		R		
Lippia rehmannii					1	1 +				
Aloe davyana						+ +				
Cussonia paniculata						1 1				
Ipomoea obscura						+ +				
Teucrium trifidum						+ +				
Kalanchoe thyrsiflora						++				
Rhoicissus tridentata						R+	+			
Diospyros whyteana						1 +				

Species group I										
Helichrysum kraussii							+R			
Lactuca species						+	R+			
Cheilanthes eckloniana							R +			
Ipomoea crassipes			+				RR			
Digitaria tricholaenoides					+		+ 1		11	
Bidens pilosa	+			R	+	+	++			
Ledebouria ovatifolia							R R			
Species group J										
Indigofera obscura					R +	R R+	++ +	+		
Berkheya setifera			RR	+	11+	2	+ ++			
Species group K										
Crabbea acaulis				+1 +1++	+++	+++R+	++++	R	+	
Cymbopogon excavatus	1			+1 +	++ 1	1 11+	11+2	+	+	1
Trachypogon spicatus				211 1 2	2 1	+3	11	1		1 +
Acalypha caperonioides				1 ++ +	1+ +	+	+++			
Vernonia oligocephala				+ ++	+ +	1 +	++1+			
Tristachya leucothrix				2+ 12	11	3	2 2	1	11	11
Ziziphus zeyheriana				+ + R	1	+	++R+			1
Chaetacanthus costatus				R +		+ R	+++			+ R
Species group L										
Hyparrhenia hirta		+				12++	+22	1+ 11		
Conyza podocephala	R				R	+++R+	+ 11	++ ++		
Felicia fascicularis	1					R	+ +	++ ++		
Speciesgroup M										
Helichrysum rugulosum				+++11 +	++ +	+ ++	++++	R +++		
Commelina africana		+		+ 1	+	++++	++++	R ++	+	+
Aristida congesta		1		+	1	+ +	+11	+1111	2	1
Dicoma anomala				+ +R	+ ++	+		++ R		+
Species group N										
Harpochloa falx				1		1			11	
Ledebouria species	1								1++	+1+
Species group O										
Trichoneura grandiglumis					+			1+1++	+1	+
Aristida junciformis				+		+		1 +	33	
Solanum panduriforme			+	+ 1	R +			++	R+	
Species group P										
Elionurus muticus			121111	2111111	1111	1+111	+121	1	111	1222211
Heteropogon contortus			2131+	11 1111	112+	111+1	+111	1+111	111	1111
Hermannia depressa		+	R+	+1111+1	+1++	+ +	++++	+ 1		R+ ++++
Eragrostis racemosa			++	+ + 1+2	21++	1	+11	1++	11	+11



HOOFSTUK 8

THE PHYTOSOCIOLOGY OF THE VILLIERS-GROOTVLEI AREA, SOUTH AFRICA. 4. THE PLANT COMMUNITIES OF THE Ca AND Ea LAND TYPES.

P.J.J BREYTENBACH*, W.J. MYBURGH*, G.K. THERON**, G.J. BREDENKAMP**

Keywords: Braun-Blanquet, classification, ordination, plant communities, Villiers-Grootvlei area.

ABSTRACT

The vegetation of the Ea Land Type occurs in two habitat types namely the high-lying and the low-lying areas. This vegetation is classified by means of the Braun-Blanquet method. On the high-lying area two communities occur, one of which is divided into two sub-communities. On the low-lying area five communities occur, one of which is divided into five sub-communities and another into two sub-communities. All communities are related to spesific environmental conditions.

UITTREKSEL

Die plantegroei van die Ea-landtipe kom voor op twee habitat tipes naamlik die hoërliggende en die laerliggende gebiede. Hierdie plantegroei is deur middel van die Braun-Blanquet metode geklassifiseer. Op die hoërliggende gebied kom twee gemeenskappe voor waarvan een verdeel is in twee sub-gemeenskappe. Op die laerliggende gebied kom vyf gemeenskappe voor waarvan een in vyf

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sub-gemeenskappe en 'n ander in twee sub-gemeenskappe verdeel is. Die gemeenskappe is gekoppel aan spesifieke omgewings toestande.

INTRODUCTION

The recovery and wise utilisation of veld as a natural resource should receive careful attention, not only from a research view point but also in terms of agricultural extension (Landbou-ontwikkelingsprogram: Hoëveldstreek 1986). The White Paper on Agricultural Policy (1984) refers to the decline of the natural pasturage and warns that indiscriminate land-use practices and the over-exploitation of the natural resources may lead to a decrease in the living standards of the human population.
The Veld Type description of Acocks (1988) is the only vegetation classification available for the Highveld Region. This classification is of a rather generalised nature. For this reason a more detailed vegetation map of the Highveld Region, with an association of vegetation types with distinct soil-climate combinations, is an urgent necessity (Landbou-ontwikkelingsprogram: Hoëveldstreek 1986).

The aim of this study is primarily to identify, describe and classify the plant communities of the Villiers-Grootvlei area. It further aims to investigate the behaviour and interactions of vegetation with regard to the environment (Edwards 1972; 1979) and to organize the vegetation in a system with maximum predictability. The study site was chosen as a key area for effective extrapolation to surrounding areas, as the area represents a link between the western and eastern parts of the Grassland Biome. Previously the classification of the Bb, Ib and Ba Land Types (Breytenbach et al. a, b, c (in prep.)) were given

while in this publication report is given of the Ca and Ea Land Types.

STUDY AREA

The 2628DC GROOTVLEI topocadastral map (1:50 000) was used as the basemap for the study.

The study area is situated between 26°45'S and 27°00'S and between 28°30'E and 28°45'E. The area occupies an area of ± 690 km² (70 000 ha), in the vicinity of Grootvlei, southern Transvaal, while a small area adjacent to Villiers in the northern Orange Free State is also included (Figure 1).

A detail description of the physical environment of the study area is given by Breytenbach et al. a. (in prep.).

METHODS

The Zürich-Montpellier phytosociological approach (Braun-Blanquet 1932; Werger 1974) and the PHYTOTAB program package (Westfall et al. 1982) was used to define and describe the different plant communities as this is the most popular and acceptable method presently used in South Africa (Bredenkamp 1975; Van Rooyen 1978). The Rangeland Ecology Section of the Grassland Research Centre (Department of Agricultural Development) is an advocator of this approach. The fact that many other researchers in the Grassland Biome (Bredenkamp 1975; Deall 1985; Bezuidenhout 1988; Bloem 1989; Turner 1989; Kooij 1990) succesfully used this approach, contributes to it's selection. Furthermore the compatibility of results obtained by this methodology ensures a succesfull ultimate sinthesis of all grassland types into an appropriate synecological and syntaxonomical system.

The vegetation was sampled by using random stratified sub-quadrats. Experiments during the reconnaissance phase of the study area revealed that adequate information may be obtained

with the sub-quadrat method, in terms of time and energy spent. A stratified random method was used for the location of the sample plots. The sub-quadrats were rectangular with the sides in the proportion of one to two, since this is more effective than square quadrats (Oosting 1956; Cain & Castro 1959). In according with Turner (1989) the sub-quadrats 3 m x 1,5 m were placed until there was an increase in species of less than 10%. During the study a minimum of three sub-quadrats per sample plot was maintained, representing a minimum area of 13,5 m². The position of the sample plots were objectively chosen by using random numbers which were generated by computer. The floristic survey included all recognisable species during the time of the survey, with Braun-Blanquet cover-abundance values (Werger 1974) for each species. Additionally basal cover of the grassland communities and crown cover of the shrubland communities was estimated.
The species names used are given by Myburgh et al. (in prep.) and is arranged according to Gibbs Russell et al. (1985; 1987).

The Ea Land Type occupy 38 500 ha and the Ca Land Type 1 400 ha of the total study area (Figure 2). The dominant soils of the Ea Land Type are of the Avalon, Arcadia, Rensburg and Bonheim Forms and of the Ca Land Type are of the Kroonstad, Westleigh, Bonheim and Arcadia Forms (MacVicar et al. 1977). The predominantly geology of the Ea Land Type is shale, sandstone, dolorite, alluvium and grit of the Ecca Group, Karoo Sequence. The predominantly geology of the Ca Land Type is Aeolian sand, shale, sandstone and grit. The dominant terrain units of the Ea Land

Type are terrain unit 3 (60% of the area) within the slope class 2-8% and terrain unit 1 (30% of the area) within the slope class 2-5% (Land Type Survey Staff 1985). The dominant terrain units of the Ca Land Type are terrain unit 1 (50% of the area) within the slope class 0-3% and terrain unit 3 (35% of the area) within the slope class 2-4%. The average rainfall of the Ea Land Type is 670,3 mm and of the Ca Land Type it is 631,5 mm (Land Type Survey Staff 1985). The area of the Ea and Ca Land Types as well as the time available determined the number of sample plots. Seventy seven sample plots were compiled in the Ea Land Type (Figure 2) and four sample plots in the Ca Land type.

RESULTS

The vegetation of the Ca Land type is not presented in a seperate phytosociological table as there are only four relevés. The vegetation on this Land Type can be described as a *Pogonarthria squarrosa-Aristida congesta* Grassland with *Pogonarthria squarrosa, Aristida congesta* and *Cynodon dactylon* as the dominant grass species and *Elephanthorhiza elephantina* as the dominant shrublet. The grassland occurs on deep (>1 200 mm) sandy soils of the Clovelly form. The grassland is situated at an altitude of 1 500 m above mean sea level on slopes with an inclination of 0-1°, on terrain units 3 and 4. There is no above ground rock in this grassland. An average of 17 species per sample plot was recorded.

The vegetation of the Ea Land Type occurs in two habitats namely high-lying and low-lying areas.

A. The low-lying vegetation of the Ea Land Type: the *Themeda triandra-Eragrostis curvula* Grassland.

The vegetation of the low-lying areas of the Ea Land Type can be described as a *Themeda triandra-Eragrostis curvula* Grassland. The species in this grassland with high cover values are *Themeda triandra, Eragrostis curvula, Cynodon dactylon, Setaria sphacelata* and *Aristida congesta* (Species group O, Table 1). An average of 19 species per sample plot was recorded. This grassland community occurs on red and yellow soils of the Clovelly, Westleigh, Bonheim, Pinedene, Bainsvley, Avalon and Hutton forms (MacVicar et al. 1977), brown to dark brown soils of the Valsrivier, Katspruit and Mispah forms (MacVicar et al. 1977) and on black vertic soils of the Arcadia and Rensburg forms (MacVicar et al. 1977). The soil depth varied between 150 mm and 1 200 mm and the clay content from 0-6% to more than 55%. The grassland is situated at an altitude of 1 500 m to 1 600 m above mean sea level on slopes with an inclination of 0-4°, on terrain units 3, 4 and 5 (Figures 3 and 4) . The above-ground rock cover in this grassland varies between 0% and 20%. There are no shrubs or trees present in this grassland.

The *Themeda triandra-Eragrostis curvula* Grassland is divided into five communities and seven sub-communities namely (Table 1; Figure 4):

1.1 *Eragrostis curvula-Pogonarthria squarrosa* Grassland

1.2 *Themeda triandra-Elionurus muticus* Grassland

1.2.1 *Themeda triandra-Digitaria ternata* Grassland

1.2.2 *Themeda triandra-Pseudognaphalium luteo-album* Grassland

1.2.3 *Themeda triandra-Urginea* sp. Grassland

1.2.4 *Themeda triandra-Brachiaria serrata* Grassland

1.2.5 *Eragrostis curvula-Felicia fascicularis* Grassland

1.3 *Themeda triandra-Chaetacanthus burchellii* Grassland

1.3.1 *Themeda triandra-Chloris virgata* Grassland

1.3.2 *Themeda triandra-Aristida bipartita* Grassland

1.4 *Eragrostis curvula-Schoenoplectus decipiens* Grassland

1.5 *Eragrostis curvula-Eragrostis plana* Grassland

1.1 The *Themeda triandra-Pogonarthria squarrosa* Grassland

The *Themeda triandra-Pogonarthria squarrosa* Grassland occurs mainly on sandy (0-6% clay) soils of the Clovelly, Avalon and Hutton forms (MacVicar et al. 1977) with parent material that consist of Aeolian sand (Qw), sandstone and shale (Pv). The community is situated at an altitude of 1 500 m to 1 540 m above mean sea level on slopes with an inclination of 0-2° on relatively upland sites in the undulating terrain (terrain units 1, 3 and 4). No above-ground rock cover occurs in this community. An average of 18 species per sample plot was recorded.

The community is characterised by the diagnostic species *Pogonarthria squarrosa, Aristida junciformis, A. sciurus, Stipagrostis zeyheri* and *Kohautia amatymbica* (Species group A, Table 1), all typical of the more sandy soils. Dominant grasses in the community are *Eragrostis curvula, Aristida congesta, Cynodon dactylon* and *Setaria sphacelata* (Species group O, Table 1). Species such as *Trichoneura grandiglumis, Aristida bipartita, Eragrostis gummiflua, Solanum panduriforme, Crassula lanceolata, Commelina africana, Bulbostylis contexta* and *Solanum supinum* also occur in the community (Table 1). Of interest is the absence of near hygrophilous species such as *Eragrostis plana* and *Berkheya pinnatifida*, which are often associated with wet bottomland situations. The occurrence of *Cynodon dactylon* and several *Aristida* species is proof of veld degradation. There are no

shrubs or trees in the community. The mean basal cover of the herbaceous layer is 11%.

1.2 The *Themeda triandra-Elionurus muticus* Grassland

The *Themeda triandra-Elionurus muticus* Grassland occurs on red and yellow clayey soils of a variety of soil forms, from a variety of parent materials. The community is situated at an altitude of 1 500 m to 1 600 m above mean sea level on slopes with an inclination of 0-4°, usually on lower slopes or bottomland sites, on terrain units 3 and 4. The habitat is generally (seasonally) more moist than that of community 1.1. The above-ground rock cover varies between 0% and 20%.
The community is characterised by the diagnostic species *Elionurus muticus* and *Microchloa caffra* (Species group B, Table 1). Species of Species groups C, D, E, F, G and H (Table 1) are also present in the community, but are diagnostic for sub-communities within this community. Dominant grasses in the community are *Themeda triandra, Eragrostis curvula, Cynodon dactylon, Setaria sphacelata, Aristida congesta, Brachiaria serrata, Eragrostis racemosa, E. plana* and *Heteropogon contortus* (Table 1). The most constant forbs in the community are *Hermannia depressa* and *Crabbea acaulis* (Table 1). There are no trees or shrubs in this community.

1.2.1 The *Themeda triandra-Digitaria ternata* Grassland

The *Themeda triandra-Digitaria ternata* Grassland occurs on black clayey soils of the Arcadia and Rensburg forms (MacVicar et al. 1977) with a soil depth of 300 mm to 1 200 mm and a clay content of more than 55%. The parent material of the soils is sandstone,

shale (Pv) and dolerite (Jd). The community is situated on the bottomland sites of terrain unit 4 (Figure 3 and 4). In this community above-ground rock is absent. An average of 19 species was recorded per sample plot.

The community is characterised by the diagnostic species *Chaetacanthus costatus, Evolvulus alsinoides, Panicum coloratum, Digitaria ternata* and *Aristida stipitata* (Species group C, Table 1). Dominant grasses in the community are *Themeda triandra, Eragrostis curvula, Cynodon dactylon, Brachiaria serrata* and *Eragrostis plana* (Table 1). Prominent forbs in the community are *Berkheya pinnatifida* and *Crabbea acaulis* (Table 1). The species of species groups B, E, G and N may also be present in this community (Table 1). The mean basal cover of the herbaceous layer is 11%.

1.2.2 The *Themeda triandra-Pseudognaphalium luteo-album* Grassland

The *Themeda triandra-Pseudognaphalium luteo-album* Grassland occurs on red and yellow soils of the Westleigh, Clovelly, Bainsvley, Pinedene and Hutton forms (MacVicar et al. 1977) with a clay content that varied between 15% and 35%. The soil depth in the community varied between 200 mm and 1 200 mm. In the community there are single occurrences of soils of the Arcadia and Katspruit forms (MacVicar et al. 1977). The parent material of these soils consists of dolerite (Jd), sandstone, shale (Pv), basaltic lava, agglomerate, tuff (Rk), quartzite and greywacke (Rjo). The community is situated on terrain units 3 and 4 (Figure 3 and 4). The above-ground rock cover in the community varies between 0% and 5%. An average of 21 species was recorded per sample plot .

The community is characterised by the diagnostic species *Salvia*

repens, Solanum panduriforme, Trichoneura grandiglumis and *Pseudognaphalium luteo-album* (Species group D, Table 1). Dominant grasses in the community are *Themeda triandra, Eragrostis curvula, Cynodon dactylon, Setaria sphacelata, Brachiaria serrata, Eragrostis racemosa, Aristida diffusa, Heteropogon contortus* and *Eragrostis plana*. Prominent forbs in the community are *Abildgaardia ovata, Trifolium africanum, Hermannia depressa* and *Crabbea acaulis* (Table 1). Species group E (Table 1) represents the common species for the *Themeda triandra-Digitaria ternata* Grassland (1.2.1) and the *Themeda triandra-Pseudognaphalium luteo-album*.Grassland, indicating some floristic relationship between these communities. The mean basal cover of the herbaceous layer is 10%.

1.2.3 The *Themeda triandra-Urginea* sp. Grassland

The *Themeda triandra-Urginea* sp. Grassland occurs on red and yellow soils of the Pinedene and Bainsvley forms (MacVicar et al. 1977) with a clay content of 25-35%. The soil depth in the community varied between 650 mm and 780 mm. The parent material of these soils is mainly Aeolian sand (Qw). The community is situated on terrain unit 4 (Figure 3 and 4). In the community there is no above-ground rock present. An average of 19 species was recorded per sample plot.

The community is characterised by the diagnostic species *Urginea* species, *Eragrostis* species, *Mariscus* species and *Cyanotis speciosa* (Species group F, Table 1). Dominant grasses in the community are *Themeda triandra, Eragrostis curvula, Setaria sphacelata, Elionurus muticus, Microchloa caffra, Eragrostis racemosa, Heteropogon contortus* and *Eragrostis plana* (Table 1). A constant forb in the community is *Hermannia depressa* (Table 1).

Species of Species groups B, G, I and N (Table 1) are also present in this community. The mean basal cover of the community is 13%.

1.2.4 The *Themeda triandra-Brachiaria serrata* Grassland

As the *Themeda triandra-Digitaria ternata* Grassland (1.2.1), the *Themeda triandra-Brachiaria serrata* Grassland occurs on dark clayey soils of the Arcadia and Rensburg forms (MacVicar et al. 1977) with a clay content of more than 55% and a depth that varied between 150 mm and 1 200 mm. Single occurrences of Mispah form soils (MacVicar et al. 1977) are also present in the community. The parent material of these soils is dolerite (Jd), sandstone and shale (Pv). This community seems to be situated at slightly raised and drier sites (beter drained) than the *Themeda triandra-Digitaria ternata* Grassland (1.2.1). This is manifested in the higher prominence of *Heteropogon contortus* and *Eragrostis racemosa* with less *Eragrostis plana*. An average of 19 species was recorded per sample plot.

This community does not have any diagnostic species but is characterised by the presence of *Brachiaria serrata* and *Eragrostis racemosa* (Species group G, Table 1) and *Chamaesyce inaequilatera* and *Aristida bipartita* (Species group L, Table 1) and the absence of Species groups C, D, E, and F (Table 1). Dominant grasses in the community are *Elionurus muticus, Heteropogon contortus, Aristida bipartita, Eragrostis plana, Themeda triandra* and *Eragrostis curvula* (Table 1). The mean basal cover of the herbaceous layer is 12%.

1.2.5 The *Eragrostis curvula-Felicia fascicularis* Grassland

The *Eragrostis curvula-Felicia fascicularis* Grassland occurs on red and brown soils of the Hutton, Katspruit, Valsrivier and Bonheim forms, and sometimes on dark clayey soils of the Arcadia and Rensburg forms or on soils of the Mispah form (MacVicar et al. 1977). The soil depth in the community varied from 260 mm to 1 200 mm and the clay content between 15% and 55%. The parent material of these soils is dolerite (Jd), sandstone and shale (Pv). The community is situated on terrain units 3 and 4 (Figure 3 and 4). The above-ground rock cover varies between 0% and 20%. This community occurs on a drier habitat than the other sub-communities of the *Themeda triandra-Elionurus muticus* Grassland (1.2). An average of 18 species was recorded per sample plot.

The community is characterised by the diagnostic species *Felicia fascicularis, Crassula lanceolata, Crabbea hirsuta, Dicoma anomala, Geigeria aspera, Gomphrena celosioides, Eragrostis lehmanniana* and a *Helichrysum* sp. (Species group H, Table 1). Dominant grasses in the community are *Elionurus muticus, Aristida bipartita, Eragrostis curvula, Themeda triandra, Cynodon dactylon* and *Aristida congesta* (Table 1). Prominent forbs in the community were *Hermannia depressa* and *Berkheya pinnatifida* (Table 1). The high occurrence of species such as *Aristida congesta, Felicia fascicularis* and *Gomphrena celosioides* indicate a degraded veld due to higher utilization of the more palatable species. Species of Species groups B, I, L and N (Table 1) are also present in the community. Species of Species group I (Table 1) represents the common species for the *Themeda triandra-Pseudognaphalium luteo-album* Grassland, the *Themeda triandra-Urginea* species Grassland, the *Themeda triandra-Brachiaria serrata* Grassland and

the *Eragrostis curvula-Felicia fascicularis* Grassland. No shrubs or trees occur in the community. The mean basal cover of the herbaceous layer is 9%.

1.3 The *Themeda triandra-Chaetacanthus burchellii* Grassland

The *Themeda triandra-Chaetacanthus burchellii* Grassland occurs mainly on dark clayey bottomland soils of the Arcadia and Rensburg forms (MacVicar et al. 1977) with a clay content of more than 55% and a soil depth that varies from 390 mm to 1 200 mm. The parent material of these soils consists of dolerite (Jd), sandstone and shale (Pv). Single occurrences of soils of the Pinedene form are also present in the community. The community is situated at an altitude of 1 500 m to 1 540 m above mean sea level on slopes with an inclination of 0-2° on terrain units 4 and 5 (Figure 3 and 4). The above-ground rock cover in the community varies between 0% and 5%. An average of 22 species was recorded per sample plot.

The community is characterised by the diagnostic species *Anthospermum pumilum, Chaetacanthus burchellii* and *Rhynchosia totta* (Species group J, Table 1). Dominant grasses in the community are *Chloris virgata, Aristida bipartita, Eragrostis plana, E. curvula, Themeda triandra, Cynodon dactylon* and *Aristida congesta* (Table 1). Prominent forbs in the community were *Chamaesyce inequilatera, Crabbea acaulis* and *Berkheya pinnatifida* (Table 1). There are no shrus or trees in the community. The mean basal cover of the herbaceous layer is 9%.

The *Themeda triandra-Chaetacanthus burchellii* Grassland is divided in two sub-communities.

1.3.1 The *Themeda triandra-Chloris virgata* Grassland

The *Themeda triandra-Chloris virgata* Grassland occurs mainly on dark clayey soils of the Arcadia and Rensburg forms (MacVicar et al. 1977) with a clay content of more than 55% and a soil depth that varies from 390 mm to 1 200 mm. Single occurrences of soils of the Pinedene form (MacVicar et al. 1977) are also present in the community. The parent material of the soils is dolerite (Jd), sandstone and shale (Pv). The community is situated at an altitude of 1 500 m to 1 540 m above mean sea level on slopes with an inclination of 0-2° on terrain units 4 and 5 (Figure 3 and 4). The above-ground rock cover varies between 0% and 5%. An average of 25 species was recorded per sample plot.

The community is characterised by the diagnostic species *Chloris virgata, Blepharis innocua, Vigna oblongifolia, Brachiaria* sp. and *Hypoxis* sp. (Species group K, Table 1). Dominant grasses in the community are *Aristida bipartita, Eragrostis plana, E. curvula, Themeda triandra* and *Cynodon dactylon* (Table 1). Prominent forbs in the community were *Chamaesyce inaequilatera* and *Schkuria pinnata* (Table 1). The mean basal cover of the community is 9%.

1.3.2 The *Themeda triandra-Aristida bipartita* Grassland

The *Themeda triandra-Aristida bipartita* Grassland occurs on dark clayey soils of the Arcadia and Rensburg forms (MacVicar et al. 1977) with a clay content of more than 55% and a soil depth that varies between 530 mm and 1 200 mm. The parent material of the soils is dolerite (Jd), sandstone and shale (Pv). The community is situated at an altitude of 1 500 m to 1 540 m above mean sea level on slopes with an inclination of 0-2° on terrain units 4

and 5 (Figure 3 and 4). In this community above-ground rock is absent. An average of 20 species was recorded per sample plot.
The community has no diagnostic species and is characterised by the presence of *Chamaesyce inaequilatera* and *Aristida bipartita* (Species group L, Table 1) and the absence of Species group K (Table 1). Species group L (Table 1) is also present in the *Themeda triandra-Brachiaria serrata* Grassland and the *Eragrostis curvula-Felicia fascicularis* Grassland. Dominant grasses in the community are *Eragrostis plana* and *Themeda triandra* (Table 1). Prominent forbs in the community are *Crabbea acaulis* and *Bulbostylis contexta* (Table 1). The mean basal cover of the herbaceous layer is 10%.

1.4 The *Eragrostis curvula-Schoenoplectus decipiens* Grassland

The *Eragrostis curvula-Schoenoplectus* Grassland occurs on dark clayey soils of the Arcadia and Rensburg forms (MacVicar et al. 1977) with a clay content of more than 55% and a soil depth that varies between 300 mm and 1 200 mm. The parent material of the soils is sandstone, shale (Pv) and aeolian sand (Qw). The community is situated at an altitude of 1 500 m to 1 520 m above mean sea level on slopes with an inclination of 0-1° on terrain units 4 and 5. In the community above-ground rock is absent. An average of 17 species was recorded per sample plot.
The community is characterised by the diagnostic species *Schoenoplectus decipiens, Falkia oblonga, Cordylogyne globosa, Fimbristylis complanata, Crinum bulbispermum, Haplocarpha lyrata* and *Senecio* sp. (Species group M, Table 1). Dominant grasses in the community are *Eragrostis plana, E. curvula* and *Themeda triandra* and the most constant forb is *Oxalis obliquifolia* (Table 1). Species of Species group N (Table 1) is also present

in the community. The mean basal cover of the community is 10%.

1.5 The *Eragrostis curvula-Eragrostis plana* Grassland

The *Eragrostis curvula-Eragrostis plana* Grassland occurs on red and yellow soils of the Hutton and Clovelly forms (MacVicar et al. 1977) with a clay content that varied between 0-6% and 35-55% and a soil depth that varied between 400 mm and 1 200 mm. Dark clay soils of the Arcadia and Rensburg forms (MacVicar et al. 1977) with a clay content of more than 55% and a soil depth that varied from 400 mm to 1 200 mm also occur in the community. The parent material of these soils consists of dolerite (Jd), sandstone, shale (Pv) and aeolian sand (Qw). The community is situated at an altitude of 1 500 m to 1 580 m above mean sea level on slopes with an inclination of 0-3° on terrain units 4 and 5 (Figure 3 and 4). Above-ground rock is absent in this community. An average of 14 species per relevé is recorded.
The community has no diagnostic species and is characterised by the presence of *Eragrostis plana* and *Berkheya pinnatifida* (Species group N, Table 1) and the absence of species of Species groups A to M (Table 1). Dominant grasses in the community are *Eragrostis curvula, Themeda triandra, Cynodon dactylon, Aristida congesta* and *Eragrostis gummiflua* (Table 1). Prominent forbs in the community are *Oxalis obliquifolia* and *Ledebouria* sp. (Table 1). The mean basal cover of the community is 10%.

B. The high-lying vegetation of Ea Land Type

The vegetation of the high-lying hills and slopes of the Ea Land Type can be described as a *Themeda triandra-Heteropogon contortus* Grassland. Species of Species group A (Table 2) represents the

common differential species for this vegetation type and species of Species group G (Table 2) is the common species for the entire Ea Land Type. The *Themeda triandra-Heteropogon contortus* Grassland occurs mainly on shallow (<300 mm) rocky soils with parent material that consists of basalt, quartzite and red hematite. This grassland is situated at an altitude of 1 520 m to 1 640 m above mean sea level on slopes with an inclination of 0-15° on terrain units 1 and 3 (Figure 5 and 6). The above ground rock cover in the grassland varies between 0% and 45%. The average number of species recorded per sample plot is 30. Dominant grasses in the grassland are *Heteropogon contortus, Brachiaria serrata, Elionurus muticus, Cynodon dactylon, Eragrostis curvula, Themeda triandra* and *Aristida congesta* (Table 2). Prominent forbs in the grassland are *Hermannia depressa, Helichrysum rugulosum, Conyza podocephala* and *Crabbea acaulis* (Table 2).

Prominent shrubs and trees in the grassland are *Diospyros lycioides, Athrixia elata, Rhus discolor, Myrsine africana, Cussonia paniculata, Euclea crispa* and the exotic encroacher *Cotoneaster pannosa* (Table 2).

The *Themeda triandra-Heteropogon contortus* Grassland is divided into two communities and one of these into two sub-communities namely:

1.1 *Diospyros lycioides-Eragrostis curvula* Shrubland

1.2 *Themeda triandra-Elionurus muticus* Grassland

1.2.1 *Themeda triandra-Trachypogon spicatus* Grassland

1.2.2 *Themeda triandra-Cymbopogon plurinodes* Grassland

1.1 The *Diospyros lycioides-Eragrostis curvula* Shrubland

The *Diospyros lycioides-Eragrostis curvula* Shrubland occurs mainly on hillcrests and slopes on shallow (<300 mm) rocky soils with andesite and hornfels as the parent material. The community is situated at an altitude of 1 600 m to 1 640 m above mean sea level on slopes with an inclination of 11-15° on terrain unit 3 (Figure 5 and 6). The above-ground rock cover in the community varies between 16% and 45%. An average of 38 species was recorded per sample plot.

The community is characterised by the diagnostic woody species *Diospyros lycioides, Felicia filifolia, Rhus discolor, Myrsine africana, Cussonia paniculata, Euclea crispa,* the shrub *Athrixia elata,* the forbes *Lippia scaberrima, Rhynchosia totta, Ipomoea crassipes, Clutia hirsuta* the geophyte *Haemanthus humilis,* the xerophytic ferns *Cheilanthes hirta* and *Pellaea calomelanos* and the exotic encroacher *Cotoneaster pannosa* (Species group B, Table 2). Dominant grasses in the community are *Heteropogon contortus, Cymbopogon excavatus, Themeda triandra* and *Eragrostis curvula* (Table 2). Prominent forbs in the community are *Conyza podocephala, Helichrysum rugulosum* and *Crabbea acaulis* (Table 2). Species of Species groups A, B, F and G (Table 2) are also present in the community. The mean crown cover of the community is 38%.

1.2 The *Themeda triandra-Elionurus muticus* Grassland

The *Themeda triandra-Elionurus muticus* Grassland occurs mainly on the uphill sites in the undulating terrain , on shallow (<300 mm) rocky soils with basalt, red hematite and quartzite as the parent material. The community is situated at an altitude of 1 520 m to

1 600 m above mean sea level on slopes with an inclination of 0-3° on terrain units 1 and 3 (Figure 5 and 6). The above-ground rock cover in the community varies between 0% and 15%. An average of 24 species per sample plot was recorded.

The community is characterised by the diagnostic species *Elionurus muticus, Cynodon dactylon, Setaria sphacelata, Ziziphus zeyheriana, Trifolium africanum, Trichoneura grandiglumis* and *Lactuca* sp. (Species group C, Table 2). Dominant grasses in the community are *Brachiaria serrata, Cymbopogon plurinodes, Aristida mollissima, Eragrostis curvula, Themeda triandra* and *Aristida congesta* (Table 2). Prominent forbs in the community are *Hermannia depressa, Conyza podocephala, Felicia fascicularis, Hermannia lancifolia, Schkuria pinnata* and *Crabbea acaulis* (Table 2). Species of Species groups A, C, D, E, F and G (Table 2) are also present in the community. The mean crown cover of the community is 61%.

The *Themeda triandra-Elionurus muticus* Grassland is divided in two sub-communities.

1.2.1 The *Themeda triandra-Trachypogon spicatus* Grassland

This sub-community is situated higher (1 560 m-1 600 m above mean sea level) than the *Themeda triandra-Cymbopogon plurinodes* Grassland (1.2.2), on terrain units 1 and upper parts of units 3. The shallow (<300 mm) rocky soils have basalt and red hematite as the parent material (Figure 5 and 6). An average of 24 species was recorded per sample plot.

The community is characterised by the diagnostic species *Trachypogon spicatus, Acalypha caperonioides, Setaria pallide-fusca, Tristachya leucothrix, Abildgaardia ovata* and *Haplocarpha scaposa* (Species group D, Table 2), all species of higher

altitude and rocky terrain. Dominant grasses in the community are *Heteropogon contortus, Brachiaria serrata, Eragrostis racemosa, Elionurus muticus, Cynodon dactylon, Setaria sphacelata, Cymbopogon excavatus, Eragrostis curvula* and *Themeda triandra* (Table 2). Prominent forbs in the community are *Berkheya setifera, Chaetacanthus costatus* and *Crabbea acaulis* (Table 2). Species of Species groups A, C, D, F and G (Table 2) are also present in the community. Species group F (Table 2) represents the common species for the *Diospyros lycioides-Eragrostis curvula* Shrubland and the *Themeda triandra-Trachypogon spicatus* Grassland, indicating a floristic and ecological relationship between these two communities. The mean crown cover of the community is 62%.

1.2.2 The *Themeda triandra-Cymbopogon plurinodes* Grassland

The *Themeda triandra-Cymbopogon plurinodes* Grassland occurs predominantly lower down on western slopes of terrain unit 3, on shallow (<300 mm) rocky soils with parent material that consists of basalt and quartzite (Figure 5 and 6). An average of 25 species was recorded per sample plot.

The community is characterised by the diagnostic species *Cymbopogon plurinodes, Felicia fascicularis, Solanum panduriforme, Schkuhria pinnata, Hermannia lancifolia, Monsonia angustifolia, Salvia repens, Solanum supinum, Tephrosia longipes, Bidens pilosa, Tagetes minuta, Sonchus nanus, Aristida mollissima, Oxalis obliquifolia* and *Pachycarpus rigidus* (Species group E, Table 2). Many of these species are of a lower ecological status, indicating the state of degradation of the vegetation, caused mainly by overgrazing and trampling by cattle and sheep. Dominant grasses in the community are *Brachiaria*

serrata, Elionurus muticus, Cynodon dactylon, Eragrostis curvula, Themeda triandra and *Aristida congesta* (Table 2). Prominent forbs in the community are *Hermannia depressa, Conyza podocephala, Ziziphus zeyheriana* and *Crabbea acaulis* (Table 2). Species of Species groups A, C, E and G (Table 2) is also present in the community. The mean crown cover of the community is 61%.

ORDINATION

The data was ordinated by using Detrended Correspondence Analysis (DECORANA) (Hill 1979). In the scatter diagram (Figure 7) there is a distinct seperation between the *Eragrostis curvula-Pogonarthria squarrosa* Grassland (A) and the other communities (B, C, D, E) of the low-lying Ea Land Type can be observed. This seperation is mainly based on geological differences were the *Eragrostis curvula-Pogonarthria squarrosa* Grassland mainly occurs on Aeolian sand and the other communities mainly on sandstone, shale and dolorite. The first two axes of the ordination may be used to illustrate the communities and environment interactions. The first axis is responsable for 76,8% (Eigen value of 0,768) and axis two for 45,3% (Eigen value of 0,453) of the variation in the data set. Although there is not a clear seperation between communities B, C, D and E (Figure 7), it can ascribed to different veld management practices as the Ea Land Type is suitable for mixed farming.

In the scatter diagram a distinct seperation between the different communities and sub-communities of the high-lying Ea Land Type can be observed (Figure 8). The first and second axes of the ordination may be used to explain the plant communities and environment interactions. The first axis is explains 73,9% (Eigen value of 0,739) and axis two 32,6% (Eigen value of 0,326)

of the variation in the data set. The relevés of the *Diospyros lycioides-Eragrostis curvula* Shrubland (A) are seperated from the *Themeda triandra-Elionurus muticus* Grassland (B, C) on the basis of inclination, altitude and geology (Figure 8). The relevés of the *Themeda triandra-Trachypogon spicatus* Grassland (B) is seperated from the relevés of the *Themeda triandra-Cymbopogon plurinodes* Grassland (C) on the basis of above-ground rock cover and the position in the landscape (Figure 8).

CONCLUSION

The vegetation of the Ea Land Type occurs in two habitat units namely the high-lying and the low-lying areas. The vegetation of the high-lying area is classified into two communities and one of these into two sub-communities, while the vegetation of the low-lying area is classified into five communities with seven sub-communities. The sub-communities are not clearly seperated, mainly because of the different management practices and this is confirmed by the DECORANA ordination. These plant communities combined with similar plant communities in the Bb, Ba and Ib Land Types (Breytenbach et al. a, b, c (in prep.)) in the study area, form management units.

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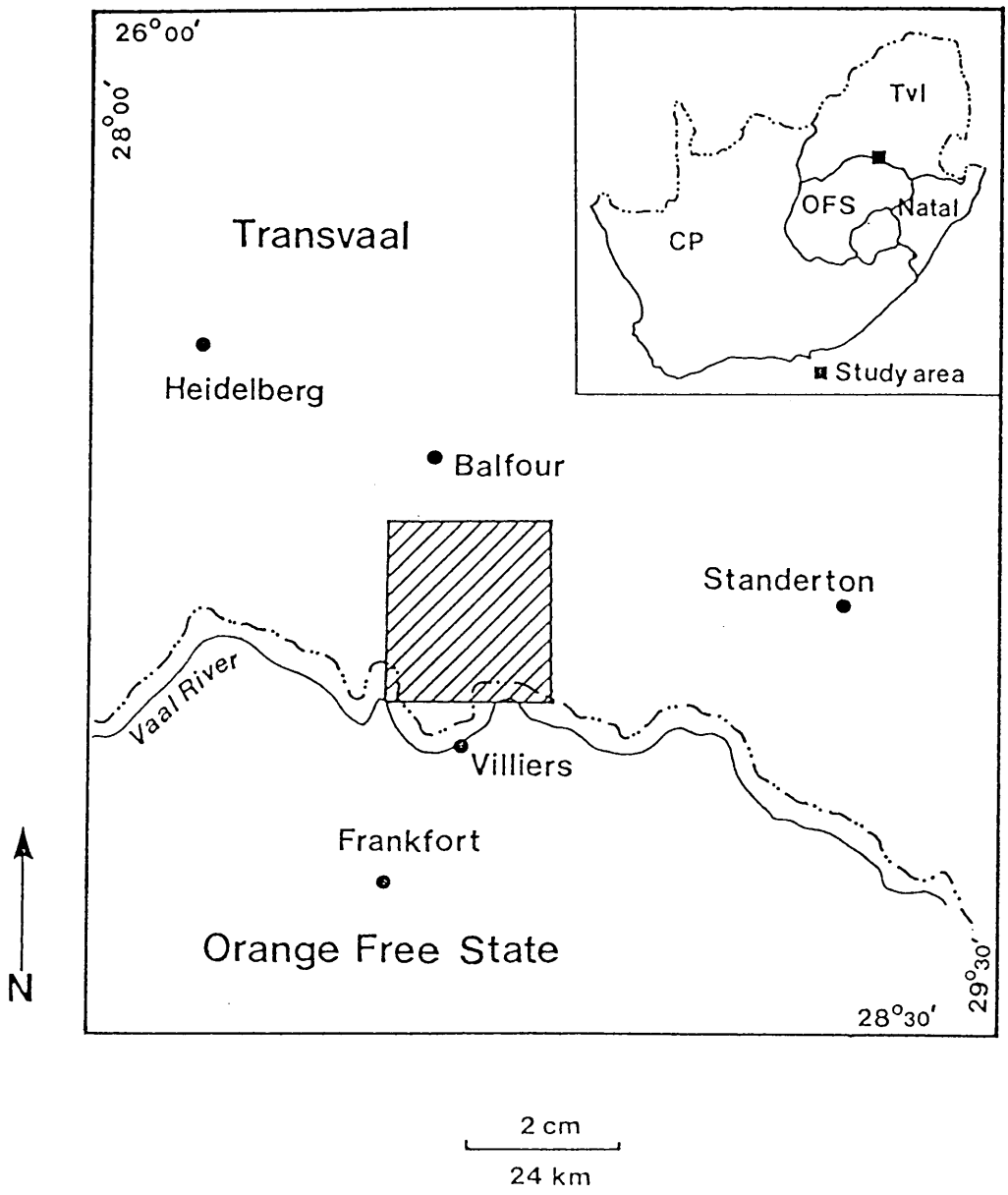


Figure 1. The location of the study area, based on the 2628 DC GROOTVLEI 1:50 000 Topocadastral map (Government Printer, Pretoria 1978).

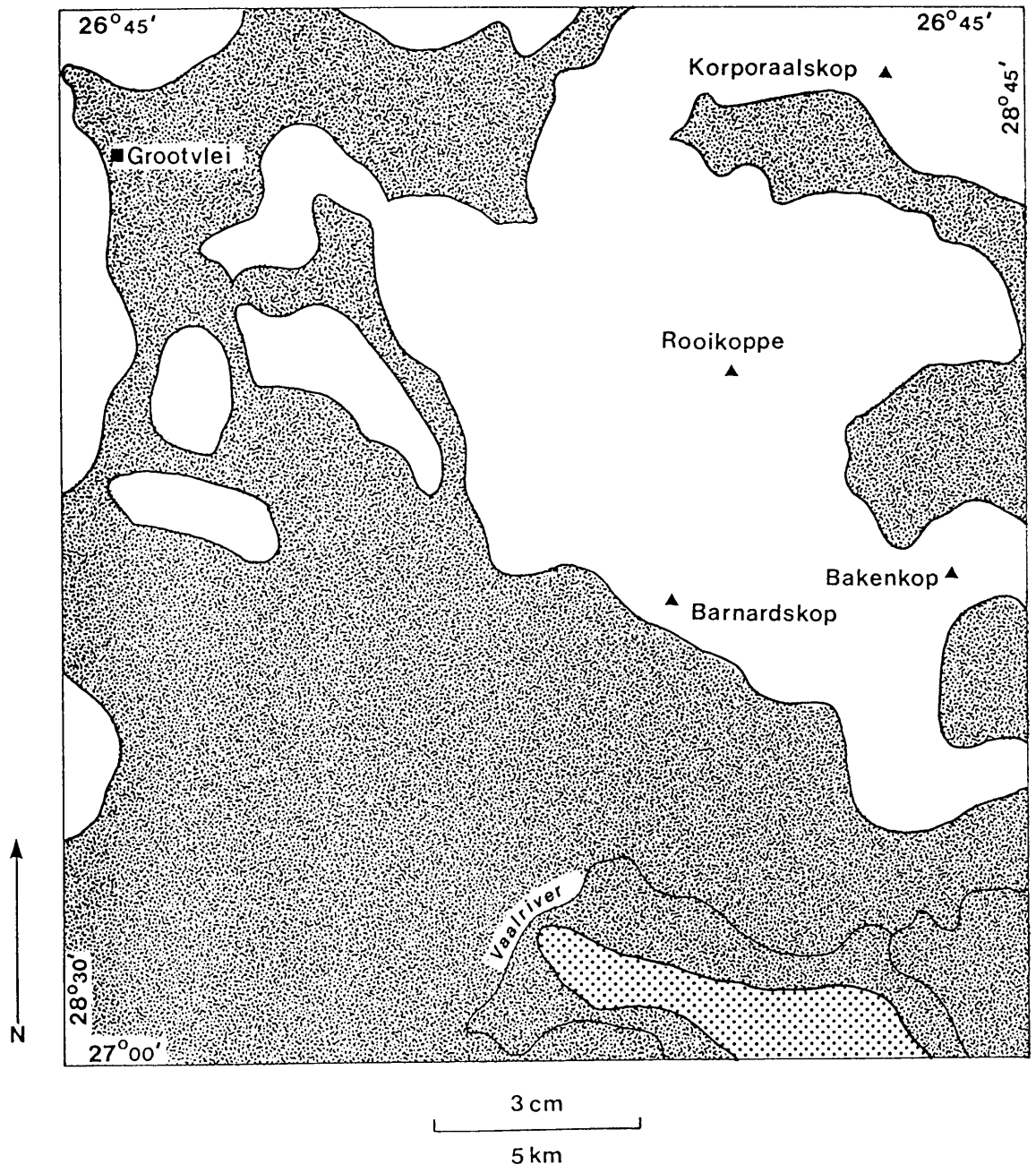


Figure 2. The location of the Ea Land Type in the study area (Land Type Survey Staff 1984).

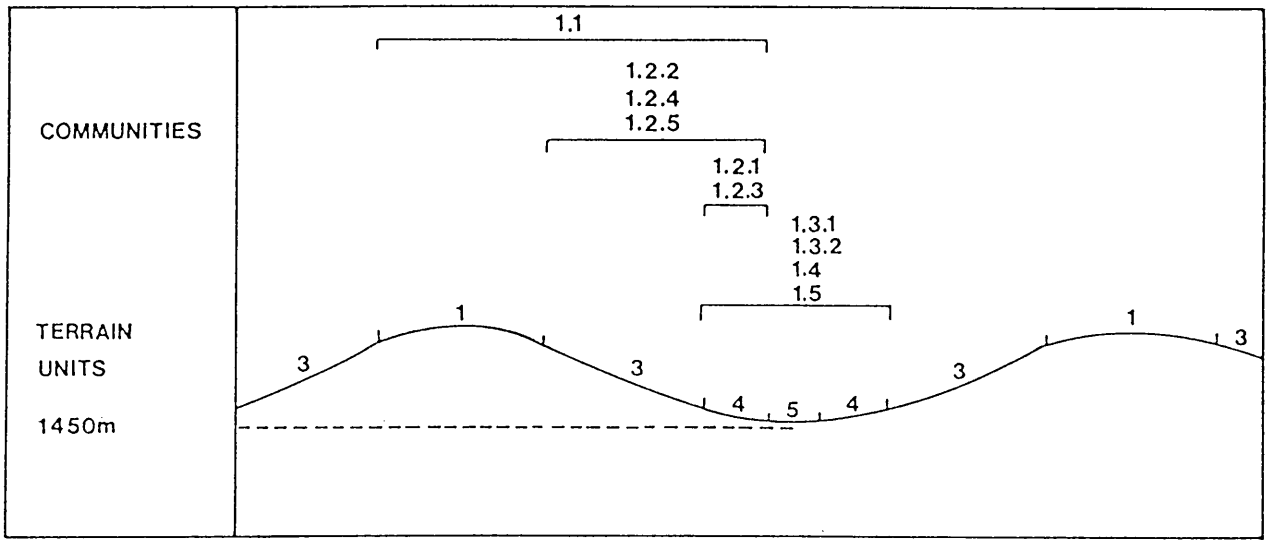


Figure 3. The location of the communities of the low-lying areas in the Ea Land Type on topographical types (see text for community names)

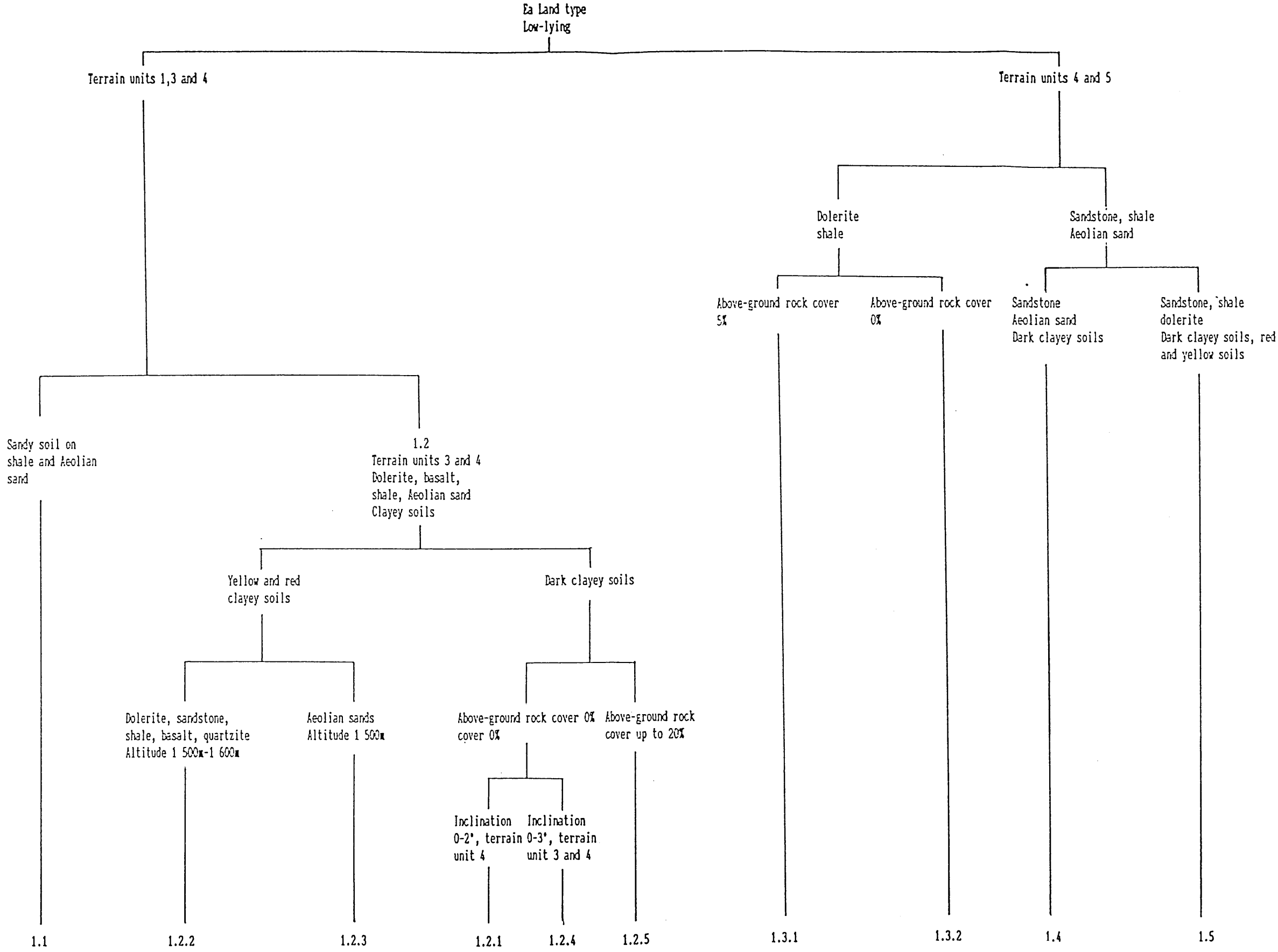


Figure 4. Dendrogram to illustrate the habitat relationships of the communities of the low-lying areas in the Ea Land Type (see text for community names).

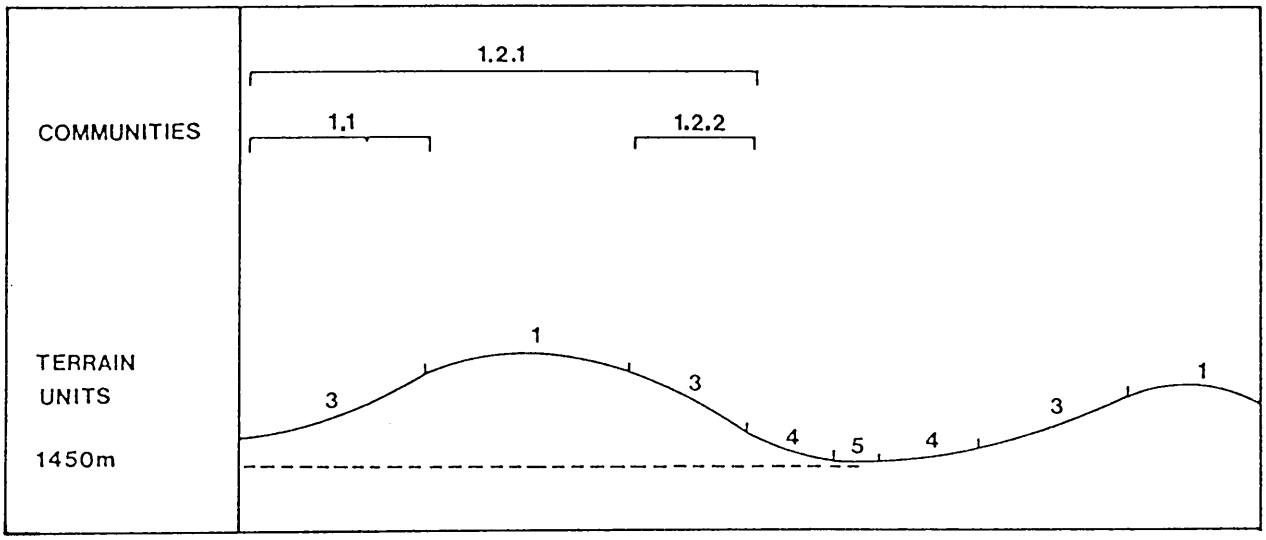


Figure 5. The location of the communities of the high-lying areas in the Ea Land Type on topographical types (see text for community names)

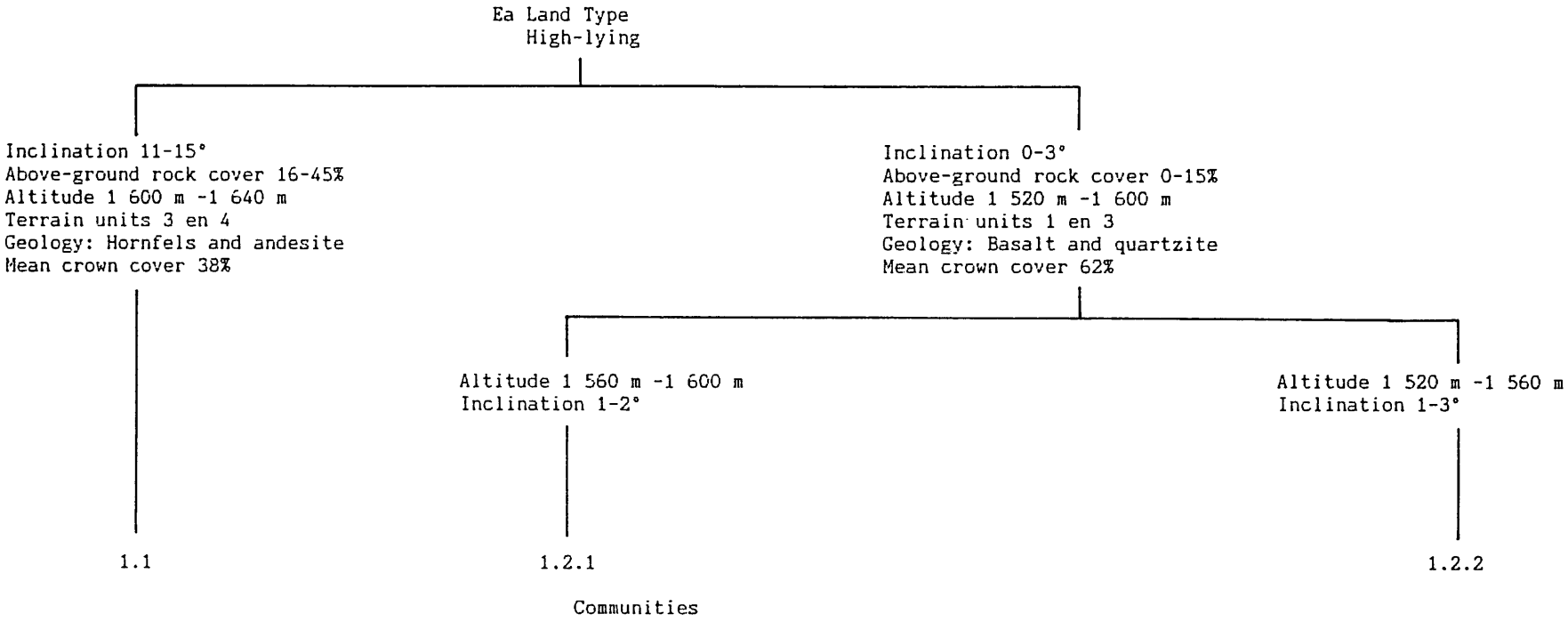


Figure 6. Dendrogram to illustrate the habitat relationships of the communities of the high-lying areas in the Ea Land Type (see text for community names)

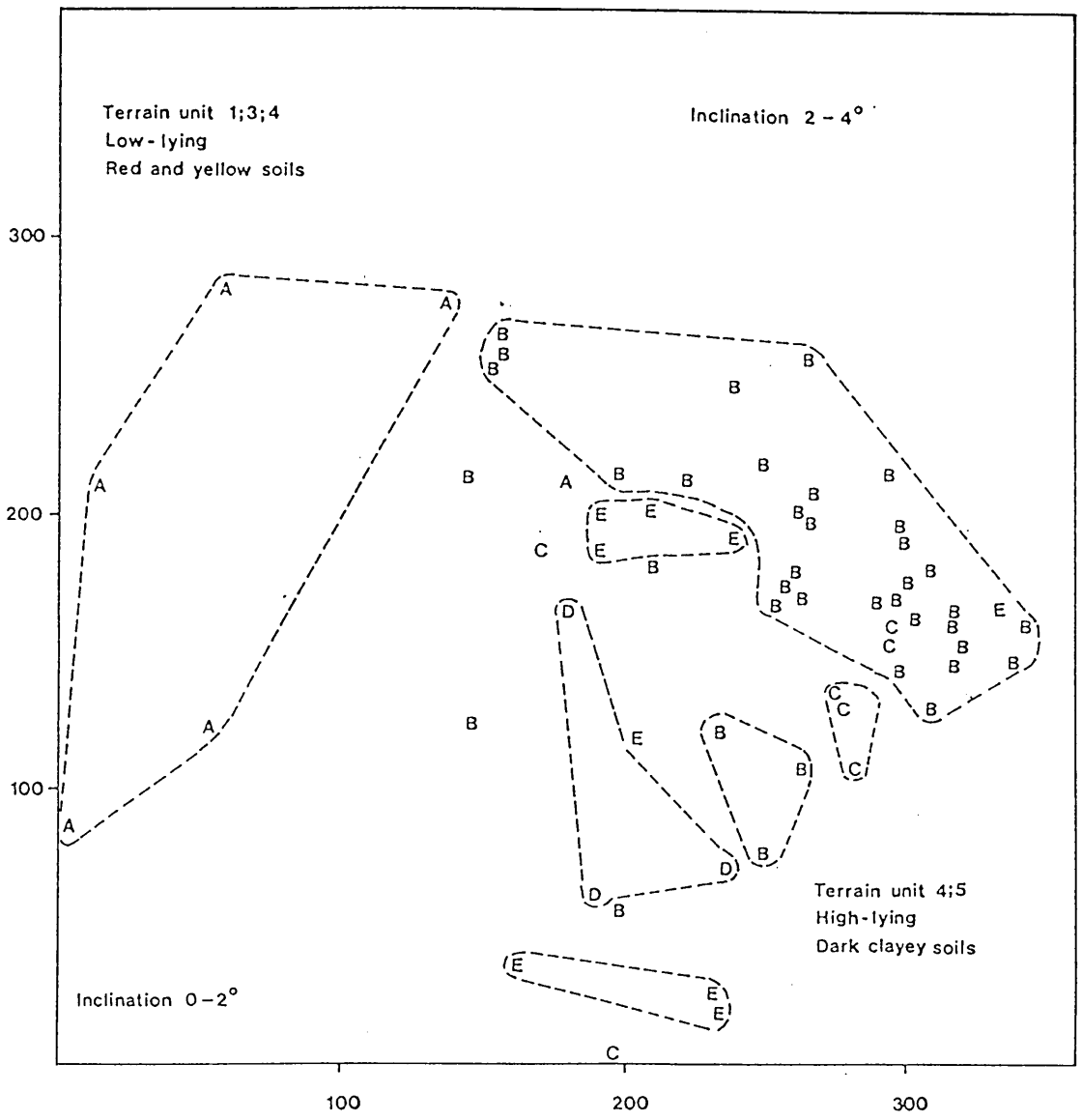


Figure 7. The DECORANA ordination of the vegetation of the low-lying area of the Ea Land Type in the Villiers-Grootvlei area, South Africa.
A - *Eragrostis curvula-Pogonarthria squarrosa* Grassland
B - *Themeda triandra-Elionurus muticus* Grassland
C - *Themeda triandra-Chaetacanthus burchellii* Grassland
D - *Eragrostis curvula-Schoenoplectus decipiens* Grassland
E - *Eragrostis curvula-Eragrostis plana* Grassland

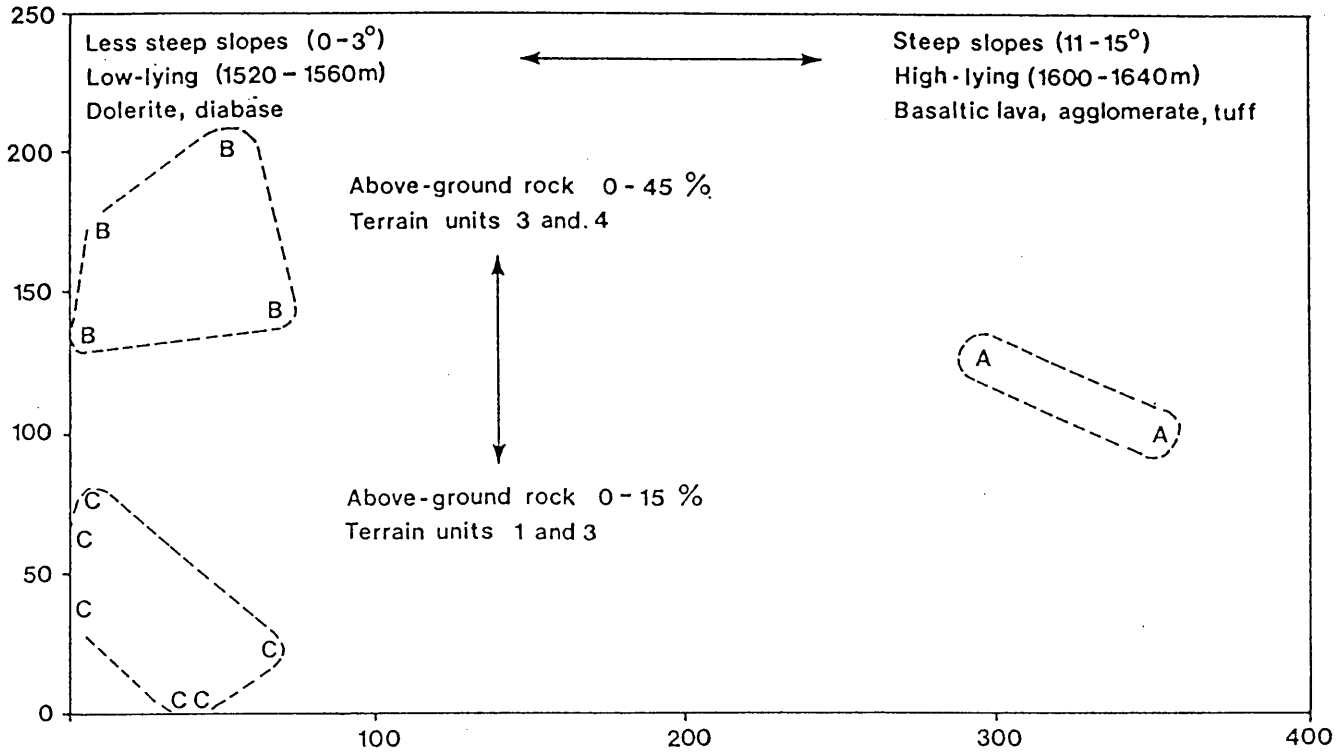
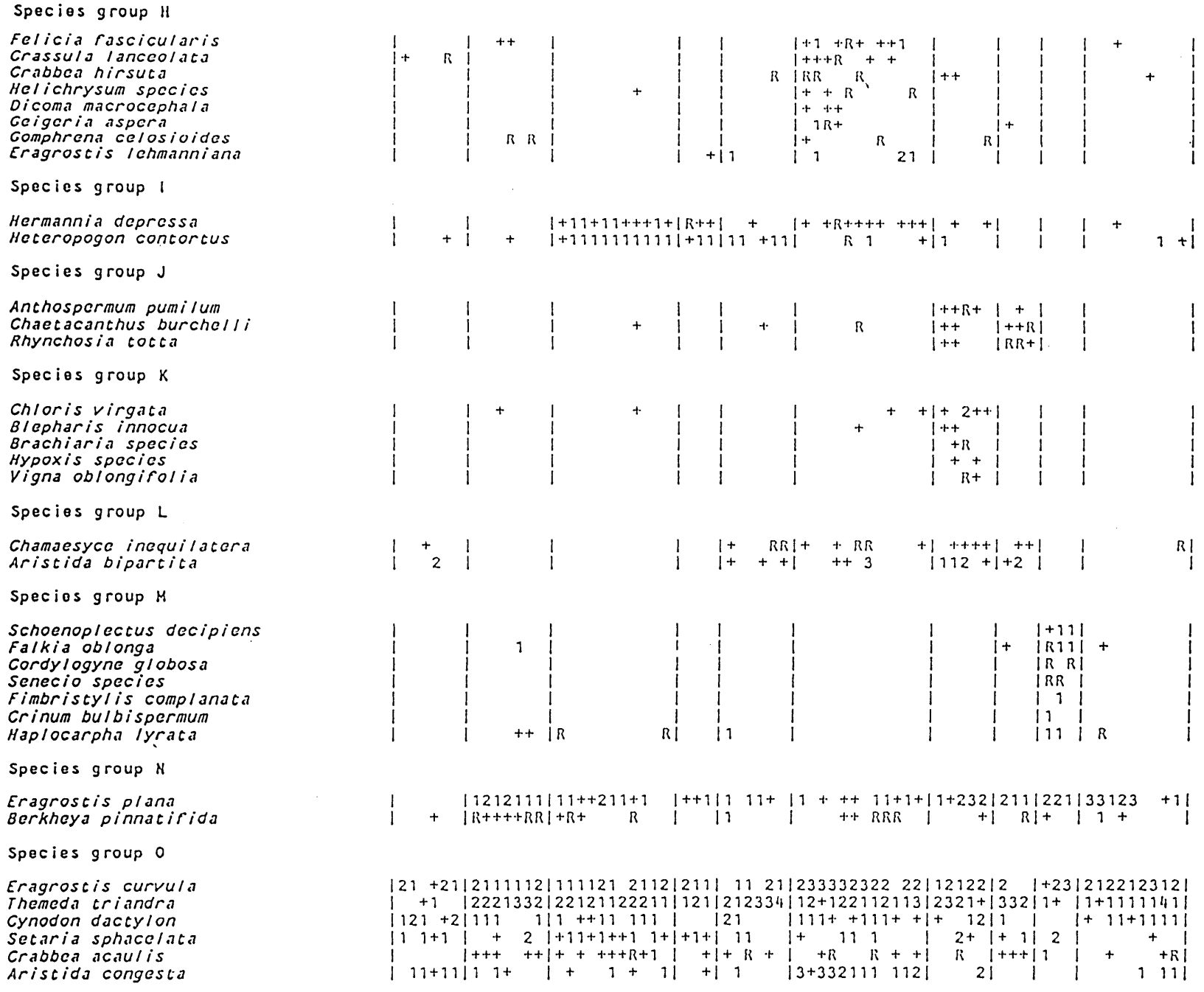


Figure 8. The DECORANA ordination of the vegetation of the high-lying area of the Ea Land Type in the Villiers-Grootvlei area, South Africa.
A - *Diospyros lycioides-Eragrostis curvula* Shrubland
B - *Themeda triandra-Trachypogon spicatus* Grassland
C - *Themeda triandra-Cymbopogon plurinodes* Grassland

Table 1. Phytosociological table of the low-lying areas of the Ea Land Type in the Villiers-Grootvlei area, South Africa.

Community number	1.1	1.2						1.3		1.4	1.5
		1.2.1		1.2.2	1.2.3	1.2.4	1.2.5	1.3.1	1.3.2		
Releve numbers	000000 111027 210838	1110011 3238902 0713826	01101010110 91090901019 72324905913		000 445 980	001000 892423 048219	000000011000 161131323553 896724152288	00000 00204 75260	000 241 019	000 676 503	000000100 585696290 193854009
Species group A											
Pogonarthria squarrosa	12 1										
Aristida junciformes	2 21										
Aristida sciurus	221						3 1				
Stipagrostis zeyheri	22										
Kohautia amatymbica	+++ +										
Species group B											
Elionurus muticus		111 11	111 111 122		121	+21+1	+1 + 1 11 1		1 2		1 1
Microchloa caffra		++	+ 1 +		111	1+	+ +1				+1
Species group C											
Chaetacanthus costatus		+++R+++	+ +				1 +		+		
Evolvulus alsinoides	+	++1 +1	+			+ +	+				R
Panicum coloratum		++ 11	1			1	1			1	
Digitaria ternata		11 1				1		+	+		
Aristida stipitata		11				1					
Species group D											
Salvia repens		+	+ R +R			+ R					1 R
Solanum panduriforme	+ R	R	R+ R			R					
Trichoneura grandiglumis	11		+ + + 1				+				1 +
Pseudognaphalium luteo-album		++	11+++								
Species group E											
Abildgaardia ovata		+ 11	++++1 +			1 ++			R		
Aristida diffusa		11	1++ 11 111								+1
Monsonia angustifolia		+R +	+ + R								R +
Trifolium africanum		+ +	+ ++1RRR			R+			R	+	R
Species group F											
Urginea species			R		111	+	1R	+			R
Eragrostis species					+11						
Mariscus species		+			11R						
Cyanotis speciosa			R +		+ R				+		



Species group P

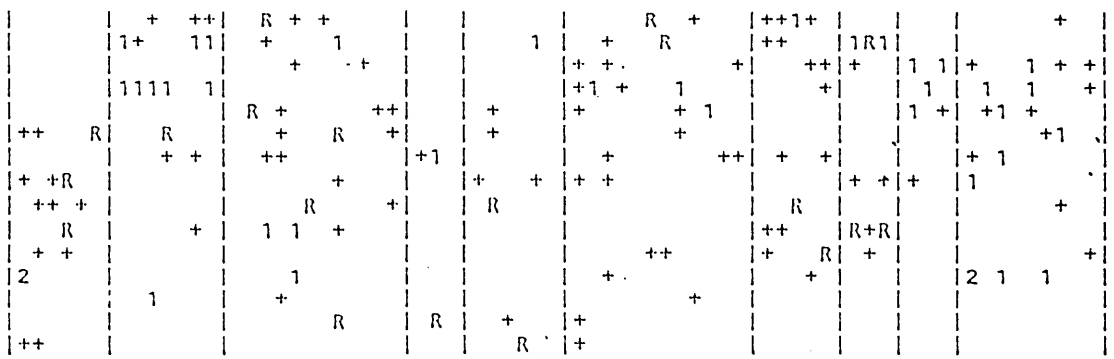


Table 2. Phytosociological table of the high-lying areas of the Ea Land Type in the Villiers-Grootvlei area, South Africa.

Community number	1.1	1.2		
		1.2.1	1.2.2	
Releve numbers	22 43 07	2211 1240	222222 000001 234560	
Species group A				
Heteropogon contortus	21	+111	1	1
Hermannia depressa	+	+ 1	1+++	1+
Helichrysum rugulosum	1+	++	+R+R	+
Brachiaria serrata	1	+11	++++	
Conyza podocephala	+2	+	++++	R
Eragrostis racemosa	1	+ 1+		+
Stoebe vulgaris	R	+	++	
Commelina africana	+	R	+ +	
Species group B				
Diospyros lycioides	+3	+		
Felicia filifolia	22			
Athrixia elata	2+			
Cheilanthes hirta	++	+		
Pellaea calomenalos	++			
Rhus discolor	++			
Myrsine africana	+R			
Lippia scaberrima	+R			
Rhynchosia totta	+R			
Haemanthus humilis	RR			
Ipomoea crassipes	+1	R		
Cussonia paniculata	1			
Euclea crispa	4			
Clutia hirsuta	2			
Cotoneaster pannosus	1			
Species group C				
Elionurus muticus		221	121	111
Cynodon dactylon		++1	1 11	+
Setaria sphacelata		+ 11		1+
Ziziphus zeyheriana		+ ++	+ ++	
Lactuca species		++	R+++	
Trifolium africanum		++	R ++	R
Trichoneura grandiglumis		+	+ +	
Species group D				
Trachypogon spicatus		111		+
Acalypha caperonioides		11	+	
Setaria pallida-fusca		+1		
Tristachya leucothrix		+ 1		
Abildgaardia ovata		+1		
Haplocarpha scaposa		R+		
Species group E				
Cymbopogon plurinodes			++	+1+
Felicia fascicularis			+	++++
Solanum panduriforme			+	+++
Schkuhria pinnata	+			+++R+
Hermannia lancifolia		+	++	++
Monsonia angustifolia			+ 1	+
Salvia repens			1+	+
Solanum supinum		R	+ +	+
Tephrosia longipes			R++	
Bidens pilosa	1		+R+	
Tagetus minuta	+		+ +	R
Sonchus nanus			+	R+
Aristida mollissima		+	1	1
Oxalis obliquifolia	+		+	R
Pachycarpus rigidus		R		RR

Species group F

Cymbopogon excavatus	1	1	+		1	1						
Berkheya setifera	+	+	+	+	R	+						
Argyrolobium velutinum	+	+	+	+								
Indigofera obscura	+	R	+	+								
Chaetacanthus costatus	+		+			1						
Helichrysum nudifolium	R		+	+					+	R		
Rhus rigida	+		R	R								

Species group G

Eragrostis curvula	1	2	1	1	1		2	1	2	1	1	2
Themeda triandra	1	1	2	1	1	2	2	1	2	2	2	2
Crabbea acaulis	+	+	+	+	+	+	+	+	+	+	+	+
Aristida congesta		+	+		1		1	1		1	1	2

Species group H

Digitaria eriantha						1						
Ehrharta erecta	+											
Microchloa caffra										+		
Eragrostis plana										1		
Berkheya pinnatifida									+	R		
Crassula lanceolata	+											
Eragrostis lehmanniana				+								
Aristida diffusa						1						
Ledebouria species					+							
Hyparrhenia hirta				1								
Pseudognaphalium luteo-album									+			
Vernonia oligocephala												+
Aristida transvaalensis		+						1				
Setaria nigrirostris	1							1				
Garuleum woodii												
Gladiolus species		R										
Aloe transvaalensis				+								
Maytenus heterophylla				+								
Schistostephium crataegifolium	1											
Hypoxis argentea	1											
Alternanthera pungens												R
Berkheya radula											R	
Cucumis zeyheri												R
Helichrysum callicomum									+			
Hypoxis obtusa									+			
Ledebouria ovatifolia												R
Urochloa panicoides							+					
Vernonia natalensis							+			+		
Anthericum cooperi						+						
Dicoma zeyheri					R							
Diheteropogon amplectans				+								
Helichrysum cerastioides				R								
Ledebouria revoluta			R									
Rhynchelytrum repens				+								
Clematis oweniae		+										
Protasparagus setaceus		+										
Senecio venosus	+											

HOOFSTUK 9

Die fitososiologie van die vlei-gebiede in die Grootvlei-omgewing, Suid Transvaal.

W.J. Myburgh*, P.J.J. Breytenbach*, G.K. Theron** & G.J. Bredenkamp**

Keywords: Braun-Blanquet, Grootvlei area, Wetlands.

UITTREKSEL

Die plantegroei van die vlei-gebiede in die Grootvlei-omgewing is fitososiologies ondersoek. 'n Totaal van 44 relevés is numeries (TWINSPAN) geklassifiseer deur gebruik te maak van Braun-Blanquet prosedure. Daar is agt plantgemeenskappe onderskei. 'n DECORANA ordening bevestig die plantegroei-eenhede met geassosieerde omgewingsgradiënte. Individuele vleie is betreklik arm aan plantspesies, tog is daar groot variasie in spesiesamestelling tussen verskillende vleie.

ABSTRACT

The phytosociology of the wetlands in the Grootvlei area is presented. The results of a numerical classification (TWINSPAN) of 44 relevés were defined by Braun-Blanquet procedures. The classification revealed eight vegetation units. A DECORANA ordination confirms the vegetation units with associated environmental gradients. Although wetlands have a low species composition there are a significant difference between plant species of the different wetlands.

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INLEIDING

Die noord oostelike-gedeelte van die Hoëveldstreek, naamlik Heidelberg substreek, beslaan 'n totale oppervlak van 2 433 000 ha waarvan 1 237 600 ha onder bewerking is (Landbou-ontwikkelingsprogram 1986). Die oorblywende natuurlike weiveld is beperk tot die rante en koppies met vlak litosols en die laagliggende gebiede, dreineringsbane en vleie met periodies waterversadigde vertiese kleie.

Die vleigebiede wat vleie, panne en vloedvlaktes insluit verskil fisionomies opvallend van die Bankenveld (Veldtipe 61) en is geleë in die Cymbopogon-Themeda -veld (Veldtipe 48), die Themeda -veld (Veldtipe 52) en die Gemengde Themeda -veld na Cymbopogon-Themeda -veld, oorgangstipe (Veldtipe 53) (Acocks 1988).

Die identifikasie, floristiese klassifikasie en waardebepaling van die vleigebiede in Suid-Afrika is van uiterste belang (Siegfried 1970, Le Roux 1972, Zaloumis & Milstein 1975, Geldenhuis 1982). Vleigebiede is hoogs sensitief vir menslike versteuring en dikwels floristies in 'n swak toestand weens vertrapping en beweiding deur skape en beeste.

Die doel van die studie is om die floristiese samestelling en omgewingsinteraksies van die vleigebiede in die Grootvlei-distrik te bestudeer, om die plantegroei en omgewingsverhoudings te toon en te organiseer en om die plantegroei in homogene eenhede of plantgemeenskappe te klassifiseer.

STUDIEGEBIED

Die studiegebied is geleë in die omgewing van Grootvlei, suidelike Transvaal, asmede 'n beperkte terrein aangrendend aan die Vaalrivier by Villiers in die noordelike Oranje-Vrystaat (Figuur 1). Die gebied is deel van die Grasveldbioom. Die gebied is tussen 26 45' en 27 00' suiderbreedte en 28 30' en 28 45' oosterlengte geleë. Die vleigebiede varieer in hoogte bo seespieël vanaf 1 500 m tot 1 600 m en beslaan 'n totale oppervlak van ongeveer 596 ha.

Die studiegebied sorteer in die Cwb sone volgens die klimatologiese klassifikasie van Köppen (Schulze & Mcgee 1978). Die Cwb sone word gekenmerk aan 'n warm gematigde klimaat gedurende die somer met 'n koue en droë winterseisoen. Langtermyn reënvalstatistieke toon aan dat die gemiddelde jaarlikse reënval by Villiers-weerstasie 635 mm is, terwyl die Heidelberg- en Standerton-weerstasies onderskeidelik gemiddeld 699 mm en 705 mm reën per jaar ontvang. 'n Omvattende beskrywing van die fisiese omgewing van die studiegebied word weergegee in Breytenbach et al. (in prep.).

Die vleigebiede word aangetref in die Bb- en Ea-landtipes (Van der Bank et al. 1978). Die geologie van dié twee landtipes bestaan oorwegend uit die Opeenvolging Karoo met sandsteen, grintsteen, skalie en dolerietdagsome. Die laerliggende gebiede van die Bb- landtipe (Terreineenhede 4 & 5, Figuur 2) word gewoonlik deur die Bonheim-, Valsrivier-, Arcadia- en Rensburg-grondvorms gedomineer (Landtipe opname personeel 1985). Laaglande (Terreineenhede 4 & 5, Figuur 2) in die Ea- landtipe word

gekenmerk deur die margalitiese waterversadigde gronde van die Willowbrook-, Sterkspruit-, Estcourt-, Rensburg- en Arcadia-vorms (Landtipe opname personeel 1985).

METODES

Die floristiese samestelling wat by elke monsterperseel aangeteken is, is op die Zurich-Montpellier fitososiologiese benadering (Braun Blanquet 1932; Werger 1974) gebasseer. Die vleigebiede is maklik herkenbaar op lugfotós en verskil fisionomies opvallend van die omringende grasveld.

Gedurende 1989 is 'n totaal van 44 monsterpersele elk met 'n oppervlak van 16m (4m x 4m) uitgeplaas. Al die identifiseerbare spesies is aangeteken en versamel. Daar is ook 'n bedekkings-getalsterktewaarde toegeken volgens die Braun-Blanquet bedekkingsgetalsterkteskaal (Werger 1974).

Die taksa is volgens Gibbs-Russel et al. (1985 & 1987) benaam en saamgevat in 'n floristiese analise en spesielys (Myburgh et. al. in prep.). Habitatdata wat ingesamel is sluit in hoogte bo seespieël, die aan of afwesigheid van water, waterdiepte en die pH van die water. Die grondklassifikasie is verkry van die 1:50 000 2628DC Grootvlei bodemkaart (Van der Bank et al. 1978).

Twinspan (Hill 1979), 'n politetiese verdelingstegniek, is gebruik om die data in tabelvorm op te stel, waarna die tabel verder verfyn is deur gebruik te maak van Braun-Blanquet prosedures (Braun Blanquet 1932). Die resultate word weergegee in Tabel 1.

RESULTATE

Die floristiese samestelling wat bestaan uit 'n totaal van 40 spesies word in Tabel 1 saamgevat. Die vleigebiede word gekenmerk aan 'n baie lae spesiediversiteit. Die getal spesies wissel van drie tot vyftien met 'n benaderde gemiddeld van ses spesies per relevé.

Vanweë die homogeniteit van die vleigebiede is duidelike omgewingsgradiënte afwesig. Dit het die klassifikasie aansienlik bemoeilik. Daar is agt plantgemeenskappe in die vleigebiede onderskei (Figure 3 & 4):

1. Schoenoplectus lacustris-Polypogon monspeliensis - vlei.
2. Andropogon appendiculatus-Pycreus macranthus - vlei.
3. Polygonum senegalense-Senecio affinis - pan.
4. Cenia microglossa-Senecio affinis - vlei.
5. Eragrostis plana-Schoenoplectus decipiens - vlei.
6. Cyperus esculentus-Tulbaghia leucantha - vlei.
7. Agrostis lachnantha-Eleocharis spesie - vlei.
8. Eleocharis spesie-Schoenoplectus decipiens - pan.

1. Die Schoenoplectus lacustris-Polypogon monspeliensis - vlei.

Die Schoenoplectus lacustris-Polypogon monspeliensis - vlei (Figuur 3) word in die noordwestelike hoek van die studiegebied op die plaas Grootvlei aangetref. Die vlei kom voor op 'n hoogte van 1500 m bo seespieël en word aangetref op gronde van die Rensburg-vorm (Macvicar et al. 1977) met 'n kleipersentasie van meer as 55%.

Die oppervlakwater van die vlei is 30 mm diep en het 'n pH van 4,42 - 4,45 wat hierdie vlei onderskei van alle ander vleie. Die

suurgraad van die water is die direkte gevolg van mynbouaktiwiteite en loging wat plaasvind vanaf nabygeleë mynhope.

Die floristiese samestelling van die Schoenoplectus lacustris-Polypogon monspeliensis - vlei word in Tabel 1 saamgevat. Die plantgemeenskap word gekarakteriseer deur spesiegroep A (Tabel 1) met Polypogon monspeliensis en Schoenoplectus lacustris as diagnostiese spesies. Die gras Paspalum distichum (spesiegroep C, Tabel 1) word ook in die plantgemeenskap aangetref. 'n Gemiddeld van slegs vier spesies per relevé met 'n gemiddelde kroonbedekking van 63% is aangeteken en spesies van die meeste spesiegroepe is afwesig.

2. Die Andropogon appendiculatis-Pycreus macranthus - vlei.

Die Andropogon appendiculatis - Pycreus macranthus - vlei (Figuur 3) kom voor in die suidelike gedeelte van die studiegebied en word op 'n hoogte van 1500 - 1520 m bo seespieël aangetref. Die vlei word aangetref op gronde van die Rensburg-vorm (Macvicar et al. 1977) met 'n kleipersentasie van 21 - 35%. Hierdie gronde het 'n laer klei-inhoud as die gronde van die Schoenoplectus lacustris-Polypogon monspeliensis - vlei as gevolg van die alluviale afsettings langs die Vaalrivier. Die vlei word verder gekenmerk deur die afwesigheid van oppervlakwater.

Die Andropogon appendiculatus-Pycreus macranthus - vlei word gekarakteriseer deur spesiegroep B (Tabel 1). Die plantgemeenskap word gekenmerk deur die dominante gras Andropogon appendiculatus, die grasagtige kruide Pycreus macranthus, Isolepis costata,

Kyllinga erecta, Juncus effusus en die kruide Centella asiatica en Senecio polyodon (Tabel 1). Spesies van die spesiegroepe C, E, H, K, L, M, N en P (Tabel 1) kom verspreid in die gemeenskap voor. Die Andropogon appendiculatus-Pycreus macranthus - vlei het 'n gemiddeld van 13 spesies per relevé met 'n gemiddelde kroonbedekking van 68%.

3. Die Polygonum senegalense-Senecio affinis - pan.

Die Polygonum senegalense-Senecio affinis - pan (Figuur 3) word verteenwoordig deur 14 relevés en toon 'n wye toleransie ten opsigte van hoogte bo seespieël. Die pan word aangetref op hoogtes van 1500m tot 1600m met 'n gemiddelde hoogte van 1558m bo seespieël.

Die Polygonum senegalense-Senecio affinis - pan word aangetref op gronde van die Longlands- en Rensburgvorms (Macvicar et al. 1977) met 'n kleipersentasie van 21 tot meer as 55%. Hierdie gemeenskap toon dus 'n baie wyer toleransie ten opsigte van grondtekstuur as die ander plantgemeenskappe in die vleigebiede. Met die uitsondering van drie relevés was oppervlakwater afwesig. Die oppervlakwater is 60 - 120 mm diep en het 'n pH wat varieër van 6,61 tot 7,38.

Die Polygonum senegalense-Senecio affinis - pan word gekarakteriseer deur spesiegroep D (Tabel 1). Die plantgemeenskap word verder ook gekenmerk deur die dominante kruid Senecio affinis (spesiegroep G, Tabel 1).

Die Polygonum senegalense - Senecio affinis - pan het 'n benaderde gemiddeld van ses spesies per relevé met 'n gemiddelde kroonbedekking van 66%.

4. Die Cenia microglossa-Senecio affinis - vloedvlakte.

Die Cenia microglossa-Senecio affinis - vloedvlakte (Figuur 3) word aangetref op 'n hoogte van 1500 - 1520 m bo seespieël. Die vloedvlakte kom voor op gronde van die Rensburgvorm (Macvicar et al. 1977) met 'n kleipersentasie van meer as 55%. Die gronde is net periodies versadig met water en die grondkonsistensie is baie hard. Die plantgemeenskap word gekenmerk deur die afwesigheid van oppervlakwater.

Die Cenia microglossa-Senecio affinis - vloedvlakte word gekarakteriseer deur spesiegroep E (Tabel 1) en in 'n mindere mate gekenmerk deur Gazania krebsiana (spesiegroep F, Tabel 1). Die gemeenskap word verder gekenmerk deur die dominante kruide Senecio affinis en Ledebouria cooperi asook die grasspesie Agrostis lachnantha. Die vloedvlakte het 'n gemiddeld van 10 spesies per relevé met 'n gemiddelde kroonbedekking van 45%.

5. Die Eragrostis plana-Schoenoplectus decipiens - vlei.

Die Eragrostis plana-Schoenoplectus decipiens - vlei (Figuur 3) word netsoos die Schoenoplectus lacustris-Polypogon monspelliensis - vlei in die noordwestelike hoek van die studiegebied aangetref. Die plantgemeenskap kom voor op 'n hoogte van 1500 - 1520 m bo seespieël.

Die Eragrostis plana-Schoenoplectus decipiens - vlei word aangetref op gronde van die Rensburgvorm (Macvicar et al. 1977) met 'n kleipersentasie van meer as 55%. Die plantgemeenskap word verder gekenmerk deur die afwesigheid van oppervlakwater.

Die vlei word gekenmerk deur spesiegroep H (Tabel 1) met Eragrostis plana, Paspalum dilatatum en Panicum maximum as

die diagnostiese spesies. Die floristiese samestelling van hierdie gemeenskap word ondersteun deur die teenwoordigheid van die grasse Eragrostis planiculmis, Elionurus muticus, Agrostis lachnantha en Cynodon dactylon, die biesies Cyperus denudatus, Schoenoplectus decipiens, die geofiete Ledebouria cooperi, Crinum bulbispermum en Oxalis obliquifolia en die kruid Ranunculus multifidus (Tabel 1). Daar is 'n gemiddeld van 13 spesies per relevé met 'n gemiddelde kroonbedekking van 55%.

6. Die Cyperus esculentus-Tulbaghia leucantha - vlei.

Die vlei-gemeenskap (Figuur 3) word op 'n hoogte van 1500 - 1520 m bo seespieël aangetref. Die Cyperus esculentus-Tulbaghia leucantha - vlei word aangetref op gronde van die Rensburgvorm (Macvicar et al. 1977) met 'n kleipersentasie van meer as 55%.

Die oppervlakwater van die vlei is 1 - 30 mm diep en het 'n pH van 6,4 wat hom onderskei van die Polygonum senegalense-Senecio affinis - pan en die Schoenoplectus lacustris-Polypogon monspeliensis - vlei (Figure 3 & 4).

Die Cyperus esculentus-Tulbaghia leucantha - vlei word gekenmerk deur spesiegroep J (Tabel 1) met Cyperus esculentus en Tulbaghia leucantha as diagnostiese spesies, terwyl die opvallende teenwoordigheid van Andropogon appendiculatus (spesiegroep B) ook differensiërend is.

Die floristiese samestelling van die plantgemeenskap word ondersteun deur die teenwoordigheid van spesies in spesiegroepe K, L, M, N, en O (Tabel 1), met veral die grasse Eragrostis planiculmis, Agrostis lachnantha en die biesies Cyperus denudatus, Eliocharis spesie en Shoenoplectus decipiens

prominent. Daar is 'n gemiddeld van 12 spesies per relevé met 'n gemiddelde kroonbedekking van 75%.

7. Die Agrostis lachnantha-Eleocharis spesie - vlei.

Die Agrostis lachnantha-Eleocharis spesie - vlei (Figuur 3) word op 'n hoogte van 1500 - 1560 m bo seespieël aangetref. Die vlei-gemeenskap word aangetref op gronde van die Rensburgvorm (Macvicar et al. 1977) met 'n kleipersentasie van meer as 55%. Oppervlakwater is slegs in enkele relevés aangeteken en varieer van 1 - 60 mm diep, met 'n pH van 5,22 tot 6,3.

Die Agrostis lachnantha-Eleocharis spesie - vlei word nie gekenmerk aan 'n diagnostiese spesiegroep nie, maar word van die ander plantgemeenskappe onderskei op grond van die teenwoordigheid van Agrostis lachnantha (spesiegroep M) en die afwesigheid van spesies van spesiegroepe H, I, J, K en L (Tabel 1).

Dominante spesies wat in die plantgemeenskap aangetref word sluit in die grasspesie Agrostis lachnantha, die biesies Eleocharis spesie en Schoenoplectus decipiens en die geofiet Oxalis obliquifolia (Tabel 1). Die plantgemeenskap het 'n gemiddelde kroonbedekking van 60%. Daar is 'n benaderde gemiddeld van ses spesies per relevé.

8. Die Eleocharis spesie-Schoenoplectus decipiens - pan.

Die Eleocharis spesie-Schoenoplectus decipiens - pan (Figuur 3) word op 'n hoogte van 1560 - 1580 m bo seespieël aangetref. Hierdie plantgemeenskap word aangetref op gronde van die Rensburgvorm (Macvicar et al. 1977) met 'n kleipersentasie van

meer as 55%. Daar is geen oppervlakwater by die pan aangeteken nie.

Die Eleocharis spesie-Schoenoplectus decipiens - pan word, netsoos die Agrostis lachnantha-Eleocharis - vlei, gekenmerk deur die afwesigheid van 'n diagnostiese spesiegroep. Die biesies Eleocharis spesie en Schoenoplectus decipiens en die geofiet Oxalis obliquifolia is dominant in die plantgemeenskap, terwyl Agrostis lachnantha (spesiegroep M) afwesig is.

Die Eleocharis spesie-Schoenoplectus decipiens - pan het 'n gemiddelde kroonbedekking van 65% met 'n benaderde gemiddeld van drie spesies per relevé.

Ordening

Die eerste en tweede asse is tydens ordening gebruik omdat dit die meeste van die variasie in die data verklaar en gevolglik die beste interpreteerbare resultate gelewer het (Figuur 5). Die eerste as is verantwoordelik vir 75,8% (eigenwaarde 0,758) van die variansie in die datastel terwyl die tweede as van ordening 72,3% (eigenwaarde 0,723) van die variansie verklaar.

In die vleigebiede is agt plantgemeenskappe onderskei. 'n Eerste ordening het getoon dat relevés 39, 40, 41 en 42, wat die Schoenoplectus lacustrus-Polypogon monspeliensis - vlei verteenwoordig (Figuur 3), totaal verskil van al die ander relevés. Die ordeningsdiagram (Figuur 5) toon dus die verhouding van die relevés van die ander plantgemeenskappe ten opsigte van mekaar, uitgesonderd bogenoemde vier relevés.

Die Schoenoplectus lacustrus-Polypogon monspeliensis -vlei word onderskei van al die ander vleie vanweë die lae pH van die oppervlakwater en word nie in Figuur 5 aangedui nie. Die

Andropogon appendiculatus-Pycreus macranthus - vlei (Eenheid B, Figuur 5) kom voor op gronde met 'n baie sagte grondkonsistensie. Alhoewel die ordeningsdiagram (Figuur 5) die Polypogon senegalense- Senecio affinis - pan verdeel in eenhede C1 en C2 word hierdie relevés saamgegroepeer op grond van floristiese samestelling. Die Cennia microglossa-Senecio affinis - vloedvlakte word deur Eenheid D verteenwoordig terwyl die Eragrostis plana-Schoenoplectus decipiens - vlei deur Eenheid E in die ordeningsdiagram (Figuur 5) voorgestel word. Eenhede F en G (Figuur 5) verteenwoordig die Cyperus esculentus-Tulbaghia leucantha en die Agrostis lachnantha-Eleocharis spesie- vleie onderskeidelik. Die Eleocharis spesie-Schoenoplectus decipiens - pan word deur Eenheid H in die ordeningsdiagram (Figuur 5) voorgestel. Die ordeningsdiagram rangskik Eenhede C1, G en F asook Eenhede C2, E en H naby mekaar. Dit kan wees as gevolg van die homogeniteit van die habitatte in die vleigebiede. Die floristiese verskille kan egter die direkte gevolg van verskillende bestuurspraktyke wees.

Gevolgtrekking

Die resultate wat verkry is dui op die suksesvolle verfyning van die TWINSPAN klassifikasie deur gebruik te maak van Braun-Blanquet prosedure. Die klassifikasie is bemoeilik vanweë die lae spesiediversiteit en homogeniteit van die verskillende habitatte. Die resultate verkry tydens ordening stel voor dat grondkonsistensie en grond pH die grootste bydra lewer tot die onderskeiding van die plantgemeenskappe. Die floristiese verskille tussen die hoërliggende panne en die laerliggende

vloedvlaktes en vleie kan moontlik toegeskryf word aan verskillende bestuurspraktyke. 'n Vergelyking van die resultate van hierdie studie met die resultate van Bloem (1988) wat ook vleigemeenskappe onderskei het, blyk dit dat vleie op die Transvaal en die Oranje Vrystaat se Hoëveld, floristies en gevolglik ook ekologies aansienlik van mekaar verskil. Hierdie groot variasie toon aan dat vleigebiede sensitiewe ekosisteme is wat fitisosiologies ondersoek moet word voordat maksimum voordeel uit 'n bewaringsprogram verkry kan word.

Bedankings

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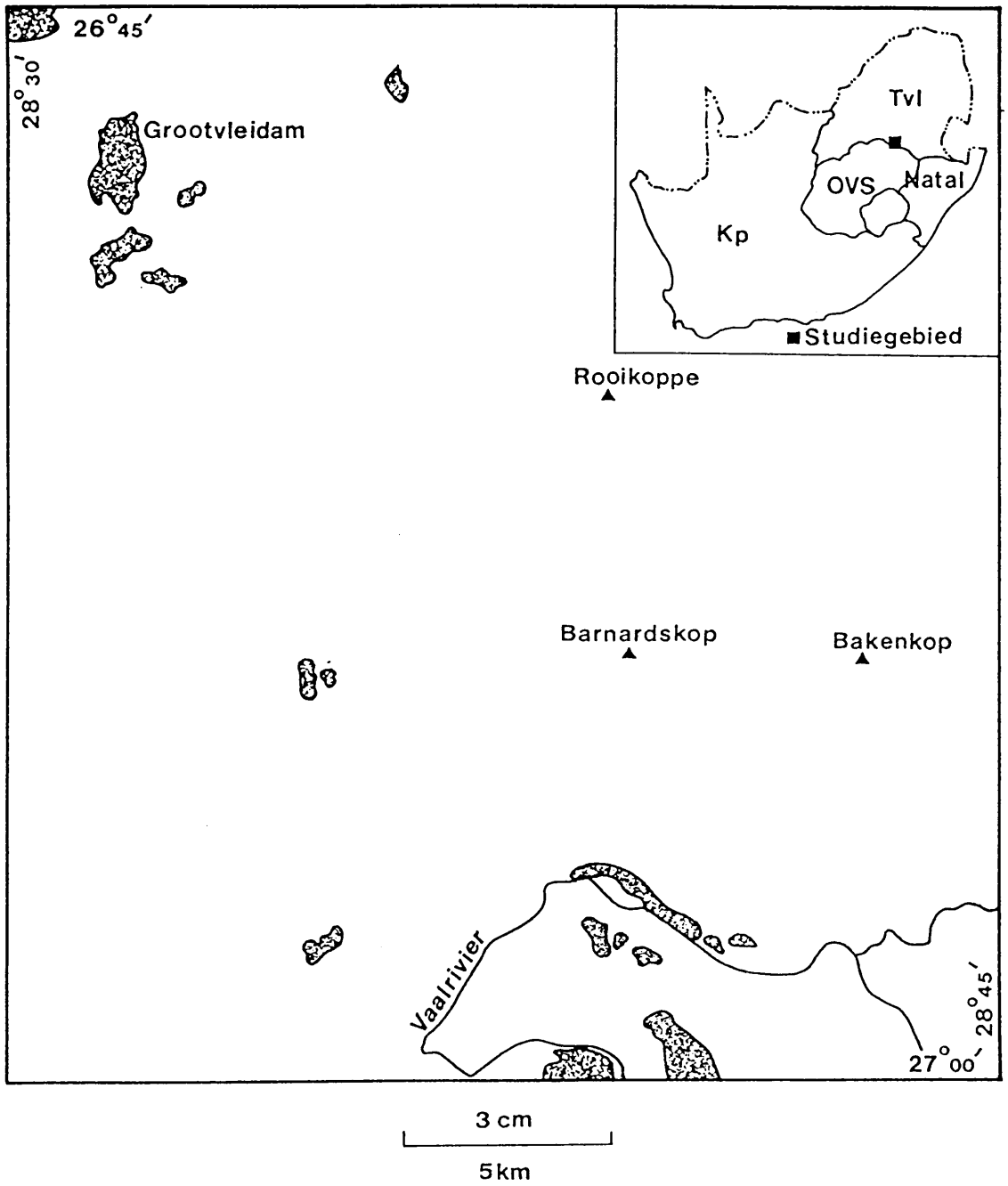
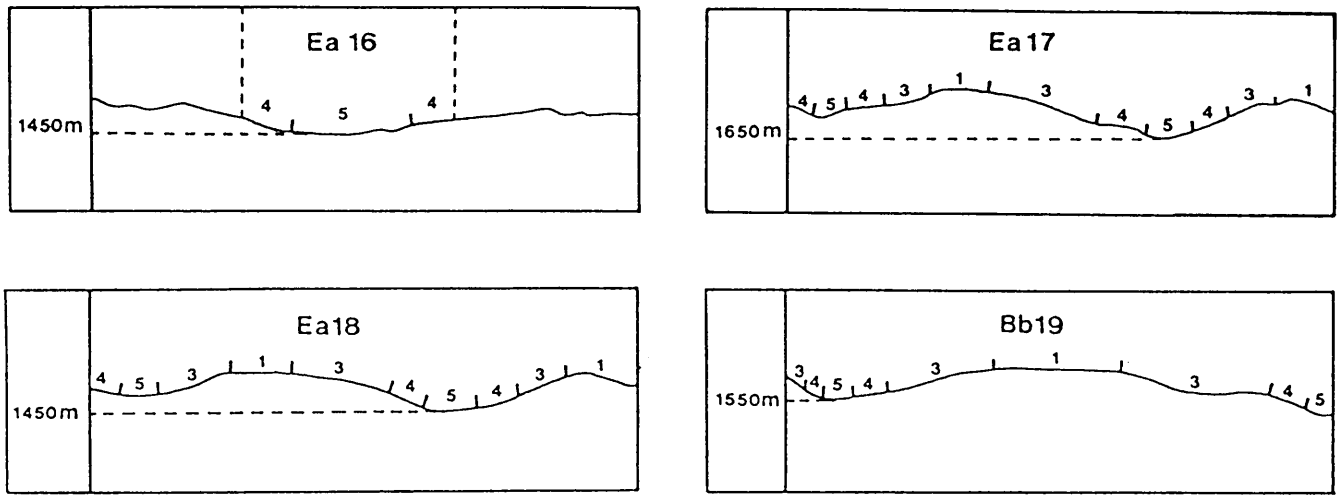
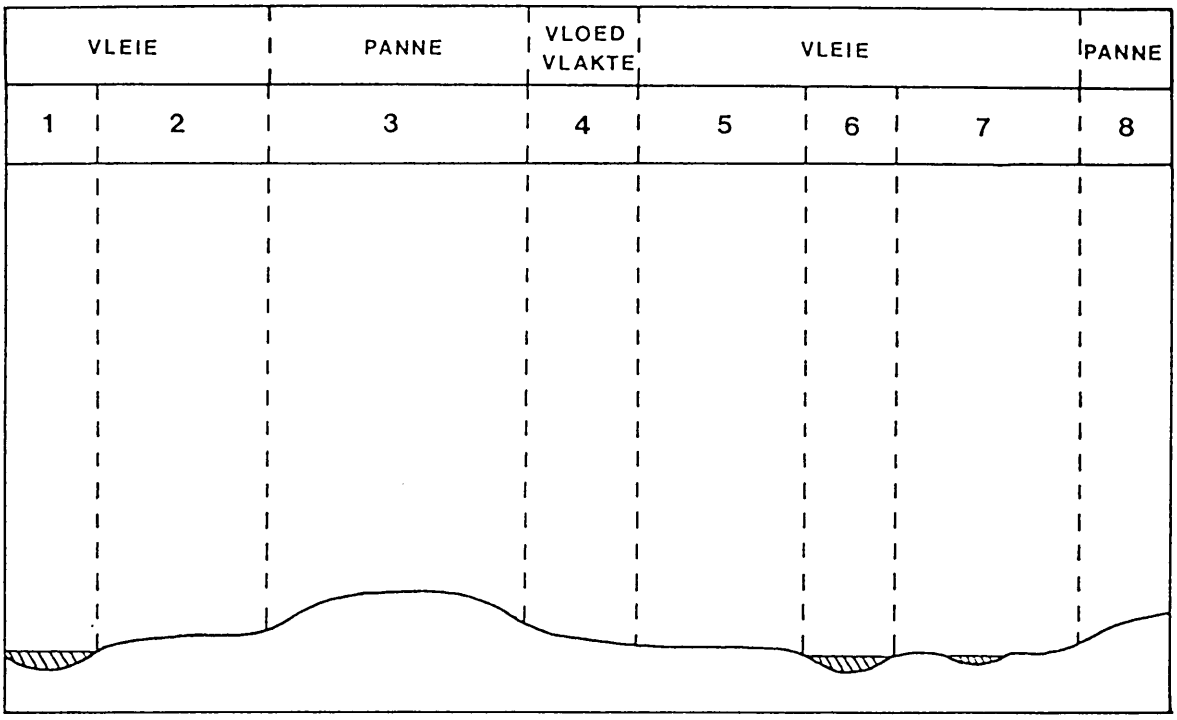


FIGUUR 1. Die verspreiding van die vlei-gebiede in die Grootvlei-omgewing (Suid Afrika 1:50 000 Topografiese Reeks 2628DC Grootvlei, Staatsdrukker, Pretoria.

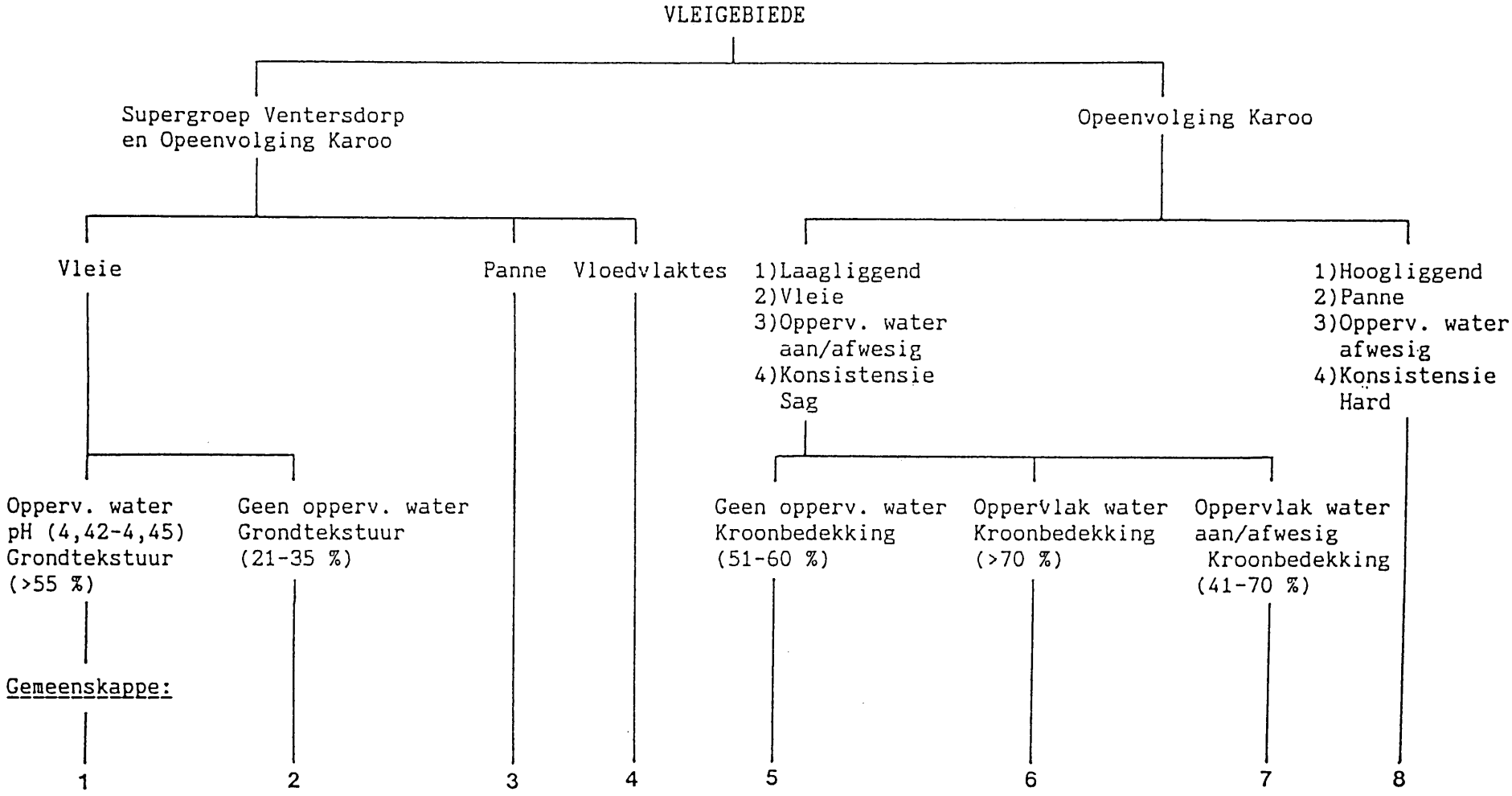


FIGUUR 2. Terreinvormsketse van die Landtipes waarin die vleigebiede aangetref word (Landtipe Opname Personeel 1985).

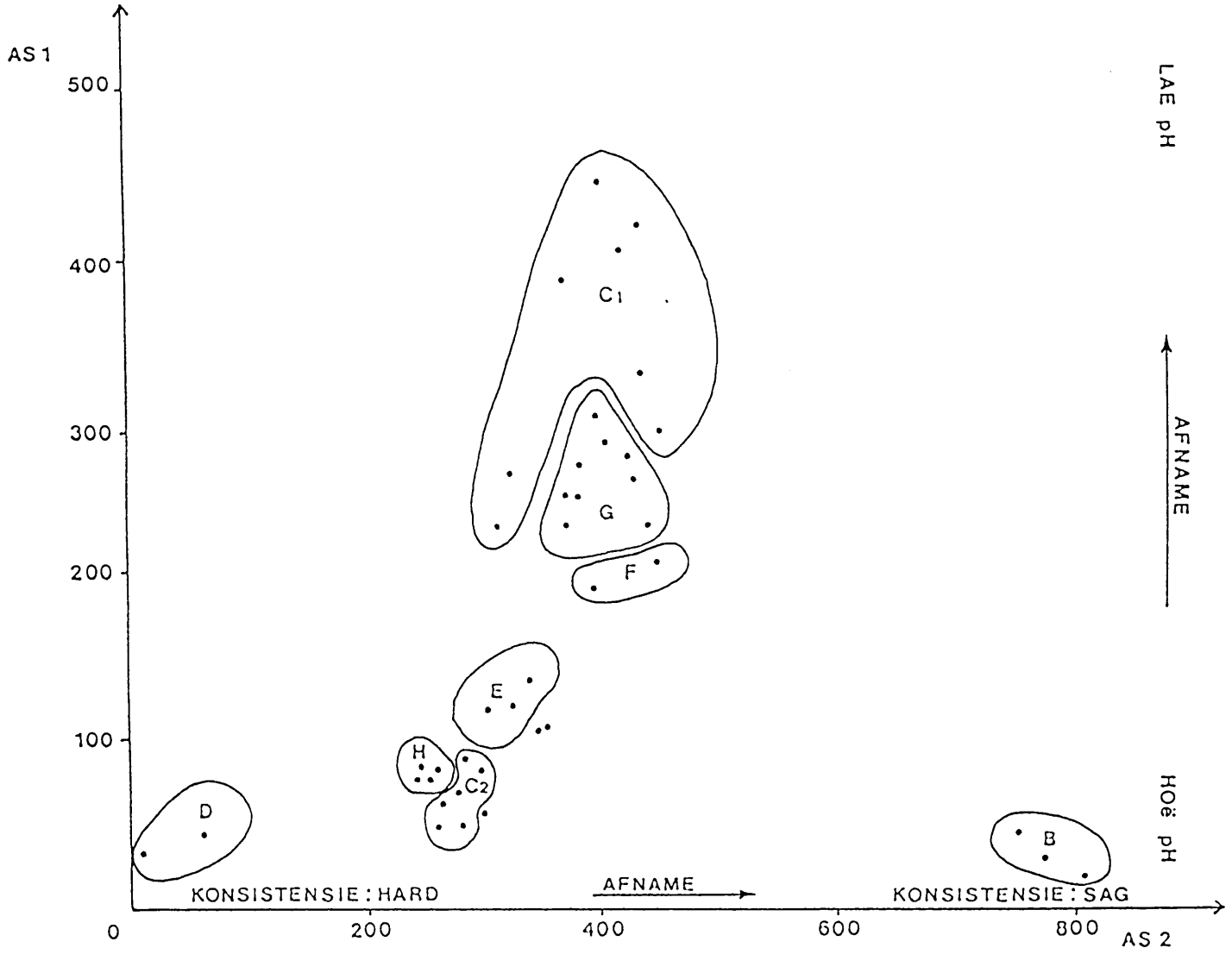


1. Schoenoplectus lacustris-Polypogon monspeliensis- vlei.
2. Andropogon appendiculatus-Pycreus macranthus- vlei.
3. Polygonum senegalense-Senecio affinis- pan.
4. Cenia microglossa-Senecio affinis- vloedvlakte.
5. Eragrostis plana-Schoenoplectus decipiens- vlei.
6. Cyperus esculentus-Tulbaghia leucantha-vlei.
7. Agrostis lachnantha-Eleocharis spesie-vlei.
8. Eleocharis spesie-Schoenoplectus decipiens- pan.

FIGUUR 3. Skematiese voorstelling van die vleigebied-sisteem.



FIGUUR 4. 'n Dendrogramatiese verdeling van die plantegroei in die vleigebiede.



* Groep A: Relevés 39, 40, 41 en 42 is weggelaat tydens die tweede ordening.

FIGUUR 5. Die verspreiding van relevés langs die eerste en tweede asse van 'n DECORANA-ordening.

TABEL 1. 'n Plantsosiologiese tabel van die vlei-gebiede in die Grootvlei-omgewing.

Gemeenskap-nommer	1	2	3	4	5	6	7	8
Aantal spesies/releve	5334	119 54	565644 14 5664 99 0	19 0	1111 4225	11 22	76656446635	3343
Releves	0000 3444 9012	000 000 128	000000 002222 463456	00 0000 00 1222 11 35 9012 78	00 11 56	0000 3333 3546	00 11 34	00000000000 33011224401 78712703490	0000 2333 9012
SPESIEGROEP A								
Polypogon monspeliensis	3334							
Schoenoplectus lacustris	3443							
SPESIEGROEP B								
Andropogon appendiculatus		111				11		
Pycreus macranthus		111						
Centella asiatica		111	+		+			
Isolepis costata		11+						
Senecio polyodon		++R						
Kyllinga erecta		22						
Juncus effusus		11						
SPESIEGROEP C								
Paspalum distichum	2111	12		11			12	
SPESIEGROEP D								
Polygonum senegalense	1 1		221R+2	12 ++	R		R++	
Pseudognaphalium luteo album		+R	3133+R	1 R +	++		+	
SPESIEGROEP E								
Cenia microglossa				11				
SPESIEGROEP F								
Gazania krebsiana				++	12			
SPESIEGROEP G								
Senecio affinis			+++1	+ +111	++	22		
SPESIEGROEP H								
Eragrostis plana		+	R +	+	1211	1+		
Paspalum dilatatum		+			+1 1	+		
Panicum maximum					1+1			
SPESIEGROEP I								
Falkia oblonga			1+11	+ RR	+ +			
SPESIEGROEP J								
Tulbaghia leucantha				+		+1		
Cyperus esculentus						1+		

TABEL 1 (vervolg)

Gemeenskap-nommer	1	2	3	4	5	6	7	8
Relevés	0000 3444 9012	000 000 128	000000 002222 463456	00 0000 35 9012	00 11 78 56	0000 3333 3546	00 11 34	00000000000 33011224401 70712703490	0000 2333 9012
SPESIEGROEP K									
Eragrostis planiculmis		+|	1		++11	22	112	
Cyperus denudatus		2|			++11	21		
SPESIEGROEP L									
Ledebouria cooperi		++		+	+2	+ ++	++		
Ranunculus multifidus		+		+R	1	+211	R+		
Crinum bulbispermum				++	+1	+1++	1+	++	
SPESIEGROEP M									
Agrostis lachnantha		+|	22++		++	2122	21	113122233 1	
SPESIEGROEP N									
Eleocharis spesie		+2	1144	1	+	11+2	12	22421333333	1111
SPESIEGROEP O									
Schoenoplectus decipiens			22	4443	22	1 3333	12	331++2211	4444
Oxalis obliquifolia	1	+	12	2212	++	++	++1+	+1	1+ +1 1122	2222
SPESIEGROEP P									
Cynodon dactylon		++	++ 2			1+11		11	
Bulbostylis humilis			31 1						
Elionurus muticus								R	
Juncus exsertus								+	
Aponogeton junceus								1 +|	
Asclepias eminens						R			
Aristida mollisima		1							
Eragrostis curvula		+							
Senecio coronatus		1|						
Berkheya radula			R						R

HOOFSTUK 10.

VERWANTSKAPPE TUSSEN GEMEENSKAPPE

Die plantegroei van die Ea-, Ib-, Bb-, Ba-, en Ca-landtipes is afsonderlik geïdentifiseer, ekologies geïnterpreteer en beskryf (Breytenbach et al.. a, b, c, d (in prep.)). Ten einde vas te stel wat die verwantskappe tussen die verskillende gemeenskappe van die verskillende landtipes is, is 'n sinoptiese tabel (Tabel 10.1) saamgestel. Deur middel van die tabel kan die floristiese ooreenkomste tussen die verskillende gemeenskappe asook die ooreenkomste of oorvleueling in habitat geïdentifiseer word. Enige ooreenkomste kan aandui in watter mate verskillende gemeenskappe saam gegroepeer kan word, veral met die oog op bestuurs moontlikhede.

Die aanvanklike hoofverdeling van groepe in die tabel is met behulp van TWINSPAN (Hill 1979b) gedoen. Verdere verfyning van die tabel is met Braun-Blanquet-prosedures (Werger 1974) en die PHYTOTAB programpakket (Westfall et al. 1982) gedoen. Die 37 plantgemeenskappe in die studiegebied kan in agt groepe gegroepeer word (Tabel 10.1). In Tabel 10.1 kan duidelik onderskeid gemaak word tussen die hoërliggende plantgemeenskappe in die landskap, wat hoofsaaklik struikveld is (Groepe 1 en 2), en die laerliggende plantgemeenskappe, wat hoofsaaklik grasveld verteenwoordig (Groepe 3, 4, 5, 6, 7 en 8). Die hoërliggende plantgemeenskappe word gekenmerk deur Spesiegroep A (Tabel 10.1) terwyl die laerliggende plantgemeenskappe gekenmerk word deur die afwesigheid van Spesiegroepe A, B en C (Tabel 10.1). Elke plantgemeenskap van 'n spesifieke landtipe word deur 'n nommer op die sinoptiese tabel voorgestel (Tabel 10.2). 'n DECORANA

Tabel 10.1 Sinoptiese tabel van die plantgemeenskappe in die Villiers-Grootvlei area.

Gemeenskapgroep	1	2	3	4	5	6	7	8
Gemeenskap	000000 031333 920345	000 000 128	00000 01013 31736	0000000 0122223 4823560	000 023 647	000000 122213 578921	000 122 401	0000 0111 5679
Spesiegroep A								
Diospyros lycioides	545454	523						
Rhus rigida	545454	332						
Indigofera obscura	324225	533				3		
Argyrolobium velutinum	234224	532						
Cheilanthes hirta	344425	52						
Rhynchelytrum repens	443452	22						
Pellaea calomelanos	452444	5 2						
Ipomoea crassipes	3334	52			2	2		
Aristida transvaalensis	22 2	3 2						
Rhynchosia totta	4 2	5 2			3 2	25		
Acalypha caperonioides	4 44	34	3					
Gladiolus spesie	2 42	3 2						
Haplocarpha scaposa	4 4	33		4	222			
Diheteropogon amplectans	4	2	2			2		
Spesiegroep B								
Euclea crispa	342522	3						
Maytenus heterophylla	245443	2						
Plectracanthus madagascariensis	223324							
Rhoicissus tridentata	242522							
Diospyros whyteana	22 423							
Aloe transvaalensis	35342	2			2			
Canthium gilfillanii	342 22	2						
Cussonia paniculata	22 24	3						
Protasparagus setaceus	2 223	3						
Lippia rehmannii	22 22	2						
Haemanthus humilis	4323	5						
Aloe davyana	25 2							
Ehretia rigida	34 2							
Asclepias fruticosa	3 3 5							
Pavonia transvaalensis	33							
Ipomoea obscura	24							
Kalanchoe thyrsiflora	23							
Crassula setulosa	22							
Berkheya seminivea	2 2							
Teucrium trifidum	2 2							
Crassula swaziensis	22							
Ledebouria ovatifolia	33					2		
Barleria obtusa	3							
Malva verticillata	2							
Hypoxis obtusa	3		2					
Celtis africana	22322							
Rhus pyroides	2343							

Cheilanthus ecklonianа	32 3							
Felicia filifolia	222	5						
Opuntia spesie	2 2							
Helichrysum kraussii	3							
Ehrythrina zeyheri	2							
Cucumis hirsutus	2							
Vernonia natalensis	2		2					
Rhus discolor	344	5						
Ziziphus mucronata	342							
Garuleum woodii	322				2	4		
Myrsine africana	223	5						
Zanthoxylum capense	22							
Heteromorpha trifoliata	2							
Rhus zeiheri	23							
Schistostephium crataegifolium	22	3						
Athrixia elata	23	5						
Leonotis microphylla	5							
Dianthus mooiensis	2							
Clematis brachiata	2							
Solanum incanum	2							
Digitaria diagonalis	2							
Spesiegroep C								
Lippia scaberrima	2	5						
Senecio venosus		3						
Ehrharta erecta	2	3						
Cotoneaster pannosus		3						
Clutia hirsuta		3						
Clematis oweniae		3						
Ledebouria revoluta		2						
Dicoma zeyheri		2						
Nidorella anomala	2	2						
Helichrysum pilosellum		2						
Lactuca capensis		2						
Spesie 312		2						
Spesie 279 1		2						
Senecio othonniflorus		2						
Spesiegroep D								
Sonchus nanus			32					
Senecio affinis			2					
Acalypha angustifolia			3		2			
Spesiegroep E								
Hermannia lancifolia		23	4 2		2	23.		
Trachypogon spicatus	223 54	43	42			2		
Helichrysum rugulosum	3 5 54	534	545	2		2		5
Conyza podocephala	5 4342	522	54	2	2			
Cymbopogon excavatus	435325	544	3	2		2		
Hyparrhenia hirta	424352	2	4		2	2		3
Tagetus minuta	32434	3	3			2		5 32
Vernonia oligocephala	245 3	3	3		3			
Bidens pilosa	43422	3 2	3	2		2		
Ziziphus zeyheriana	252	42	3 3		22		2	
Hypoxis argentea	4 2	3	3					

Pachycarpus rigidus	33	2	2					
Stoebe vulgaris	2 2	323	2223	2		2		
Tristachya leucothrix	3 24	33	323		2	45		
Helichrysum nudifolium	3 23	334	2 4		2			
Lactuca spesie	3 22	3	4					
Gomphrena celosioides	3 2	2	2	2			2	3
Berkheya setifera	4254	554	2	2	2 2			3
Aristida mollissima	2 2	24	2					
Dicoma anomala	42	4	33	2	2	3		
Berkheya onopordifolia	4	3	2					
Senecio coronatus	2	3	2		2			
Spesiegroep F-								
Abildgaardia ovata		3	2	2 333		2 2		
Panicum coloratum		2		4 3		2 2		3
Digitaria ternata				4 3		4		5
Aristida stipitata		2		2 2				
Haplocarpha lyrata			2	4 2		4		
Euphorbia clavaroides				2				
Mariscus 369				2				
Spesie 439				2				
Eragrostis gummiflua				2 2				
Pentzia incana				2				
Pentzia globosa				2				
Pseudognaphalium luteo-a				23	2	2		
Dicoma macrocephala				2				
Geigeria aspera				2		2		
Spesiegroep G								
Chaetacanthus costatus	234 2	33	22	35		2		
Felicia fascicularis	23		54	232 4		2		
Digitaria eriantha	22	2		4 4 22		2		3
Spesiegroep H								
Urginea spesie					552			
Convolvulus sagittatus					3 3			
Hypoxis iridifolia					22	2		
Spesie 280					2			
Eragrostis spesie				2	52			
Mariscus spesie					5			
Cyanotis speciosa					4	2		
Sporobolus discosporus					2			
Spesie 371					2			
Spesie 367					2			
Menodora africana					2			
Sutera aurantica					2			
Scabiosa columbaria					2			
Conyza bonariensis					2			
Stipagrostis zeyheri					2		2	
Hyparrhenia anamesa					2			

Spesiegroep I

Monsonia angustifolia	2		3	2 32 2	3	2		
Ledebouria spesie		2	3	23 2 22	3	45		
Aptosimum indivisum				232 2	4	2 2		
Aristida diffusa		2	2	2 24 2	2			
Evolvulus alsinoides	2	2		23 2	4 2	2		
Eragrostis capensis				2 22	34	2		

Spesiegroep J

Hermannia depressa	2 5243	335	52555	2 5 5	252	2		35
Salvia repens	22 2	2	3	2 22 2	3 2			
Microchloa caffra	2 2	2	3	2 22222	5	2		3

Spesiegroep K

Aristida bipartita				32		544		
Cymbopogon plurinodes		4	5	3	2	425		
Crabbea hirsuta				2	3	22		
Brachiaria spesie						22		
Hypoxis spesie						22		
Chenopodium schraderanum				2		4 2	2	
Spesie 287						2 2		
Spesie 230					2	4		
Chamaesyca inequilatera			2	33		44		2
Chaetacanthus burchelli					2	25		
Anthospermum pumilum						42		
Spesie 217						22	2	
Blepharis innocua						2		
Spesie 203						2		
Chloris virgata						4		3
Vigna oblongifolia						2		
Chloris virgata						4		3
Falkia oblonga				5		25		
Setaria incrassata					2	22		
Phyllanthes burchellii						2		
Spesie 198						2		
Fuirena coerulescens		2				2		
Tephrosia purpurea						2		
Ipomoea bathycolpos						2		
Gnidia burchelli					2	2		
Alectra sessiliflora					2	2		
Drimiopsis maxima						2		
Cordylogyne globosa						4		
Schoenoplectus decipiens						5		
Senecio spesie						4		
Helichrysum coriaceum						2		
Cycnium tubulosum						2		
Crinum bulbispermum						2		
Tulbaghia leucantha						2		
Spesie 400						2		
Spesie 398						2		
Spesie 379						2		
Fimbristylis complanata						2		

Digitaria tricholaenoides	3	2				24		
Loudetia simplex						25		
Harpochloa falx	2					43		
Khadia acutipetala						3		
Euryops transvaalensis		3				5		
Gazania krebsiana		2				3		
Diheteropogon filifolius						3		
Polygala hottentotta		2				2		
Helichrysum cerastioides		2				2		
Sporobolus pectinatus						2		
Schizachyrium sanguieum						2		
Panicum natalense						2		
Monocymbium cerisiiforme						2		
Aristida adscensionis						2		
Helichrysum callicomum						2		
Helichrysum spesie				2		2		

Spesiegroep L

Elionurus muticus	555254	45	5 553	445532	554	2 4 52		
Heteropogon contortus	555454	555	25534	5522	552	4 53		
Brachiaria serrata	353343	344	4 434	23555 2	243	2 4		55
Trifolium africanum	2 242	33	4 322	4 242	3	22		
Eragrostis racemosa	4 43	345	3433	3245	253	45		
Oxalis obliquifolia	3	3 2	22	23	3 2	224		3

Spesiegroep M

Pogonarthria squarrosa			2				553	
Cyperus rigidifolius							5	
Halafrida densiflora					2	2	42	
Spesie 136				2			32	
Kohautia amatymbica							24	2
Spesie 129							4	
Elephatorrhiza elephantina	3						4	
Cleome maculata							4	
Oxygonum dregeanum					2		2	
Cyperus margaritaceus					2		2	
Cassia biensis			2	2		2	2	
Acalypha spesie					2		2	
Spesie 164							2	
Spesie 154							2	
Barleria macrostegia						2	4	
Scolopia zeyheri							2	
Helichrysum paronychioides						2	2	
Cyperus spesie							2	
Brayulinea densa							2	
Cyperus tenax				2			2	

Spesiegroep N

Bulbostylis contexta				2		4 42	23	3
Aristida sciurus						4 2	43	
Limeum viscosum		2				2 22	33	
Aristida junciformis	4		2			44	23	
Crassula lanceolata		3		3		3	2	

Spesiegroep O

Setaria pallide-fusca								3														3		2										5			2
Urochloa panicoides																														2				5		3	
Alternanthera pungens																																		3			
Eleusine indica																																		3			
Cyperus denudatus																												2						3			
Paspalum dilatatum																																			5		
Sporobolus africanus												2																							5		
Asclepias multicaulis																																				3	
Anthericum cooperi								2																												3	
Spesie 411																																					3

Spesiegroep P

Eragrostis curvula	5	5	5	5	5	4	5	4	5	5	4	5	5	5	5	5	5	5	4	5	5	5	5	4	5	5	2	5	5	4	5		5	5	5	3	5
Themeda triandra	4	4	5	4	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	4	5	3		2	2	5	5	5	3
Eragrostis plana	2	2	2						3		5	3	3	5	5	4	5	5	4	4	4	3	5	4	2	5	5	5		3		2		5	5	5	4
Crabbea acaulis	5	4	5	3	4	5	5	5	4	5		5		4			4	4	3	3	2		2	2	4		5	2	2			2				3	
Commelina africana	4	4	5	3	4	2	3	2	2	2	3	2						2			2								2	3	5	2	3	3			2
Aristida congesta	2	2	4	3	2		3	3	2	5	5			4		2	3	2		5	2		2	2	4				2	4	5	5	5	3			
Setaria sphacelata		2	4	2	4			4	5	2	5	3	5	2	2		2	5	2	2			5	3		2	4	2	4	2		2	4				
Schkuhria pinnata		2	2	2			3		2	5							3	2								4						2		5		3	
Cynodon dactylon			3	2				4	3	4	4	3	3	5	5		3	4	2	5	5	2			2	3	2		4	3	5	3	5	3	5	5	4
Setaria nigrirostis			2	2	4	4	3					3	3		2						2								2	3					5	3	
Berkheya pinnatifida			2						3	2				2	2	4	5	2		3	2						2	2							5	5	
Solanum panduriforme					2				3	4	2	2						2							2				4	4	5	2	2			3	
Trichoneura grandiglumis								2	2	2	5			2				2			2								4	3	5	3	2				
Solanum supinum			2					2		3		2	2																	2		4	3	3	5	3	

Spesiegroep Q

Indigofera spesie																	2				4		4		2	5											
Helichrysum aureum					2									2													2										
Eragrostis lehmanniana								2												2			2										3					
Argyrolobium spesie									2										2											2							
Tephrosia longipes					2					3													2														

Tabel 10.2 Nuwe plantgemeenskapnommers, landtipes, gemeenskapsnommers name van plantgemeenskappe en veldtipes van die sinoptiese tabel.

Nuwe nommers vir plantgemeenskappe soos in Tabel 10.1 gebruik word	Landtipe	Gemeenskap nommer	Plantgemeenskap	Veldtipe
1	Ea-hoogliggend	1.1	*Diospyros lycioides-Eragrostis curvula*-struikveld	Bankenveld (61)
2	Ea-hoogliggend	1.2.1	*Themeda triandra-Trachypogon spicatus*-grasveld	Bankenveld (61)
3	Ea-hoogliggend	1.2.2	*Themeda triandra-Cymbopogon plurinodes*-grasveld	Bankenveld (61)
4	Ba	1.1	*Eragrostis plana-Falkia oblonga*-grasveld	Bankenveld (61)
5	Ba	1.2	*Eragrostis plana-Setaria pallide-fusca*-grasveld	Bankenveld (61)
6	Ba	1.3	*Themeda triandra-Urginea* spesie-grasveld	Bankenveld (61)
7	Ba	1.4	*Themeda triandra-Setaria nigrirostris*-grasveld	Themeda Veld (52)
8	Ba	1.5	*Themeda triandra-Aristida mollissima*-grasveld	Bankenveld (61)
9	Ba	1.6.1	*Diospyros lycioides-Euclea crispa*-struikveld	Bankenveld (61)
10	Ba	1.6.2	*Diospyros lycioides-Digitaria tricholaenoides*-struikveld	Bankenveld (61)
11	Ba	1.7	*Eragrostis curvula-Hyparrhenia hirta*-grasveld	Themeda Veld (52), Bankenveld (61)
12	Ba	1.8	*Eragrostis curvula-Harpochloa falx*-grasveld	Bankenveld (61)
13	Ba	1.9	*Themeda triandra-Elionurus muticus*-grasveld	Themeda Veld (52), Themeda Veld na Bankenveld oorgangstipe (55)
14	Bb	1.1	*Cynodon dactylon-Pogonarthria squarrosa*-grasveld	Cymbopogon-Themeda Veld (48)
15	Bb	1.2	*Themeda triandra-Aristida sciurus*-grasveld	Themeda Veld (52)
16	Bb	1.3.1	*Eragrostis plana-Setaria nigrirostris*-grasveld	Themeda Veld (52)
17	Bb	1.3.2	*Eragrostis plana-Digitaria ternata*-grasveld	Themeda Veld (52)
18	Bb	1.3.3	*Eragrostis plana-Elionurus muticus*-grasveld	Themeda Veld (52)
19	Bb	1.3.4	*Eragrostis plana-Commelina africana*-grasveld	Cymbopogon-Themeda Veld (48)
20	Ca		*Pogonarthria squarrosa-Aristida congesta*-grasveld	Gemengde Themeda Veld na Cymbopogon-Themeda Veld oorgangstipe (53)
21	Ea-laagliggend	1.1	*Eragrostis curvula-Pogonarthria squarrosa*-grasveld	Gemengde Themeda Veld na Cymbopogon-Themeda Veld oorgangstipe (53)
22	Ea-laagliggend	1.2.1	*Themeda triandra-Digitaria ternata*-grasveld	Themeda Veld (52)
23	Ea-laagliggend	1.2.2	*Themeda triandra-Pseudognaphalium luteo-album*-grasveld	Themeda Veld (52)
24	Ea-laagliggend	1.2.3	*Themeda triandra-Urginea* spesie-grasveld	Themeda Veld (52)
25	Ea-laagliggend	1.2.4	*Themeda triandra-Brachiaria serrata*-grasveld	Themeda Veld (52), Bankenveld (61)
26	Ea-laagliggend	1.2.5	*Eragrostis curvula-Felicia fascicularis*-grasveld	Cymbopogon-Themeda Veld (48), Themeda Veld (52), Bankenveld (61)
27	Ea-laagliggend	1.3.1	*Themeda triandra-Chloris virgata*-grasveld	Themeda Veld (52)
28	Ea-laagliggend	1.3.2	*Themeda triandra-Aristida bipartita*-grasveld	Themeda Veld (52)
29	Ea-laagliggend	1.4	*Eragrostis curvula-Schoenoplectus decipiens*-grasveld	Gemengde Themeda Veld na Cymbopogon-Themeda Veld oorgangstipe (53)
30	Ea-laagliggend	1.5	*Eragrostis curvula-Eragrostis plana*-grasveld	Cymbopogon-Themeda Veld (48), Themeda Veld (52), Bankenveld (61)
31	Ib	1.1	*Loudetia simplex-Eragrostis curvula*-grasveld	Bankenveld (61)
32	Ib	1.2	*Euclea crispa-Aloe davyana*-struikveld	Bankenveld (61)
33	Ib	1.3	*Diospyros lycioides-Heteromorpha trifoliata*-struikveld	Bankenveld (61)
34	Ib	1.4	*Diospyros lycioides-Leonotis microphylla*-struikveld	Bankenveld (61)
35	Ib	1.5	*Diospyros lycioides-Trachypogon spicatus*-struikveld	Bankenveld (61)
36	Ib	1.6.1	*Eragrostis plana-Cynodon dactylon*-grasveld	Themeda Veld (52)
37	Ib	1.6.2	*Eragrostis plana-Indigofera* spesie-grasveld	Themeda Veld (52), Bankenveld (61)

verspreidingsdiagram (Hill 1979a) van die verskillende groepe plantgemeenskappe is saamgestel.

Groep 1

Plantgemeenskappe 9, 10, 32, 33, 34 en 35 (Tabel 10.1) is floristies nouverwant. Groep 1 word gekenmerk deur Spesiegroep B (Tabel 10.1). Spesies uit Spesiegroepe A, F, H, K, M en Q is ook in die gemeenskapgroep teenwoordig (Tabel 10.1). Plantgemeenskappe 9 en 10 is van die hoërliggende gebiede van die Ba-landtipe terwyl plantgemeenskappe 32, 33, 34 en 35 die hoërliggende gebiede van die Ib-landtipe verteenwoordig (Tabel 10.2). Uit Spesiegroep B (Tabel 10.1) is dit duidelik dat hoewel die plantgemeenskappe floristies verwant is, hulle tog voldoende van mekaar verskil om as afsonderlike entiteite beskou te word. Die beperkte teenwoordigheid van onder andere *Aloe davyana, Ehretia rigida, Haemanthus humilis* en *Teucrium trifidum* (Tabel 10.1; B) tot gemeenskappe 33, 34 en 35 dui ook op die regverdiging om in dié geval afsonderlike fitososiologiese tabelle vir die Ba- en Ib-landtipes op te stel.

Die plantgemeenskappe van Groep 1 kom op vlak (< 300 mm) klipperige grond van die Mispa grondvorm (MacVicar et al. 1977) met basaltiese lawa, agglomeraat, tuf, diabaas en doleriet as onderliggende moedermateriaal, voor. Die groep word op 'n hoogte van 1 580 m tot 1 760 m bo seespieël teen glooiings met 'n helling van 1-25° op terreineenhede 1 en 3, met 'n bogrondse klipbedekking van 16-60% aangetref.

Groep 2

Plantgemeenskappe 1, 2 en 8 is in die sinoptiese tabel saamgegroepeer (Tabel 10.1). Groep 2 word gekenmerk deur afwesigheid van Spesiegroep B en die teenwoordigheid van Spesiegroep C (Tabel 10.1). Terselfdertyd dui Spesiegroep C ook aan dat plantgemeenskappe 1, 2 en 8 floristies verskillend is en as afsonderlike entiteite gesien moet word (Tabel 10.1). Spesies van Spesiegroepe A, E, F, H, K, M en Q kom ook in Groep 2 voor (Tabel 10.1). Plantgemeenskappe 1 en 2 is die hoërliggende struikveld in die Ea-landtipe terwyl gemeenskap 8 die hoërliggende grasveld in die Ba-landtipe verteenwoordig (Tabel 10.2). Spesiegroep A is die gemeenskaplike spesies van Groepe 1 en 2 (Tabel 10.1). Groepe 1 en 2 verteenwoordig hoofsaaklik klipperige struikveld of hoërliggende klipperige grasveldgemeenskappe in die studiegebied.

Groep 2 kom op, rooi leem- en kleigronde en Mispa gronde (MacVicar et al. 1977) met sandsteen, skalie en doleriet as onderliggende moedermateriaal voor. Die groep word op 'n hoogte van 1 560 m tot 1 640 m bo seespieël teen glooiings met 'n helling van 0-15° op terreineenhede 1 en 3 met 'n bogrondse klipbedekking van 0-45% aangetref.

Groep 3

Plantgemeenskappe 3, 7, 11, 13 en 36 word in die sinoptiese tabel (Tabel 10.1) saamgegroepeer. Groep 3 word deels gekenmerk deur Spesiegroep D asook die teenwoordigheid van Spesiegroep E (Tabel 10.1). Spesies van Spesiegroepe F, H, K, M en Q kom ook in Groep 3 voor (Tabel 10.1). Spesiegroep E (Tabel 10.1) is die

gemeenskaplike spesies van Groepe 1, 2 en 3 en dui op die floristiese verwantskap tussen die hoërliggende struikveld en die hoërliggende grasveld. Plantgemeenskap 3 is van die hoërliggende grasveld op die Ea-landtipe terwyl plantgemeenskappe 7, 11 en 13 die hoërliggende grasveld van die Ba-landtipe verteenwoordig. Plantgemeenskap 36 is laerliggende grasveld van die Ib-landtipe (Tabel 10.2). Plantgemeenskap 36 stem egter floristies min met enige van die ander plantgemeenskappe ooreen, maar pas die beste by Groep 3 (Tabel 10.1). Plantgemeenskap 36 kan moontlik ook as 'n afsonderlike eenheid beskou word.

Die plantgemeenskappe van Groep 3 kom op rooi en geel leem- en kleigronde met ongedifferensieerde Witwatersrandkwartsiet, skalie, basaltiese lawa, agglomeraat, tuf en doloriet as onderliggende moedermateriaal voor. Die gemiddelde gronddiepte varieër tussen 100 mm en 1 200 mm. Die groep word op 'n hoogte van 1 520 m tot 1 680 m bo seespieël teen glooiings met 'n helling van 1-4° op terreineenhede 1 en 3 met 'n bogrondse klipbedekking van 0-45% aangetref.

Groep 4

Plantgemeenskappe 4, 18, 22, 23, 25, 26 en 30 is op die sinoptiese tabel (Tabel 10.1) saamgegroepeer. Groep 4 word gekenmerk deur Spesiegroep F terwyl Spesiegroep I oorwegend tot Groep 4 beperk is (Tabel 10.1). Spesiegroepe J, L en P (Tabel 10.1) is ook in Groep 4 teenwoordig. Die gesamentlike teenwoordigheid van Spesiegroepe G en I (Tabel 10.1) is ook karakteristiek vir die plantgemeenskappe van Groep 4. Plantgemeenskap 4 verteenwoordig laerliggende grasveld in die Ba-landtipe en het 'n unieke en karakteristieke spesiesamestelling

(Spesiegroep F) terwyl plantgemeenskap 18 'n laerliggende grasveld in die Bb-landtipe is (Tabel 10.2). Plantgemeenskappe 22, 23, 25, 26 en 30 is laerliggende grasveld in die Ea-landtipe (Tabel 10.2).

Die plantgemeenskappe van Groep 4 kom deurgaans laerliggend op swart kleigronde, geel en rooi leem- en kleigronde met 'n gemiddelde diepte van 150 mm tot 1 200 mm en basaltiese lawa, agglomeraat, tuf, sandsteen, skalie en doloriet as onderliggende moedermateriaal voor. Die groep word op 'n hoogte van 1 500 m tot 1 600 m bo seespieël teen glooiings met 'n helling van 0-4° op terreineenhede 3 en 4 met geen bogrondse klip aangetref.

Groep 5

Plantgemeenskappe 6, 24 en 37 is op die sinoptiese tabel (Tabel 10.1) saamgegroepeer. Groep 5 word gekenmerk deur Spesiegroep H (Tabel 10.1). Spesiegroep H dui terselfdertyd op die floristiese verskille tussen die drie plantgemeenskappe aan. Spesies van Spesiegroeppe I, J, en P is ook in Groep 5 teenwoordig (Tabel 10.1). Plantgemeenskap 6 is 'n laerliggende grasveld in die Ba-landtipe, plantgemeenskap 24 'n laerliggende grasveld in die Ea-landtipe en plantgemeenskap 37 'n laerliggende grasveld in die Ib-landtipe (Tabel 10.2).

Soos in die geval van Groep 4 is die plantgemeenskappe van Groep 5 ook beperk tot die laerliggende dele en kom op swart kleigronde, geel leem- en kleigronde met 'n gemiddelde gronddiepte van < 780 mm met diabaas, eoliese sand, doleriet, basaltiese lawa, agglomeraat en tuf as onderliggende moedermateriaal voor. Die groep word op 'n hoogte van 1 500 m tot

1 620 m bo seespieël teen glooiings met 'n helling van 0-4° op terreineenheid 4 met 'n bogrondse klipbedekking van 0-10% aangetref.

Groep 6

Plantgemeenskappe 12, 15, 27, 28, 29 en 31 word op die sinoptiese tabel (Tabel 10.1) saamgegroepeer. Groep 6 word gekenmerk deur Spesiegroep K (Tabel 10.1). Spesiegroep K dui terselfdertyd ook die duidelike floristiese verskille tussen die ses gemeenskappe aan. Spesies van Spesiegroepe L, N en P word ook in Groep 6 aangetref (Tabel 10.1). Plantgemeenskappe 12 en 31 word op grond van hoogte bo seespieël, geologie en bogrondse klipbedekking van plantgemeenskappe 15, 27, 28 en 29 onderskei. Plantgemeenskap 12 is 'n hoërliggende grasveld in die Ba-landtipe terwyl plantgemeenskap 31 'n hoërliggende grasveld in die Ib-landtipe is (Tabel 10.2). Plantgemeenskap 15 is 'n laerliggende grasveld in die Bb-landtipe terwyl plantgemeenskappe 27, 28 en 29 laerliggende grasveld in die Ea-landtipe is (Tabel 10.2).

Plantgemeenskappe van Groep 6 kom op swart kleigronde en Mispa gronde (MacVicar et al. 1977) met ongedifferensieerde Witwatersrandkwartsiet, skalie, sandsteen en doloriet as onderliggende moedermateriaal voor. Die gemiddelde gronddiepte is <1 200 mm. Die groep word op 'n hoogte van 1 500 m tot 1 640 m bo seespieël teen glooiings met 'n helling van 0-3° op terreineenhede 3, 4 en 5 met 'n klipbedekking van 0-30% aangetref.

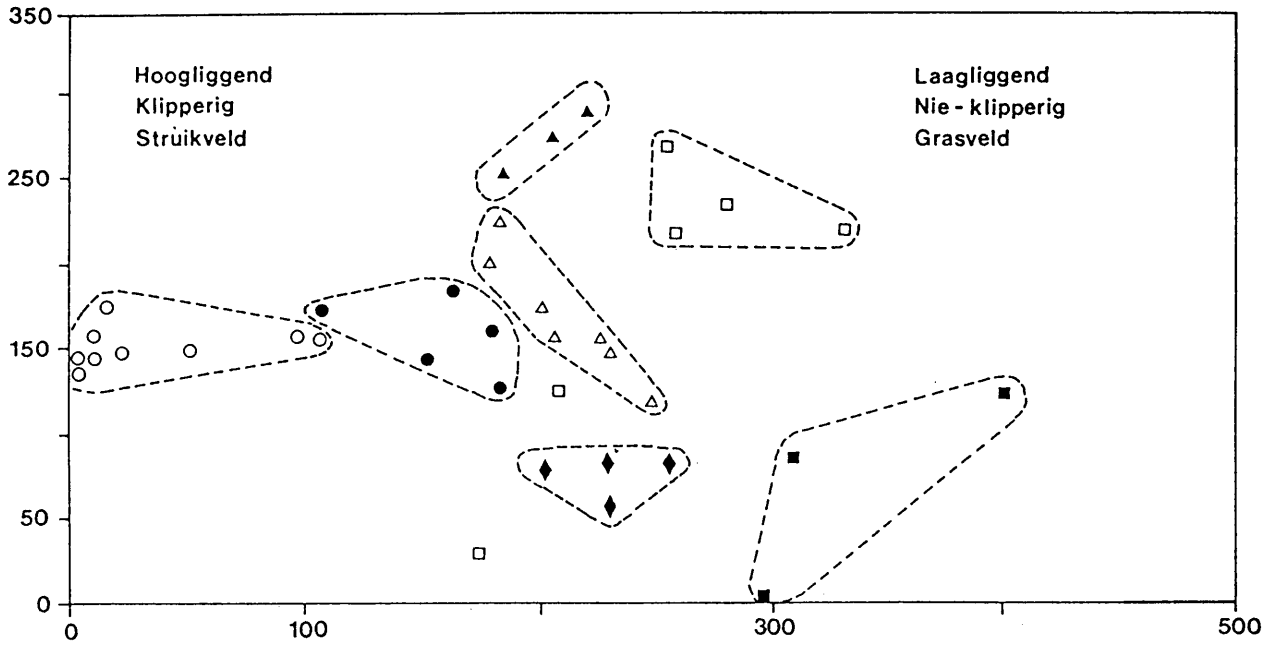
Groep 7

Plantgemeenskappe 14, 20 en 21 word in groep 7 op die sinoptiese tabel saamgegroepeer (Tabel 10.1). Groep 7 word gekenmerk deur Spesiegroep M (Tabel 10.1). Spesies van Spesiegroepe N en P kom ook in groep 7 voor (Tabel 10.1). Groep 7 word van al die ander Groepe op grond van geologie en grondvorm onderskei. Groep 7 is verteenwoordigend van die sandgronde van die studiegebied. Plantgemeenskap 14 is 'n laerliggende grasveld in die Bb-landtipe, plantgemeenskap 21 'n laerliggende grasveld in die Ea-landtipe en plantgemeenskap 20 'n laerliggende grasveld in die Ca-landtipe (Tabel 10.2). Plantgemeenskap 20 is verteenwoordigend van die totale Ca-landtipe in die studiegebied en is aan die Oranje Vrystaat kant van die Vaalrivier geleë.

Die plantgemeenskappe van Groep 7 kom op rooi en geel leem- en kleigronde asook op geel en grys growwe sand met hoofsaaklik eoliese sand as onderliggende moedermateriaal voor. Sansteen en skalie as onderliggende moedermateriaal is ook in die groep teenwoordig. Die gemiddelde gronddiepte is < 1 200 mm. Die groep word op 'n hoogte van 1 500 m tot 1 540 m bo seespieël teen glooiings met 'n helling van 0-3° en geen bogrondse klip aangetref.

Groep 8

Plantgemeenskappe 5, 16, 17 en 19 is in Groep 8 op die sinoptiese tabel (Tabel 10.1) saamgegroepeer. Groep 8 word gekenmerk deur Spesiegroep O (Tabel 10.1). Spesies van Spesiegroep P kom ook in Groep 8 voor (Tabel 10.1). Groep 8 verteenwoordig die laerliggende higrofiele plantgemeenskappe in die studiegebied.



Figuur 10.1 'n DECORANA verspreidingsdiagram van die plantgemeenskappe in die Villiers-Grootvlei-omgewing.

○ Groep 1 en 2
● Groep 3
△ Groep 4
▲ Groep 5
□ Groep 6
■ Groep 7
♦ Groep 8

Plantgemeenskap 5 is 'n laerliggende grasveld in die Ba-landtipe terwyl plantgemeenskappe 16, 17 en 19 laerliggende grasveld in die Bb-landtipe is (Tabel 10.1).

Die plantgemeenskappe van Groep 8 kom op swart kleigronde en geel leem- en kleigronde met 'n gronddiepte van < 730 mm en met sandsteen en skalie as onderliggende moedermateriaal voor. Die groep word op 'n hoogte van 1 520 m tot 1 600 m bo seespieël teen glooiings met 'n helling van 0-2° op terreineenhede 4 en 5 met geen bogrondse klip aangetref.

'n Ordeningsverspreidingsdiagram van die plantgemeenskappe (Figuur 10.1) is met behulp van DECORANA (Hill 1979a) opgestel om die verwantskappe tussen die verskillende Groepe aan te toon. As een teenoor As twee is gebruik om die variasie van die datastel voor te stel. As 1 is vir 57,1% (Eigen waarde van 0,571) en As 2 vir 33,2% (Eigen waarde van 0,332) van die variasie in die data verantwoordelik. Die Groepe is op die eerste-as langs 'n hoogte-gradiënt met Groepe links hoogliggend en Groepe regs laerliggend versprei (Figuur 10.1). 'n Dreinerings-gradiënt met goeie dreinering links en swak dreinering regs, met die uitsondering van Groep 7, kan ook aangedui word (Figuur 10.1). Ten spyte daarvan dat die gemeenskappe 'n duidelike gradiënt langs die x-as verteenwoordig, is dit moontlik om die verskillende groepe te omgrens.

Die sinoptiese tabel (Tabel 10.1) sowel as die ordening (Figuur 10.1) dui aan dat alhoewel verskillende plantgemeenskappe in die onderskeie landtipes verkry is daar verwantskappe tussen die soortgelyke plantgemeenskappe in die verskillende landtipes voorkom. Die spesiesamestelling van die onderskeie gemeenskappe toon egter dat die verskillende

plantgemeenskappe floristies onderskei kan word. Verder meer kan die verdeling van die datastel in die verskillende landtipes geregverdig word. Die verskille tussen die plantgemeenskappe is as gevolg van geologie, gronde, hoogte bo seespieël, bogrondse klipbedekking en verskillende bestuurspraktyke.

Die oorgrote plantgemeenskappe van die Ib-, Ba- en die hoërliggende gebiede van die Ea-landtipes kom voor in die Bankenveld (Veldtipe 61) terwyl die plantgemeenskappe van die Bb- en die laerliggende gebiede van die Ea-landtipes voorkom in Themeda Veld (Veldtipe 52) (Tabel 10.2). Enkele plantgemeenskappe van die Bb- en die Ea-landtipe kom voor in die Cymbopogon-Themeda Veld (Veldtipe 48) terwyl die plantegroei van die Ca-landtipe en een plantgemeenskap van die laerliggende gebied van die Ea-landtipe voorkom in die Gemengde Themeda Veld na Cymbopogon-Themeda Veld oorgangstipe (Veldtipe 53) (Tabel 10.2). Slegs een plantgemeenskap van die Ba-landipe kom voor in die Themeda Veld na Bankenveld oorgangstipe (Veldtipe 55) (Tabel 10.2).

HOOFSTUK 11.

The phytosociology of the Villiers-Grootvlei area, South Africa. 5. Floristic analysis and checklist.

W.J. Myburgh*, P.J.J. Breytenbach*, G.K. Theron**, and G.J. Bredenkamp**

Keywords:Checklist, Villiers-Grootvlei area

ABSTRACT

The checklist consists of 365 plant taxa occurring between 1 500 m and 1 827 m above mean sea level in the Villiers-Grootvlei area. The species are arranged alphabetically within the genera. Annotations include genus author, species author, collector and specimen number. Floristic analysis shows the Poaceae as representing the largest family, followed by the Asteraceae, Cyperaceae and Fabaceae.

UITTREKSEL

Die spesielys bestaan uit 365 planttaksa wat tussen 1 500 m en 1 827 m bo seespieël in die Villiers-Grootvlei area aangetref word. Die spesies is alfabeties onder die genusse gerangskik. Aantekeninge sluit die genus-outeur, spesie-outeur, versamelaar en eksemplaarnommer in. Volgens die floristiese analise verteenwoordig die Poaceae die grootste familie gevolg deur die Asteraceae, Cyperaceae en Fabaceae

INTRODUCTION

The floristic composition of the Cymbopogon -Themeda Veld (Veldtype 48), Themeda Veld (Veldtype 52), patchy Highveld

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to Cymbopogon-Themeda Veld transition (Veldtype 53), Bankenveld to Turf Highveld transition (Veldtype 55) and the Bankenveld Veldtype 61) (Acocks 1988) in the Grootvlei area, southern Transvaal, consists of 68 plant taxa according to PRECIS (computerized herbarium specimens) of the National Herbarium* in Pretoria. The phytososiological survey (Myburgh 1991; Breytenbach 1991) indicated the inadequate representation of plant taxa in the study area (Figure 1).

METHOD

The plant taxa, collected from November 1987 till April 1990, were identified by the National Herbarium personnel. Most taxa are represented by voucher specimens housed in the National Herbarium, Pretoria.

Classification of the Pteridophyta is according to Anthony & Schelpe (1985) and that of the Angiospermae is according to Gibbs Russel et al. (1985, 1987). The species are arranged alphabetically within the genera. Exotic species are indicated by an #. The collectors number of W.J. Myburgh and P.J.J. Breytenbach (*) follow the species name.

FLORISTIC ANALYSIS

A total of 365 plant taxa, wich include 65 families and 220 genera (Table 1) were collected in the study area.

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Pretoria, 0001.

TABLE 1. Floristic analysis of the taxa in the Grootvlei area, southern Transvaal.

Major families and groups	No. of families	No. of genera	No. of species
Monocotyledonae	10	74	135
Poaceae		40	79
Cyperaceae		12	29
Liliaceae		9	16
Dicotyledonae	53	143	225
Asteraceae		32	70
Fabaceae		15	18
Angiospermae	63	217	360
Pteridophyta	2	3	5
Total	65	220	365

A floristic analysis of the checklist shows that the Pteridophyta represents only two families (3,1% of the total number of families), the Monocotyledonae ten families (15,4%) and the Dicotyledonae 53 families (81,5%) (Figure 2a). The total number of species represent 1,4% Pteridophyta, 37% Monocotyledonae and 61,6% Dicotyledonae (Figure 2c) with the Poaceae (79 species) and the Asteraceae (70 species) as the largest families (Table 1). Scheepers (1979), Deall (1989) and Turner (1990) obtained similar results. The genera Helichrysum (14 species), Senecio (10 species), Aristida (10 species) and Eragrostis (9 species) contain the most species in the study area.

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CHECKLIST

PTERIDOPHYTA

ADIANTHACEAE

340	Cheilanthes Swartz	
	Cheilanthes eckloniana (Kunze) Mett.	062
	C. hirta Swartz	025
360	Pellaea Link	
	Pellaea calomelanos (Swartz) Link	026
	P. spesie	029

ASPLENIACEAE

520	Asplenium L.	
	Asplenium splendens Kunże	076

ANGIOSPERMAE

MONOCOTYLEDONAE

APONOGETONACEAE

650	Aponogeton L. F.	
	Aponogeton junceus Lehm. ex Schlechtd. subsp. exsertus	103

POACEAE

28	Elionurus Kunth ex willd.	
	Elionurus muticus (Spreng.) Kunth	050*
37	Imperata L.	
	Imperata cylindrica (L.) Raeuschel	093*
46	Sorghum Moench.	
	Sorghum bicolor (L.) Moench. subsp. arundinaceum (Desv.) De Wet & Harlan	335*
	#S. halepense (L.) Pers.	116*
68	Schizachyrium Nees	
	Schizachyrium sanguieum (Retz.) Alst.	313*
71	Andropogon L.	
	Andropogon appendiculatus Nees	093
	A. eucomus Nees	425*
	A. schirensis A. Rich.	339*

72	Cymbopogon Spreng.	
	Cymbopogon dieterlenii Stapf ex Phill.	094*
	C. excavatus (Hochst.) Stapf ex Burtt Davy	032
	C. plurinodis (Stapf) Stapf ex Burtt Davy	
73	Hyparrhenia Anderss. ex Fourn.	
	Hyparrhenia anamesa Clayton	068*
	H. hirta (L.) Stapf	060
75	Monocymbium Stapf	
	Monocymbium cerisiiforme (Nees) Stapf	
78	Trachypogon Nees	
	Trachypogon spicatus (L. F.) Kuntze	338*
80	Heteropogon Pers.	
	Heteropogon contortus (L.) Roem. & Schult.	081*
81	Diheteropogon Stapf	
	Diheteropogon amplectens (Nees) Clayton	
	D. filifolius (Nees) Clayton	059
83	Themeda Forssk.	
	Themeda trianda Forssk.	058*
89	Digitaria Nees	
	Digitaria diagonalis(Nees) Stapf	
	var. diagonalis	066
	D. eriantha Steud.	127*
	D. ternata (A. Rich.) Stapf	174*
	D. tricholaenoides Stapf	044
94	Alloteropsis J.S. Presl	
	Alloteropsis semialata (R. Br.) Hitchc.	
	subsp. semialata	089*
104	Brachiaria Griseb.	
	Brachiaria eruciformis (J.E. S.) Griseb.	121*
	B. serrata (Thunb.) Stapf	051*
107	Paspalum L.	
	Paspalum dilatatum Poir.	418*
	P. distichum L.	095
110	Urochloa Beauv.	
	Urochloa panicoides Beauv.	321*
116	Panicum L.	
	Panicum coloratum L.	
	var. coloratum	057*
	P. maximum Jacq.	124*
	P. natalense Hochst.	007
	P. schinzii Hack.	124*

128	Setaria Beauv.	
	Setaria incrassata (Hochst.) Hack.	043*
	S. nigrirostris (Nees) Dur. & Schinz	048
	S. pallide-fusca (Schumach.) Stapf & C.E. Hubb	123*
	S. sphacelata (Schumach.) Moss	
	var. sericera (Stapf) Clayton	430*
	var. sphacelata	083
	var. torta (Stapf) Clayton	384*
132/1	Rhynchelytrum (Nees)	
	Rhynchelytrum nerviglume (Franch.) Chiov.	065*
	R. repens (Willd.) C.E. Hubb.	
159	Leersia Swartz.	
	Leersia hexandra Swartz.	422*
160	Ehrharta Thub.	
	Ehrharta erecta Lam.	
	var. natalensis Stapf	072
174	Tristachya Nees	
	Tristachya leucothrix Nees	066*
175/1	Loudetia Hochst. ex Steud.	
	Loudetia simplex (Nees) C. E. Hubb.	
197	Helictotrychon Bess. ex Schult.	
	Helictotrychon spesie	419*
	H. turgidulum (Stapf) Schweick.	400*
243	Agrostis L.	
	Agrostis lachnantha Nees	103
244	Polypogon L.	
	Polypogon monspeliensis (L.) Desf.	108
261/1	Stipagrostis Nees	
	Stipagrostis zeyheri (Nees) De Winter	
	subsp. sericans (Hack.) De Winter	226*
262	Aristida L.	
	Aristida adscensionis L.	
	subsp. guineensis (Trin. & Rupr.) Henr.	225*
	A. bipartita (Nees) Trin. & Rupr.	188*
	A. canescens Henr.	
	subsp. canescens	056
	A. congesta Roem. & Schult.	
	subsp. congesta	053*
	A. diffusa Trin.	
	subsp. burkei (Stapf) Meld.	099*
	subsp. diffusa	
	A. junciformis Trin. & Rupr.	
	subsp. junciformis	158*
	A. mollissima Pilg.	
	subsp. argentea (Schweick.) Meld.	147*

	subsp. mollissima	090*
	A. sciurus Stapf	130*
	A. stipitata Hack.	
	subsp. spicata (De Winter) Meld.	147*
	A. transvaalensis Henr.	
283	Sporobolus BR.	
	Sporobolus africanus (Poir.) Robyns & Tournay	
	S. discosporus Nees	281*
	S. pectinatus Hack.	308*
286	Eragrostis Beauv.	
	Eragrostis capensis (Thunb.) Trin.	052*
	E. curvula (Schrad.) Nees	010*
	E. gummiflua Nees	134*
	E. lehmanniana Nees	
	var. lehmanniana	
	E. plana Nees	091*
	E. planiculmis	100
	E. racemosa (Thunb.) Steud.	047*
	E. sclerantha Nees	
	subsp. sclerantha	238*
	E. spesie	054*
294	Microchloa R. Br.	
	Microchloa caffra Nees	
296	Cynodon Rich. ex Pers.	
	Cynodon dactylon (L.) Pers.	086*
298	Harpochloa Kuntz	
	Harpochloa falx (L. F.) Kunze	078*
301	Chloris Swartz	
	Chloris virgata Swartz	176*
331	Eleusine Gaertn.	
	Eleusine coracana (L.) Gaertn.	
	subsp. africana (K. -O'Bryne) S.M. Phillips	125*
334	Pogonarthria	
	Pogonarthria squarrosa (Roem. & Schult.) Pilg.	119*
350	Triraphis R. Br.	
	Triraphis andropogonoides (Steud.) Phill.	051
353	Trichoneura N.J. Anderss.	
	Trichoneura grandiglumis (Nees) Ekman	
	var. grandiglumis	146*
428	Bromus L.	
	Bromus catharticus Vahl	366*

459	Cyperus L.	
	Cyperus denudatus L.F.	104
	C. esculentus L.	171*
	C. margaritaceus Vahl	139*
	C. obtusiflorus Vahl var. sphaerocephalus (Vahl) Kuekenth.	413*
	C. rigidifolius Steud.	437*
	C. semitrifidus Schad. var. semitrifidus	060
	C. tenax Boeck.	236*
459/1	Pycreus Beauv.	
	Pycreus macranthus (Boeck.) C.B. Cl.	087
	P. pumilus (L.) Nees	244*
459/3	Mariscus Gaertn.	
	Mariscus capensis (Steud.) Schrad.	049*
	M. congestus (Vahl.) Bodard	141*
	M. spesie	369*
	M. usitatus (Burch.) Vorster Ms. var. usitatus	080*
462	Kyllinga Rottb.	
	Kyllinga erecta Schumach.	086
	K. intricata Cherm.	239*
467	Fuirena Rottb.	
	Fuirena coerulescens Steud.	298*
	F. pubescens (Poir.) Kunth	420*
468	Scirpus L.	
	Scirpus burkei C.B. Cl.	082*
468/1	Schoenoplectus Palla	
	Schoenoplectus decipiens (Nees) J. Raynal	097
	S. lacustris (L.) Palla	107
468/2	Isolepis R. Br.	
	Isolepis cosata (Boeck.) A. Rich. var. macra (Boeck.) B. L. Burtt	085
469	Eleocharis R. Br.	
	Eleocharis spesie	093
471	Fimbristylis Vahl	
	Fimbristylis complanata (Retz.) Link	429*
471/1	Bulbostylis Kunth	
	Bulbostylis contexta (Nees) Bodard	141*
	B. hispidula (Vahl.) R. Haines	172*
	B. humilus (Kunth) C. B. Cl.	099
	B. oritrephes (Ridley) C. B. Cl. subsp. australis B. L. Burtt	074*

	B. scleropus C.B. Cl.	385*
471/2	Abildgaardia Vahl	
	Abildgaardia ovata (Burm. F.) Kral.	085*

COMMELINACEAE

896	Commelina L.	
	Commelina africana L.	
	var. africana	363*
	var. krebsiana (Kunth) C.B. Cl.	163*
904	Cyanotis D. Don	
	Cyanotis speciosa (L. F.) Hassk.	271*

JUNCACEAE

936	Juncus L.	
	Juncus effusus L.	084
	J. exsertus Buchen.	102

LILIACEAE

985	Bulbine Willd.	
	Bulbine capitata V. Poelln.	038*
	B. narcissifolia Salm-Dyck	013*
	B. spesie	285*
989	Anthericum L.	
	Anthericum fasciculatum Bak.	253*
1026	Aloe L.	
	Aloe davyana Schonl.	
	var. davyana	
	A. transvaalensis Kuntze	
1047	Tulbaghia L.	
	Tulbaghia leucantha Bak.	105
1084	Dipcadi Medic.	
	Dipcadi gracillimum Bak.	087*
1086	Scilla L.	
	Scilla nervosa (Burch.) Jessop	
	var. nervosa	311*
1090	Drimiopsis Lindl.	
	Drimiopsis maxima Bak.	214*
1090/1	Ledebouria Roth.	
	Ledebouria cooperi (Hook. F.) Jessop	091
	L. ovatifolia (Bak.) Jessop	005*
	L. revoluta (L. F.) Jessop	

	L. spesie	292*
1113/1	Protasparagus Oberm.	
	Protasparagus laricinus (Burch.) Oberm.	075
	P. setaceus (Kunth.) Oberm.	057

AMARYLLIDACEAE

1167	Haemanthus L.	
	Haemanthus humilis Jacq. subsp.humilis	
	H. montanus Bak.	407*
1168	Boophane Herb.	
	Boophane disticha (L. F.) Herb.	
1189	Crinum L.	
	Crinum bulbispermum (Burm. F.) Milne-Redh.	
1191	Cyrtanthus L. F.	
	Cyrtanthus tuckii Bak. var. transvaalensis Verdoorn	025*

HYPOXIDACEAE

1230	Hypoxis L.	
	Hypoxis acuminata Bak.	072*
	H. argentea Harv. ex Bak.	004*
	H. hemerocallidea Fisch. & Mey.	041
	H. iridifolia Bak.	365*
	H. obtusa Burch. ex Edwards var. obtusa	
	H. spesie	195*

IRIDACEAE

1277	Homeria Vent.	
	Homeria pallida Bak.	027*
1303	Dierama K. Koch	
	Dierama mossii (N. E. Br.) Hillard	096
1311	Gladiolus L.	
	Gladiolus crassifolius Bak.	249*
	G. spesie.	

ORCHIDACEAE

1422/2	Bonatea Willd.	
	Bonatea porrecta (H. Bol.) Summerh.	

DICOTYLEDONAE

ULMACEAE

1898 Celtis L.
Celtis africana Burm. F. 001

POLYGONACEAE

2195 Rumex L.
Rumex lanceolatus Thunb. 396*

2201 Polygonum L.
Polygonum senegalense Meisn.
subsp. albotromentosum (R.A. Grah.)Germishuizen 098

2204 Oxygonum Burch.
Oxygonum dregeanum Meisn.
var. canescens (Sond.) R.A. Grah. 144*

CHENOPODIACEAE

2223 Chenopodium L.
#Chenopodium schraderanum Roem. & Schult. 229*

AMARANTHACEAE

2330 Brayulinea Small
#Brayulinea densa (Willd.) Small 159*

2335 Alternanthera Forsk.
#Alternanthera pungens H.B.K. 256*

2338 Gomphrena L.
#Gomphrena celosioides Mart. 160*

AIZOACEAE

2376 Limeum L.
Limeum viscosum (Gay) Fenzl
subsp. viscosum
var. glomeratum (Eckl. & Zeyh.) Friedr. 145*

2379 Psammotropha Eckl.& Zeyh.
Psammotropha mucronata (Thunb.) Fenzl
var. mucronata 316*

MESEMBRYANTHEMACEAE

2405/6 Khadia N.E. Br.
Khadia acutipetala (N.E. Br.) N.E. Br. 312*

ILLECEBRACEAE

2502	Dianthus L.	
	Dianthus basuticus Burtt Davy subsp. basuticus var. basuticus	272*
	D. mooiensis F.N. Williams	

RANUNCULACEAE

2542	Clematis L.	
	Clematis brachiata Thunb.	034
	C. oweniae Harv.	073
2546	Ranunculus L.	
	Ranunculus multifidus Forssk.	089

BRASSICACEAE

2945	Sinapis L.	
	#Sinapis arvensis L.	184*
2946	Diplotaxis DC.	
	#Diplotaxis muralis (L.) DC.	379*

CAPPARACEAE

3082	Cleome L.	
	Cleome maculata (Sond.) Szyszyl.	138*
3101	Capparis L.	
	Capparis brassii DC.	110*

CRASSULACEAE

3166	Kalanchoe Adans.	
	Kalanchoe thyrsiflora Harv.	
3168	Crassula L.	
	Crassula alba Forssk.	005
	C. lanceolata (Eckl. & Zeyh.) Endl. ex Walp. subsp. transvaalensis (Kunze) Toelken	242*
	C. setulosa Harv.	
	var. rubra (N.E. Br.) Rowley	028
	var. setulosa	318*
	C. swaziensis Schonl.	

VAHLIACEAE

3201	Vahlia Thunb.	
	Vahlia spesie	204*

ROSACEAE

3333	Cotoneaster Medik.	
	#Cotoneaster pannosus Franch.	052
3333/1	Pyracantha M.J. Roemer	
	#Pyracantha angustifolia (Franch.) Schneid.	026*

FABACEAE

3446	Acacia Mill.	
	#Acacia dealbata Link	034*
	A. karroo Hayne	107*
3467	Elephantorrhiza Benth.	
	Elephantorrhiza elephantina (Burch.) Skeels	132*
3536	Cassia L.	
	Cassia biensis (Steyaert) Mendona & Torre	142*
3657	Lotononis (DC.) Eckl. & Zeyh.	
	Lotononis listii Polhill	243*
3665	Melolobium Eckl. & Zeyh.	
	Melolobium alpinum Eckl. & Zeyh.	435*
	M. canescens	002*
	M. microphyllum (L.F.) Eckl. & Zeyh.	279*
3669	Crotalaria L.	
	C. virgulata Klotzch	
	subsp. grantiana (Harv.) Polhill	216*
3673	Argyrolobium Eckl. & Zeyh.	
	Argyrolobium pauciflorum Eckl. & Zeyh.	
	var. pauciflorum	003*
	var. semiglabrum Harv.	
	A. spesie	190*
	A. velutinum Eckl. & Zeyh.	012
3690	Trifolium L.	
	Trifolium africanum Ser.	277*
3702	Indigofera L.	
	Indigofera obscura N.E. Br.	016
	I. spesie	205*
3718	Tephrosia Pers.	
	Tephrosia longipes Meisn.	317*
	T. purpurea (L.) Pers.	
	subsp. leptostachya (DC.) Brummitt	
	var. leptostachya	197*

3756	Lessertia DC.	
	Lessertia spesie	
3821	Dalbergia L.F.	
	Dalbergia nitidula Bak.	068
3870	Erythrina L.	
	Erythrina zeyheri Harv.	
3897	Rhynchosia Lour.	
	Rhynchosia adenodes Eckl. & Zeyh.	
	R. totta (Thunb.) D.C.	209*
3905	Vigna Savi	
	Vigna oblongifolia A. Rich.	
	var. parviflora (Bak.) Verdc.	185*

GERANIACEAE

3925	Monsonia L.	
	Monsonia angustifolia E. Mey. ex A. Rich.	217*
	M. attenuata Harv.	030
3928	Pelargonium L'Herit.	
	Pelargonium luridum (Andr.) Sweet	409*

OXALIDACEAE

3936	Oxalis L.	
	Oxalis obliquifolia Steud. ex Rich.	186*

LINACEAE

3945	Linum L.	
	Linum thunbergii Eckl. & Zeyh.	416*

RUTACEAE

3991	Zanthoxylum L.	
	Zanthoxylum capense (Thunb.) Harv.	358*

POLYGALACEAE

4273	Polygala L.	
	Polygala hottentotta Presl.	
	P. spesie	320*

EUPHORBIACEAE

4299	Phyllanthes L.	
	Phyllanthes burchellii Muell. Arg.	354*

	P. maderaspatensis L.	024
4407	Acalypha L.	
	Acalypha caperonioides Baill.	323*
	A. penducularis E. Mey. ex Meisn.	019*
	A. spesie	165*
4448	Clutia L.	
	Clutia hirsuta E. Mey. ex Sond.	042
4498	Euphorbia L.	
	Euphorbia epicyparissias E. Mey. ex Sond.	063
	E. striata Thunb.	
	var. striata	031*
4498/1	Chamaesyce S.F. Gray	
	Chamaesyce inequilatera (Sond.) Sojak	181*

ANACARDIACEAE

4594	Rhus L.	
	Rhus discolor E. Mey. ex Sond.	103*
	R. pyroides Burch.	
	var. pyroides	041
	R. rigida Mill.	022
	R. zeyheri Sond.	

CELASTRACEAE

4626	Maytenus Molina	
	Maytenus heterophylla (Eckl. & Zeyh.)N.K.B. Robson	008

RHAMNACEAE

4861	Ziziphus Mill.	
	Ziziphus mucronata Willd.	
	subsp. mucronata	061*
	Z. zeyheriana Sond.	

VITACEAE

4917	Rhoicissus Planch.	
	Rhoicissus tridentata (L.F.) Wild & Drum.	
	subsp. cuneifolia (Eckl. & Zeyh.) N.R. Urton	021*

MALVACEAE

4992	Malva L.
	#Malva verticillata (L.) G. Don
5007	Pavonia Cav.
	Pavonia transvaalensis (Ulbr.) A. Meeuse

5013 Hibiscus L.
Hibiscus aethiopicus L.
var. ovatus Harv. 390*
H. pusilus Thunb. 371*

STERCULIACEAE

5056 Hermannia L.
Hermannia coccocarpa (Eckl. & Zeyh.) Kunze 012*
H. depressa N.E. Br. 189*
H. lancifolia Szyszyl. 315*

FLACOURTIACEAE

5304 Scolopia Schreb.
Scolopia zeyheri (Nees) Harv. 111*

CACTACEAE

5417 Opuntia Mill.
#Opuntia spesie

THYMELACEAE

5435 Gnidia L.
Gnidia burchellii (Meisn.) Gilg. 037*
G. kraussiana Meisn.
var. kraussiana

ONAGRACEAE

5804 Oenothera L.
Oenothera rosea L'Herit. ex Ait.

ARALIACEAE

5872 Cussonia Thunb.
Cussonia paniculata Eckl. & Zeyh. 069*

APIACEAE

5894 Centella L.
Centella asiatica (L.) Urb. 088

6116 Peucedanum L.
Peucedanum magalismontanum Sond. 391*

MYRSINACEAE

6313 Myrsine L.

	Myrsine africana L.	054
	EBENACEAE	
6404	Euclea Murray	
	Euclea crispa (Thunb.) Geurke subsp. crispa	073*
6406	Diospyros L.	
	Diospyros lycioides Desf. subsp. guerkei (Kunze) De Winter	355*
	subsp. sericea (Bernh.) De Winter	062*
	D. whyteana (Hiern.) F. White	023
	OLEACEAE	
6438	Menodora Humb. & Bonpl.	
	Menodora africana Hook.	
	LOGANIACEAE	
6473	Buddleja L.	
	Buddleja saligna L.	081
	B. salviifolia (L.) Lam.	080
	GENTIANACEAE	
6481	Sebaea Soland. ex R. Br.	
	Sebaea leiostyla Gilg	061
	PERIPLOCACEAE	
6747	Raphionacme Harv.	
	Raphionacme spesie	112*
	ASCLEPIADACEAE	
6783	Cordylogyne E. Mey.	
	Cordylogyne globosa E. Mey.	382*
6787	Pachycarpus E. Mey.	
	Pachycarpus rigidus E. Mey.	367*
6791	Asclepias L.	
	Asclepias decipiens N.E. Br.	403*
	A. eminens (Harv.) Schltr.	411*
	A. fruticosa L.	
	A. multicaulis (E. Mey.) Schltr.	373*
	A. spesie	275*
6870	Brachystelma R. Br.	
	Brachystelma spesie	191*

CONVOLVULACEAE

6972	Falkia L. F.	
	Falkia oblonga Bernh. ex Krauss	006*
6973	Evolvulus L.	
	Evolvulus alsinoides (L.) L.	
	var. linifolius (L.) Bak.	254*
6993	Convolvulus L.	
	Convolvulus sagittatus Thunb.	
	subsp. sagittatus	
	var. phyllosepalus (Hallier F.) A. Meeuse	224*
7003	Ipomoea L.	
	Ipomoea bathycolpos Hallier F.	
	var. bathycolpos	267*
	I. crassipes Hook.	040
	I. obscura (L.) Ker-Gawl.	
7008/1	Turbina Rafin.	
	Turbina oblongata (E. Mey. ex Choisy) A. Meeuse	395*

BORAGINACEAE

7043	Ehretia P. BR.	
	Ehretia rigida (Thunb.) Druce	031

VERBENACEAE

7138	Verbena L.	
	#Verbena bonariensis L.	417*
	#V. brasiliensis Vell.	178*
7145	Lippia L.	
	Lippia rehmannii H. Pearson	004
	L. scaberrima Sond.	

LAMIACEAE

7211	Ajuga L.	
	Ajuga ophrydis Burch. ex Benth.	414*
7212	Teucrium L.	
	Teucrium trifidum Retz.	011
7264	Leonotis (Pers.) R. Br.	
	Leonotis microphylla Skan.	
7290	Salvia L.	
	Salvia repens Burch. ex Benth.	
	var. transvaalensis Hedge	436*

7345	Aeollanthus Mart. ex K. Spreng.	
	Aeollanthus buchnerianus Briq.	053
7350	Plectracanthus L'Herit.	
	Plectracanthus madagascariensis (Pers.) Benth. var. ramosior Benth.	362*

SOLANACEAE

7407	Solanum L.	
	Solanum capense L.	047
	S. incanum L.	048
	S. panduriforme E. Mey.	137*
	S. supinum Dun.	135*

SCROPHULARIACEAE (I)

7467	Aptosimum Burch.	
	Aptosimum indivisum Burch. ex Benth.	001*
7476	Nemesia Vent.	
	Nemesia spesie	035*
7477	Diclus Benth.	
	Diclus rotundifolia (Hiern) Hilliard & Burtt	028*
7519	Sutera Roth.	
	Sutera aurantica (Burch.) Hiern	
	S. caerulea (L.F.) Hiern	064
	S. pallida (Pilg.) Overk. ex Roessl.	
7524	Mimulus L.	
	Mimulus gracilis R.Br.	399*

SELAGINACEAE

7568/1	Walafrida E. Mey.	
	Walafrida densiflora (Rolfe) Rolfe	148*

SCROPHULARIACEAE (II)

7597/1	Alectra Thunb.	
	A. sessiliflora (Vahl) Kunze var. sessiliflora	300*
7623	Cycnium E. Mey. ex Benth.	
	Cycnium tubulosum (L.F.) Engl.	424*
7625	Striga Lour.	
	Striga bilabiata (Thunb.) Kunze	388*
	S. elegans Benth.	

ACANTHACEAE

7941	Chaetacanthus Nees	
	Chaetacanthus burchelli Nees	200*
	C. costatus Nees	
	C. spesie	
7972	Crabbea Harv.	
	Crabbea acaulis N.E. Br.	162*
	C. hirsuta Harv.	199*
7973	Barleria L.	
	Barleria macrostegia Nees	150*
	B. obtusa Nees	065
7980	Blepharis Juss.	
	Blepharis innocua C.B. Cl. var. innocua	207*

RUBIACEAE

8136/6	Kohautia Cham. & Schlechtd.	
	Kohautia amatymbica Eckl. & Zeyh.	149*
	K. virgata (Willd.) Brem.	234*
8348	Pentanisia Harv.	
	Pentanisia angustifolia (Hochst.) Hochst.	
8352	Canthium Lam.	
	Canthium gilfillanii (N.E. Br.) O.B. Miller	055
8438	Anthospermum L.	
	Anthospermum pumilum Sond. subsp. pumilum	180*

DIPSACACEAE

8546	Scabiosa L.	
	Scabiosa columbaria L.	044*

CUCURBITACEAE

8599	Cucumis L.	
	Cucumis hirsutus Sond.	258*
	C. zeyheri Sond.	227*

CAMPANULACEAE

8668	Wahlenbergia Schrad. ex Roth	
	Wahlenbergia indulata (L.F.) A. DC.	421*
8668/1	Craterocapsa Hilliard & Burtt	
	Craterocapsa tarsodes Hilliard & Burtt	211*

8751	Vernonia Schreb.	
	Vernonia capensis (Houtt.) Druce	077
	V. galpinii Klatt	064*
	V. natalensis Sch. Bip.	027
	V. oligocephala (DC.) Sch. Bip. ex Walp.	033*
8919	Felicia Cass.	
	Felicia fascicularis DC.	007*
	F. filifolia (Vent.) Burtt Davy subsp. filifolia	022*
8925	Nidorella Cass.	
	Nidorella anomala Steetz	038
	N. resedifolia DC. subsp. resedifolia	118*
8926	Conyza Less.	
	Conyza bonariensis (L.) Cronq.	307*
	C. podocephala DC.	331*
8949	Denekia Thunb.	
	Denekia capensis Thunb.	397*
8992/5	Pseudognaphalium Kirp.	
	Pseudognaphalium luteo-album (L.) Hillard & Burtt	090
	P. oligandrum (DC.) Hilliard & Burtt.	045
9006	Helichrysum Mill.	
	Helichrysum aureonitens Sch. Bip.	372*
	H. aureum (Houtt.) Merr. var. monocephalium (DC.) Hilliard	
	H. callicomum Harv.	046
	H. cerastioides DC.	
	H. coriaceum Harv.	342*
	H. kraussii Sch. Bip.	067
	H. lepidissimum S. Moore	039
	H. lineare DC.	036*
	H. melanacme DC.	058
	H. nudifolium (L.) Less.	433*
	H. paronychioides DC.	140*
	H. pilosellum (L. F.) Less.	045*
	H. rugulosum Less.	175*
	H. spesie	268*
9037	Stoebe L.	
	Stoebe vulgaris Levyns	023*
9055	Athrixia Ker-Gawl.	
	Athrixia elata Sond.	006
9090	Geigeria Griesselich	
	Geigeria aspera Harv. var. aspera	284*

9155	Zinnia L.	
	#Zinnia peruviana (L.) L.	002
9237	Bidens L.	
	#Bidens pilosa L.	
9291	Schkuhria Roth.	
	#Schkuhria pinnata (Lam.) Cabr.	161*
9311	Tagetus L.	
	#Tagetus minuta L.	
9351/1	Cenia Comm.	
	Cenia microglossa DC.	106
9356	Schistostephium Less.	
	Schistostephium crataegifolium (DC.) Fenzl.	003
9358	Artemisia L.	
	Artemisia afra Jacq. ex Willd.	078
9366	Pentzia Thunb.	
	Pentzia globosa DC.	377*
	P. incana (Thunb.) Kunze	283*
9411	Senecio L.	
	Senecio affinis DC.	
	S. asperulus DC.	386*
	S. coronatus (Thunb.) Harv.	325*
	S. erubescens Ait.	
	var. dichotomus DC.	
	S. hieracioides DC.	032*
	S. othonniflorus DC.	392*
	S. oxyriifolius DC.	
	S. polyodon DC.	
	var. polyodon	092
	S. spesie	252*
	S. venosus Harv.	
9417	Euryops Cass.	
	Euryops transvaalensis Klatt	
	subsp. transvaalensis	309*
9426	Garuleum Cass.	
	Garuleum woodii Schinz	009
9427	Osteospermum L.	
	Osteospermum scariosum DC.	
	var. scariosum	259*
9432	Arctotis L.	
	Arctotis arctotoides (L.F.) O. Hoffm.	387*
	A. microcephala (DC.) Beauv.	030*

9432/3	Haplocarpha Less.	
	Haplocarpha lyrata Harv.	293*
	H. scaposa Harv.	037
9434	Gazania Gaertn.	
	Gazania krebsiana Less.	
	subsp. arctotoides (Less.) Roessl.	009*
	subsp. serrulata (DC.) Roessl.	029*
9438	Berkheya Ehrh.	
	Berkheya onopordifolia (DC.) o. Hoffm. ex Burtt Davy	
	var. onopordifolia	434*
	B. pinnatifida (Thunb.) Less.	
	subsp. ingrata (H. Bol.) Roessl.	115*
	B. radula (Harv.) De Wild.	
	B. seminivea Harv. & Sond.	036
	B. setifera DC.	376*
9441	Platycarpha Less.	
	Platycarpha parvifolia S. Moore	011*
9501	Dicoma Cass.	
	Dicoma anomala Sond.	
	subsp.anomala	
	D. macrocephala DC.	282*
9528	Gerbera L.	
	Gerbera piloselloides (L.) Cass.	016*
	G. viridifolia (DC.) Sch. Bip.	
	subsp. viridifolia	019
9561	Tolpis Adams	
	Tolpis capensis (L.) Sch. Bip.	375*
9595	Sonchus L.	
	Sonchus nanus Sond. ex Harv.	194*
9596	Lactuca L.	
	Lactuca spesie	324*

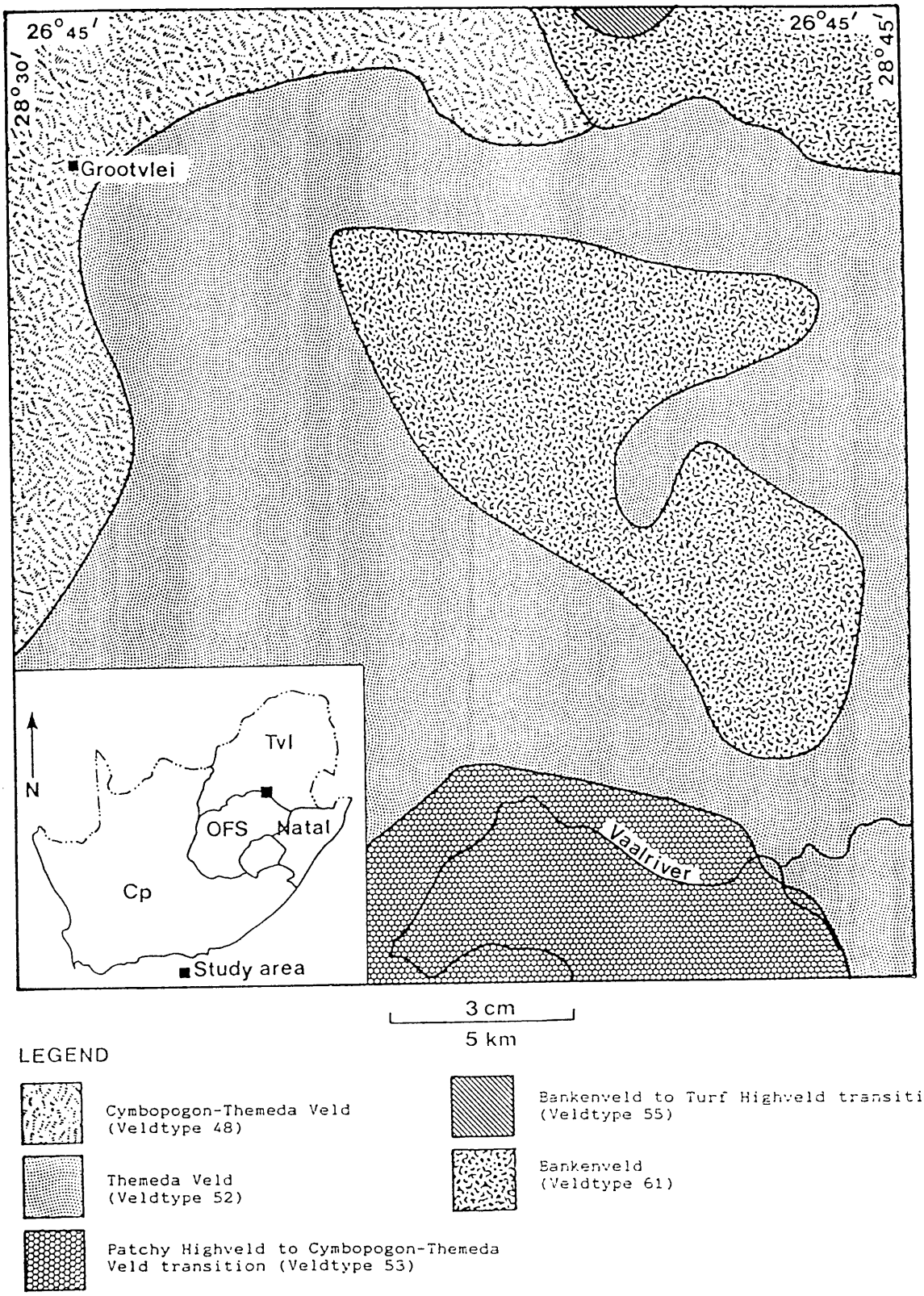

FIGURE 1. The location of the Veldtypes (Acocks 1988) in the study area.

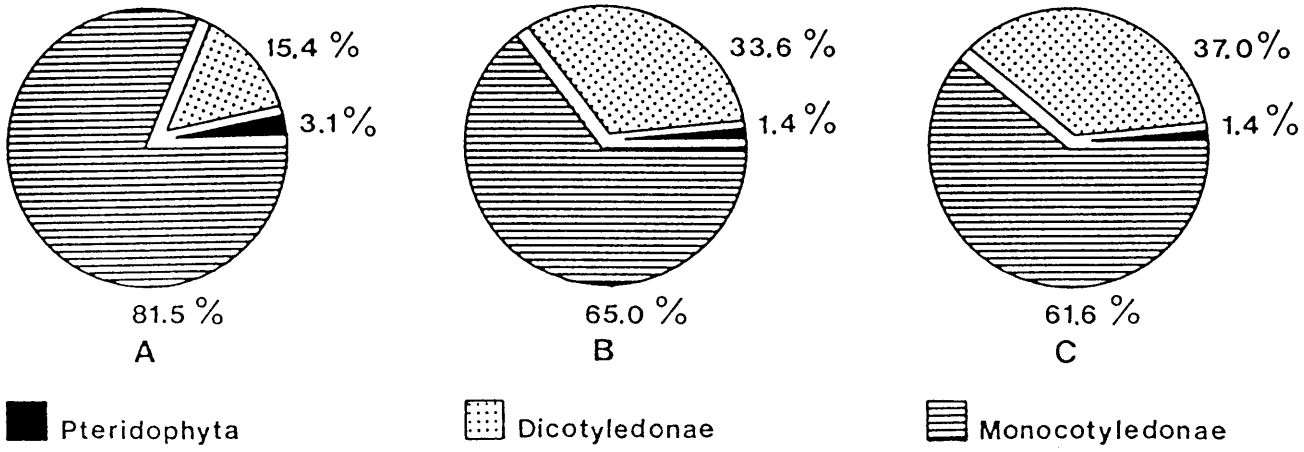

FIGURE 2. Floristic analysis of taxa (a) families, (b) genera, (c) species.

HOOFSTUK 12

ALGEMENE BESPREKING

Die doel van die studie was om die floristiese samestelling, struktuur en omgewingsinteraksies van die plantegroei in die Villiers-Grootvlei-omgewing te bestudeer en om die plantegroei-omgewing interaksies te verstaan en te organiseer in 'n maksimaal voorspelbare sisteem.

Monsterneming

Die grootste gedeelte van die studiegebied word gebruik vir kontantgewasverbouing soos onder andere mielies, sonneblom en koring. Die natuurlike veld wat beskikbaar is vir monsterneming is aangewend vir beweiding deur beeste en skape. Die natuurlike veld is heterogeen as gevolg van verskille in die fisiese omgewing en ook weens verskillende bestuurspraktyke soos deur die verskillende grondgebruikers toegepas. Sub-kwadrate in een opnameperseel het soms daartoe gelei dat heterogene plantegroei aangeteken is wat die klassifisering van die persele heelwat bemoeilik het. Relatief homogene opnamepersele wat in die Bankenveld uitgeplaas is (10 m x 20 m) was in vergelyking met die sub-perseel benadering baie meer effektief omdat hierdie data meer homogeen was wat verwerking baie vergemaklik het, en plantgemeenskappe wat ekologies interpreteerbaar is makliker uit die datastel geïdentifiseer kon word.

Die stratifisering van die studiegebied met behulp van landtipes en geologie kan as baie geslaagd beskou word aangesien die plantgemeenskappe wat verkry is, ekologies verklaar, en maklik in die veld geïdentifiseer kan word. Hierdie resultate bevestig

bevindinge van Bezuidenhout (1988), Bredenkamp et al. (1989), Bezuidenhout en Bredenkamp (1990) en Kooij (1990), wat ook landtipes suksesvol gebruik vir stratifisering van die studiegebied.

Floristiese opname

Die Braun-Blanquet opname tegniek is suksesvol in die grasveld toegepas, aangesien die plantgemeenskappe wat verkry is, ekologies verklaar en beskou kan word as realistiese ekosisteme, wat die basis van doeltreffende veldbestuur verteenwoordig. Die DECORANA ordening bevestig dat die verskillende eenhede met sekere omgewingsgradiënte geassosieer is. Die resultate wat verkry is kan dus saam met die resultate van ander studies in die grasveld gebruik word vir 'n fitososiologiese en moontlike sintaksonomiese sintese.

Habitat opname

Habitat-data van die verskillende opnamepersele is belangrik vir die interpretasie van die plantgemeenskap-habitat verhoudings. Voldoende habitat inligting is nodig om die gemeenskappe te identifiseer en ekologies te verklaar en moontlike ekosisteme te omgrens. Die afsonderlike plantgemeenskappe is geidentifiseer en ekologies verklaar deurdat voldoende habitat-data aangeteken is. By sommige gemeenskappe was daar wel probleme met die interpretasie van die habitat, maar dit was nie die gevolg van onvoldoende habitat-data nie, maar wel weens die verskillende veldbestuurspraktyke van die grondgebruikers. Habitat-faktore wat 'n duidelike rol gespeel het in die verspreiding van die verskillende plantgemeenskappe sluit hoogte bo seespieël,

bogrondse klipbedekking, grondvorm, kleipersentasie van die gronde, geologie, terrein eenhede en helling in.

Verwerking van die data

Die resultate wat verkry is dui op die suksesvolle verfyning van die TWINSPAN klassifikasie deur gebruik te maak van Braun-Blanquet prosedures. Die poging om uit die totale datastel 'n klassifikasie op te stel en in een fitososiologiese tabel weer te gee was nie suksesvol nie. In een groot tabel is daar meer uitskieters as in afsonderlike tabelle vir elke landtipe, en die inherente patroon in die data, word deur die groot datastel verberg. Meer sukses is behaal deur die data op te deel in afsonderlike tabelle vir die veskillende landtipes. Binne elke afsonderlike tabel is die relevés en spesies effektief in groepe geklassifiseer, en groeperings wat deur die totale datastel verberg was, kon daargestel word (Bredenkamp 1982). Die akkuraatheid en betroubaarheid van hierdie klassifikasies binne afsonderlike fitososiologiese tabelle is deur die suksesvolle ekologiese interpretasie bevestig. Soortgelyke prosedures is suksesvol uitgevoer deur Bezuidenhout (1988) en Kooij (1990). Die data van verskillende studies kan dus nou gebruik word in 'n sintese aangesien dieselfde kriteria gebruik is om die data te verwerk.

Die resultate van die klassifikasies van die verskillende landtipes is afsonderlik gepubliseer (Breytenbach et al. a, b, c, d (in prep.)). Die verskillende plantgemeenskappe is met mekaar vergelyk in 'n sinoptiese tabel. Deur die saamgroepering van die fitososiologiese tabelle in 'n sinoptiese tabel kan nie alleen verwante gemeenskappe saamgegroepeer word nie maar bevestig ook

die geldigheid of onderskeiding van die verskillende gemeenskappe in die afsonderlike fitososiologiese tabelle. Die verskillende groepe van plantgemeenskappe wat verkry is, is ekologies geinterpreteer en beskryf. Hierdie groepe plantgemeenskappe kan vergelyk word met ander groepe in die grasveld soos verkry deur Bezuidenhout (1988) en Kooij (1990). Die groepe plantgemeenskappe wat verkry is kan ook moontlik as afsonderlike landbou-bestuurseenhede beskou word.

Die resultate wat verkry is van die studiegebied kan gebruik word vir ekstrapolering na omliggende gebiede met soortgelyke klimaat en habitat. Die ekstrapolering moet egter nog fisies in die veld getoets word. Die oorgang tussen die westelike en oostelike gedeeltes van die Grasveldbioom moet nog ondersoek word. Die plantgemeenskappe saam met die habitatbeskrywings kan as hulpmiddels vir die beplanning en bestuur van die natuurlike veld dien. Uit die resultate van hierdie studie kan ook moontlike probleem areas, byvoorbeeld versteurde gebiede, erosie, gedegradeerde veld, en ook potensiële bewaringsgebiede geïdentifiseer word.

Die fitososiologie van die Villiers-Grootvlei-omgewing.

deur

Philippus Johannes Jacobus Breytenbach

Voorgelê ter vervulling van 'n deel van die vereistes vir die graad

Magister Scientiae

in die Fakulteit Natuurwetenskappe
Universiteit van Pretoria
Pretoria

Studieleier : Prof. G.K. Theron
Medeleier : Prof. G.J. Bredenkamp

Opsomming

Die doel van die studie was om die floristiese samestelling, struktuur en omgewingsinteraksies van die plantegroei in die grasveld en Bankenveld te bestudeer om die plantegroei-omgewings-interaksies te verstaan en te organiseer in 'n sisteem met maksimale voorspelbaarheid voor oë.

Die studiegebied is in die suidelike Transvaal asmede 'n beperkte gebied aangrensend met die Vaalrivier in die noordelike Oranje Vrystaat geleë en beslaan ongeveer 70 000 ha. Die studie is op 'n skaal van 1:50 000 uitgevoer.

Binne die studiegebied kom die Supergroep Ventersdorp, Supergroep Witwatersrand en die Opeenvolging Karoo voor. Die grootste gedeelte van die studiegebied word deur die Opeenvolging Karoo bedek. Die gronde van die studiegebied varieër van donker kleigronde tot rooi en geel sandgronde. Die studiegebied sorteer in die Cwb-klimaatstreek (warm gematigde somers met 'n droë winterseisoen).
Die studiegebied is volgens landtipes en geologie gestratifiseer en 226 monsterpersele is objektief sowel as subjektief in die eenhede uitgeplaas. 'n Floristiese opname volgens die Braun-Blanquet-tegniek sowel as 'n habitatopname is uitgevoer. 'n Eerste verdeling met behulp van TWINSPAN is verkry en met die Braun-Blanquet-prosedure verder verfyn.

Vyf afsonderlike tabelle is aan die hand van landtipes saamgestel en die resultate van elkeen van die tabelle is afsonderlik bespreek. Sewe en dertig plantgemeenskappe is in die studiegebied onderskei. Die plantgemeenskappe, met die uitsondering van die vleigebiede, is in 'n sinoptiese tabel saamgevat. In die sinoptiese tabel is die gemeenskappe in agt groepe geklassifiseer. Ordening met behulp van die DECORANA-ordeningsprogram is op elke afsonderlike tabel gedoen om die plantegroei-omgewing interaksies aan te toon.

Die Bankenveld (hoërliggende struik- en grasveld) is duidelik van die grasveld (laagliggende grasveld) geskei. Die vleigebiede is afsonderlik van die res van die plantegroei behandel. Deur die studiegebied in landtipes te verdeel het daartoe gelei dat plantgemeenskappe sinvol onderskei, beskryf en ekologies geïnterpreteer kon word.

Hierdie studie kan as basis vir doeltreffende ekstrapolering na omliggende gebiede gebruik word. Dit kan ook as 'n skakel tussen die westelike en oostelike dele van die Grasveldbioom dien.

The phytosociology of the Villiers-Grootvlei area.

by

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Submitted in partial fulfilment of the
requirements for the degree

Magister Scientiae

in the Faculty of Science
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Study leader : Prof. G.K. Theron
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Summary

The aim of this study was to evaluate the floristic composition, structure and environmental interactions of the vegetation in the grassland and Bankenveld in order to understand the vegetation/environment interactions and to organize the communities in a predictable system.

The study area is a limited area in the southern Transvaal bordering the Vaal River in the northern Orange Free State and covers approximately 70 000 ha. The scale used in the study was 1:50 000.

The Ventersdorp and Witwatersrand Supergroup and the Karoo Sequence occur in the study area. Most of the study area is covered by the Karoo Sequence. The soils in the study area vary from dark clayey soils to red and yellow sandy soils. The study area falls into the Cwb climatic zone (warm to mild summers with a dry winter season.

The study area was stratified according to Land Types and geology. Two hundred and twenty six sample plots were set out in these units following subjective and objective determination. A floristic survey according to the Braun-Blanquet technique, as well as a habitat survey were carried out. A preliminary classification was obtained by using the TWINSPAN program and it was then refined using the Braun-Blanquet procedure.

Five seperate tables were compiled and the results of each table are discussed seperately. In the study area thirty seven plant communities were distinguished. These plant communities, with the exception of vlei areas, were compiled into a sinoptic table. On the sinoptic table the communities were classified into eight groups. Using the DECORANA program, each table was ordinated seperately to indicate the vegetation/environmental interactions.

The Bankenveld (high-lying shrubland and grassland) can be clearly distinguised from the low-lying grassland. The vlei areas were treated seperately from the rest of the vegetation. By dividing the study area into Land Types, the plant communities could be clearly distinguised, describe and ecological interpreted.

This study can serve as a baseline for effective extrapolation to

surounding areas. It can also forms a link between the eastern and western Grassland Biome.

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