An ecological study of the major vegetation communities of the Vaalbos National Park, Northern Cape. 2. The Graspan-Holpan section

H. BEZUIDENHOUT

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Detailed classification, description and mapping of the Graspan-Holpan section of the Vaalbos National Park, Northern Cape, were initiated. This classification is intended to serve as a basis for the establishment of an efficient wildlife management programme as well as conservation policies for the Vaalbos National Park. Using a numerical classification technique (TWINSPAN) as a first approximation, the classification was refined by applying Braun-Blanquet procedures. A hierarchical plant community classification, description, ecological interpretation and a vegetation map are presented. In the phytosociological table nine major plant communities are recognised.

Keywords: conservation, environmental data, Northern Cape, Vaalbos National Park, vegetation classification.

H. Bezuidenhout, Scientific Services, National Parks Board, P.O. Box 110040, Hadison Park, Kimberley, 8306 Republic of South Africa.

Introduction

The Vaalbos National Park (VNP) is one of the most recently proclaimed national parks (September 1986). The necessity for an ecological classification, description and mapping of the vegetation of a conservation area was stated by Bredenkamp & Theron (1978), NACOR (1979) and Van Rooyen *et al.* (1981). A sound knowledge of the ecology will contribute considerably to the compilation of an efficient wildlife management programme and conservation policy for the Vaalbos National Park. As a national park, it should also serve as a permanent reference area for wider reconnaissance surveys in the Northern Cape region. Apart from Gubb's (1989) broad-scale vegetation classification of the Northern Cape and Acocks' (1953) description of the veld types of South Africa, little is known about the vegetation of the area. Therefore, the main aim of this study was to classify, describe, interpret and map the vegetation of the Vaalbos National Park.

This project also forms part of a broader inventory of the diversity of plant species and plant communities conserved in the different national parks. Such inventories already exist for the Augrabies Falls National Park (Werger & Coetzee 1977), Mountain Zebra National Park (Van der Walt 1980), Van Rooyen *et al.* (1981), Zuurberg National Park (Van Wyk *et al.* 1988), Golden Gate Highlands National Park (Kay *et al.* 1993) and the Than-Droogeveld section of the Vaalbos National Park (Bezuidenhout 1994).

In a floristic analysis of the VNP, 334 species were collected and identified, representing 211 genera and 65 families (Zietsman *et al.* 1992). The Dicotyledonae is represented by 55 families which comprise 85.9% of the total number of families in the Vaalbos National Park. The largest plant family represented in the VNP is the

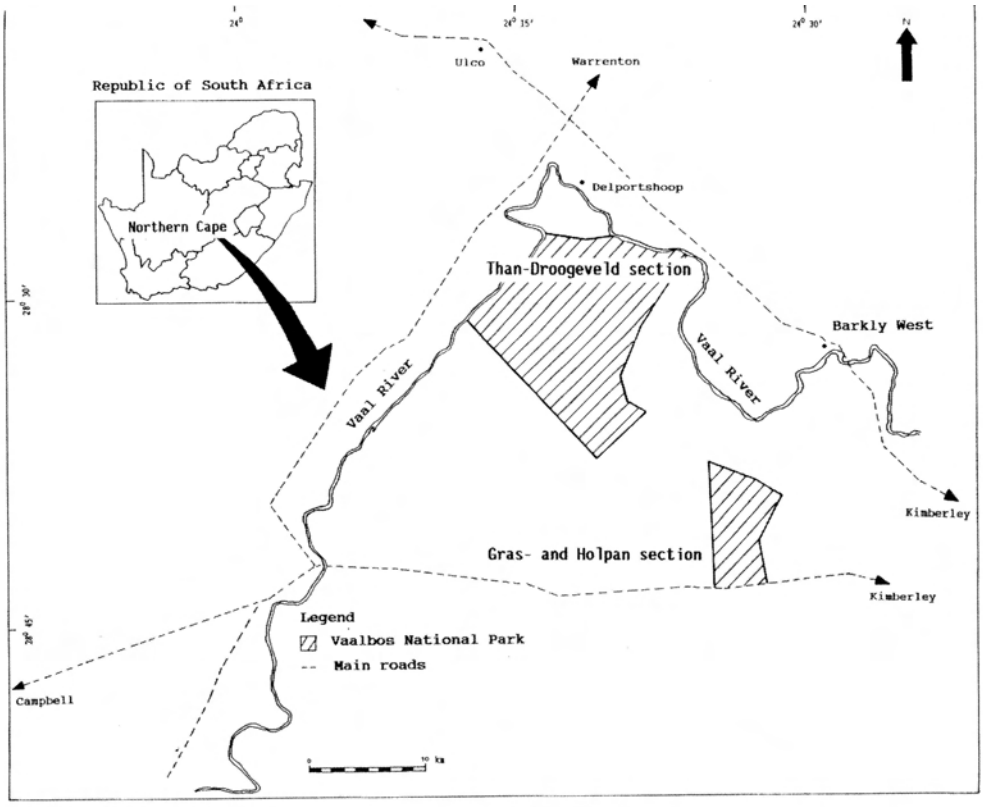

Fig. 1. The location of the Vaalbos National Park in relation to towns and the Vaal River.

Poaceae, with 57 species (17.1% of all species). According to Zietsman *et al.* (1992) the life form spectrum of the plants indicates that the VNP is a hemi-cryptophytic-therophytic area.

Study area

Location

The VNP consists of two sections. The largest, the Than-Droogeveld section (18 120 ha) is located approximately 61 km north-northwest of Kimberley. The smaller Graspan-Holpan section (4 576 ha) is situated about 25 km west of Kimberley (Fig. 1). Unfortunately, these two sections are separated by private land and are consequently managed separately. The VNP extends from latitude 28°25'–28°40'S and longitude 24°12'–24°26'E. This report deals with the vegetation of the Graspan-Holpan section (GH section) only.

Physiography, geology, soils, land types and vegetation

The landscape varies from flat to gently undulating plains. Altitude varies from 1 136 m to 1 160 m. The following topographical positions are distinguished in the GH section: midslopes, bottomlands and pans (Fig. 2; adapted from the Land Type Survey Staff 1986). Small isolated patches

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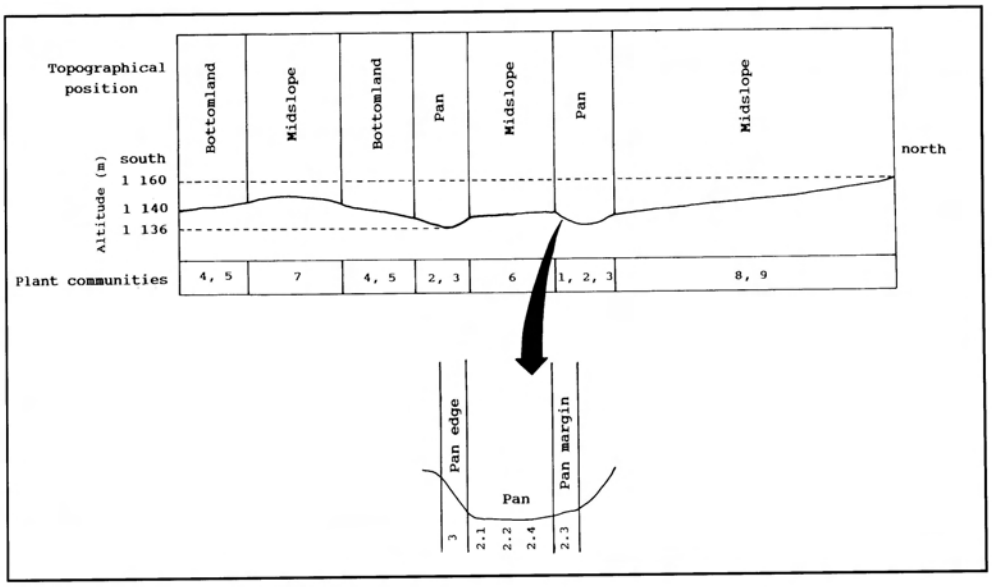


Fig. 2. A simplified sketch of the landscape of the GH section, indicating the topographical positions of the plant communities.

of rocky outcrops occur mainly in the southern parts of the GH section.

The GH section is underlain mainly by three geological systems. Andesitic to basaltic lava rocky outcrops of the Ventersdorp Supergroup, which is mostly overlain by calcrete, occur in the southern part of the study area. Outcrops of tillite of the Dwyka Formation and shale of the Prince Albert Formation (Karoo Sequence) also occur in the southern part of the GH section (Land Type Survey Staff 1986). The northern part of GH section is mainly underlain by red to flesh-coloured aeolian sand with surface limestone also occurring in places (Land Type Survey Staff 1986).

The soil type varies from moderately deep (0.3 m - 0.6 m) to deep (> 0.6 m) red and yellow sands (Hutton, Clovelly and Kimberley soil forms) to shallow (< 0.3 m) and stony (Mispah, Prieska and Glenrosa soil forms). The soil in the small strip along the southern border is moderately deep and clayey, with 25-35% clay content (Shortland and Swartland soil forms). The soil of the pans is moderately deep and very clayey with >35% clay content, and are of the Arcadia, Rensburg and Willowbrook soil forms (Soil Classification Working Group 1991).

Three land types, the Ae, Ah and Fb land types occur in the GH section. According to the Land Type Survey Staff (1986) "*A land type denotes an area that can be shown at 1:250 000 scale and that displays a marked degree of uniformity with respect to terrain form, soil pattern and climate*". The A unit refers to yellow and red apedal, freely drained soil without water tables. The Ae land type refers to red, high base status soil, of which the depth varies from 0.1 m to deeper than 0.3 m. The Ah land type varies from the Ae land type in that it also includes yellow soil and is consistently deeper than 0.3 m. Most of the northern and central parts of the GH section is underlain by the A land types. The F unit indicates land where the dominant soil-forming processes have been

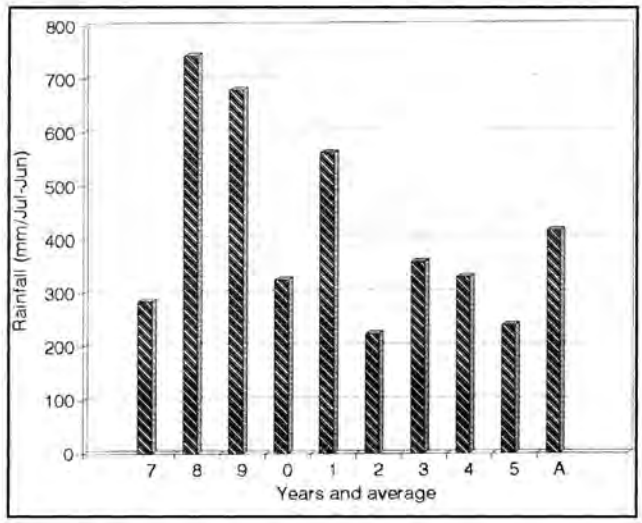


Fig. 3. The rainfall (mm/July - June) statistics for the past nine years of the Vaalbos National Park (7 - 1986/1987; 8 - 1987/1988; 9 - 1988/1989; 0 - 1989/1990; 1 - 1990/1991; 2 - 1991/1992; 3 - 1992/1993; 4 - 1993/1994; 5 - 1994/1995; A - average of 9 years).

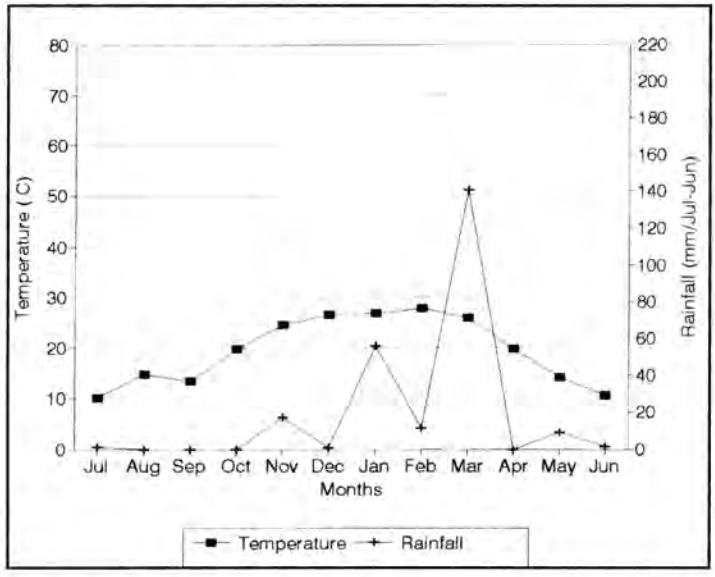


Fig. 4. A climate diagram for Vaalbos National Park (July 1994 to June 1995).

rock weathering, typically giving rise to lithocutanic horizons. The Fb land type indicates land where lime occurs regularly (Land Type Survey Staff 1986). The southern parts of GH section is underlain by the Fb land type. The land type concept has frequently provided a useful basis for description of vegetation (Bezuidenhout 1988, 1993; Kooij 1990; Breytenbach 1991; Smit 1992; Coetzee 1993; Myburgh 1993).

In terms of Acocks' classification (1953, 1988), the vegetation of the GH section consists of Kalahari Thornveld invaded by Karoo (veld type 17). One of the interesting conservation-worthy features of the VNP, is the interface of the Savanna Biome and the Nama-Karoo Biome in the Graspan-Holpan section (Rutherford & Westfall 1986).

Climate

The rainfall, mainly in summer, is erratic and can be as high as 700 mm per year but also lower than 300 mm per year (July to June) (Fig. 3). The average annual (July to June) rainfall for the VNP is just over 400 mm per annum. This figure is based on data collected in the Than-Droogeveld section of the VNP over the past nine years (1987 - 1995). The year 1995 was a dry year (Fig. 3). February and March 1995, the months in which the survey was done, represented the wet period (Fig. 4) (Bezuidenhout & Bredenkamp 1991). The average rainfall for the 1994/1995 rainfall season (July - June), was lower than the average rainfall for this semi-arid region (Fig. 3).

The temperature is less erratic than the rainfall, with winter temperatures (coldest months June - July) as low as -4 °C. Summer temperatures can reach 44 °C, with the warmest months being December and January. Frost occurs between 27 April and 23 September (the earliest and latest dates recorded). Its duration can be 107 days (Land Type Survey Staff 1986).

Methods

The stratification of the area into relatively homogeneous physiographic-physiognomic units was done on 1:50 000 aerial photographs. Sample plots were allocated *pro rata* to these units on the basis of the sizes of the areas. Relevés were compiled in 88 sample plots. Plot sizes were fixed on 900 m^2 (30 m x 30 m) according to Bezuidenhout (1994). Fieldwork was done between February and the end of March 1995. The cover-abundance for each species present in the sample plot was estimated according to the Braun-Blanquet scale (Mueller-Dombois & Ellenberg 1974). Average estimated height and average canopy cover for the tree, shrub and herbaceous layers are given for each individual community (Bezuidenhout 1988). Environmental data include rock, terrain and soil types, as well as soil depth, soil texture and an estimation of the rockiness of the soil surface (Fig. 5). The TWINSPAN classification algorithm (Hill 1979a) was used for analysing the floristic data as first approximation, and subsequently Braun-Blanquet procedures were used to refine these results. The final result of the classification procedure is a phytosociological table (Table 1). This approach has been proven to produce ecologically reliable results in many phytosociological studies in South Africa (Bredenkamp & Bezuidenhout 1990; Kooij 1990; Breytenbach 1991; Du Preez 1991; Bezuidenhout 1993; Eckhardt 1993; Fuls 1993; McDonald 1993; Mustart *et al.* 1993; Myburgh 1993). No attempt was made to formally fix syntaxa names as this is normally avoided in detailed local studies (Coetzee 1983).

An ordination algorithm, DECORANA (Hill 1979b) was also applied to the floristic data to illustrate floristic relationships between plant communities. This was done to detect possible gradients in and between communities and to detect possible habitat gradients associated with vegetation gradients (Fig. 6). Taxa names conform to those of Arnold & De Wet (1993). Soil nomenclature follows the classification of the Soil Classification Working Group (1991). Edwards' (1983) broad-scale structural classification was used for describing the structure of the vegetation.

Results

Classification

In the phytosociological table (Table 1), 12 plant communities are recognised, which can be grouped into nine major plant communities. The hierarchical classification of these communities are summarised as follows:

1. *Sporobolus coromandelianus -Sporobolus discosporus* low open grassland.
2. *Chloris virgata - Eragrostis bicolor* tall closed grassland.
   - 2.1 *Diplachne fusca* variant
   - 2.2 *Sporobolus ioclados* variant
   - 2.3 *Panicum coloratum* variant
   - 2.4 *Aristida adscensionis* variant
3. *Eragrostis obtusa - Stipagrostis obtusa* short open grassland.
4. *Zygophyllum incrustatum - Salsola calluma* low open herbland.
5. *Plinthus karooicus - Rhigozum trichotomum* tall closed shrubland.
6. *Tarchonanthus camphoratus - Ziziphus mucronata* short open woodland.
7. *Cadaba aphylla - Acacia tortilis* low open woodland.
8. *Tarchonanthus camphoratus - Rhus ciliata* high closed shrubland.
9. *Hermannia tomentosa - Schmidtia pappophoroides* short closed grassland.

Description of the vegetation

The vegetation is strongly related to soil type. Three major soil type/vegetation associations can be recognised: the plant species of the moderately deep clayey soil (species group B, Table 1), the plant species of the stony soil (species group M, Table 1) and the plant species of moderately deep sandy soil (species group R, Table 1) (Fig. 5). The plant species of species group U (Table 1) are generally found in all the plant communities with the exception of the *Sporobolus coromandelianus - Sporobolus discosporus* low open grassland.

1. *Sporobolus coromandelianus - Sporobolus discosporus* low open grassland

This grassland is restricted to the middle of the largest pan (Holpan) (Figs. 2 & 7). It is strongly associated with poorly drained, moderately deep, clayey (> 25% clay-content – A & B horizons) soil. The parent material is Dwyka tillite and shale. Less than 10% of the soil surface is covered by stones or rocks (Figs. 5 & 6). At the time of sampling a shallow (< 0.2 m) layer of water covered the surface of the pan. The pan is only occasionally inundated during the rainy season.

Two grasses are diagnostic species for this low open grassland (species group A, Table 1). The herbaceous layer is poorly developed with a canopy cover of 25% and is 0.1 m tall. The diagnostic grasses *Sporobolus coromandelianus* and *Sporobolus discosporus* are the only two plant species noted in this community. The tree and shrub strata are absent.

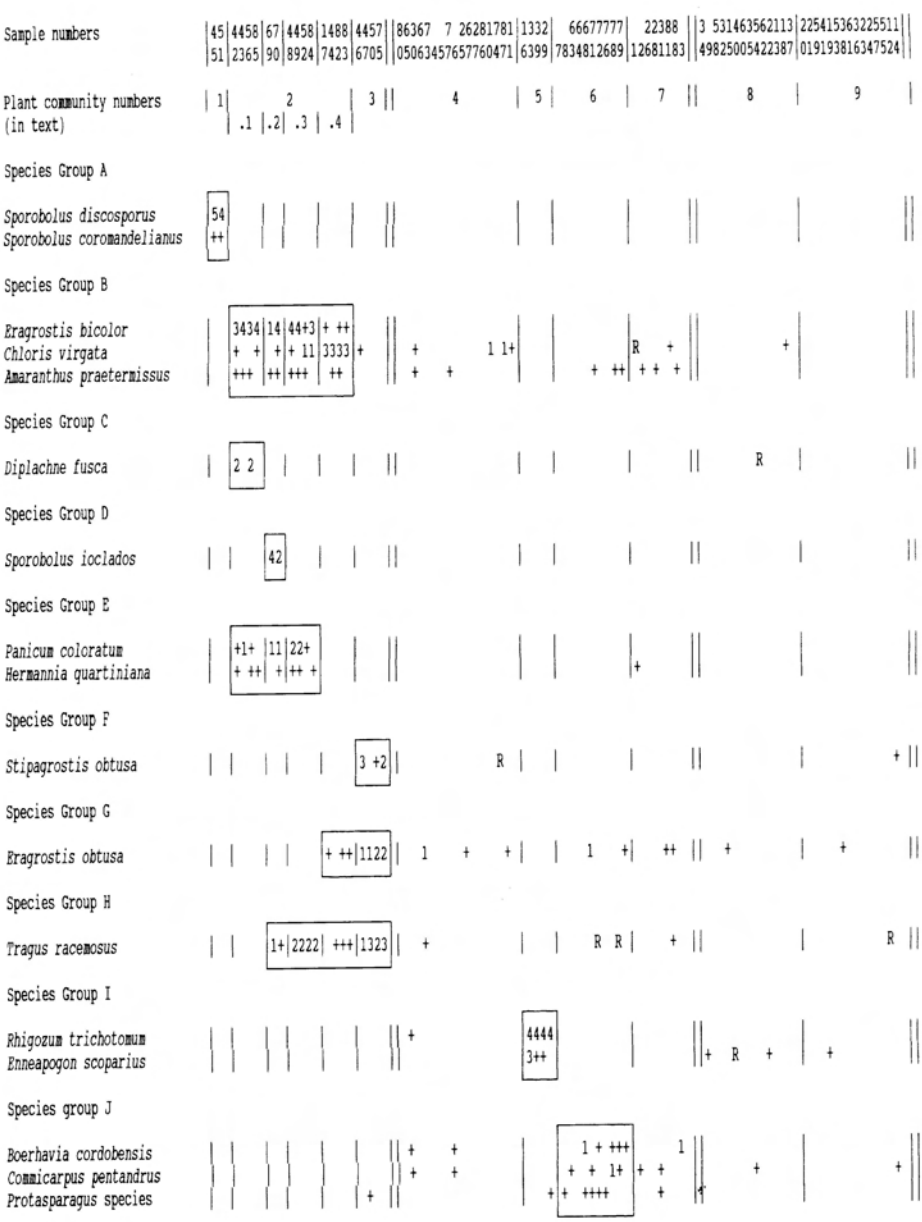
2. *Chloris virgata - Eragrostis bicolor* tall closed grassland

The *Chloris virgata - Eragrostis bicolor* tall closed grassland is strongly associated with the poorly drained, moderately deep, clayey (> 25% clay content – A & B horizons) soil of the pans (Figs. 5 & 6). No, or less than 10%, rocks or stones occur on the soil surface. Dwyka tillite and shale as well as andesitic lavas is the parent material for this habitat. The pans occur in the southern, central and north-eastern parts of the GH section (Figs. 2 & 7).

This community is characterised by species group B (Table 1) and the diagnostic species are the grasses *Eragrostis bicolor* and *Chloris virgata* and the forb (Trollope *et al.* 1990) *Amaranthus praetermissus*. No trees and shrubs are present in this community.

Table 1

A phytosociological table of the vegetation of the Graspan-Holpan section, Vaalbos National Park



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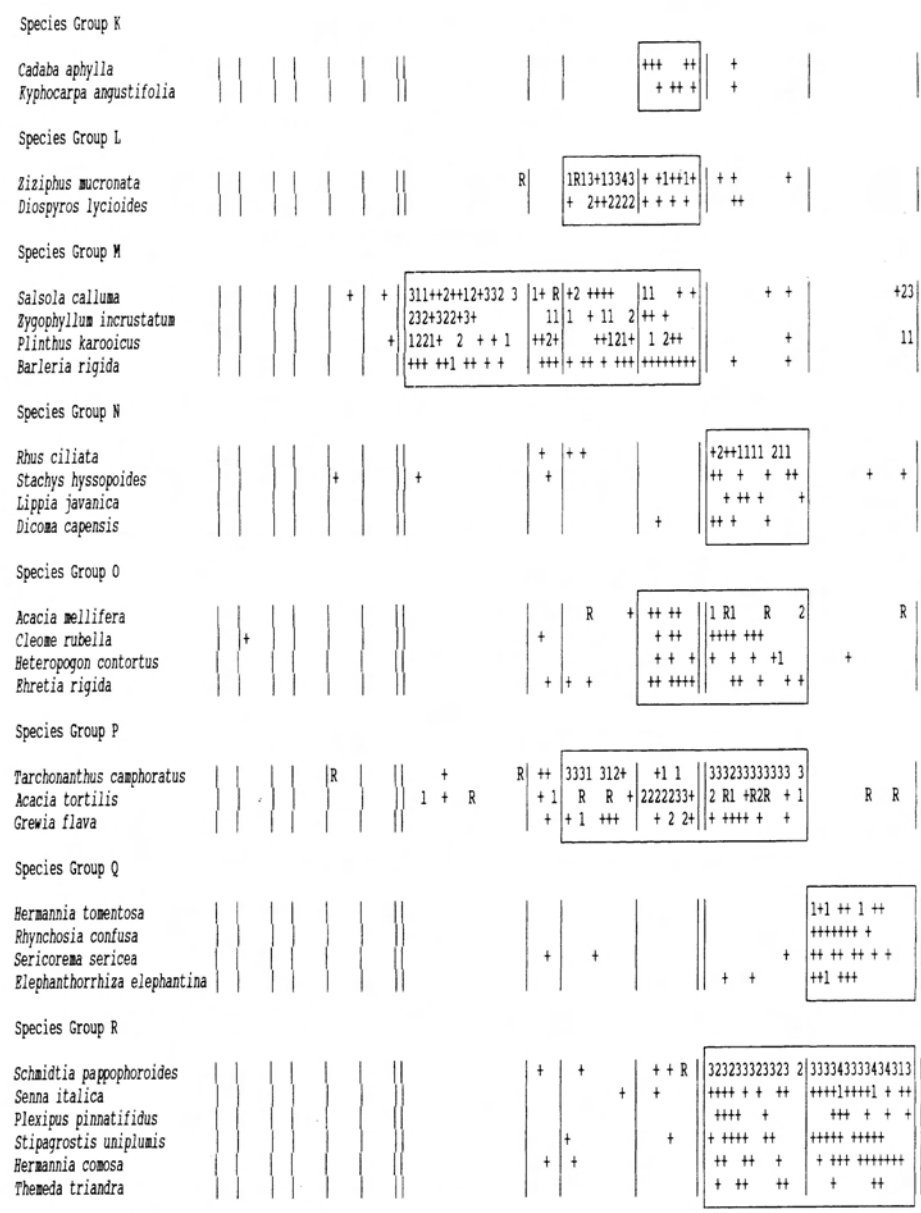

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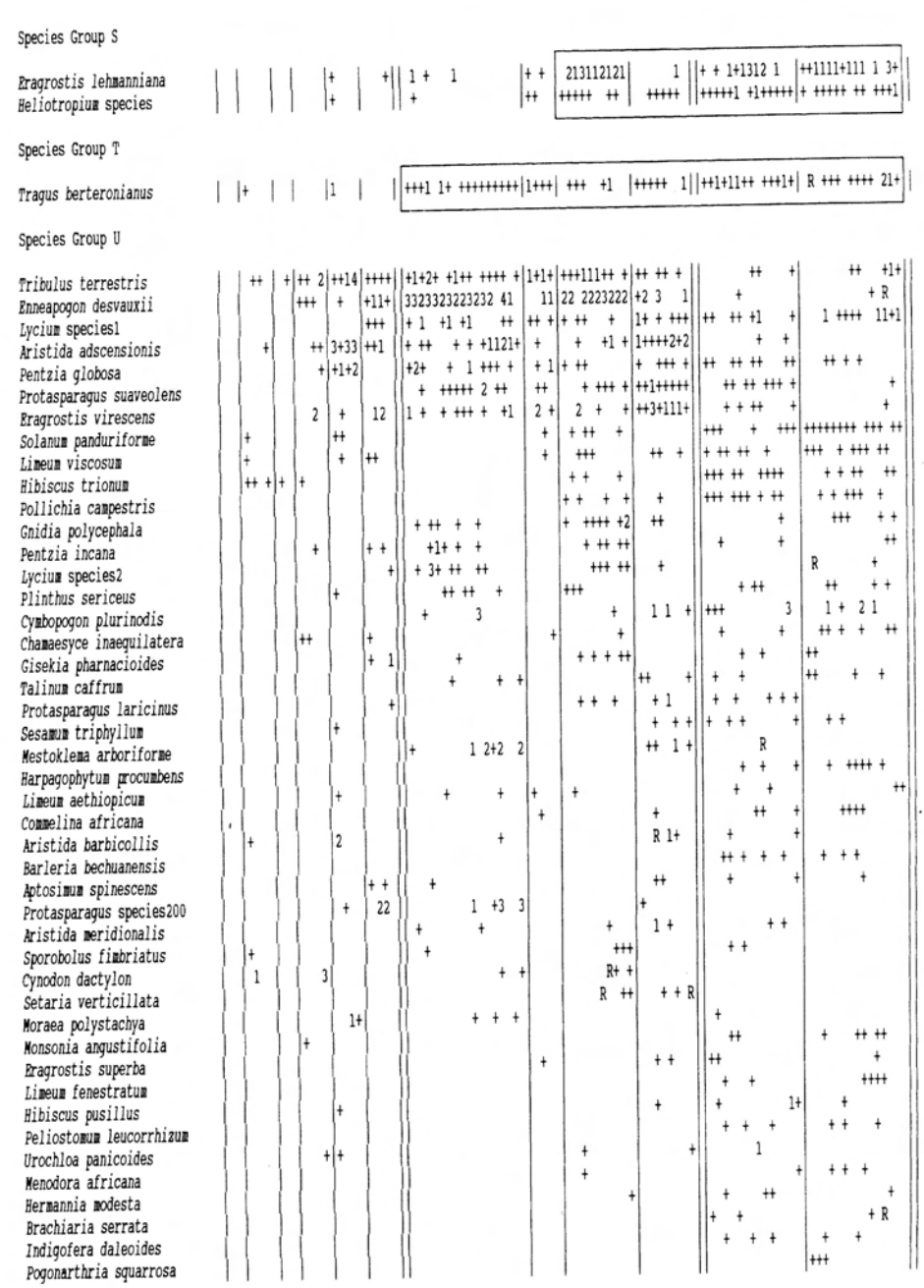

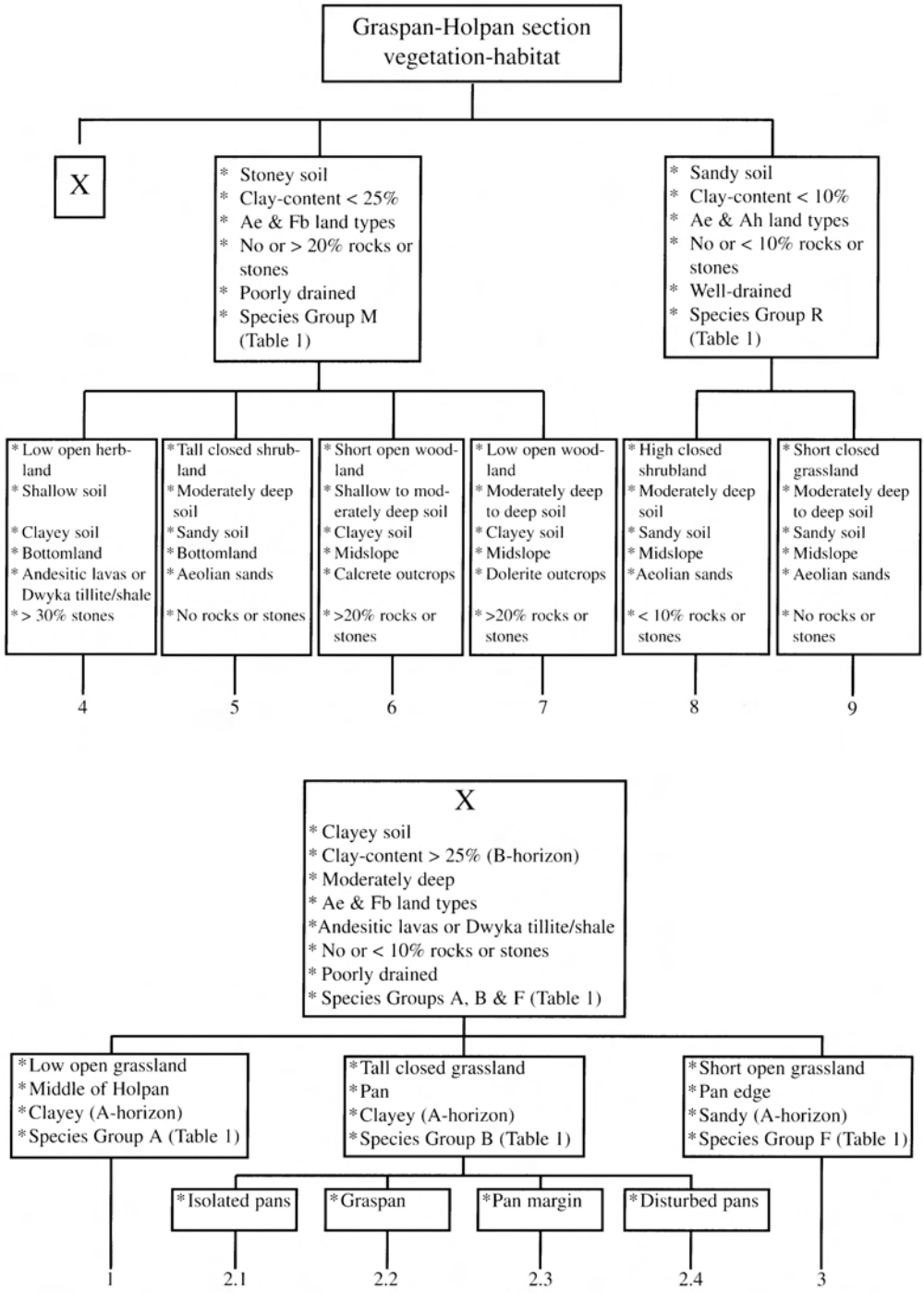

Fig. 5. A dendrogram to illustrate the habitat relationships of the plant communities (numbers refer to text) of the GH section, Vaalbos National Park.

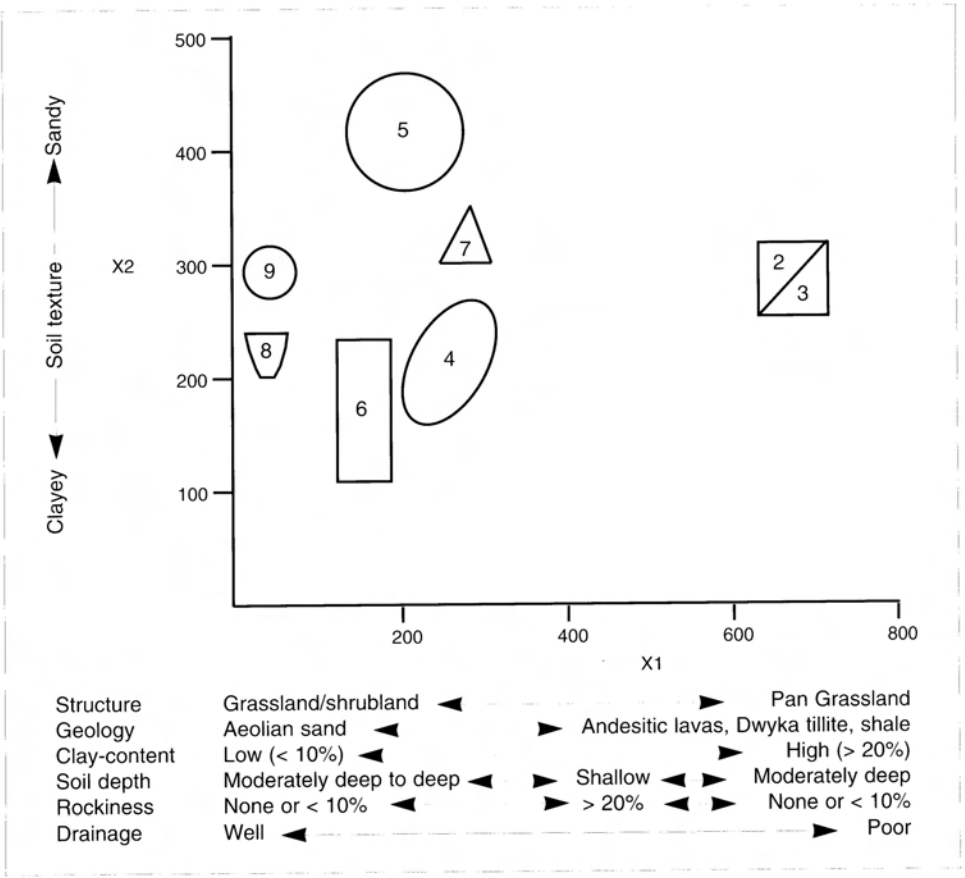

Fig. 6. The relative positions of the plant communities (numbers refer to text) along the first and second axes of the ordination.

The herbaceous layer is well-developed with a canopy cover of 64.6% and a height of 0.5 m.

Four variants are recognised.

2.1 *Diplachne fusca* variant

This variant is found in isolated pans which have a relatively wide distribution in the GH section (Figs. 2 & 7). It has the same abiotic environment as for the *Chloris virgata* - *Eragrostis bicolor* tall closed grassland (2) (Figs. 5 & 6). This variant is characterised by species group C (Table 1), with *Diplachne fusca* the only diagnostic plant species. This perennial grass is, according to Van Oudtshoorn (1991), as well as Gibbs Russell *et al.* (1990) always found near to or in fresh or brackish water. Other prominent grasses are *Eragrostis bicolor* (species group B, Table 1) and *Panicum coloratum* (species group E, Table 1). Sometimes species from species groups B, E and U are also present in this variant (Table 1).

2.2 *Sporobolus ioclados* variant

The *Sporobolus ioclados* variant is restricted to Graspan (Figs. 2 & 7). The abiotic environment is the same as was described

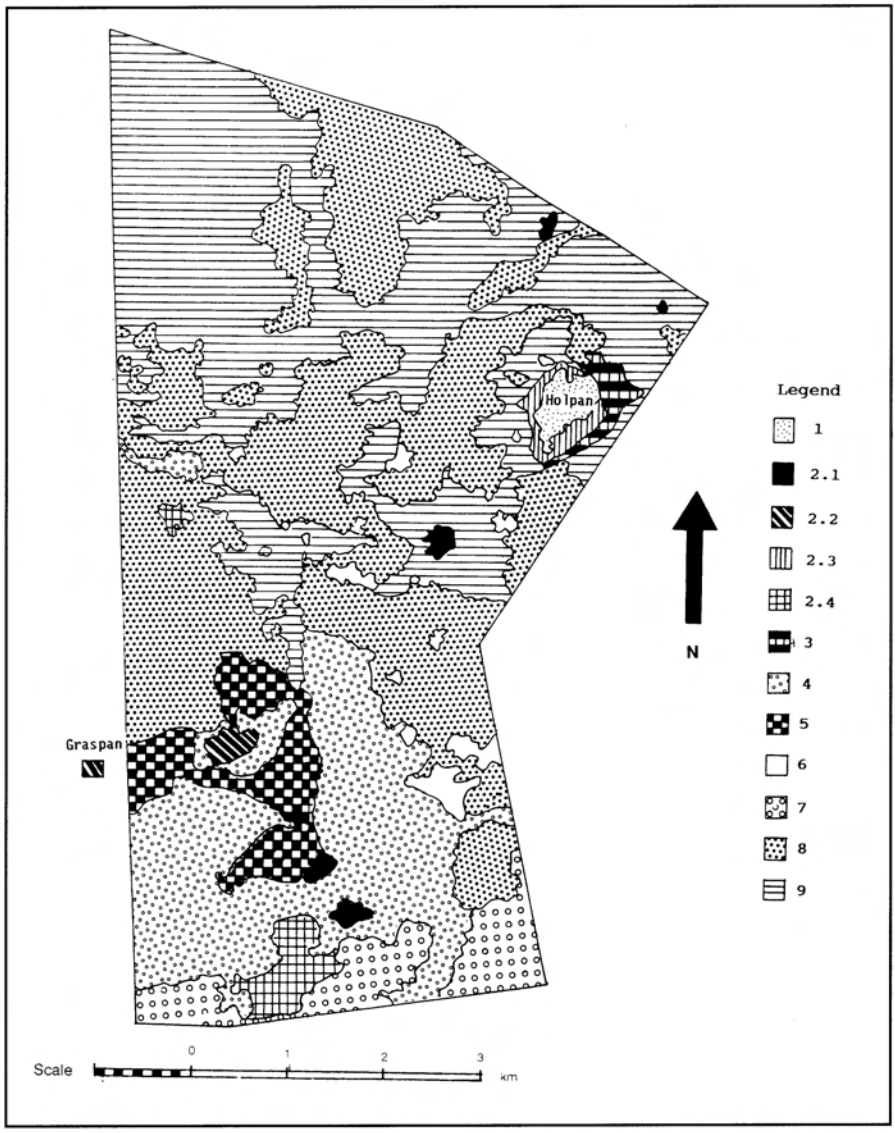

Fig. 7. A vegetation map of the GH section, Vaalbos National Park (1. *Sporobolus coromandelianus - Sporobolus discosporus* low open grassland, 2.1 *Diplachne fusca* variant, 2.2 *Sporobolus ioclados* variant, 2.3 *Panicum coloratum* variant, 2.4 *Aristida adscensionis* variant, 3. *Eragrostis obtusa - Stipagrostis obtusa* short open grassland, 4. *Zygophyllum incrustatum - Salsola calluma* low open herbland, 5. *Plinthus karooicus - Rhigozum trichotomum* tall closed shrubland, 6. *Tarchonanthus camphoratus - Ziziphus mucronata* short open woodland, 7. *Cadaba aphylla - Acacia tortilis* low open woodland, 8. *Tarchonanthus camphoratus - Rhus ciliata* high closed shrubland, 9. *Hermannia tomentosa - Schmidtia pappophoroides* short closed grassland).

for the *Chloris virgata - Eragrostis bicolor* tall closed grassland (2) (Figs. 5 & 6). According to Van Oudtshoorn (1991), the diagnostic species *Sporobolus ioclados* (species group D, Table 1) often grows in or near pans. Apart from the diagnostic species, *Eragrostis bicolor* (species group B, Table 1) is also very prominent. Other species from species groups B, E, H and U are also represented in this variant (Table 1).

2.3 *Panicum coloratum* variant

This variant occurs on the margin of Holpan (Fig. 2). The same abiotic environment as in the *Chloris virgata - Eragrostis bicolor* tall closed grassland (2) is present (Figs. 5, 6 & 7). No diagnostic species was noted. The presence of species of species groups E and H and the absence of species groups D and G characterise this variant (Table 1). Prominent species are the grasses *Eragrostis bicolor* (species group B), *Panicum coloratum* (species group E) and *Tragus racemosus* (species group H) (Table 1). Species of species groups B and U are also present in this variant (Table 1).

2.4 *Aristida adscensionis* variant

The *Aristida adscensionis* variant is associated with disturbed pans (Figs. 2 & 7). The same abiotic environment as in the *Chloris virgata - Eragrostis bicolor* tall closed grassland (2) is present (Figs. 5 & 6). These pans were ploughed for crop cultivation. The prominent grasses are the pioneers *Chloris virgata* and *Aristida adscensionis* (Van Oudtshoorn 1991) and the prominent forbs are *Tribulus terrestris* and *Pentzia globosa*. This species composition gives a strong indication of the disturbed status of these pans. The presence of species of species groups B, G and H and the absence of species groups E and F characterise this variant (Table 1).

3. *Eragrostis obtusa - Stipagrostis obtusa* short open grassland

This short open grassland is strongly associated with the pan edge of Holpan (Figs. 2 & 7). It also occurs at the pan edge of Graspan but this unit was too small to be mapped. It is characteristically found on a shallow, sandy A-horizon (< 10% clay content) with a clayey B-horizon (> 25% clay content). Less than 10 % rocks or stones occur on the soil surface (Figs. 5 & 6).

The diagnostic species is *Stipagrostis obtusa* (species group F, Table 1). The tree and shrub strata are absent. The herbaceous layer is about 0.1 m tall with a canopy cover of 40%. Apart from the diagnostic species, the grasses *Eragrostis obtusa* (species group G) and *Tragus racemosus* (species group H) are prominent in this short open grassland (Table 1). Species of the common species group U (Table 1) are also present in this community.

4. *Zygophyllum incrustatum - Salsola calluma* low open herbland

The *Zygophyllum incrustatum - Salsola calluma* low open herbland is restricted to the shallow, clayey (< 25% clay content), stony soil of the bottomland of the southern part of the study area (Figs. 2, 5, 6 & 7). More than 30% calcrete, lava, tillite and shale stones were noted on the soil surface in the sample plots of this community. The parent material which underlay this community is a mixture of either andesitic lavas or Dwyka tillite or shale. Isolated depressions, too small to map, also occur on the poorly drained soil of this low open herbland.

This community is characterised by the presence of species groups M and T and the absence of species groups P and S (Table 1). Isolated *Acacia tortilis* and *Tarchonanthus camphoratus* trees or shrubs represent poorly developed tree and shrub strata. The herbaceous stratum is 0.4 m tall and has a canopy cover of 44%. The Karoo forbs

Salsola calluma, *Zygophyllum incrustatum*, *Plinthus karooicus* (species group M) and *Pentzia globosa* (species group U) (Shearing 1994) are dominant, along with three other forb species *Barleria rigida* (species group M), *Tribulus terrestris* (species group U) and *Mestoklema arboriforme* (species group U) in this low open herbland (Table 1). The grasses *Tragus berteronianus* (species group T) and *Enneapogon desvauxii* (species group U) are also prominent in this community (Table 1).

Small isolated patches of the *Aristida adscensionis* variant (2.4) are found in the depressions of this habitat.

As indicated by the presence of invader karroid species such as *Pentzia globosa*, *Plinthus karooicus*, *Tribulus terrestris* and the grass *Enneapogon desvauxii* (Acocks 1953, 1988) which are prominent in this plant community, the habitat is different to the habitat of the Kalahari Thornveld.

5. *Plinthus karooicus - Rhigozum trichotomum* tall closed shrubland

This tall closed shrubland is found on the moderately deep, poorly drained, sandy, stony soil, which occurs widely as small isolated patches in the GH section (Figs. 5, 6 & 7). It is restricted to the bottomlands which are overlain by aeolian sand covering the Dwyka tillite/shale or andesitic lavas (Figs. 2 & 5). No rocks or stones were noted on the soil surface in the sample plots of this community (Fig. 5).

Diagnostic species (species group I, Table 1) are the shrub *Rhigozum trichotomum* and the grass *Enneapogon scoparius*. The poorly developed tree stratum, with a canopy cover of 2% and a height of 2.1 m is represented by the prominent tree *Acacia tortilis* (species group P, Table 1). The dominant shrub species is the diagnostic *Rhigozum trichotomum* (species group I) with other shrub species such as *Grewia flava* (species group P), *Tarchonanthus camphoratus* (species group P) and *Protasparagus suaveolens* (species group U) also present (Table 1). The shrub layer has a canopy cover of 49% and is 1 m tall. The poorly developed herbaceous layer is 0.3 m tall and has a canopy cover of 20%. Prominent grass species are the diagnostic *Enneapogon scoparius* (species group I) and *E. desvauxii* (species group U) (Table 1). Forbs that are present are *Salsola calluma*, *Zygophyllum incrustatum*, *Plinthus karooicus* (species group M) and *Tribulus terrestris* (species group U, Table 1).

6. *Tarchonanthus camphoratus - Ziziphus mucronata* short open woodland

This midslope woodland is associated with shallow to moderately deep, poorly drained, clayey, stony soil (Figs. 2, 5 & 6). Outcrops of calcrete are often present. More than 20% of the soil surface is covered by rocks or stones (Fig. 5). The *Tarchonanthus camphoratus - Ziziphus mucronata* short open woodland is distributed in the south-southwestern part of the GH section (Fig. 7).

The diagnostic species are the non-conspicuous forbs *Commicarpus pentandrus*, *Boerhavia cordobensis* and *Protasparagus* species (species group J, Table 1). The presence of species of species groups L, P and S and the absence of members of species groups K and O also characterise this short open woodland (Table 1). The short (5 m - 10 m) *Ziziphus mucronata* tree (species group L, Table 1) is prominent in this poorly developed tree stratum with a canopy cover of 3.6%. The shrub stratum, which is dominated by *Tarchonanthus camphoratus* (species group P, Table 1) is 2.1 m tall with a canopy cover of 8.5%. Two other prominent shrub species in this stratum are *Diospyros lycioides* (species group L) and *Grewia flava* (species group P) (Table 1). The herbaceous layer is 0.4 m tall and has a canopy cover of 44.5%. Apart from the diagnostic forbs for this community, other forbs such as *Salsola calluma*, *Zygophyllum incrustatum*, *Plinthus karooicus* (species group M) and *Gnidia*

polycephala (species group U) are present (Table 1). The prominent grass species are *Eragrostis lehmanniana* (species group S) and *Enneapogon desvauxii* (species group U) (Table 1).

7. *Cadaba aphylla - Acacia tortilis* low open woodland

This low open woodland community is associated with the midslope, on moderately deep to deep, poorly drained, clayey, stony soil, which occurs in the southern part of the GH section (Figs. 2, 5, 6 & 7). More than 20% rocks or stones were recorded in these sample plots, dolerite outcrops also occur sporadically in this community (Fig. 5).

The shrub *Cadaba aphylla* and the non-conspicuous forb *Kyphocarpa angustifolia* are the only diagnostic species for this woodland (species group K, Table 1). The tree stratum is 4.6 m tall and the canopy cover is 3% while the shrub stratum is 1.9 m tall with the canopy cover 5.5%. The *Acacia tortilis* tree (species group P, Table 1) is very prominent, being the dominant woody species. Other woody species include *Acacia mellifera* (species group O), Ehretia rigida (species group O), *Ziziphus mucronata* (species group L), *Grewia flava* (species group P) and *Tarchonanthus camphoratus* (species group P) (Table 1). The shrub *Protasparagus suaveolens* (species group U, Table 1) is also associated with the *Cadaba aphylla - Acacia tortilis* low open woodland. The poorly developed herbaceous layer has a canopy cover of 36% and is 0.4 m tall. Forbs such as *Salsola calluma* (species group M), *Plinthus karooicus* (species group M) and *Barleria rigida* (species group M) are present (Table 1). The grass species *Aristida adscensionis* and Sporobolus species (species group U, Table 1) are prominent in this woodland.

In isolated patches of this woodland, where the soil is shallow and rocky (dolerite outcrops), the shrubs *Acacia mellifera* and *Tarchonanthus camphoratus* are more prominent and are co-dominant with *Acacia tortilis*.

8. *Tarchonanthus camphoratus - Rhus ciliata* high closed shrubland

The *Tarchonanthus camphoratus - Rhus ciliata* high closed shrubland is found on the midslopes of the GH section (Fig. 2). This shrubland habitat is associated with moderately deep, well-drained, aeolian sandy soil (Figs. 5 & 6). Less than 10% rocks or stones were noted on the soil surface in the sample plots of this community. As was found in the Than-Droogeveld section (Bezuidenhout 1994), the *Tarchonanthus camphoratus - Rhus ciliata* high closed shrubland is widely distributed (Fig. 7). The dominant plant species is the shrub *Tarchonanthus camphoratus*, commonly known as "vaalbos", from which the name of the park originated.

The diagnostic species for this shrubland are the shrub *Rhus ciliata* and the forbs *Stachys hyssopoides, Lippia javanica* and *Dicoma capensis* (species group N, Table 1). The dominant woody component is dense, with the poorly developed tree stratum 4.8 m tall and a canopy cover of 1.5%. The shrub stratum is 2.4 m tall with a canopy cover of 11.7%. The woody species which are present in this shrubland are the tree *Acacia tortilis* (species group P) and the shrubs *Rhus ciliata* (species group N), *Acacia mellifera* (species group O), *Ehretia rigida* (species group O), *Grewia flava* (species group P) and the dominant *Tarchonanthus camphoratus* (species group P) (Table 1). The herbaceous layer is 0.6 m tall and has a canopy cover of 43.7%. Apart from the diagnostic forbs (species group N), *Cleome rubella* (species group O), *Senna italica*, *Plexipus pinnatifidus* and *Hermannia comosa* (species group R) are also present in this shrubland (Table 1). Prominent grasses are *Schmidtia pappophoroides* (species group R), *Stipagrostis uniplumis* (species group R) and

Eragrostis lehmanniana (species group S) (Table 1).

A similar community was described in the Than-Droogeveld section of the Vaalbos National Park (Bezuidenhout 1994).

9. Hermannia tomentosa - *Schmidtia pappophoroides* short closed grassland

This short closed grassland occurs on the midslope, mainly in the northern part of the study area (Figs. 2 & 7). It is strongly associated with deep to moderately deep, well-drained sandy soil (clay-content < 10%) (Figs. 5 & 6). This community is underlain by aeolian sand covering Dwyka tillite. Surface limestone occurs sporadically. No rocks or stones on the soil surface were recorded in the sample plots of this community (Fig. 5).

Diagnostic species (species group Q, Table 1) are the forbs *Hermannia tomentosa*, *Rhynchosia confusa*, *Sericorema sericea* and *Elephantorrhiza elephantina*. The tree stratum is almost absent. Sparsely distributed *Acacia erioloba* is the prominent tree in this community. The shrub stratum is absent. The herbaceous stratum is well developed, about 0.6 m tall with a canopy cover of 52%. The dominant grasses are *Schmidtia pappophoroides* (species group R), *Stipagrostis uniplumis* (species group R), *Eragrostis lehmanniana* (species group S) and *Tragus berteronianus* (species group U), while the most prominent forbs, apart from the diagnostic species (species group Q), are *Senna italica* (species group R) and *Solanum panduriforme* (species group U) (Table 1).

A similar vegetation type, namely the Kalahari-Kuruman Sourveld Transitional Grasslands, was described by Gubb (1989). Bezuidenhout (1994) also described a similar community in the Than-Droogeveld section.

Ordination

A discontinuity can clearly be recognised between the *Sporobolus coromandelianus - Sporobolus discosporus* low open grassland and the rest of the vegetation (Table 1). This was also verified by the ordination of the total data set which is not presented in this paper. The position of the plant communities on the ordination diagram, excluding the *Sporobolus coromandelianus - Sporobolus discosporus* low open grassland along the first and second axes of the scatter diagram is given in Fig. 6. The plant communities are restricted to specific spatial areas in the diagram. Although the plant communities are floristically not totally different (Table 1), the ordination result clearly recognised the different plant communities except for the *Chloris virgata - Eragrostis bicolor* tall closed grassland (2) and *Eragrostis obtusa - Stipagrostis obtusa* short open grassland (3). The diagram illustrates a gradient along the first and second axes which could be related to the vegetation structure, geology, clay-content, soil depth, presence of rocks and stones on the soil surface and drainage.

Concluding remarks

The rich variety of the described vegetation types which inhabit some of the available habitats in the Northern Cape Province is reflected in the GH section's faunal diversity, as was also noticed by Crowe *et al.* (1981) on the Rooipoort farm (Table 2). Only two of the communities in the GH section are similar to those in the Than-Droogeveld section. The others are not present at all, which means that the GH section is important for expanding the diversity at community as well as plant species level, preserved in the Vaalbos National Park.

The Karoo species *Pentzia incana*, *P. globosa* and the grass *Enneapogon desvauxii* which, according to Acocks (1988), invade the Kalahari Thornveld (veld type 17) are

Table 2
The following mammals occurred in the GH section at the time of the survey (April 1995)

Common name	Scientific name
Cape hare	*Lepus capensis*
Striped ground squirrel	*Xerus inaurus*
Crested porcupine	*Hystrix africaeaustralis*
Black-backed jackal	*Canis mesomelas*
Bat-eared fox	*Otocyon megalotis*
Small-spotted genet	*Genetta genetta*
Slender mongoose	*Herpestes sanguineus*
Yellow mongoose	*Cynictis penicillata*
Suricate	*Suricata suricatta*
Brown Hyaena	*Hyaena brunnea*
Black-footed cat	*Felis nigripes*
Caracal	*Felis caracal*
Burchell's zebra	*Equus burchellii*
Warthog	*Phacochoerus aethiopicus*
Kudu	*Tragelaphus strepsiceros*
Gemsbok	*Oryx gazella*
Red hartebeest	*Alcelaphus buselaphus*
Springbok	*Antidorcas marsupialis*
Grey duiker	*Sylvicapra grimmia*
Steenbok	*Raphicerus campestris*
Black wildebeest	*Connochaetes gnou*
Blesbok	*Damaliscus dorcas phillipsi*

present only in some of the communities. The habitats of these communities differ from those of the other communities (typical Kalahari Thornveld communities), and therefore the conclusion can be made that the Karoo species are not invasive in these communities.

The pans, which occur widely in the GH section of the Vaalbos National Park, are characteristic of this part of the Northern Cape Province and have the potential of a high carrying capacity (Berry 1991). A more detailed study should be done on the pans of this area. The soil of the pans need also to be studied in more detail.

The description of the plant communities, together with the vegetation map, can serve as a basis to formulate a management programme for the GH section of the Vaalbos National Park. An understanding of the plant communities and their associated habitats is of fundamental importance for devising sound management and conservation strategies. The vegetation description and map were used to initiate a monitoring project for vegetation and animal-habitat relationships.

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