Landscape units of Mokala National Park,
Northern Cape Province, South Africa

by

H. Bezuidenhout, P.L. Bradshaw, M. Bradshaw & P.C. Zietsman
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Cover: The iconic Camel Thorn Tree (Vachellia erioloba), characteristic of Mokala National Park.
(Photograph: P.C. Zietsman)
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ABSTRACT

Bezuidenhout, H., Bradshaw, P.L., Bradshaw, M. & Zietsman, P.C. 2015. Landscape units of Mokala National Park, Northern Cape Province, South Africa. Navors. nas. Mus., Bloemfontein 31(1): 1-27. The relatively newly proclaimed Mokala National Park, following the deproclamation of Vaalbos National Park, lacked an ecological landscape unit classification (description and mapping) of the conservation area. Nine landscape units and one degraded area were classified, mapped and described. This has already been used to make informed decisions on vegetation and animal conservation, and tourism management in the park.
(classification, landscape unit, vegetation, Mokala National Park, habitat description)

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INTRODUCTION

The necessity for an ecological landscape unit classification, which describes and maps a conservation area, has been established (Bredenkamp & Theron 1978; Van Rooyen et al. 2008; Chytry’ et al. 2011; De Ca’ceres & Wiser 2012; Jürgens et al. 2012; Luther-Mosebach et al. 2012). A sound understanding of the ecology of Mokala National Park (MoNP), summarised in a landscape classification map, will contribute considerably to the compilation of an effective wildlife management programme and conservation policy. As a natural protected area, it could also serve as a permanent reference site for wider landscape vegetation reconnaissance surveys in the Northern Cape region.

Proclaimed on 19 June 2007, MoNP is the most recently proclaimed national park in South Africa (SANParks 2008). The de-proclamation, in 2007, of Vaalbos National Park (VNP) in the Northern Cape Province, led to the establishment of MoNP in the general vicinity of the previous park. Not only is the region highly productive and able to support relatively high numbers of wildlife, but habitat types represented in VNP are not present in other national parks. The declaration of MoNP therefore helps to fulfil the SANParks mission to develop, manage and promote a system of national parks that represents the biodiversity and heritage assets of the country by applying best practice, environmental justice, benefit
sharing and sustainable use”. This “replacement” park further provides a tourism product that helps to promote local economic development.

Vaalbos National Park comprised two sections, the larger Than-Droogeveld section (18 120 ha), situated approximately 61 km north-west of Kimberley, and the smaller Gras-Holpan section (4 576 ha), located approximately 25 km west of Kimberley (Bezuidenhout 1994, 1995) (Fig. 1). During November 1997 and December 1998 a land claim was instigated against the Than-Droogeveld section of VNP by the Sidney-on-Vaal claimants. After the claim was legitimised, SANParks investigated five other possible locations for the new national park. All the reports indicated Wintershoek, in the Ploosburg area, to be the best option (Koch et al. 1999). The land claim was officially gazetted in November 2002 and SANParks accepted the validity of the claim. In November 2004 the negotiation process with the landowners was officially initiated and the submission report was forwarded to the Minister of Land Affairs and signed on 30 May 2006. SANParks commenced management of Wintershoek on 30 May 2006. The new park was named Mokala National Park, and was officially proclaimed by the Minister of Environmental Affairs and Tourism on 29 June 2007. ‘Mokala’ is a Setswana name for the camel thorn tree (Vachellia erioloba), the most characteristic tree in the area (SANParks 2008).

This study forms part of a broader inventory of the diversity of plant species, plant communities and landscapes (landscape unit classifications are closely associated with plant communities) represented in all the national parks of South Africa. Similar studies have already been conducted for Augrabies Falls National Park (Werger & Coetzee 1977; Bezuidenhout 1996), Mountain Zebra National Park (Van der Walt 1980; Brown & Bezuidenhout 2005), Kruger National Park (Van Rooyen et al. 1981; Gertenbach 1983), Zuurberg National Park (Van Wyk et al. 1988), Golden Gate Highlands National Park (Kay et al. 1993), Vaalbos National Park (Bezuidenhout 1994, 1995) and Kalahari Gemsbok National Park (Van Rooyen et al. 2008). With regard to flowering plant diversity, the MoNP has already proven to be more diverse than VNP was. During the last three years, two of the authors (Zietsman & Bezuidenhout) collected 420 plant species at the “replacement” park, 86 more than the 334 species recorded for VNP (Zietsman et al., 1992). Once this survey has been completed it will contribute towards a detailed phytosociological description of the park.

The landscape units and associated vegetation of the habitats of the Northern Cape Province, as reflected in the park’s high faunal richness (25 mammal species), was also noted by Crowe et al. (1981) in the nearby Rooipoort Nature Reserve. Two of the “big five” are also resident in the Park, namely the endangered black and white rhinoceros species and the disease-free Cape Buffalo. Rare and endangered species such as roan, tsessebe and sable also occur here (SANParks 2008).

The main aim of this study was to produce an accurate landscape unit map of MoNP, before a more comprehensive and detailed phytosociological analysis can be undertaken (Brown et al. 2013). There is an immediate need for such a meaningful ecological classification in this young and expanding park for research, park planning and management purposes. Such a description and map can be used to aid in the selection of sites for vegetation monitoring and serve as a basis to determine wildlife-habitat relationships (Ferreira et al. 2013). The units identified in the present study are termed “landscape units”, adapted from the definition of Gertenbach (1983): “A landscape is an area with a specific geomorphology,
macroclimate, soil and vegetation pattern, and associated fauna”. The landscape unit is a smaller scale entity than that of the Kruger defined landscape (Gertenbach 1983). A landscape unit has a distinctive geomorphology, land type, soil, and plant species composition and vegetation structure associated with it (sensu Bezuidenhout 1993).

**STUDY AREA**

**Location and size**
MoNP is located in the Northern Cape Province, 80 km south-west of Kimberley, and west of the N12 (Cape Town) highway (Fig. 1). The park is currently 27 572 hectares (ha) in extent, but is still expanding. MoNP is situated within the Siyancuma local municipality, in the Pixley ka Seme district municipality of the Northern Cape Province (Van Wyk 2007; SANParks 2008).

**Geology**
The Park is underlain by various geological types. Aeolian sand of Tertiary to Recent age covering the Dwyka Formation rocks cover most of the Park (SRK 2009). Outcrops of the andesitic lavas of the Allanridge Andesite Formation (the oldest rocks in the area) occur in isolated patches as rocky hills in the northern section of MoNP. Karoo dolerite intrusions, mostly occurring as sills and dykes, are found in the rocky hills surrounding the Mosu Lodge rest camp. The sedimentary succession mainly comprises shale of the Tierberg Formation as well as white weathering shale of the Whitehill Formation. The latter is a relatively soft rock that weathers easily, and is overlain by aeolian sand and calcrete.

**Physiography, soil, land types and vegetation**
The physiography of the study area varies from flat to gently undulating plains, to hills in the centre of the park. The following terrain types are present in MoNP: plateaux, crest, scarp, midslopes, valley bottomlands, drainage lines, pans and river (Land Type Survey Staff 1986; Bezuidenhout 1993).

Soil types vary from moderately deep (0.3–0.6 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 soils of the pans are moderately deep and very clayey (>35% clay content) (Arcadia, Rensburg and Willowbrook soil forms) (Soil Classification Working Group 1991).

The land type concept has frequently provided a useful basis for description of vegetation (Kooij 1990; Bezuidenhout 1993; Myburgh 1993). 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". Four land types, namely Ae, Ag, Ia and Ib, occur in MoNP. The “A” unit refers to yellow and red apedal, freely-drained soil without water tables. Most of the park is underlain by the “A” land types (Fig. 2). The Ae land type refers to red, high base status soil, usually deeper than 0.3 m. The Ag land type is similar to the Ae land type (reddish colour with high base status soil), except that it is consistently shallower than 0.3 m. The Ia land type refers to pedologically-youthful, deep, unconsolidated deposits; while the Ib unit is indicative of land types with exposed rock covering 60–80% of the specific area (Land Type Survey Staff 2012) (Fig. 2).
Figure 1: Location of Mokala National Park in relation to Rooipoort Nature Reserve and the deproclaimed Vaalbos National Park, with vegetation types in the background (Mucina & Rutherford 2006).
Figure 2: Land type map of Mokala National Park adapted from Land Type Survey Staff (2012).
According to the South African national vegetation map (Mucina & Rutherford 2006), three vegetation types occur in the park, namely Kimberley Thornveld (Svk4) and Vaalbos Rocky Shrubland (Svk5) which are part of the Savanna Biome, and Northern Upper Karoo (Nku 3) of the Nama Karoo Biome in the northwest of the park (Fig. 1). Historically, Acocks (1988) classified the vegetation of MoNP as Kalahari Thornveld invaded by Karoo (Veld Type 17). The interface of the Savanna Biome and the Nama-Karoo Biome (Rutherford & Westfall 1986) in MoNP increases its conservation value, as this is the only protected area incorporating this ecotone. The park may also monitor potential shifts in biome boundaries in response to climate change in a relatively natural environment (Bezuidenhout 1995).

Climate
MoNP is situated in a semi-arid area that experiences frequent thunderstorm activity. Temperature and rainfall data have been collected at Mosu since the park was proclaimed in 2008. However, we only report on climate data from 2008 to 2013. The predominantly summer rainfall is erratic, varying between 350 and 558 mm per year (June to May). Average annual rainfall recorded in the park was 397.5 ± 102.8 mm (Fig. 3). Temperature is less erratic than rainfall, with cold winters (coldest months June and July), as low as -6.61°C (July 2011); while summer (warmest months December and January) temperatures reach as high as 39.95 °C (January 2012) (Fig. 3). Frost occurs, with the earliest recorded frost event on 27 April, persisting to as late as 23 September (ARC 2012).

Figure 3: Rainfall and temperature at Mokala National Park for January 2008 – April 2014 (ARC 2013, climatic data). Error bars indicate 1SD.
METHODS

Division of the area into landscape units
The park was visited several times to reconnoitre its different landscape units. As several new developments were planned for the park, landscape unit assessments were undertaken to provide a more thorough understanding of habitat patterns, and to help guide development initiatives and tourist pressure away from potentially sensitive habitats. Aerial surveys proved useful in providing an added perspective of the study area. A mosaic of land types occur in MoNP (Fig. 2; Land Type Survey Staff 2012). These broad land types were used as a first stratification unit in the identification of MoNP landscape units, while topographic terrain types, as well as vegetation structure, were used to further refine stratification. This approach has provided ecologically reliable results in many phytosociological studies in South Africa (Van Wyk et al. 1988; Kooij 1990; Bezuidenhout 1993; Coetzee 1993; Eckhardt 1993). In a phytosociological study of the western Transvaal Grassland Biome area, this procedure and the compilation of separate plant sociological tables for each land type resulted in the successful identification of ecologically meaningful plant communities (Bezuidenhout 1993). The utilisation of high resolution (2.5 m) up-to-date (2011) SPOT5 satellite imagery assisted greatly not only in assessing the accuracy of delineation of the land type units, but more importantly in facilitating the identification of geomorphological features (distinct topographic terrain types) in the study area.

To verify the validity of the landscape units identified and their similarities to habitat types recorded during previous studies in similar environments (Bezuidenhout 1994, 1995, 2009), qualitative vegetation and habitat surveys were conducted throughout the park. Plot location was guided by its representivity of vegetation community structure of the entire landscape unit. A large (100 x 100 m) plot per landscape unit was sampled, and the most dominant plant species, together with canopy cover abundance value (Braun-Blanquet scale) for each, was recorded (Mueller-Dombois & Ellenberg 1974). Mean estimated height and average canopy cover for the tree, shrub and herbaceous layers were recorded for each plot (Bezuidenhout 1994). Stratification and interpretation was undertaken with cognisance of previous studies conducted on similar plant communities in the nearby deproclaimed Vaalbos National Park (Than-Droogeveldt section [138 sample plots] and Gras-und Holpan section [88 sample plots]), and Rooipoort Nature Reserve [120 sample plots]; Bezuidenhout 1994, 1995, 2009) (Fig. 1). Although certain plant species names have changed, the names used here conform to those of Klopper et al. (2006), except for *Acacia*. The genus *Acacia* plays an important role in the names of landscape units, and the newly-revised taxonomy of Kyalangalilwa et al. (2013) was used. Structural classification of the vegetation follows Edwards (1983).

Environmental data recorded in each plot included rock cover, terrain and soil forms as well as soil depth, soil texture and an estimation of the rockiness of the soil surface. Soil nomenclature follows the classification of the Soil Classification Working Group (1991).

Mapping of the area
Labelled wireframe land type units (Land Type Survey Staff 2012) were plotted on SPOT5 imagery (CNES 2011) which was draped over a hillshade layer in a GIS (ESRI, 2006), and printed at A0. The hardcopy map was then visually inspected, and refinements were made to derive our finer scale landscape units, based on a combination of field work and satellite imagery. The finer landscape units were then digitised to a shapefile. Finally, these refined
mapped landscape units were ground truthed, and the shapefile of the landscape unit map was adjusted where necessary by further onscreen digitisation.

RESULTS

Classification of landscape units
In MoNP the following nine landscape units and one degraded unit (old irrigation agricultural land) were identified (Fig. 4; Table 1):

1. Undulating plains open woodland
2. Flat plains open woodland
3. Flat plains sparse woodland
4. Rolling hills open shrubland
5. Slightly undulating footslopes open shrubland
6. Slightly undulating clayey drainage line open woodland
7. Slightly undulating rocky drainage line open woodland
8. Slightly undulating valley bottomlands open forbland
9. Flat Riet River open woodland
10. Flat cultivated lands open forbland

Description and discussion of landscape units
Table 1 summarises the various characteristics of each landscape unit, described in more detail below, complemented by Fig. 4 which shows the location of the various units in MoNP.

1. Undulating plains open woodland
Summary: This landscape unit is associated with undulating plains, deep well-drained sandy soil, with *Vachellia erioloba*–*Vachellia tortilis* open woodland.

Plains woodland was found on deep (>1.2 m) well-drained red sandy soil which occurs mainly in the southern section of MoNP (Figs 4 & 5). It was restricted to the undulating plains which are overlain by Aeolian sand covering the Dwyka Formation. Surface limestone occurred sporadically in this Ae land type woodland landscape unit (Table 1). No rocks or stones were noted on the soil surface. The dominant soil form was Hutton, while Clovelly and Mispah soil forms were also found.

*Vachellia tortilis* and *V. erioloba* were prominent in the tree stratum, with a canopy cover of 10% and a height of 7 m. Prominent shrub species were *Grewia flava*, *Senegalia mellifera*, *Tarchonanthus camphoratus* and *Protagaricus suaveolens*. The shrub layer had a canopy cover of 15% and was 2 m tall. These prominent woody species, along with the trees *Ziziphus mucronata* and *Searsia lancea*, were widely distributed in this unit. The herbaceous layer was 0.8 m tall and had a canopy cover of 65%. Prominent grasses were *Eragrostis pallens*, *E. lehmanniana*, *Pogonarthria squarrosa*, *Schmidtia pappophoroides*, *Eragrostis trichophora*, *Aristida congesta* and *Stipagrostis uniplumis*. Forbs consistently present were *Hirpicium echinum*, *Dicoma schinzii*, *Hermannia tomentosa* and *Indigofera daleoides*. 
Figure 4: Landscape unit map of Mokala National Park.
<table>
<thead>
<tr>
<th>Landscape unit</th>
<th>Map</th>
<th>Geology</th>
<th>Habitat</th>
<th>Land type and soil characteristics</th>
<th>Soil depth (m)</th>
<th>Tree</th>
<th>Shrub</th>
<th>Herbaceous</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Plains, undulating, sandy, deep with <em>Vachellia erioloba</em> – <em>Vachellia tortilis</em> open woodland</td>
<td>Undulating plains open woodland</td>
<td>Aeolian sand covering the Dwyka Formation</td>
<td>Ae land type–well-drained red sandy</td>
<td>&gt;1.2</td>
<td>10</td>
<td>7</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>2 Plains, flat, sandy, deep with <em>Senegalia mellifera</em> – <em>Vachellia erioloba</em> open to closed woodland</td>
<td>Flat plains open woodland</td>
<td>Aeolian sand covering the Dwyka Formation</td>
<td>Ae land type–well-drained yellow sandy</td>
<td>&gt;1.2</td>
<td>8.6</td>
<td>9</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>3 Plains, flat, sandy, moderate deep with <em>Schmidtia pappophoroides</em> – <em>Vachellia erioloba</em> sparse woodland</td>
<td>Flat plains sparse woodland</td>
<td>Aeolian sand covering the Dwyka Formation</td>
<td>Ae land type–well-drained sandy (clay content &lt;10%)</td>
<td>0.3 - 0.6</td>
<td>2</td>
<td>6</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4 Hills, rolling, rocky, shallow with <em>Rhus pubescens</em> – <em>Senegalia mellifera</em> open shrubland</td>
<td>Rolling hills open shrubland</td>
<td>Andesitic lava and dolerite</td>
<td>Ib land type–well drained but rocky</td>
<td>&gt;0.3</td>
<td>2</td>
<td>4</td>
<td>12</td>
<td>1.5</td>
</tr>
<tr>
<td>5 Footslopes / Midslopes, slightly undulating, rocky, shallow with <em>Senegalia mellifera</em> – <em>Vachellia tortilis</em> open shrubland</td>
<td>Slightly undulating footslopes open shrubland</td>
<td>Andesitic lava, dolerite and shale</td>
<td>Ib land type–well drained but rocky with soil</td>
<td>&gt;0.3</td>
<td>3</td>
<td>5</td>
<td>18</td>
<td>2.5</td>
</tr>
<tr>
<td>6 Drainage line (major), slightly undulating, clayeys, moderate deep with <em>Cynodon dactylon</em> – <em>Ziziphus mucronata</em> open woodland</td>
<td>Slightly undulating clayey drainage line open woodland</td>
<td>Alluvium</td>
<td>Ae land type–poorly drained, &gt;30% clay content</td>
<td>&gt;0.6</td>
<td>60</td>
<td>65</td>
<td>30</td>
<td>2</td>
</tr>
<tr>
<td>7 Drainage line, slightly undulating, rocky, shallow with <em>Searsia lancea</em> open woodland</td>
<td>Slightly undulating rocky drainage line open woodland</td>
<td>Calcrete</td>
<td>Ag land type–&gt;70% of soil surface covered by rocks or stones</td>
<td>&lt;0.3</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>8 Valley bottoms, slightly undulating, rocky, shallow with <em>Stylosanthes species</em> open forbland</td>
<td>Slightly undulating valley bottoms open forbland</td>
<td>Calcrete</td>
<td>Ag land type–clayeys (&lt;25% clay content), stony</td>
<td>&lt;0.3</td>
<td>poorly developed</td>
<td>poorly developed</td>
<td>44</td>
<td>0.4</td>
</tr>
<tr>
<td>9 Riet River, flat, sandy, moderate deep, riparian with <em>Searsia pendulina</em> open woodland</td>
<td>Flat Riet River open woodland</td>
<td>Alluvium</td>
<td>In land type–poorly drained, silt-clayeys, alluvial (clay content &gt;10%)</td>
<td>&gt;0.8</td>
<td>25</td>
<td>8</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>10 Old cultivated lands, flat, sandy, moderate deep with degraded open forbland</td>
<td>Flat cultivated lands open forbland</td>
<td>Aeolian sand covering the Dwyka Formation</td>
<td>Ae land type–well drained sandy</td>
<td>&gt;0.8</td>
<td>heavily degraded</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The landscape unit has similarities/associations with the following plant communities described by Bezuidenhout (1994, 1995, 2009):

- *Vachellia erioloba*–*Vachellia tortilis* woodland (Vaalbos National Park – Thandroogevelt section)
- *Cadaba aphylla*–*Vachellia tortilis* low open woodland (Vaalbos National Park Gras and Holpan section)
- *Senegalia mellifera*–*Vachellia tortilis* shrubland (Rooipoort Nature Reserve)

2. **Flat plains open woodland**

Summary: This landscape unit is associated with flat plains and deep, well-drained, sandy soil with *Senegalia mellifera*–*Vachellia erioloba* open to closed woodland.

This woodland landscape unit is associated with MoNP’s undulating plains, on deep (>1.2 m), well-drained, yellow sandy soil, mainly in the northern section of the park (Figs 4 & 6). The dominant soil form was Clovelly, with other soil forms such as Hutton and Mispah also present. No rocks or stones were recorded in this aeolian sandy landscape unit, although surface calcrete occurred sporadically. This unit is closely associated with the Ae land type (Table 1).
The tree stratum was 9 m tall and the canopy cover varied from 8 to 60%; while the shrub stratum was 2 m tall with canopy cover of 15%. *Vachellia erioloba* was the dominant woody tree species. Other woody species which grow mainly beneath or around *Vachellia erioloba* were *Lycium hirsutum*, *Senegalia mellifera*, *Ziziphus mucronata*, *Grewia flava* and to a lesser extent, *Tarchonanthus camphoratus* and *Vachellia tortilis*. The shrub *Protasparagus suaveolens* was also strongly associated with *V. erioloba*. The herbaceous layer canopy cover varied from 20 to 60 % and was 0.9 m high. Forbs such as *Pavonia burchellii*, *Cucumis africana*, *Hermannia tomentosa*, *Dicoma schinzii*, *Elephantorrhiza elephantina*, *Plinthus sericeus*, *Harpagophytum procumbens*, *Indigofera daleoides* and *Chamaecrista biensis* were abundant. The grass species *Schmidtia pappophoroides*, *Eragrostis lehmanniana*, *E. trichophora*, *Aristida congesta* and *Stipagrostis uniplumis* were prominent.

Relatively small (diameter of 30–50 m) isolated pans occurred in this landscape unit. Landscape unit 6, with *Cynodon dactylon–Ziziphus mucronata* open woodland, forms the major drainage line landscape unit in the park, orientated south–north, terminating in this large deep sandy basin with associated pans, without reaching the Riet River (Fig. 4).

The landscape unit has similarities with the following plant communities described by Bezuidenhout (1994, 2009):

- *Grewia flava–Vachellia erioloba* woodland and *Lycium hirsutum–Vachellia erioloba* woodland (Vaalbos National Park, Than-Droogeveldt section)
3. **Flat plains sparse woodland**

Summary: This landscape unit is associated with flat plains, moderately deep well-drained sandy soil, with *Schmidtia pappophoroides–Vachellia erioloba* sparse woodland.

This landscape unit occurred on the undulating plains of the western section of the Park (Figs 4 & 7) and was strongly associated with moderately deep (0.3–0.8 m), well-drained sandy soil (clay content < 10%). It was underlain by aeolian sand which covered calcrete rock, while surface limestone occurred sporadically. No surface rocks or stones were recorded. The dominant soil forms were Hutton and Clovelly, but the Mispah form did also occur. This *Schmidtia pappophoroides–Vachellia erioloba* sparse woodland was closely associated with the Ae land type (Table 1).

The poorly developed tree stratum was 6 m tall, with a canopy cover of 2%. Sparsely distributed *Vachellia erioloba* was the dominant tree in this unit. The shrub stratum, with species such as *Grewia flava* and *Tarchonanthus camphoratus*, was poorly developed with a canopy cover of 3% and a height of 2 m. The herbaceous stratum was well developed, at about 0.8 m tall and with a canopy cover of 65%. The dominant grasses were *Schmidtia pappophoroides*, *Eragrostis lehmanniana* and *Aristida congesta* subsp. *congesta*, while the most prominent forbs were *Indigofera daleoides*, *Hermannia tomentosa* and *Convolvulus multifidus*.

*Figure 7: Part of the 'Flat plains sparse woodland' landscape unit. (Photo: P.C. Zietsman)*
This landscape unit has similarities with the following plant communities described by Bezuidenhout (1994, 1995, 2009):

- *Schmidtia pappophoroides–Themeda triandra* grassland and *Tarchonanthus camphoratus–Searsia ciliata* high closed shrubland (Vaalbos National Park, Than–Droogeveldt section)
- *Hermannia tomentosa–Schmidtia pappophoroides* short closed grassland (Vaalbos National Park, Gras- and Holpan section)
- *Schmidtia pappophoroides–Themeda triandra* grassland (Rooipoort Nature Reserve)

4. **Rolling hills open shrubland**

Summary: This landscape unit is associated with rolling hills covered by a rocky, shallow rock-soil complex, with *Rhigozum obovatum–Senegalia mellifera* open shrubland.

The *Rhigozum obovatum–Senegalial mellifera* shrubland landscape unit was strongly associated with the rolling hills of the MoNP (Figs 4 & 8). The soil-rock complex consisted of rock and the Mispah soil form, with scattered outcrops of andesitic lava and dolerite. Rocks and stones covered more than 80% of the soil surface, and the soil was shallow (<0.3 m) and well-drained. In MoNP, this landscape unit was strongly associated with the Ib land type (Table 1).
The shrub *Rhigozum obovatum* was the most prominent plant species. The poorly-developed tree stratum (4 m high) was dominated by *Vachellia tortilis* and had a canopy cover of only 2%. The shrub stratum was well-developed, and apart from the prominent shrub species *Rhigozum obovatum*, other shrubs such as *Searsia burchellii*, *Grewia flava*, *Ehretia rigida*, *Senegalia mellifera* and *Tarchonanthus camphoratus* were also well represented. The shrub stratum 1.5 m high and canopy cover 12%, while the herbaceous stratum was 0.35 m high and its canopy cover was 52%. Prominent grass species included *Digitaria eriantha*, *Enneapogon scoparius* and *Heteropogon contortus*. Also present was the inconspicuous fern *Pellaea calomelanos*.

This landscape unit has similarities with the following plant community described by Bezuidenhout (2009):

- *Digitaria eriantha–Rhigozum obovatum* shrubland (Rooipoort Nature Reserve)

### 5. Slightly undulating footslopes open shrubland

Summary: This landscape unit is associated with slightly undulating footslopes/midslopes covered by a rocky and shallow soil-rock complex, with *Senegalia mellifera–Vachellia tortilis* open shrubland.

The *Senegalia mellifera–Vachellia tortilis* open shrubland landscape unit was strongly associated with the footslopes of the hills on the northern side of the Puntberg hill series in MoNP (Figs 4 & 9). The habitat of this landscape unit comprised shallow (<0.3 m) well-drained rocky soil with andesitic lava, dolerite and shale rocks (>25%) on the soil surface. It was strongly associated with the Ib land type. The soil-rock complex of this unit consisted of rock and the Mispah soil form (Table 1).

The poorly-developed tree stratum was 5 m tall with a canopy cover of 3%. Only two tree species were prominent, namely *Boscia albitrunca* and *Vachellia tortilis*. The well-developed shrub stratum, with dominant shrub species (*Senegalia mellifera*, *V. tortilis*, *Searsia burchellii*, *Tarchonanthus camphoratus*, *Ehretia rigida* and *Grewia flava*), was 2.5 m tall with a canopy cover of 18%. The herbaceous layer was 0.2 m tall with a canopy cover of 38%. The prominent grass species were *Aristida meridionalis*, *A. congesta* subsp. *barbicollis*, *Digitaria eriantha*, *Cenchrus ciliaris*, *Enneapogon cenchroides*, *Aristida adscensionis* and *Eragrostis lehmanniana*. Prominent forbs included *Pentzia incana*, *Phyllanthus maderaspatensis*, *Pupalia lappacea*, *Pollichia campestris* and *Lippia javanica*. The physiognomy of this unit sometimes changed to impenetrable *Senegalia mellifera* and *Vachellia tortilis* thickets.

This landscape unit was also recorded within a different terrain unit, namely on the midslopes closer to the Riet River (Fig. 4). It was restricted to the northern section of the MoNP and was strongly associated with Riet River alluvial gravel (Fig. 4). Because of the debris of the old diamond diggings, the soil was very disturbed and the soil depth varied from shallow (>0.3 m) to deep (>1.2 m), with Mispah and Hutton soil forms present. Soil was also well drained, with more than 30% cover of well-rounded rocks or stones on the soil surface. This unit was associated with Ae and Ag land types.
This landscape unit has similarities with the following plant communities described by Bezuidenhout (1994, 2009):

- *Boscia albitrunca–Senegalia mellifera* shrubland and *Vachellia tortilis–Senegalia mellifera* shrubland (Vaalbos National Park, Than–Droogeveldt section)
- *Senegalia mellifera–Vachellia tortilis* shrubland and *Tarchonanthus camphorates–Senegalia mellifera* shrubland (Rooipoort Nature Reserve)

6. **Slightly undulating clayey drainage line open woodland**

Summary: This landscape unit is associated with a lightly undulating major drainage line, moderate deep clayey soil, and *Cynodon dactylon–Ziziphus mucronata* open woodland.

The habitat of this major drainage line was closely associated with the drainage of the rolling hills (koppieveld) in the central section of MoNP, draining from the south to the north. The main terrain units were the drainage line and the floodplain (Figs 4 & 10) to the north of the hills. The dominant soil form was Swartland, with clay content of more than 30%, and deeper than 0.8 m. This landscape unit is associated with the Ae land type (Table 1).
The drainage line was dominated by the woody plant species *Ziziphus mucronata* and *Vachellia karroo*. Other woody plant species such as *Lycium cinereum*, *L. hirsutum*, *Searsia cf. undulata*, *Diospyros lycioides*, *Protasparagus laricinus* and *Tarchonanthus camphoratus* were also recorded. The height of the tree layer was 8.5 m, with 60% canopy cover. The shrub layer stood 2.0 m tall and the canopy cover was 30%; while the herbaceous layer height was 0.2 m with a canopy cover of 5%. The poorly-developed herbaceous layer had two prominent grass species, *Sporobolus africanus* and *Cynodon dactylon*, with forbs such as *Pentzia globosa* and *Salvia runcinata* more conspicuous than the grasses.

The floodplain, closely associated with the drainage line, was dominated by the shrub-like forbs *Salsola glabrescens* and *Ruschia ruralis*. Sparsely distributed *Vachellia tortilis* trees were also noted in the drainage line of this landscape unit. The height of the herbaceous layer was 0.3 m and the canopy cover was 65%. Apart from *Salsola glabrescens* and *Ruschia ruralis*, the conspicuous “vygie” *Mestoklema copiosum*, *Eriocephalus ericoides* subsp. *ericoides*, *Euryops subcarnosus* subsp. *vulgaris* and *Felicia muricata* subsp. *muricata* were also recorded. Grass species recorded included *Cynodon dactylon*, *Eragrostis obtusa*, *Tragus berteronianus* and *Urochloa panicoides*. The shrub layer was 2.0 m tall and the canopy cover was 15%; while the poorly-developed tree layer was 8.0 m high with a canopy cover of 10%. Other woody plant species that were recorded included the shrubs *Ziziphus mucronata* and *Tarchonanthus camphoratus*. 

Figure 10: Part of the ‘Slightly undulating clayey drainage line open woodland’ landscape unit. (Photo: D. Engelbrecht)
This landscape unit is similar to the following plant communities described by Bezuidenhout (1995, 2009):

- *Tarchonanthus camphoratus–Ziziphus mucronata* short open woodland (Vaalbos National Park, Gras- and Holpan section)
- *Ziziphus mucronata–Tarchonanthus camphoratus* shrubland (Rooipoort Nature Reserve)

7. Slightly undulating rocky drainage line open woodland

Summary: This landscape unit is associated with a slightly undulating drainage line, covered by a rocky, shallow rock-soil complex, with *Searsia lancea* open woodland.

This open woodland landscape unit was associated with a drainage line that occurred in the north-eastern section of the park (Figs 4 & 11). The drainage line flows into the Riet River and was associated with the Ag land type. More than 70% of the shallow (<0.3m) soil surface was covered by rocks or stones, and outcrops of calcrete were present (Table 1).

![Figure 11: Part of the 'Slightly undulating rocky drainage line open woodland' landscape unit. (Photo: P.C. Zietsman)](image)

Although the tree *Searsia lancea* was prominent, the development of the tree stratum was poor, with a canopy cover of only 10% and height of 8 m. The shrub stratum, which was dominated by *Tarchonanthus camphoratus* was 2 m tall with a canopy cover of 8%. Other prominent shrub species in this stratum were *Ziziphus mucronata*, *Diospyros lycioides* and *Grewia flava*. The herbaceous layer was 0.4 m tall and had a canopy cover of 40%. Apart from the forbs *Salsola glabrescens* and *Ruschia ruralis* which were diagnostic for this
landscape unit, other forbs were present such as *Salsola calluma*, *Zygophyllum incrustatum*, *Plinthus karooicus* and *Gnidia polycephala*. Prominent grass species were *Eragrostis lehmanniana* and *Enneapogon desvauxii*.

This landscape unit is similar to the following plant community described by Bezuidenhout (1995):

- *Searsia ciliata–Tarchonanthus camphoratus* shrubland (Vaalbos National Park, Gras- and Holpan section)

8. **Slightly undulating valley bottomlands open forbland**

Summary: This landscape unit is associated with slightly undulating valley bottomlands, and has shallow soil with *Stipagrostis uniplumis* open forbland.

This open forbland landscape unit was restricted to the shallow (<0.3 m), clayey (<25% clay content), stony soil of the valley bottomland of the north-eastern section of the Park (Figs 4 & 12). Stones covered more than 30% of the soil surface, of various rock types including calcrete, lava, tillite and shale. The parent material which underlies this landscape unit was a mixture of either andesitic lavas, Dwyka tillite or shale. Isolated depressions, too small to map (2 m²), also occurred on the poorly drained soil of this unit. It was closely associated with the Ag land type and falls in the Nama Karoo Biome as described by Mucina & Rutherford (2006) (Table 1).

![Figure 12: Part of the ‘Slightly undulating valley bottomlands open forbland’ landscape unit.](Photo: P.C. Zietsman)
Isolated *Vachellia tortilis*, *Cadaba aphylla* and *Tarchonanthus camphoratus* shrubs represented a poorly-developed tree and shrub strata. The herbaceous stratum was 0.4 m high and had a canopy cover of 44%. Karoo forbs *Salsola calluma*, *Zygophyllum incrustatum*, *Plinthus karooicus* and *Pentzia globosa* (Shearing 1994) were dominant, along with other forb species such as *Barleria rigidia*, *Kypocarpha angustifolia*, *Tribulus terrestris* and *Mestoklema arboriforme*. The grasses *Stipagrostis uniplumis*, *S. ciliata*, *S. obtusa*, *Aristida adscensionis*, *Tragus berteronianus* and *Enneapogon desvauxii* were also prominent.

This landscape unit is similar to the following plant communities described by Bezuidenhout (1995, 2009):

- *Plinthus karooicus*–*Rhigozum trichotomum* tall closed shrubland and *Zygophyllum incrustatum*–*Salsola calluma* low open herbland (Vaalbos National Park, Gras- and Holpan section)
- *Pentzia globosa*–*Eragrostis truncata* Forbland (Rooipoort Nature Reserve)

9. **Flat Riet River open woodland**

Summary: This landscape unit is flat, centred on the Riet River, and has moderately deep sandy soil, with *Searsia pendulina* open woodland.

The Riet River landscape unit was strongly associated with the poorly drained, silt-clayey, alluvial soil (clay content >10%) of the Riet River riparian banks (Figs 4 & 13). No rocks or stones were recorded on the soil surface of the alluvial banks. In some areas, rocky outcrops without any vegetation were noted. This unit was strongly associated with the Middle Orange River system described by Bezuidenhout (1994, 1996, 2009). The dominant soil form was Oakleaf (depth of soil >0.8 m), while other soil forms such as Dundee and Mispah were also present. The Ia land type is closely associated with the Riet River landscape unit (Table 1).

The tree stratum was very well developed and 8 m tall, with a canopy cover of 25%, whereas the shrub stratum was 3 m tall and had a canopy cover of 15%. Prominent woody species included the trees *Searsia pendulina*, *Vachellia karroo*, *Salix mucronata*, *Ziziphus mucronata*, *Searsia lancea*, the shrub *Diospyros lycioides*, as well as the exotic shrubs/trees *Nicotiana glauca* and *Prosopis glandulosa*. The herbaceous layer, which was very disturbed and poorly developed, was 0.9 m tall with a canopy cover of 35%. Prominent grasses included *Setaria verticillata* and *Cynodon dactylon*. Diagnostic and prominent forbs were the exotics *Argemone ochroleuca*, *Datura stramonium* and *Verbena bonariensis*. The common reed *Phragmites australis* was also fairly abundant.

This landscape unit has similarities with the following plant communities described by Bezuidenhout (1994, 2009):

- *Eragrostis* species–*Chloris virgata* grassland and *Combretum erythrophyllum*–*Vachellia karroo* woodland (Vaalbos National Park, Than–Droogeveldt section)
- *Salsola rabieana*–*Diospyros lycioides* shrubland and *Diospyros lycioides*–*Vachellia karroo* woodland (Rooipoort Nature Reserve)
10. Flat cultivated lands open forbland

Summary: This landscape unit is flat and situated on old cultivated lands. It has moderately deep, well-drained, sandy soil with degraded open forbland.

This landscape unit comprised a heavily degraded area where two irrigation pivots were previously located, on moderately (>0.8 m) deep, sandy soil, in the northern section of MoNP (Figs 4 & 14). The old agricultural lands were associated with the Ae land type. Dominant plant species were alien or annual plants.

Since the ecological processes and patterns had changed in this landscape unit, the description of the flat plains open woodland (2) (the surrounding landscape unit) should provide clear guidelines for the rehabilitation and restoration of this degraded woodland (Table 1).
CONCLUSION

The classification, description and mapping of the landscape units of MoNP, together with the vegetation description, will contribute to biodiversity conservation and tourist management of the park. An understanding of these landscape units and their associated habitats is of fundamental importance for devising sound management and conservation strategies that consider ecosystem requirements.

This broad classification and description of the landscape units serve as baseline data and should be followed by a detailed vegetation classification, description and mapping exercise for the Park. Such a vegetation study will assist with identifying the habitat of rare, endangered and protected plant species, as well as rare and endangered plant communities, that need special protection and management. It will also assist with the SANParks Species of Special Concern monitoring programme, designed to ensure the protection of all threatened plant and animal species and plant communities.
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