Fine-Scale Vegetation Map of the Nieuwoudtville Wildflower Reserve.

Plant Conservation Unit

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Introduction

The Nieuwoudtville Wildflower Reserve is located on the Bokkeveld Plateau along the R27, approximately 3km east of Nieuwoudtville. The Reserve encompasses an area of 119 ha and was established in 1974 to conserve the high botanical diversity of the Nieuwoudtville area as well as create a space where tourists could view the flower displays during the spring. Snijman and Perry (1987) conducted a botanical survey of a 66 ha portion of the reserve and recorded 299 different species, illustrating the impressive diversity of the area. They also recorded 19 species present that are endemic to the Bokkeveld Plateau. Snijman and Perry (1987) found that the flora of the reserve is unusual in that it is dominated by geophytes which make up almost 40% of the flora and petaloid monocots which form an additional 33.4% of the flora.

Despite its relatively small size, the reserve contains a diverse landscape, consisting of several different habitats and soil types. Prominent features include a rocky dolerite ridge which dominates the northern extent of the reserve; heavy-clay dolerite plains along the base of this ridge; and grey Dwyka-Tillite-derived soils on the plains of the southern and western portion of the reserve. The reserve also has a long history of landuse which has impacted the distribution of vegetation in the reserve. Records indicate that the reserve has been grazed by livestock since 1938 (Snijman and Perry 1987), but was probably grazed for a long time prior to this as well. The western and south-western portion of the reserve has also been ploughed and cultivated with wheat in the past. Although it has not been cultivated in several decades, this portion of the reserve is still conspicuous as few woody plants have re-established in this area.

To date, the only published information specifically on the Nieuwoudtville Wildflower Reserve is the study of Snijman and Perry (1987), who provide a species list for the Reserve and briefly discuss the vegetation and growth form composition of the Reserve. Snijman and Perry (1987) recognised three zones or vegetation types within the Reserve; the rocky dolerite ridge; the spongy dolerite plain; and the Dwyka Tillite plain. The vegetation map of South Africa (Mucina & Rutherford 2006), indicates that the Reserve contains two vegetation types, namely, Nieuwoudtville Dolerite Renosterveld, which encompasses the dolerite ridge and adjacent plain and Nieuwoudtville Shale Renosterveld, which encompasses the remainder of the Reserve. The vegetation map has however been produced at a large scale and does not accurately reflect vegetation

patterns at the scale of the Reserve itself. The vegetation map also does not include information on the transformation status of the vegetation. The purpose of this study is to bridge these two studies by presenting a fine-scale vegetation map of the Reserve and a description of each of the units mapped, in terms of its associated environment, dominant species composition, and land use history. The implications and management options presented by the results are also discussed.

Methodology

The Reserve was mapped on foot using a handheld GPS (GARMIN GPS60cs) at a resolution of approximately 2m. Boundaries between all consistently identifiable vegetation units were walked during October 2007. A hierarchical approach was taken whereby broad habitat units were first mapped and then progressively finer units within each of these were mapped until it was no longer possible or practical to differentiate units on a finer scale. As a result, some units can be considered to be equivalent to a single plant community while others are more analogous to a single vegetation type and may consist of several finely structured plant communities. The following habitat units were identified and mapped: 1. The Dolerite Koppies. 2. The Dolerite Plains. 3. The Tillite Plains. These units correspond largely with the different zones identified by Snijman and Perry (1987). Within each of these different units several different vegetation types and plant communities were identified and mapped according to the criteria as discussed below.

1. The Dolerite Koppies. Although several different plant communities occur here, associated with the rocky outcrops and their interstices, it is not possible to map these, and the Koppies are best considered as a habitat mosaic.
2. The Dolerite Plains. Within the dolerite plains, several distinct units were identified, 2.1. Bare areas that had been denuded by the underground activity of beetle larvae. 2.2. Areas dominated by Wild Oats (*Avena fatua*) with little indigenous vegetation, but which did not appear to have been cultivated in the past. 2.3. Intact Nieuwoudtville Dolerite Renosterveld. 2.4 The Tillite-Dolerite transition.
3. The Tillite Plains. Within the tillite plains two communities were identified. 3.1 Intact Nieuwoudtville Tillite Renosterveld 3.2 Disturbed Tillite Renosterveld.
Additional vegetation combinations comprising the above where they occurred in areas that had previously been cultivated were also mapped.

Results

The different combinations of vegetation and transformation gave rise to a total of ten vegetation units whose distribution is illustrated by the vegetation map of the Reserve as depicted by Figure 1 and whose mapped extents are listed in Table 1. The different vegetation units can be characterised as follows:

1. The Dolerite Koppies. At 31 ha, the Dolerite Koppies comprise the largest intact extent of the Nieuwoudtville Wildflower Reserve. This is the only vegetation type in the Reserve that contains conspicuous large woody trees and shrubs. Typical and characteristic species that occur in the koppies include trees such as Wild Olives, *Olea europea* subsp. *africana*, and a solitary but conspicuous Rock Fig, *Ficus cordata*; low trees and large shrubs such as *Diospyros austro-africana* and *D. ramulosa*; *Zygophyllum foetidum*; *Rhus undulata* and *Montinia caryophyllacea*; the perennial grasses *Chaetobromus dregeanus* and *Ehrhata calycina*; geophytes such as *Laperousia oreogena*, *Babiana framesii* and *Albuca maxima*. Endemic species that occur in the koppies include *Zantedeschia odorata*, *Laperousia oreogena* and *Androcymbium pulchrum*. Alien species are common or dominant in places, particularly in damp environments between the koppies. Particularly prevalent alien species include *Avena fatua*, *Lolium perenne* and *Medicago polymorpha*.

2. Intact Nieuwoudtville Dolerite Renosterveld. Nieuwoudtville Dolerite Renosterveld occurs on the spongy clay slopes and flats adjacent to the rocky ridge. Although much smaller in extent than the koppies, this vegetation type is the second largest intact vegetation type and has an extent of approximately 6.6 ha. This is a low vegetation type with few shrubs or other plants with above-ground perennial parts. Typical species include the perennial grass *Ehrharta delicatula* and annual grass *Tribolium echinata*, perennial forbs such as *Arctotis acaulis*, annual forbs such as *Emelia hantamensis* and *Nemesia leipodtii*, the geophytes *Bulbinella latifolia* var. *doleritica*, *Romulea monodelpha* and *Hesperantha vaginata*. Endemic species include *Heliophila collina*, *Romulea monodelpha*, *Sparaxis pillansii*, *Bulbinella latifolia* var. *doleritica*, *Emelia hantamensis* and *Haemanthus barkerae*. Common

alien species include *Avena fatua* which dominates large areas and *Medicago polymorpha*.

3. Bare Nieuwoudtville Dolerite Renosterveld. This plant community occurs where subterranean beetle larvae have consumed the majority of plants, leaving large expanses with little or no vegetation. Not all species are eaten and some species typically not eaten include amaryllids such as *Brunsvigia bosmaniae*, *Haemathus coccineus* and *Haemanthus barkerae*. In the longer term these areas appear to be fairly dynamic and may become recolonised by vegetation after some time. Outbreaks of these larvae appear to be related to the soil nutrient or organic matter status as they tend to occur more frequently near to livestock watering points, where there has been an accumulation of dung and urine in the soil. In the reserve some of these bare patches appear to be associated with old kraal sites and places where animals tended to congregate.

4. Nieuwoudtville Dolerite Renosterveld heavily invested by *Avena fatua*. These areas contain few indigenous species either because they have been overgrazed or have been out-competed by *Avena fatua*. These areas are conspicuous in their near complete domination by very dense stands of *Avena*. These dense stands appear to be associated with places with greater than normal nutrient and/or water availability. Few other species are able to persist in these apart from an occasional *Brunsvigia bosmaniae*.

5. The Dolerite-Tillite Transition. The transition between the dolerite and tillite is usually a conspicuous band from a few to tens of meters wide. The soil can usually be distinguished from the spongy dolerite plains by the presence of loose gravel on the soil surface and a less spongy texture. It is dominated by a suite of characteristic species, in particular *Galeolemma oculus-cati*, *Bulbine alooides* and *Othonna auriculifolia*. It may also contain shrubs such as *Hermannia cuneifolia* and other geophytes such as *Haemanthus barkerae* and *Brunsvigia bosmaniae*.

6. Transformed Nieuwoudtville Dolerite Renosterveld. This anthropogenic community results from past ploughing and cultivation of the intact vegetation. Despite the fact that the reserve has not been ploughed for some decades, recovery of the natural

vegetation is slow, apparently due to nutrient enrichment of the soil which encourages the dominance of alien species such as *Avena fatua* and *Medicago polymorpha*, which dominate this community.

7. Transformed Dolerite-Tillite Transition. Past cultivation has transformed this community into a simple one dominated by *Galeolemma oculus-cati* and grasses such as *Tribolium echinata*. The geophytes typical of the intact community are conspicuously absent.

8. Intact Nieuwoudtville Tillite Renosterveld. This was originally the most extensive vegetation type in the Flower Reserve and covered over 50 ha of the southern and western portion of the reserve. Less than 4 ha of this vegetation type remains in what can be considered to be a reasonably intact condition. This community is dominated by low shrubs such as *Eriocephalus purpureus*, *Pentzia incana*, *Asparagus capensis* and *Zygophyllum pygmaeum*. It also contains an abundance of geophytes such as *Sparaxis elegans*, *Babiana spathacea* and *Moraea pseudospicata*. Endemic species include *Geissorhiza spendidissima*, *Sparaxis elegans* and *Moraea pseudospicata*. Alien species are generally not very abundant in this community when it is in a good condition, but *Avena fatua*, *Bromus pectinatus*, *Hordeum murinum* and *Medicago polymorpha* may be abundant in overgrazed or disturbed areas.

9. Disturbed Nieuwoudtville Tillite Renosterveld. This vegetation type is dominated by similar geophyte species as the above vegetation type but contains few or no shrubs and a larger proportion of alien species such as *Avena fatua*, *Hordeum murinum* and *Bromus pectinatus*. These disturbed areas are apparently a legacy of overgrazing and the reserve having been used during the construction of the R27 as a source of fill and parking area for the construction vehicles.

10. Transformed Nieuwoudtville Tillite Renosterveld. This transformed community covers an area of 43 ha and constitutes the largest extent of the Reserve. It is dominated by alien species such as *Avena fatua*, *Hordeum murinum* and *Erodium cicutarium*, with a few indigenous species such as *Arctotheca calendula* and *Oxalis grammophylla*. The activity of harvester ants has created patches or clumps of

Avena fatua, which are conspicuous during the late growing season, apparently through bringing seed to the burrow from the inter-mound areas. This decreases the abundance of *Avena* in the inter-mound areas and uneaten seed which is ejected from the burrow germinates and grows larger or better in the fertile soil patches around the mounds.

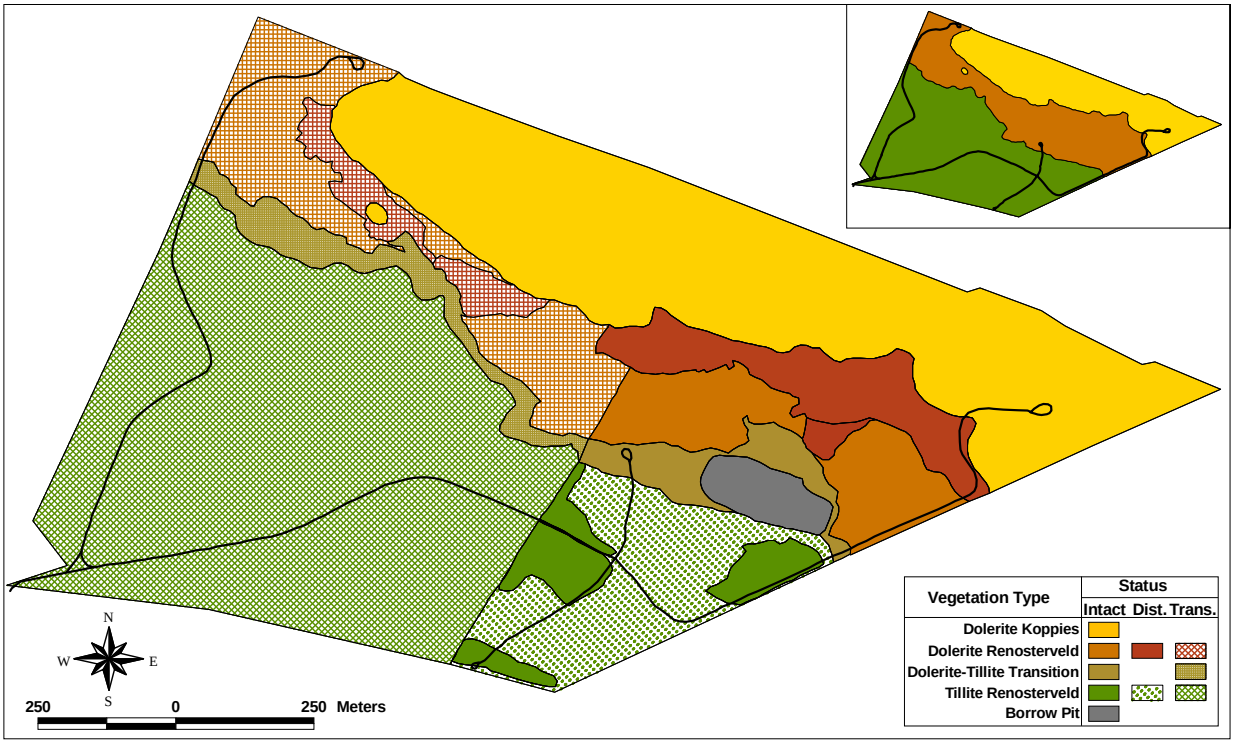

Figure 1. Fine-scale vegetation map of the Nieuwoudtville flower reserve, showing the different vegetation types that occur within the reserve as well as the disturbed and transformed (previously cultivated) areas of these original vegetation types. The extent of each vegetation unit is listed in Table 1.

Table 1. The extent (ha) of the different vegetation types of the Nieuwoudtville Wildflower Reserve and the extent of intact, disturbed and transformed vegetation within each.

Vegetation	Total ha	Intact	Disturbed			% Remaining
			Aliens	Bare	Transformed	
Koppies	31.12	31.12	-	-	-	100.0
Dolerite Renosterveld	24.4	6.64	0.42	5.67	11.67	27.2
Dolerite-Tillite Transition	7.97	2.68	-	-	3.52	43.2
Tillite Renosterveld	56.22	3.67	9.20	-	43.35	6.5
Total	**119.71**	**44.11**	**9.62**	**5.67**	**60.31**	**36.85**

Interpretation and Implications

The fine-scale vegetation map of the Nieuwoudtville Wildflower Reserve shows that the vegetation patterns of the Reserve reflect the fine-scale edaphic (environmental) variation of the Reserve. Distinct vegetation types and communities are present, each associated with a different soil type or environment. This fine-scale differentiation is an important contributing factor to the high species diversity of the Reserve and the Bokkeveld escarpment as a whole. The map also demonstrates that land-use has an over-riding effect, simplifying and homogenising the vegetation. Despite the extended period since the Reserve was last cultivated, the natural vegetation has recovered little, probably as a result of changes in the soil structure and nutrient status associated with cultivation as well as competitive exclusion by alien species.

Management Recommendations

Less than 40% of the Nieuwoudtville Wildflower Reserve is intact, with the remainder being transformed and disturbed habitat. From a management perspective, the challenge lies in retaining and improving the integrity of the remaining intact portions. This would be best achieved through active management aimed at rehabilitating the transformed sections rather than allowing the alien species which dominate these transformed areas to invade and dominate the intact areas. There are three main management options available to manage the Reserve and achieve the desired outcome or vegetation state. The first is livestock grazing which is currently being used to manage the reserve, although at present, the exact objective of grazing the Reserve is not entirely clear. The logic appears to be to reduce the build up of organic matter from the previous growing season, so as to improve the visual appearance of the coming spring flower display. The merit of this argument will be discussed in more detail later. An alternative management option is not to allow any grazing. This option is probably also not desirable as some degree of disturbance and grazing maintains diversity and is required by some plants such as perennial grasses to prevent them from becoming moribund. The final management option is to actively manage the composition of the vegetation through the application of selective herbicides. This is the most costly option since grazing or not grazing the reserve is economically either positive or neutral, whereas the application of selective herbicides carries a potentially high financial cost. However, this is also the most flexible approach and can be used in conjunction with or without grazing.

The major threat to the vegetation of the reserve is clearly invasive alien grasses which displace and compete with indigenous species. The high level of disturbance that the reserve has experienced in the past has no doubt promoted alien species to their current high levels. The presence of these species also hinders vegetation recovery, probably by shading the seedlings of indigenous species as well as competing with them for nutrients and water. The management of alien grasses is problematic because the commonly held solution also tends to maintain the dominance of alien species. The high biomass build up of alien species is seen as problem because it negatively affects the attractiveness of the spring flower displays as a large amount of dead material remains from the previous season, especially if it was wetter than average. The common solution to this problem is to stock such areas heavily during the summer to ensure that the grass is either removed by grazing or trampled to the ground. Despite the fact that this occurs during the dormant season, it nevertheless represents a disturbance that further encourages alien species. This is a particular problem in the koppies as well as on the tillite plains where a large number of indigenous shrub species are present. Alien grasses are poor competitors and either do not invade or remain scarce in renosterveld that is in good condition. The heavy grazing that occurs in the Flower Reserve has a large impact on the shrub species present as many of them are not dormant during the summer and usually offer the only green grazing material present. As a result, these shrubs are heavily grazed, impacting their vigour and preventing them from increasing in abundance and competing effectively with the alien grasses. This may also explain why the indigenous shrub species on the tillite plain have failed to recolonise and dominate the disturbed areas that occur between the intact areas. These areas have not previously been ploughed, so it is unlikely that the recolonisation is being inhibited by soil changes.

The Reserve contains several vegetation types as detailed by this study. As a consequence, livestock are likely to show a marked preference for certain areas over others. Grazing pressure will not be evenly spread across the reserve and some areas are likely to be receiving grazing pressures above the recommended rates. As a result the Reserve should be grazed at approximately 50% of the recommended stocking rate. This will also reduce the amount of disturbance created by the grazing event. This aspect deserves greater attention and the spatial use of the reserve by livestock could be relatively easily investigated by fitting a GPS or GPS Collar to one or several sheep for the duration of the grazing event.

It remains to be seen whether or not grazing management alone can reduce the abundance of alien grasses in the reserve. Alternative strategies such as mowing and the use of selective herbicides may prove to be more effective in eliminating these grasses in the short to medium term. However, in the long term, once acceptable levels of infestation have been achieved, appropriate grazing management is the only sustainable solution.

References

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