Supplementary material

Supplementary material 1:
Annotated plant checklist for the North West province

Only available online: http://dx.doi.org/10.38201/btha.abc.v54.10.S1

Supplementary material 2:
Vegetation type descriptions

1. FOz 2 Northern Afrotemperate Forest

Distribution	In the North West province (NW) forest is restricted to mesic fire-free sites on the Magaliesberg with small, scattered patches in the Pilanesberg, Swartruggens and on the Enzelsberg.
Altitude	Most patches occur at altitudes between 1 600 and 1 700 m.
Vegetation and landscape features	Low (in the Low Escarpment region with canopy reaching up to 20 m), relatively species-poor evergreen forests of afromontane origin and some of them still showing clear afromontane character. Found as small patches in kloofs and on subridge scarps typically in rock and bolder scree slopes.
Geology and soils	The Magaliesberg is comprised primarily of rough, large-grained quartzite, which weathers to coarse and shallow sandy soil. This supports mostly open savanna and grassland. However, there are a number of ravines/kloofs on north-facing slopes, as well as steep slopes on south-facing slopes that provides some protection from fires. Forests on the north-facing slopes are restricted to well-defined kloofs/ravines with sharp boundaries. Other conditions in these kloofs that contribute to the development of forests are the accumulation of deep soils (in contrast to the very shallow, coarse, sandy soils in most of the Magaliesberg), and the presence of perennial streams and moist seepage zones.
Important taxa	**Species of the north-facing slopes**: *Calodendrum capense* (d*), *Celtis africana* (d), *Diospyros whyteana* (d), *Englerophytum magalismontanum* (d), *Ficus burkei* (d), *Empogona lanceolata* (d), *Maytenus undata* (d), *Ochna holstii* (d), *Acokanthera oppositifolia, Apodytes dimidiata, Cussonia transvaalensis, Halleria lucida, Ilex mitis, Olea capensis* subsp. *enervis, Olea europaea* subsp. *cuspidata, Mimusops zeyheri, Olinia emarginata, Prunus africana, Rauvolfia caffra, Rothmannia capensis, Scolopia mundii, Secamone alpini, Solanum giganteum, Trema orientale, Vangueria bowkeri*. **Species of the south-facing slopes**: *Acalypha glabrata* var. *glabrata* (d), *Buddleja saligna* (d), *Celtis africana* (d), *Senegalia ataxacantha* (d), *Olea europaea* subsp. *cuspidata* (d), *Calodendrum capense, Dovyalis zeyheri, Maytenus undata, Myrsine africana, Pittosporum viridiflorum, Secamone alpini, Senegalia caffra, Solanum giganteum, Vangueria bowkeri*.
Remarks	**Biogeography**: The forests of the Magaliesberg are classified as Northern Afrotemperate Forests, together with the forests of the Waterberg in the current vegetation map, but the floristic composition of the forests in these mountain ranges is significantly different. Some species occur exclusively in the Magaliesberg (but not in the Waterberg) and vice versa. For instance, *Podocarpus latifolius* and *Curtisia dentata* are dominant species in many Waterberg forests, but these species are absent from the Magaliesberg. Conversely, species with a tropical affinity such as *Rauvolfia caffra* occur in the Magaliesberg, but not in the Waterberg. Both these forests are considered to be relic forests, as they are representative of communities that would have been more common under a former wetter climate. In the Magaliesberg, the presence of isolated specimens of species such as *Psydrax obovata* subsp. *elliptica* and *Scolopia mundii*, which are normally associated with high-rainfall escarpment habitats, provides some evidence for this.

*d = dominant species, see Table 9 in main text.

Remarks (continued)	**Vegetation dynamics**: Based on aerial and satellite image interpretation of the same areas over several decades, between the 1930s and 1940s to the present day, it is clear that the area covered by woody vegetation is expanding. This could be primarily attributed to protection from burning. Evidence of this expansion includes the presence of trees in dense forests that would ordinarily be dependent on germination and development in open habitats. Examples include large specimens of *Erythrina lysistemon* and *Senegalia ataxacantha* inside closed forests, as well as the presence of dense stands of forest pioneers such as *Trema orientalis* on the margins of some forests. The presence of extensive Olea Sclerophyllous Forest with its low tree species diversity could also be an indication of expanding forests with this distinct and widespread forest community forming a primary forest succession phase. **Conservation and utilisation**: Most of these forests are well-protected, being situated on private land where access is restricted. The primary uses are conservation, recreation, and for ecosystem services, e.g., sustainable water production. Many farming areas north of the Magaliesberg are dependent on the harvesting of water from the north-facing kloofs. Many of the kloofs are used for hiking throughout the year. The Mountain Club of South Africa's kloofs are accessible to members and to the public through permits. There is little evidence of current or historical exploitation. The only exception is Majakaneng Kloof, which is owned by a community property association, and where trees are heavily harvested for medicinal use. Forests on south-facing slopes tend to develop in moist, fire-protected positions in south-facing gullies and steep slopes below the cliffs with boulder and rock scree, where they are well-protected against fire. The forests on south-facing slopes, being drier and cooler, have a different floristic composition to the wetter kloof forests of the north-facing slopes. The forests on south-facing slopes tend to dominate on the higher altitudes just below the cliffs, and often grade into dense Olea Sclerophyllous Forest comprising *Olea europaea* subsp. *cuspidata, Celtis africana, Ziziphus mucronata* and *Buddleja saligna,* with no clear distinction between the boundary of the two forest types. However, Olea Sclerophyllous Forest is much less diverse in species, and often completely dominated by *Olea europaea* subsp. *cuspidata*. This forest type or community is widespread in the NW, as well as other parts of South Africa from the Eastern Cape to the northern provinces. It is typically found in fire refuges on deeper soils such as alluvial soils (bottom slope) or rock scree slopes (top slope). In the NW well-developed examples of this unit are found in the Magaliesberg, often associated with Northern Temperate Forests; dolines in Carletonville Dolomite Grassland; valleys in the Dwarsberg-Swartruggens Mountain Bushveld; and on koppies throughout the Bankenveld region.
References	Roberts (1961), Van Vuuren (1961), Killick (1963), Van Vuuren and Van der Schijff (1970), Van Zinderen Bakker (1971, 1973), Coetzee (1974, 1975), Van der Meulen (1978, 1979), Bredenkamp and Theron (1978, 1980), Westfall (1981), Cooper (1985), Westfall et al. (1984), Everard (1986), Behr and Bredenkamp (1988), Du Preez and Bredenkamp (1991), Du Preez (1991), Smit et al. (1993), Hill (1996), Eckhardt et al. (1997), Ellery et al. (2001), Siebert (2001), Van Staden (2002), Von Maltitz et al. (2003), Van Staden and Bredenkamp (2005, 2006), Geldenhuys and Mucina (2006).

2. Gh 10 Vaal-Vet Sandy Grassland

Distribution	North West and Free State provinces, south of Lichtenburg and Ventersdorp, stretching southwards to Klerksdorp, Leeudoringstad, Bothaville and to the Brandfort area north of Bloemfontein.
Altitude	1 200–1 620 m (median 1 420 m).
Vegetation and landscape features	Dry, medium (0.75–1.00 m) tussock grassland dominated by *Themeda triandra* with a karroid shrub element. In pockets of deeper sand Kalahari elements, such as stands of *Vachellia erioloba*, are present.
Geology and soils	Mostly Kalahari sand aeolian deposits with some colluvial soils overlaying various geologies. Dominant land types Bc and Bd with soil forms mostly Avalon, Westleigh and Clovelly. Red, eutrophic, plinthic soils, depth 0.5–1.0 m, average clay content 15–20%
Important taxa	**Grasses**: *Themeda triandra* (d*), *Anthephora pubescens* (d), *Eragrostis lehmanniana* (d), *Aristida congesta, Brachiaria serrata, Cynodon dactylon, Eragrostis curvula, E. superba, Panicum coloratum, Tragus berteronianus, Triraphis andropogonoides*.

*d = dominant species, see Table 9 in main text.

Important taxa (continued)	**Shrubs**: *Asparagus laricinus* (d). **Herbs**: *Felicia muricata* (d)*, Pentzia globosa* (d), *Selago densiflora, Hibiscus pusillus, Ledebouria marginata*.
Remarks	Key identifying features of this vegetation type is the presence of *Asparagus laricinus*, as well as the abundance of narrow-leaf ironbark eucalyptus (*Eucalyptus crebra*) woodlots. These species are indicative of deep, freely draining, sandy soils. The absence of these woodlots is especially useful when marking the transition to Gh 14 Western Highveld Sandy Grassland. Pockets of aeolian sand in neighbouring vegetation units tend to contain Vaal-Vet Sandy Grassland. This is especially observable in Gh 15 Carletonville Dolomite Grassland. Locally, low cover of *Themeda triandra* and the associated increase in *Elionurus muticus, Cymbopogon pospischilii* and *Aristida congesta* is attributed to heavy grazing. *Seriphium plumosum* or bankrupt bush can also be prevalent in overgrazed situations. The bush encroaching tree species in this vegetation unit is *Vachellia karroo*. This vegetation type is highly suitable for cultivation, and it is currently extensively cultivated. In its definitive form occurring on deep soils on gentle gradients there are no impediments to ploughing and it is likely that this type has been largely eradicated by cultivation and is most likely extinct. Any intact examples of this vegetation unit that remain would be very important conservation targets.
References	Louw (1951), Morris (1973, 1976), Bredenkamp and Bezuidenhout (1990), Kooij (1990), Bezuidenhout and Bredenkamp (1991a), Kooij et al. (1990, 1992), Bezuidenhout et al. (1994a).

3. Gh 11 Vredefort Dome Granite Grassland

Distribution	Free State and North West provinces, central portion of the Vredefort Dome around Parys and Vredefort.
Altitude	1 330–1 540 m (median 1 400 m).
Vegetation and landscape features	Moderately undulating plains with medium (0.5–0.75 m) tussock grassland. Plains are interspersed with large granite-domed koppies.
Geology and soils	Coarse textured colluvial soils derived from the underlying granite bedrock. Ba land type with red dystrophic plinthic soils (Hutton, Mispah, Avalon forms), average depth < 0.5 m, average clay 20%.
Important taxa	**Grasses**: *Themeda triandra* (d*)*, Elionurus muticus* (d)*, Setaria sphacelata* var. *torta* (d)*, Brachiaria serrata, Cymbopogon pospischilii, Eragrostis chloromelas, E. racemosa, Heteropogon contortus, Trichoneura grandiglumis*. **Forbs**: *Barleria macrostegia, Helichrysum rugulosum, Hermannia depressa, Polygala hottentotta, Scabiosa columbaria, Turbina oblongata*.
Remarks	Vredefort Dome is an interesting geological structure – a strongly eroded remnant of one of the largest impact craters of the world, about 2.2 billion years old. This vegetation type is mostly very degraded through overgrazing and cropping. Examples of intact plains grassland are rare. Fields of bankrupt bush (*Seriphium plumosum*) are widespread.

*d = dominant species, see Table 9 in main text.

Remarks (continued)	The vegetation of the granite koppies in the vegetation type contain good examples of Olea Sclerophyllous Forest. This is a primary succession forest community that originates with the emergence of *Olea europaea* subsp. *cuspidata* from woodland vegetation to form a closed and contiguous evergreen forest cover. *Olea europaea* subsp. *cuspidata* is joined by *Celtis africana* and *Ziziphus mucronata* as dominant tree species. The development of this community is likely due to the general reduction in fire frequency in the landscape. This forest community is widespread in South Africa, encountered in most bushveld and woodland vegetation types in mesic, fire-protected positions. In terms of the vegetation type typology discussed in Results (Table 6), plains vs mountains is a key environmental discriminant of vegetation types. The woodland vegetation of the granite koppies mapped as part of this vegetation type has closer affinity to that of surrounding Gold Reef Mountain Bushveld vegetation types rather than to the grassland of this vegetation type. Therefore, these koppies should rather be grouped with the neighbouring Gold Reef Mountain Bushveld, Andesite Mountain Bushveld, or be assigned their own vegetation type.
References	Du Preez (1986), Bezuidenhout et al. (1988, 1994c), Bredenkamp et al. (1989), Du Preez and Venter (1990a, 1990b), Bezuidenhout (1993), Eckhardt et al. (1993), Fuls et al. (1992, 1993).

4. Gh 12 Vaal Reefs Dolomite Sinkhole Woodland

Distribution	NW, small area associated with the dolomite sinkholes in and around Stilfontein and Orkney (Vaal Reefs). The Vaal River forms the southern distribution limit of this vegetation unit.
Altitude	Altitude 1 280–1 380 m.
Vegetation and landscape features	Slightly undulating landscape dissected by prominent rocky chert/dolomite ridges and supporting a grassland-woodland vegetation complex. The most typical vegetation feature is the woodland, which occurs naturally in clumps around sand-filled dolines (sinkholes), which is characteristic of karst landscapes.
Geology and soils	This area occurs almost exclusively on the dolomites of the Malmani Subgroup (Chuniespoort Group, Transvaal Supergroup), where underground dissolution of the rock causes sinkholes, as well as caves. More than 50% of the main soil types are relatively shallow (50–150 mm) and rocky, with the dominant soil forms including Mispah, Glenrosa and shallow Hutton. Land type Fa.
Important taxa	**Trees**: *Vachellia erioloba* (d*), *Celtis africana* (d), *Searsia lancea* (d), *Senegalia caffra, Vachellia karroo, V. robusta* subsp. *clavigera*. **Tall shrubs**: *Diospyros lycioides* subsp. *lycioides* (d), *Ehretia rigida* (d), *Grewia flava* (d). **Shrubs**: *Asparagus suaveolens* (d), *Gymnosporia heterophylla* (d), *Pavonia burchellii* (d), *Sida dregei* (d), *Elephantorrhiza elephantina*. **Grasses**: *Aristida congesta* (d), *Digitaria eriantha* (d), *Eragrostis biflora* (d), *E. curvula* (d), *Themeda triandra* (d).
Remarks	The mapped extent of the dolomite sinkhole woodlands should be revisited at a more detailed scale than that offered by our current coverage. Clear separation (expressed in appropriate mapping coverage) between this unit and the adjacent Carletonville Dolomite Grassland is needed. These two units are closely related given the same underlying geology and soils. There is an observable gradient in tree abundance/density as one descends from the Vaal/Limpopo interfluve (Carletonville Dolomite Grassland) down into the Vaal River Valley (Vaal Reefs Dolomite Sinkhole Woodland) and the boundary between these two vegetation units is a cline rather than a clear demarcation.

*d = dominant species, see Table 9 in main text.

Remarks (continued)	Consideration should be given to updating the name of this vegetation unit. The 'sinkholes' referred to in the vegetation name are technically dolines, therefore a more technically correct name for this vegetation unit should be 'Vaal Reefs Dolomite Doline Woodland'. Aesthetically this is one of the more scenic landscapes in the western Grassland Biome having suffered less transformation relative to surrounding vegetation types and it certainly deserves high conservation priority (i.e., Highveld National Park at Potchefstroom).
References	Louw (1951), Acocks (1953, 1975, 1988), Morris (1973), Coetzee (1974), Van Wyk (1983), Van Wyk and Bredenkamp (1986), Bezuidenhout (1993), Bezuidenhout et al. (1994b, 1994c, 1994e), Siebert and Siebert (2005).

5. Gh 13 Klerksdorp Thornveld

Distribution	NW between Klerksdorp, Leeudoringstad, Wolmaransstad and Ottosdal with an outlying occurrence in the region of the Botsolano Game Reserve north of Mafikeng.
Altitude	1 240–1 580 m (median 1 380 m).
Vegetation and landscape features	Irregular undulating plains with dense to open 'Acacia' woodland clumps in a dry tussock grassland matrix.
Geology and soils	Relatively shallow, rocky, clayey colluvial soils on the foot slopes of basalt, quartzite or chert hills. Soils red eutrophic plinthic soils (Hutton form), depth < 0.5 m, average clay 20%. Land types Bc and Bd.
Important taxa	**Trees**: *Vachellia karroo* (d*), *Senegalia caffra* (d), *Celtis africana, Searsia lancea, S. pyroides, Ziziphus mucronata*. **Shrubs;** *Diospyros lycioides, Ehretia rigida, Grewia flava, Gymnosporia buxifolia*. **Grasses**: *Cynodon dactylon* (d), *Panicum coloratum* (d), *Sporobolus fimbriatus* (d), *Themeda triandra* (d), *Andropogon schirensis, Aristida congesta, Brachiaria serrata, Cymbopogon plurinodis, Digitaria eriantha, Diheteropogon amplectens, Eragrostis curvula, E. obtusa, E. superba, Elionurus muticus, Eustachys paspaloides, Heteropogon contortus, Setaria sphacelata, Sporobolus africanus, Tragus berteronianus, Triraphis andropogonoides*. **Forbs**: *Acalypha angustata, Anthospermum hispidulum, Asparagus africanus, Bulbostylis burchellii, Gnidia capitata, Helichrysum nudifolium, Hermannia lancifolia, Justicia anagalloides, Ledebouria marginata, Pavonia burchellii, Plexipus adenostachyus, Pollichia campestris, Raphionacme hirsuta, Rhynchosia totta* var. *venulosa, Solanum incanum, Teucrium trifidum, Triumfetta sonderi, Ziziphus zeyheriana*.
Remarks	The presence and dominance of *Senegalia caffra* is a defining characteristic of this vegetation type. This vegetation type grades into mountain bushveld types along a catena on steeper more rocky slopes, and with surrounding grassland types on deeper, sandier soils. Thus this vegetation type is transitional in character between Western Highveld Sandy Grassland (shallow sand with calcrete exposed), Vaal Vet Sandy Grassland (deep sandy soils with *Asparagus laricinus* dominant) and Andesite Mountain Bushveld, and therefore could be considered a grassland or bushveld vegetation type. This vegetation unit has a high grazing capacity, and this leads to overutilisation and degradation and subsequent invasion of *Vachellia karroo* into adjacent dry grassland.
References	Louw (1951), Morris (1973, 1976), Bredenkamp and Bezuidenhout (1990), Bezuidenhout (1993), Bezuidenhout et al. (1994c, 1994d), Bredenkamp and Brown (2003b).

*d = dominant species, see Table 9 in main text.

6. Gh 14 Western Highveld Sandy Grassland

Distribution	NW from Mareetsane and Deelpan in the north to Bloemhof and Christiana in the south, west of Sannieshof and Wolmaransstad as far as Stella.
Altitude	930–1 250 m (median 1 060 m).
Vegetation and landscape features	Flat to gently undulating plains with short (< 0.5 m), dry mixed tussock/lawn grassland, with karoo shrub elements and (very) scattered woody species occurring in bush clumps. Surface calcrete can be common.
Geology and soils	Shallow Kalahari sand aeolian soil overlaying calcrete, which can be exposed in places. These recent surface deposits overlie mainly basalt geologies. Soil is red-yellow, red apedal (Hutton), soil depth < 0.5 m with a calcrete hardpan, average clay 15%. Land type Ae. Note that the bottomlands in this vegetation unit have been mostly mapped as Highveld Alluvial Vegetation in this vegetation map.
Important taxa	**Trees**: *Vachellia hebeclada, Vachellia tortilis, Diospyros lycioides*. **Grasses**: *Anthephora pubescens* (d*), *Aristida diffusa* (d), *Sporobolus africanus* (d), *Themeda triandra* (d), *A. canescens, A. stipitata, Brachiaria serrata, Digitaria argyrograpta, Diheteropogon amplectens, Elionurus muticus, Eragrostis curvula, E. gummiflua, E. racemosa, Eustachys paspaloides, Melinis nerviglumis, Setaria sphacelata, Sporobolus discosporus, S. fimbriatus, Trichoneura grandiglumis, Triraphis andropogonoides*. **Forbs**: *Chamaecrista mimosoides, Dicoma anomala, Helichrysum callicomum, Hermannia depressa, Indigofera comosa, Kyphocarpa angustifolia, Leucas capensis, Mariscus indecorus, Polygala hottentotta, Sebaea grandis, Sida dregei, Solanum panduriforme, Vernonia oligocephala*.
Remarks	Many endorheic pans (Highveld Salt Pans – not mapped here) are associated with this vegetation unit, but these have been largely included in the Highveld Alluvial Vegetation unit in this map. There is a soil depth and aridity gradient from Vaal-Vet Sandy Grassland to Western Highveld Sandy Grassland. These two grassland types are closely related floristically. The short grassland stature and presence of calcrete, and the general absence of trees and especially of the shrub *Asparagus laricinus* and *Eucalyptus* woodlots are particularly indicative of the transition to Western Highveld Sandy Grassland. This vegetation type is suitable for cultivation, but the low rainfall makes it a high-risk area for agriculture. Historically this unit was extensively cultivated, however, presently very little dryland cultivation occurs in this vegetation type. Consequently, whilst there appears to be large extents of this grassland remaining, these are mostly old-fields, and the best examples and largest extents of this vegetation type are encountered in historically communal lands. Flax-leaf fleabane (*Erigeron bonariensis*) is an alien invasive annual daisy species that is a major invader in this vegetation type leading to a loss of grassland. This is especially prevalent on commercial farms where veld fires are suppressed. It is less of a problem in communal areas. *Vachellia tortilis* and to a lesser extent *Tarchonanthus camphoratus* contribute to bush encroachment in this vegetation type.
References	Van Zyl (1965), Morris (1973, 1976), Bezuidenhout (1993), Bezuidenhout et al. (1993, 1994c).

*d = dominant species, see Table 9 in main text.

7. Gh 15 Carletonville Dolomite Grassland

Distribution	NW (mainly), Gauteng and marginally into the Free State, The karst landscape associated with the Malmani dolomite geological system stretching east–west from Centurion and Bapsfontein in Gauteng Province through to the Botswana border via Ventersdorp, Lichtenburg and Ottoshoop, with a north-south arm running from Carletonville to west of Potchefstroom.
Altitude	1 170–1 780 m (median 1 510 m).
Vegetation and landscape features	Slightly undulating plains dissected by prominent rocky chert ridges and hills dominated by medium (0.75–1.00 m) sour, wiry, tussock grasslands on the plains and woodland elements on the hills, as well as open *Protea* woodland above 1 600 m. Large depressions or dolines created from infilled sinkholes are a characteristic feature of this landscape.
Geology and soils	Dolomite and chert of the Malmani dolomites supporting mostly shallow, rocky soils. Shallow rocky soils (Mispah and Glenrosa forms), average depth 0.1–0.4 m, average clay 15%. Land type Fa. **Note**: Depressions in this landscape contain aeolian or alluvial deposits that have soils typical of the Ab land type with red to yellow apedal soils (Hutton and Clovelly forms).
Important taxa	**Grasses**: *Diheteropogon amplectens* (d*), *Loudetia simplex* (d), *Schizachyrium sanguineum* (d), *Themeda triandra* (d), *Alloteropsis semialata, Andropogon shirensis, Aristida canescens, Bewsia biflora, Elionurus muticus, Eragrostis gummiflua, Eragrostis racemosa, Monocymbium ceresiiforme, Panicum coloratum, Pogonarthria squarrosa, Triraphis andropogonoides, Tristachya leucothrix, T. rehmannii.* **Forbs**: *Bulbostylis burchelli, Dianthus mooiensis, Helichrysum miconiifolium, Indigofera comosa, Kyphocarpa angustifolia, Ophrestia oblongifolia, Parinari capensis, Searsia magalismontana, Tylosema esculentum, Protea welwitschii*.
Remarks	This vegetation type in the NW has complex phytosociological patterns as extensive recent aeolian and alluvial deposits remain in depressions in the karst landscape. The alluvial deposits in dolines are mostly associated with Olea Sclerophyllous Forest. These alluvial deposits have largely been mined for diamonds and hence there are very few intact examples of this habitat and vegetation type remaining in this landscape. The pockets of aeolian sand contain Gh 10 Vaal-Vet Sandy Grassland or Gm 11 Rand Highveld Grassland. The erratic distribution of cultivated fields throughout this vegetation type are indicative of the presence of these pockets of sand. Rock piles adjacent to cultivated lands are indicative of Carletonville Dolomite Grassland being cleared for agriculture. A characteristic feature of this vegetation type is the absence of surface water. The karst geology means most surface water drains into the bedrock below. This water discharges from the ground water around the periphery of this vegetation type where the dolomite geology makes contact with the underlying bedrock of surrounding vegetation types. This gives rise to numerous springs or 'eyes' and associated peat wetlands that are a feature of the NW landscape surrounding the various karst landscapes in the province, namely, Carletonville Dolomite Grassland, Ghaap Plateau Vaalbosveld and Morokweng Thornveld. This vegetation type forms an important catchment for most major rivers flowing in the province. Vegetation types on dolomite geology are the only types in the province where the typology includes both plains and mountain environmental groups. This definition is consistently applied to all dolomite vegetation types in South Africa and therefore the typology rule is not changed here.
References	Louw (1951), Morris (1973, 1976), Coetzee (1974), Coetzee and Werger (1975), Van Wyk (1983), Van Wyk and Bredenkamp (1986), Bezuidenhout and Bredenkamp (1990), Scogings and Theron (1990), Bezuidenhout et al. (1994b, 1994c, 1994f), Bredenkamp et al. (1994), Grobler (2000), Hartmann (2001), Siebert and Siebert (2005), Grobler et al. (2006), Daemane et al. (2010),Veldsman (2021).

*d = dominant species, see Table 9 in main text.

8. Gm 11 Rand Highveld Grassland

Distribution	Gauteng, North West, Free State and Mpumalanga provinces, slopes and valleys between rocky ridges above 1 300 m. Occurs in the NW in two areas north and south of the Malmani dolomites. In the north on the Highveld around Derby and Koster above the Swartruggens hills, and in the southeast near Potchefstroom.
Altitude	1 300–1 700 m (median 1 530 m).
Vegetation and landscape features	Wide, gently sloping valleys/plains interspersed with low ridges or hills. Tall (1 m), wiry, sour grassland in the east with shorter (0.75 m) grassland in the west. Open *Protea* woodland occurs above 1 600 m. Most common grasses on the plains belong to the genera *Themeda, Eragrostis, Heteropogon* and *Elionurus*. Low, sour shrubland and woodland on rocky outcrops and steeper slopes belongs to SVcb 9 Gold Reef Mountain Bushveld.
Geology and soils	Colluvial soils derived from underlying geology, which is varied and includes basalt/dolerite, shale/mudstone and quartzite geologies. Dystrophic and eutrophic red soils (Hutton and Clovelly forms), average depth 0.50–0.75 m, average clay 25%. Land types Ba and Bc.
Important taxa	**Eastern extent**: **Grasses**: *Cymbopogon caesius* (d*), *C. plurinodis* (d), *Eragrostis curvula* (d), *Themeda triandra* (d), *Aristida congesta, Brachiaria serrata, Cynodon dactylon, Eragrostis racemosa, E. superba, Heteropogon contortus, Setaria sphacelata var. torta*. **Forbs**: *Anthospermum hispidulum, Felicia muricata, Graderia subintegra, Helichrysum miconiifolium, H. nudifolium, Hermannia depressa, Hibiscus pusillus, Justicia anagalloides, Lippia scaberrima, Vernonia oligocephala, Ziziphus zeyheriana*. **Western extent**: **Grasses**: *Anthephora pubescens* (d), *Eragrostis lehmanniana* (d), *Themeda triandra* (d), *Aristida congesta, Cynodon dactylon, Eragrostis curvula, E. superba, Tragus berteronianus*. **Forbs**: *Hibiscus pusillus, Ledebouria marginata, Felicia muricata* (d), *Pentzia globosa* (d), *Selago densiflora*.
Remarks	This vegetation unit is very varied and geographically disjunct and requires further investigation. Most importantly, the underlying geology of this vegetation group is very diverse. As most soils are colluvial being derived from the underlying bedrock, a closer environmental/phytosociological investigation is required to determine if this vegetation type warrants splitting based on geology and/or biogeography. Bankrupt bush encroachment is prevalent in many areas due to lack of regular fire.
References	Acocks (1953, 1975, 1988), Bezuidenhout (1988), Scogings and Theron (1990), Bezuidenhout and Bredenkamp (1991b), Coetzee (1993), Coetzee et al. (1994, 1995), Smit et al. (1997), Burgoyne et al. (2000), Grobler (2000), Grobler et al. (2006).

*d = dominant species, see Table 9 in main text.

9. Gm 29 Waterberg-Magaliesberg Summit Sourveld

Distribution	Limpopo and North West provinces and marginally into Gauteng, isolated patches on summits of the Waterberg (including the Sandrivierberge, Hoekberge, Hanglipberge and Swaershoekberge), Pilanesberg and Magaliesberg.
Altitude	Altitude 1 500–2 088 m in the Waterberg, 1 853 m in the Magaliesberg and 1 687 m in the Pilanesberg.
Vegetation and landscape features	Higher slopes and summit positions including crests, and steep rocky scarps and cliff faces, covered with grassland (and accompanying rocky outcrops) dominated by wiry tussock grasses. Patches of open *Protea caffra* savannoid vegetation and open shrubland with *Englerophytum magalismontanum* and *Ancylobothrys capensis* are common and typical of this sourveld vegetation type.
Geology and soils	Acidic sandy, loamy to gravel soil derived from coarse sandstone, quartzite, and conglomerate. Land type Ib and Fa.
Important taxa	**Trees**: *Englerophytum magalismontanum, Protea caffra* subsp. *caffra, Protea roupelliae* subsp. *roupelliae, Acacia caffra, Brachylaena rotundata, Combretum moggii, Combretum molle, Faurea saligna, Vangueria infausta, Zanthoxylum capense, Elephantorrhiza burkei, Protea gaguedi, Searsia dentata*. **Grasses**: *Loudetia simplex, Aristida transvaalensis, Bulbostylis burchellii, Coleochloa setifera, Diheteropogon amplectens, Eragrostis nindensis, Melinis nerviglumis, Schizachyrium sanguineum, Trachypogon spicatus, Tristachya biseriata*. **Shrubs**: *Ancylobothrys capensis, Lopholaena coriifolia, Passerina montana, Searsia magalismontana* subsp. *magalismontana, Acalypha angustata, Euphorbia clavarioides* var. *truncata, Euphorbia schinzii, Elephantorrhiza elephantina, Parinari capensis, Selaginella dregei, Xerophyta retinervis*.
Remarks	Embedded within this sourveld there are abundant rocky sheets found on exposed mountain tops and ridges, supporting sparse edaphic grassland/herbland with resurrection plants such as *Myrothamnus flabellifolius, Xerophyta retinervis* and *Selaginella dregei*. It is here where succulents (some endemic) of the genera *Frithia*, *Khadia* and *Delosperma* (Aizoaceae), *Adromischus* (Crassulaceae), *Anacampseros* (Anacampserotaceae) and numerous low succulent representatives of *Euphorbia* are found.
References	Acocks (1953, 1975, 1988), Coetzee (1974, 1975), Coetzee and Werger (1975), Van der Meulen (1979), Westfall (1981), Burgoyne et al. (2000), Van Staden (2002), Bredenkamp and Brown (2003a, 2003b), Van Staden and Bredenkamp (2005), Van Staden et al. (2021).

10. SVcb 1 Dwaalboom Thornveld

Distribution	Limpopo and North West provinces, flats both north and south of the Dwarsberge and associated ridges mainly west of the Crocodile River in the Dwaalboom area but including a patch around Sentrum. South of the ridges it extends eastwards from the Nietverdiend area, north of the Pilanesberg to the Northam area.
Altitude	Altitude 900–1 200 m.
Vegetation and landscape features	Plains with layer of scattered, low to medium-high, deciduous microphyllous trees and shrubs with a few broad-leaved tree species, and an almost continuous herbaceous layer dominated by grass species. *Vachellia tortilis* and *V. nilotica* dominate on the medium clays (at least 21% clay in the upper soil horizon but high in the lower horizons; on particularly heavy clays (> 55% clay in all horizons) most other woody plants are excluded and the diminutive *V. tenuispina* dominates at a height of less than 1 m above ground. On the sandy clay loam soils (with not more than 35% clay in the upper horizon but high in the lower horizons) *Senegalia erubescens* is the most prominent tree. The alternation of these substrate types creates a mosaic of different 'Acacia' woodlands.
Geology and soils	Vertic black ultramafic clays which developed from norite and gabbro, also locally in small depressions along streams. Some areas have less clay. Some with high base status and eutrophic red soils. Land type Ea.

Important taxa	**Trees**: *Vachellia nilotica, V. tortilis* subsp. *heteracantha, Senegalia erubescens, S. fleckii, S. mellifera* subsp. *detinens, Combretum imberbe, Searsia lancea, Ziziphus mucronata, Vachellia hebeclada* subsp. *hebeclada, Combretum hereroense, Diospyros lycioides* subsp. *lycioides, Euclea undulata, Grewia flava, Tarchonanthus camphoratus*. **Grasses**: *Aristida bipartita, Bothriochloa insculpta, Digitaria eriantha* subsp. *eriantha, Ischaemum afrum, Panicum maximum, Cymbopogon pospischilii, Eragrostis curvula, Sehima galpinii, Setaria incrassata*. **Shrubs**: *Vachellia tenuispina, Abutilon austro-africanum, Aptosimum elongatum, Hirpicium bechuanense, Pavonia burchellii, Solanum delagoense, Kalanchoe rotundifolia, Talinum caffrum, Heliotropium ciliatum, Kohautia caespitosa* subsp. *brachyloba*.
Remarks	Contains some very clayey soils that swell when wet and shrink when dry. On the clays, woody plant biomass is generally low, and productivity of woody plants is usually lower than that of herbaceous plants. These areas with ultramafic soils are, contrary to Sekhukhuneland, low in species diversity and in endemic species. Erosion is very low to low. Main use is extensive cattle grazing.
References	Bosch (1971), Coetzee (1971), Morris (1972), Van der Meulen (1979), Van der Meulen and Westfall (1980), Pauw (1988), Rutherford (1993), Winterbach (1998), Viljoen et al. (2014).

11. SVcb 2 Madikwe Dolomite Bushveld

Distribution	North West and Limpopo provinces, extends along the low dolomite ridge from the international border at Ramotswa in the west via the Rand Van Tweede Poort, Tlhaapitse and Maakane to west of the Crocodile River near Thabazimbi. It is also found on dolomite hills between Assen and Northam.
Altitude	Altitude 950–1 450 m (median 1 150 m).
Vegetation and landscape features	Gentle ridges and low hills up to about 100–150 m above the surrounding plains. Open (plains) to dense (slopes) woodland with tree and shrub layers often not clearly distinct, especially on steeper slopes; they are dominated by deciduous trees, particularly *Combretum apiculatum* and *Kirkia wilmsii* (especially in the east). Herbaceous layer continuous, dominated by grasses.
Geology and soils	Shallow, stony to rocky soils of the Glenrosa and Mispah forms on dolomite. Land type is mainly Fa.
Important taxa	**Trees**: *Combretum apiculatum, Searsia lancea, Searsia leptodictya, Ziziphus mucronata, Sclerocarya birrea, Ozoroa paniculosa*. **Shrubs**: *Vitex zeyheri, Tarchonanthus camphoratus, Grewia flava, Grewia bicolor, Grewia monticola, Ximenia americana*. **Grasses**: *Heteropogon contortus, Enneapogon scoparius, Aristida congesta, Panicum coloratum, P. maximum*. **Forbs**: *Clerodendrum glabrum, Brachystelma gracillimum, Euphorbia perangusta*.
Remarks	Some species distributions are associated with the east–west climatic gradient, for example *Kirkia wilmsii* is restricted to the eastern parts of the unit where it forms large monospecific forests on mountain slopes. These *Kirkia* forests are indicative of dolomite bands in the bedrock, and they do not occur on other geologies. These forest are especially apparent in autumn when their orange autumn foliage stands out from the surrounding landscape. In contrast to the bush encroachment seen on the red clay loams surrounding this unit, the rocky soils of dolomitic origin support a more open canopy structure and are resistant to bush encroachment.
References	Zacharias (1994), Hudak and Wessman (2001), Stalmans and De Wet (2003).

*d = dominant species, see Table 9 in main text.

12. SVcb 3 Zeerust Thornveld

Distribution	NW, extends along the valleys/plains from the Lobatsi River in the west via Zeerust, Groot Marico and Mabaalstad to the flats between the Pilanesberg and western end of the Magaliesberg in the east (including the valley of the lower Selons River).
Altitude	Altitude mainly 1 000–1 250 m.
Vegetation and landscape features	Deciduous, open to dense short thorny woodland, dominated by 'Acacia' species with herbaceous layer of mainly grasses on deep, high base-status and some clay soils on plains and lowlands, also between rocky ridges of Dwarsberg-Swartruggens Mountain Bushveld.
Geology and soils	Gentle catenal sequences from deep, red-yellow, apedal, freely drained with high base-status on upper slopes grading to sodic vertic or melanic clays in valley bottoms. Land type mainly Ae.
Important taxa	**Trees**: *Vachellia nilotica, Vachellia tortilis, Senegalia fleckii, Senegalia galpinii, Senegalia mellifera*. **Shrubs**: *Grewia flava*, *Aloe marlothii*. **Grasses**: *Eragrostis lehmanniana, Panicum maximum* (d)*, Aristida congesta, Cymbopogon plurinodis*. **Forbs**: *Agathisanthemum bojeri, Blepharis integrifolius, Chaetacanthus costatus, Chamaecrista absus, Chamaecrista mimosoides, Cleome maculata, Clerodendrum ternatum, Dicoma anomala, Indigofera filipes, Kyphocarpa angustifolia, Limeum viscosum, Lophiocarpus tenuissimus, Sida chrysantha, Stylosanthes fruticosa*.
Remarks	This unit is somewhat more temperate than the Dwaalboom Thornveld that borders it to the north. It occurs in the valleys of the Swartruggens Mountains. The presence of sodic soils at the base of a catena with bare soils adjacent to a wooded streamline with a dense band of *Vachellia tortilis* above is indicative of this vegetation type.
References	Van Wyk (1959), Van der Meulen (1979), Van der Meulen and Westfall (1980), Malan and Van Niekerk (2005).

13. SVcb 4 Dwarsberg-Swartruggens Mountain Bushveld

Distribution	NW, occurs on hills and ridges east of the Lobatsi River through the Zeerust and the Swartruggens areas to Mabeskraal and the Selons River Valley in the east. Also occurs on the parallel ridges of the Dwarsberge from Witkleigat in the west to the hills of the Dwarsberg area in the east.
Altitude	Altitude about 1 000–1 500 m.
Vegetation and landscape features	Rocky low- to medium-high hills and ridges with some steep faces in places. Height above the surrounding plains can reach about 300 m. Mixed bushveld woodland with variable vegetation structure depending on slope, exposure, aspect and local habitat – various combinations of tree and shrub layers often with dense grass layer. Bush clumps also occur.
Geology and soils	Predominately shale and mudstone with stony shallow soils of the Glenrosa and Mispah soil forms. Land type mainly Fb.
Important taxa	**Trees**: *Senegalia caffra, Olea europaea* subsp. *africana, Buddleja saligna, Combretum molle, Dombeya rotundifolia*. **Grasses**: *Loudetia simplex, Schizachyrium sanguineum, Setaria lindenbergiana, Cymbopogon plurinodis, Elionurus muticus, Heteropogon contortus, Melinis nerviglumis, Setaria sphacelata* var. *sphacelata, Themeda triandra, Trachypogon spicatus, Tristachya biseriata*. **Shrubs**: *Vangueria infausta, Nuxia glomerulata, Erythrophysa transvaalensis, Athrixia elata, Pavonia burchellii, Searsia magalismontana* subsp. *magalismontana, Searsia rigida* var. *rigida*.

Remarks	This vegetation has some similarities with the surrounding Gold Reef Mountain Bushveld; however, it is generally drier and warmer than this unit and is associated with shale/mudstone as opposed to quartzite for Gold Reef Mountain Bushveld. This unit extends into Botswana, for example on the hills around Lobatse. Alien species include *Cereus jamacaru* and particularly *Acacia mearnsii* that form extensive thickets especially on the ecotone with the cooler and moister Rand Highveld Grassland vegetation type.
References	Van der Meulen (1979), Zacharias (1994), Bredenkamp (1999), Viljoen et al. (2014).

14. SVcb 5 Pilanesberg Mountain Bushveld

Distribution	NW, hills and mountains immediately north of Sun City and west of Heystekrand (Mankwe District).
Altitude	Altitude about 1 100–1 500 m.
Vegetation and landscape features	Broad-leaved deciduous bushveld with trees and shrubs with wiry grass layer on slopes of rocky mountains and hills, with mountain summits more grassy and valley floors sometimes less woody but the latter may be related to past disturbance.
Geology and soils	The alkaline complex consists of potassium- and sodium-rich, silica-poor rocks, mainly foyaite, lava and tuff with some syenite. Wide range of elements found, particularly rare earth elements and fluorine in the form of CaF_2 (fluorite). Due to the original volcanic actions, subsequent fracturing, emplacement of intrusions, collapse and resurgence of magma and radial emplacement of dykes, a complex geological pattern exists. Pilanesberg is one of the very few large alkaline ring complexes in the world, approximately 1.3 million years old. Soils are shallow, rocky lithosols on the hills and mountains of the Glenrosa and Mispah soil forms, but with deeper, sandy soils on the valley floors. Land type is Ib.
Important taxa	**Trees**: *Combretum apiculatum, Combretum molle, Combretum zeyheri, Strychnos cocculoides, Croton gratissimus, Englerophytum magalismontanum, Searsia leptodictya, Vangueria parvifolia, Diplorhynchus condylocarpon, Elephantorrhiza burkei, Grewia flava, Hibiscus calyphyllus, Mundulea sericea, Steganotaenia araliacea, Vitex rehmannii, Polygala hottentotta, Xerophyta retinervis, Erythrophysa transvaalensis*. **Grasses**: *Chrysopogon serrulatus, Elionurus muticus, Panicum maximum, Enneapogon scoparius, Hyperthelia dissoluta, Panicum deustum*.
Remarks	This unit is a meeting ground for several species of *Grewia*, for example northwestern limits of *G. occidentalis*, southwestern limits of *G. monticola* and *G. hexamita* and southeastern limits of *G. retinervis*. The vegetation of the southern slopes of this unit is similar to that of the southern slopes of the northeastern end of the Magaliesberg (Gold Reef Mountain Bushveld), whereas the northern slopes of the two units have distinct physiognomic differences. The valley floor vegetation is mapped as Central Sandy Bushveld. The Pilanesberg Alkaline Ring Complex is a near circular (diameter 23–27 km) ring dyke complex constituting an intrusive and extrusive massif with the original volcanic caldera completely eroded away leaving a broken ring of hills and low mountains, as well as the eroded intrusions of the core remaining in the form of many hills and low mountains. Valley floors between the hills and mountains tend to be at most 1–2 km wide.
References	Van Wyk (1959).

15. SVcb 6 Marikana Thornveld

Distribution	North West and Gauteng provinces, occurs on plains from the Rustenburg area in the west, through Marikana and Brits to the Pretoria area in the east.
Altitude	Altitude about 1 050–1 450 m.
Vegetation and landscape features	Open, grassy 'Acacia' woodland occurring on gently undulating plains.
Geology and soils	Most of the area is underlain by the mafic intrusive rocks of the Bushveld Igneous Complex which give rise to heavy black cotton soils (vertic melanic clays). Land type Ea.
Important taxa	**Trees**: *Vachellia karroo, Vachellia tortilis, Vachellia nilotica, Ziziphus mucronata*. **Shrubs**: *Diospyros lycioides, Grewia flava*. **Grasses**: *Aristida bipartita, Bothriochloa insculpta, Digitaria eriantha, Ischaemum afrum, Panicum maximum, Cymbopogon plurinodis, Eragrostis curvula, Sehima galpinii, Setaria incrassata*. **Forbs**: *Abutilon austro-africanum, Aptosimum depressum, Heliotropium ciliatum, Hibiscus trionum, Hirpicium bechuanense, Nidorella hottentotica, Kalanchoe rotundifolia, Pavonia burchellii, Rhynchosia minima, Solanum panduriforme, Talinum caffrum*.
Remarks	Historically this vegetation unit presented as open grass-covered plains. Today, however, due to bush encroachment most of this unit presents as a dense 'Acacia' woodland. The only examples of the open savanna form of this vegetation unit are to be found in communal areas.
References	Van der Meulen (1979), Van Rooyen (1983, 1984), Panagos et al. (1998), Lamprecht (2010), Lamprecht et al. (2011).

16. SVcb 7 Norite Koppies Bushveld

Distribution	North West and Gauteng provinces on 'The Norite Hills' occurring between Rustenburg and Pretoria, north of the Magaliesberg.
Altitude	Altitude about 1 100–1 350 m.
Vegetation and landscape features	Variable woodland, low, semi-open to closed, up to 5 m tall, consisting of dense deciduous shrubs and trees with very sparse undergrowth on shallow rocky soils, with large areas of rock sheet/boulders not covered by vegetation. Tree and shrub layers are continuous. The stands of this unit are found on norite outcrops and koppies, many occurring as inselbergs above the surrounding plains.
Geology and soils	Gabbro (norite is a type of gabbro) of the Bushveld Igneous Complex that give rise to hills with large rocks and boulders and very shallow lithosols. Soils are well-drained, Glenrosa and Mispah forms. Gabbro is a coarse-grained igneous rock that is relatively low in silica and rich in iron, magnesium and calcium. Such rock is described as mafic. Land type Ib.
Important taxa	**Trees**: *Combretum molle, Croton gratissimus, Ficus abutilifolia, Pappea capensis, Bridelia mollis, Psydrax livida, Volkameria glabra, Combretum apiculatum, Diplorhynchus condylocarpon, Dombeya rotundifolia, Euclea natalensis, Euphorbia cooperi, Ficus glumosa, Lannea discolor, Peltophorum africanum, Sclerocarya birrea, Triaspis glaucophylla*. **Shrubs**: *Grewia flavescens, Pouzolzia mixta, Vitex zeyheri, Jatropha latifolia*. **Grasses**: *Chrysopogon serrulatus, Setaria lindenbergiana*. **Forbs**: *Cyphostemma lanigerum, Helinus integrifolius, Hermannia floribunda, Hibiscus subreniformis, Hibiscus schinzii, Pellaea viridis, Turraea obtusifolia, Urera tenax*.

Remarks	Vegetation patterns on norite koppies are primarily determined by the amount of rockiness and aspect, warmer north-facing slopes and cooler south-facing slopes bearing floristically distinct vegetation. A number of the woody species e.g., species of *Ficus*, are typical chasmophytes, penetrating the rocks with their roots (Van der Meulen 1979). The vegetation unit is transitional between xeric lowland bushveld and mesophyllous woodland in cooler more moist upland areas associated with the Magaliesberg. It may be considered to be a more xeric expression of these upland areas (Van der Meulen 1979). There are no endemic plant species associated with this vegetation unit. The unique character of this vegetation unit is derived from the combination of species (communities) and structure of vegetation due to the unique geological structure of the inselbergs. Mining is primarily in the form of granite quarries on koppies, but also affects surrounding lower-lying areas. Areas close to human settlements are often severely disturbed and many woody species may have been harvested from these areas for fuel or building materials. Weeds, including a number of declared aliens, are more common in these disturbed sites. Erosion is very low to moderate. The granite-like hills and koppies west of Madikwe towards the Botswana border are currently not considered part of this vegetation unit. Given further investigation it is likely that this vegetation unit could extend further to the west.
References	Van der Meulen (1979), Panagos (1996), Lamprecht (2010), Lamprecht et al. (2011).

17. SVcb 8 Moot Plains Bushveld

Distribution	North West and Gauteng provinces, main belt occurs immediately south of the Magaliesberg from the Selons River Valley in the west through Maanhaarrand, filling the valley bottom of the Magalies River, proceeding east of the Hartebeespoort Dam between the Magaliesberg and Daspoort mountain ranges to Pretoria. It also occurs as a narrow belt immediately north of the Magaliesberg from Rustenburg in the west to just east of the Crocodile River in the east; also south of the Swartruggens–Zeerust line.
Altitude	Altitude typically about 1 050–1 450 m.
Vegetation and landscape features	Open to closed, low, often thorny savanna dominated by various species of 'Acacia' in the bottom-lands and plains, as well as woodlands of varying height and density on the lower hillsides. Herbaceous layer is dominated by grasses.
Geology and soils	Soils varied, mostly stony with colluvial clay-loam or sand derived from shale (south of the Magaliesberg), norite (north of the Magaliesberg), or quartzite. Catenas are distinctive with red-yellow apedal freely drained, dystrophic sandy soils on the top slope near the base of hills down to eutrophic vertic and melanic clays in the bottom-lands. Land types Ba, Bc and Ea.
Important taxa	**Trees**: *Vachellia nilotica, Vachellia tortilis, Searsia lancea, Terminalia sericea, Buddleja saligna, Euclea undulata, Olea europaea, Grewia occidentalis, Gymnosporia polyacantha, Mystroxylon aethiopicum*. **Grasses**: *Heteropogon contortus, Setaria sphacelata, Themeda triandra, Aristida congesta, Chloris virgata, Cynodon dactylon, Sporobolus nitens, Tragus koelerioides*. **Shrubs**: *Aptosimum elongatum, Felicia fascicularis, Lantana rugosa, Teucrium trifidum, Kalanchoe paniculata, Jasminum breviflorum, Listia bainesii, Achyropsis avicularis, Evolvulus alsinoides, Helichrysum nudifolium, Hermannia depressa, Osteospermum muricatum, Phyllanthus maderaspatensis*.
Remarks	Plant communities characteristically vary in relation to catena position. Top slope communities on sandy soils are dominated by broad-leaved woodland (e.g., *Terminalia sericea*). These communities are structurally and floristically very similar to the Central Sandy Bushveld vegetation type. Bottom-lands are dominated by 'Acacia' woodland communities on clay rich soils. Plant communities here are similar to Zeerust Thornveld or Marikana Thornveld.
References	Coetzee (1975), Van der Meulen (1979).

18. SVcb 9 Gold Reef Mountain Bushveld

Distribution	North West, Gauteng, Free State and Mpumalanga provinces, occurs on the quartzite ridges of the Swartruggens, Magaliesberg, Witwatersrand, Gatsrand, Suikerbosrand, and Vredefort Dome mountain ranges.
Altitude	Altitude 1 200–1 750 m.
Vegetation and landscape features	Quartzite rocky hills and ridges mostly dominated by wiry, sour grasses on summits with more woody vegetation on slopes associated with distinct floristic differences (e.g., preponderance of *Senegalia caffra* on the southern slopes, *Protea* 'savannas' above 1600 m on southern aspects). Tree cover is variable dependent on soil depth, aspect and rockiness. Tree and shrub layers are often continuous. Herbaceous layer is dominated by grasses. A heterogenous vegetation type with several distinct plant communities discernible based on aspect, slope and rockiness.
Geology and soils	Quartzite bedrock that gives rise to shallow, dystrophic, gravelly lithosols of the Mispah form. Land types mainly Ib and Fb.
Important taxa	**Trees**: *Senegalia caffra, Combretum molle, Protea caffra, Celtis africana, Dombeya rotundifolia, Englerophytum magalismontanum, Ochna pretoriensis, Searsia leptodictya, Vangueria infausta, Vangueria parvifolia, Ziziphus mucronata, Afrocanthium gilfillanii, Ehretia rigida, Grewia occidentalis, Gymnosporia buxifolia, Mystroxylon aethiopicum*. **Grasses**: *Loudetia simplex, Panicum natalense, Schizachyrium sanguineum, Trachypogon spicatus, Alloteropsis semialata, Bewsia biflora, Digitaria tricholaenoides, Diheteropogon amplectens, Sporobolus pectinatus, Tristachya biseriata, Tristachya leucothrix*. **Shrubs**: *Athrixia elata, Pearsonia cajanifolia, Searsia magalismontana, Searsia rigida, Ancylobothrys capensis*. **Herbs**: *Helichrysum nudifolium, Helichrysum rugulosum, Pentanisia angustifolia, Senecio venosus, Xerophyta equisetoides, Cheilanthes contracta, Hypoxis hemerocallidea, Pellaea calomelanos*.
Remarks	This is a very widespread vegetation type stretching across four provinces; however, the dominant species and general physiognomic characteristics of the vegetation type are consistent across its range. All endemic and/or rare plant species in the region are associated with this vegetation type (e.g., *Aloe peglerae, Frithia pulchra, Euphorbia knobelii, Burmannia madagascariensis, Myrsine pillansii, Nuxia glomerulata*). It therefore deserves a disproportionally higher conservation importance value than other vegetation types. This vegetation type is regarded as the 'typical' or 'climax' Bankenveld vegetation type. Many small quartzite ridges that are present in this unit have not been mapped. In addition, some quartzite ridges in Gauteng are currently incorrectly mapped in the National Vegetation Map as Andesite Mountain Bushveld (e.g., Bronberg).
References	Van Vuuren and Van der Schijff (1970), Bredenkamp (1975), Coetzee (1975), Bredenkamp (1977), Bredenkamp and Theron (1978), Behr and Bredenkamp (1988), Bezuidenhout et al. (1988), Du Preez and Venter (1990b) Coetzee et al. (1993), Bezuidenhout et al. (1994c), Coetzee et al. (1994, 1995), Grobler et al. (2002), Pfab (2002), Reddy et al. (2001, 2012), Bredenkamp and Brown (2003a).

19. SVcb 10 Gauteng Shale Mountain Bushveld

Distribution	Gauteng and North West provinces, Occurs on shale and mudstone ridges and hills throughout Gauteng and into eastern NW, notably, the Gatsrand south of Carletonville–Westonaria–Lenasia, and Moot area of the Magaliesberg between Pretoria and Tarlton, and south of Koster.
Altitude	Altitude 1 300–1 750 m.
Vegetation and landscape features	Low, broken ridges varying in steepness and with high surface rock cover. Vegetation is a short (3–6 m tall), semi-open woody thicket or woodland.

Geology and soils	Mostly shale and mudstone that give rise to shallow, rocky lithosols of the Mispah form. Bottom slopes can have deeper rocky, colluvial soils. Land type Fb.
Important taxa	**Trees**: *Senegalia caffra, Dombeya rotundifolia, Vachellia karroo, Celtis africana, Combretum molle, Cussonia spicata, Englerophytum magalismontanum, Protea caffra, Searsia leptodictya, Vangueria infausta, Zanthoxylum capense, Ziziphus mucronata, Asparagus laricinus, Afrocanthium gilfillanii, Osteospermum incanum, Dichrostachys cinerea, Diospyros austroafricana, Diospyros lycioides, Ehretia rigida, Euclea crispa, Grewia occidentalis, Gymnosporia polyacantha, Olea europaea, Tephrosia capensis, Tephrosia longipes*. **Grasses**: *Hyparrhenia dregeana, Cymbopogon caesius, Cymbopogon pospischilii, Digitaria eriantha, Eragrostis curvula*. **Shrubs**: *Acalypha angustata, Asparagus suaveolens, Athrixia elata, Felicia muricata, Indigofera comosa, Searsia magalismontana, Elephantorrhiza burkei, Kalanchoe neglecta, Ancylobothrys capensis*. **Herbs**: *Macledium zeyheri, Helichrysum nudifolium, Helichrysum rugulosum, Hermannia lancifolia, Hibiscus pusillus, Selaginella dregei, Senecio venosus, Hilliardiella aristata, Hilliardiella elaeagnoides, Cheilanthes contracta, Scadoxus puniceus*.
Remarks	This vegetation type is floristically and structurally similar to Andesite Mountain Bushveld with geology as a key differentiating variable. Gauteng Shale Mountain Bushveld is associated with sedimentary shale and mudstone of sedimentary origin, whereas Andesite Mountain Bushveld is associated with andesite rocks of volcanic origin. The vegetation structure and composition of Gauteng Shale Mountain Bushveld together with Andesite Mountain Bushveld and Gold Reef Mountain Bushveld typify the Bankenveld vegetation concept.
References	Coetzee (1972, 1974), Scogings and Theron (1990), Bezuidenhout et al. (1994c, 1994e), Bredenkamp and Brown (2003a).

20. SVcb 11 Andesite Mountain Bushveld

Distribution	Gauteng, North West, Mpumalanga and Free State provinces, Andesite and related igneous rocky ridges and koppies through the region.
Altitude	Altitude about 1 350–1 800 m.
Vegetation and landscape features	Dense, medium-tall thorny mixed bushveld with a well-developed grass layer on hill slopes.
Geology and soils	Andesite volcanic rock that gives rise to shallow, rocky, clayey soils of mainly Mispah and Glenrosa soil forms. Land types Ib and Fb.
Important taxa	**Trees**: *Senegalia caffra, Vachellia karroo, Celtis africana, Protea caffra, Zanthoxylum capense, Ziziphus mucronata, Euclea crispa, Searsia pyroides, Diospyros lycioides, Gymnosporia polyacantha, Lippia javanica, Rhamnus prinoides*. **Grasses**: *Eragrostis curvula, Hyparrhenia finitima, Setaria sphacelata, Themeda triandra, Cymbopogon pospischilii, Digitaria eriantha, Elionurus muticus, Eragrostis racemosa, Eragrostis superba, Panicum maximum*. **Shrubs**: *Asparagus suaveolens, Searsia rigida, Teucrium trifidum, Isoglossa ciliata, Rhoicissus tridentata, Commelina africana, Pseudopegolettia tenella, Aloe davyana*.
Remarks	See remarks for Gauteng Shale Mountain Bushveld.
References	Bredenkamp (1975, 1977), Bredenkamp and Theron (1976, 1978, 1980), Du Preez and Venter (1990a, 1990b), Coetzee et al. (1995), Grobler (2000), Reddy et al. (2001, 2012), Bredenkamp and Brown (2003a), Daemane et al. (2010, 2012).

21. SVcb 12 Central Sandy Bushveld

Distribution	Limpopo, Mpumalanga, Gauteng and North West provinces, on undulating terrain, occurs mainly in a broad arc south of the Springbokvlakte from the Pilanesberg in the west through Hammanskraal and Groblersdal to GaMasemola in the east. A generally narrow irregular band along the northwestern edge of the Springbokvlakte (including Modimolle) extending into a series of valleys and lower-altitude areas within the Waterberg including the upper Mokolo River Valley near Vaalwater, the corridor between Rankins Pass and the Doorndraai Dam, and the lowlands from the Mabula area to south of the Hoekberge. Some isolated sandy patches found on the Springbokvlakte are assigned to Western Sandy Bushveld.
Altitude	Ranges from 900–1 450 m (median 1 070 m).
Vegetation and landscape features	Closed to open broad-leaved woodland with grass-dominated herbaceous layer, relatively low basal cover on dystrophic sands. Undulating plains and valleys, sometimes between mountains, with distinct catenas supporting tall, deciduous *Terminalia sericea* and *Burkea africana* woodland on deep sandy soils (with the former often dominant on the lower slopes of sandy catenas) and low, broad-leaved *Combretum* woodland on shallow rocky or gravelly soils. Species of *Vachellia*, *Ziziphus* and *Euclea* are found on flats and lower slopes on eutrophic sands and some less sandy soils.
Geology and soils	Fersiallitic soils - medium sandy clay loams with good drainage, derived from mafic (basic) granite rocks of the Bushveld Igneous Complex. Undulating landscapes with pronounced catenas. Fa and Fb land types with coarse textured sandy soils. Average depth 0.45 m. Average clay 10%. Well-drained, deep Hutton or Clovelly soils often with a catenary sequence from Hutton at the top to Clovelly on the lower slopes; shallow, skeletal Glenrosa soils also occur.
Important taxa	**Trees**: *Burkea africana, Combretum apiculatum, Combretum zeyheri, Terminalia sericea, Combretum imberbe, Peltophorum africanum, Sclerocarya birrea, Ochna pulchra*. **Grasses**: *Brachiaria nigropedata, Eragrostis pallens, E. rigidior, Panicum maximum, Brachiaria serrata, Elionurus muticus, Eragrostis nindensis, Loudetia simplex, Mosdenia leptostachys, Perotis patens, Themeda triandra, Trachypogon spicatus*. **Herbs**: *Agathisanthemum bojeri, Arthrosolen sericocephalus, Clerodendrum triphyllum, Dicerocaryum zanguebarium, Dichapetalum cymosum, Felicia fascicularis, Indigofera daleoides, Justicia anagalloides, Plexipus hederaceus, Waltheria indica*.
Remarks	*Vachellia sieberiana* occurs in the transition zone with grassland in the east, while *V. caffra* and *Faurea saligna* are dominant in the transition zone to Central Sandy Mountain Bushveld in the western parts of this unit. Central Sandy Bushveld is similar to Western Sandy Bushveld, but the former occurs on aeolian Kalahari sand (often shallow over clay soils) and is generally a taller more open bushveld type. *Vachellia tortilis* and other 'Acacia' species may dominate on heavy clay soil in valleys, but this is assigned to Springbokvlakte Thornveld. This vegetation unit includes probably the most intensively studied South African savanna field site of the South African Savanna Ecosystem Programme in the Nylsvlei Nature Reserve (Limpopo Province). This vegetation type is a complex unit that comprises a variety of distinct vegetation units. In this revision it is proposed that the mountain bushveld vegetation currently included in this unit in the National Vegetation Map is separated out into a new vegetation type (Central Sandy Mountain Bushveld). On the plains, there is also justification for the separation of the *Combretum* woodland on gravelly Glenrosa soils to be separated out from the *Terminalia-Burkea* woodland on deeper sandy Hutton/Clovelly soils. The former is the dominant type that occurs in the NW, whereas the latter is more dominant in the southern Waterberg where the soils are derived from quartzite rather than granite.
References	Grunow (1965), Coetzee et al. (1976), Van der Meulen (1979), Van der Meulen and Westfall (1980), Lubke et al. (1983), Lubke and Thatcher (1983), Scholes and Walker (1993), Brown (1997), Brown et al. (1995, 1996, 1997), Dörgeloh (1998, 1999a, 1999b), Brown and Bredenkamp (2004).

22. SVcb XX[1] Central Sandy Mountain Bushveld

Distribution	Limpopo, Mpumalanga, Gauteng and North West provinces, Mountainous terrain distributed in a broad arc from the Moretele River northwards into the Waterberg.
Altitude	850–1 450 m (median 1 100 m).
Vegetation and landscape features	Mostly dense broad-leaved mountain bushveld on slopes. Tree layer well-developed consisting of trees taller than three meters with canopy cover of 70–80%. Steep slopes on mountains with mostly skeletal rocky soils, as well as rocky pediments. Includes densely wooded ravines and kloofs that do not contain forest.
Geology and soils	Mostly quartzite of the Rayton Group or coarse-grained granite of the Nebo Granite Group that both give rise to shallow coarse-grained sandy soils with high rock content. Ib land type with shallow rocky soils. Average depth 0.3 m. Average clay 20%.
Important taxa	**Trees**: *Pappea capensis, Combretum apiculatum, Combretum molle, Combretum zeyheri, Bridelia mollis, Gymnosporia glaucophylla, Spirostachys africana, Grewia monticola, Grewia subspathulata, Ochna inermis, Sclerocarya birrea, Lannea discolor, Dombeya rotundifolia, Diplorhynchus condylocarpon* and *Pterocarpus rotundifolius*. Trees such as *Kirkia wilmsii, Croton gratissimus* and *Mimusops zeyheri* are restricted to sheltered ravines. **Grasses**: *Brachiaria deflexa, Aristida canescens, Aristida diffusa, Panicum maximum, Enneapogon scoparius, Chrysopogon serrulatus, Eustachys paspaloides, Digitaria eriantha, Eragrostis rigidior, Melinis repens* and *Enneapogon scoparius*. **Fern**: *Pellaea calomelanos*.
Remarks	See comments for Central Sandy Bushveld. Having been grouped with Central Sandy Bushveld or Western Sandy Bushveld in the National Vegetation Map since 2006 this vegetation type is being reinstated as a vegetation type. It is a well-established vegetation type recognised by Van der Meulen and Westfall (1979); Brown and Bredenkamp (1994); Brown et al. (1995, 1996 and 1997); and Bredenkamp and Brown (2003b). It is synonymous with Van der Meulen's *Combretum molle–Diheteropogon amplectens* Order described in his vegetation map of the western Transvaal bushveld (Van der Meulen & Westfall 1979); Brown's *Pappea capensis–Combretum apiculatum* (mountain) bushveld vegetation type described for the vegetation study of the Borakalalo Nature Reserve (Brown & Bredenkamp 1994, Brown et al. 1995, 1996 and 1997); and Bredenkamp and Brown (2003b) Mogosane Mountain Bushveld and Central Mixed Bushveld vegetation types in their vegetation map of the NW. Note that to the north and the southeast this unit transitions into related mountain bushveld units, namely, Waterberg Mountain Bushveld and Loskop Mountain Bushveld, respectively.
References	Van der Meulen and Westfall (1979), Bredenkamp and Brown (2003b), Brown and Bredenkamp (1994), Brown et al. (1995, 1996, 1997).

23. SVcb 15 Springbokvlakte Thornveld

Distribution	Limpopo, Mpumalanga, North West and Gauteng provinces, flats from Zebediela in the northeast to Hammanskraal and Assen in the southwest, as well as from Bela-Bela and Mookgophong in the northwest to Marble Hall and Rust de Winter in the southeast.
Altitude	Altitude about 900–1 200 m.
Vegetation and landscape features	Black cotton soil flats with open to dense, low thorn savanna dominated by 'Acacia' species or open grassland with a very low shrub layer.

[1]Vegetation type number to be assigned by the National Vegetation Map Committee.

Geology and soils	Vertisols derived from mafic volcanic rocks of the Bushveld Igneous Complex. Land type Ea.
Important taxa	**Trees**: *Vachellia tortilis, Vachellia karroo, Vachellia nilotica, Vachellia tenuispina, Ziziphus mucronata, Dichrostachys cinerea, Grewia flava*. **Grasses**: *Aristida bipartita, Dichanthium annulatum, Ischaemum afrum, Setaria incrassata, Brachiaria eruciformis*. **Herbs**: *Aspilia mossambicensis, Corchorus trilocularis, Hibiscus trionum, Indigastrum parviflorum, Nidorella hottentotica, Orthosiphon suffrutescens, Rhynchosia minima, Isolepis capensis, Mesogramma apiifolium, Kleinia longiflora, Jamesbrittenia micrantha, Ptycholobium plicatum*.
Remarks	The black clay soils of this unit are characterised by pronounced swelling and cracking with wet and dry cycles, considerable soil cracking when dry, a loose soil surface, high calcium carbonate content in the soil and gilgai micro-relief. Consequently, they are referred to as self-mulching soils and few perennial plants are able to tolerate the physical stress of this soil dynamic leading to a vegetation type with considerably lower species diversity than surrounding vegetation types. They are also referred to as black cotton soils as they are highly suitable for the cultivation of cotton and as a consequence have been extensively cleared for cultivation. Environmentally and floristically this unit is very similar to Marikana Thornveld. The open, grassy savanna form of this vegetation type is very rarely encountered anymore due to bush encroachment and habitat loss through cultivation. Some examples are still to be found in communal areas.
References	Galpin (1926), Coetzee et al. (1976), Van der Meulen (1979), Van der Meulen and Westfall (1980), Winterbach (1998).

24. SVcb 16 Western Sandy Bushveld

Distribution	Limpopo and North West provinces, occurs on flats and undulating plains from Assen near the Crocodile River westwards to the Botswana border between the Swartruggens and Dwarsberg mountain ranges. Also, around Thabazimbi northwards to Steenbokpan and west of the Waterberg Mountains.
Altitude	Mostly at altitudes of 900–1 200 m.
Vegetation and landscape features	Tall, open or closed broad-leaved woodland on gently undulating flats with sandy soils. Bottomlands with clay soils, which are dominated by microphyllous 'Acacia' tree species, belong to the Dwaalboom Thornveld vegetation type.
Geology and soils	Kalahari sand. Quaternary surface deposits comprising remnants of a formerly more widespread covering of Kalahari sand that stretched eastwards as far as the Springbokvlakte. The underlying geology is variable but has no influence on the current surface geology of this vegetation unit. Soils are plinthic catenas, eutrophic, red-yellow apedal, freely drained, high base status, Hutton and Clovelly soil forms. Land types mainly Ae.
Important taxa	**Trees**: *Vachellia erioloba, Senegalia nigrescens, Sclerocarya birrea, Combretum apiculatum, Combretum imberbe, Terminalia sericea, Combretum zeyheri, Lannea discolor, Ochna pulchra, Peltophorum africanum, Combretum hereroense, Euclea undulata, Coptosperma supra-axillare, Dichrostachys cinerea, Grewia bicolor, Grewia flava, Grewia monticola*. **Grasses**: *Anthephora pubescens, Digitaria eriantha, Eragrostis pallens, Eragrostis rigidior, Schmidtia pappophoroides, Aristida congesta, Aristida diffusa, Aristida stipitata, Eragrostis superba, Panicum maximum, Perotis patens*.

Important taxa (continued)	**Shrubs**: *Clerodendrum ternatum, Indigofera filipes, Justicia flava*. **Herbs**: *Blepharis integrifolia, Chamaecrista absus, Evolvulus alsinoides, Geigeria burkei, Cyphocarpa angustifolia, Limeum fenestratum, Limeum argute-carinatum, Lophiocarpus tenuissimus, Monsonia angustifolia*.
Remarks	There are many floristic similarities between this vegetation type and Central Sandy Bushveld. The key difference is that this type occurs on relic aeolian Kalahari sands, whereas the latter is associated with coarse sandy-loam soils derived from the underlying granite rocks. This vegetation type also tends to be taller, more open bushveld whereas the latter is shorter and denser. Large specimens of tree species such as *Vachellia erioloba, Sclerocarya birrea* subsp. *caffra, Senegalia erubescens, V. nigrescens* and *Combretum imberbe* are characteristic of this unit whereas these species are absent from Central Sandy Bushveld. On deeper sands *Terminalia sericea* can form tall, dense stands. Rural settlements between the Pilanesberg, Swartruggens and Dwarsberg is often associated with this unit as the surrounding thornveld units on black cotton soils are not suitable for settlement.
References	Bosch (1971), Herbst (1973), Peel (1990), Peel et al. (1991), Brown and Bredenkamp (1994, 2004), Brown et al. (1995, 1996, 1997), Brown (1997), Winterbach (1998), Winterbach et al. (2000), Stalmans and De Wet (2003).

25. SVcb 17 Waterberg Mountain Bushveld

Distribution	Limpopo Province extending into the far northeast of the NW, Waterberg Mountains, including the foothills, escarpment and tablelands south of the line between Lephalale and Marken and north of Bela-Bela and west of Mokopane and with outliers in the southwest such as the Boshofsberge and Vlieëpoortberge near Thabazimbi.
Altitude	Altitude about 1 000–1 600 m and generally at a lower altitude than the Gm 29 Waterberg-Magaliesberg Summit Sourveld.
Vegetation and landscape features	Rugged mountains with vegetation grading from *Faurea saligna–Protea caffra* bushveld on higher slopes (in turn grading into the Waterberg-Magaliesberg Summit Sourveld) through broad-leaved deciduous bushveld (dominated by *Diplorhynchus condylocarpon*) on rocky mid- and foot slopes to *Burkea africana–Terminalia sericea* savanna in the lower-lying valleys, as well as on deeper sands of the plateaus. The grass layer is moderately developed or well developed.
Geology and soils	Mainly sandstone and quartzite rocks that give rise to dystrophic, acidic sandy, loamy to gravelly soil. Glenrosa and Mispah Forms. Land types mainly Ib, Fa and Ad.
Important taxa	**Trees**: *Vachellia karroo, Senegalia caffra, Burkea africana, Combretum apiculatum, Croton gratissimus, Cussonia transvaalensis, Faurea saligna, Heteropyxis natalensis, Ochna pulchra, Protea caffra, Albizia tanganyicensis, Combretum molle, Englerophytum magalismontanum, Ficus burkei, Ficus glumosa, Ochna pretoriensis, Pseudolachnostylis maprouneifolia, Searsia lancea, Terminalia sericea, Vangueria infausta, Vangueria parvifolia, Diplorhynchus condylocarpon, Elephantorrhiza burkei, Combretum moggii, Combretum nelsonii, Dichrostachys cinerea, Euclea crispa, Lasiosiphon kraussianus, Olea capensis, Searsia pyroides, Strychnos pungens, Vitex rehmannii*. **Grasses**: *Loudetia simplex, Schizachyrium sanguineum, Trachypogon spicatus, Brachiaria serrata, Digitaria eriantha, Elionurus muticus, Enneapogon scoparius, Setaria sphacelata, Themeda triandra, Tristachya leucothrix*. **Shrubs**: *Anthospermum rigidum, Barleria affinis, Felicia muricata, Helichrysum kraussii, Protea welwitschii, Searsia rigida, Dichapetalum cymosum, Parinari capensis, Aloe chabaudii, Lopholaena coriifolia, Ancylobothrys capensis, Rhoicissus revoilii*. **Herbs**: *Berkheya insignis, Chamaecrista mimosoides, Geigeria elongata, Hibiscus meyeri, Xerophyta equisetoides, Haemanthus humilis, Hypoxis rigidula*.

Important taxa (continued)	**Biogeographically important taxa**: Northern Sourveld Endemic, *Encephalartos eugene-maraisii, Chorisochora transvaalensis*. **Central Bushveld endemic**, *Erythrophysa transvaalensis, Mosdenia leptostachys*. **Waterberg endemic**, *Grewia rogersii, Vangueria triflora, Oxygonum delagoense*.
Remarks	Carrying capacity of the vegetation for domestic stock animals is low, especially during the dry season (viz, 'sourveld').
References	Coetzee et al. (1981), Westfall (1981), Westfall et al. (1983, 1984), Ben-Shahar (1988), Van Staden (2002), Van Staden and Bredenkamp (2005), Van Staden et al. (2021).

26. SVk 1 Mafikeng Bushveld

Distribution	NW, west of Mafikeng and south of the Botswana border westwards to around Vergeleë, southwards to Piet Plessis and Setlagole.
Altitude	Altitude 1 100–1 400 m.
Vegetation and landscape features	Dense, well developed, tall (> 5 m) woodland with high canopy cover on deep sand.
Geology and soils	Aeolian Kalahari sand of Tertiary to Recent age on flat sandy plains, soils deep (> 1.2 m). Clovelly and Hutton soil forms. Land types Ah and Ai.
Important taxa	**Trees**: *Vachellia erioloba, Terminalia sericea, Ziziphus mucronata, Vachellia luederitzii, Dichrostachys cinerea, Grewia flava, Searsia tenuinervis, Diospyros austroafricana, Ehretia rigida, Rhigozum obovatum, Tarchonanthus camphoratus, Vachellia hebeclada, Grewia retinervis*. **Grasses**: *Anthephora pubescens, Cymbopogon pospischilii, Digitaria eriantha, Eragrostis lehmanniana, Eragrostis pallens, Eragrostis superba, Eragrostis trichophora, Schmidtia pappophoroides, Stipagrostis uniplumis, Aristida congesta, Aristida meridionalis, Aristida mollissima, Aristida stipitata, Brachiaria nigropedata, Digitaria argyrograpta, Melinis repens, Tragus koelerioides, Urochloa panicoides, Panicum kalaharense*. **Shrubs**: *Aptosimum elongatum, Felicia muricata, Lasiosiphon polycephalus, Helichrysum zeyheri, Pomaria burchellii, Lantana rugosa, Talinum arnotii, Elephantorrhiza burkei, Lycium cinereum, Asparagus africanus*. **Herbs**: *Barleria macrostegia, Erlangea misera, Harpagophytum procumbens, Hermannia tomentosa, Hermbstaedtia odorata, Indigofera daleoides, Limeum fenestratum, Nidorella microcephala, Oxygonum delagoense, Senna italica, Ledebouria marginata*.
Remarks	The absence of *Vachellia haematoxylon* (but present in Molopo Bushveld) is characteristic in this vegetation type. In the east near the Molopo River–Harts River interfluve this unit grades into Vryburg thornveld.
References	Smit (2000).

27. SVk 2 Stella Bushveld

Distribution	NW, North of Vryburg around Stella westwards to Louwna and eastwards to about 20 km west of Delareyville, with patches extending toward the Mafikeng area,
Altitude	Altitude 1 250–1 400 m.
Vegetation and landscape features	Flat to gently undulating deep sand-covered plains with open grassy savanna woodland dominated by very large *Searsia lancea* and (less so) *Vachellia erioloba* trees and *Tarchonanthus camphoratus* shrubs.

Geology and soils	Aeolian Kalahari sand with a calcrete layer at depth overlying a variety of geologies. Deep (> 0.4 m), red-yellow apedal, freely drained soils with high base status. Land types Ae and Ag.
Important taxa	**Trees**: *Searsia lancea, Vachellia erioloba, Tarchonanthus camphoratus, Senegalia caffra, Vachellia hebeclada, Vachellia karroo, Dichrostachys cinerea, Grewia flava, Diospyros lycioides, Ehretia rigida, Grewia flava*. **Grasses**: *Cenchrus ciliaris, Cymbopogon pospischilii, Eragrostis rigidior, Panicum coloratum, Themeda triandra, Aristida congesta, Cynodon dactylon, Eragrostis superba, Eragrostis obtusa, Pogonarthria squarrosa, Sporobolus fimbriatus, Tragus koelerioides*. **Shrubs**: *Asparagus laricinus*. **Herbs**: *Chrysocoma ciliata, Hertia pallens, Osteospermum muricatum, Pentzia viridis, Asparagus africanus, Babiana bainesii, Dicoma capensis, Hermannia quartiniana, Hibiscus pusillus, Indigofera alternans, Indigofera daleoides, Lippia scaberrima, Rhynchosia confusa, Schkuhria pinnata, Solanum supinum, Osteospermum scariosum*.
Remarks	This vegetation type represents the ecotone between the Highveld grasslands to the east and Kalahari bushveld to the west, hence on the margins of this vegetation unit it will grade into these neighbouring vegetation types. As the depth of sand decreases and the underlying calcrete becomes exposed then this unit grades into Western Highveld Sandy Grassland. Due to lack of fire, *Tarchonanthus camphoratus* tends to bush encroach leading to a closed bushveld structure. Flax-leaf fleabane (*Erigeron bonariensis*) is an alien invasive annual daisy species that is a major invader in this vegetation type leading to a loss of grassland. This is particularly a problem on commercial farms where veld fires are suppressed.
References	Smit (2000).

28. SVk 3 Schweizer-Reneke Bushveld

Distribution	NW, Schweizer-Reneke area in the east to Amalia in the west and from the farming areas of around Broedersput in the north to Never Mind (Christiana District) in the south.
Altitude	Altitude 1 250–1 400 m.
Vegetation and landscape features	Gently undulating, deep sand covered plains supporting open, tall camelthorn (*Vachellia erioloba*) woodland sometimes with a dense understory of smaller trees comprising *Vachellia karroo, Searsia lancea, Diospyros lycioides, Grewia flava* and *Tarchonanthus camphoratus*.
Geology and soils	Aeolian Kalahari sand. Deep (0.9–1.2 m) sandy soils, with Hutton and Clovelly the dominant soil forms. Land type Ah.
Important taxa	**Trees**: *Vachellia erioloba, Vachellia karroo, Searsia lancea, Diospyros lycioides, Grewia flava, Tarchonanthus camphoratus, Diospyros pallens, Ehretia rigida, Gymnosporia buxifolia, Searsia tridactyla*. **Grasses**: *Anthephora pubescens, Digitaria eriantha, Heteropogon contortus, Stipagrostis uniplumis, Themeda triandra, Aristida congesta, Aristida stipitata, Chloris virgata, Eragrostis biflora, Eragrostis rigidior, Eragrostis superba, Eragrostis trichophora, Sporobolus fimbriatus*. **Shrubs**: *Asparagus laricinus, Vachellia hebeclada*. **Herbs**: *Aptosimum elongatum, Chrysocoma ciliata, Lasiosiphon polycephalus, Pentzia viridis, Asparagus africanus, Barleria macrostegia, Hermannia tomentosa, Hibiscus pusillus, Indigofera daleoides, Lippia scaberrima, Osteospermum muricatum, Pollichia campestris, Rhynchosia adenodes, Dipcadi papillatum, Nerine krigei*.

Remarks	Very similar to Stella Bushveld but is distinguished by the dominance of very large camelthorn trees (not a feature of Stella Bushveld where *Searsia lancea* is dominant), deeper sand and absence of calcrete near the surface. Very few examples of this vegetation remain as almost the entire extent of this vegetation type has been lost to cultivation.
References	Smit (2000).

29. SVk 4 Kimberley Thornveld

Distribution	North West, Free State and Northern Cape provinces, Most of the Kimberley, Hartswater, Bloemhof and Hoopstad Districts, as well as substantial parts of the Warrenton, Christiana, Taung, Boshof and to some extent the Barkly West Districts. Also includes pediment areas in the Herbert and Jacobsdal Districts.
Altitude	Altitude 1 050–1 400 m.
Vegetation and landscape features	Gently undulating sand-covered plains. Grassy with irregular to well-developed, short tree layer comprising *Vachellia tortilis*, *Senegalia mellifera, Vachellia karroo, Vachellia erioloba* and *Boscia albitrunca*. Grass layer open with much uncovered soil.
Geology and soils	Gently undulating plains of aeolian Kalahari sand overlying Andesitic lavas (basalt). Shallow (0.3 m) sandy loams (15% clay) of the Hutton soil form on top of calcrete. Land type Ae.
Important taxa	**Trees**: *Vachellia tortilis, Vachellia hebeclada, Vachellia karroo, Senegalia mellifera, Searsia lancea, Vachellia erioloba, Tarchonanthus camphoratus, Searsia tridactyla, Ehretia rigida, Grewia flava*. **Grasses**: *Aristida congesta, Cymbopogon pospischilii, Digitaria eriantha, Enneapogon cenchroides, Enneapogon scoparius, Eragrostis lehmanniana, Eragrostis rigidior, Heteropogon contortus, Themeda triandra*. **Herbs**: *Aloe grandidentata, Barleria macrostegia, Lippia scaberrima*.
Remarks	This vegetation type and Western Highveld Sandy Grassland share the same land type and the latter grades into this vegetation type along the east-west aridity gradient. *Senegalia mellifera* and *Vachellia tortilis* are the primary bush encroaching species in this vegetation type.
References	Bezuidenhout (1994, 1995, 2009), Smit (2000).

30. SVk 6 Schmidtsdrif Thornveld

Distribution	Northern Cape, Free State and North West provinces, foot slopes and mid slopes to the southeast and below the Ghaap Plateau from around Douglas in the southwest via Schmidtsdrif towards Taung in the northeast. A small less typical section is found east of the Ghaap Plateau from Warrenton towards Hertzogville.
Altitude	Altitude 1 000–1 350 m.
Vegetation and landscape features	Alluvial terraces in the valley floor of the Harts River. Mostly a short or tall closed shrubby thornveld dominated by *Senegalia mellifera* and *Vachellia tortilis*.
Geology and soils	Red, clay rich (> 30%) alluvial soils with a diagnostic B horizon. Land type Dc.
Important taxa	**Trees**: *Vachellia tortilis, Senegalia mellifera, Ziziphus mucronata, Grewia flava*.

Important taxa (continued)	**Grasses**: *Aristida meridionalis, Enneapogon cenchroides, Eragrostis lehmanniana, Eragrostis obtusa, Enneapogon desvauxii*. **Herbs**: *Aptosimum albomarginatum, Barleria rigida, Justicia incana, Pentzia incana, Hermannia affinis, Hermannia comosa, Ptycholobium biflorum, Roepera pubescens, Lacomucinaea lineata, Lepidium bonariense, Amaranthus praetermissus, Heliotropium ciliatum, Indigastrum parviflorum, Osteospermum muricatum, Seddera capensis, Stachys hyssopoides*.
Remarks	Due to its very favourable agricultural soils much of this vegetation type has been lost to cultivation, as well as settlements.
References	Gubb (1980), Crowe et al. (1981), Bezuidenhout (1994, 2009), Smit (2000).

31. SVk 7 Ghaap Plateau Vaalbosveld

Distribution	Northern Cape and North West provinces, flat plateau from around Campbell in the south, east of Danielskuil through Reivilo to around Vryburg in the north.
Altitude	Altitude 1 100–1 500 m.
Vegetation and landscape features	Flat, rocky karst plateau mostly open grassland with well-developed shrub layer dominated by *Tarchonanthus camphoratus* and *Vachellia karroo*. Tall (> 5 m), dense bush clumps comprising *Vachellia karroo, Searsia lancea, Olea europaea* and *Ziziphus mucronata* occur on low, linear ridges (termed grikes or kluftkarren, see remarks below) that bisect the karst landscape and can run for many kilometres.
Geology and soils	Limestone pavement overlying dolomite with shallow, rocky soils (0.10–0.25 m) of Mispah and Hutton soil forms. Land type Fc.
Important taxa	**Trees**: *Tarchonanthus camphoratus, Searsia lancea, Vachellia karroo, Vachellia erioloba, Senegalia mellifera, Vachellia tortilis, Boscia albitrunca, Olea europaea, Rhigozum trichotomum, Ziziphus mucronata, Diospyros austroafricana, Diospyros pallens, Ehretia rigida, Euclea crispa, Grewia flava, Gymnosporia buxifolia, Lessertia frutescens, Searsia tridactyla, Vachellia hebeclada*. **Grasses**: *Themeda triandra, Anthephora pubescens, Cenchrus ciliaris, Digitaria eriantha, Enneapogon scoparius, Eragrostis lehmanniana, Schmidtia pappophoroides, Aristida congesta, Aristida diffusa, Cymbopogon pospischilii, Enneapogon cenchroides, Enneapogon desvauxii, Eragrostis echinochloidea, Eragrostis obtusa, Eragrostis rigidior, Eragrostis superba, Fingerhuthia africana, Heteropogon contortus, Sporobolus fimbriatus, Stipagrostis uniplumis, Tragus koelerioides*. **Shrubs**: *Aptosimum elongatum, Chrysocoma ciliata, Helichrysum zeyheri, Hermannia comosa, Lantana rugosa, Leonotis pentadentata, Melolobium lampolobum, Peliostomum junceum, Pentzia globosa, Pentzia viridis, Roepera pubescens, Hertia pallens, Lycium cinereum, Thesium hystrix, Asparagus africanus*. **Herbs**: *Barleria macrostegia, Geigeria filifolia, Geigeria ornativa, Gisekia africana, Helichrysum cerastioides, Heliotropium ciliatum, Hermbstaedtia odorata, Hibiscus marlothianus, Hibiscus pusillus, Jamesbrittenia aurantiaca, Limeum fenestratum, Lippia scaberrima, Selago densiflora, Vahlia capensis, Aloe grandidentata, Pentzia stellata*.
Remarks	The Ghaap Plateau is recognised as part of the Griqualand West Centre of Endemism. Important taxa include (GW = Griqualand West endemic, K = Kalahari endemic, D = Broadly disjunct distribution): *Calobota cuspidosa* GW, *Nuxia gracilis* D, *Blepharis marginata* GW, *Putterlickia saxatilis* GW, *Tarchonanthus obovatus* GW, *Euphorbia patula* GW, *Prepodesma orpenii* GW (endemic genus), *Digitaria polyphylla* GW, *Panicum kalaharense* K, *Corchorus pinnatipartitus* GW, *Helichrysum arenicola* K, *Orbea knobelii* K.

Remarks (continued)	Unlike the Malmani karst geology that is mostly covered by Tertiary deposits, both the Ghaap Plateau and the Morokweng karst landscapes can be described as exposed limestone pavements with a very characteristic karst geological weathering pattern immediately observable in aerial imagery. The weathering of these landscapes give rise to low (< 5 m high) linear ridges that run for many kilometres and at odd angles to one another. These are solution fissures that follow joins or faults in the underlying dolomite and the geological term for these ridges is grikes or kluftkarren. These kluftkarren are characteristically covered in woodland vegetation, and in communal areas settlement is often concentrated on these features to avoid occasional flooding. *Tarchonanthus camphoratus* is a woody encroaching species that can dominate the vegetation in parts of the landscape.
References	Smit (2000), Frisby (2016), Frisby et al. (2019).

32. SVk 8 Kuruman Vaalbosveld

Distribution	North West and Northern Cape provinces, east of Kuruman to Lykso, south of Bendell towards Good Hope.
Altitude	Altitude 1 300–1 500 m.
Vegetation and landscape features	Flat to gently undulating shallow sand-covered plains with open grassy savanna woodland characterised by *Vachellia erioloba, Vachellia karroo, Searsia lancea* and *Ziziphus mucronata*. Shrub layer is poorly developed, with *Grewia flava* and *Tarchonanthus camphoratus* and the grass layer is open, with much bare soil in places.
Geology and soils	Aeolian Kalahari sand overlying dolomites of the Ghaap Plateau. Calcrete layer is present. Soils are shallow (< 0.6 m), red sand with a high base status of the Hutton and Clovelly forms. Land types Ae and Ai.
Important taxa	**Trees**: *Searsia lancea, Vachellia erioloba, Vachellia karroo, Ziziphus mucronata, Tarchonanthus camphoratus, Cadaba aphylla, Diospyros austroafricana, Diospyros lycioides, Grewia flava, Gymnosporia buxifolia*. **Grasses**: *Anthephora pubescens, Aristida meridionalis, Anthephora argentea, Eragrostis lehmanniana, Stipagrostis uniplumis, Aristida stipitata, Cymbopogon caesius, Digitaria eriantha, Fingerhuthia africana, Pogonarthria squarrosa, Schmidtia pappophoroides, Themeda triandra, Tragus koelerioides*. **Shrubs**: *Amphiglossa triflora, Anthospermum rigidum, Helichrysum zeyheri, Elephantorrhiza burkei, Rhynchosia holosericea*. **Herbs**: *Acrotome inflata, Dicoma schinzii, Geigeria ornativa, Heliotropium strigosum, Stachys spathulata, Osteospermum scariosum*.
Remarks	Being a dolomite or karst landscape there are many sinkholes that have been filled-in with aeolian sand. These are called dolines. In the Malmani karst landscape (Carletonville Dolomite Grassland) dolines support Olea Sclerophyllous Forest. In this landscape dolines support conspicuous clumps of *Vachellia erioloba*. Kuruman Vaalbosveld is environmentally, structurally and floristically very similar to Stella Bushveld, and both are closely related to Ghaap Plateau Vaalbosveld. Aridity increases from east to west as one descends off the Ghaap Plateau. Kuruman Vaalbosveld is an arid form of Stella Bushveld, and both these vegetation types are distinguished from Ghaap Plateau Vaalbosveld by the presence of a continuous sand layer with no surface limestone (calcrete) or rockiness. Extensive exposures of calcrete, particularly associated with drainage lines and freshwater springs, belong to the Southern Kalahari Mekgacha vegetation type.
References	Smit (2000).

33. SVk 10 Kuruman Mountain Bushveld

Distribution	Northern Cape and North West provinces, from the Asbestos Mountains southwest and northwest of Griekwastad, along the Kuruman Hills north of Danielskuil, passing west of Kuruman town and re-emerging as isolated hills, i.e., Makhubung and the hills around Pomfret in the north. In the NW includes all mountains and hills west of the Harts River that fall in the Molopo River catchment.
Altitude	Altitude 1 100–1 800 m.
Vegetation and landscape features	Open to dense mixed woodland on rolling, rock hills and koppies with generally gentle to moderate slopes and includes the rocky pediment or apron at the base of hills. Grass layer is well developed.
Geology and soils	Various geologies including sandstone, banded ironstone and basalt (andesite). Soils mostly lithosols on upper slopes with deeper, sandy, rocky soils on lower slopes and pediments. Land types Ib and Fb towards the east.
Important taxa	**Trees**: *Searsia lancea, Senegalia mellifera, Dichrostachys cinerea, Diospyros austroafricana, Euclea crispa, Euclea undulata, Olea europaea, Searsia pyroides, Searsia tridactyla, Vachellia nilotica, Tarchonanthus camphoratus, Tephrosia longipes, Searsia ciliata, Boscia albitrunca*. **Shrubs**: *Amphiglossa triflora, Anthospermum rigidum, Gomphocarpus fruticosus, Helichrysum zeyheri, Lantana rugosa, Wahlenbergia nodosa, Ebracteola wilmaniae, Hertia pallens, Rhynchosia totta*. **Grasses**: *Andropogon chinensis, Andropogon schirensis, Anthephora pubescens, Aristida congesta, Digitaria eriantha, Themeda triandra, Triraphis andropogonoides, Aristida diffusa, Brachiaria nigropedata, Bulbostylis burchellii, Cymbopogon caesius, Diheteropogon amplectens, Elionurus muticus, Eragrostis chloromelas, Eragrostis nindensis, Eustachys paspaloides, Heteropogon contortus, Melinis repens, Schizachyrium sanguineum, Trichoneura grandiglumis*. **Herbs**: *Dicoma anomala, Dicoma schinzii, Geigeria ornativa, Helichrysum cerastioides, Heliotropium strigosum, Hibiscus marlothianus, Kohautia cynanchica, Cyphocarpa angustifolia, Boophone disticha, Pellaea calomelanos*. **Griqualand West endemics**: *Calobota cuspidosa, Justicia puberula, Tarchonanthus obovatus, Euphorbia patula, Digitaria polyphylla, Sutera griquensis, Euphorbia patula*.
Remarks	Many species in this unit are widely distributed to the northeast of the subcontinent and reach their southwestern limit in this unit (e.g., *Andropogon schirensis*). There are distinct floristic differences with the relatively nearby and parallel mountains of Koranna-Langeberg Mountain Bushveld. For example, *Croton gratissimus* is common in the Koranna-Langeberg Mountain Bushveld unit but rare in Kuruman Mountain Bushveld. *Calobota cuspidosa* shows just the reverse distributional pattern between these units. The Harts River is used here as the biogeographic and mapping divide between Andesite Mountain Bushveld (east) and Kuruman Mountain Bushveld (west) vegetation types. There are observable floristic changes in this vegetation unit associated with geology and the east–west rainfall gradient. Tree density decreases westwards with the western mountains being more open and dominated by thorn trees. Further floristic analysis is required to determine where the boundary of these two vegetation types is located. Bush encroachment is a major problem in this vegetation type. Both *Senegalia mellifera* and *Dichrostachys cinerea* can form vast impenetrable thickets such as around Pomfret and Heuningvlei.
References	Smit (2000), Van Wyk and Smith (2001).

34. SVk 11 Molopo Bushveld

Distribution	North West and Northern Cape provinces, in the Molopo area from Bray and Werda in the north on the border with Botswana, southwards through Morokweng and Tosca in the east and Vorstershoop to McCarthy's Rest and Eldorado in the west to Bendell in the south.
Altitude	1 000–1 300 m.

Vegetation and landscape features	Flat to gently undulating sandy plains with open Kalahari woodland to a closed shrubland interspersed with numerous small pans. Grass layer is usually very well developed and open.
Geology and soils	Red aeolian Kalahari sand overlying dorbank. Surface calcrete is not present. Soils are deep (> 1.2 m) and sandy (Hutton and Clovelly soil forms). Land type mainly Ah.
Important taxa	**Trees**: *Vachellia erioloba, Boscia albitrunca, Terminalia sericea, Vachellia luederitzii, Vachellia haematoxylon, Lycium hirsutum, Rhigozum trichotomum, Grewia flava, Lycium villosum, Searsia burchellii, Vachellia hebeclada*. **Grasses**: *Aristida meridionalis, Aristida stipitata, Cenchrus ciliaris, Eragrostis lehmanniana, Anthephora argentea, Megaloprotachne albescens, Panicum kalaharense, Aristida congesta, Eragrostis biflora, Eragrostis pallens, Eragrostis rigidior, Pogonarthria squarrosa, Schmidtia kalahariensis, Schmidtia pappophoroides, Stipagrostis ciliata, Stipagrostis uniplumis*. **Shrubs**: *Aptosimum albomarginatum, Aptosimum marlothii, Eriocephalus ericoides, Justicia divaricata, Justicia incana, Elephantorrhiza burkei, Momordica balsamina*. **Herbs**: *Acanthosicyos naudinianus, Acrotome angustifolia, Acrotome inflata, Dicoma schinzii, Geigeria ornativa, Helichrysum cerastioides, Hermannia tomentosa, Hermbstaedtia fleckii, Limeum arenicolum, Limeum fenestratum, Limeum argute-carinatum, Leobordea platycarpa, Senna italica, Sericorema remotiflora, Tephrosia purpurea, Tribulus terrestris*.
Remarks	An extensive unit with increasing diversity of savanna plant species towards the north and northeast. The abundance of small pans throughout this unit and the sparser woody element separate this unit from Mafikeng Bushveld.
References	Smit (2000).

35. SVk XX[*] Vryburg Thornveld

Distribution	NW, headwaters of the Molopo River catchment below the northern edge of the Ghaap Plateau, stretching in an arc from Ganyesa in the south to Mahikeng in the north. Also associated with the eroding flanks of larger west flowing rivers thus it is encountered as far west as Bray along the Molopo River.
Altitude	1 000–1 420 m (median 1 270 m).
Vegetation and landscape features	Open, tall woodland dominated by very tall *Vachellia erioloba* trees and scattered low *Vachellia hebeclada, Senegalia mellifera* and *Dichrostachys cinerea* thickets. *Terminalia sericea* is present but not characteristic or dominant of this vegetation type.
Geology and soils	Aeolian sand with red-yellow, free-draining, apedal soils with high base status (Clovelly and Hutton forms). Average depth 1.2 m. Average clay 8%. Land type Ah.
Important taxa	**Trees**: *Acacia erioloba* (d*), *A. hebeclada* (d), *A. karroo, A. mellifera* (d), *Terminalia sericea*. **Shrubs**: *Tarchonanthus camphoratus* (d), *Dichrostachys cinerea, Grewia flava, Ehretia rigida, Elephantorrhiza elephantina*. **Grasses**: *Anthephora pubescens* (d), *Aristida meridionalis* (d), *Eragrostis pallens* (d), *E. lehmanniana*(d), *Stipagrostis uniplumis* (d), *Cynodon dactylon, Aristida stipitata, Cymbopogon plurinodis, Digitaria eriantha, Eragrostis trichophora, Schmidtia pappophoroides*. **Forbs**: *Asparagus africanus, Chenopodium album, Erlangea misera, Felicia muricata, Gnidia polycephala, Hermannia tomentosa, Indigofera daleoides, Lantana rugosa, Senna italica, Verbesina encelioides*.

[2]Vegetation type number to be assigned by the National Vegetation Map Committee.

Remarks	The undulating and eroding character of this landscape with exposed dorbank and calcrete (along streams), as well as the presence of springs and hydromorphic grasslands is definitive of this vegetation type. Most of the broad-leaved woody elements and the dense woodland that characterise the neighbouring Mafikeng Bushveld are absent or much reduced here. Eroding slopes mostly expose dorbank hardpan. Only in drainage lines is calcrete encountered (viz. Southern Kalahari Mekgacha). The numerous springs in this landscape are decanting groundwater from the Ghaap Plateau. Consequently, rural settlement in this vegetation type is very high relative to surrounding Kalahari vegetation types.
References	Smit (2000), Bredenkamp and Brown (2003b).

36. SVk XX[3] Morokweng Thornveld

Distribution	NW, Kalahari region around the town of Morokweng.
Altitude	1 060–1 230 m (median 1 148 m).
Vegetation and landscape features	Mostly flat karst landscape with open to dense, low (1–2 m) thornveld with sparse grass layer dominated by herbs and karroid shrubs.
Geology and soils	Dolomite with shallow rocky sandy soils (Glenrosa or Mispah forms) with extensive surface calcrete/limestone present. Average depth < 0.3 m. Average clay 6%. Land type Fc.
Important taxa	**Trees**: *Senegalia mellifera* (d*), *Vachellia hebeclada* (d), *Boscia albitrunca* (d), *Grewia flava* (d), *Lycium cinereum, Vachellia erioloba*. **Grasses**: *Eragrostis lehmanniana* (d), *Tragus racemosus* (d), *Aristida congesta, Brachiaria marlothii, Enneapogon cenchroides, Enneapogon scoparius, Stipagrostis uniplumis*. **Shrubs and forbs**: *Acrotome inflata, Asparagus africanus, Felicia muricata, Geigeria ornativa, Hermannia modesta, Hermannia tomentosa, Hermbstaedtia odorata, Kyphocarpa angustifolia, Limeum viscosum, Melhania rehmannii, Phyllanthus maderaspatensis, Senna italica, Sericorema remotiflora, Tephrosia purpurea*.
Remarks	This is a new vegetation type that is restricted to the NW. Whilst the geology is similar to that of the Ghaap Plateau, the lower rainfall supports a short arid thornveld as opposed to a grassy open woodland encountered in the more mesic Ghaap Plateau Vaalbosveld. Soil biogenic crusts are very well developed in this vegetation type approaching 'elephant skin' structure/texture.
References	Smit (2000).

[3]Vegetation type number to be assigned by the National Vegetation Map Committee.

References

Acocks, J.P.H., 1953, 'Veld types of South Africa', *Memoirs of the Botanical Survey of South Africa* 28, 1–192.

Acocks, J.P.H., 1975, 'Veld types of South Africa', 2nd ed., *Memoirs of the Botanical Survey of South Africa* 40, 1–128.

Acocks, J.P.H., 1988, 'Veld types of South Africa', 3rd ed., *Memoirs of the Botanical Survey of South Africa* 57, 1–146.

Behr, C.M. & Bredenkamp, G.J., 1988, 'A phytosociological classification of the Witwatersrand National Botanic Garden', *South African Journal of Botany* 54, 525–533, https://doi.org/10.1016/S0254-6299(16)31248-0.

Ben-Shahar, R., 1988, 'Patterns of plant species associations on a Sour Bushveld nature reserve', *South African Journal of Botany* 54, 504–506, https://doi.org/10.1016/S0254-6299(16)31287-X.

Bezuidenhout, H., 1988, '*'n Plantekologiese studie van die Mooirivieropvanggebied, Transvaal*', MSc thesis, Potchefstroom University [University of the North West], South Africa.

Bezuidenhout, H., 1993, '*Syntaxonomy and synecology of western Transvaal grasslands*', PhD thesis, University of Pretoria, South Africa, http://hdl.handle.net/2263/82461.

Bezuidenhout, H., 1994, 'An ecological study of the major vegetation communities of the Vaalbos National Park, Northern Cape. 1. The Than-Droogeveld section', *Koedoe* 37, 19–42, https://doi.org/10.4102/koedoe.v37i2.335.

Bezuidenhout, H., 1995, 'An ecological study of the major vegetation communities of the Vaalbos National Park, Northern Cape. 2. The Graspan-Holpan section', *Koedoe* 38, 65–83, https://doi.org/10.4102/koedoe.v38i2.315.

Bezuidenhout, H., 2009, 'The classification, mapping and description of the vegetation of the Rooipoort Nature Reserve, Northern Cape, South Africa', *Koedoe* 51, 1–11, https://doi.org/10.4102/koedoe.v51i1.695.

Bezuidenhout, H. & Bredenkamp, G.J., 1990, 'A reconnaissance survey of the vegetation of the dolomitic region in the Potchefstroom–Ventersdorp–Randfontein area, South Africa', *Phytocoenologia* 18, 387–403, https://doi.org/10.1127/phyto/18/1990/387.

Bezuidenhout, H. & Bredenkamp, G.J., 1991a, 'The vegetation of the Bc land type in the western Transvaal grassland, South Africa', *Phytocoenologia* 19, 497–518, https://doi.org/10.1127/phyto/19/1991/497.

Bezuidenhout, H. & Bredenkamp, G.J., 1991b, 'Classification of the vegetation of the Ba land type in the Mooi River catchment area, Transvaal', *South African Journal of Science and Technology* 10, 85–92, https://doi.org/10.4102/satnt.v10i1.478.

Bezuidenhout, H., Bredenkamp, G.J. & Elsenbroek, J.H., 1988, 'The vegetation of the alkali granite and bordering quartzite in the Vredefort Dome north-west of Parys', *South African Journal of Science and Technology* 7, 4–9, https://doi.org/10.4102/satnt.v7i1.892.

Bezuidenhout, H., Bredenkamp, G.J. & Theron, G.K., 1993, 'The vegetation of the Bd and Ea land types in the grassland of the western Transvaal, South Africa', *South African Journal of Botany* 59, 319–331, https://doi.org/10.1016/S0254-6299(16)30735-9.

Bezuidenhout, H., Bredenkamp, G.J. & Theron, G.K., 1994a, 'A Braun-Blanquet reclassification of the Cymbopogon–Themeda grassland in the Lichtenburg area, south-western Transvaal', *South African Journal of Botany* 60, 306–314, https://doi.org/10.1016/S0254-6299(16)30584-1.

Bezuidenhout, H., Bredenkamp, G.J. & Theron, G.K., 1994b, 'A classification of the vegetation of the western Transvaal dolomite and chert grassland, South Africa', *South African Journal of Botany* 60, 152–161, http://dx.doi.org/10.1016/S0254-6299(16)30626-3.

Bezuidenhout, H., Bredenkamp, G.J. & Theron, G.K., 1994c, 'Phytosociological classes of the western Transvaal grassland, South Africa', *Koedoe* 37, 1–18, https://doi.org/10.4102/koedoe.v37i1.322.

Bezuidenhout, H., Bredenkamp, G.J. & Theron, G.K., 1994d, 'Syntaxonomy of the vegetation of the Fb land type in the western Transvaal grassland, South Africa', *South African Journal of Botany* 60, 72–81, https://doi.org/10.1016/S0254-6299(16)30663-9.

Bezuidenhout, H., Bredenkamp, G.J. & Theron, G.K., 1994e, 'The vegetation syntaxa of the Ba land type in the western Transvaal grassland, South Africa', *South African Journal of Botany* 60, 214–224, http://dx.doi.org/10.1016/S0254-6299(16)30616-0.

Bezuidenhout, H., Bredenkamp, G.J., Theron, G.K. & Morris, J.W., 1994f, 'A Braun-Blanquet reclassification of the Bankenveld Grassland in the Lichtenburg area, south-western Transvaal', *South African Journal of Botany* 60, 297–305, https://doi.org/10.1016/S0254-6299(16)30583-X.

Bosch, O.J.H., 1971, '*'n Ekologiese ondersoek van die plantegroei van 'n gedeelte van die laer Krokodilriviervallei noordwes van Thabazimbi, met besondere aandag aan die bodemkundige aspek*', MSc thesis, University of Potchefstroom, South Africa, http://hdl.handle.net/10394/39185.

Bredenkamp, G.J., 1975, 'Plant communities of the Suikerbosrand Nature Reserve, Transvaal', *South African Journal of Science* 71, 30–31, https://www.cabidigitallibrary.org/doi/full/10.5555/19750732068.

Bredenkamp, G.J., 1977, 'The grasses of the Suikerbosrand Nature Reserve, their habitat preferences and synecological significance', *Proceedings of the Grassland Society of Southern Africa,* 12, 135–139, https://doi.org/10.1080/00725560.1977.9648823.

Bredenkamp, G.J., 1999, '*A vegetation assessment of parts of the farm Syferfontein',* Report, Ekotrust, Pretoria.

Bredenkamp, G.J. & Bezuidenhout, H., 1990, 'The phytosociology of the Faan Meintjes Nature Reserve in the western Transvaal grassland', *South African Journal of Botany* 56, 54–64, https://doi.org/10.1016/S0254-6299(16)31111-5.

Bredenkamp, G.J., Bezuidenhout, H., Joubert, A.F. & Naude, C., 1994, 'The vegetation of the Boskop Dam Nature Reserve, Potchefstroom', *Koedoe* 37, 19–33. https://doi.org/10.4102/koedoe.v37i1.323.

Bredenkamp, G.J. & Brown, L.R., 2003a, 'A reappraisal of Acocks' Bankenveld, origin and diversity of vegetation types', *South African Journal of Botany* 69, 7–26, https://doi.org/10.1016/S0254-6299(15)30357-4.

Bredenkamp, G.J. & Brown, L.R., 2003b, 'Habitat Types of North-West Province', in '*North West Province Biodiversity Site Inventory and Database Development*', Technical Report, Strategic Environmental Focus (Pty) Ltd, Pretoria.

Bredenkamp, G.J., Joubert, A.F. & Bezuidenhout, H., 1989, 'A reconnaissance survey of the vegetation of the plains of the Potchefstroom–Fochville–Parys area', *South African Journal of Botany* 55, 199–206, https://doi.org/10.1016/S0254-6299(16)31208-X.

Bredenkamp, G.J. & Theron, G.K., 1976, 'Vegetation units for the management of the grasslands of the Suikerbosrand Nature Reserve', *South African Journal of Wildlife Research* 6, 113–122.

Bredenkamp, G.J. & Theron, G.K., 1978, 'A synecological account of the Suikerbos Nature Reserve. I. The phytosociology of the Witwatersrand geological system', *Bothalia* 12, 513-529, https://doi.org/10.4102/abc.v12i3.1810.

Bredenkamp, G.J. & Theron, G.K., 1980, 'A synecological account of the Suikerbosrand Nature Reserve. II. The phytosociology of the Ventersdorp geological system', *Bothalia* 13, 199–216, http://dx.doi.org/10.4102/abc.v13i1/2.1310.

Brown, L.R., 1997, '*A plant ecological study and wildlife management plan of the Borakalalo Nature Reserve, North-West Province*', PhD thesis, University of Pretoria, South Africa, http://hdl.handle.net/2263/82472.

Brown, L.R & Bredenkamp, G.J., 1994, 'The phytosociology of the southern section of Borakalalo Nature Reserve, South Africa', *Koedoe* 37, 59–72, https://doi.org/10.4102/koedoe.v37i2.337.

Brown, L.R. & Bredenkamp, G.J., 2004, 'The use of structural species size classes in the description of the woody vegetation of a nature reserve', *African Journal of Ecology* 42, 252–269, https://doi.org/10.1111/j.1365-2028.2004.00480.x.

Brown, L.R., Bredenkamp, G.J. & Van Rooyen, N., 1995, 'The phytosociology of the western section of Borakalalo Nature Reserve', *Koedoe* 38, 49–64, http://dx.doi.org/10.4102/koedoe.v38i2.314.

Brown, L.R., Bredenkamp, G.J. & Van Rooyen, N., 1996, 'The phytosociology of the northern section of the Borakalalo Nature Reserve', *Koedoe* 39, 9–24, https://doi.org/10.4102/koedoe.v39i1.279.

Brown, L.R., Bredenkamp, G.J. & Van Rooyen, N., 1997, 'Phytosociological synthesis of the vegetation of the Borakalalo Nature Reserve, North-West Province', *South African Journal of Botany* 63, 242–253, https://doi.org/10.1016/S0254-6299(15)30761-4.

Burgoyne, P.M., Bredenkamp, G.J. & Van Rooyen, N., 2000, 'Wetland vegetation in the North-eastern Sandy Highveld, Mpumalanga, South Africa', *Bothalia* 30, 187–200, http://dx.doi.org/10.4102/abc.v30i2.558.

Coetzee, B.J., 1972, ''*n Plantsosiologiese studie van die Jack Scott-natuurreservaat*', MSc thesis, University of Pretoria, South Africa.

Coetzee, B.J., 1974, 'A phytosociological classification of the vegetation of the Jack Scott Nature Reserve', *Bothalia* 11, 329–347, https://doi.org/10.4102/abc.v11i3.1792.

Coetzee, B.J., 1975, 'A phytosociological classification of the Rustenburg Nature Reserve', *Bothalia* 11, 561–580, https://doi.org/10.4102/abc.v11i4.1502.

Coetzee, B.J., Van der Meulen, F., Zwanziger, S., Gonsalves, P. & Weisser, P.J., 1976, 'A phytosociological classification of the Nylsvley Nature Reserve', *Bothalia* 12, 137–160, https://doi.org/10.4102/abc.v12i1.1388.

Coetzee, B.J., Van Wyk, P., Gertenbach, W.P.D., Hall-Martin, A. & Joubert, S.C.J., 1981, ''n Plantekologiese verkenning van die Waterberggebied in die noord-Transvaalse bosveld', *Koedoe* 24, 1–23, https://doi.org/10.4102/koedoe.v24i1.615.

Coetzee, B.J. & Werger, M.J.A., 1975, 'A west-east vegetation transect through Africa south of the Tropic of Capricorn', *Bothalia* 11, 539–560, http://dx.doi.org/10.4102/abc.v11i4.1501.

Coetzee, J.J., 1971, '*Die landboupotensiaal van die Noordwes-Transvaalse soetbosveld*', PhD thesis, University of Pretoria, South Africa.

Coetzee, J.P., 1993, '*Phytosociology of the Ba and Ib land types in the Pretoria–Witbank–Heidelberg area*', MSc thesis, University of Pretoria, South Africa, http://hdl.handle.net/2263/83203.

Coetzee, J.P., Bredenkamp, G.J. & Van Rooyen, N., 1993, 'The Sub-humid Warm Temperate Mountain Bushveld plant communities of the Pretoria–Witbank–Heidelberg area', *South African Journal of Botany* 59, 623–632, https://doi.org/10.1016/S0254-6299(16)30679-2.

Coetzee, J.P., Bredenkamp, G.J. & Van Rooyen, N., 1995, 'Plant communities of the Sub-humid Cool Temperate Mountain Bushveld in the Pretoria–Witbank–Heidelberg area, South Africa', *South African Journal of Botany* 61, 114–122, https://doi.org/10.1016/S0254-6299(15)30497-X.

Coetzee, J.P., Bredenkamp, G.J., Van Rooyen, N. & Theron, G.K., 1994, 'An overview of the physical environment and vegetation units of the Ba and Ib land types of the Pretoria–Witbank–Heidelberg area', *South African Journal of Botany* 60, 49–61, https://doi.org/10.1016/S0254-6299(16)30660-3.

Cooper, K.H., 1985, '*The conservation status of indigenous forests in Transvaal, Natal and O.F.S., South Africa*', Report, Wildlife Society of Southern Africa, Durban.

Crowe, T.M., Schijf, J.C. & Gubb, A.A., 1981, 'Effects of rainfall variation, fire, vegetation and habitat physiognomy on a northern Cape animal community', *South African Journal of Wildlife Research* 11, 87–104, https://journals.co.za/doi/pdf/10.10520/AJA03794369_2600.

Daemane, M.E., Cilliers, S.S. & Bezuidenhout, H., 2010, 'An ecological study of the plant communities in the proposed Highveld National Park, in the peri-urban area of Potchefstroom, South Africa', *Koedoe* 52, 1–8, https://koedoe.co.za/index.php/koedoe/article/view/708/1134.

Daemane, M.E., Cilliers, S.S. & Bezuidenhout, H., 2012, 'Classification and description of the vegetation in the Spitskop area in the proposed Highveld National Park, North West Province, South Africa', *Koedoe* 54, 1–7, http://dx.doi.org/10.4102/koedoe.v54i1.1020.

Dörgeloh, W.G., 1998, 'A comparison of tree density and canopy cover between different plant communities in Mixed Bushveld, Northern Province', *South African Journal of Botany* 64, 86–87. https://doi.org/10.1016/S0254-6299(15)30830-9.

Dörgeloh, W.G., 1999a, 'Assessment of veld conditions with multivariate techniques in mixed bushveld, South Africa', *African Journal of Ecology* 37, 194–201, http://dx.doi.org/10.1046/j.1365-2028.1999.00168.x.

Dörgeloh, W.G., 1999b, 'Diversity of the herbaceous layer in mixed bushveld', *Journal of Range Management* 52, 519–524, https://journals.uair.arizona.edu/index.php/jrm/article/viewFile/9451/9063.

Du Preez, P.J., 1986, '*Ekologie van die boomgemeenskappe van die Vredefort Distrik, Oranje-Vrystaat*', MSc thesis, University of the Orange Free State, South Africa.

Du Preez, P.J., 1991, '*A syntaxonomical and synecological study of the vegetation of the south-eastern Orange Free State and related areas with special reference to Koranberg*', PhD thesis, University of the Orange Free State, South Africa.

Du Preez, P.J. & Bredenkamp, G.J., 1991, 'Vegetation classes of the southern and eastern Orange Free State (Republic of South Africa) and the highlands of Lesotho', *Navorsinge van die Nasionale Museum* 7, 477–526, https://journals.co.za/doi/pdf/10.10520/AJA00679208_2204.

Du Preez, P.J. & Venter, H.J.T., 1990a, 'The phytosociology of the woody vegetation in the southern part of the Vredefort Dome Area. Part I, Communities of the plains, riverbanks and islands', *South African Journal of Botany* 56, 631–636, https://doi.org/10.1016/S0254-6299(16)30998-X.

Du Preez, P.J. & Venter, H.J.T., 1990b, 'The phytosociology of the woody vegetation in the southern part of the Vredefort Dome Area. Part II, Communities of the hills', *South African Journal of Botany* 56, 637–644, http://dx.doi.org/10.1016/S0254-6299(16)30999-1.

Eckhardt, H.C., Van Rooyen, N. & Bredenkamp, G.J., 1993, 'An overview of the vegetation of the Vrede–Memel–Warden area, north-eastern Orange Free State', *South African Journal of Botany* 59, 391–400, https://doi.org/10.1016/S0254-6299(16)30712-8.

Eckhardt, H.C., Van Rooyen, N. & Bredenkamp, G.J., 1997, 'Plant communities of the forests, woodlands and thickets in northern KwaZulu-Natal', *Koedoe* 40, 91–112, https://doi.org/10.4102/koedoe.v40i1.266.

Ellery, W.N., Balkwill, K., Ellery, K. & Reddy, R.A., 2001, 'Conservation of the vegetation on the Melville Ridge, Johannesburg', *South African Journal of Botany* 67, 261–273, https://doi.org/10.1016/S0254-6299(15)31128-5.

Everard, D.A., 1986, 'The effects of fire on the *Podocarpus latifolius* forests of the Royal Natal National Park, Natal Drakensberg', *South African Journal of Botany* 52, 60–66, https://doi.org/10.1016/S0254-6299(16)31603-9.

Frisby, A.W., 2016, '*Redefining the Griqualand West Centre of Endemism'*, MSc thesis, North-West University, South Africa, https://repository.nwu.ac.za/bitstream/handle/10394/18035/Frisby_AW_2016.pdf?sequence=1.

Frisby, A.W., Siebert, S.J., Struwig, M. & Cilliers, D.P., 2019, 'Plant endemism in Griqualand West, South Africa', *South African Journal of Botany* 124, 127–137, https://doi.org/10.1016/j.sajb.2019.03.041.

Fuls, E.R., Bredenkamp, G.J. & Van Rooyen, N., 1992, 'The plant communities of the undulating grasslands of the Vredefort–Kroonstad–Lindley–Heilbron area, northern Orange Free State', *South African Journal of Botany* 58, 224–230, https://doi.org/10.1016/S0254-6299(16)30838-9.

Fuls, E.R., Bredenkamp, G.J. & Van Rooyen, N., 1993, 'Grassland communities of rocky outcrops in the northern Orange Free State', *South African Journal of Botany* 59, 370–376, https://doi.org/10.1016/S0254-6299(16)30709-8.

Galpin, E.E., 1926, 'Botanical survey of the Springbok Flats', *Memoirs of the Botanical Survey of South Africa* 12, 1–100.

Geldenhuys, C.J. & Mucina, L., 2006, 'Towards a new forest classification for South Africa', in, S.A. Ghazanfar, S. & H.J. Beentje (eds), '*Taxonomy and ecology of African plants, their conservation and sustainable use*', Royal Botanic Gardens, Kew, pp. 111–129, http://hdl.handle.net/20.500.11937/17059.

Grobler, C.H., 2000, '*The vegetation ecology of urban open spaces in Gauteng*', MSc thesis, University of Pretoria, South Africa, http://hdl.handle.net/2263/28873.

Grobler, C.H., Bredenkamp, G.J. & Brown, L.R., 2002, 'Natural woodland vegetation and plant species richness of the urban open spaces in Gauteng, South Africa', *Koedoe* 45, 19–34, http://dx.doi.org/10.4102/koedoe.v45i1.13.

Grobler, C.H., Bredenkamp G.J. & Brown L.R., 2006, 'Primary grassland communities of urban open spaces in Gauteng, South Africa', *South African Journal of Botany* 72, 367–377, https://doi.org/10.1016/j.sajb.2005.10.008.

Grunow, J.O., 1965, 'Objective classification of plant communities, a synecological study in the sourish mixed bushveld of Transvaal', *Journal of Ecology* 55, 691–710.

Gubb, A.A., 1980, '*Vegetation map of the Northern Cape Province*', Report, McGregor Museum, Kimberley.

Hartmann, H.E.K., 2001, 'The genus *Delosperma* in Gauteng. I. A new species in the white-flowered group, *Delosperma gautengense* H.E.K.Hartmann', *Aloe* 38, 4–8, https://www.cabidigitallibrary.org/doi/full/10.5555/20013106956.

Herbst, M.J., 1973, '*'n Ekologiese ondersoek van die plantgemeenskappe tussen die Krokodil- en die Matlabasrivier, met spesiale aandag aan die invloed van edafiese faktore op die verspreiding van houtagtige spesies*', MSc thesis, University of Potchefstroom, South Africa, https://repository.nwu.ac.za/bitstream/handle/10394/39627/Herbst_Matthys%20Jacobus.pdf?sequence=1.

Hill, T.R., 1996, 'Description, classification and ordination of the dominant vegetation communities, Cathedral Peak, KwaZulu-Natal Drakensberg', *South African Journal of Botany* 62, 263–269, https://doi.org/10.1016/S0254-6299(15)30655-4.

Hudak, A.T. & Wessman, C.A., 2001, 'Textural analysis of high resolution imagery to quantify bush encroachment in Madikwe Game Reserve, South Africa, 1955–1996', *International Journal of Remote Sensing* 22, 2731–2740, http://dx.doi.org/10.1080/01431160152518660.

Killick, D.J.B., 1963, 'An account of the plant ecology of the Cathedral Peak Area of the Natal Drakensberg', *Memoirs of the Botanical Survey of South Africa* 34, 1–178.

Kooij, M.S., 1990, '*A phytosociological survey of the north-western Orange Free State*', MSc thesis, University of Pretoria, South Africa, http://hdl.handle.net/2263/83249.

Kooij, M.S., Bredenkamp, G.J. & Theron, G.K., 1990, 'Classification of the vegetation of the B land type in the north-western Orange Free State', *South African Journal of Botany* 56, 309–318, https://doi.org/10.1016/S0254-6299(16)31058-4.

Kooij, M.S., Scheepers, J.C., Bredenkamp, G.J. & Theron, G.K., 1992, 'The vegetation of the Kroonstad area, a description of the grassland communities', *South African Journal of Botany* 58, 155–164, https://doi.org/10.1016/S0254-6299(16)30861-4.

Lamprecht, A.J.H., 2010, '*A vegetation study on the area leased for mining purposes by Impala Platinum Rustenburg South Africa*', MSc thesis, North-West University, South Africa, https://repository.nwu.ac.za/handle/10394/4604.

Lamprecht, A.J.H., Cilliers, S.S., Götze, A.R. & Du Toit, M.J., 2011, 'Phytosociological description of norite koppies in the Rustenburg area, North-West Province and refinement of the distribution of the Norite Koppies Bushveld on the national vegetation classification map of South Africa', *Bothalia* 41, 327–339, https://doi.org/10.4102/abc.v41i2.76.

Louw, W.J., 1951, 'An ecological account of the vegetation of the Potchefstroom area', *Memoirs of the Botanical Survey of South Africa* 24, 1–105.

Lubke, R.A., Morris, J.W., Theron, G.K. & Van Rooyen, N., 1983, 'Diversity, structure and pattern in Nylsvley vegetation', *South African Journal of Botany* 2, 26–41, https://doi.org/10.1016/S0022-4618(16)30142-5.

Lubke, R.A. & Thatcher, F.M., 1983, 'Short term changes in the woody vegetation of Nylsvley', *South African Journal of Botany* 2, 85–97, https://doi.org/10.1016/S0022-4618(16)30122-X.

Malan, P.W. & Van Niekerk, S., 2005, 'The extent of grass species composition in Braklaagte, Zeerust District, North-West Province, South Africa', *African Journal of Range and Forage Science* 22, 177–184, https://www.ajol.info/index.php/ajrfs/article/view/315.

Morris, J.W., 1973, '*Automatic classification and ecological profiles of southwestern Transvaal Highveld grassland*', PhD thesis, University of Natal, South Africa, http://hdl.handle.net/10413/13106.

Morris, J.W., 1976, 'Automatic classification of the highveld grassland of Lichtenburg, south-eastern Transvaal', *Bothalia* 12, 267–292, https://doi.org/10.4102/abc.v12i2.1419.

Morris, P.P.J., 1972, '*'n Ekologiese ondersoek van die samestelling en struktuur van verteenwoordigende plantgemeenskappe van die Soet-Bosveld, met spesiale aandag aan die invloed van edafiese faktore op die verspreiding van houtagtige spesies'*, MSc thesis, University of Potchefstroom, South Africa, http://hdl.handle.net/10394/39628.

Panagos, M.D., 1996, '*The plant communities of the Onderstepoort Nature Reserve*', Report, ARC Onderstepoort Veterinary Research Institute, Pretoria.

Panagos, M.D., Westfall, R.H., Van Staden, J.M. & Zacharias, P.J.K., 1998, 'The plant communities of the Roodeplaat Experimental Farm, Gauteng, South Africa and the importance of classification verification', *South African Journal of Botany* 64, 44–61, https://doi.org/10.1016/S0254-6299(15)30826-7.

Pauw, J.C., 1988, '*Riglyne vir die bestuur van die natuurlewe in die bosveld gemeenskappe van die Atherstone-natuurreservaat in die noordwes-Transvaal*', MSc thesis, University of Pretoria, South Africa, http://hdl.handle.net/2263/50471.

Peel, M.J.S., 1990, '*Determinants of veld composition on a number of ranches in the north-west Transvaal*', MSc thesis, University of Pretoria, South Africa.

Peel, M.J.S., Grossman, D. & Van Rooyen, N., 1991, 'Determinants of herbaceous plant species composition on a number of ranches in the north-western Transvaal', *Journal of the Grassland Society of Southern Africa* 8, 99–102, https://doi.org/10.1080/02566702.1991.9648272.

Pfab, M., 2002, 'The quartzite ridges of Gauteng', *Veld & Flora* 88, 56–59, https://journals.co.za/doi/pdf/10.10520/AJA00423203_2941.

Reddy, R.A., Balkwill, K. & McLellan, T., 2001, 'Is there a unique serpentine flora on the Witwatersrand?', *South African Journal of Science* 97, 485–495, https://hdl.handle.net/10520/EJC97261.

Reddy, R.A., Balkwill, K. & McLellan, T., 2012, 'Are plant taxa found on the Witwatersrand serpentine ecotypes or substrate-generalists?', *South African Journal of Botany* 80, 81–95, https://doi.org/10.1016/j.sajb.2012.03.002.

Roberts, B.R., 1961, 'Preliminary notes on the vegetation of Thaba 'Nchu', *Journal of South African Botany* 27, 241–251, https://www.cabidigitallibrary.org/doi/full/10.5555/19620701017.

Rutherford, M.C., 1993, 'Empiricism and the prediction of primary production at the mesoscale, a savanna example', *Ecological Modelling* 67, 129–146, https://doi.org/10.1016/0304-3800(93)90002-A.

Scholes, R.J. & Walker, B.H., 1993, *An African savanna, synthesis of the Nylsvley study*, Cambridge University Press, Cambridge, UK.

Scogings, P.F. & Theron, G.K., 1990, 'An application of multivariate techniques to dry-weight-rank data from a Bankenveld nature reserve', *South African Journal of Botany* 56, 648–653, https://doi.org/10.1016/S0254-6299(16)31001-8.

Siebert, F. & Siebert, S.J., 2005, 'Dolomitic vegetation of the Sterkfontein Caves World Heritage Site and its importance in the conservation of Rocky Highveld Grassland', *Koedoe* 48, 17–31, https://doi.org/10.4102/koedoe.v48i1.163.

Siebert, S.J., 2001, '*Vegetation on the ultramafic soils of the Sekhukhuneland Centre of Endemism*', PhD thesis, University of Pretoria, South Africa, http://hdl.handle.net/2263/29756.

Smit, C.M., Bredenkamp, G.J. & Van Rooyen, N., 1993, 'Woodland plant communities of the Fa land type in the Newcastle–Memel–Chelmsford Dam area', *South African Journal of Botany* 59, 14–20, https://doi.org/10.1016/S0254-6299(16)30769-4.

Smit, C.M., Bredenkamp, G.J., Van Rooyen, N., Van Wyk, A.E. & Combrinck, J.M., 1997, 'Vegetation of the Witbank Nature Reserve and its importance for conservation of threatened Rocky Highveld Grassland', *Koedoe* 40, 85–104, https://doi.org/10.4102/koedoe.v40i2.275.

Smit, J.H.L., 2000, '*Phytosociology and veld management of the eastern Kalahari thornveld*', MSc thesis, University of Pretoria, South Africa, http://hdl.handle.net/2263/27293.

Stalmans, M. & De Wet, F., 2003, '*Soils and vegetation of the Madikwe and Pilanesberg expansion areas in the Heritage Park, North West Province*', Report, International Conservation Services and EnviroPulse, August 2003.

Van der Meulen, F., 1978, 'Progress with vegetation studies in the Sourish Mixed Bushveld of the western Transvaal', *Bothalia* 12, 531–536, https://doi.org/10.4102/abc.v12i3.1811.

Van der Meulen, F., 1979, '*Plant sociology of the western Transvaal Bushveld, South Africa, a syntaxonomic and synecological study*', PhD thesis, Katholieke Universiteit van Nijmegen, Netherlands, https://repository.ubn.ru.nl/bitstream/2066/148754/1/mmubn000001_025240471.pdf.

Van der Meulen, F. & Westfall RH., 1979, 'A vegetation map of the western Transvaal Bushveld', *Bothalia* 12, 731–735, https://doi.org/10.4102/abc.v12i4.1445.

Van der Meulen, F. & Westfall, R.H., 1980, 'Structural analysis of Bushveld vegetation in Transvaal, South Africa', *Journal of Biogeography* 7, 337–348, https://doi.org/10.2307/2844654.

Van Rooyen, N., 1983, 'Die plantegroei van die Roodeplaatdam-natuurreservaat. II. Die plantgemeenskappe', *South African Journal of Botany* 2, 115–125, https://doi.org/10.1016/S0022-4618(16)30125-5.

Van Rooyen, N., 1984, '*'n Fenologiese studie van die plantegroei van die Roodeplaatdam-natuurreservaat*', PhD thesis, University of Pretoria, South Africa, https://repository.up.ac.za/handle/2263/85462.

Van Staden, P.J. 2002, '*An ecological study of the plant communities of Marakele National Park*', MSc thesis, University of Pretoria, South Africa, http://hdl.handle.net/2263/30592.

Van Staden, P.J. & Bredenkamp, G.J., 2005, 'Major plant communities of the Marakele National Park', *Koedoe* 48, 59–70, https://doi.org/10.4102/koedoe.v48i2.101.

Van Staden, P.J. & Bredenkamp, G.J., 2006, 'A floristic analysis of forest and thicket vegetation of the Marakele National Park', *Koedoe* 49, 15–32, https://doi.org/10.4102/koedoe.v49i1.109.

Van Staden, P.J., Bredenkamp, G.J., Bezuidenhout, H. & Brown, L.R., 2021, 'A reclassification and description of the Waterberg Mountain vegetation of the Marakele National Park, Limpopo province, South Africa', *Koedoe* 63, a1689, https://doi.org/10.4102/koedoe.v63i1.1689.

Van Vuuren, D.R.J., 1961, ''*n Ekologiese studie van 'n noordelike en suidelike kloof van die Magaliesberge*', MSc thesis, University of Pretoria, South Africa.

Van Vuuren, D.R.J. & Van der Schijff, H.P., 1970, ''n Vergelykende ekologiese studie van die plantegroei van 'n noordelike en suidelike kloof van die Magaliesberg', *Tydskrif vir Natuurwetenskap* 10, 16–75.

Van Wyk, A.E. & Smith, G.F., 2001, *Regions of floristic endemism in southern Africa, a review with emphasis on succulents*, Umdaus Press, Pretoria.

Van Wyk, J.J.P., 1959, ''*n Sistematies-ekologiese studie van die plantegroei van die plaas Koedoesfontein no. 746 en omgewing in die Rustenburgse distrik*', MSc thesis, University of Potchefstroom, South Africa.

Van Wyk, S., 1983, '*A plant ecological study of the Abe Bailey Nature Reserve*', MSc thesis, University of Potchefstroom, South Africa.

Van Wyk, S. & Bredenkamp, G.J., 1986, 'A Braun-Blanquet classification of the vegetation of the Abe Bailey Reserve', *South African Journal of Botany* 52, 321–331, https://doi.org/10.1016/S0254-6299(16)31528-9.

Van Zinderen Bakker Jr., E.M., 1971, '*Ecological investigations on ravine forests of the Eastern Orange Free State (South Africa)*', MSc thesis, University of the Orange Free State, South Africa.

Van Zinderen Bakker Jr., E.M., 1973, 'Ecological investigations of forest communities in the eastern Orange Free State and the adjacent Natal Drakensberg', *Vegetatio* 28, 299–334, https://www.jstor.org/stable/20036782.

Van Zyl, J.H.M., 1965, 'The vegetation of the S.A. Lombard Nature Reserve and its utilisation by certain antelope', *Zoologica Africana* 1, 55–71, https://doi.org/10.1080/00445096.1965.11447299.

Veldsman, S., 2021, '*Vegetation monitoring report for the Abe Bailey Nature Reserve*', Report, Gauteng Department of Rural Development Directorate of Biodiversity Management, Johannesburg.

Viljoen, F., Bullock, K., Panagos, M. & Myburgh, W., 2014, 'Topographical units and soil types prove more efficient for vegetation sample site placement than Land Type units in semi-arid savanna, North West Province, South Africa', *African Journal of Range and Forage Science* 31, 1–6, http://dx.doi.org/10.2989/10220119.2013.848237.

Von Maltitz, G., Mucina, L., Geldenhuys, C.J., Lawes, M., Eeley, H., Adie, H., Vink, D., Fleming, G. & Bailey, C., 2003, '*Classification system for South African indigenous forests, an objective classification for the Department of Water Affairs and Forestry*', Report ENV-P-C 2003-017, Environmentek, CSIR, Pretoria, https://www.dffe.gov.za/sites/default/files/Pdf-Files/guidelines-and-policies/classificationsystem_southafricanindigenousforests.pdf.

Westfall, R.H., 1981, '*The plant ecology of the farm Groothoek, Thabazimbi District*', MSc thesis, University of Pretoria, South Africa, https://repository.up.ac.za/handle/2263/85479.

Westfall, R.H., Van Rooyen, N. & Theron, G.K., 1983, 'The plant ecology of the farm Groothoek, Thabazimbi District. I. Ordination', *Bothalia* 14, 785–790, https://doi.org/10.4102/abc.v14i3/4.1242.

Westfall, R.H., Van Rooyen, N. & Theron, G.K., 1984, 'The plant ecology of the farm Groothoek, Thabazimbi District. II. Classification', *Bothalia* 15, 655–688, https://doi.org/10.4102/abc.v15i3/4.1833.

Winterbach, R., 1998, '*A phytosociological synthesis of* Acacia tortilis *communities in the north-western savanna of South Africa*', MSc thesis, University of Pretoria, South Africa, http://hdl.handle.net/2263/83194.

Winterbach, R., Bredenkamp, G.J., Deutschländer, M.S. & Mucina, L., 2000, 'Preliminary syntaxonomic scheme of vegetation classes for the Central Bushveld of South Africa', In, White, P.S., Mucina, L., Lepš, J.S. & Van der Maarel, E. (eds.), *Proceedings of 41st I.A.V.S. Symposium*, Uppsala, pp. 123–127, http://hdl.handle.net/20.500.11937/8283.

Zacharias, P.J.K., 1994, '*The vegetation of Madikwe—a first approximation*', Report, Bophuthatswana Parks Board, Rustenburg.