

Vegetation Map of South Africa, Lesotho and Swaziland 2009 and 2012: A description of changes from 2006



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Dates:

Received: 09 Feb. 2017
Accepted: 01 May 2017
Published: 29 June 2017

How to cite this article:

Dayaram, A., Powrie, L., Rebelo, T. & Skowno, A., 2017, 'Vegetation Map of South Africa, Lesotho and Swaziland 2009 and 2012: A description of changes from 2006', *Bothalia* 47(1), a2223. <https://doi.org/10.4102/abc.v47i1.2223>

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Background: The variety of applications in which the Vegetation Map of South Africa, Lesotho and Swaziland (VEGMAP) is used requires the map to be continually updated and refined to reflect the latest available information. The VEGMAP has been updated twice, in 2009 and 2012, since its first release in 2006.

Objectives: The first objective is to report on the motivations for changes in the 2009 and 2012 versions. The second objective is to describe new vegetation types and subtypes included in these versions.

Method: Changes to the VEGMAP are implemented after a peer-review process that is managed by the National Vegetation Map Committee. Accepted changes are then incorporated into the VEGMAP using GIS software.

Results: Seventy-one of the 449 vegetation types were affected by updates. Changes included the addition of new vegetation types and subtypes, modifications to the boundaries of types present in the 2006 VEGMAP and changes to the names of vegetation types.

Conclusion: The updates have affected a small portion of the map but have reflected a progressive refinement in quality. Regions that are still mapped at a coarse scale, especially those earmarked for land-use development, should be prioritised for improved map accuracy and classification through a more proactive approach towards vegetation mapping, using guidelines that are under development.

Introduction

The National Vegetation Map of South Africa, Lesotho and Swaziland (VEGMAP) (ed. Mucina & Rutherford 2006) is a geographical classification of groups of plant communities across South Africa. The project was a collaboration between vegetation experts in the early 2000s under the custodianship of the South African National Biodiversity Institute (SANBI). Uses for the VEGMAP are widespread and cross-sectorial. Therefore, SANBI has a responsibility to ensure that the map reflects the most up-to-date knowledge available. Similar to early versions of vegetation maps in other parts of the world (Barbour, Todd Keeler-Wolf & Schoenherr 2007), the first version of the VEGMAP was based on the best available data at the time and implemented through a largely top-down approach as vast regions of the country had been poorly sampled. While some areas of the map were developed from existing fine scale maps and floristic data (~6% of the map), much of the vegetation map was inferred from environmental predictors of floristic biogeography such as geology (~8%), climate (~5%), topography (~0.1%), bioresource units (~5%), land types (~42%) and satellite imagery (~7%) (Mucina, Rutherford & Powrie 2006). Consequently, the VEGMAP is effective in representing natural vegetation communities at the national scale, but the top-down classification is less effective at the local scale (Barbour et al. 2007; Greenberg et al. 2006). There is thus a process through which the National Vegetation Map can be updated to improve its mapping accuracy in large parts of the country.

The 2009 and 2012 updates of the VEGMAP drew on suggestions and queries submitted by botanists and ecologists working at SANBI and various partner organisations. These versions were made available on the Biodiversity GIS (BGIS) website (www.bgis.org.za) since 2009, where full descriptions of each new vegetation type were recently (2016) added as downloadable portable documents (pdf). However, the justifications for re-classification of vegetation types and additions of new types have not been formally published. This paper highlights areas edited in the 2009 and the 2012 updates. We justify these changes and provide summary descriptions of the new vegetation types and subtypes.

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Methods

Data requirements for changes to the Vegetation Map of South Africa, Lesotho and Swaziland

Proposed changes require review and validation before they can be accepted. Therefore, a National Vegetation Map Committee (NVMC) was formed in 2007. Similar to other international classification committees, such as the vegetation subcommittee of the American Federal Geographic Data Committee (FGDC 2008) and the Canadian National Vegetation Classification Technical Committee, the NVMC provides technical direction for the VEGMAP project and ratifies proposed changes where sufficient justification has been submitted. The minimum information required for a proposed change will depend on the nature of the change. Minor changes include changes to the boundaries of existing vegetation types and updates to the descriptions. Major changes include the proposal of new vegetation types or merging of existing types. The minimum information required for a change to be accepted includes: (1) a digital map of proposed boundaries; (2) detailed justification for the various changes (often with satellite imagery, aerial photographs or orthophotographs); (3) for new vegetation types and subtypes the justification must include a broad description of the landscape, vegetation structure, associated geology, soils, landscape features and climate, lists of dominant and diagnostic species, conservation status and (optionally) threats; and (4) a georeferenced colour photograph with a caption. Major changes must be accompanied by a peer reviewed publication or report.

Results

Summary of changes to the Vegetation Map of South Africa, Lesotho and Swaziland

The sources of changes implemented in the updates include vegetation mapping for fine scale planning (Helme 2007a, 2007b, 2007c; Helme & Koopman 2007; Van der Merwe et al. 2008a, 2008b; Vlok, Cowling & Wolf 2005), provincial planning (Scott-Shaw & Escott 2011) and field work conducted by members of the NVMC. Accepted changes to the VEGMAP have included alterations to the boundaries of vegetation types classified in 2006: changes to the spelling of vegetation type names (4), the addition of new vegetation types (11) and the addition of subtypes of existing vegetation types (9). The reasons for changes ranged from ground truthed (direct observation of vegetation patterns in the field) evidence to evidence based on re-analysis using updated satellite imagery (Table 1).

Ground-truthing was the most common form of evidence (90% of the affected vegetation types) used to justify changes, often supplemented by information on floristic, geomorphological, structural or geological distinctness. Minor changes in 2012 included changing the names of four vegetation types to remove the circumflex (^) from the region name '*Rûens*'. This was aimed at eliminating errors in computer syntax.

The boundaries of 43 vegetation types were edited in the 2009 version and four in the 2012 version. New vegetation types were added mainly in KwaZulu-Natal, Mpumalanga and the Western Cape provinces (Figure 1). Six new vegetation types and nine subtypes (mainly in the Western and Northern Cape provinces) were added in 2009, and six types were added in 2012. Four of the new vegetation types (SKk9, SVI25, SVI26 and SVI27) were described in the Succulent Karoo biome, with two each from the Fynbos (FFs32, FFh11) and Grassland (Gs19, Gs20) biomes, and one from the Indian Ocean Coastal Belt (CB6). One vegetation type (FFa5 Olifants Alluvium Fynbos) was added in 2009 from fine scale planning, but it was removed in 2012 as supporting evidence was insufficient to justify the change. Three of the five sources of accepted updates emerged out of provincial or city-funded fine scale planning projects. New polygons were added (W5 Reclaimed Land) to represent the current extent of a small portion of coast in Table Bay that was filled in during upgrades to Cape Town Harbour in the 1940s. This area was not historically vegetated and is mapped but not considered to be a vegetation type.

A condensed version of the descriptions for new vegetation types and subtypes added in 2009 and 2012 versions is outlined in Tables 2 and 3.

Discussion

Overall, the 2009 and 2012 versions of the VEGMAP have been progressive refinements in scale and accuracy compared to the 2006 version, although these are limited to a few regions. Recent versions have also allowed for the inclusion of finer scale data in the form of subtypes. A problem remains as when to allow subtypes in a way that prevents a proliferation of vegetation units that will compromise the national scale of VEGMAP. Subtypes vary in scale, and in the criteria used to define them; thus some subtypes are represented by several units spread over larger geographies (e.g. FS1.2 Graafwater Flats Strandveld), while others are represented by a single isolated unit (e.g. FRs8.2 Kluitjieskraal Silcrete Renosterveld). This has the potential to become problematic as the units for types are refined, and approach the same scale as the units currently mapped as subtypes. This occurrence can only be avoided by a clear and well-defined classification hierarchy.

The VEGMAP changes to date were driven by a relatively passive approach to data acquisition, from private botanical consultants and government conservation officials raising concerns about the current map, and providing information from fine scale planning work. Consequently, updates have been concentrated in areas where funding, capacity and historical baseline information was available. Areas that have been updated so far coincided with three principal regions and two centres of plant endemism, namely, Kamiesberg Centre of the Cape Floristic Region, the Little Karoo Centre of the Succulent Karoo Region and a large extent of the Maputaland-Pondoland Region (Steenkamp et al. 2005).

TABLE 1: The South African vegetation types updated in 2009 and 2012 grouped by change category. Subscripts are referenced below the table.

Vegetation type (and code)	Nature of the update ('Other' includes: Geomorphologically distinct ^a ; disjunct community ^b ; altitude, topographic position and climatic factors ^c ; and ASCII character set transfer error ^d)					
	Ground truthed	Floristically distinct	Geologically distinct	Structurally distinct	Supported by Satellite imagery	Other
Polygon boundary adjustment						
Agter-Sederberg Shrubland SKv3 ¹	†	-	-	-	-	-
Bokkeveld Sandstone Fynbos FFs1 ¹	†	†	†	-	-	-
Cape Estuarine Salt Marshes Aze2 ¹	†	-	-	-	-	-
Cape Inland Salt Pans AZI9 ¹	†	-	-	-	-	-
Cape Lowland Freshwater Wetland AZf1 ¹	†	-	-	-	-	-
Cape Seashore Vegetation AZd3 ¹	†	-	†	-	-	-
Cederberg Sandstone Fynbos FFs4 ¹	†	-	-	-	-	-
Cederberg Sandstone Fynbos FFs4 ¹	-	-	-	-	-	-
Citrusdal Vygieveld SKk7 ¹	†	†	-	†	-	-
Doringrivier Quartzite Karoo SKv1 ¹	†	†	-	-	-	-
Graafwater Sandstone Fynbos FFs2 ¹	†	-	†	-	-	-
Hantam Karoo SKt2 ⁵	-	-	-	-	-	† ^e
Hopefield Sand Fynbos FFd3 ¹	†	†	-	-	-	-
Klawer Sandy Shrubland SKs13 ¹	†	-	†	-	†	-
Knersvlakte Dolomite Vygieveld SKk6 ¹	†	-	-	-	†	-
Knersvlakte Quartz Vygieveld SKk3 ¹	†	-	†	-	†	-
Knersvlakte Shale Vygieveld SKk4 ¹	†	-	-	-	-	-
KwaZulu-Natal Sandstone Sourveld SVs5 ⁴	‡	-	-	-	-	-
Lamberts Bay Strandveld FS1 ¹	†	†	-	-	-	-
Langebaan Dune Strandveld FS5 ¹	†	†	†	-	-	-
Leipoldtville Sand Fynbos FFd2 ¹	†	†	-	†	-	-
Little Karoo Quartz Vygieveld SKv10 ⁶	†	†	-	†	-	-
Midlands Mistbelt Grassland Gs9 ¹	‡	-	-	-	-	-
Namaqualand Riviere AZI1 ¹	†	-	-	-	†	-
Namaqualand Sand Fynbos FFd1 ¹	†	†	-	-	-	-
Namaqualand Spinescent Grassland SKs12 ¹	†	†	-	†	-	-
Namaqualand Strandveld SKs7 ¹	†	†	-	†	-	-
Nieuwoudtville Shale Renosterveld FRs2 ¹	†	-	-	-	-	-
Northern Inland Shale Band Vegetation FFb1 ¹	†	†	†	-	-	-
Northern Zululand Mistbelt Grassland Gs1 ⁴	‡	-	-	-	-	-
Olifants Sandstone Fynbos FFs3 ¹	†	†	-	-	-	-
Paulpietersburg Moist Grassland Gm15 ⁴	†	-	-	-	-	-
Piketberg Quartz Succulent Shrubland SKk8 ¹	†	†	†	-	-	-
Piketberg Sandstone Fynbos FFs6 ¹	†	†	-	-	-	-
Robertson Karoo SKv7 ¹	†	-	-	-	-	-
Roggeveld Shale Renosterveld FRs3 ⁵	†	†	-	-	-	-
Saldanha Flats Strandveld FS3 ²	†	†	†	-	-	-
Saldanha Granite Strandveld FS2 ²	†	†	†	-	-	-
Saldanha Limestone Strandveld FS4 ²	†	-	†	-	-	-
Southern Afrotropical Forest FOz1 ¹	†	-	-	-	-	-
Southern Drakensberg Highland Grassland Gd4 ⁴	†	-	-	-	-	-
Swartland Shale Renosterveld FRs9 ¹	†	-	-	-	-	† ^b
Swartland Silcrete Renosterveld FRc1 ¹	†	-	†	-	-	-
Vanrhynsdorp Gannabosveld SKk5 ¹	†	-	-	-	†	-
Winterhoek Sandstone Fynbos FFs5 ¹	†	-	-	-	-	-
Zululand Lowveld SVL23 ⁴	‡	-	-	-	-	-
New vegetation type						
Citrusdal Shale Renosterveld FRs20 ¹	†	†	-	†	-	-
Dry Coast Hinterland Grassland Gs19 ⁴	‡	‡	-	-	-	-
Kobee Succulent Shrubland SKk9 ¹	†	†	-	†	-	-
KwaZulu-Natal Coastal Belt Thornveld CB6 ⁴	-	-	-	-	-	‡ ^c
Long Tom Pass Montane Grassland Gm31 ⁴	†	†	-	-	-	-
Maputaland Pallid Sandy Bushveld SVI25 ⁴	‡	-	‡	-	‡	-

Source: ¹Helme 2007a, 2007b, 2007c; ²Helme and Koopman 2007; ³NVMC decision; ⁴Scott-Shaw and Escott 2011; ⁵Van der Merwe et al. 2008a, 2008b; ⁶Vlok et al. 2005

^a, Geomorphologically distinct;

^b, disjunct community;

^c, altitude, topographic position and climatic factors;

^d, ASCII character set transfer error.

†, updated in 2009; ‡, updated in 2012; §, added in 2009 and removed in 2012.

Table 1 continues on the next page →

TABLE 1 (Continues...): The South African vegetation types updated in 2009 and 2012 grouped by change category. Subscripts are referenced below the table.

Vegetation type (and code)	Nature of the update ('Other' includes: Geomorphologically distinct ^a ; disjunct community ^b ; altitude, topographic position and climatic factors ^c ; and ASCII character set transfer error ^d)					
	Ground truthed	Floristically distinct	Geologically distinct	Structurally distinct	Supported by Satellite imagery	Other
Moist Coast Hinterland Grassland Gs20 ⁴	‡	‡	-	-	-	-
Muzi Palm Veld and Wooded Grassland SVI26 ⁴	‡	-	‡	-	‡	-
Nardouw Sandstone Fynbos FFs32 ¹	†	†	-	†	-	-
Olifants Alluvium Fynbos FFa5 ¹	§	-	-	-	-	-
Peninsula Shale Fynbos FFh11 ³	‡	‡	-	‡	-	-
Steenkampsberg Montane Grassland Gm30 ⁴	†	†	-	-	-	-
Subtype of Vegetation type						
Graafwater Flats Strandveld FS1.2 ¹	†	†	-	-	-	-
Hantam Escarpment Shrubland SKt2.2 ⁵	†	-	-	-	-	-
Kluitjieskraal Silcrete Renosterveld FRs8.2 ¹	†	†	-	-	-	-
Nekkies Silty Floodplain FFa2.2 ¹	†	†	-	-	-	-
Nieuwoudtville Sandstone Renosterveld FRs2.2 ¹	†	-	-	†	-	† ^a
Noord Bokkeveld Shale Renosterveld FRs2.3 ¹	†	-	-	†	-	† ^a
Papkuilsfontein Sandstone Renosterveld FRs2.4 ¹	†	-	-	†	-	† ^a
Varkvlei Shale Strandveld FS3.2 ¹	†	-	†	-	-	-
Stormsvlei Aalwyn Fynbos FFs13.2 ¹	†	†	-	-	-	-
Vegetation type name change						
Central Ruens Shale Renosterveld FRs12 ³	-	-	-	-	-	‡ ^d
Eastern Ruens Shale Renosterveld FRs13 ³	-	-	-	-	-	‡ ^d
Ruens Silcrete Renosterveld FRc2 ³	-	-	-	-	-	‡ ^d
Western Ruens Shale Renosterveld FRs11 ³	-	-	-	-	-	‡ ^d

Source: ¹Helme 2007a, 2007b, 2007c; ²Helme and Koopman 2007; ³NVMC decision; ⁴Scott-Shaw and Escott 2011; ⁵Van der Merwe et al. 2008a, 2008b; ⁶Vlok et al. 2005

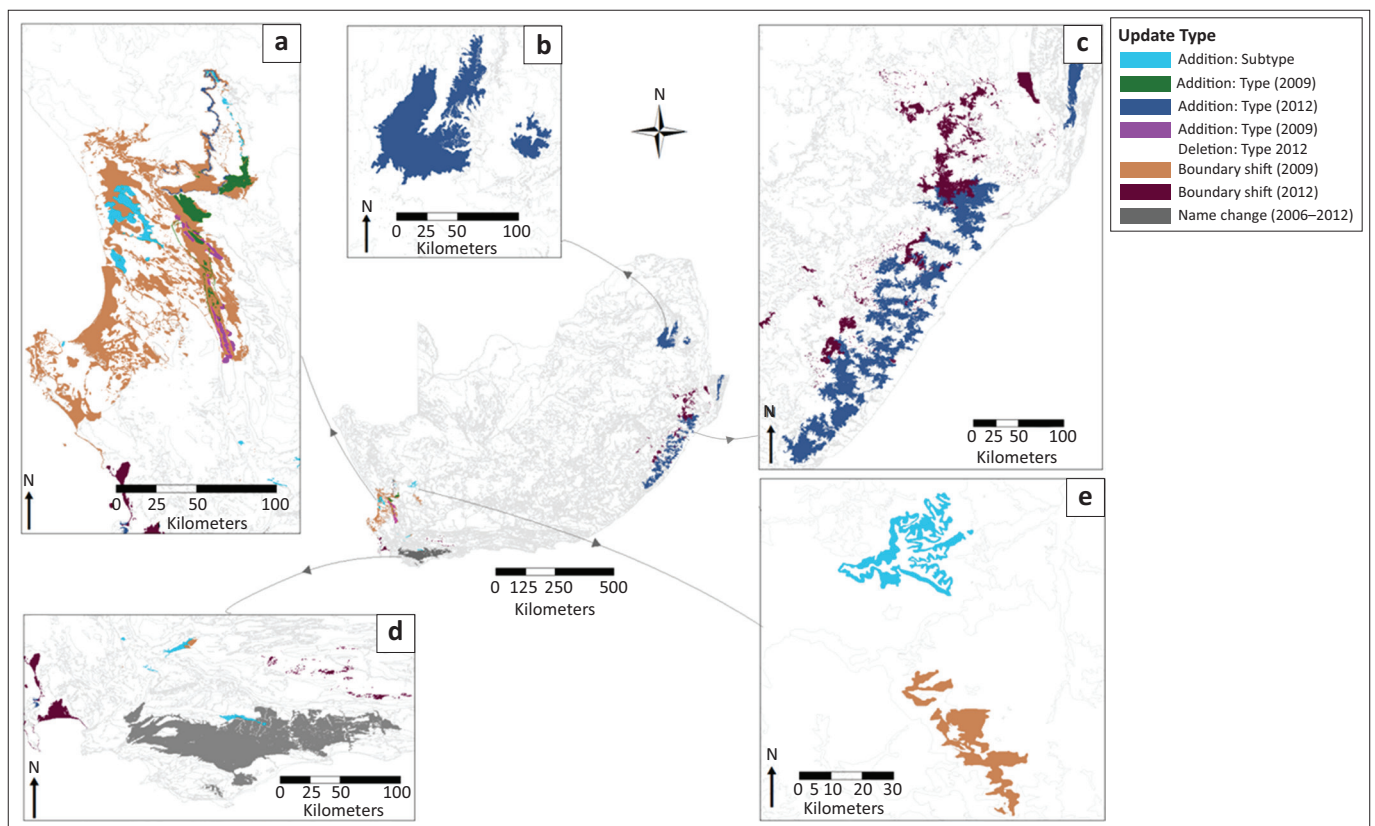
^a, Geomorphologically distinct;

^b, disjunct community;

^c, altitude, topographic position and climatic factors;

^d, ASCII character set transfer error.

†, updated in 2009; ‡, updated in 2012; §, added in 2009 and removed in 2012.



Source: These changes were based on evidence from the following sources: (a) Helme (2007), (b) ground truthed evidence from members of the National Vegetation Map Committee, (c) Scott-Shaw and Escott (2011), (d) Vlok et al. (2005) and (e) Van der Merwe et al. (2008a, 2008b)

FIGURE 1: The edited areas of the South African VEGMAP affected by the 2009 and 2012 updates.

TABLE 2: Names, vegetation map codes and summarised descriptions of new vegetation types added to the Vegetation Map of South Africa, Lesotho and Swaziland since the original 2006 publication.

Name of new type	Distribution and protection	Landscape features & vegetation structure	Geology, soils and climate	Species composition
SKK 9 Kobee Succulent Shrubland ^{1a}	Extends from the west of Nieuwoudtville southwards to an area between Klawer and Doringbos. Relatively untransformed (mainly due to inaccessibility) but barely protected. Small areas impacted by roads and gravel quarries, agricultural fields, and small dams. Appears to be prone to overgrazing. Previously mapped as SK16 Kamiesberg Mountain Shrubland (46%), FRs1 Vanrhynsdorp Shale Renosterveld (21%), SKV1 Doringrivier Quartzite Karoo (18%), SKK4 Knersvlakte Shale Vgieveld (5%), and marginal portions of FFS1 Bokkeveld Sandstone Fynbos, SKS5 Vanrhynsdorp Gannabosveld, SKS13 Klawer Sandy Shrubland. The unit did not fit comfortably within these units, either structurally or floristically.	Medium tall shrubland with many deciduous and succulent shrubs. Fynbos elements rare and trees only amongst rocky outcrops (<i>Ficus</i> , <i>Moyenus</i> , <i>Diospyros</i>) and in moister areas (<i>Olea</i>). Grasses rare - may be because of heavy grazing. Bulbs and annuals uncommon.	Occurs not only on substrates of mainly medium to coarse-grained quartzitic sandstone but also on mudrocks, sandstones, siltstones, limestone and shales. Predominantly on land type lb and lc. MAP approximately 200 mm–350 mm.	Dominant taxa: <i>Euphorbia mauritanica</i> L., <i>Euphorbia burmannii</i> (Klotzsch & Garcke), <i>Aloe comosa</i> Marloth & A. Berger, <i>Lampranthus watermeyerii</i> N.E. Br., <i>Tylocladus paniculatus</i> (L.F.) Toelken, <i>Crassula rupestris</i> L.f., <i>Searsia lucida</i> (L.) F.A. Barkley, <i>Searsia undulata</i> (Jacq.) T.S.Yi, A.J. Mill. & J.W. Enslin, <i>Lebeckia cythoides</i> Thunb., <i>Lebeckia leipoldiana</i> Jacq., <i>Pteronia divaricata</i> (P. Bergius), <i>Pteronia pallens</i> L.f., <i>Didelta spinosa</i> (L.f.) Alton, <i>Tripteris oppositifolia</i> (Alton) B.Nord., <i>Pentzia incana</i> (Thunb.) Kuntze, <i>Galenia africana</i> L., <i>Montinia caryophyllacea</i> Thunb., <i>Thesium lineare</i> Spreng. Ex. A.D.C., <i>Lotononis maximiliani</i> De Wild., <i>Dodonaea angustifolia</i> L.f., <i>Zygophyllum morganii</i> L., <i>Euryops rehmannii</i> Comp., <i>Asparagus capensis</i> L., <i>Eriocarpus purpureus</i> Burch., <i>Euclea tomentosa</i> E.Mey. ex A.D.C., <i>Galenia sarcophylla</i> Fenzl, <i>Cotyledon orbiculata</i> L., <i>Fingernuthia africana</i> Lehmann. Biogeographically important taxa: <i>Aloe comosa</i> Marloth & A. Berger, <i>Rhynchosia arida</i> C.H. Shrt. Near Endemic Taxa: <i>Eriosperrum minutipustulatum</i> , <i>Moraea macgregarii</i> , <i>Rhynchosia arida</i> .
SVI 25 Maputaland Pallid Sandy Bushveld ⁴	On the Maputaland coastal plain region east of the Pongola River. Aligned with the Muzi swamp and its water catchment and to the south it extends to Hluhluwe between SV1 18 and CB 1. Altitude 10 m–90 m. Statutorily conserved in Tembe Elephant Park and Isimangaliso Wetland Park. Previously mapped as CB1 Maputaland Coastal Belt (81%), SVI18 Tembe Sandy Bushveld (18%), and marginal portions of SVI20 Western Maputaland Clay Bushveld, FOz8 Sand Forest, FOa1 Lowveld Riverine Forest, AZ16 Subtropical Freshwater Wetlands and AZ111 Subtropical Salt Pans. The unit extends to the Maputaland part of southern Mozambique. It differs from SV1 18 Tembe Sandy Bushveld in the higher clay content of the soils and higher water table and lower evaporation rates arising from its proximity to the east coast.	On ancient coastal dune cordons on gently undulating terrain. Open to closed evergreen woodland with canopy 5 m–10 m tall.	Quaternary sediments of marine origin – mainly grey regic to reddish redistributed sand dunes. Grey dystrophic regosols. Summer rainfall with some rain in winter. MAP 550 mm–800 mm. No incidence of frost.	Dominant taxa: <i>Ureylium agropyroides</i> (Hack.) Hack., <i>Sapium integrum</i> Hochst., <i>Albizia vesicular</i> Oliv., <i>Diheteropogon amplexans</i> (Nees) Clayton, <i>Indigofera podophylla</i> Harv., <i>Albizia adianthifolia</i> (Schum.) W.Wright, <i>Antidesma venosum</i> E. Mey. ex Tul., <i>Fimbristylis complanata</i> (Retz.) Link, <i>Carida monoloca</i> Roxb., <i>Sclerocarya birrea</i> (A.Rich.) Hochst., <i>Melinis repens</i> (Willd.) Zizka, <i>Rothmannia fischeri</i> (K.Schum.) Bullock ex Oberm., <i>Ptaeroxylon obliquum</i> (Thunb.) Radlk., <i>Strychnos henningsii</i> Gilg., <i>Andropogon schirensis</i> Hochst., <i>Tephrosia longipes</i> Meisner subsp. <i>longipes</i> .
SVI 26 Muzi Palm Veld and Wooded Grassland ³	On the coastal plain in the Maputaland region east of the Pongola River between SV1 18 and CB 1. Altitude 40 m–90 m. Statutorily conserved in Tembe Elephant Park. Previously mapped as CB1 Maputaland Coastal Belt (80%), SVI18 Tembe Sandy Bushveld (14%), AZ16 Subtropical Freshwater Wetlands (5%), and marginal portions of CB2 Maputaland Wooded Grassland, FOz8 Sand Forest, W1 Freshwater Lakes and AZ111 Subtropical Salt Pans. The unit extends to the Maputaland part of southern Mozambique. It differs from Eastern Maputaland Pallid Sandy Bushveld in the generally higher and very seasonal water table which is unsuitable for bushveld trees. Small unmapped fragments of Muzi Palm Veld and Wooded Grassland occur embedded in mainly Eastern Maputaland Pallid Sandy Bushveld between the Mkuzi River and the Nyalazi River.	Generally undulating terrain on ancient coastal dune cordons. Dry basins associated with Muzi Swamps and Stream draining Pongola and Mkuzi River. Two broad plant communities: <i>Hyphaene coriacea</i> (in seasonally wet Palm Veld lacking in shrubs and herbs) and wooded grassland (rich in shrubs, dwarf shrubs, geoxylic suffrutices and herbs) dominate in a patchwork pattern.	Quaternary sediments of marine origin – mainly grey regic to reddish redistributed sand dunes. Grey brown to orange grey dystrophic regosols. Land type mainly Ha. Summer rainfall with some rain in winter. MAP 550 mm–650 mm. No incidence of frost.	Dominant taxa: <i>Hyphaene coriacea</i> Gaertn., <i>Drypetes arguta</i> (Müll.Arg.) Hutch., <i>Uvaria lucida</i> subsp. <i>virrens</i> (N.E.Br.) Verdc., <i>Spirostachys africana</i> Sond., <i>Berchemia zeyheri</i> (Sond.) Grubb., <i>Senegalia burkeri</i> (Benth.) Kyal. & Boatw., <i>Euclea natalensis</i> A.C., <i>Nidorella auriculata</i> DC., <i>Justicia flava</i> (Forssk.) Vahl, <i>Imperata cylindrical</i> (L.) Rauschb., <i>Eragrostis lapulla</i> Nees, <i>Oxalis</i> cf. <i>semiloba</i> , <i>Nymphaea nouchali</i> Sond., <i>Phragmites australis</i> Burm.f.
FRs 20 Citrusdal Shale Renosterveld ^{2b}	Threatened by agricultural expansion, alien invasive vegetation (invasive grasses e.g. <i>Avena</i> spp. and herbs, urban expansion (mainly around Citrusdal), dams, heavy grazing and trampling pressure. Nothing conserved. Previously mapped as SKK7 Citrusdal Vgieveld (79%), FFS2 Graafwater Sandstone Fynbos (7%), and marginal portions of FFS4 Cederberg Sandstone Fynbos, FFD2 Leipoldville Sand Fynbos and FFS3 Olfants Sandstone Fynbos. Previously included within Citrusdal Vgieveld but clearly distinct (structurally and floristically), occurring on cooler/moister slopes, and dominated by shrubs rather than succulents.	Typical Renosterveld, dominated by low to medium shrubs, with abundant annuals and geophytes. Herbs can be common, but trees are usually not present, and succulents are uncommon to common (more common where transitional to Citrusdal Vgieveld, on drier slopes). Alien vegetation tends to be rare, but invasive alien grasses are a threat. Heuweltjies may be present.	Occurs not only on substrates of mainly quartzitic sandstone but also on mudrocks, sandstones, siltstones and shales. Predominantly on land type la and lb. MAP approximately 250 mm–350 mm.	Dominant taxa: <i>Searsia incisa</i> (L.f.) F.A. Barkley, <i>Wilbergia leptoptera</i> R.Dahlgren, <i>Didelta spinosa</i> (L.f.) Alton, <i>Lebeckia cythoides</i> Thunb., <i>Euclea tomentosa</i> E.Mey. ex A.D.C., <i>Berkheya fruticosa</i> (L.) Ehrh., <i>Diospyros ramulosa</i> (E.Mey. ex A.D.C.) De Winter, <i>Diceratherium rhinoceros</i> (L.f.) Koek, <i>Eriocarpus africanus</i> L., <i>Pteronia incana</i> (Burm.) DC., <i>Anthospermum spatulatum</i> Spreng., <i>Zygophyllum spinosum</i> L., <i>Nylandtia spinosa</i> (L.) Dumort., <i>Chrysocoma ciliata</i> L., <i>Montinia caryophyllacea</i> Thunb., <i>Motria caffrorum</i> (L.) Desv., <i>Cheilanthes namaquensis</i> Schelpe, <i>E. burmannii</i> , <i>Eurobia loricata</i> Lam., <i>Tetragonia rosea</i> Schltr., <i>Ehrharta calycina</i> Sm., <i>Tribolium hispidum</i> (Thunb.) Desv., <i>Geissorhiza aspera</i> Goldblatt, <i>Wurmbea spicata</i> (Burm.f.) T.Durand & Schinz, <i>Bulbineella cauda-felis</i> (L.f.) T.Durand & Schinz, <i>Babiana angustifolia</i> Sweet, <i>Moraea flaccida</i> (Sweet) Steud., <i>Cyanella hyacinthoides</i> Royen ex L., <i>Lotononis hirsute</i> (Thunb.) D.Dietr., <i>Cyphia bulbosa</i> (L.) P.J.Bergius, <i>Arctopus monacanthus</i> Carmich. ex Sond., <i>Helichrysum moeserianum</i> Thell., <i>Hemimeris racemosa</i> (Houtt.) Meir., <i>Oncosiphon suffruticosum</i> (L.) Källersjö. Endemic taxa: <i>Lotononis macrocarpa</i> Eckl. & Zeyh., <i>L. rosea</i> DuRoi, <i>L. pallens</i> Benth., <i>Oxalis amblyosepala</i> Schltr., <i>O. uliginosa</i> Schltr. Near endemic taxa: <i>Polycarena subtilis</i> , <i>Geissorhiza louisaboulisiae</i> R.C.Foster, <i>Sparaxis roxburghii</i> (Baker) Goldblatt.

Table 2 continues on the next page →

TABLE 2 (Continues...): Names, vegetation map codes and summarised descriptions of new vegetation types added to the Vegetation Map of South Africa, Lesotho and Swaziland since the original 2006 publication.

Name of new type	Distribution and protection	Landscape features & vegetation structure	Geology, soils and climate	Species composition
Ffs 32 Nardouw Sandstone Fynbos ^a	With a small distribution in the south-east of Vanrhynsdorp in the Western Cape. Threatened primarily by the ongoing expansion of rooibos tea cultivation, overgrazing and fire exclusion. Rocky areas are relatively safe. Previously mapped as Ffs1 Bokkeveld Sandstone Fynbos (60%), Ffs4 Cederberg Sandstone Fynbos (28%), and marginal portions of SKV1 Doringrivier Quartzite Karoo, SKK2 Hantam Karoo, SKN6 Kamiesberg Mountains Shrubland, SKK5 Vanrhynsdorp Gannabosveld and Ffs1 Vanrhynsdorp Shale Renosterveld. A much more arid type than Bokkeveld Sandstone Fynbos or Cederberg Sandstone Fynbos (250mm/yr), is floristically distinct, and supports significantly fewer endemic species.	Structurally a typical arid Fynbos shrubland. Large areas of weathered rock, supporting dwarf succulents and shrubs, lichens and mosses. Graminoids and proteoids common and often dominant, but Ericaceae is poorly represented. Less prominent wetlands and Thicket than in Bokkeveld or Cederberg Sandstone Fynbos, and trees largely absent except on fire protected rocky outcrops. Waboomveld is absent. Annuals and bulbs are common in open areas and in younger veld, and succulents often common on rocky pavements.	Occurs on substrates of mainly coarse, weathering quartzitic sandstone, but also on dolomites, dolomites and tillite. Predominantly on land types A1 and lb. MAP approximately 200 mm–300 mm.	Dominant taxa: <i>Leucadendron pubescens</i> R. Br., <i>Aristida diffusa</i> Trin., <i>Restio vimineus</i> Rottb., <i>Ehrharta thunbergii</i> Gibbs Russ., <i>Restio marlothii</i> Planch., <i>monanthis</i> Mast., <i>Isolobis marginata</i> (Thunb.) A. Dietr., <i>Thamnochortus platypterus</i> Kunth, <i>Willdenowia giomerata</i> (Thunb.) H.P. Linder, <i>Willdenowia incurvata</i> (Thunb.) H.P. Linder. Biogeographically important taxa: <i>Gladiolus splendens</i> (Sweet) Herb., <i>Leucadendron loranthifolium</i> I.A. Williams, <i>Lampranthus pakhuisensis</i> L. Bolus, <i>Leucospermum praeromum</i> (Mesn) E. Phillips. Endemic taxa: <i>Babiana engysiphon</i> J.C. Manning & Goldblatt, <i>B. rigida</i> Goldblatt & J.C. Manning, <i>B. unguiculata</i> G.J. Lewis, <i>Othonna papaveroides</i> Hutch., <i>Wahlenbergia</i> sp. nov., Near endemic taxa: <i>Amphiglossa grisea</i> Koek., <i>Akhanasia spathulata</i> (DC.) D. Dietr.
Ffh 11 Peninsula Shale Fynbos ^b	Higher hills and lower mountain slopes on the Cape Peninsula at Devils Peak, on south and east aspects. Separated from Bolland Shale Fynbos by the dominance of Silvertrees and an understory of Rooigras. Altitude 0 m–700 m. Well conserved in the Table Mountain National Park. Heavy infestation of <i>Acacia mearnsii</i> De Wilde and <i>Acacia melanoxylon</i> . Previously mapped as FFH5 Cape Winelands Shale Fynbos (62%), Ffs10 Peninsula Shale Renosterveld (28%), Ffg3 Peninsula Granite Fynbos (5.6%), and marginal portions of Ffs9 Peninsula Sandstone Fynbos, FFd5 Cape Flats Sand Fynbos and FOz1 Southern Afrotemperate Forest.	Steep slopes against the mountains. Vegetation is moderately tall and dense. Shrubland structurally dominated by proteoid and closed-scrub Fynbos with strong grass elements, dominated by <i>Themeda triandra</i> .	Acidic, moist clay-loamy, red-yellow apedal, Glenrosa and Mispah forms derived from Malmesbury Shales. Land types Ac, Fa 1c. MAP 520 mm–1690 mm. Mean daily temperatures between 26.4°C and 6.6°C. Frost incidence 2 or 3 days per year.	Dominant taxa: species of <i>Kiggelaria</i> , <i>Leucadendron</i> , <i>Leucospermum</i> , <i>Halleria</i> , <i>Maytenus</i> , <i>Myrsine</i> , <i>Olea</i> , <i>Protea</i> , <i>Searsia</i> , <i>Aspalathus</i> , <i>Brunia</i> , <i>Cliffortia</i> , <i>Cullinia</i> , <i>Erica</i> , <i>Leucadendron</i> , <i>Stoebe</i> , <i>Bobartia</i> , <i>Mohria</i> , <i>Pteridium</i> , <i>Watsonia</i> , <i>Cassytha</i> , <i>Cannomolis</i> , <i>Ehrharta</i> , <i>Elegia</i> , <i>Ficinia</i> , <i>Merxmuellera</i> , <i>Pentameris</i> , <i>Restio</i> , <i>Schoenoxiphium</i> , <i>Staberoha</i> , <i>Tetaria</i> .
Gm 30 Steenkampsberg Montane Grassland ^d	Occurs along the Steenkampsberg escarpment that extends from the headwaters of the Waterval River in mountains north-west of Lydenburg, extending southwards through Dullstroom towards Belfast, then eastwards through Machadoodorp to Bambi and Elandshoogte. Poorly protected but over 70% is still natural. Previously mapped as Gm18 Lydenburg Montane Grassland (100%), which was split into Gm30 and Gm31. A floristic analysis along the Mpumalanga escarpment supports the recognition proposal of two subcentres of plant endemism, namely the Long Tom Pass subcentre and the Steenkampsberg subcentre.	Mountainous with plateau grasslands, mountain slopes and shallow valleys. Grasslands are short with high forb diversity. The highest point in Mpumalanga (2330 m) occurs just north of the Steenkampsberg Pass.	Forms part of the Pretoria Group (intersected by Transvaal Diabase), with the several hill formations running from west to east. Rocks are quartzite, shale, dolerite, diabase and basalt. Soils are shallow to deep, well drained; either dystrophic and/or mesotrophic depending on geology. Soil derived from quartzite results in sandy, white dystrophic soils with high humus content. Seasonally arid temperate region with hot summers and cool and dry winters. Winter frost is common and summer mist is infrequent. Its inland position and higher elevation than the Long Tom pass Montane Grasslands, it is colder and receives significantly less mist during summer.	Dominant Taxa: <i>Leucosidea sericea</i> Eckl. & Zeyh., <i>Hilliardiella aristata</i> (DC.) H. Rob., <i>Searsia discolor</i> (E. Mey. ex Sond.) Maffett, <i>Rubus ludwigii</i> Eckl. & Zeyh., <i>Lopholena corifolia</i> (Sond.) E. Phillips & C.A. Sm., <i>Otholobium wilmsii</i> (Harms) C.H. Stirt., <i>Tristachya leucochroa</i> Trin. ex Nees, <i>Harporchloa faix</i> (L.f.) Kuntze, <i>Andropogon schrenkii</i> Hochst., <i>Monocymbium ceteriforme</i> (Nees) Stapf, <i>Aclypha wilmsii</i> Pax ex Prain & Hutch., <i>Argyrobolium tererosum</i> Eckl. & Zeyh., <i>Helichrysum adenocarum</i> subsp. <i>adenocarum</i> DC., <i>Labelia flaccida</i> (C.Presl) A. DC. Biogeographically important taxa: The flora of the Steenkampsberg Montane Grassland is more common to the vegetation in the south, than to the north, e.g. <i>Aloe modesta</i> Reynolds and <i>Watsonia watsonioides</i> (Baker) Oberm. It also shares local endemics with the Long Tom Pass Montane Grasslands: <i>Disa klugei</i> McMurry, <i>Khadia alticola</i> Chess. & H.E.K. Hartmann, <i>Brachystelma stellatum</i> E.A. Bruce & R.A. Dyer, <i>Indigofera longibarbara</i> Engl. Endemic taxa: <i>Searsia tumulicola</i> var. <i>meuseana</i> Maffett, <i>Crotalaria monophylla</i> Germish, <i>Indigofera heydenantha</i> var. <i>meuseana</i> Maffett, Eckl. & Zeyh., <i>Kniphofia rigida</i> E.A. Bruce, <i>Riocrexia aberrans</i> R.A. Dyer, <i>Streptocarpus latens</i> Hilliard & B.L. Burt., <i>Gladiolus cataractarum</i> Oberm., <i>Gladiolus malvinus</i> Goldblatt & J.C. Manning, <i>Graderia linearifolia</i> Codd, <i>Xysmalobium pedifloratum</i> S.P. Bester & Nicholas, <i>Eucamis vandermerwei</i> Verd., <i>Drimiopsis purpurea</i> Van der Merwe, <i>Aloe chailisii</i> Van Jaarsv. & A.E. van Wyk.
Gm 31 Long Tom Pass Montane Grassland ^d	Along the escarpment, from Morgenzen Reserve just north of Crystal Springs Mountain Lodge, southwards to the Schoemanskoof. Altitude around 1650 m in the north (where it is drier), to around 1500 m in the south. This type is well protected and target of 27% is met. Previously mapped as Gm18 Lydenburg Montane Grassland (100%), which was split into Gm30 and Gm31. A floristic analysis along the Mpumalanga escarpment supports the recognition proposal of two subcentres of plant endemism, namely the Long Tom Pass subcentre and the Steenkampsberg subcentre.	Physiography is diverse with subalpine peaks, level terraces and rolling plains in the higher lying areas with steeply sloping mountain slopes. The highest point is Mount Anderson (2280 m), occurring just north of Long Tom Pass.	Pretoria Group (intersected by Transvaal Diabase), with the several hill formations, and the distinctive volcanic elements of the Hekepoort Andesite Formations which are on the summits of the highest lying areas. Well drained, shallow soils with pockets of silty clay loam. Seasonally arid temperate region with hot summers and dry winters. Frost (winter) and mist (summer) is common. Compared to the Steenkampsberg Montane Grassland, it is warmer and receives more mist.	Dominant taxa: <i>Protea roupelliae</i> Meisn. subsp. <i>roupelliae</i> , <i>Protea parvula</i> Beard, <i>Phymaspermum acerum</i> (DC.) Källersjö, <i>Psoralea latifolia</i> , <i>Cliffortia nitidula</i> Weim. subsp. <i>pilosa</i> , <i>Erica woodii</i> Bolus, <i>Andropogon schrenkii</i> Hochst., <i>Festuca costata</i> Nees var. <i>costata</i> , <i>Allotetopsis semialata</i> subsp. <i>ecklonia</i> (Nees) Gibbs Russ., <i>Cremium concinnum</i> Nees, <i>Loudelia densipica</i> (Rendle) C.E. Hubb., <i>Microchloa altera</i> (Rendle) Stapf, <i>Microchloa caffra</i> Nees, <i>Diheteropogon filifolius</i> (Nees) Hilliard, <i>Harporchloa faix</i> (L.f.) Kuntze, <i>Koeleria capensis</i> Nees, <i>Scleria flexuosa</i> Boeckeler, <i>Helichrysum wilmsii</i> Moeser, <i>Helichrysum glomeratum</i> Klatt, <i>Helichrysum spiralepis</i> Hilliard & B.L. Burt., <i>Helichrysum subulatum</i> Burt Doye, <i>Sapubia cana</i> Harv., <i>Eriosema kraussianum</i> Meisner, <i>Selago atherstonei</i> Rolfe, <i>Gladiolus longicalis</i> var. <i>platyptelus</i> (Baker) Goldblatt & J.C. Manning, <i>Psammatropha myriantha</i> Sond., <i>Xysmalobium aceratoides</i> (Schltr.) N.E. Br., <i>Syncolostemon subvelutinus</i> (Gurke) D.F. Othelo.

Table 2 continues on the next page →

TABLE 2 (Continues...): Names, vegetation map codes and summarised descriptions of new vegetation types added to the Vegetation Map of South Africa, Lesotho and Swaziland since the original 2006 publication.

Name of new type	Distribution and protection	Landscape features & vegetation structure	Geology, soils and climate	Species composition
Gs 19 Dry Coast Hinterland Grassland ¹	From Melmoth in the north to near Libode in the former Transkei (including Camperdown, Umiaas Road, Eston, Bisi, iZingolweni, Ngqelani near Mthatha). Altitude 450 m–900 m. Statutorily conserved in Oribi Gorge Nature Reserve. Previously mapped as SVs4 Ngongoni Veld (86%), and marginal portions of SVs6 Eastern Valley Bushveld, CB3 KwaZulu-Natal Coastal Belt, SVs3 KwaZulu-Natal Hinterland Thornveld, G59 Midlands Mistbelt Grassland, SV122 Northern Zululand Sourveld, CB4 Pondoland-Ugu Sandstone Coastal Sourveld, FO25 Scarp Forest, Gs11 Southern KwaZulu-Natal Moist Grassland, FO23 Southern Mistbelt Forest, SVs1 Thukela Valley Bushveld and SV123 Zululand Lowveld. Herbaceous species richness is much less in Dry Coast Hinterland Grassland compared with the adjoining vegetation units KwaZulu-Natal Sandstone Sourveld; Moist Coast Hinterland Grassland; Midlands Mistbelt Grassland and relatively few of its common species are shared with these. A Bioresource classification for the region (Camp 1999) refined vegetation into different types based on climate, and the presence and abundance of dominant plant species.	Undulating plains and hilly landscape mainly associated with drier coast hinterland valleys in the rain shadow of the rain bearing frontal weather systems from the east coast. Sparse wiry grassland dominated by unpalatable Ngononi grass. In good condition dominated by <i>Themeda triandra</i> and <i>Tristachya leucothrix</i> . Wooded areas are found in valleys at lower altitudes. Termitaria with trees and shrubs present.	Acid, leached heavy soils derived from Karoo Super group and intrusive Karoo dolerites. Predominantly summer rainfall. Droughts occasional. MAP 750 mm to 780 mm. Frost infrequent. Mean monthly temperatures between 38.2°C and -0.2°C.	Dominant taxa: <i>Themeda triandra</i> Forssk., <i>Tristachya leucothrix</i> Trin. ex Nees, <i>Aristida juncea</i> Trin. & Rupr., <i>Digitaria eriantha</i> Steud., <i>Vachellia karroo</i> (Hayne) Banfi & Galasso, <i>Lantana camara</i> L., <i>Rauvolfia caffra</i> Sond., <i>Syzgium cordatum</i> Hochst. ex Krauss, <i>Solanum mauritanum</i> Scop., <i>Aristida congesta</i> Roem. & Schult., <i>Bothriochloa insculpta</i> (A.Rich.) A.Camus, <i>Eragrostis superba</i> Peyr., <i>Hyparrhenia hirta</i> (L.) Stapf, <i>Sporobolus pyramidalis</i> P.Beauv., <i>Vachellia nilotica</i> (L.) P.J.H. Hurter & Mabb., <i>Vachellia sieberiana</i> (DC.) Nyal. & Botwv., <i>Ziziphus mucronata</i> Willd., <i>Diospyros lycioides</i> Desf., <i>Alloteropsis semialata</i> (R.Br.) Hitchc., <i>Andropogon eucamus</i> Nees, <i>Digitaria trichalaenoides</i> Stapf, <i>Eragrostis gumiflora</i> (Roem. & Schult.) Pilg., <i>Hyparrhenia hirta</i> (L.) Stapf, <i>Pogonarthria squarrosa</i> (Roem. & Schult.) Pilg., <i>Sporobolus pyramidalis</i> P.Beauv., <i>Vachellia tortilis</i> (Forssk.) Galasso & Banfi, <i>Dichrostachys cinerea</i> .
Gs 20 Moist Coast Hinterland Grassland ²	From near Melmoth in the north to near Libode in the south. Altitude 450 m–900 m. Statutorily conserved in Vernon Crookes and Entumeni Nature Reserves. Previously mapped as SVs4 Ngongoni Veld (98%), and marginal portions of SVs6 Eastern Valley Bushveld, CB3 KwaZulu-Natal Coastal Belt, SVs3 KwaZulu-Natal Hinterland Thornveld, G59 Midlands Mistbelt Grassland, SV122 Northern Zululand Sourveld, CB4 Pondoland-Ugu Sandstone Coastal Sourveld, FO25 Scarp Forest, FO23 Southern Mistbelt Forest, SVs1 Thukela Valley Bushveld, CB5 Transkei Coastal Belt and SV123 Zululand Lowveld. A Bioresource classification for the region (Camp 1999) refined vegetation into different types based on climate, and the presence and abundance of dominant plants.	Rolling and hilly landscape. Dense tall sour grassland dominated by unpalatable Ngononi grass with this mono-dominance associated with low species diversity, when in good condition dominated by <i>Themeda triandra</i> and <i>Tristachya leucothrix</i> .	Acid leached heavy soils derived from Karoo Super group sediments and intrusive Karoo dolerites. Predominantly summer rainfall. MAP 800 mm to 1160 mm. Frost infrequent.	Dominant taxa: <i>Aristida juncea</i> Trin. & Rupr., <i>Themeda triandra</i> Forssk., <i>Tristachya leucothrix</i> Trin. ex Nees, <i>Alloteropsis semialata</i> (R.Br.) Hitchc., <i>Digitaria eriantha</i> Steud., <i>Digitaria trichalaenoides</i> Stapf, <i>Harpachloa fax</i> (L.f.) Kuntze, <i>Acacia dealbata</i> Link, A. meansii, <i>Cyrtocarpus dregei</i> Kunze, <i>Halleria lucida</i> L., <i>Podocarpus</i> spp., <i>Pteridium aquilinum</i> (L.) Kuhn, <i>Rubus canefolius</i> Pursh, <i>Solanum mauritanum</i> Scop., <i>H. hirta</i> , <i>A. dealbata</i> , <i>D. lycioides</i> .
CB 6 KwaZulu-Natal Coastal Belt Thornveld ³	From near Mandini to Oribi Gorge in the south. Altitude 30 m–500 m. Statutorily conserved in Harold Johnson Nature Reserve. Previously mapped as CB3 KwaZulu-Natal Coastal Belt (99%), and marginal portions of SVs6 Eastern Valley Bushveld, SVs5 KwaZulu-Natal Sandstone Sourveld, SVs4 Ngongoni Veld, FO27 Northern Coastal Forest, CB4 Pondoland-Ugu Sandstone Coastal Sourveld, FO25 Scarp Forest and W2 Subtropical Coastal Lagoons. This vegetation unit grades into the SVs 6 Eastern Valley Bushveld and SVs 3 KwaZulu-Natal Hinterland Thornveld in the larger river valleys. A Bioresource classification for the region (Camp 1999) refined vegetation into different types based on climate, and the presence and abundance of dominant plant species, specifically palms.	Steep valley sides and hilly landscape mainly associated with drier larger river valleys in the rain shadow of the rain bearing frontal weather systems from the east coast. Bushed grassland and thicket, bushland and open woodland.	Summer rainfall with some rain in winter. MAP about 740 mm to 940 mm. Summers are hot and humid and winters mild. Frost does not occur.	Dominant taxa: <i>H. hirta</i> , <i>Sporobolus pyramidalis</i> P.Beauv., <i>V. nilotica</i> , <i>V. sieberiana</i> , <i>V. tortilis</i> , <i>Combretum apiculatum</i> Sond., <i>Combretum molle</i> R.Br. ex G.Don, <i>D. cinerea</i> , <i>Euphorbia ingens</i> E.Mey. ex Boiss., <i>Euphorbia</i> spp. (trees), <i>L. camara</i> , <i>R. caffra</i> , <i>Ziziphus mucronata</i> Willd.

Source: ¹Helme 2007a, 2007b; ²NVMC decision; ³Scott-Shaw and Escott 2011For full species lists and descriptions, please refer to the descriptions published online at www.bgis.sanbi.org.za.

TABLE 3: Names, vegetation map codes and summarised descriptions of new vegetation subtypes added to the Vegetation Map of South Africa, Lesotho and Swaziland since the original 2006 publication.

Name of new subtype	Justification for separation	Distribution and protection	Landscape features & vegetation structure	Geology, soils and climate	Species composition
FS1.2 Graafwater Flats Strandveld¹ Main Type: FS1 Lambert's Bay Strandveld	No trees and lack of proteoids, <i>Erica</i> , <i>Phylla</i> , <i>Diosna</i> , <i>Aspalathus</i> , and <i>Nylandria scoparia</i> distinguish this unit from Leipoldtville Sand Fynbos. The unit has a higher restio component (<10%) than Lambert's Bay Strandveld. The unit has numerous annuals, and moderate to low geophyte diversity and abundance. <i>Pterocelastrus</i> sp. and <i>Putterlickia</i> sp. are lacking.	On the coastal plain near Graafwater. Much of this unit is already transformed (mainly for cereals, with saltbush (<i>Atriplex</i>) the most commonly planted perennial). This is not a fire driven vegetation type. Alien vegetation covers about 5% of this unit, comprising <i>Acacia cyclops</i> , <i>Eucalyptus</i> sp., <i>Atriplex nummularia</i> , and <i>Prosopis</i> sp. Due to the flat topography, much of the northern part of the unit has been ploughed, but the area is mostly too dry to support crops. In the northern parts of this unit many strip cultivated areas have been heavily grazed and only unpalatable and invasive kraalbos (<i>Galenia africana</i>) remains in the unploughed strips. The southern areas are threatened by potato farming.	Found on deep, loamy to neutral sands on the coastal plain halfway between the coast and the first line of mountains. No exposed bedrock and most areas well drained, although there are small pans where underlying clays are close to the surface. This is an ecotonal vegetation type, usually occurring between Lambert's Bay Strandveld and Leipoldtville Sand Fynbos or Graafwater Sandstone Fynbos. Medium to tall shrubland, with high percentage of deciduous and succulent elements.	Semi-arid, and hot and dry in summer, with mild winters and occasional heavy mists and fog. Has a slightly lower incidence of fog than Lambert's Bay Strandveld.	Dominant taxa: <i>Searsia lucida</i> (L.) F.A. Barkley, <i>Searsia glauca</i> (Thunb.) Moffett, <i>Euclea racemosa</i> L., <i>Euclea tomentosa</i> E.Mey. ex A.DC., <i>Diospyros pubescens</i> Pers., <i>Diospyros glabra</i> (L.) De Winter, <i>Roepera marasana</i> (L.) Beier & Thulin, <i>Lebeckia sericea</i> Thunb., <i>Montania caryophyllacea</i> Thunb., <i>Pteronia divaricate</i> (P. Bergius) Less., <i>Wiborgia leptoptera</i> R.Dahlgren, <i>Chrysanthemoides incana</i> (Burm.f.) Nol., <i>Euryops speciosissimus</i> DC., <i>Asparagus capensis</i> L., <i>Struthiola ciliata</i> (L.) Lam., <i>Gymnosporia buxifolia</i> (L.) Szyszka, <i>Euphorbia burmannii</i> (Klotzsch & Garcke) E.Mey. ex Boiss., <i>E. mauritanica</i> L., <i>E. caput-medusae</i> L., <i>Conicosia pugioniformis</i> (L.) N.E.Br., <i>Cotyledon orbiculata</i> L., <i>Ruschia</i> sp., <i>Tetragonia frutescens</i> L., <i>Othonia cylindrica</i> (Lam.) DC., <i>Joranda niela dubia</i> H.E.K. Hartm., <i>Enriharta calycina</i> Sm., <i>Willdenowia incurvata</i> (Thunb.) H.P.Linder, <i>Thamnochortus bachmannii</i> Mast., <i>Grieliem grandiflorum</i> (L.) Druce, <i>Kedrostis psammophila</i> , <i>Gladiolus carinatus</i> Aiton, <i>Albucca Canadensis</i> (L.) F.M.Leight., <i>Dimorphotheca alvialis</i> (L.) Moench, <i>Arctostichum hirsutum</i> (Harv.) Beauverd, <i>Diascia unilabiata</i> (Thunb.) Benth., <i>Cotula turbinata</i> L. Biogeographically important taxa: Potentially supports <i>Manulea pillansii</i> M. psilostoma, <i>Felicia josephinae</i> J.C.Manning & Goldblatt, <i>Selago heterotricha</i> , <i>Pelargonium attenuatum</i> Harv., <i>Pelargonium appendiculatum</i> (L. f.) Willd., <i>Babiana petiolata</i> Goldblatt & J.C.Manning, <i>Babiana confuse</i> (G.J.Lewis) Goldblatt & J.C.Manning, <i>Diascia unilabiata</i> (Thunb.) Benth.
FRs8.2 Kluitjeskraal Silcrete Renosterveld² Main Type: FRs8 Breede Shale Renosterveld	The distinguishing floristic feature is the presence of <i>Elegia extensa</i> . The presence of Silcrete is also unique.	Restricted to the western parts of the Tulbagh valley, west of Walseley. The bulk of this single unit habitat was transformed into plantation and is restricted to patches where plantation density is low, notably under the Eskom powerline servitude that crosses this area. Not yet formally conserved.	Very similar to Breede Shale Renosterveld but with the key addition of Silcrete, which creates a unique gravelly substrate, not represented elsewhere in the area.	Occurs on phyllitic shale, greywacke, limestone and arenite. Predominantly on land types Ia and Fa. MAP approximately 700 mm–830 mm.	<i>Elegia extensa</i> Pillans. Other threatened species include <i>Leucadendron lanigerum</i> H. Buek ex Meisn., <i>Raffia crispa</i> C.H. Stirt., <i>Aspalathus aculea</i> Thunb., <i>Otholobium canalicans</i> (Eckl. & Zeyh.) C.H. Stirt., <i>Otholobium uncinatum</i> (Eckl. & Zeyh.) C.H. Stirt.
FRa2.2 Nekkie's Silty Floodplain¹ Main Type: FRa2 Breede Alluvium Fynbos	Nekkie's Silty Floodplain is part of the Breede river floodplain and may be more extensive than currently mapped. The unit is distinguished by its soil type and unique floristics and structure.	The best example lies between the Breede river and the Brandvlei dam (north of Nekkie's ridge), west of Worcester, where this unit is in good condition. Not formally conserved and largely transformed.	The subtype resembles grassland with many bulbs.	Soils are deep loamy silts, which overlay the normal sandy soils and cobble alluvium of the Breede valley, and may be highly fertile.	<i>Themeda triandra</i> Forssk., <i>Elegia recta</i> (Mast.) Moline & H.P.Linder, <i>Restio tetragonus</i> Thunb., <i>Elegia asperiflora</i> (Nees) Kunth, <i>Staberoha distachyos</i> (Rottb.) Kunth, <i>Diospyros glabra</i> (L.) De Winter, <i>Eragrostis capensis</i> (Thunb.) Trin., <i>Chironia lindes</i> L., <i>Wimmerella arabidea</i> (C.Presl) Serris, M.B. Crespo & Lammers, <i>Aspalathus filicaulis</i> Eckl. & Zeyh., <i>Ficinia</i> sp. and <i>Leucadendron bruniaides</i> Meisn., <i>Satyrium</i> sp., <i>Babiana</i> sp., <i>Lachenalia</i> sp., <i>Watsonia meriana</i> (L.) Mill.
FRs2.2 Nieuwoudtville Sandstone Renosterveld³ Main Type: FRs2 Nieuwoudtville Shale Renosterveld	The subtype is very similar to Papkuisfontein Sandstone Renosterveld, but with many wild olives (<i>Olea europaea</i> subsp. <i>africana</i>).	This ecotonal unit occurs on the plateau, at the boundary of Shale Renosterveld and Sandstone Fynbos, from Ouplaas to Matjiesfontein, further north than Papkuisfontein Sandstone Renosterveld. Much of the original extent has been transformed. Not formally conserved.	The habitat is flat, with shallow sandstones underlying sandy loams. The substrate is similar to Noord Bokkeveld Renosterveld, but the habitat is more mesic with more Fynbos elements, with groves of prominent wild olives. Trees are a significant and typical feature of this vegetation type, primarily in the form of <i>Olea europaea</i> subsp. <i>africana</i> , which may cover up to 25% of any area. The remainder of the vegetation consists of an open low to medium shrubland, with large open areas due to shallow soils and exposed sandstone bedrock. Bulbs and annuals are an important feature, but succulents are rare.	The area is slightly wetter than similar habitat in the Noord Bokkeveld, and also more mesic than Papkuisfontein Sandstone Renosterveld.	Dominant taxa: <i>Olea europaea</i> subsp. <i>cuspidata</i> (Wall. & G. Don) Cif., <i>Searsia glauca</i> , <i>Diospyros pubescens</i> , <i>Gymnosporia buxifolia</i> , <i>Wiborgia tetraptera</i> E.Mey., <i>Nylandria spinosa</i> (L.) Dumort., <i>Passerina glomerata</i> , <i>Willdenowia incurvata</i> (Thunb.) H.P.Linder, <i>Amphiglossa tomentosa</i> (Thunb.) Harv., <i>Dicerorhammus rhinocerotis</i> (L.f.) Koek., <i>Bulbinella nutans</i> (Thunb.) T.Durand & Schinz, <i>Ornithogalum thyrsoides</i> Jacq., <i>Moraea vallisbellii</i> (Goldblatt) Goldblatt, <i>Romulea sabulosa</i> Schltr. ex Bég., <i>Babiana vanzijliae</i> L. Bolus, <i>Ursinia cackieflora</i> DC., <i>Gorteria personata</i> L., <i>Felicia australis</i> (Alston) E. Phillips, <i>Cotula barbata</i> DC. Biogeographically important taxa: Special species are shared with Bokkeveld Sandstone Fynbos, and Shale Renosterveld, indicating the affiliations of this ecotonal vegetation type. These include: <i>Moraea vallisbellii</i> (Goldblatt) Goldblatt, <i>Romulea sabulosa</i> Schltr. ex Bég., <i>Romulea toxiomantha</i> M.P.de Vos, <i>Babiana vanzijliae</i> L. Bolus, <i>Euryops mirus</i> B. Nord., <i>Euryops virgatus</i> B. Nord., <i>Euryops rosulatus</i> B. Nord., <i>Gaissorhiza subrigida</i> L. Bolus, <i>Eriospermum exigium</i> P.L. Perry.
FRs2.3 Noord Bokkeveld Shale Renosterveld¹ Main Type: FRs2 Nieuwoudtville Shale Renosterveld	This subtype is restricted to shallow sandy clays overlying the sandstone cap, and was thus not previously differentiated.	Found only in the Noord Bokkeveld, between Woiwepunt and Kookfontein. The subtype has been heavily transformed by agriculture. Greatly transformed and very few remaining examples of this vegetation type still remain. Not formally conserved.	The habitat is largely flat, and this has resulted in the formation of a number of seasonal pans. The area is most closely related to Vanrhynsdorp Shale Renosterveld but is restricted to the Bokkeveld plateau, has underlying sandstone and a slightly different flora and structure. Fairly homogenous low	Slightly more arid than the area around Nieuwoudtville but very similar, with hot dry summers and mild to cold winters, with occasional light snow, and fairly frequent escarpment cloud.	Dominant Taxa: <i>Dicerorhammus rhinocerotis</i> , <i>Wiborgia sericea</i> , <i>Oedera squarrosa</i> (L.) Anderb. & K. Bremner, <i>Senecio junceus</i> (DC.) Harv., <i>Chrysocoma ciliata</i> L., <i>Nylandria spinosa</i> , <i>Senecio glauca</i> , <i>Passerina glomerata</i> , <i>Tenaxos stricta</i> (Schrad.) N.P.Barker & H.P.Linder, <i>Ehrlharta calycina</i> Sm., <i>Cotula turbinata</i> L., <i>Diascia veronicoides</i> Schltr., <i>Diascia cardiosepala</i> Hiern, <i>Chlorophytum araminifolium</i> (Willd.) Kunth, <i>Lachenalia elegans</i> W.F. Barker, <i>Sparaxis elegans</i> (Sweet) Goldblatt (on edges of pans), <i>Oxalis disticha</i> Jacq. (floating aquatic). Biogeographically important taxa: <i>Cliffortia acutifolia</i> , <i>Sparaxis elegans</i> (Sweet) Goldblatt (regional endemic on shales), <i>Oxalis disticha</i> .

Table 3 continues on the next page →

TABLE 3 (Continues...): Names, vegetation map codes and summarised descriptions of new vegetation subtypes added to the Vegetation Map of South Africa, Lesotho and Swaziland since the original 2006 publication.

Name of new subtype	Justification for separation	Distribution and protection	Landscape features & vegetation structure	Geology, soils and climate	Species composition
FRs2.4 Papkuisfontein Sandstone Renosterfeld³ Main Type: FRs2 Nieuwoudtville Shale Renosterfeld	The unit is thus more southern than Nieuwoudtville Sandstone Renosterfeld, which is very similar, but supports tall groves of wild olives, which are mostly absent from this vegetation type.	This is an ecotonal subtype and occurs on the Bokkeveld plateau at the boundary of Shale Renosterfeld and Sandstone Fynbos, in the area from Matjiesfontein south to the Lokenburg area. Not formally conserved and has lost much of its original extent to agriculture. The shallow soils and rocky areas mean that the vegetation is very sensitive to trampling.	The habitat is flat, with shallow sandstones underlying sandy loams. Trees are a not a significant or typical feature of this vegetation type, and the vegetation is a medium tall shrubland with large open areas due to the shallow soils and exposed sandstone bedrock. Bulbs and annuals are important features, but succulents are rare, and the subtype shares elements of both Sandstone Fynbos and Shale Renosterfeld.	Similar to Renosterfeld in the Noord Bokkeveld, and slightly drier than Nieuwoudtville Sandstone Renosterfeld.	Dominant taxa: <i>Searsia lucida</i> , <i>Diceratherium rhinocerotis</i> , <i>Wiborgia sericea</i> , <i>Wiborgia monopectea</i> E.Mey., <i>Lycium ferocissimum</i> Miets., <i>Euryops rehmannii</i> Compton, <i>Asparagus capensis</i> L., <i>Chrysocoma ciliata</i> L., <i>Diospyros pubescens</i> , <i>Nylantha spinosa</i> , <i>Cliffortia Juniperina</i> L.f., <i>Berkheya</i> sp., <i>Heterarachis aculeata</i> (Burm.f.) Roessler, <i>Willdenowia incurvata</i> (Thunb.) H.P.Linder, <i>Cotula turbinata</i> L., <i>Gorteria personata</i> L., <i>Senecio cakilefolia</i> , <i>Erodium moschatum</i> (allen), <i>Rhynchosidium pumilum</i> (L.f.) DC., <i>Lapeirousia divaricata</i> Baker, <i>Hesperantha pauciflora</i> G.J.Lewis, <i>Trachyantha muricata</i> (L.f.) Kunth, <i>Lachenalia elegans</i> W.F.Barke, <i>Ehretia calycina</i> Sm. <i>Prosopis</i> is a fairly common invasive tree, along with annual grasses such as <i>Lolium</i> and <i>Avena</i> . Biogeographically important taxa: Special species are shared with Bokkeveld Sandstone Fynbos, and Shale Renosterfeld, indicating the affiliations of this ecotonal vegetation type. These include: <i>Euryops mirus</i> B.Nord., <i>Euryops rosulatus</i> B.Nord., <i>Hesperantha rivulicola</i> Goldblatt, <i>Conophytum swanepoelianum</i> Rawe ssp. <i>swanepoelianum</i> , <i>Lotononis carnea</i> B.-E. van Wyk, <i>Babiana pauciflora</i> G.J.Lewis, <i>Eriosepium erinum</i> P.L.Perry, and <i>Geissorhiza subrigida</i> L.Bolus, <i>Pelargonium faciale</i> E.M. Marais, <i>Heterorachis aculeata</i> (Burm.f.) Roessler.
FS3.2 Varkvlei Shale Strandveld⁴ Main Type: FS3 Saldanha Flats Strandveld	Located close to the town of Laingville, north-east of Vredenburg. Very restricted in extent, and has already been substantially transformed, so that less than 60 ha remain intact. Large parts of this unit have been ploughed up, and most of the remaining slopes are too steep or rocky for cereal agriculture. Unconserved.	The unit occurs on a low-shale hill close to the sea, just east of Laingville, and is the only shale within the Vredenburg region, which was one of the primary reasons for the recognition of this as a distinct unit. Low to medium shrubland, with restios, succulents, low shrubs, and annuals all prominent.	The remaining portion features a fair degree of exposed shales. Soils are clays and clay loams, with heuveltjies that support better aerated, lighter soils. The unit is hot, dry and windy in summer but being close to the sea receives a substantial amount of coastal fog, which may account for the presence of Strandveld than Renosterfeld.	Dominant taxa: <i>Willdenowia incurvata</i> (Thunb.) H.P.Linder, <i>Senecio aloides</i> DC., <i>Galenia fruticosa</i> (L.f.) Sond., <i>Searsia incisa</i> , <i>Passeria filiformis</i> ssp. <i>Glutinosus</i> (Thoday) Bredenkamp & A.E. van Wyk, <i>Aspalathus cf. hispida</i> Thunb. (sterile) <i>Ruschia cf. langebaanensis</i> L. Bolus, <i>Euphorbia burmanii</i> (Klotzsch & Garcke) E. Mey. ex Boiss., <i>Searsia glauca</i> , <i>Ruschia cf. cupulata</i> Schwantes, <i>Ehretia thunbergii</i> Gibbs Russ., <i>Ficinia indica</i> (Lam.) H.Pfleiff, <i>Thesium strictum</i> P.J. Bergius, <i>Pteronia onobromoides</i> DC., <i>Asparagus capensis</i> L., <i>Chrysanthemoides incana</i> (Burm.f.) Norl., <i>Thamnochortus cf. bachmanii</i> Mast., <i>Oncosiphon suffruticosum</i> (L.) Källersjö, <i>Trachyantha falcata</i> (L.f.) Kunth, <i>Melolabium aethiopicum</i> (L.) Druce, <i>Oxalis luteola</i> Jacq., <i>Oxalis hirta</i> L., <i>Felicia dregei</i> DC., <i>Hesperantha erecta</i> (Baker) Benth. ex Baker.	
FFs13.2 Stormsvlei Aalwyn Fynbos² Main type: FFs13 North Sonderend Sandstone Fynbos [In Helme (2007c) as Stormsvlei Thicket Fynbos]	Differentiated by the vegetation, which is a mix of Renosterfeld, Fynbos and Thicket, which may be partly a product of very long fire intervals caused by rocky substrate.	Occurs in a small area, north of the town Stormsvlei. Much of original extent still remains. Unconserved.	The type has an interesting mix of Renosterfeld, Fynbos and Thicket elements, with Thicket dominating in protected gulleys.	Occurs in an area that has a bimodal autumn and spring rainfall peak.	Dominant taxa: <i>Aloe ferox</i> , <i>Protea nitida</i> Mill., <i>Protea repens</i> , <i>Leucadendron salignum</i> R. Br., <i>Sideroxylon inerme</i> L., <i>Buddleia saligna</i> Willd., <i>Olea europaea</i> ssp. <i>cuspidata</i> , <i>Gymnosporia buxifolia</i> , <i>Cliffortia ruscifolia</i> L., <i>Aspalathus hirta</i> , <i>Muraltia heisteria</i> (L.) DC., <i>Rehmania pungens</i> L'Hér., <i>Erica inaequalis</i> (Klotzsch) E.G.H.Oliv., <i>Serruria caracarpa</i> R.Br. Biogeographically important taxa: <i>Athanasia ocephala</i> (DC.) Källersjö, <i>Opuntia imbricata</i> , <i>Acrodon purpureostylus</i> (L.Bolus) Burgoyne.
SK2.2 Hantam Escarpment Shrubland¹ Main type: SK2 Hantam Karoo [In Van der Merwe et al. (2008b) as <i>Galenia africana</i> - <i>Pteronia glauca</i> Escarpment Karoo]	The abundance of <i>Pteronia glauca</i> is diagnostic of this subtype.	This subtype is located on the slopes of the Hantam Mountain, the undulating slopes of the escarpment in the Platberg and surrounding area southwest of Calvinia, and the slopes where the Roggeveld and Klein Roggeveld Mountains meet. The subtype is also found in the mosaic between the Roggeveld and Koedoesberg Mountains. Elements can also be found on ridges between dolerite soils at Grootfontein, east of Nieuwoudtville.	The landscape is a mix of undulating slopes of the escarpment in and can also be found in the mosaic between the Roggeveld and Koedoesberg Mountains. Small patches can be found on dolerite ridges. Shrub cover is high (> 70%), while grass and annual components are not well represented.	Land types include Fb, Ia, Ib and Da, ranging from 700 m to 1 200 m above sea level. Ecce shales and dolerite intrusions predominate on gently sloping terrain. A low rock cover (< 10%) or a high rock cover (> 80%) consisting of gravel, small stones, stones and boulders, covers the light brown or brown loamy soils.	Dominant taxa: <i>Pteronia glauca</i> Thunb., <i>Eriosepium purpureum</i> Burch., <i>Pentzia incana</i> (Thunb.) Kuntze, <i>Ruschia cradockensis</i> , <i>Eriosepium ericoides</i> (L.f.) Druce, <i>Asparagus capensis</i> L., <i>Ruschia intricata</i> H.E.K. Hartmann, <i>Aridaria noctiflora</i> L., <i>Drosanthemum</i> sp., <i>Pteronia pallens</i> L.f.

Source: ¹Helme 2007b; ²Helme 2007a; ³Helme 2007c; ⁴Helme and Koopman 2007; ⁵Van der Merwe et al. 2008b

Twelve of the centres of plant endemism have not been refined in the nine-year update period. Of these, seven (i.e. Albany Centre, Drakensberg-alpine Centre, Barberton Centre, Wolkberg Center, Sekhukhuneland Centre, Soutpansberg Centre and Griqualand Centre) occur in the northern and central interiors of the country. These centres coincide with areas that either historically fell within the homeland territory (Wessels et al. 2004), are agricultural areas or are areas of economic development. Thus, botanical exploration has not been conducted to the same extent as in the eastern and western coastal regions where the updates have occurred. These unrefined parts of the northern, central interior and parts of the coastal Western Cape need to be prioritised for future refinement as the units in these regions are often large and were initially mapped at a coarse scale by inferring vegetation types from environmental patterns, e.g. land types were used to map many vegetation types in the Nama Karoo. In addition, many of these areas are in various stages of land-use transformation caused by urban and industrial development (Donaldson 2006), platinum and coal mining (Jeffrey 2005; Armitage, McDonald & Tredoux 2007), the installation of solar and wind farms (Sparks et al. 2014) and shale gas development activities (Greef 2012).

To improve the VEGMAP in these regions, we need to streamline a process of data collection from the mapping of units to the submission and acceptance of updates, while providing reasonable standards to maintain data quality. To this end, we are developing a defined classification hierarchy for the VEGMAP, explicit standards to guide the mapping of VEGMAP units across each of the biomes and a set of guidelines for submitting and accepting updates to the VEGMAP. We are also exploring more proactive approaches to narrowing gaps between the expert driven classification that underpins the current VEGMAP and the actual communities that they represent.

Acknowledgements

The Vegetation Map Project is a large collaborative project that has spanned over two decades. Many have contributed to the success of this project and are too numerous to name individually; however, they are acknowledged in the original publication. The authors wish to thank Mr Nick Helme, Dr Helga van der Merwe, the late Mr Robb Scott-Shaw, Mr Boyd Escott and Mr Jan Vlok for sharing data that contributed to the updated areas in the 2009 and 2012 versions of the vegetation map. The authors also thank Emily Botts for proofreading.

Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

A.D. prepared the draft; L.P. implemented the bulk of the technical changes to the map; and T.R. and A.S. edited the text.

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