

The phytosociology of the southern section of Borakalalo Nature Reserve, South Africa

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As part of a vegetation survey programme for conservation areas in South Africa, the plant communities of the Borakalalo Nature Reserve were investigated. A TWINSPAN classification, refined by Braun-Blanquet procedures was used for a phytosociological study. The analysis resulted in five major plant communities, one with two subcommunities and one with four subcommunities and two variants. Habitat factors associated with differences in vegetation include topography, soil form and grazing pressure. Descriptions of the plant communities include diagnostic species as well as prominent and less conspicuous species of the tree, shrub, forb and grass strata. The classification provides the necessary delimitation of homogeneous areas which are considered necessary for veld management.

Keywords: TWINSPAN, Braun-Blanquet procedures, conservation area, plant communities, floristic composition, vegetation classification, phytosociology.

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Introduction

Borakalalo Nature Reserve lies approximately 60 km north of Brits in the North West Province. It is situated around the Klipvoor Dam between 27°45'E to 27°55'E and 25°04'S to 25°15'S (Fig. 1). The reserve falls under the authorisation of the former Bophuthatswana Parks Board. According to the Bophuthatswana Parks Board, the southern part of the reserve was first proclaimed a nature reserve in 1960. Since then numerous sections have been added — to the south, west, north and east. The remainder of the western section was finally proclaimed in 1985. The reserve currently covers approximately 12 000 hectares.

Vegetation and ecological surveys of conservation areas are considered to have high priority (NACOR 1979). This project was undertaken as part of a vegetation survey programme for conservation areas in South Africa, and also because no vegetation study of the area had been conducted. The aim of the study was to classify, describe and map the vegetation of the southern section of the reserve as an inventory of the ecosystems and

their biota, and also for subsequent use in compiling wildlife management plans.

The study area

The study area covers approximately 2 800 ha. The entire area slopes gradually to the north in the direction of the Klipvoor Dam from 1 047 m to 990 m above sea level. Following Acocks (1988), the area could be classified as Sourish Mixed Bushveld (Veld Type 19).

Climate

According to data supplied by the Weather Bureau in Pretoria, the average annual rainfall for the area is 609 mm; the total rainfall recorded for 1992 and 1993 was 409 mm and 528 mm respectively; the average maximum temperature is 31,2 °C in January (summer) and 24,7 °C in July (winter); while the average minimum temperature is 16,0 °C in summer and 5,8 °C in winter.

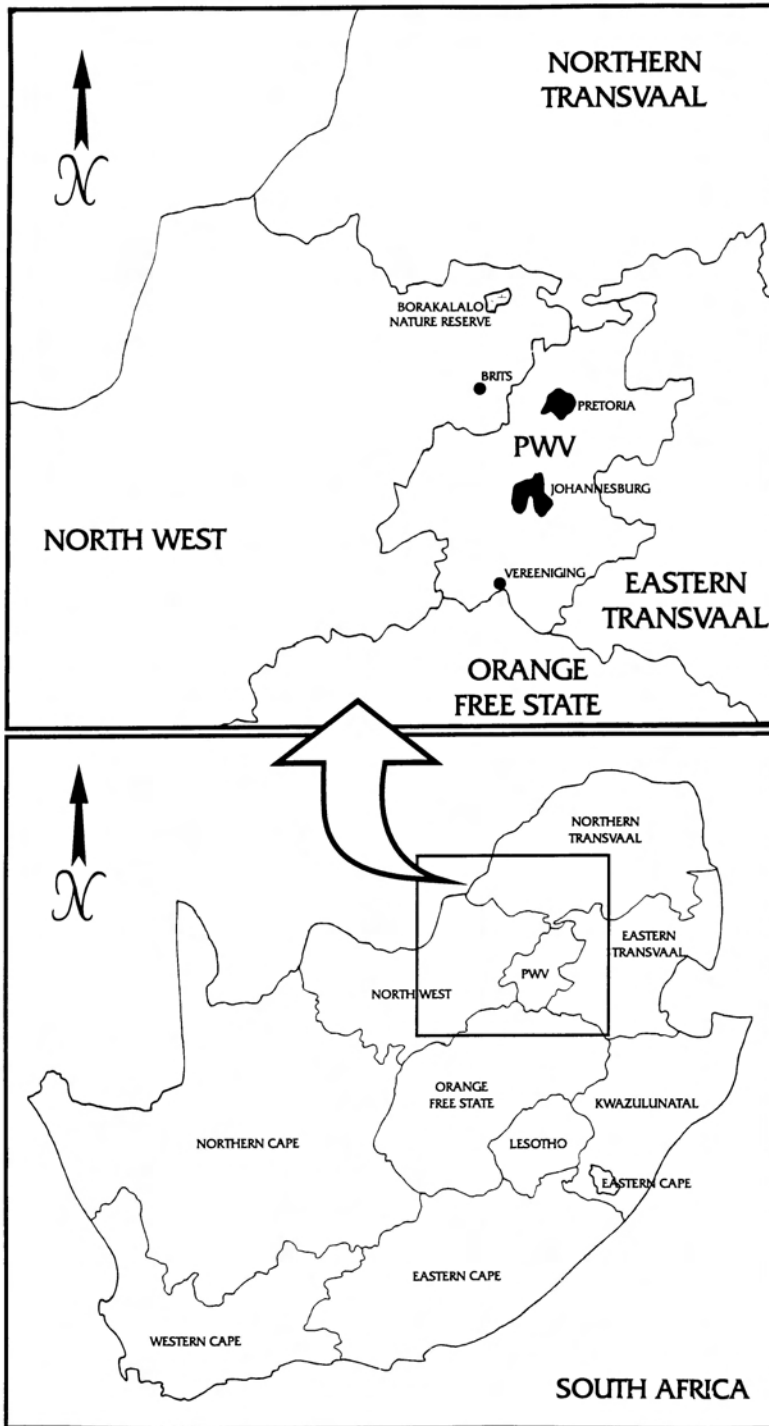


Fig. 1. The location of the study area in South Africa.

Geologically the reserve falls within the Transvaal Supergroup (Van der Meulen 1979). Approximately 95% of the southern section of the reserve lies on coarse-grained porphyritic granite while the remaining 5% is divided more or less equally between a mudstone, siltstone, marl, sandstone and grit section and a shale, sandstone, grit and conglomerate section.

Methods

Relevés were compiled in 83 stratified random sample plots. Stratification was done using 1:50 000 aerial photographs. Plot sizes were fixed at 200 m² in accordance with the size used by Bophuthatswana Parks Board in their vegetation surveys. In each sample plot all species were recorded and the cover-abundance of each species was assessed according to the Braun-Blanquet cover-abundance scale (Mueller-Dombois & Ellenberg 1974). The taxon names conform to those of Arnold & De Wet (1993). The woody vegetation was surveyed in accordance to Bophuthatswana Parks Board woody vegetation survey method. The woody strata were divided into three height levels namely the lower (0-1 m), middle (1-3 m) and upper levels (>3 m). The percentages canopy cover of the herbaceous, shrub and tree strata in each plot were also estimated.

Environmental data included soil type, erosion, an estimation of aspect, slope and rockiness of the soil surface, and degree of grazing or trampling. Two-way indicator species analysis (TWINSPAN) (Hill 1979) was applied to the floristic data to derive a first approximation of the main plant communities found in this area. Further refinement was achieved by Braun-Blanquet procedures (Bredenkamp *et al.* 1989; Kooij *et al.* 1990; Fuls *et al.* 1993). The results are presented in a phytosociological table (Table 1). The identified plant communities are mapped at a scale of 1:50 000 (Fig. 2). In this study diagnostic species are used in accordance with Westhoff & Van der Maarel (1978), but no distinction is made between character and differential species, as it is not possible to identify character species from the relatively small area covered by the reserve.

Results

Classification

The classes obtained from the TWINSPAN classification are very similar to the final communities of the Braun-Blanquet analysis. The Braun-Blanquet analysis resulted in the following ten plant communities, sub-communities or variants, which may be grouped into five major community types:

1. *Sporobolus ioclados* - *Acacia luederitzii* woodland.

1.1 *Tarchonanthus camphoratus* - *Acacia luederitzii* mixed woodland.

1.2 *Sporobolus nitens* - *Acacia luederitzii* woodland.

2. *Portulaca quadrifida* - *Acacia tortilis* disturbed woodland.

3. *Combretum apiculatum* - *Clerodendrum ternatum* disturbed woodland.

4. *Perotis patens* - *Terminalia sericea* woodland.

4.1 *Acacia luederitzii* - *Combretum here-roense* - *Terminalia sericea* woodland.

4.2 *Eragrostis gummiflua* - *Terminalia sericea* woodland.

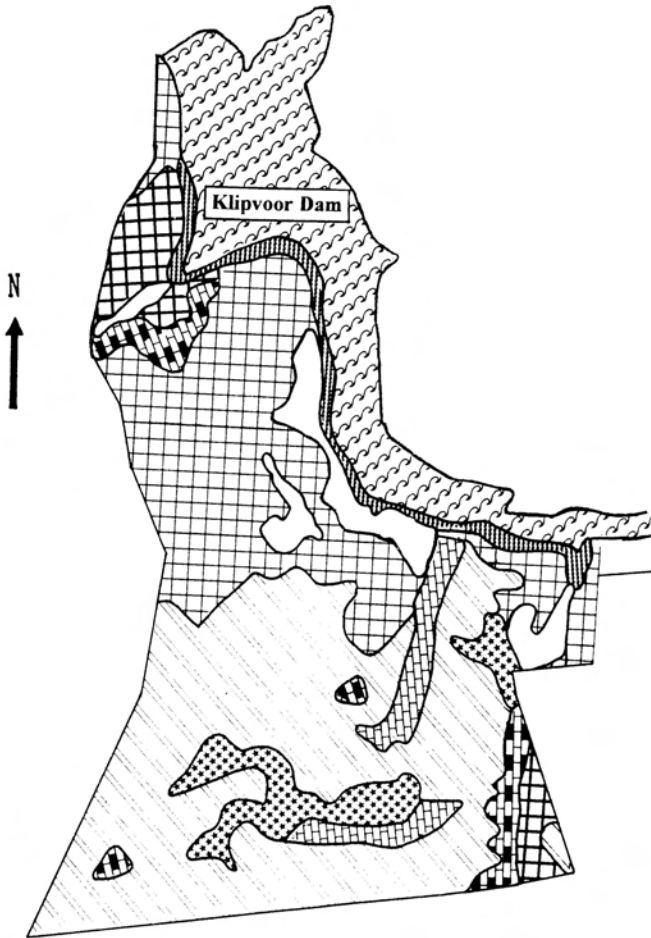
4.3 *Eragrostis pallens* - *Terminalia sericea* woodland.

4.3.1 *Eragrostis pallens* - *Terminalia sericea* - *Burkea africana* woodland.

4.3.2 *Eragrostis pallens* - *Terminalia sericea* - *Cleome maculata* mixed woodland.

4.4 *Schizachyrium jeffreysii* - *Terminalia sericea* woodland.

5. *Schoenoplectus corymbosus* - *Cynodon dactylon* grassland.



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





- 
Tarchonanthus camphoratus - *Acacia luederitzii* mixed woodland.
- 
Sporobolus nitens - *Acacia luederitzii* woodland.
- 
Portulaca quadrifida - *Acacia tortilis* disturbed woodland.
- 
Combretum apiculatum - *Clerodendrum ternatum* disturbed woodland.
- 
Acacia luederitzii - *Combretum hereroense* - *Terminalia sericea* woodland.
- 
Eragrostis gummiflua - *Terminalia sericea* woodland.
- 
Eragrostis pallens - *Terminalia sericea* - *Burkea africana* woodland.
- 
Eragrostis pallens - *Terminalia sericea* - *Cleome maculata* mixed woodland.
- 
Schoenoplectus corymbosus - *Cynodon dactylon* grassland.

Fig. 2. A vegetation map of the southern section of the Borakalalo Nature Reserve.

Description of the plant communities

The general vegetation of the area is characterised by the presence of the species of group N (Table 1) in all the plant communities except the *Schoenoplectus corymbosus* - *Cynodon dactylon* grassland community on the disturbed banks of the dam. These species can therefore be considered as common species for the area. The most prominent woody species, which occur in almost all the communities, are *Dichrostachys cinerea*, *Ziziphus mucronata* and *Euclea undulata*, while the most constantly present grass species are *Eragrostis rigidior*, *Digitaria eriantha*, *Schmidtia pappophoroides*, *Aristida congesta* subsp. *congesta*, *Urochloa mosambicensis* and *Panicum maximum*. Forbs that are constantly found include the weedy pioneers *Kyphocarpa angustifolia*, *Monsonia angustifolia*, *Portulaca oleracea* and *Schkuhria pinnata*, indicating the general degree of degradation in the area.

It is of importance to note that many of these species indicate previous mismanagement and signify drought and poor veld condition. Examples are the abundance of the potential bush encroacher *Dichrostachys cinerea* (Brendenkamp 1986; Bothma 1988), and also the constancy and high cover-abundance of increaser grass species such as *Eragrostis rigidior*, *Aristida congesta* subsp. *congesta*, *Urochloa mosambicensis* and *Tricholaena monachne* (Van Oudtshoorn 1991). The presence of most pioneer forbs, for example *Abutilon austro-africanum*, *Kyphocarpa angustifolia*, *Portulaca oleracea* and *Schkuhria pinnata* emphasises the general degraded state of the habitat.

1. *Sporobolus ioclados* - *Acacia luederitzii* woodland.

With the exception of relevés 74 and 75, which lie in the western part of the study area, this community is mainly situated on the eastern side and occurs in, or close to, dry river beds. The soil found here is often allu-

vial, has a clayish texture and shows sodic properties.

This woodland is characterised by species group A (Table 1) and the diagnostic species are the trees *Acacia luederitzii* and *A. mellifera*, the grasses *Sporobolus ioclados*, *S. nitens*, and the forbs *Kalanchoe rotundifolia*, *Plectranthus madagascariensis* and *Lycium* spp.

The average height of the woody layer varies between one and three metres although many individual trees are taller than three metres. This layer covers 30-60% of the sample plots, with the shrub layer 15-40%, and the herbaceous layer (which includes grasses and forbs) 20-30%. *Acacia tortilis* trees as well as the shrub *Grewia flava* are conspicuous species found scattered in this woodland. Both *Acacia luederitzii* and *Acacia mellifera* can form impenetrable thickets with the latter being able to spread rapidly (Palgrave 1983), posing a bush encroachment threat.

Both the grasses *Sporobolus ioclados* and *S. nitens* are indicators of slightly sodic (brackish) soils, and are highly palatable and preferred by grazing animals (Van Oudtshoorn 1991) — explaining the high degree of trampling and grazing found in this community. One prominent grass is *Tragus berteronianus* which is an indicator of deterioration of the veld (Dannhauser 1985; Van Oudtshoorn 1991). The absence of the grass *Schmidtia pappophoroides* and the forb *Leucas glabrata* (group N) is another feature of this community.

1.1 *Tarchonanthus camphoratus* - *Acacia luederitzii* mixed woodland.

This woodland occurs in the northern and eastern sections of the study area (Fig. 2). The vegetation in all sample plots has been prone to a high degree of grazing, estimated as up to 70% at certain localities. The soil has a sandy to clayish texture, while the diagnostic species (species groups B and G - Table 1), include the shrubs *Tarchonanthus cam-*

phoratus, *Ehretia rigida*, the grasses *Dactyloctenium aegyptium*, *Eragrostis trichophora*, and the forbs *Justicia flava*, *Hibiscus pusillus* and *Ruellia cordata*.

The woody layer is dominated by *Acacia luederitzii* and *A. tortilis*, while *A. mellifera* occurs sporadically. The *Acacia luederitzii* canopy is mostly higher than three metres indicating that it is in an adult stage, while the height of the other woody species varies between one and three metres. Woody or shrub-like species found in this community with heights varying between one and three metres include *Tarchonanthus camphoratus*, *Ehretia rigida* and *Grewia flava*. The grass layer is dominated by the palatable *Sporobolus ioclados* and *S. nitens* (Van Oudtshoorn 1991), heavily utilised by grazing animals, which explains the high degree of grazing and trampling found here. This fact also explains the presence of pioneer grasses such as *Dactyloctenium aegyptium*, *Eragrostis trichophora*, *Tragus berteronianus*, *Chloris virgata*, *Aristida canescens* subsp. *canescens* and *Urochloa mosambicensis* (Van Oudtshoorn 1991).

Forbs found in this community include *Kalanchoe rotundifolia*, *Plectranthus madagascariensis*, *Hibiscus pusillus*, *Ruellia cordata* and *Justicia flava*. The absence of the grass *Schmidtia pappophoroides* is characteristic of this community.

1.2 *Sporobolus nitens* - *Acacia luederitzii* woodland.

This community is situated in the southern part of the reserve in old and dry riverbeds, where the soil is sandy to clayish.

This woodland is characterised by the presence of species groups A and C (Table 1) and the simultaneous absence of species groups B and G, which do occur in the *Tarchonanthus camphoratus* - *Acacia luederitzii* woodland. Diagnostic species include only the forb *Pavonia burchellii* (species group C, Table 1).

The woody layer is totally dominated by *Acacia luederitzii* trees that have an average canopy cover of up to 40%, while *A. mellifera* and *A. tortilis* are also present. The average height of the woody layer varies between one and three metres, while some of the *A. luederitzii* trees are taller than three metres. *Grewia flava* is the most prominent shrub, varying in height between 0.5 m and 1 m. The grass layer is dominated by *Sporobolus nitens* while *S. ioclados* can sometimes be a co-dominant. As previously mentioned these grasses are palatable and utilised by animals, therefore leading to the high degree of grazing found here. The presence of increased 2 grass species such as *Tragus berteronianus* and *Aristida congesta* subsp. *barbicollis* and sometimes *Enneapogon scoparius* is therefore explained.

Conspicuous forbs for this community include *Kalanchoe rotundifolia*, *Plectranthus madagascariensis*, *Lycium* spp., *Pavonia burchellii*, *Abutilon austro-africanum* and sometimes *Solanum panduriforme*. Another characteristic of this community is the absence of the forbs *Monsonia angustifolia* and *Evolvulus alsinoides*, which are found in all the other communities.

2. The *Portulaca quadrifida* - *Acacia tortilis* disturbed woodland. This woodland is situated in the southern and eastern parts of the reserve (Fig. 2), typically on coarse-grained soil derived from granite. The vegetation has been subjected to a high degree of grazing, estimated as up to 80% on some plots, with slight surface erosion evident.

This community is characterised by the presence of the following diagnostic species, most of which are pioneer species: *Acacia tortilis*, *Portulaca quadrifida*, *Limnium viscosum*, *Achyranthes aspera*, *Talinum caffrum* and *Tribulus terrestris* (species groups D and E, Table 1).

The woody layer, which is higher than three metres, is dominated by *Acacia tortilis* trees although *Dichrostachys cinerea* may, to a

lesser extent, also be present. Shrub-like species include *Grewia subspathulata*.

The grass layer is dominated by *Eragrostis rigidior* and also includes *Tragus berteronianus*, *Aristida congesta* subsp. *barbicollis* and *Chloris virgata*. All these grasses are increaser 2 species (Van Oudtshoorn 1991) indicating the deteriorated condition of the herbaceous layer.

The herbaceous layer of this community is dominated by *Portulaca quadrifida*, *Solanum panduriforme* and *Portulaca oleracea*. Other forbs found are *Achyranthes aspera*, *Limeum viscosum*, *Tribulus terrestris*, *Talinum caffrum* and *Schkuhria pinnata*. These forbs are all weedy pioneers that are usually found in disturbed areas.

Another characteristic of this community is that woody species such as *Rhus leptodictya*, *Euclea undulata* as well as the grasses *Digitaria eriantha* and *Tricholaena monachne* occur sporadically.

3. *Combretum apiculatum* - *Clerodendrum ternatum* woodland.

This community is strongly associated with coarse-grained granite soil and granite boulders. It is found throughout the southern parts, and constitutes the largest portion of the study area (Fig. 2). Nearly all the sample plots are situated on slight slopes with little or no erosion being detected. Characteristic species include the trees *Combretum apiculatum*, *Acacia robusta*, *Vitex rehmannii*, the grass *Brachiaria nigropedata*, and the forbs *Clerodendrum ternatum*, *Hermannia glanduligera* and *Ceratotheca triloba* (species group F, Table 1).

Although the woody layer is dominated by *Combretum apiculatum* with an average height of more than three metres, other species such as *Acacia robusta* and *Dichrostachys cinerea* also occur. Locally *Acacia tortilis*, *A. nilotica* and *Peltophorum africanum* are present in small numbers. The

shorter shrub stratum is dominated by *Grewia flava* which varies in height between one and three metres.

The grass layer is dominated by increaser 2 species such as *Eragrostis rigidior*, *Tragus berteronianus* and *Enneapogon scoparius*, while decreaseers that are highly nutritious and palatable, such as *Brachiaria nigropedata*, *Schmidtia pappophoroides* and *Panicum maximum*, also occur.

The most prominent forbs are *Clerodendrum ternatum* and *Kyphocarpa angustifolia* while other forbs include *Monsonia angustifolia*, *Portulaca quadrifida*, *P. oleracea*, *Schkuhria pinnata*, *Evolvulus alsinoides*, *Limeum viscosum*, *Hermannia glanduligera*, *Ceratotheca triloba* and *Solanum panduriforme*. Most of these forbs are pioneer species and indicate deterioration of the herbaceous layer.

The species of group E (Table 1) are common to both this community and the *Portulaca quadrifida* - *Acacia tortilis* disturbed woodland.

4. *Perotis patens* - *Terminalia sericea* woodland.

This community, which can be subdivided into four subcommunities, is mainly situated in the northern part of the study area which constitutes about one-third of the reserve (Fig. 2). The soil texture is sandy and coarse-grained. The four subcommunities often occur in a continuous mosaic distribution pattern throughout this part of the reserve. The major distribution centres of some of these subcommunities are, however, indicated on the vegetation map (Fig. 2).

Diagnostic species include the trees *Terminalia sericea*, *Acacia karroo*, *Rhus pyroides*, *Rhus lancea*, *Acacia caffra*, the shrubs *Grewia flavescens* and *Diospyros lycioides*, the grasses *Perotis patens*, *Melinis repens*, *Eragrostis lehmanniana*, *Stipagrostis uniplumis*, *Themeda triandra*,

and the forbs *Limeum fenestratum*, *Vernonia poskeana*, *Felicia muricata*, *Lophiocarpus tenuissimus* and *Sida cordifolia* (species group L, Table 1). Of these species the following are indicators of sandy soils: *Terminalia sericea*, *Perotis patens*, *Eragrostis lehmanniana*, *Stipagrostis uniplumis* and *Limeum fenestratum* (Van Oudtshoorn 1991). These species show a Kalahari affinity (Van Rooyen 1990).

The shrub layer is about 0,5-3 m tall while the trees, which constitute 50-70% of the vegetation cover, are taller than three metres. The most prominent species are *Terminalia sericea* and *Dichrostachys cinerea* which have a 40-80% coverage. The most prominent grasses are *Perotis patens*, *Melinis repens* and *Eragrostis rigidior*.

4.1 *Acacia luederitzii* - *Combretum hereroense* - *Terminalia sericea* woodland.

This subcommunity is situated in the north-eastern part, close to the south-western edges of the Klipvoor Dam (Fig. 2). The soil texture varies from sandy to coarse-grained soil on granite gravel. Erosion does occur and is estimated at about 25%.

Diagnostic species include *Acacia luederitzii*, *Ehretia rigida*, *Justicia flava* and *Tarchonanthus camphoratus* (species groups A and G, Table 1). This community and the *Tarchonanthus camphoratus* - *Acacia luederitzii* mixed woodland have species group G (Table 1) in common. Another characteristic feature is the absence of species group K (Table 1).

The woody layer is dominated by *Acacia luederitzii* and includes species such as *Acacia tortilis*, *Terminalia sericea*, *Combretum hereroense*, *Dichrostachys cinerea*, *Ehretia rigida* and sometimes *Rhus lancea*. The shrub layer is dominated by *Grewia flava*, although *Tarchonanthus camphoratus* occurs locally.

The most prominent grass species is *Eragrostis rigidior* while other grasses that occur constantly are *Tragus berteronianus*,

Aristida congesta subsp. *barbicollis*, *Aristida stipagrostis*, *Tricholaena monachne* and *Perotis patens*. All these grasses occur on sandy soils and are indicative of a deteriorated veld (Van Wyk & Malan 1988; Van Oudtshoorn 1991).

Forbs that occur include *Justicia flava*, *Waltheria indica* and sometimes *Limeum fenestratum*, *Lophiocarpus tenuissimus*, *Sida cordifolia* and *Chamaecrista absus*.

Another feature of this community is the absence of species such as *Rhus leptodictya*, *Combretum zeyheri* and *Triconeura grandiglumis* (species groups M and N, Table 1). Other species that rarely occur are *Combretum imberbe*, *Geigeria burkei*, *Rhynchosia totta* and *Hibiscus trionum* (species groups M and N, Table 1).

4.2 *Eragrostis gummiflua* - *Terminalia sericea* mixed woodland.

This woodland is mainly restricted to the northern part of this section of the reserve, but also occurs in the south-eastern corner of the reserve. The vegetation has a total canopy cover of 50% and occurs in sandy soil. Diagnostic species other than those of group L (Table 1), include *Eragrostis gummiflua*, *Schizachyrium jeffreysii*, *Aristida adscensionis*, *Agathisanthemum bojeri*, *Acacia tenuispina*, *Jatropha zeyheri*, *Crabbea angustifolia* and *Chamaecrista mimosoides* (species group K, Table 1). The absence of species groups I and J (Table 1) is also characteristic of this community.

The woody layer is dominated by *Terminalia sericea* and *Dichrostachys cinerea*. Other species include *Boscia albitrunca*, *Acacia tenuispina*, *Acacia karroo*, *Rhus pyroides*, *Combretum hereroense*, *Peltophorum africanum*, *Ziziphus mucronata*, and sometimes *Acacia tortilis*, *Acacia erubescens*, *Rhus lancea* and *Acacia caffra*.

The most prominent grasses include *Eragrostis gummiflua*, *Eragrostis rigidior*, *Aristida congesta* subsp. *barbicollis*,

Schizachyrium jeffreysii, *Perotis patens*, *Melinis repens*, *Aristida stipitata* subsp. *graciliflora*, *Pogonarthria squarrosa*, and sometimes *Tragus berteronianus*, *Aristida adscensionis* and *Enneapogon scoparius* are also found.

Forbs include *Agathisanthemum bojeri*, *Limeum fenestratum*, *Waltheria indica*, *Chamaecrista absus*, and sometimes, *Chamaecrista mimosoides*, *Crabbea angustifolia* and *Jatropha zeyheri*.

4.3 *Eragrostis pallens* - *Terminalia sericea* woodland.

This community, which is strongly associated with deep sandy soil, occupies a large area in the northern part of this section of the reserve (Fig. 2).

Diagnostic species include the grasses *Eragrostis pallens*, *Eragrostis curvula* and the forbs *Blepharis integrifolia*, *Indigofera filipes*, *Leonotis ocimifolius*, *Justicia anagalloides*, *Dicoma anomala* and *Hibiscus* sp. (species group J, Table 1).

The grass *Eragrostis pallens*, which is generally found in sandy soils and usually in association with *Terminalia sericea* and *Burkea africana* trees (Van Oudtshoorn 1991), is only found in this woodland on the reserve. The absence of *Acacia caffra*, *Combretum imberbe*, *Themeda triandra* and *Geigeria burkei* is also characteristic of this community.

Two variants, which occur in a mosaic distribution pattern and which are not mapped separately, were recognised:

4.3.1 The *Eragrostis pallens* - *Terminalia sericea* - *Burkea africana* woodland variant.

This vegetation is characterised by the total dominance of *Terminalia sericea* and very prominence of *Burkea africana*, with an esti-

mated 50-70% and 12-20% canopy coverage respectively. Another prominent species, which occurs prominently in almost all the communities, is *Dichrostachys cinerea*.

Diagnostic species for this woodland, include *Triraphis andropogonoides*, *Bidens pilosa*, *Elephantorrhiza elephantina*, *Schizachyrium sanguineum*, *Raphionacme galpinii* and *Burkea africana* (species group I, Table 1). The absence of species such as *Acacia tenuispina* and *Cymbopogon plurinodis* is also indicative of this community.

The woody layer further includes *Peltophorum africanum* and *Dichrostachys cinerea*, while the most prominent grass species are *Triraphis andropogonoides*, *Perotis patens*, *Melinis repens*, *Eragrostis lehmanniana*, *Aristida stipitata*, *Digitaria eriantha*, *Aristida congesta* subsp. *congesta* and *Panicum maximum*.

The forbs are represented by *Chamaecrista absus*, while *Bidens pilosa*, *Limeum fenestratum*, *Vernonia poskeana* and *Waltheria indica* also occur.

4.3.2 The *Eragrostis pallens* - *Terminalia sericea* - *Cleome maculata* mixed woodland variant.

As mentioned, this variant forms a mosaic distribution pattern with the *Eragrostis pallens* - *Terminalia sericea* - *Burkea africana* woodland variant on the northern parts of the study area. The soil varies from sandy to slightly clayish with approximately 5% granite sheet outcrops. Only slight erosion occurs but the degree of grazing is estimated at 30%.

Diagnostic species include species group J (Table 1) and the forb *Cleome maculata*. Another characteristic is the absence of species group I (Table 1).

The woody layer is dominated by *Terminalia sericea*, with an average height of over three

metres, while *Dichrostachys cinerea* is conspicuous.

The most prominent grasses are *Eragrostis pallens* and *Perotis patens*. Other grasses that are found here include *Schizachyrium jeffreysii*, *Eragrostis curvula*, *Aristida stipitata* and *Pogonarthria squarrosa*.

Forbs for this variant include *Blepharis integrifolia*, *Indigofera filipes*, *Leonotis oymifolia*, *Justicia anagalloides*, *Dicoma anomala*, *Hibiscus* sp., *Cleome maculata*, *Agathisanthemum bojeri*, *Limeum fenestratum*, *Vernonia poskeana*, *Waltheria indica* and *Chamaecrista absus*, which is also the most prominent. The absence of *Rhus lancea*, *Peltophorum africanum*, *Tricholena monachne* and *Hibiscus trionum* is also a diagnostic feature of this community.

4.4 *Schizachyrium jeffreysii* - *Terminalia sericea* woodland.

This subcommunity is mainly spread over the northern portion of the study area, where it forms a mosaic distribution pattern with the *Eragrostis pallens*-*Terminalia sericea* woodland (4.3). This woodland is associated with coarse-grained granite soil with granite boulders, which is found scattered throughout the distribution range of subcommunity 4.3. This subcommunity is, therefore, not mapped separately.

No diagnostic species group is associated with this subcommunity, but this vegetation is characterised by the presence of *Acacia tenuispina*, *Eragrostis gummiflua*, *Schizachyrium jeffreysii*, *Aristida adscensionis* subsp. *adscensionis*, *Agathisanthemum bojeri* and *Chamaecrista mimosoides* (species group K, Table 1). Also characteristic is the absence of *Crabbea angustifolia* and *Jatropha zeyheri* (species group K) as well as species groups I and J (Table 1).

The woody layer is dominated by *Terminalia sericea*, while *Acacia karroo* may be present.

The height of the woody layer varies between two and three metres.

Eragrostis gummiflua and *Schizachyrium jeffreysii* are the most prominent grasses, while *Aristida adscensionis*, *Perotis patens*, *Themeda triandra*, *Aristida stipitata* subsp. *graciliflora* and *Digitaria eriantha* are also found.

Forbs include *Agathisanthemum bojeri*, *Chamaecrista mimosoides* and *Waltheria indica*. Another characteristic is the absence of *Limeum fenestratum*, *Grewia flavescens*, *Schmidtia pappophoroides*, *Panicum maximum* and *Leucas glabrata*.

5. *Schoenoplectus corymbosus* - *Cynodon dactylon* grassland.

Lying on the flat, marshy banks of the Klipvoor Dam, this community is associated with clayey soil. It consists of a herbaceous layer (species group O, Table 1), that is dominated by the grass *Cynodon dactylon* which is often found on the overgrazed and trampled banks of rivers and dams (Van Oudtshoorn 1991). This grass is characteristic of disturbed areas (Dannhauser 1985; Van Oudtshoorn 1991), caused, in this case, by game flocking to the water to graze the short, sweet grass — leading to a high degree of trampling. Regular flooding after rains also causes disturbance of this habitat. Locally the herbaceous layer is co-dominated by the sedge *Schoenoplectus corymbosus*. These form dense stands closer to the water, where it is more marshy. The forb, *Gomphrena celosioides*, characteristic of disturbed areas (Van Wyk & Malan 1988), is also present.

Concluding remarks

Although in some cases the communities form a mosaic pattern, there are clear distinctions between the five main communities identified. It is therefore recommended that each be managed as a separate ecological

Table 1 (continued)

Species group G												
<i>Justicia flava</i>	+++	+										
<i>Enretia rigida</i>	+++	+										
<i>Tarconanthus camphoratus</i>	+++	1										
Species group H												
<i>Trogon barteronianus</i>	+++A1+	1A++	+++	1A++	+++	1A++	+++	1A++	+++	1A++	+++	1A++
<i>Grewia flava</i>	IRRB+	IR++A+	+++	IR++	+++	IR++	+++	IR++	+++	IR++	+++	IR++
<i>Aristida congesta</i> sp. <i>barbicollis</i>	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
<i>Acacia tortilis</i>	+BRA5R	1R+BB1	43BB3	+33	1	RR331	RR	+R	1BAR	11A++	RRR	+
<i>Enneapogon scoparius</i>	+	+	+	+	+	+	+	+	+	+	+	+
<i>Acacia nilotica</i>	+	A+	IR	RR	RR	R+BBBR	R1+RRRR	BB	AR1+	+	+	+
<i>Solanum panduriforme</i>	+	+	+	+	+	+	+	+	+	+	+	+
<i>Grewia subspatiolata</i>	RRRR	B	A	R	B	AR	+++	1R	ARRAR	+	RR	+
<i>Grewia patens</i>	+	+	+	+	+	+	+	+	+	+	+	+
<i>Chloris virens</i>	+	+	+	+	+	+	+	+	+	+	+	+
<i>Aristida canescens</i>	1A+	+	+	+	+	+	+	+	+	+	+	+
<i>Boscia albitrunca</i>	RR	+	RR	R								
Species group I												
<i>Burkea africana</i>												
<i>Triraphis andropogonoides</i>												
<i>Bidens pilosa</i>	+											
<i>Sphenantrhiza elephantina</i>												
<i>Sphenantrhiza capriuum</i>												
<i>Raphionacme galpieri</i>												
Species group J												
<i>Eragrostis pallens</i>												
<i>Blepharis integrifolia</i>	+											
<i>Eragrostis curvula</i>												
<i>Indigofera filipes</i>												
<i>Leonotis occymifolia</i>												
<i>Justicia anagalloides</i>	+											
<i>Justicia sp.</i>												
<i>Hibiscus speciosus</i>												
<i>Cleome maculata</i>												
Species group K												
<i>Eragrostis gumiflua</i>												
<i>Agathisanthemum bojeri</i>		A										
<i>Schizachyrium jeffreysii</i>												
<i>Chamaecrista mimosoides</i>												
<i>Acacia tenuispina</i>												
<i>Aristida adscensionis</i>												
<i>Gabbaea angustifolia</i>												
<i>Jatropha zeyheri</i>	+	+										
Species group L												
<i>Terminalia sericea</i>												
<i>Perotis patens</i>												
<i>Acacia karroo</i>	R											
<i>Melinis repens</i>												
<i>Rhus pyroides</i>	R	1										
<i>Limeum fenestratum</i>												
<i>Rhus lancea</i>	R	+										

unit. This would imply an assessment of the grazing potential of each of the management units, to evaluate the present stocking rate of the reserve.

Of interest is the abundance and probable increase of *Dichrostachys cinerea* throughout the reserve. According to Bothma (1988), overgrazing can lead to bush encroachment by *Dichrostachys cinerea*. The *Perotis patens* - *Terminalia sericea* woodland (community 4) is of interest since *Terminalia sericea* is a declared invader plant in the Transvaal (Henderson *et al.* 1987). Although it normally occurs on sandy soils, monitoring measures should be taken to ensure the early detection of possible undesirable increases. An assessment of the woody strata, to evaluate both possible bush encroachment and browsing potential, could contribute to the management of the reserve.

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