Semela

Helehelele semela, kobo ya lefatshe!
Seng sa hao se tletse naha ho pota.
Ekaba matswatlareng, ekaba motsitseng.
Ekaba mongobong, ekaba lehlabatheng,
Baheno ha ba hlome ba a jala sebele,
Ba jala ba dumellwa kapa ba hanelwa.

Ha o namme tjee maoto o a nka kae?
Ha o batalletse tjee maqheka o a nka kae?
Ke bua ka wena kobo ya lefatshe,
Ke bua ka wena palesa ya lefatshe,
Ha o palesa feela empa o bile o morena,
Hoba o ratwa ke batho le diphoofolo.

Ke se ke itse o hole o name semela,
Ke se itse peseletsa o peseletse kgutsana,
Nama o namele lefatshe o tlise ditharollo,
Ditharollo e be tsa tlala le ona malwetse;
Le hara malwetse ke bua ka ana a kajeno;
A kajeno ke afe ha e se bona bo HIV le AIDS?

(Ka M.A. Dladla)

Grassland Biome 8

Ladislav Mucina, David B. Hoare, Mervyn C. Lötter, P. Johann du Preez, Michael C. Rutherford, C. Robert Scott-Shaw, George J. Bredenkamp, Leslie W. Powrie, Louis Scott, Kelson G.T. Camp, Sarel S. Cilliers, Hugo Bezuidenhout, Theo H. Mostert, Stefan J. Siebert, Pieter J.D. Winter, John E. Burrows, Linda Dobson, Robert A. Ward, Marc Stalmans, Edward G.H. (Ted) Oliver, Frances Siebert, Ernst Schmidt, Khotso Kobisi and Lerato Kose

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Figure 8.1 Le Bihan Falls surrounded by species-rich basalt grasslands with *Felicia muricata* in the foreground, on the Maletsunyane River near Semonkong (south-central Lesotho). At 189 m, the falls are supposed to be the highest single-drop waterfall in southern Africa.

W.S. Matthews

List of Vegetation Units

1. Introduction

1.1 Grassland Biome and 'grasslands': What's in the Name?

This chapter is a descriptive, biogeographical and conservation account of the Grassland Biome as defined by the new boundaries in the National Vegetation Map (Mucina et al. 2005; see also Chapter 18 in this book). Its primary aim is to describe patterns and variation in the floristic and plant-functional composition and environmental parameters of plant communities in the Grassland Biome. Ideas on the origins of plant diversity and biogeographical patterns in grasslands, the problems regarding the interface with other biomes, and the topical conservation issues are also featured. This chapter extends and updates previous reviews featuring the ecology and origins of the Grassland Biome patterns (e.g. Low & Rebelo 1996, O'Connor & Bredenkamp 1997, Bredenkamp et al. 2002) by presenting new data as well as new interpretations.

The term 'grassland' is one of the most used, misused and abused terms of vegetation ecology—both by vegetation ecologists and by users of the products of their work. Obviously, any piece of land dominated by grasses can be called 'grassland'. This term then is addressing purely the structural facet of this vegetation—it is neutral and basically all inclusive. Some researchers would take this approach to global level and call all grasslands of the world 'Grassland Biome' (e.g. Coupland 1993), including grasslands of both temperate and tropical provenience. And it is here where the conceptual problems with the term 'grassland' start. Following the definitions of biomes (Rutherford & Westfall 1986, Mucina 2000), we separate two major (so-called climatically controlled) grassland types into temperate and tropical. Despite major structural similarities and often common evolutionary roots, they differ in the major features of macroclimate, structure and, from a textural point of view, in composition of life forms and species. The analytical comparisons of these two different types of grassland are justified at the broad scale (across continents), but become very problematic due to different sets of ecological and evolutionary driving forces at detailed scales (such as landscape and habitats). The (sub)tropical grasslands are considered to be part of the (sub)tropical biomes such as the Savanna Biome and Indian Ocean Coastal Belt (see the relevant chapters in this book). The warm-temperate and cool-temperate grasslands (and shrublands embedded within these) of the Highveld, Drakensberg and its northern continuation in the form of the Northern Escarpment, a whole suite of sub-escarpment grasslands, and small pockets of (most) summit sourveld composed of grasslands and savannoid bushveld (see below) make up the

Grassland Biome in our view. There are also azonal (satellite) patches of Grassland Biome communities that occur outside the main biome boundaries, such as grassy shrublands on koppies of Gh 4 Besemkaree Koppies Shrubland embedded within Nama-Karoo. The existence of these communities is linked to special habitat conditions involving shallow soils and rocky outcrops (Figure 8.2).

The extent of the Grassland Biome in Low & Rebelo (1996) and that represented here differ, especially with respect to the edaphic grasslands occurring within the subtropical biomes of South Africa. For instance, Low & Rebelo (1996) mapped Grassland Biome along the eastern coast from the Albany region, through Pondoland as far as Maputaland in the north. We consider these grasslands either secondary (Albany Coastal Belt and Transkei Coastal Belt) or edaphic (Pondoland sourveld and Maputaland coastal grasslands). In the light of this and for climatic reasons, two 'grassland' units such as SVs 4 Ngongoni Veld and SVs 5 KwaZulu-Natal Sandstone Sourveld (both classified as Sub-Escarpment Savanna, see the chapter on Savanna Biome in this book) are not considered as Grassland Biome units. Our knowledge about the primary versus secondary status of the Ngongoni grasslands is in its infancy. We hypothesise that 'ngongoni (*Aristida junciformis*) is a grass of high competitive potential and can, by virtue of building dense swards resistant to grazing damage, control recruitment of woody plants. In any case, both of the latter units are of transitional character and further insights into their ecology (especially patterns of floristic composition) and origins may result in their re-classification.

In this chapter the term 'grassland' refers to herbaceous vegetation of relatively short and simple structure that is dominated by graminoids, usually of the family Poaceae. Woody plants are rare (usually low or medium-sized shrubs) or absent or are confined to specific habitats, such as smaller escarpments or koppies. Core grassland areas usually have deep, fertile soils although a wide spectrum of soil types occurs. Precipitation is strongly seasonal and the growing season lasts approximately half the year.

1.2 Global Patterns and Local Distribution

The Grassland Biome (latitude 25° to 33° S) is part of the global Temperate Grassland Biome, which comprises the Eurasian steppes and American prairies (Great Plains) in the northern hemisphere as well as the Argentinean and Uruguayan pampas (and to an extent also grassland of southern Brazil), the temperate grasslands of the Australian Alps and the tussock grasslands of New Zealand in the southern hemisphere. The most extensive temperate grasslands in the northern hemisphere are the Eurasian steppes, which extend almost a third of the way around the world between latitudes 45° and 60° N,

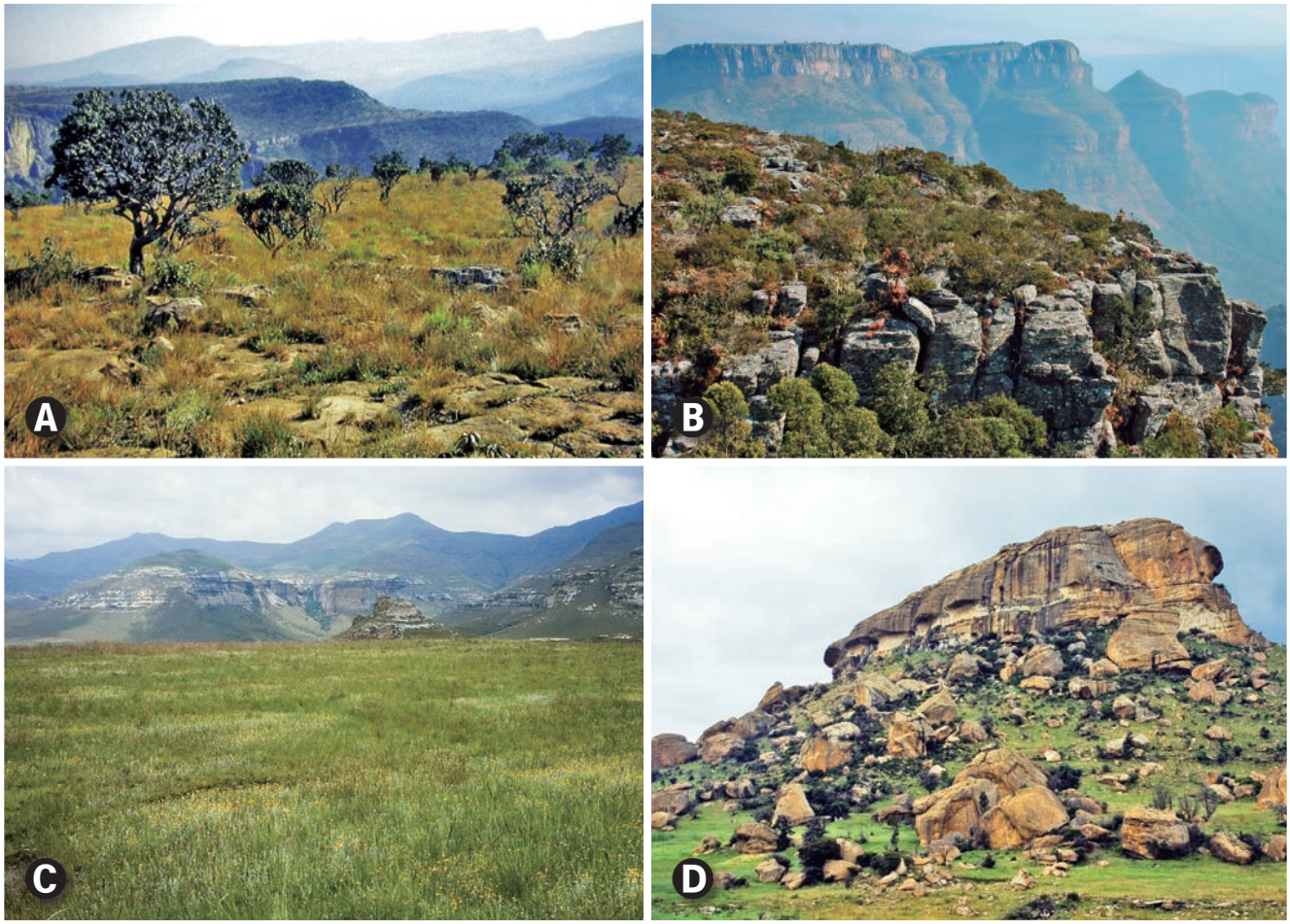

Figure 8.2 Various faces of plant communities of the Grassland Biome: A: Proteoid 'savanna' on shallow soils on quartzite with scattered *Protea rubropilosa* trees, near Aventura Blydepoort (Mpumalanga Escarpment); B: Dense shrubland of 'montane fynbos' on the Northern Escarpment of Mpumalanga; C: Typical species-rich high-altitude (2 000 m) moist grassland with *Monocymbium ceresiiforme* and numerous *Helichrysum* species on Clarens sandstone in the Golden Gate Highlands National Park near Clarens (Free State); D: Slope shrublands (with *Buddleja salviifolia*, *Euclea coriacea*, *Myrsine africana*, *Diospyros austro-africana* and *Heteromorpha frutescens* var. *abyssinica*) on a sandstone koppie near a Basotho Cultural Village in the Qwaqwa National Park near Phuthaditjhaba (Free State). All photographs by L. Mucina.

from the Dobrogea steppes near the mouth of the Danube (Romania), the northern shores of the Black Sea, through Ukraine and southern Russia, to northern Central Asia almost to the Yellow Sea in China (Manchuria). The entire Midwest of North America, ranging from the central Canadian provinces of Alberta, Saskatchewan and Manitoba to the Gulf of Mexico (30° to 55° N latitude) was covered by prairies prior to transformation. The Argentinean pampas are the largest continuous area of temperate grass steppe in the southern hemisphere and occur between 32° and 38° S.

The latitudinal differences between the two hemispheres in terms of occurrence of the temperate grasslands can be ascribed to the larger land mass concentrated in the northern hemisphere and consequently to harsher (more continental) climates governing the larger land stretches of North America and Eurasia as opposed to the more oceanic climates of the southern hemisphere.

In South Africa, the extent of the Grassland Biome can be reasonably well defined on the basis of vegetation structure in combination with environmental factors, primarily the amount of summer rainfall and minimum temperatures in winter (e.g. Rutherford & Westfall 1986). The Grassland Biome in South Africa occurs mainly on the high central plateau (Highveld), the inland areas of the eastern seaboard, the mountainous areas of KwaZulu-Natal and the central parts of the Eastern Cape. The topography is mainly flat to rolling, but also includes mountainous regions and the Escarpment. The elevation associated with grassland regions is from about 300–400 m (Gs 2 Ithala Quartzite Sourveld and Gs 9 Midlands Mistbelt Grassland, respectively) to Thabana Ntlenyana (3 482 m)—the highest mountain in southern Africa. The Lesotho Plateau and highest peaks of the Drakensberg are covered by a mosaic of grassland (Gd 8), heathlands (Gd 10) and mires (AZf 5), in which plants exhibit xeromorphic characteristics that reflect the severity of the climate at these localities. The effect of being at a high elevation in the interior of the continent results in large temperature differences from one time of the year to another and a high frequency of frost. In winter the climate on the Highveld is very cold and dry.

The occurrence of grasslands below the main Escarpment (Drakensberg), both in KwaZulu-Natal and the Eastern Cape, with floristic links to the high-altitude Drakensberg grassland, is interesting. One possible explanation for their occurrence is climatic anomalies such as the formation in winter of streams of cold air that descend from the Drakensberg and create severe climatic conditions that support frost-tolerant grasslands rather than savanna vegetation on the affected slopes and valleys.

2. Origins and Future of the Grassland Biome

2.1 Palaeoecological Patterns

Although fossil pollen records alone are not firm enough evidence for determining the time of origin of grasses, they suggest that Poaceae (the dominant element of the grasslands on global scale) and related families such as the Restionaceae, probably first developed in the Late Cretaceous (Jardine & Magloire 1965, Muller 1981, Scott & Srivastava 1984, Grass Phylogeny Working Group 2001). Earlier palaeontological studies suggested that the Poaceae was a minor component of global vegetation for several millions of years before grasslands finally became globally prominent in the Neogene worldwide (Leopold 1969, Thomasson 1988, Cerling et al. 1997) and in southern Africa (Coetzee 1978, Van Zinderen Bakker 1984, Coetzee & Rogers 1982, Scholtz 1985, Scott 1995). However, recent findings from India (Piperno & Sues 2005, Prasad et al. 2005) reported that the grasses must not only have been well diversified in Gondwana by the Maastrichian (the latest Cretaceous), but that they have also been incorporated into the diet of dinosaurs. In southern Africa the lack of terrestrial pollen records and uncertain dating of available evidence make it difficult to determine more precisely when significant grassland expansion took place (Van Zinderen Bakker 1984, Scott 1995). Cooling of global ocean temperatures is indicated in the marine isotope record (Shackleton & Kennet 1975) during the Late Miocene, and this seems to coincide with the development of modern biomes such as the Nama-Karoo, Fynbos and possibly also the Grassland Biome in southern Africa (Scott et al. 1997, Linder 2003). In southern Africa the global cooling during the Late Tertiary was accompanied by events of continental uplift, which started in the Early Miocene and culminated in significant vertical movement of up to 600–900 m in the southeastern part of the subcontinent during the Pliocene (Partridge 1997). This uplift moved a considerable area into colder higher altitudes more suitable for grasslands than for (sub)tropical savanna woodlands. Uplift in the central to western parts of the continent was much less pronounced, resulting in a sloping gradient from east to west. The effects of the gradient, enhanced by the east-west moisture gradient of the continent which was already in existence by then (Partridge 1997), may have determined the limits of grassland.

A major event in the continuing evolution of grasslands was the evolution of C_4 metabolism, which is today clearly manifested in the wide distribution of 'Kranz grasses' in the tropical and drier summer-rain regions of southern Africa (Vogel et al. 1978; see Gibbs Russell et al. 1991 for classification of the southern African grasses into various types of the C_4 syndrome). Although C_4 metabolism is most prominent in the grasses, this photosynthetic strategy is also found in some unrelated dicotyledonous families (e.g. Kadereit et al. 2003). The C_4 evolved many times during the Tertiary period (Cerling et al. 1997, Ehleringer et al. 1997, Keeley & Rundel 2003). Fossil chloridoid grasses were, however, reported from the Miocene of Kansas, and the Middle Miocene from Kenya (Thomasson et al. 1986, Retallack 1992). It is possible that plants with the C_4 strategy survived well under unique global environmental conditions including global cooling during the Neogene (Shackleton & Kennet 1975) and declining atmospheric pressures of CO_2 that developed during the Tertiary. The ability of C_4 species to bind CO_2 more effectively under dry tropical and subtropical conditions without excessive water loss furthermore give them the advantage to survive under low atmospheric CO_2 concentrations (Cerling et al. 1997, Ehleringer et al. 1997, Sage 2004). Since C_3 and C_4 metabolic mechanisms result in different degrees of ^{13}C isotope fractionation in grasses, data derived from soils, speleothems (stalagmites), fossil bones and fossil tooth enamel, can be used to trace the early history of C_4 grasses. Results suggest that grasslands dominated by C_4 grasses expanded rapidly during the Late Miocene (~ 8–4 mya) but the role of atmospheric CO_2 pressures as a possible trigger of this expansion remains uncertain. Some recent palaeoclimatic studies are at variance with the assumption that CO_2 played a significant role in the rapid spread of C_4 grasses since the CO_2 concentrations in Late Miocene were not as low as presumed earlier (Pagani et al. 1999, Pearson & Palmer 2000). Isotopes from soils, grass phytoliths and pollen evidence from the Last Glacial Maximum (LGM) suggest that at higher latitudes and altitudes C_4 grasses in southern Africa were less prominent, except in the dry southern Kalahari region where they were relatively prominent (Vogel 1978, Talma & Vogel 1992, Lee-Thorp

& Beaumont 1995, Lee-Thorp & Talma 2000, Scott 2002). Their distribution was probably limited by unfavourably low winter temperature extremes in the southern Highveld that cancelled out any advantages gained from lowered CO_2 concentrations in the atmosphere (Scott 2002).

The origin of South African grasslands (of the Grassland Biome in particular) has been the subject of a number of speculative reviews as well as serious scientific analyses (Bews 1929, Acocks 1953, Ellery et al. 1991, Meadows & Linder 1993, Scott et al. 1997, Anderson 1999, Bredenkamp et al. 2002). Several hypotheses have been formulated, especially addressing the question of lack of trees in the grassland:

1) Acocks (1953) ascribed the current extent of the grassland to recent human (agricultural) activity which destroyed large stretches of forests, considered the climatic climax in the area.

2) Tinley (1982) suggested that woody elements are excluded from grasslands by the waterlogging desiccation effect of shallow pan horizons.

3) Ellery et al. (1991) suggested that climate contributes to the maintenance of grassland by maintaining a disturbance (fire and grazing) regime that excludes woody plants.

4) Bredenkamp et al. (2002) argued that the South African grassland is a climatically controlled ecosystem in which cooler conditions at high altitudes are one of the major driving forces that prevent colonisation of trees of a generally tropical origin.

The first hypothesis has been convincingly rejected (Meadows & Linder 1993). O'Connor & Bredenkamp (1997) found the waterlogging argument incompletely supported in the Grassland Biome. The third (fire-related) hypothesis does not address the fact that both the Grassland and Savanna Biomes are fire-prone ecosystems (see also arguments in Bredenkamp et al. 2002). The case of the fourth hypothesis is still undecided, since it has not been corroborated by conclusive evidence rooted either in experimental studies of the life history of extant woody species or at least in a circumstantial manner by phylogenetic analyses.

However, these review accounts do not take into consideration the differences between the Highveld (dominated by C_4 grasses) and Drakensberg (dominated by C_3 grasses) regions of the Grassland Biome. Bredenkamp et al. (2002) did acknowledge the Drakensberg grasslands to be rich in endemic taxa and concluded that they must be primary and old, but their argument does not translate into a testable hypothesis addressing the reasons for the lack of trees in the Grassland Biome.

Firstly and most importantly, we have to admit that there are indeed woody species (including tall shrubs and trees) in some communities of the Grassland Biome. These 'shrubland' units, as featured in the section 8 of this chapter, are usually limited to special substrates showing a higher moisture input or retention ability (koppies, deep kloofs and gullies, steep slopes of incised valleys). Shrubland and tree-dominated vegetation embedded within the Grassland Biome also occurs on azonal alluvial soils. The shrubland units may be seen as relicts of past climates and vegetation patterns, and show phytogeographic links to various phytochoria. For instance the Gh 4 Besemkaree Koppies Shrubland straddles the Nama-Karoo/Grassland interface and Gh 8 Bloemfontein Karroid Shrubland may be a direct relict of the dry climate periods; the units Gm 5 Basotho Montane Shrubland, Gd 9 Western Lesotho Basalt Shrubland and Gm 2 Senqu Montane Shrubland show direct floristic links with Drakensberg grasslands and units such as Gh 12 Vaal Reefs Dolomite Sinkhole Woodland, Gh 13 Klerksdorp Thornveld, Gm 21 Lydenburg Thornveld, Gm 7 Northern Free State Shrubland and Gs 5 Northern KwaZulu-Natal Shrubland, link floristically with the Savanna Biome.

Secondly, we have to address the question of the origin of the high-altitude, endemic-rich and C_3-dominated cool-temperate grasslands in a different way than the C_4-dominated highveld grasslands, both under dry and mesic conditions. The former vegetation experiences cold and wet conditions (MAP as high as 2 500 mm in places!; with some rainshadow anomalies in Lesotho) and relatively stable climatic conditions during the periods of large climatic fluctuations of the Plio-Pleistocene. The high-altitude ecosystem did clearly react to Plio-Pleistocene climatic cycles, as suggested for instance by Scott (1989) who found that montane fynbos tended to expand to lower altitudes during the LGM. The direct data on the phylogenetic age of the endemic Drakensberg lineages, such as for *Ehrharta longigluma* (Verboom et al. 2003), and the fact that the highest number of endemics is found in young, evolutionary dynamic families such as the Asteraceae and Scrophulariaceae suggest that the speciation events which led to the Drakensberg endemism are rather recent (last 5 my).

The major grassy components of the Drakensberg grasslands are of either northern (e.g. *Festuca*, *Bromus*, *Koeleria*) or southern (e.g. *Aristida*, *Merxmuellera*, *Pentaschistis*) provenience, hence showing links to the East African (and in effect further Eurasian) mountains on one hand or to the post-Gondwanan flora of the Cape on the other. The northern track is strong and represented by nongrassy genera such as *Erica* (McGuire & Kron 2005), *Helichrysum* (Bayer et al. 2000), *Ranunculus* (Hörandl et al. 2005), and presumably many northern genera such as *Festuca*, *Geum*, *Ajuga*, *Rorippa*, *Scabiosa*, *Myosotis* and *Alchemilla*. Many of the current Drakensberg floristic constituents have been found to be firmly embedded within the Cape clades: *Cliffortia* (Whitehouse 2002, Galley & Linder 2006), Restionaceae (Linder 2000), *Leucadendron* (Barker et al. 2004), *Ehrharta* (Verboom et al. 2003), *Protea* (Reeves 2001), *Disa* (Bellstedt et al. 2001), *Phylica* (Richardson et al. 2001), *Moraea* (Goldblatt et al. 2002), *Eucomis* and *Ledebouria* (Pfosser et al. 2003), *Metalasia* (Karis 1989) and *Heliophila* (Mummedorf et al. 2005), among others. We hypothesise the same patterns also for genera such as *Aristea*, *Berkheya*, *Cotula*, *Euryops*, *Felicia*, *Hesperantha, Passerina*, *Othonna*, *Romulea* and *Ursinia*, although not excluding the possibility of two-way migrations between the Cape and Drakensberg using the Karoo Escarpment as bridge. Notable local (Drakensberg) radiations include *Schizochilus* (Linder 1980), a *Ledebouria/Resnova* alliance (Pfosser et al. 2003), *Eucomis*, *Galtonia*, *Berkheya*, *Helichrysum* and *Hypoxis*.

Interpretation of the highveld grasslands poses a different evolutionary challenge. Here endemics are very rare and, if present, are mostly found in mainly quartzite sourveld communities, showing a clear link to the flora of the Escarpment (Drakensberg in the broad sense)—see the position of the centres of endemism (CE) as defined by Van Wyk & Smith (2001) and recognised migration links such as the Magaliesberg Extension (White 1978).

Determinants for grassland ecotones in southern Africa are discussed by O'Connor & Bredenkamp (1997). From the fossil pollen evidence it is clear that marked shifts in grassland composition and grassland boundaries within the Nama-Karoo, Savanna and afromontane fynbos did occur during the glacial and interglacial periods (Scott et al. 1997). During glacial periods a considerable lowering of vegetation zones forced temperate (frost-controlled) grasslands to spread over a much wider

area, extending its limits by more than 100 km to the north of the current Highveld region. The current high-altitude grassland of the Drakensberg, dominated by C_3 grasses and fynbos elements showing the same assimilation syndrome, followed this pattern (Scott 1989). While Late Quaternary grasslands were generally more extensive, interglacial events showed grassland/savanna distributions similar to the present pattern except during peak temperature or increased CO_2-concentration events (Scott & Vogel 1983, Bond et al. 2003a). An example is a brief and limited southward expansion of savanna over the northern Highveld during the Middle Holocene temperature optimum (Scott & Vogel 1983). During the Early Holocene dry phase, karroid shrubs were prominent in the southern parts of the current Grassland Biome (Scott & Nyakale 2002, Scott et al. 2005) at the expense of grasses, but grass cover gradually increased to a maximum at ca. 2000 years BP, following the southernmost penetration of the Inter-Tropical Convergence Zone (Scott 1993, Tyson 1999, Scott & Nyakale 2002, Scott & Lee-Thorp 2004, Scott et al. 2005). Pollen records suggest the open nature of modern grasslands in the moist eastern parts of southern Africa was apparently not the result of recent anthropogenic activities (Acocks 1953), but that they were well established throughout the Holocene (Scott & Vogel 1983, Meadows & Linder 1993). Karoo expansion into the grassland areas during the 20th century was predicted by Acocks (1953), but did not realise as a result of lower grazing intensity and adequate rainfall (Hoffman & Cowling 1990).

2.2 Climate Change Outlook

Ellery et al. (1991) predicted (and illustrated their prediction on a simple map) that an increase of 2°C plus and 15% less precipitation than present would result in a dramatic change in the extent of the Grassland Biome. Their map has shown that basically only C_3-dominated grasslands of the Drakensberg and their northern extensions along the Northern Escarpment would survive such dramatic change. Present predictions on the extent of the Grassland Biome under climate change scenarios (Rutherford et al. 1999; see also Figure 8.3) brought on by an increase in atmospheric carbon dioxide foresee a significant reduction in the extent of the biome. Modelling scenarios predict a 3°C warmer and much drier future for southern Africa, with January temperatures increasing most in the central interior and rainfall decreasing by 5% in the north and 25% in the south. This increased temperature and aridity may obliterate the western portion of the biome and possibly a third to 55% of the biome extent may be lost. Frosts, which often kill the seedlings of woody species, will become less frequent so that woody plants will be able to invade grasslands more easily, transforming them into savanna (WWF 2001).

Other modelling studies addressed the role of fire in controlling the distribution of southern African biomes, including the Grassland Biome. Using a Dynamic Global Vegetation Model, Bond et al. (2003b) showed that exclusion of fire in regions with MAP above 650 mm would lead to an expansion of fire-sensitive forests. The regions with precipitation below 650 mm per year would show an increase of woody cover, but no trend of changing composition to forest.

3. Environmental Features

3.1 Current Climate

The cold, dry conditions of the Highveld region are the result of the high elevation and inland continental aspect of these areas, and these factors are important in defining the current climate of these areas. The temperate grasslands of southern Africa occur where there is summer to strong summer rainfall and winter drought. The rainfall may vary spatially from 400–2 500 mm per year and corresponds to the amount of rainfall found in other parts of the world where similar vegetation is found. Frost is a common phenomenon; the coldest periods (June–August) are exacerbated by aridity or along an increasing elevation gradient. Fog is found on the upper slopes of the Great Escarpment and seaward scarps, which support hygrophilous mistbelt vegetation. The biome has high lightning flash densities, making the incidence of lightning-induced fire a relatively high likelihood (Schulze 1984).

Studies of grassland vegetation activity from satellite data indicate that grasslands are strongly seasonal with a late summer maximum in vegetation activity and near complete termination of activity during the winter months. The areas on the western side of the biome, in the region that borders with Nama-Karoo and arid savanna, have the highest vegetation activity in February, March and April. There is a correlation between increasingly late summer to autumn maximum vegetation activity and proximity of the adjacent Nama-Karoo and arid parts of the Savanna Biome. The temperate eastern half of the Grassland Biome has a period of maximum vegetation activity in January. Some of the steeper mountain regions within this eastern region are more active in December (Hoare & Frost 2004).

3.2 Geology, Soils and Moisture Availability

The Grassland Biome covers large areas of the central part of South Africa. In the general geological description of the Savanna Biome (see the relevant chapter in this book) the history of the Kaapvaal Craton is summarised, which also applies here. The grasslands of South Africa cover a more significant portion of the Karoo Supergroup than the regions of the Savanna Biome, therefore somewhat more attention will be paid to this important sequence here.

The Kaapvaal Craton is the thick, stable block of continental crust that underlies most of the central, northern and eastern parts of South Africa. It was formed by the welding together of ancient blocks of crust by voluminous intrusions of granitoid plutons around 3 gya, which formed a continental crust strong and stable enough to preserve the thick volcano-sedimentary sequences of the Witwatersrand, Ventersdorp and Transvaal Supergroups as well as the massive intrusion of the Bushveld Igneous Complex.

During the Proterozoic, orogenic activity on the fringes of the craton formed the Namaqua-Natal Metamorphic Belt which marks the western and southern boundaries of the craton. In the north the Limpopo Belt forms the boundary between the Kaapvaal and the Zimbabwe Cratons.

The craton has survived several episodes of supercontinental assembly and break-up, such as those of Rodinia around 1 gya and Gondwana at the end of the Precambrian being the most recent. The Kaapvaal Craton and its adjacent orogenic belts came to support the Karoo depositional basin, one of several large basins in southern Gondwana, formed towards the end of the Carboniferous and still covered in large parts by these sediments.

The Pan-African orogenic cycle of around 550 mya resulted in the juxtaposition of several continental plates to form southern Gondwana. These have since rifted apart to form southern South America and the Falkland Islands, southern Africa, East Antarctica and the microplates of West Antarctica. Large, intra-

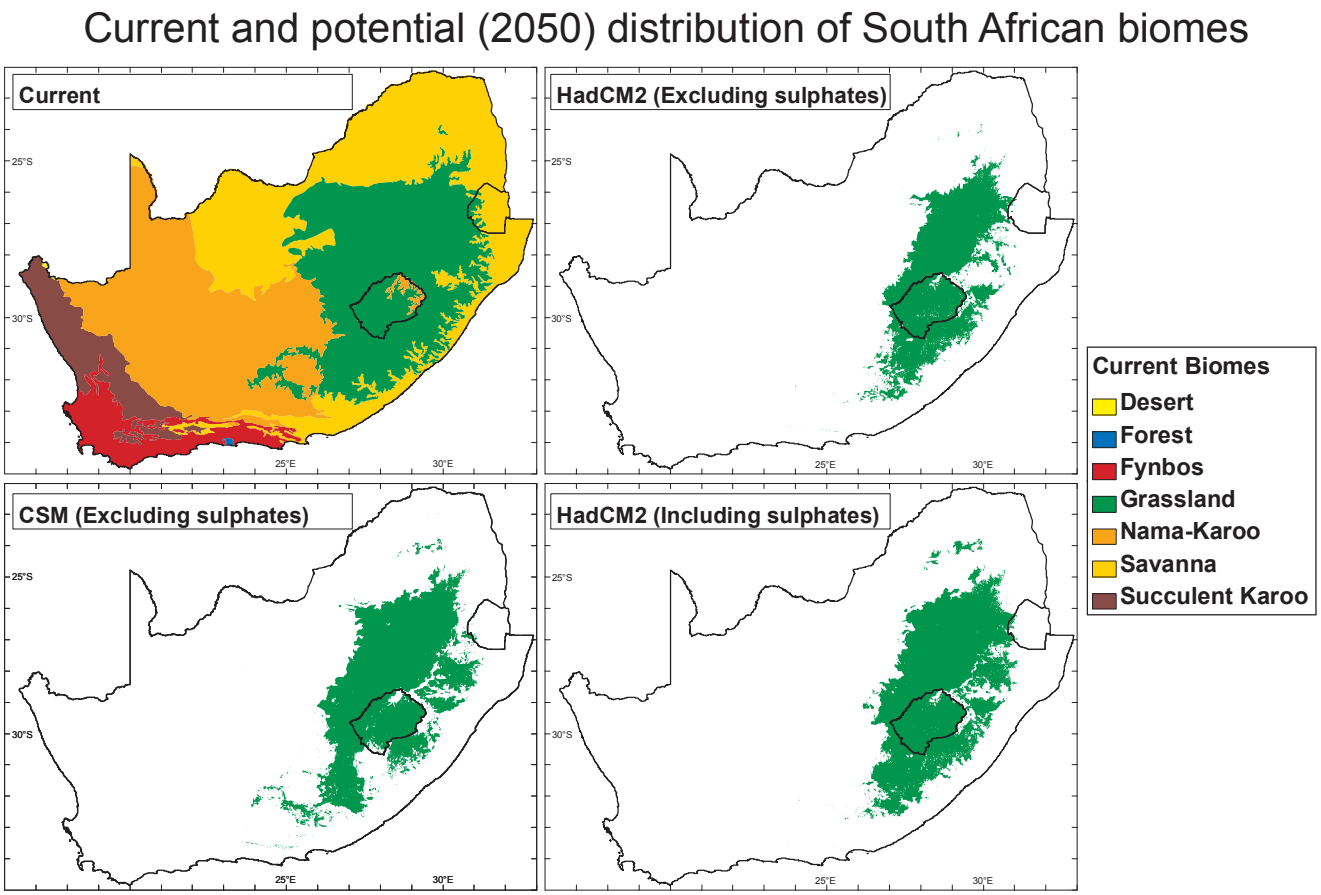

Figure 8.3 Potential distribution of the Grassland Biome with projected climate change corresponding to a doubling of CO_2 concentration from three scenarios generated by CSM and HadCM2 with and without sulphates (from Rutherford et al. 1999). The 'Current' biome coverage follows Rutherford & Westfall (1986).

continental basins formed on this land mass that at one stage, during the Early Permian, covered some 4.5 million km^2 and continued to accumulate sediments for over 100 my (Smith et al. 1993).

The supercontinent drifted over the South Pole during the Late Carboniferous, resulting in a large ice sheet that covered most of the early Karoo basin and surrounding highlands to form the widespread Dwyka Formation at the base of the Karoo Supergroup.

Smith et al. (1993), in their review paper on the Karoo-aged basins of southern Africa explain how subduction of the palaeo-Pacific plate below southern Gondwana resulted in the formation of the 'Gondwanide' mountains that deformed and truncated the southern rim of the Karoo basin. This folding of the older Karoo sediments is clearly visible in the southernmost parts of the Karoo. Furthermore, sediments derived from the erosion of this mountain chain accumulated in large deltas that built into an inland sea to form the Upper Ecca Group. These broad delta plains together with a humid climate promoted the formation of peat which would later form the vast coal reserves of southern Africa.

Overlying the Ecca sediments are those of the Beaufort Group that were deposited on broad alluvial plains during a time when the climate warmed and dried as the supercontinent drifted towards lower latitudes. These Permo-Triassic times saw an abundance of reptilian fauna; particularly prominent were the therapsids or 'mammal-like reptiles' of which the Karoo preserves the longest and most complete record (e.g. Cluver 1978, Smith et al. 1993).

Aridification continued in the upper Karoo Sequence during the Jurassic and culminated in the deposition of dune sands on a playa-like environment. These sediments of the Elliot and Clarens formation were eventually covered by thick outpourings of basalt of the Drakensberg Group which brought the Karoo sedimentation to a close. This volcanic activity occurred basin-wide during the Jurassic and included the intrusion of Karoo Dolerite dykes that form a characteristic feature of the Karoo and some of the grassland landscapes. These flood basalts formed as a result of the initial stages of the rifting apart of Gondwana during the Late Jurassic to form the more familiar arrangement of the continents today. For this reason, part of this flood basalt province is found on the Antarctic continent, where it is known as the Ferrar traps. The estimated volume of lava erupted in the Karoo basin, including the Ferrar basalts, is 2.5 × 10^6 km^3 (Wignall 2001), which would have had a profound effect on the global climate and life on earth at the time.

Moisture availability is the major factor which can be used to divide the Grassland Biome into two classes (Ellery et al. 1995). Moist grassland consists of sour grasses, leached and dystrophic soils and high canopy cover, high plant production and high fire frequency. Dry grassland has sweet, palatable grasses, soils are less leached and are eutrophic and canopy cover, plant production and fire frequency are lower than in moist grasslands. Sweet grasses, mostly belonging to the subfamily Chloridoideae, have a lower fibre content and maintain a higher above-ground nutrient content in winter than sour grasses, belonging mostly to the subfamily Panicoideae (Andropogoneae), thus making them more palatable to stock (Rutherford & Westfall 1986).

Sour grasslands (sourveld) in South Africa are generally found at higher altitudes—usually linked to high water supply, and where parent material gives rise to soils with a low base status. Sweet grasslands (sweetveld) occur mainly at lower altitudes, in areas with lower water supply, and where parent material gives rise to soils with a high base status.

3.3 Fire

Grassland is a fire-prone ecosystem, hence fire is vital to the maintenance of both its structural and textural patterns (Edwards 1961, 1968, Granger 1976, Tainton 1981, Everson 1985, Bainbridge 1993, O'Connor & Bredenkamp 1997). Dynamic vegetation models indicate that without fire most of the eastern half of South Africa would be covered in trees (Bond et al. 2003b). Fire exclusion studies indicate that in the absence of fire there is a succession trend towards shrublands with fynbos affinities and then to forest in grasslands with annual rainfall of more than 650 mm. In grasslands with less than 650 mm of annual rainfall, the exclusion of fire leads to an increase in tree density without a change in species composition (Figure 8.4). Grassland vegetation with less than 650 mm annual rainfall is therefore climate-limited, whereas those areas with more than 650 mm annual rainfall are fire-limited and are in a meta-stable state, with alternate climate-dependent states (Bond et al. 2003b).

The key components of a fire regime are the frequency, seasonality and intensity of fires (Gill 1975). Fire in grasslands occurs every 1–4 years and, in montane grasslands, occurs mostly in late winter from July to September (Le Maitre & Midgley 1992). Fire intensity depends on fuel moisture, air temperature and wind speed. Lightning is the primary natural source of ignition for grassland fires. The Grassland Biome has a high frequency of lightning strikes per area of ground and thus natural fires that maintain grassland dominance over woodland are a natural ecological component of the landscape. Natural breaks such as drainage lines and man-made structures such as roads pose barriers to the large-scale fires, assisting in creation of landscapes composed of grassland patches in different stages of recovery (Figure 8.5).

The dominant grasses of the cool, temperate grasslands of South Africa are from the Panicoideae (Gibbs Russell 1988), specifically from the tribe Andropogoneae, including genera such as *Andropogon*, *Trachypogon*, *Heteropogon*, *Cymbopogon*, *Dihetero-*

L. Mucina

Figure 8.5 Grassland mosaic created by wild fire in the Golden Gate Highlands National Park near Clarens (Free State).

L. Mucina

L. Mucina

Figure 8.6 Fire sweeping through *Acacia sieberiana* var. *woodii* savannoid grassland below the Van Reenen's Pass on a slope near Tugela Toll Plaza (KwaZulu-Natal).

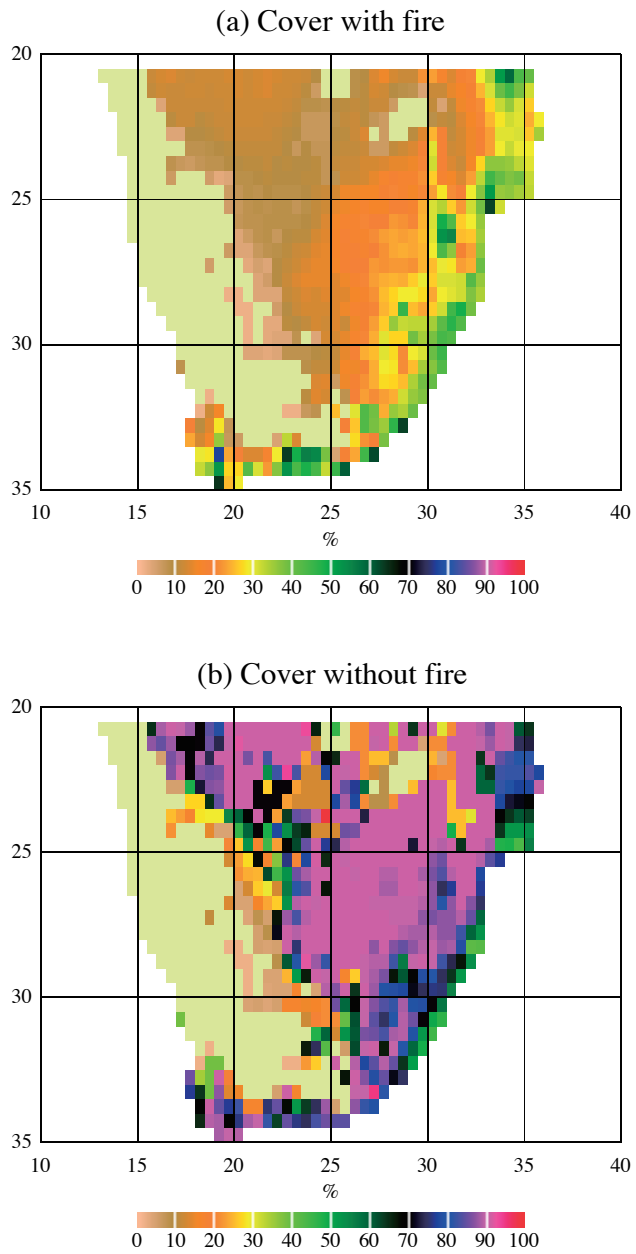

Figure 8.4 Simulated tree cover (%) using the Sheffield Dynamic Global Vegetation Model. The model is a global-scale tool, simulating carbon and water dynamics and structure of vegetation using input data of climate, soil properties and atmospheric CO_2. It also includes a fire module that approximates fire frequency based on empirical relationships between moisture content of plant litter (which can be simulated from climate) and fire return intervals. The upper figure (a) features modelling with fire included, while the lower picture (b) shows the modelling result with fire excluded. (After Bond et al. 2003b, Figure 4; courtesy of the authors and the South African Association of Botanists.)

pogon, *Monocymbium*, *Tristachya*, *Schizachyrium*, *Themeda* and *Hyparrhenia*. The low nutritional value and high tannin content (Ellis 1990) of these grasses cause slow decomposition rates and, therefore, the build-up of highly flammable fuel (Bond et al. 2003b). They also produce basal tillers, which make them susceptible to shading by old growth that persists from previous seasons (O'Connor & Bredenkamp 1997) and they therefore have an obligate dependence on defoliation. The dominant species of andropogonoid grasses often decline rapidly in importance in the absence of burning (Tainton & Mentis 1984), a trend also reported from North and South America, Australia and Southeast Asia (Stott 1988, Silva & Castro 1989, Morgan & Lunt 1999). Woody species that are often found in temperate grasslands include small trees such as *Acacia sieberiana* var. *woodii* and species of *Protea* and *Cussonia* that have thick, fire-resistant bark that allows them to tolerate low-intensity (skimming), high-frequency fires (Figure 8.6). The proteas are furthermore serotinous but, in grasslands, almost all resprout to recover from fire rather than reseed (Le Maitre & Midgley 1992). Fire stimulates flowering in grassland geophytes (Frost 1984).

3.4 Grazing Pressure

Grazing has a major influence on canopy structure in grasslands as well as on species composition. The grass plant is well adapted to defoliation by grazing, fire or mowing: the basal meristems of grass leaves enable regrowth after defoliation and draw on carbohydrate reserves from the stem bases or rhizomes (Rutherford & Westfall 1986). Although this adaptation is effective, excessive or frequent defoliation can deplete reserves, with adverse consequences (Rutherford & Westfall 1986). Some species respond to grazing pressure by changing growth patterns (often preferred grazing species) thus allowing niche displacement in relation to grazing intensity. Grazing can alter plant density/size, plant longevity, community composition and diversity, vegetation response to climate patterns, and vegetation response to other abiotic factors such as soil depth. Besides defoliation, heavy grazing can affect grass seed production negatively. Grazing pressure (including density of grazers and composition of grazing herds) varies from farm to farm, dramatically shaping the overall appearance of grasslands by creating the so-called fence-line effect (Figure 8.7).

Degradation of grasslands, including the spread of karroid shrubland into the Grassland Biome, has been blamed on high stocking rates of domestic livestock in commercial farming areas. Many communal grazing lands are commonly stocked at 3–4 times the recommended stocking rates for commercial farming and, although these areas appear to be degraded, they have remained in a stable and apparently productive state for decades. Heavy grazing in the communal areas of the Transkei appears to have reduced overall species richness (Hoare 2002) and changed species composition to less palatable grasses, especially on nutrient-poor soils (Owen-Smith & Danckwerts 1997).

High concentrations of indigenous herbivores can also alter plant species cover and composition. The primary difference between domestic livestock and wild herbivores is scale-related (Owen-Smith & Danckwerts 1997): the provision of supplementary fodder in commercial farming areas during drought periods prevents animal mortality so that grazing pressure is maintained during all seasons, whereas wild herbivore impacts are more spatially and temporally heterogeneous.

Prominent wild ungulate herbivores in highveld grasslands include black wildebeest (*Connochaetes gnou*), blesbok (*Damaliscus dorcas phillipsi*), extinct quagga *(Equus quagga)*, springbok (*Antidorcas marsupialis*) and eland (*Taurotragus oryx*; Figure 8.8*)*. Historically, these species may have seasonally moved along rainfall gradients in areas near the Drakensberg, occurring near water sources in the dry season and away from water sources during the wet season. The abundance and grazing impact of small mammals may exceed that of ungulates, but the distribution of the former is patchy and abundances may vary considerably over time (Owen-Smith & Danckwerts 1997). Prominent species in grasslands include porcupine and several species of hare. Other wild herbivores in grasslands include

L. Mucina

Figure 8.7 Typical fence-line effect (former 'national' border between the Cape and Transkei) marking the difference between a commercial farm with well-developed *Themeda triandra* grassland (left) and communal land with invading unpalatable *Euryops floribundus* (Asteraceae) near Elliot (Eastern Cape).

leopard tortoises, hinged tortoises, grasshoppers and harvester termites. Although the last-named are strictly detritivores, they can cause severe denudation of grasses during drought periods. Avian granivores strip and consume many grass seeds from inflorescences. Granivory appears to affect species with large seeds, e.g. *Themeda triandra* and *Heteropogon contortus*, more than those with small seeds, e.g. species of *Aristida* (Owen-Smith & Danckwerts 1997).

Different kinds of herbivores may have different and complementary effects on different plant species. Domestic grazers, wild ungulates, small mammals and insects favour different grass species and may be sensitive to different secondary chemicals. Different plant defences are effective against different herbivores and no single deterrent is effective against all herbivores (Owen-Smith & Danckwerts 1997).

4. Vegetation Structure and Texture

Grasslands are structurally simple and strongly dominated by grasses (Poaceae). The canopy cover is moisture-dependant and decreases with lower mean annual rainfall, but is influenced by the amount and type of grazing and by the presence of fire. Minimum temperature plays a decisive role in structurally distinguishing temperate grasslands from those where frosts are rare (Walker 1993). Woody species, where they occur, are limited to specialised niches/habitats. Forbs form an important component of grasslands and, although not usually dominant, probably contribute more to the species richness of grasslands than grass species do. Annuals do not form a large component of the vegetation, but are important in filling gaps where disturbance occurs.

Above ground, there are two primary structuring forces within grasslands that operate in opposite directions: competition for canopy space (i.e. light) and ungulate grazing pressure (Diaz et al. 1992). Besides herbivory, rainfall (plant available moisture), soil type (nutrient availability) and fire are further major determinants of grassland structure and these are strongly interactive (Walker 1993). Diaz et al. (1992) identified six species modes (similar to functional types) in which sustained occupation of above-ground space increases along a gradient from annuals to prostrate stoloniferous plants to rosette plants with below-ground storage organs to small graminoids to medium-sized graminoids to tussock grasses. Silvertown et al. (1992) demonstrated that heavy grazing conditions (reduced cover of dominant species) foster seedling emergence in annual dicotyledons, but also jeopardise subsequent survival (by grazing at various stages of life cycle), which is why productive grassland communities may contain few palatable dicotyledons since few of them can successfully complete their life cycle.

M.C. Lötter

Figure 8.8 Eland (*Taurotragus oryx*) grazing in a grassland near Vryheid (northern KwaZulu-Natal).

Grass species diversity of the subfamily Panicoideae is higher in the Grassland Biome than that of the Arundinoideae, Chloridoideae or Pooideae. The Panicoideae are a major C_4 photosynthesis group and tend to predominate in the Grassland Biome and moist parts of the Savanna Biome of South Africa (Vogel et al. 1978, Gibbs Russell 1986, Gibbs Russell et al. 1991). The most abundant

component of the Panicoideae is from the tribe Andropogoneae (Gibbs Russell et al. 1991). The Pooideae, an exclusively C_3 subfamily, have maximum diversity and abundance only at high altitude and in moist habitats and are important in the high Drakensberg region (Vogel et al. 1978, Gibbs Russell 1986, Rutherford & Westfall 1986).

5. Biodiversity and Biogeographical Patterns

5.1 Phytochorological Considerations

The Grassland Biome in South Africa coincides with two major phytochoria (White 1983): Kalahari-Highveld Regional Transition Zone and Afromontane and Afroalpine Region. The mountainous landscapes along the Northern Escarpment are within the Afromontane and Afroalpine Region of White (1983). These areas also include the most temperate components of the biome, both floristically and climatically. The largest part of the Grassland Biome boundary interfaces with the Savanna Biome, an area considered to be primarily linked to White's (1983) Kalahari-Highveld Regional Transition Zone and Zambezian Regions and, therefore, of more tropical affinity. The Grassland and Savanna Biomes both have strong rainfall seasonality and very similar summer-rainfall patterns and amounts. The major environmental factor separating them is summer aridity in combination with winter minimum temperature that leads to 'phanerophyte exclusion' (Rutherford & Westfall 1986), resulting in the absence of a major woody component. The clear floristic link between the Grassland and Savanna Biome (see also discussion on the origins of the Grassland Biome above) has been corroborated in the phytochorological classification of Takhtajan (1986). Most of the Grassland Biome as defined in our study falls within Takhtajan's Sudano-Zambezian Floristic Region (with tropical connotation). The Sub-Escarpment Grasslands are classified within the Uzambara-Zululand Floristic Region—a view which we do not share. The transitional Karoo Escarpment Grassland falls within the Karoo-Namib Floristic Region or, after current revisions (see the chapter on Nama-Karoo Biome in this book), in the Nama-Karoo Floristic Region. We do not subscribe to this view either and suggest that the boundaries of phytochoria on the Karoo/Grassland interface are revised.

The drier western and southwestern boundary of the Grassland Biome interfaces with the Nama-Karoo along a zone of high rainfall uncertainty. This region also represents a gradient of decreasing rainfall and lower elevation with distance westwards. It has been hypothesised that overgrazing by domestic livestock has led to the eastward expansion of the Nama-Karoo into the Grassland Biome through the reduction of perennial grass cover in this zone (Acocks 1953), but an alternative hypothesis suggests that cyclic shifts in rainfall amount and seasonality promote a dynamic change in the relationship between perennial grasses and karoo bushes (Hoffman & Cowling 1990).

There is little interface between grassland and fynbos, but a dynamic relationship exists between these two vegetation types and satellite grasslands occur in the Fynbos Biome in the mountains of the Eastern Cape and satellite fynbos occurs within the grasslands of the Northern Escarpment region, especially on nutrient-poor soils in areas protected from fire. Numerous studies have demonstrated the floristic linkages between the Fynbos Biome, the mountain regions of the Grassland Biome and afromontane regions further northwards in Africa (e.g. Weimarck 1934, 1940, Goldblatt 1978, Rourke 1980, Linder 1983, Linder & Ellis 1990, Hartmann 1991, Linder et al. 2005, Galley & Linder 2006). The number of Cape species becomes less as the distance from the Fynbos Biome increases and the number of afromontane species increases.

Grassland interfaces with indigenous afrotemperate forests in many places, but especially along the Escarpment (Von Maltitz et al. 2003, Geldenhuys & Mucina 2006), where forest patches may be found on steep, south-facing slopes with high soil moisture or in deep, sheltered, moist gullies. In these topographic positions they survive the dry periods and from these positions they expand further along the slopes. As already argued (see Chapter 12 on forests in this book), fire plays a major role in forest/grassland border dynamics. Vegetation models suggest that without fire most of the eastern half of South Africa would be covered by dense tree-dominated vegetation (Bond et al. 2003b).

5.2 Endemism

Five Centres of Plant Endemism (CEs) have been identified within the borders of the Grassland Biome (Van Wyk & Smith 2001): Drakensberg Alpine, Barberton, Wolkberg, Sekhukhune and Soutpansberg. Only the Drakensberg Alpine CE and Wolkberg CE falls completely within the Grassland Biome, while the other CEs are shared with the Savanna Biome (Figure 8.9). As suggested by unpublished data sources and the descriptive accounts of vegetation units in this chapter, high concentrations of local (confirmed to only a single vegetation unit as defined in this study) or regional (shared by several geographically bordering and ecologically similar vegetation units) endemics are also found in the KwaZulu-Natal Midlands (C.R. Scott-Shaw, unpublished data), Sneeuberg Mountains on the Karoo Escarpment (N. Barker & R. Clark, unpublished data), low Drakensberg (L. Mucina, M.C. Lötter & C.R. Scott-Shaw, unpublished data), and in the mountainous surrounds of Lydenburg (M.C. Lötter, unpublished data). Detailed analyses of the local floras of these regions as well as their phytogeographical links may reveal the existence of several new centres of endemism. The most extensive and most endemic-rich phytochorion of all the above is the Drakensberg Alpine CE with about 13% of endemism, counting about 334 endemic taxa and five endemic genera (Van Wyk & Smith 2001, Carbutt & Edwards 2004, 2006). There are a number of species linking the core of the Drakensberg Alpine CE (defined in our study by the extent of Gd units as currently delimited) with the Midlands, especially with the mountains lying south and southeast of the Escarpment in a triangle approximately defined by Himeville, Kokstad and Matatiele (and, importantly, also including the Ingeli Mountain). The vegetation map of these high-altitude islands (interestingly indicated by Carbutt & Edwards 2004 as parts of their Drakensberg Alpine CE) should be reconsidered and perhaps included in one of the Gd units in future. Species showing this distribution pattern are designated as Dg (Drakensberg/Griqualand East) and include, for instance, *Erica algida*, *E. thodei* and *Berkheya pannosa*.

The currently recognised centres of endemism are either linked to high altitudes (Drakensberg Alpine, Wolkberg) or special substrates, among which quartzites and rare ultramafics (Barberton and Sekhukhune regions) play the major role. Another interesting aspect of the location of the CEs is the fact that they occur in the Grassland-Savanna 'tension' zone. Here the endemic-rich grassland vegetation is usually a 'summit sourveld'—forming an elevated island surrounded by the 'hot sea' of the subtropical savanna vegetation. The Drakensberg Alpine CE may be the hub of this 'sourveld phenomenon', showing a number of distinct floristic and phytogeographical links westwards (towards Capensis via the Escarpment), northwards (via the low Drakensberg) towards the Northern Escarpment and fur-

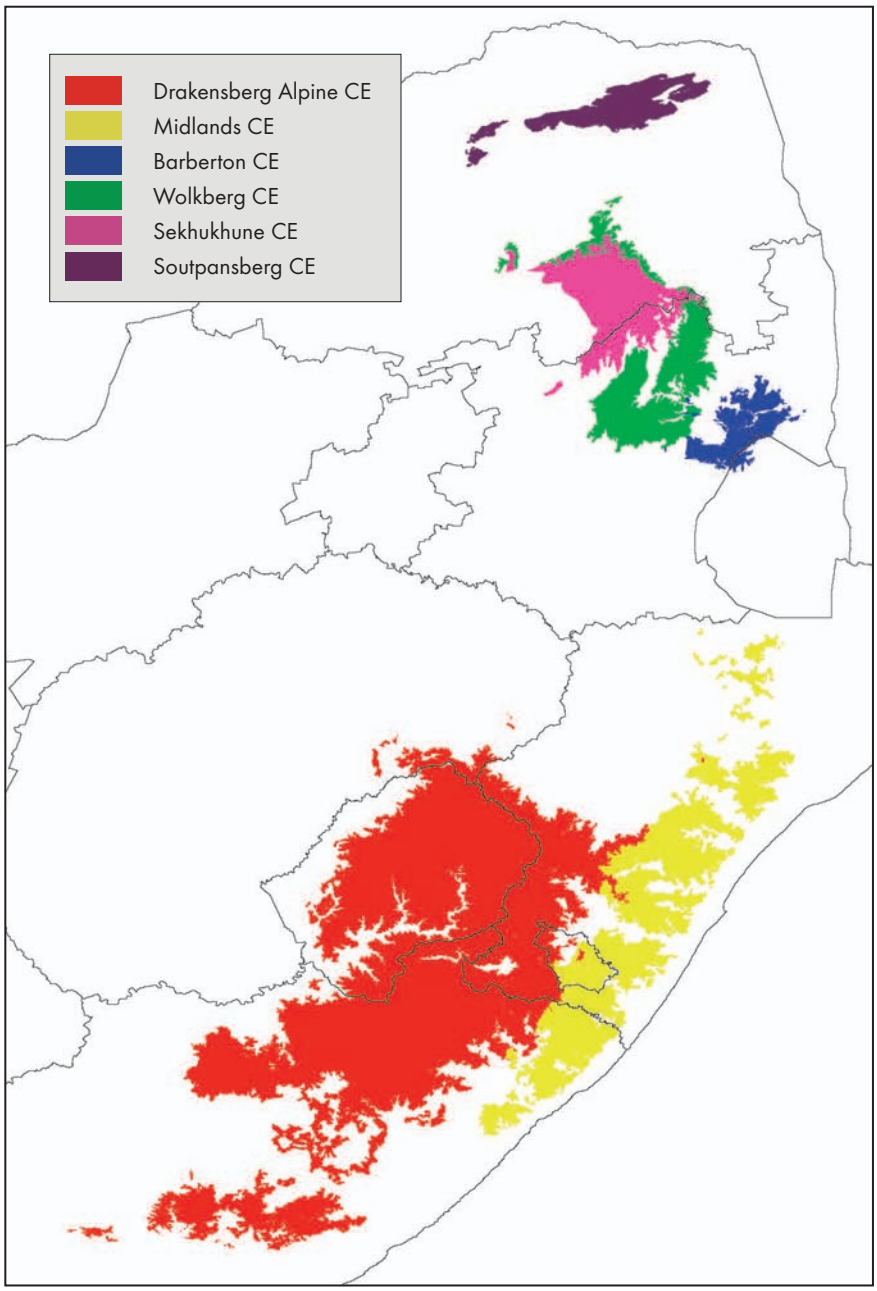

Figure 8.9 Six putative centres of endemism embedded within the Grassland Biome or straddling borders of the Grassland and Savanna Biomes.

ther north as far as the high mountains of eastern Zimbabwe (also shared with Mozambique in the Chimanimani Range) and southeastwards (at lower altitudes) towards the midlands of Transkei and KwaZulu-Natal and reaching the lowest altitude in Pondoland (see discussion in Carbutt & Edwards 2001, 2004). Van Wyk & Smith (2001) mentioned the multiple links between these phytochoria as well as with other 'summit sourveld' grasslands of the northern provinces several times. We believe that the definition, hierarchical position and demarcation of the relevant phytochoria of the current CEs within the Grassland Biome require revision. As a contribution to these future developments, we have introduced the concept of 'Northern sourveld endemics'. This category encompasses species shared by several currently recognised CEs and being confined to grassland habitats within these CEs.

It is also of significant importance to confirm that the core of the Grassland Biome (dominated by C_4 grasses) contains no regions of endemism, indicating either a relatively young age of these grasslands and/or dramatic (recurrent) climatic changes causing repeated floral extinctions (see the discussion on the evolution of the Grassland Biome above).

There are 34 grass taxa that are endemic to the Grassland Biome of South Africa of which 13 are from the subfamily Arundinoideae and 11 from the Pooideae (Steenkamp et al. 2002). The Arundinoideae forms the dominant component of the winter-rainfall region of South Africa and the Pooideae are only occasionally dominant in high-altitude grasslands (Gibbs Russell 1986). It is unknown what the total levels of endemism amongst other taxa in the Grassland Biome are, but upper and lower values can be estimated. Assuming the proportion of endemism is equal across all taxonomic groups, then the number of endemics other than grasses may be 179. Of the grasses, most of the endemics are found only in the high-altitude montane grasslands and only five are found in highveld grasslands (Steenkamp et al. 2002). Only two endemic grass genera are known from the Grassland Biome so far—*Polevansia* and *Catalepis*.

Among the herbs, high endemism occurs in the orchids—of 161 orchid taxa found in the Grassland Biome, 67% are endemic (Linder et al. 2005). There are seven orchid clades identified in (but none restricted to) the flora of the Grassland Biome; the most speciose subtribes are the Habenariinae (55 taxa), Disinae (41 taxa) and Coryciinae (31 taxa; Linder et al. 2005). Generic endemism in herbs is not very high compared to that in the biomes of the winter-rainfall regions of South Africa. The endemic herb genera are concentrated especially in the Drakensberg (including the Low Escarpment and Northern Escarpment) and include: *Anisopappus*, *Arrowsmithia*, *Callilepis*, *Cymbopappus*, *Eumorphia*, *Glekia*, *Heteromma*, *Hilliardia*, *Inulanthera* and *Macowania* (Asteraceae), *Rhodohypoxis* (Hypoxidaceae), *Huttonaea*, *Dracomonticola* and *Schizochilus* (Orchidaceae), *Guthriea* (Achariaceae), *Galtonia* (Hyacinthaceae), *Glumicalyx* and *Strobilopsis* (both Scrophulariaceae), *Peltocalathos* (Ranunculaceae), *Hemizygia* and *Thorncroftia* (Lamiaceae), *Frithia*, *Khadia*, *Mossia* and *Neohenricia* (Aizoaceae), among others. Very speciose genera such as *Senecio*, *Helichrysum*, *Erica*, *Berkheya*, *Delosperma*, *Wahlenbergia*, *Ledebouria* and *Disa* also contribute a high number of species-level endemics (Figure 8.10).

5.3 Species Diversity Patterns

Data on patterns and maintenance of species richness in the grasslands of South Africa are relatively sparse (Cowling et al. 1989). A 100 m^2 plot in high-altitude grassland of the Eastern Cape or KwaZulu-Natal may contain 9–39 species within veg-

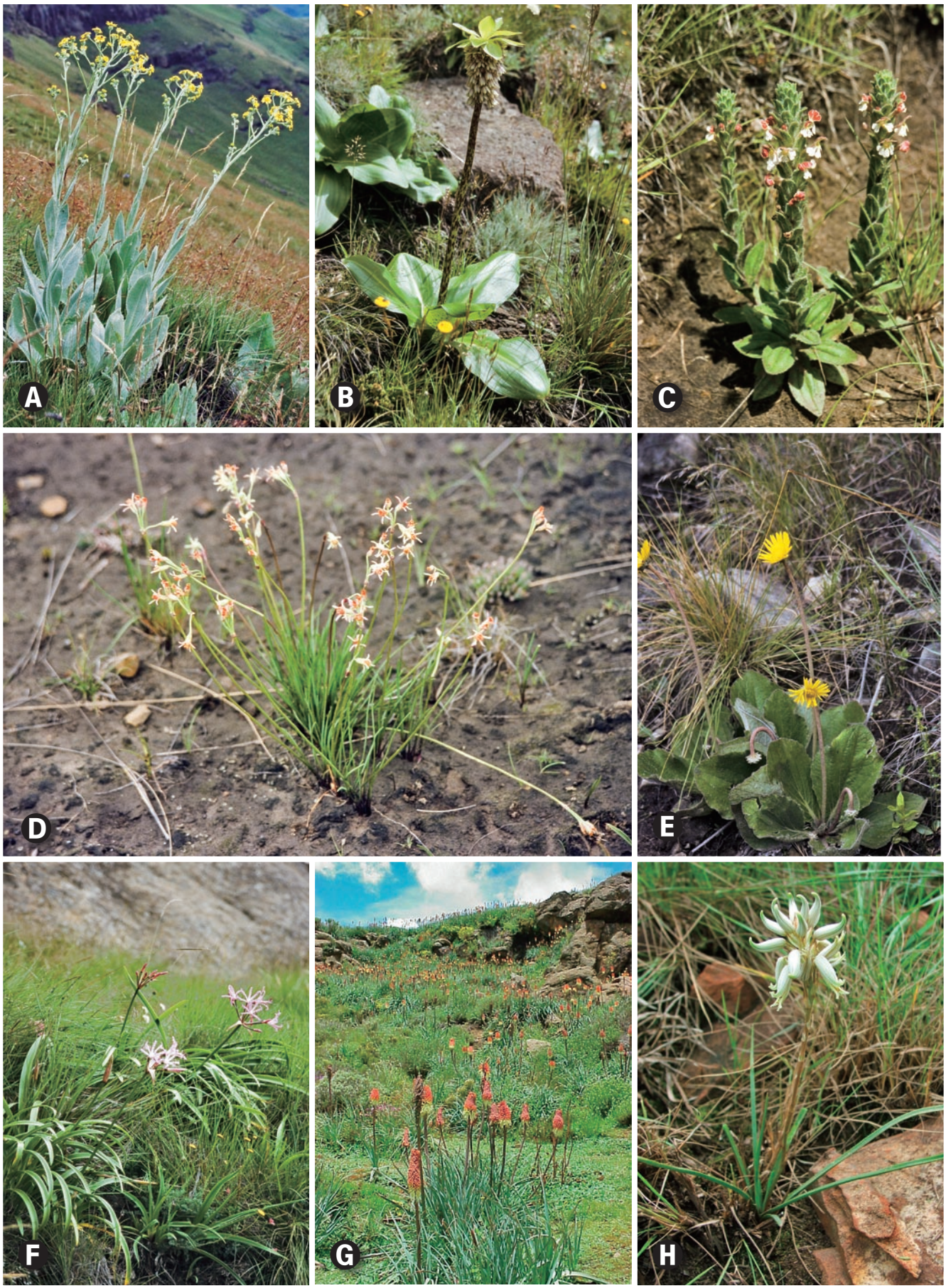

Figure 8.10 A selection of grassland endemics. A: *Senecio macrospermus* (Asteraceae), B: *Eucomis bicolor* (Hyacinthaceae), C: *Zaluzianskya microsiphon* (Scrophulariaceae), D: *Tulbaghia leucantha* (Alliaceae), E: *Haplocarpha nervosa* (Asteraceae), F: *Nerine bowdenii* (Amaryllidaceae), G: *Kniphofia caulescens* (Asphodelaceae), H: *Aloe albida* (Asphodelaceae). The taxa A–C, F and G are endemic to the Drakensberg CE, E is endemic to the Grassland Biome and H is endemic to the Barberton CE. Photographers: A–F: L. Mucina, G: M.C. Rutherford, H: M.C. Lötter.

etation with a single uniform grass layer (Eckhardt et al. 1996a, Hoare 1997). This may increase by 10 or more species in specialised habitats where multistructural vegetation is able to develop, e.g. rocky outcrops (Hoare 1997). There is a curvilinear relationship between species richness and the amount of surface rockiness in temperate grasslands, with intermediate amounts of surface rock containing the highest number of species (Hoare 2003). A 1 000 m^2 plot may contain 55–100 species. At a regional scale, grasslands have a high alpha diversity and a moderate gamma diversity; the Highveld region on its own has almost 4 000 species and contains centres of diversity for many speciose genera (Cowling et al. 1989).

High local species richness in grasslands is difficult to understand, considering the limited growth form richness in this vegetation. A number of explanations have been put forward to explain how so many species within the same functional guild coexist. These include the effects of differential responses to grazing, fire and local disturbance on competitive hierarchies, phenological separation and resource partitioning in mesic grasslands and the dampening of long-term competitive interactions due to the effects of variable climate patterns in semi-arid grasslands (Cowling et al. 1989). Management can have a strong effect on species richness and composition of grasslands by affecting competitive interactions amongst species. For example, communally managed grasslands of the Eastern Cape have 24 species per 100 m^2 plot in comparison to 34 species in commercially managed rangelands where all other environmental factors are constant. These poorly managed grasslands also have more exotic species, are dominated by forb species rather than grasses and have a higher dominance by individual species (Hoare 2002).

Species turnover in grasslands may be relatively high where topographical and environmental gradients are steep and, in the mountains and the Escarpment region, there may be high rates of turnover due to both rainfall and elevation: complete turnover of species may occur for every 400 mm change in amount of mean annual rainfall or for every 400 m of change in elevation (Hoare 2003). These high rates of beta diversity permit coexistence of species at a landscape level that contributes to the overall richness of the biome.

6. Transformation and Conservation

6.1 Patterns of Land Use and Threats to Grasslands

Land cover data (Fairbanks et al. 2000) indicate that almost 30% of the Grassland Biome of South Africa has been permanently transformed, primarily as a result of cultivation (23%), plantation forestry (4%), urbanisation (2%) and mining (1%). A further 7% has been severely degraded by erosion, agricultural improvement and other factors. Significant parts of the remaining vegetation may be secondary lands or may be degrading by gradual processes such as woody encroachment, but no exact statistics are available. Ground surveys of land cover in areas of the Eastern Cape with dense rural populations indicate that up to 80% of the 'natural' grassland may be old fields and therefore of a secondary nature (D.B. Hoare, unpublished data), suggesting that, at least in some of the worst-affected areas of South Africa, as little as 15% of the natural grassland is still in a natural state. This is consistent with statistics in Low & Rebelo (1996) in which the average level of transformation for all grassland types is given as 58%. Of additional concern is the fact that those areas of grassland that are untransformed are highly fragmented and that as much as half the remaining areas of grassland may be composed of fragments of only a few hectares in extent.

Future threats to the vegetation of the Grassland Biome include continuous transformation by existing land uses due to the suitability of many areas of the biome for important economic activities and the threat of climate change, which may reduce the extent of the biome by up to 55% (see section above). Highveld grassland is particularly suitable for agricultural activities, and has significant mineral deposits and high urban densities. The latter two are likely to expand with economic growth in the future. The Escarpment and mountain regions are threatened mainly by afforestation with exotic *Pinus* and *Eucalyptus* species. It is estimated that this land use has doubled in the last ten years (Fairbanks et al. 2000) and that as much as 200 km^2 of grassland in these regions are lost to forestry alone every year (Van Wyk 1998). Furthermore, most of the communal land in the Grassland Biome occurs in the Escarpment region and is susceptible to overgrazing and the associated degradation.

The Grassland Biome contains 640 Red List species (Hilton-Taylor 1996, excluding species categorised as 'not threatened') of which 136 are threatened with extinction and six are already extinct. There are only nine grass species on this list.

6.2 Conservation Activities

There are numerous small reserves in the Grassland Biome, but together they make up only 2.2% of the biome area (Low & Rebelo 1996). This is not evenly distributed and the Highveld region is very poorly conserved in comparison to the Northern Escarpment and mountain regions. Nature reserves include Suikerbosrand, Rustenburg, Golden Gate, Qwaqwa, Blyde River Canyon and various dams. The reserves around dams are especially contentious since they were created around man-made structures for recreational purposes and are not based on systematic conservation principles.

The most important current conservation initiative under development is the Maloti-Drakensberg Transfrontier Park, which incorporates the Natal Drakensberg Park and the Drakensberg Mountains World Heritage Site declared in November 2000. The South African component of this Transfrontier Park is the uKhahlamba-Drakensberg Park, which contains spectacular natural landscapes and a rich biodiversity (Zunckel 2003). A total of 2 153 plant species have been recorded for the park (Derwent et al. 2001), of which more than 400 are endemic or near-endemic (Van Wyk & Smith 2001). Most of these are associated with the grasslands. There are 32 bird species, 11 mammal species and 40 frog species that are endemic to southern Africa that occur in the park and it is considered to be one of the eight major centres of diversity for reptiles and amphibians in southern Africa (Derwent et al. 2001).

Another conservation initiative being considered is the Pondoland National Park, which includes an area that has not been well conserved although deserving of special attention due to high diversity and endemism as well as exceptional scenic beauty. The area suggested for the proposed Pondoland National Park would include most of the Pondoland Centre of Floristic Endemism, which has about 1 800 plant species of which more than 120 are endemic or near-endemic (Van Wyk & Smith 2001).

The most significant conservation work being undertaken outside major conservation areas in the grasslands of southern Africa is often focused on highly threatened species, such as the blue swallow, various crane species, black and white rhinos

or Rudd's lark. The basis for these conservation efforts is the awareness that managing habitats is the key to managing the threats to these species since habitat loss is the primary reason for their decline. WWF South Africa plays a key role in supporting these initiatives. At the time of writing, a National Grasslands Initiative for conserving grasslands was in the process of being formalised. This is a nationwide South African project aiming at co-ordination of ongoing conservation planning within the grasslands, to identify gaps in these conservation plans, to highlight conservation priorities, and to ensure the successful implementation of these plans within the existing political and socio-economic framework of the region (Reyers & Tosh 2003). The project recognises that promoting off-reserve conservation on privately or communally owned land will have to form a major component of sustainable land management. Initial indications are that the project enjoys wide support among administrators at various levels in government, NGOs, academic institutions, agricultural bodies and international donors. An all-inclusive group will contain landowners as well and, once this has been achieved, this project should have all the components required to address sustainable long-term management of the Grassland Biome.

7. Subdivision of the Grassland Biome

The division between dry and moist grassland can be made on the basis of annual rainfall, with 500–700 mm rainfall marking the boundary. This corresponds to the dry limit of 500 mm annual rainfall of the Argentinean pampas and is consistent (under considerations of the role of parent material and soil nutrients) also with divisions of the grasslands in South Africa into sweetveld and sourveld (Huntley 1984, Ellery et al. 1995, Bond 1997). Above 600 mm of rainfall, sour andropogonoid grasses predominate, whereas below 600 mm sweet chloridoid grasses are more common. The 600 mm rainfall limit also corresponds to soil nutrient factors: plant growth in moist grasslands with dystrophic soils is mostly macronutrient-limited and in dry grasslands with eutrophic soils it is mostly water-limited. These ecological factors affect a number of other patterns found in grasslands, including, for example, diversity relationships within grassland plant communities which are explained by entirely different suites of factors in moist versus dry grasslands (D.B. Hoare, unpublished data) and structure, where moist grasslands are dependent on fire for maintaining structure, unlike dry grasslands (Bond et al. 2003b).

Altitude has a strong influence on most climatic variables. Generally, an increase in altitude corresponds with a decrease in temperature and an increase in rainfall. Mountains also have an orographic influence on rainfall, escarpment zones usually experiencing increased rainfall and mists, and, depending on aspect, cause an increase or decrease in mean daily insolation levels. The major subdivisions of the Grassland Biome are based on gradients of altitude and moisture. Subdivisions of these groups were made on the basis of correlating floristic and environmental factors. The major subdivisions are the four bioregions described below.

8. Description of Vegetation Units

Drakensberg Grassland

Drakensberg grasslands are found primarily associated with the Great Escarpment of the Drakensberg region, including Lesotho and extending southwestwards into the Stormberg and Amathole Mountains. These are some of the highest elevation regions of southern Africa and the topography in these

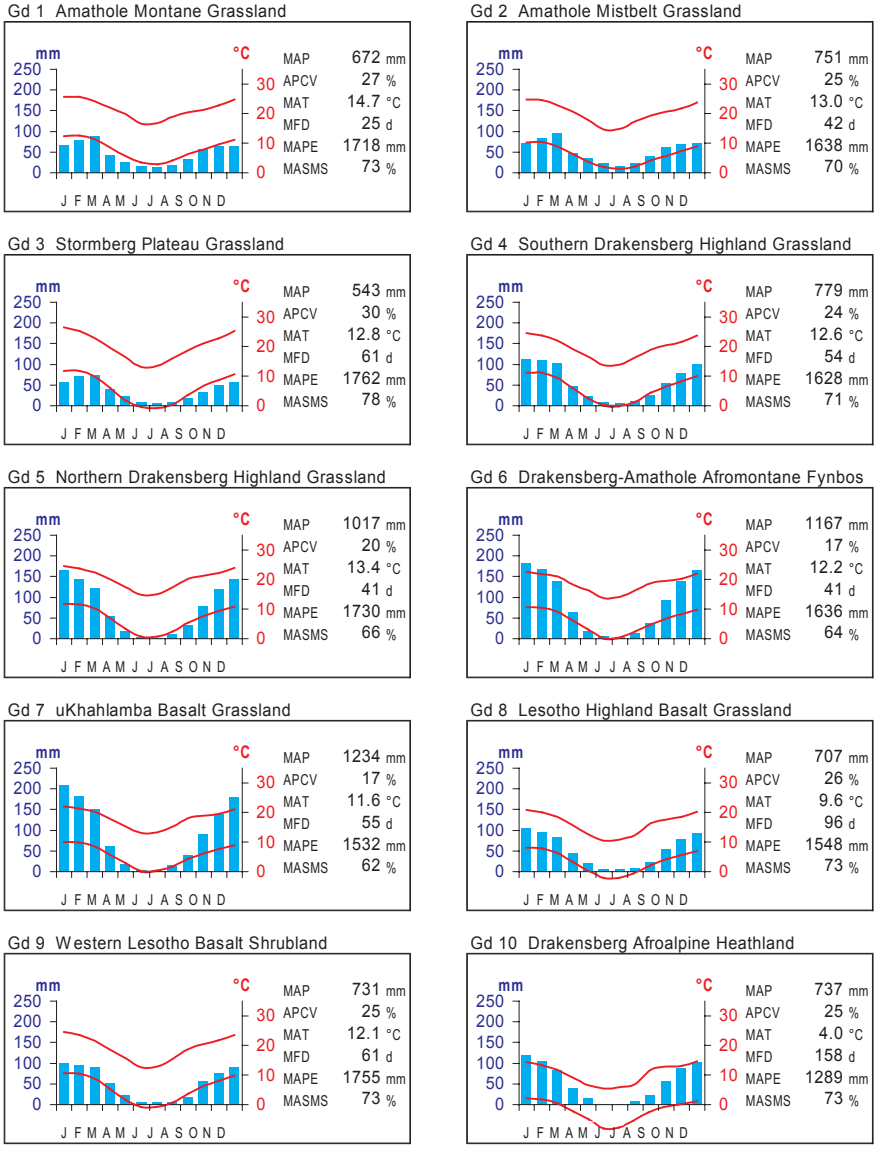

Figure 8.11 Climate diagrams of the Drakensberg Grassland Bioregion units. Blue bars show the median monthly precipitation. The upper and lower red lines show the mean daily maximum and minimum temperature respectively. MAP: Mean Annual Precipitation; APCV: Annual Precipitation Coefficient of Variation; MAT: Mean Annual Temperature; MFD: Mean Frost Days (days when screen temperature was below 0°C); MAPE: Mean Annual Potential Evaporation; MASMS: Mean Annual Soil Moisture Stress (% of days when evaporative demand was more than double the soil moisture supply).

areas may be very steep. The rainfall is generally very high, precipitation may occur at any time of the year and orographic mists supplement rainfall. At the highest elevations snow and frost are common and temperatures are usually cool to cold (Figure 8.11).

Heathlands are found either on steep slopes or in the extreme summit positions such as the highest mountain ridges, edges of flat mesas or damp, high-altitude plateaus. These are found in South Africa from the Soutpansberg to the Amathole, with larger patches occurring on the Lesotho plateau. The substrate in these localities is often leached by continuous precipitation and soils tend to be nutrient-poor. Similar heathlands may be found throughout the East African mountain chains and also in Madagascar and on the Mascarene Islands at similar (or higher) elevations (Hedberg 1951, 1955, 1964, White 1983, Carbutt & Edwards 2001).

Gd 1 Amathole Montane Grassland

VT 44 Highland Sourveld and Dohne Sourveld (73%) (Acocks 1953). LR 42 Moist Upland Grassland (52%) (Low & Rebelo 1996).

Distribution Eastern Cape Province: The main grassland unit of the Amathole, Winterberg and Kologha Mountains as well as the mountains just north of Somerset East (Bosberg and other outlying peaks). Also found on broken veld between Stutterheim and Komga. At altitudes 650–1 500 m.

Vegetation & Landscape Features Low mountain ranges and moderately undulating landscapes characterised by short grassland with high species richness of forbs, especially those of the family Asteraceae (especially *Helichrysum* and *Senecio*). The grasslands are dominated by a variety of grasses, including *Themeda triandra*, *Elionurus muticus*, *Sporobolus africanus*, *Eragrostis chloromelas*, *E. curvula*, *Heteropogon contortus*, *Alloteropsis semialata* and *Tristachya leucothrix*.

Geology & Soils On sedimentary rocks of the Beaufort Group (Karoo Supergroup) overlaid by deep, freely drained, highly weathered soils (Hartmann 1988). Weakly developed lithosols are also found in places. Most common land types Fb, Fa and Fc.

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Figure 8.12 Gd 1 Amathole Montane Grassland: Montane grasslands north of Hogsback (Amathole, Eastern Cape) with Elandsberg in the background; *Themeda triandra* and a species of *Scabiosa* are prominent here.

Climate Bimodal rainfall pattern with spring and late summer peaks. MAP around 670 mm (range 500–740 mm, up to 1 000 mm in isolated places). Rainfall the highest in high-altitude areas due to orographic factors and becoming lower with reduction in elevation and with distance westwards. Coefficient of variation in rainfall decreases with elevation, and ranges from 15–31% across the unit. Overall MAP close to 15°C. Winter frost is not common in the southeastern part of this unit, but it is more frequent (up to 80 days per year) in the western and northwestern regions. See also climate diagram for Gd 1 Amathole Montane Grassland (Figure 8.11).

Important Taxa Graminoids: *Cynodon dactylon* (d), *Eragrostis chloromelas* (d), *E. curvula* (d), *Microchloa caffra* (d), *Themeda triandra* (d), *Tristachya leucothrix* (d), *Agrostis lachnantha*, *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon appendiculatus*, *Brachiaria serrata*, *Cymbopogon pospischilii*, *Cyperus usitatus*, *Elionurus muticus*, *Eragrostis capensis*, *E. plana*, *E. planiculmis*, *E. racemosa*, *Eulalia villosa*, *Harpochloa falx*, *Heteropogon contortus*, *Koeleria capensis*, *Kyllinga alata*, *Melica decumbens*, *Pennisetum sphacelatum*, *Pentaschistis cirrhulosa*, *P. tysonii*, *Schoenoxiphium sparteum*, *Sporobolus africanus*, *Trachypogon spicatus*. Herbs: *Ajuga ophrydis*, *Commelina africana*, *Gerbera piloselloides*, *Haplocarpha scaposa*, *Helichrysum nudifolium* var. *pilosellum*, *H. rugulosum*, *H. simillimum*, *H. umbraculigerum*, *Lepidium africanum* subsp. *africanum*, *Lobelia erinus*, *Rumex lanceolatus*, *Selago densiflora*, *Senecio erubescens* var. *crepidifolius*, *S. retrorsus*, *Tephrosia capensis* var. *acutifolia*, *Tolpis capensis*, *Trifolium burchellianum* subsp. *burchellianum*, *Wahlenbergia stellarioides*. Geophytic Herbs: *Disa tysonii*, *D. versicolor*, *Disperis oxyglossa*, *Eucomis autumnalis* subsp. *autumnalis*, *Geum capense*, *Gladiolus longicollis* subsp. *longicollis*, *Habenaria lithophila*, *Hypoxis argentea* var. *argentea*, *Oxalis smithiana*, *Satyrium cristatum*. Succulent Shrub: *Delosperma crassuloides*. Herbaceous Climber: *Rhynchosia totta*. Low Shrubs: *Anthospermum rigidum* subsp. *pumilum*, *Chrysocoma ciliata*, *Felicia filifolia* subsp. *filifolia*, *F. muricata*, *Helichrysum asperum* var. *albidulum*, *H. odoratissimum*, *H. trilineatum*, *Otholobium caffrum*, *Senecio burchellii*, *S. pterophorus*.

Biogeographically Important Taxa ([D]Drakensberg endemic, [Dg]Drakensberg endemic extending to Griqualand East) Graminoids: *Bromus speciosus*[D], *Helictotrichon galpinii*[D], *Pentaschistis airoides* subsp. *jugorum*[D]. Herbs: *Helichrysum aureum* var. *serotinum*[D], *Psammotropha mucronata* var. *marginata*[D]. Geophytic Herb: *Disa stricta*[Dg].

Endemic Taxa Herbs: *Alchemilla bolusii*, *Alepidea macowani*, *Cineraria vagans*, *Diascia ramosa*, *Helichrysum isolepis*, *Heliophila katbergensis*, *Hermannia violacea*, *Wahlenbergia laxiflora*. Geophytic Herbs: *Aspidoglossum uncinatum*, *Nerine filamentosa*, *Pachycarpus linearis*, *Watsonia amatolae*. Succulent Shrub: *Delosperma katbergense*. Semiparasitic Herb: *Thesium orientale*. Low Shrubs: *Abutilon flanaganii*, *Arrowsmithia styphelioides*, *Erica amatolensis*, *Euryops ciliatus, Garuleum tanacetifolium*, *Indigofera cuneifolia* var. *angustifolia*, *Lotononis trichodes*, *Macowania revoluta*, *Muraltia rara*, *Phylica galpinii*, *P. simii*, *Tephrosia polystachya* var. *longidens*.

Conservation Least threatened. Target 27%. Only about 5% conserved in 11 statutory conservation areas (Mpofu Game Reserve, Fort Fordyce, Bosberg, Bush Nek Outspan and Quacu Nature Reserves, Kologha Forest Reserve as well as in Kubusi, Hogsback, Isidenge, Katberg and Cathcart State Forests). Some patches are conserved in at least two private reserves (Bushy Park Natural Heritage Site, Oudekraal Game Farm). More than 10% already transformed for plantations and cultivation. Heavily grazed by cattle and horses (in places), resulting in a uniform, short grassland structure and several prominent indigenous weedy forbs (e.g. *Senecio retrorsus*). The alien invaders include *Acacia mearnsii* and *A. dealbata*. Erosion very low, low or moderate.

Remarks Northern and southern watersheds tend to have distinctive species compositions due to differences in solar insolation levels and moisture regime (Hoare 1997, Hoare & Bredenkamp 1999). Due to this factor, the northern watershed towards the western end of this unit forms a mosaic with and is then gradually replaced by Gh 1 Karoo Escarpment Grassland in the mountains. The Gd 2 Amathole Mistbelt Grassland unit is embedded within this unit at higher altitudes.

References Acocks (1953), Hoare (1997), Hoare & Bredenkamp (1999).

Gd 2 Amathole Mistbelt Grassland

VT 44 Highland Sourveld and Dohne Sourveld (98%) (Acocks 1953). LR 42 Moist Upland Grassland (92%) (Low & Rebelo 1996).

Distribution Eastern Cape Province: On the highest ridges of the Winterberg, Katberg, Amathole and Kologha ranges. Altitude 1 380–2 080 m, most of the area 1 500–1 680 m.

Vegetation & Landscape Features Mountains and moderately undulating slopes below peaks, often with ridges of rock or boulder outcrops. Vegetation is a short grassland dominated by *Themeda triandra*, *Heteropogon contortus*, *Alloteropsis semialata*, *Tristachya leucothrix*, *Festuca caprina* and *F. costata*, with a high diversity of asteraceous herbs, including *Helichrysum appendiculatum*, *H. aureum*, *H. asperum*, *H. simillimum*, *H. odoratissimum*, *H. nudifolium* and *H. anomalum*.

Geology & Soils Deep, freely drained, highly weathered soils overlying the Beaufort Group (predominantly Triassic Tarkastad Subgroup) sedimentary rocks. Dominant land type Fb (two thirds of the region), Ib land type covers about a third.

Climate Bimodal spring-autumn rainfall pattern although rain can fall at any time of the year, and it increases from west to east as well as with increasing elevation. Coefficient of variation in MAP from 15–29% across the unit. MAP 550–1 100 mm (overall regional average 750 mm). Precipitation supplemented by orographically induced precipitation (mist and drizzle). MAT of 13°C indicates a cool-temperate climate. Incidence of frost is 20–95 days (average 42) per year, but the probability of the frost occurrence is higher in the western regions of the unit. See also climate diagram for Gd 2 Amathole Mistbelt Grassland (Figure 8.11).

Important Taxa Graminoids: *Heteropogon contortus* (d), *Themeda triandra* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon appendiculatus*, *Cymbopogon marginatus*, *Elionurus muticus*, *Eragrostis capensis*, *E. chloromelas*, *E. planiculmis*, *Festuca caprina*, *F. costata*, *Melica decumbens*, *Microchloa caffra*, *Sporobolus africanus*, *Tristachya leucothrix*. Herbs: *Aster bakerianus*, *Cephalaria oblongifolia*, *Helichrysum glomeratum*, *H. mixtum*, *H. nudifolium* var. *pilosellum*, *H. rugulosum*, *H. simillimum*, *Lasiospermum bipinnatum*, *Lobelia erinus*, *L. flaccida*, *Monopsis scabra*, *Selago densiflora*, *Senecio asperulus*, *Trifolium burchellianum* subsp. *burchellianum*. Geophytic Herb: *Moraea reticulata*. Low Shrubs: *Anthospermum paniculatum*, *Chrysocoma ciliata*, *Euphorbia striata*, *Felicia filifolia* subsp. *filifolia*, *Helichrysum anomalum*, *H. asperum* var. *albidulum*, *H. odoratissimum*, *Pentzia cooperi*, *Rubus ludwigii* subsp. *ludwigii*, *Stoebe plumosa*.

Endemic Taxa Herbs: *Galium amatymbicum*, *Nidorella undulata*. Geophytic Herb: *Hypoxis woodii*. Low Shrubs: *Helichrysum montis-cati* (d), *Euryops dyeri*, *Indigofera elandsbergensis*, *Lotononis holosericea*. Succulent Shrubs: *Delosperma alpinum*, *D. dyeri*.

Conservation Least threatened. Target 27%. About 4% conserved in units under governmental management: Hogsback State Forest, Kologha Forest Reserve, Katberg State Forest and Kubusi Indigenous State Forest. About 3% already transformed for plantations. Invasive alien *Acacia dealbata* is a local threat. Erosion very low or low.

Remarks There are some very isolated unmapped patches of Gd 6 Drakensberg-Amathole Afromontane Fynbos embedded within this grassland unit. This vegetation is probably what Acocks (1988) referred to when he remarked on the similarity of grassy fynbos to some parts of the Dohne Sourveld on the summits of the Amathole and Katberg Mountains. The number of *Helichrysum* species in this vegetation is noteworthy—a small plot can share as many as 10 species.

References Story (1952), Acocks (1953, 1988), Killick (1978b), Hoare (1997), Hoare & Bredenkamp (1999).

Gd 3 Stormberg Plateau Grassland

VT 59 Stormberg Plateau Sweet Veld (63%) (Acocks 1953). LR 44 Southeastern Mountain Grassland (76%) (Low & Rebelo 1996).

Distribution Eastern Cape Province: Gently sloping landscapes on the Stormberg Plateau north of Molteno and Dordrecht, east of Burgersdorp and extending northwards not much beyond Jamestown. Altitude 1 520–1 960 m, concentrated between 1 640 m and 1 680 m.

Vegetation & Landscape Features Relatively flat to undulating landscape with hills and mountain peaks jutting above the general landscape. The vegetation is a grassland with a strong dwarf shrub component and, on rocky outcrops, shrubland vegetation may occur. Common and dominant species include *Themeda triandra*, *Eragrostis chloromelas*, *Elionurus muticus*, *Karroochloa purpurea*, *Heteropogon contortus*, *Eragrostis capensis*, *Merxmuellera disticha*, *Helictotrichon turgidulum*, *Felicia filifolia* and *Chrysocoma ciliata*.

Geology & Soils Generally shallow soils (typical of Fb, Da and Db land types), with variable amounts of soil skeleton and overlying mudstones and sandstones of the Elliot Formation and in some areas also of the Molteno Formation (Stormberg Group, Karoo Supergroup).

Climate Variable. The rainfall pattern shows a spring-autumn bimodality with overall MAP 540 mm. There is an east-west rainfall gradient across this vegetation unit from 450 mm in the west to over 700 mm in the east. Coefficient of variation of MAP 30%, varying only slightly from 26–31% across the unit. MAT of nearly 13°C indicates a cool-temperate regime, with climate becoming extremely cold in places. One of the coldest recorded minimum temperatures in South Africa was –18.9°C at Buffelsfontein in the centre of this unit. Frosts can occur at any time of the year, but with a low probability in summer. Incidence of frost from 30–75 days, increasing with

elevation. See also climate diagram for Gd 3 Stormberg Plateau Grassland (Figure 8.11).

Important Taxa Graminoids: *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *Merxmuellera disticha* (d), *Themeda triandra* (d), *Andropogon appendiculatus*, *Aristida diffusa*, *Cynodon incompletus*, *Cyperus usitatus*, *Digitaria eriantha*, *Eragrostis capensis*, *E. curvula*, *E. racemosa*, *Festuca scabra*, *Ficinia gracilis*, *Harpochloa falx*, *Helictotrichon turgidulum*, *Karroochloa purpurea*, *Koeleria capensis*, *Merxmuellera drakensbergensis*, *Microchloa caffra*, *Miscanthus capensis*, *Panicum gilvum*, *Pennisetum sphacelatum*, *Pentaschistis microphylla*, *Schoenoxiphium rufum*, *Tetrachne dregei*, *Tragus koelerioides*, *T. racemosus*. Herbs: *Ajuga ophrydis*, *Galium capense* subsp. *capense*, *Gazania krebsiana* subsp. *krebsiana*, *Gerbera piloselloides*, *Hebenstretia dentata*, *Helichrysum nudifolium* var. *pilosellum*, *H. rugulosum*, *Pseudognaphalium oligandrum*, *Senecio asperulus*, *S. retrorsus*, *Tribulus terrestris*, *Trifolium burchellianum* subsp. *burchellianum*, *Wahlenbergia stellarioides*. Succulent Herb: *Crassula lanceolata*. Low Shrubs: *Chrysocoma ciliata* (d), *Felicia filifolia* subsp. *filifolia*, *F. muricata*, *Gomphocarpus fruticosus* subsp. *fruticosus*, *Helichrysum asperum* var. *albidulum*, *H. dregeanum*, *H. trilineatum*, *Passerina montana*, *Pentzia globosa*, *Selago saxatilis*, *Wahlenbergia albens*. Tall Shrub: *Rhus pyroides*. Woody Climber: *Clematis brachiata*.

Biogeographically Important Taxa ([D]Drakensberg endemic, [Dg]Drakensberg endemic extending to Griqualand East) Graminoid: *Pentaschistis galpinii*[D]. Herbs: *Diascia integerrima*[D], *Psammotropha mucronata* var. *marginata*[D]. Low Shrub: *Relhania acerosa*[Dg]. Tall Shrub: *Lotononis lotononoides*[D].

Endemic Taxon Low Shrub: *Euryops calvescens*.

Conservation Least threatened. Target 27%. None conserved in statutory conservation areas. About 9% transformed, mostly for cultivation. Erosion moderate, high and low.

Remarks The region of this unit forms a transitional zone between the Gh 1 Karoo Escarpment Grassland to the west and the Gd 4 Southern Drakensberg Highland Grassland towards the higher altitudes in the east. Floristic elements typical of both neighbouring regions meet here. Outcrops of the Drakensberg and Stormberg Groups (Karoo Supergroup) and pyroclastic rocks within this unit support vegetation resembling that of the Gd 4 Southern Drakensberg Highland Grassland. On the other hand, rocky, dry aspects in the gently sloping landscapes tend to have more karoo elements. Within the Stormberg Plateau Grassland unit, the vegetation patterns are strongly influenced by moisture gradients (Hoare & Bredenkamp 2001). The bottomlands at the foot of the hills consist mostly of flat, wide, unchannelled drainage valleys containing dense hygrophilous grasslands dominated by species such as *Pennisetum sphacelatum*.

References Acocks (1953, 1988), Hoare & Bredenkamp (2001).

Gd 4 Southern Drakensberg Highland Grassland

VT 44 Highland Sourveld and Dohne Sourveld (40%), VT 58 *Themeda–Festuca* Alpine Veld (32%) (Acocks 1953). LR 44 South-eastern Mountain Grassland (36%), LR 42 Moist Upland Grassland (27%) (Low & Rebelo 1996). BRG 10 Montane Veld (Camp 1999b).

Distribution Eastern Cape and KwaZulu-Natal Provinces: An intricate system of patches and corridors across the highest mountains and ridges of the Stormberg, from Molteno to the surrounds of Dordrecht, also including the elevated broad valley of the Kraairivier (near Barkly East) and its tributaries. Further occurring in a broad band (and abutting onto Gd 8 Lesotho Highland Basalt Grassland at upper boundary) on steep slopes of head-valleys fringing the edge of the southern Drakensberg Escarpment covering the regions north and northwest of Indwe, Elliot, Ugie, Maclear, Mt Fletcher (all Eastern Cape) as far as Matatiele (KwaZulu-Natal). From about the Ramatseliso Nek (pass) north of Matatiele the upper boundary of this unit is formed by the Gd 7 uKhahlamba Basalt Grassland—from here the Gd 4 Southern Drakensberg Highland Grassland follows a system of high northwest-southeast-tending ridges as far north as the southeastern extension of the Giant's Castle buttress (KwaThabamnyana). Altitude 1 420–2 080 m, mainly between 1 720–1 840 m.

Vegetation & Landscape Features Steeply sloping mountainous areas on and below the summit of the Great Escarpment supporting dense tussock grassland on slopes sometimes with a dwarf-shrubby component and dwarf shrubland on exposed rocky areas. The tussock grassland is dominated by various species of *Festuca* and other grasses such as *Themeda triandra*, *Heteropogon contortus*, *Eragrostis racemosa*, *Eragrostis chloromelas*, *E. curvula*, *Elionurus muticus*, *Trachypogon spicatus*, *Andropogon appendiculatus*, *Harpochloa falx* and *Tristachya leucothrix*.

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Figure 8.13 Gd 3 Stormberg Plateau Grassland: Grasslands with prominent *Themeda triandra*, *Eragrostis chloromelas*, *Cymbopogon pospischilii*, *Eragrostis gummiflua*, *Elionurus muticus*, north of Jamestown (Eastern Cape).

Geology & Soils Sandstones of the Clarens Formation and sandstones, siltstones and mudstones of the Elliot Formation (both formations belonging to the Stormberg Group, Karoo Supergroup) as well as the basaltic lava flows of the Drakensberg Group. Soils on the steep escarpment slopes tend to be deep and fine-grained, typical of land types Fa, Fb and Ea.

Climate Summer rainfall, with very dry winters. MAP 780 mm (500–1 120 mm), increasing from west to east to close to the southern border of Lesotho.

M.C. Rutherford

Figure 8.14 Gd 4 Southern Drakensberg Highland Grassland: High-altitude grasslands on the Pitseng Pass between Mount Fletcher and Naudesnek (Eastern Cape) with patches of unmapped FOz 3 Southern Mistbelt Forest in the ravines.

Northeast of the latter region MAP increases with increasing elevation. The coefficient of variation of MAP 16–31% across the unit, with the highest values in the region around the Stormberg Plateau. Temperature regime cool-temperate (MAT around 13°C), typically montane, with cool day-time temperatures throughout the year and the potential for cold conditions at any time. Winter frost is common (30–90 days, average 54 days), incidence increasing with elevation. The areas of high altitude regularly receive snow in winter, sometimes in considerable quantities as a result of clashes of water-laden eastbound fronts with high-altitude cold air masses. See also climate diagram for Gd 4 Southern Drakensberg Highland Grassland (Figure 8.11).

Important Taxa Graminoids: *Alloteropsis semialata* subsp. *eckloniana* (d), *Aristida junciformis* subsp. *galpinii* (d), *Catalepis gracilis* (d), *Diheteropogon filifolius* (d), *Eragrostis caesia* (d), *E. chloromelas* (d), *E. planiculmis* (d), *E. racemosa* (d), *Festuca caprina* (d), *Microchloa caffra* (d), *Monocymbium ceresiiforme* (d), *Pennisetum sphacelatum* (d), *Rendlia altera* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *Agrostis lachnantha*, *Andropogon appendiculatus*, *Aristida diffusa*, *Cymbopogon pospischilii*, *Elionurus muticus*, *Eragrostis capensis*, *E. curvula*, *E. plana*, *Festuca scabra*, *Fingerhuthia sesleriiformis*, *Harpochloa falx*, *Helictotrichon turgidulum*, *Heteropogon contortus*, *Juncus exsertus* subsp. *exsertus*, *Koeleria capensis*, *Pentaschistis cirrhulosa*, *P. microphylla*, *Poa binata*, *Schoenoxiphium sparteum*, *Sporobolus centrifugus*. Herbs: *Ajuga ophrydis*, *Aster bakerianus*, *Euphorbia epicyparissias*, *Galium capense* subsp. *capense*, *Gazania krebsiana* subsp. *krebsiana*, *Haplocarpha scaposa*, *Hebenstretia dentata*, *Helichrysum chionosphaerum*, *H. nudifolium* var. *piloselloides*, *H. rugulosum*, *H. umbraculigerum*, *Kohautia amatymbica*, *Lactuca inermis*, *Lasiospermum bipinnatum*, *Lobelia erinus*, *L. flaccida*, *L. vanreenensis*, *Pentanisia prunelloides* subsp. *latifolia*, *Psammotropha mucronata* var. *foliosa*, *Rumex lanceolatus*, *Salvia stenophylla*, *Selago densiflora*, *S. galpinii*, *Senecio asperulus*, *S. erubescens* var. *crepidifolius*, *Tolpis capensis*, *Trifolium burchellianum* subsp. *burchellianum*, *Wahlenbergia cuspidata*, *W. stellarioides*. Geophytic Herbs: *Cheilanthes hirta*, *Corycium dracomontanum*, *Disa fragrans* subsp. *fragrans*, *Disperis oxyglossa*, *Drimia macrocentra*, *Eriospermum ornithogaloides*, *Geum capense*, *Hypoxis rigidula* var. *pilosissima*. Herbaceous Climber: *Rhynchosia totta*. Low Shrubs: *Chrysocoma ciliata*, *Erica caffrorum* var. *caffrorum*, *Euryops candollei, Felicia filifolia* subsp. *filifolia*, *F. muricata*, *Helichrysum asperum* var. *albidulum*, *H. splendidum*, *H. trilineatum*, *Passerina montivagus*, *Pentzia cooperi*, *Rubus ludwigii* subsp. *ludwigii*, *Selago albida*, *S. saxatilis*, *Senecio burchellii*.

Biogeographically Important Taxa ([D]Drakensberg endemic, [Dg]Drakensberg endemic extending to Griqualand East) Graminoids: *Pentaschistis airoides* subsp. *jugorum*[D], *Polevansia rigida*[D], *Restio galpinii*[Dg]. Herbs: *Aster ananthocladus*[D], *Berkheya multijuga*[D], *Diascia integerrima*[D], *Wahlenbergia polytrichifolia* subsp. *dracomontana*[D]. Geophytic Herbs: *Corycium alticola*[D], *Merwilla dracomontana*[D], *Rhodohypoxis rubella*[D], *Schizochilus bulbinella*[Dg]. Low Shrubs: *Erica aestiva* var. *aestiva*[D], *E. algida*[Dg], *E. dominans*[D], *E. dracomontana*[D], *E. frigida*[D], *E. schlechterii*[D], *E. wyliei*[D], *Helichrysum glaciale*[D], *H. marginatum*[D], *Relhania acerosa*[Dg]. Tall Shrub: *Lotononis lotononoides*[D].

Endemic Taxa Graminoid: *Festuca vulpioides*. Herbs: *Alepidea insculpta*, *Aster confertifolius*, *Diascia megathura*, *Felicia caespitosa*, *Helichrysum longinquum*, *Osteospermum attenuatum*, *Selago leptothrix*, *Wahlenbergia appressifolia*. Geophytic Herbs: *Aspidonepsis cognata*, *Disa nivea*, *Trachyandra smalliana*. Low Shrubs: *Erica anomala*, *E. caffrorum* var. *glomerata*, *E. hillburttii*, *Lotononis jacottetii*, *L. minor*.

Conservation Least threatened. Target 27%. Almost 9% statutorily conserved in uKhahlamba Drakensberg Park and Malekgonyane (Ongeluksnek) Wildlife Reserve. More than 5% already transformed for cultivation. Alien invader *Acacia dealbata* occurs scattered in places. Erosion mainly very low (57%), to lesser extent low or moderate (13%).

Remark Unmapped patches of AZf 4 Drakensberg Wetlands are abundant in seepage areas (dominated by *Merxmuellera drakensbergensis*) and in drainage valleys, typically with the tall shrub *Leucosidea sericea* dominant.

References Acocks (1953, 1988), Bester (1998), Camp (1999b), Hoare & Bredenkamp (2001).

Gd 5 Northern Drakensberg Highland Grassland

VT 44 Highland Sourveld and Dohne Sourveld (81%) (Acocks 1953). LR 41 Wet Cold Highveld Grassland (51%) (Low & Rebelo 1996). BRG 10 Montane Veld (55%) (Camp 1999b).

Distribution KwaZulu-Natal and Free State Provinces: Northeastern and eastern slopes of valleys and buttresses of the Drakensberg in KwaZulu-Natal where most of the region is locally known as Little Berg, from Giant's Castle to slopes in any direction in the surrounds of Clarens in the Free State. Altitude 1 460–2 060 m, mostly 1 780–1 840 m.

Vegetation & Landscape Features Mountainous region characterised by steep slopes of broad valleys and supporting mainly short, sour grasslands, rich in forbs. So-called '*Protea*

L. Mucina

Figure 8.15 Gd 5 Northern Drakensberg Highland Grassland: Sandstone cliffs with *Leucosidea sericea* shrubland in a belt of *Protea subvestita* in the Golden Gate Highlands National Park near Clarens (Free State).

savannas'—grasslands that contain widely scattered trees of *Protea caffra* and occasionally *P. roupelliae*—fall within this unit. Sandstone cliffs, a major characteristic of this landscape, create a multitude of special habitats (often fire-protected) for many special plant communities.

Geology & Soils Mudstone and sandstone of the Elliot Formation and sandstone of the Clarens Formation (Stormberg Group, Karoo Supergroup) supporting soils typical of the Fc land type (dominant) as well as Ac and Bb land types (of lesser importance).

Climate Summer-rainfall region, with MAP broadly ranging from 720–1 630 mm (overall average MAP 1 017 mm). Snowfalls are occasional and last several days. Summer mists frequent. Hot dry winds frequent from July to October. Summers warm and winters cold, with frequent considerably severe frost events. Overall regional MAT 13.4°C. See also climate diagram for Gd 5 Northern Drakensberg Highland Grassland (Figure 8.11).

Important Taxa Graminoids: *Setaria sphacelata* (d), *Themeda triandra* (d), *Agrostis lachnantha*, *Andropogon schirensis*, *Aristida adscensionis*, *A. bipartita*, *A. diffusa*, *A. junciformis* subsp. *galpinii*, *Brachiaria eruciformis*, *B. serrata*, *Bulbostylis densa* subsp. *densa*, *B. humilis*, *Catalepis gracilis*, *Digitaria flaccida*, *D. monodactyla*, *D. ternata*, *Diheteropogon filifolius*, *Elionurus muticus*, *Eragrostis capensis*, *E. chloromelas*, *E. gummiflua*, *E. plana*, *E. racemosa*, *E. sclerantha*, *Harpochloa falx*, *Heteropogon contortus*, *Hyparrhenia dregeana*, *H. hirta*, *Kyllinga melanosperma*, *K. pauciflora*, *Melinis nerviglumis*, *Microchloa caffra*, *Monocymbium ceresiiforme*, *Panicum natalense*, *Pennisetum sphacelatum*, *Setaria nigrirostris*, *Stipagrostis zeyheri* subsp. *sericans*, *Trachypogon spicatus*, *Trichoneura grandiglumis*, *Tristachya leucothrix*. Herbs: *Ajuga ophrydis*, *Berkheya discolor*, *Cineraria lyratiformis*, *Conyza podocephala*, *Helichrysum adenocarpum*, *H. chionosphaerum*, *H. glomeratum*, *H. rugulosum*, *Hermannia depressa*, *Hibiscus aethiopicus* var. *ovatus*, *Indigastrum fastigiatum*, *Monopsis decipiens*, *Salvia repens* var. *keiensis*, *S. stenophylla*, *Senecio erubescens* var. *crepidifolius*, *S. latifolius*. Geophytic Herbs: *Disa versicolor*, *Eucomis autumnalis* subsp. *autumnalis*, *E. bicolor*, *Pteridium aquilinum*. Low Shrubs: *Anthospermum rigidum* subsp. *pumilum*, *Clutia affinis*, *Erica drakensbergensis*, *Felicia muricata*, *Gnidia kraussiana*, *Helichrysum hypoleucum*, *Protea dracomontana*, *P. simplex*, *Wahlenbergia dieterlenii*. Succulent Shrub: *Crassula dependens*. Small Trees: *Protea caffra* subsp. *caffra* (d), *P. roupelliae* subsp. *roupelliae* (d), *P. subvestita* (d).

Biogeographically Important Taxa ([D]Drakensberg endemic, [Dg]Drakensberg endemic extending to Griqualand East) Herbs: *Alepidea pilifera*[D], *Chironia peglerae*[D]. Geophytic Herbs: *Asclepias oreophila*[D], *Elaphoglossum drakensbergense*[D], *Eucomis schijffii*[D], *Galtonia regalis*[D], *Merwilla dracomontana*[D], *Ornithogalum diphyllum*[Dg]. Low Shrubs: *Erica ebracteata*[D] (d), *E. aestiva* var. *aestiva*[D], *E. algida*[Dg].

Endemic Taxa Geophytic Herbs: *Gladiolus loteniensis*, *Hesperantha scopulosa*.

Conservation Least threatened. Target 27%. Some 38% statutorily conserved in the uKhahlamba Drakensberg Park, Sterkfontein Dam Nature Reserve, Golden Gate Highlands National Park, Qwaqwa National Park and Poccolan Nature Reserve. About 7% already transformed by cultivation, urban sprawl or by the building of dams. Alien plant invasions are generally localised, but can be severe. Some important problem species include: *Acacia dealbata*, *A. mearnsii*, *Hypericum perforatum*, *Pinus patula*, *Populus canescens*, *Pyracantha angustifo-*

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Figure 8.16 Gd 5 Northern Drakensberg Highland Grassland: Species-rich moist grassland on sandstone with scattered *Protea caffra* at Cathkin Peak, Drakensberg (KwaZulu-Natal).

lia, *P. crenulata*, *Robinia pseudoacacia*, *Rubus cuneifolius* and *Salix fragilis*. Erosion very low (72%) or low (25%).

References Acocks (1953, 1988), Killick (1963), Edwards (1967), Du Preez & Bredenkamp (1991), Hill (1996), Camp (1999b).

Gd 6 Drakensberg-Amathole Afromontane Fynbos

VT 44 Highland Sourveld and Dohne Sourveld (57%) (Acocks 1953). LR 46 Alti Mountain Grassland (41%), LR 41 Wet Cold Highveld Grassland (21%) (Low & Rebelo 1996). BRG 10 Montane Veld p.p. (Camp 1999b). Subalpine Fynbos & Subalpine Heath (Killick 1978a). Including *Cymbopogon–Passerina* Macchia (Roberts 1966).

Distribution KwaZulu-Natal, Eastern Cape and Free State Provinces (presumably also in Lesotho): Series of isolated patches in deeply incised Drakensberg valleys (both in the Northern and Southern Berg) with the southernmost outliers on the Amathole Mountains (Eastern Cape) as well as odd outliers deep into KwaZulu-Natal at high altitude (e.g. Madlozi Mountain) north of Qudeni in the Nkandla District. Most patches found at altitudes around 1 660 m, and then from 1 900–2 060 m, with notable outliers situated as low as 1 520 m and as high as 2 600 m.

Vegetation & Landscape Features Steep valleys and escarpment slopes at the head of rivers with small stands in stream gullies and depressions. Evergreen shrublands 1–3 m tall, many shrubs with ericoid leaves. The most prominent shrubland elements comprise genera such as *Passerina*, *Cliffortia*, *Erica*, *Euryops*, *Helichrysum*, *Macowania*, *Protea*, *Widdringtonia* and *Ischyrolepis*.

Geology & Soils Jurassic basalts (Drakensberg Group) and a variety of Karoo Supergroup sedimentary rocks (mainly sandstone of the Clarens Formation of the Stormberg Group) giving rise to soils of varying depth and nutrient status. Dominant land type Ac, followed by Fa and Ad.

Climate Summer-rainfall region, with MAP 800–1 820 mm (overall regional MAP 1 167 mm). Snowfalls are occasional and summer mists occur frequently. Overall regional MAT of 12.2°C might be misleading since summer days can be quite hot and frost occurs frequently in winter (more than 40 days) and the sheltered position of the afromontane fynbos habitats (steep slopes), often out of direct sun, probably has a profound influence on local microclimate. Hot, dry winds are common from July to October. See also climate diagram for Gd 6 Drakensberg-Amathole Afromontane Fynbos (Figure 8.11).

Important Taxa Small Trees: *Widdringtonia nodiflora* (d), *Encephalartos ghellinckii*, *Protea lacticolor*, *P. subvestita*. Low Shrubs: *Passerina montana* (d), *Cliffortia linearifolia*, *C. nitidula*, *C. paucistaminea*, *Clutia natalensis*, *Erica caffrorum* var. *caffrorum*, *E. cerinthoides*, *E. evansii*, *Gymnopentzia bifurcata*, *Otholobium caffrum*, *Protea dracomontana*, *Rhus discolor*, *Stoebe plumosa*. Graminoids: *Aristida junciformis* subsp. *galpinii*, *Cymbopogon nardus*, *Ischyrolepis schoenoides*. Herb: *Helichrysum cooperi*.

Biogeographically Important Taxa ([D]Drakensberg endemic, [Dg]Drakensberg endemic extending to Griqualand East) Tall Shrub: *Lotononis lotononoides*[D] (d). Low Shrubs: *Erica ebracteata*[D] (d), *E. algida*[Dg], *E. dissimulans*[D], *E. frigida*[D], *Euryops tysonii*[D], *Helichrysum albirosulatum*[D].

Endemic Taxa Tall Shrubs: *Melianthus villosus*, *Polemannia montana*. Low Shrubs: *Cliffortia spathulata* (d), *Helichrysum argyrophyllum* (d), *Erica brownleeae*, *E. westii*, *Helichrysum setosum*, *H. tenax*, *H. tenuifolium*, *Macowania conferta*, *Phylica thodei*, *Senecio haygarthii*. Herbs: *Berkheya macrocephala*, *Selago longipedicellata*.

Conservation Target 27%. Least threatened due to poor accessibility and formal protection (more than 50% of the mapped area) in conservation areas such as the uKhahlamba Drakensberg Park (KwaZulu-Natal), Tšehlanyane National Park (Lesotho), Golden Gate Highlands National Park and Qwaqwa National Park (Free State). Those patches that occur some distance away from the Drakensberg Escarpment are threatened by increased fire frequencies.

Remarks Two structurally similar, but floristically very different afromontane fynbos (or fynbos-like) shrublands can be recognised in the Drakensberg and broader surrounds. These two subunits are also differentiated in terms of altitude and the grasslands within which they are embedded. A low-altitude (and relatively species-poor) fynbos-like shrubland with *Passerina montana* is still found on edges of some high eastern Free State tafelbergs, such as Thaba 'Nchu (Roberts 1961), and Korannaberg (Du Preez 1992) as well as at the foot of Clarens sandstone cliffs in the Golden Gate Highlands National Park. *P. montana* also dominates extensive areas of Gd 8 Lesotho Highland Basalt Grassland in Lesotho (see description below) The patches in the Nkandla District are embedded within the Midlands Mistbelt Grassland and we hypothesise that they are evidence of an earlier larger extent that these 'fynbos-like' shrublands might have experienced in some wetter Plio-Pleistocene

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Figure 8.17 Gd 6 Drakensberg-Amathole Afromontane Fynbos: Shrubland on Korannaberg (eastern Free State) dominated by *Passerina montana* and accompanied by species of the genera *Cliffortia, Metalasia, Erica, Muraltia, Selago* and *Anthospermum*.

periods. The high-altitude fynbos is a unit with clear afromontane links (*sensu* White 1978) and is limited to Killick's (1963) 'subalpine belt'. Terms such as 'Subalpine Fynbos', 'Subalpine Heath' and '*Passerina–Philippia–Widdringtonia* Fynbos' were coined to designate this unit. Killick (1963), following the then in vogue Clementsian doctrine, considered this fynbos to be the climax of his 'subalpine belt'—an assertion which we do not share.

This vegetation unit is one of the most endemic-rich in the Drakensberg Alpine Centre of Regional Endemism (as defined by Van Wyk & Smith 2001).

Hundreds of small patches of this unique fynbos have not yet been mapped (especially in the Drakensberg and even more so in the Amathole Mountains where none have yet been mapped) due to lack of formal data. In the Amathole Mountains some sites can be regarded as azonal (afromontane) fynbos and contain, among others, *Protea subvestita*, *Erica peltata* and *Cliffortia paucistaminea* (Hoare 1997, Hoare & Bredenkamp 1999). Similar azonal fynbos, including species of *Cliffortia, Erica*, *Protea*, *Restio* and others may be found on the slopes of Gaika's Kop near Hogsback. Previous studies have indicated that in the absence of fire and management, mountain grasslands in this area change to a *Cliffortia–Erica*-dominated, fynbos-type vegetation (Story 1952).

References Story (1952), Acocks (1953, 1988), Roberts (1961, 1966), Killick (1963, 1978a, b, 1994), Edwards (1967), Trollope & Booysen (1971), Trollope (1973), Downing et al. (1978), Potgieter (1982), Killick (1990), Du Preez & Bredenkamp (1991), Du Preez (1992), Hill (1996), Hoare (1997), Hoare & Bredenkamp (1999), Van Wyk & Smith (2001).

Gd 7 uKhahlamba Basalt Grassland

VT 58 *Themeda–Festuca* Alpine Veld (54%) (Acocks 1953). LR 46 Alti Mountain Grassland (65%) (Low & Rebelo 1996). BRG 10 Montane Veld p.p. (Camp 1999b).

Distribution KwaZulu-Natal and to a small extent also the Free State and Eastern Cape Provinces and very slightly in Lesotho: Uppermost slopes of the Drakensberg Mountains just below the edge of the highland plateau. Altitude 1 820–3 300 m.

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Figure 8.18 Gd 7 uKhahlamba Basalt Grassland: Dramatic montane landscape of basalt slopes and peaks of the northern Drakensberg supporting the northernmost occurrence of the high-altitude, species-rich basalt grassland below the Sentinel (Qwaqwa region, close to the meeting point of three political regions: KwaZulu-Natal, the Free State and the Kingdom of Lesotho).

Vegetation & Landscape Features Species-rich grasslands of varying levels of density, forming girlands (terraced tussocks) due to steepness of slopes. Comprising a series of communities dominated by *Bromus speciosus*, *Pentaschistis tysoniana*, *Cymbopogon nardus*, *Festuca caprina*, *Rendlia altera* and *Themeda triandra* that are accompanied by numerous (and in places dominant) herbs (*Agapanthus*, *Merwilla*, *Helichrysum*) and shrubs (*Erica*, *Helichrysum*, *Euryops*). Deep gullies on basalt support luxuriant tall-herb vegetation. Steep basalt rock faces and terraces (the most imposing array of cliffs in southern Africa) are the most dramatic landscape element characteristic of the uKhahlamba (The Barrier of Spears).

Geology & Soils Jurassic Basalts of the Drakensberg Group (Karoo Supergroup)—a result of prolonged volcanic activity accompanying the birth of the African continent by breaking from Gondwana. Deep nutrient-rich soils are formed on less steep slopes, while basalt outcrops usually do not carry any fine soil, except for shallow pockets of basalt rubble. Dominant land type Fa, followed by Ac and Ic.

Climate Summer rainfall, with MAP 830–1 820 mm (overall regional MAP 1 234 mm). Great temperature differences between summer (some days with temperature exceeding 30°C) and winter, characterised by occurrence of snow (does not persist for long on steep exposed slopes) and frequent frost (55 days per year). Morning summer mists are also frequent, but so are hot, dry winds from July to October. Depending on altitude and aspect, the climate characteristics vary considerably. See also climate diagram for Gd 7 uKhahlamba Basalt Grassland (Figure 8.11).

Important Taxa Graminoids: *Cymbopogon nardus* (d), *Eragrostis caesia* (d), *E. curvula* (d), *Festuca costata* (d), *Harpochloa falx* (d), *Heteropogon contortus* (d), *Merxmuellera disticha* (d), *M. stricta* (d), *Monocymbium ceresiiforme* (d), *Pentaschistis tysonii* (d), *Rendlia altera* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *Agrostis barbuligera*, *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon appendiculatus*, *Aristida junciformis* subsp. *galpinii*, *A. monticola*, *Brachypodium bolusii*, *Bulbostylis humilis*, *B. schoenoides*, *Carex glomerabilis*, *Cymbopogon marginatus*, *Cyperus schlechteri*, *Digitaria flaccida*, *D. ternata*, *Diheteropogon filifolius*, *Elionurus muticus*, *Eragrostis capensis*, *Festuca scabra*, *Ficinia stolonifera*, *Koeleria capensis*, *Loudetia simplex*, *Merxmuellera stereophylla*, *Panicum ecklonii*, *Pentaschistis aurea* subsp. *pilosogluma*, *P. cirrhulosa*, *P. natalensis*, *Poa binata*, *Scirpus falsus*, *Stiburus alopecuroides*, *Styppeiochloa gynoglossa*, *Tetraria cuspidata*. Herbs: *Cycnium racemosum* (d), *Xerophyta viscosa* (d), *Aster bakerianus*, *Berkheya discolor*, *B. rhapontica* subsp. *rhapontica*, *Craterocapsa tarsodes*, *Cyphia elata*, *Galium capense* subsp. *capense*, *Gnaphalium griquense*, *Helichrysum adenocarpum*, *H. aureonitens*, *H. aureum* var. *monocephalum*, *H. ecklonis*, *H. hyphocephalum*, *H. nanum*, *H. rugulosum*, *H. setigerum*, *H. spiralepis*, *H. subglomeratum*, *H. umbraculigerum*, *Lobelia vanreenensis*, *Protea dracomontana*, *Psammotropha alternifolia*, *P. obovata*, *Sebaea sedoides* var. *confertiflora*, *Senecio arabidifolius*, *S. asperulus*, *Sutera neglecta*, *Wahlenbergia and-*

rosacea, *W. undulata*, *Zaluzianskya microsiphon*. Geophytic Herbs: *Agapanthus campanulatus* (d), *Brunsvigia natalensis* (d), *Corycium nigrescens* (d), *Eucomis autumnalis* subsp. *clavata* (d), *Nerine bowdenii* (d), *Albuca shawii*, *Brownleea galpinii*, *Chlorophytum acutum*, *Corycium dracomontanum*, *Dipcadi gracillimum*, *Disa fragrans* subsp. *fragrans*, *D. sankeyi*, *D. versicolor*, *Disperis oxyglossa*, *D. renibractea*, *Drimia macrocentra*, *Eriospermum ornithogaloides*, *Eucomis bicolor*, *Gladiolus dalenii*, *G. ecklonii*, *G. longicollis* subsp. *longicollis*, *Habenaria lithophila*, *Haemanthus humilis* subsp. *hirsutus*, *Hesperantha baurii*, *Holothrix thodei*, *Huttonaea oreophila*, *Hypoxis multiceps*, *Kniphofia ritualis*, *K. triangularis*, *Moraea modesta*, *M. robusta*, *Neobolusia tysonii*, *Oxalis depressa*, *Pachycarpus vexillaris*, *Pterygodium cooperi*, *P. hastatum*, *Rhodohypoxis baurii* var. *baurii*, *Satyrium cristatum*, *S. longicauda*, *S. microrrhynchum*, *Schizochilus flexuosus*, *Tulbaghia leucantha*, *Watsonia gladioloides*, *W. lepida*, *Xysmalobium prunelloides*. Semiparasitic Herb: *Thesium durum*. Low Shrubs: *Helichrysum sutherlandii* (d), *Anthospermum hispidulum*, *Chrysocoma ciliata*, *Dichilus strictus*, *Erica caespitosa*, *E. glaphyra*, *E. woodii*, *Eriocephalus eximius*, *Euryops pedunculatus, Gnidia gymnostachya*, *Helichrysum swynnertonii*, *Pelargonium sidoides*. Succulent Shrubs: *Aloe pratensis*, *Crassula sarcocaulis*, *C. tetragona* subsp. *acutifolia*.

Biogeographically Important Taxa ([D]Drakensberg endemic, [Dg]Drakensberg endemic extending to Griqualand East) Graminoids: *Bromus speciosus*[D] (d), *Carex monotropa*[D], *Helictotrichon galpinii*[D], *Pentaschistis exserta*[D], *P. galpinii*[D], *Restio galpinii*[Dg]. Herbs: *Berkheya multijuga*[D] (d), *Alchemilla colura*[Dg], *Aster ananthocladus*[D], *Berkheya pannosa*[Dg], *Cephalaria galpiniana* subsp. *simplicior*[D], *Chironia peglerae*[D], *Cotula lineariloba*[D], *Diascia anastrepta*[D], *D. vigilis*[D], *Felicia linearis*[Dg], *Glumicalyx flanaganii*[D], *Helichrysum albirosulatum*[D], *H. album*[D], *H. argentissimum*[Dg], *H. aureum* var. *scopulosum*[Dg], *H. aureum* var. *serotinum*[D], *H. basalticum*[D], *H. bellum*[D], *H. subfalcatum*[D], *Psammotropha mucronata* var. *marginata*[D], *Senecio tugelensis*[D]. Geophytic Herbs: *Galtonia regalis*[D] (d), *Asclepias oreophila*[D], *Cyrtanthus flanaganii*[D], *Dierama tysonii*[Dg], *Disa cephalotes* subsp. *frigida*[D], *D. oreophila* subsp. *erecta*[D], *D. stricta*[Dg], *D. thodei*[D], *Elaphoglossum drakensbergense*[D], *Eucomis schijffii*[D], *Gladiolus microcarpus*[D], *Hesperantha schelpeana*[D], *Huttonaea grandiflora*[D], *H. woodii*[Dg], *Miraglossum superbum*[D], *Moraea alticola*[D], *Saniella verna* (generic link to Hantam-Roggeveld CE), *Schizochilus angustifolius*[D], *Schizoglossum montanum*[D], *Tulbaghia montana*[D]. Herbaceous Climber: *Cyphia tysonii*[D]. Low Shrubs: *Berkheya rosulata*[D], *Comborhiza virgata*[D], *Erica flanaganii*[D], *E. straussiana*[D], *E. thodei*[Dg], *E. wyliei*[D], *Euryops decumbens*[D], *E. evansii* subsp. *evansii*[D], *E. montanus*[D], *Gnidia compacta*[D], *Helichrysum glaciale*[D], *H. milfordiae*[D], *H. sessilioides*[D], *H. witbergense*[D], *Passerina drakensbergensis*[D].

Endemic Taxa ([N]Northern Berg and [S]Southern Berg only, respectively) Graminoids: *Merxmuellera aureocephala*. Herbs: *Aplanodes doidgeana*, *Berkheya draco*[N], *B. leucaugeta*[N], *Diascia austromontana*, *D. purpurea*, *D. tugelensis*, *Dracosciadium saniculifolium*[N], *Geranium drakensbergensis*[S], *Gerbera parva*, *H. amplectens*[N], *H. evansii*[N], *H. heterolasium*, *H. mollifolium*, *Heliophila formosa*[S], *Hermannia malvifolia*, *Indigofera pseudoevansii*, *Melpomene flabelliformis*, *Nemesia glabriuscula*, *Pimpinella krookii*, *Satureja compacta*, *S. grandibracteata*, *Sebaea radiata*, *Selago trauseldii*, *Senecio basalticus*[N], *S. brevilorus*, *S. cristimontanus*, *S. dissimulans*, *S. mauricei*[S], *S. parentalis*, *S. polelensis*[S], *S. praeteritus*, *S. qathlambanus*, *S. saniensis*[N], *S. telmateius*, *S. thamathuensis*[N], *Wahlenbergia pulvillus-gigantis*[N], *W. tetramera*[N], *Xerophyta longicaulis*, *Xysmalobium woodii*. Geophytic Herbs: *Albuca affinis*[N], *Brachystelma alpinum*[N], *Crocosmia pearsei*[N], *Cyrtanthus erubescens*[N], *Disa dracomontana*[N], *Drimia saniensis*[N], *Gladiolus flanaganii*, *G. symonsii*, *Glossostelma xysmalobioides*, *Hesperantha altimontana*[N], *H. curvula*[N], *H. pubinervia*[N], *Moraea vigilans*[N], *Rhodohypoxis incompta*[S], *R. thodiana*[S], *Schizoglossum crassipes*, *S. elingue* subsp. *elingue*, *S. elingue* subsp. *purpureum*, *S. hilliardiae*[N], *Wurmbea burttii*, *W. tenuis* subsp. *australis*. Parasitic Herb: *Harveya leucopharynx*. Low Shrubs: *Erica aestiva* var. *minor*[N], *E. caffrorum* var. *luxurians*[N], *E. flanaganii*, *Eumorphia prostrata*[S], *Euryops brevipes*, *E. evansii* subsp. *parvus*, *Gnidia renniana*, *Helichrysum confertum*[N], *H. drakensbergense*, *H. haygarthii*, *Inulanthera montana*, *Lessertia stipulata*[N], *Lotononis virgata*, *Macowania deflexa*[N], *M. hamata*, *M. sororis*, *Otholobium fumeum*, *Protea nubigena*[N], *Struthiola angustiloba*[N]. Succulent Shrubs: *Delosperma lavisiae*[N], *Othonna burttii*[N].

Conservation Least threatened. The target of 27% has been superseded, since 75% of the unit's surface enjoys statutory protection in the uKhahlamba Drakensberg Park (South Africa). Some patches are also protected in the Sehlabathebe National Park (Lesotho). Erosion very low (76%) and low (19%).

Remarks This unit forms the core of the Drakensberg Alpine CE (as defined by Van Wyk & Smith 2001).

References Acocks (1953, 1988), Killick (1963, 1978a, b, 1994), Edwards (1967), Jacot Guillarmod (1971), White (1978), Hilliard & Burtt (1987), Killick (1990), Hill (1996), Camp (1999b), Van Wyk & Smith (2001).

Gd 8 Lesotho Highland Basalt Grassland

VT 58 *Themeda–Festuca* Alpine Veld (84%) (Acocks 1953). LR 45 Afro Mountain Grassland (55%) (Low & Rebelo 1996).

Distribution Lesotho, Eastern Cape, Free State (and partly also into southern KwaZulu-Natal): Most of the high dissected basalt plateau of Lesotho, including most of the districts of Mokhotlong, Thaba-Tseka, Qacha's Nek and Quthing and the eastern parts of Butha-Buthe, Leribe, Berea, Maseru, Mafeteng and Mohale's Hoek. Extends on the basalt from around 'Makholo (Ben Macdhui) into the Eastern Cape southwards to the vicinity of Barclay East, and westwards along the Witteberge to the vicinity of Lady Grey. Extends in a small area of the northeastern Free State on the high basalt mountains such as Ribbokkop (within the Golden Gate Highlands National Park) and on the top of Oorsprongsberg. Altitude about 1 900–2 900 m. The unit extends to KwaZulu-Natal at the lower parts of the Escarpment edge (e.g. around the Loteni and Mkhomazi Passes). The areas of Drakensberg Afroalpine Heathland (above 2 900 m) are embedded in this unit as are some Lesotho Mires (at higher altitudes). For practical reasons, the vegetation unit includes a small area of high-altitude sandstone (up to about 2 600 m) that is limited to the eastern edge of Lesotho (notably in the Sehlabathebe National Park).

Vegetation & Landscape Features Landscape consists of many plateaus and high ridges of mountains separated by often deep valleys. Although many valley slopes are steep, major cliff faces are only occasionally encountered, especially along parts of the main Maloti Mountain chain. Vegetation is closed, short grassland with many areas also with *Passerina montana*-dominated shrubland. The much smaller shrubs, such as *Chrysocoma ciliata* and *Pentzia cooperi*, are often very common also in clearly disturbed areas (especially on the warmer slopes at higher altitudes). *Chrysocoma ciliata* is the typical component of 'sehalahala scrub' (Anonymous 2000). Within the considerable altitude range in the unit there are many plant species that extend to various altitudinal levels or belts. Also in terms of dominants, for example, *Themeda triandra* tends to be more important at the lower and middle elevations and *Festuca caprina* at higher

altitudes, although there is considerable altitudinal overlap between these species. Although *Kniphofia caulescens* has a wide altitudinal distribution, its large aggregate patches (often hundreds of square metres in extent) are mostly evident in the upper half of the altitudinal range corresponding to larger sponge areas (2 500 to 2 900 m with most mass flowering displays best observed around 2 700 m within Lesotho). The medium-tall distinctive grass *Merxmuellera macowanii* occurs along water courses and drainage lines.

D.J. McDonald

Figure 8.19 Gd 8 Lesotho Highland Basalt Grassland: Mass display of *Kniphofia caulescens* at an altitude of about 2 700 m on basalt at Tiffindell (Eastern Cape) in the southern Drakensberg.

Geology & Soils The area is almost entirely underlain by basaltic lava flows of the Drakensberg Group, with some of the shallow soils covering sandstones of the Clarens Formation (Stormberg Group, Karoo Supergroup) in the form of disintegrating carpets. Soils derived from the basalt have fairly even proportions of coarse sand, fine sand, silt, clay and organic matter. The organic matter increases from about 20% on the slopes to about 26% in the valleys (Herbst & Roberts 1974a). The high organic content (acid, slowly decomposing humus formed largely by decaying grass roots) results in a high water-retention capacity of the soil. Water redistribution through seeps is frequent. Main land type, at least in the South African section, is Ea.

Climate Summer rainfall, with little rain in winter, particularly away from the Northern Escarpment. Much of the area is in a rainshadow with weather stations such as Mokhotlong at an elevation of 2 377 m with a MAP of only 575 mm (Tyson et al. 1976, Killick 1978a). MAP is higher along the eastern edge, for example, 928 mm at Qacha's Nek and also in the southeast, with 686 mm at Barkly East Golf Club. Mean monthly maximum and minimum temperatures for Barkly East Golf Club are 31.4°C and –10.5°C for December and July, respectively. Frost occurs throughout winter and on occasion even in summer at higher elevations. Snow occurs in winter, especially at higher elevations where some light snow can occur in summer. There is a high incidence of lightning in summer and hail is common. See also climate diagram for Gd 8 Lesotho Highland Basalt Grassland (Figure 8.11).

Important Taxa Graminoids: *Bulbostylis humilis* (d), *Cymbopogon dieterlenii* (d), *Elionurus muticus* (d), *Eragrostis curvula* (d), *Festuca caprina* (d), *Harpochloa falx* (d), *Koeleria capensis* (d), *Merxmuellera disticha* (d), *Pentaschistis oreodoxa* (d), *Poa binata* (d), *Scirpus falsus* (d), *Aristida junciformis* subsp. *galpinii*, *Carex glomerabilis*, *Cymbopogon marginatus*, *Eragrostis caesia*, *Helictotrichon turgidulum*, *Luzula africana*, *Merxmuellera drakensbergensis*, *Rendlia altera*. Herbs: *Helichrysum subglomeratum* (d), *Anthospermum herbaceum*, *Cerastium arabidis*, *Cotula hispida*, *Dimorphotheca jucunda*, *Haplocarpha scaposa*, *Helichrysum acutatum*, *H. cerastioides*, *H. setigerum*, *Senecio asperulus*, *Silene burchellii*, *Trifolium burchellianum* subsp. *burchellianum*, *Ursinia montana*, *Zaluzianskya microsiphon*. Geophytic Herbs: *Disa sankeyi*, *D. tysonii*, *Geum capense*, *Moraea modesta*, *Oxalis depressa*, *Rhodohypoxis baurii* var. *baurii*, *R. baurii* var. *confecta*, *R. baurii* var. *platypetala*, *Satyrium longicauda*. Succulent Herb: *Crassula peploides*. Semiparasitic Herb: *Thesium nigrum*. Low Shrubs: *Euphorbia striata*, *Hebenstretia dura*, *Helichrysum infaustum*, *H. odoratissimum*, *H. sessile*, *H. sutherlandii*, *Pentzia cooperi*. Succulent Shrub: *Delosperma crassuloides*.

Biogeographically Important Taxa ([D]Drakensberg endemic, [Dg]Drakensberg endemic extending to Griqualand East) Graminoids: *Ehrharta longigluma*[D], *Helictotrichon galpinii*[D], *Pentaschistis airoides* subsp. *jugorum*[D], *P. exserta*[D], *P. galpinii*[D], *Polevansia rigida*[D], *Restio galpinii*[Dg]. Herbs: *Alchemilla colura*[Dg], *Alepidea pilifera*[D], *Berkheya cirsiifolia*[D], *B. multijuga*[D], *Cephalaria galpiniana* subsp. *simplicior*[D], *Diascia anastrepta*[D], *Felicia linearis*[Dg], *Glumicalyx flanaganii*[D], *G. lesuticus*[D] (Lesotho endemic), *G. montanus*[D], *Helichrysum album*[D], *H. aureum* var. *scopulosum*[Dg], *H. aureum* var. *serotinum*[D], *H. basalticum*[D], *H. bellum*[D], *H. elegantissimum*[D], *H. palustre*[D], *H. subfalcatum*[D], *Heliophila alpina*[D], *Lobelia galpinii*[D], *Psammotropha mucronata* var. *marginata*[D], *Sebaea thodeana*[D], *Senecio tugelensis*[D], *Wahlenbergia polytrichifolia* subsp. *dracomontana*[D], *Zaluzianskya rubrostellata*[D]. Geophytic Herbs: *Corycium alticola*[D], *Cyrtanthus flanagani*[D], *Disa cephalotes* subsp. *frigida*[D], *D. stricta*[Dg], *D. thodei*[D], *Eucomis schijffii*[D], *Euryops decumbens*[D], *E. evansii* subsp. *evansii*[D], *E. tysonii*[D], *Galtonia regalis*[D], *Gladiolus microcarpus*[D], *Hesperantha schelpeana*[D], *Huttonaea grandiflora*[D], *Moraea alticola*[D], *Rhodohypoxis rubella*[D], *Schizochilus angustifolius*[D], *S. bulbinella*[Dg], *Tulbaghia montana*[D]. Semiparasitic Herb: *Thesium decipiens*[D]. Herbaceous Climber: *Cyphia tysonii*[D]. Low Shrubs: *Helichrysum sessilioides*[D] (d), *Berkheya rosulata*[D], *Clutia nana*[D], *Erica algida*[Dg], *E. dissimulans*[D], *E. dominans*[D], *E. dracomontana*[D], *E. flanaganii*[D], *E. schlechteri*[D], *E. straussiana*[D], *Eumorphia sericea* subsp. *sericea*[D], *Felicia drakensbergensis*[D], *Gnidia compacta*[D], *G. propinqua*[D], *Helichrysum marginatum*[D], *H. trilineatum*[D], *H. witbergense*[D], *Inulanthera thodei*[D], *Passerina drakensbergensis*[D], *Relhania acerosa*[Dg], *R. dieterlenii*[D]. Succulent Shrub: *Delosperma nubigenum*[D].

Endemic Taxa Herbs: *Argyrolobium summomontanum*, *Conium fontanum* var. *alticola*, *Cynoglossum alticola*, *Glumicalyx apiculatus*, *Helichrysum nimbicola*, *Jamesbrittenia beverlyana*, *Lessertia dykei*, *Polygala erubescens*, *Selago melliodora*, *Strobilopsis wrightii*, *Zaluzianskya oreophila*. Geophytic Herbs: *Dryopteris dracomontana*, *Gladiolus saundersii*, *Hesperantha exiliflora*, *Kniphofia hirsuta*, *Moraea alpina*, *Ornithogalum sephtonii*.

Parasitic Herb: *Harveya pulchra*. Low Shrubs: *Clutia alpina*, *Erica caffrorum* var. *aristula*, *E. dracomontana*, *Euryops evansii* subsp. *dendroides*, *E. inops*, *Jamesbrittenia lesutica*, *Macowania pulvinaris*. Succulent Shrubs: *Aloe polyphylla* (Lesotho endemic), *Delosperma aliwalense*, *D. clavipes*.

Conservation Least threatened. Target 27%. Only slightly more than 1% statutorily conserved in the Malekgonyane (Ongeluksnek) Wildlife Reserve, Golden Gate Highlands National Park (both South Africa) and Sehlabathebe National Park (Lesotho). This does not include the portion conserved in the lower reaches of the Bokong Nature Reserve. The planned Maloti-Drakensberg Transfrontier Park would increase the conservation status of the higher-altitude parts of this unit in the north. Almost 10% of the unit has already been transformed, mainly by cultivation, which seldom occurs above an altitude of 2 500 m (usually as narrow isolated belts of maize). This vegetation type has also been affected by the relatively recent completion of the Katse Dam on Malibamatso River and the Mohale Dam on Sengunyane River, representing the highest concrete arch dam and highest rock fill dam on the African continent, respectively. The unit is heavily utilised for grazing (under a communal system; see Tshabalala 1995) by sheep, goats, cattle and donkeys (Chakela 1999), with the most impact at lower altitudes. High-altitude grazing is limited to the warmer months of the year. The large shrub component (*Passerina montana*, *Chrysocoma ciliata* etc.) is probably a consequence of high grazing pressure over many years. Even if grazing has increased the incidence of *P. montana*, it is in turn partly controlled by serving as a major source of fuel for local people. Erosion is very evident in many areas and includes dramatic streaks on some steeper slopes. *Aloe polyphylla* has a relatively high market value for collectors and has vanished from virtually all sites in the Front Range of the Maloti (Anonymous 2000).

L.W. Powrie

Figure 8.20 Gd 8 Lesotho Highland Basalt Grassland on the slopes of the Malibamatso River valley immediately below Katse Dam in northern Lesotho.

Remark 1 Along the southern edge of this unit in the Eastern Cape, some of Bester's (1998) vegetation types occur across the basalt and the lower elevation sedimentary rocks. Only his *Euryops tysonii–Cotula socialis* scrub community is confined to the basalt. Within the Golden Gate Highlands National Park, at least five vegetation types have been identified as occurring exclusively on the basalt (Kay et al. 1993), although there are a number of others that straddle the basalt and sandstone. Further research will reveal whether the flora of the relatively well-collected (in the Sehlabathebe National Park) high-altitude sandstone area is, as Hilliard & Burtt (1987) assert, significantly different from that of the undercollected and often inaccessible basalt areas at the same elevation towards the interior. Hilliard & Burtt (1987) also stated that this elevated sandstone block marks the northeasterly limit of many species from the south (i.e. these species do not continue northwards on the high-altitude basalt substrate). Morris et al. (1993) suggest partitioning this unit into an upper subalpine belt (approximately at 2 900–2 290 m) and a montane belt below 2 290 m. Herbst & Roberts (1974a, b), who included about 30% of the altitude range of their study area in the Drakensberg 'Afro-Alpine Heathland' and the rest in the Lesotho Highland Basalt Grassland, pointed to a very different species composition between these areas and equivalent elevation areas in uKhahlamba Basalt Grassland.

Remark 2 This unit constitutes the major part (in terms of area) of the Drakensberg Alpine Centre of Endemism (Van Wyk & Smith 2001). The Sehlabathebe area has a remarkably high bulbous component such as orchids, which require high soil moisture over prolonged periods of time. The dominant shrub of the slopes of the Western Lesotho Basalt Shrubland (*Leucosidea sericea*) seems, curiously, to be largely absent from even the lower slopes of this unit.

References Herbst & Roberts (1974a, b), Killick (1978a, b), Potgieter (1982), Wieland (1982), Martin (1986), Hilliard & Burtt (1987), Backéus (1988), Morris (1990), Mokuku (1991), Kay et al. (1993), Morris et al. (1993), Morris (1994), Bester (1998), Willis et al. (1999), Anonymous (2000), Wyk & Smith (2001), Kobisi (2005).

Gd 9 Western Lesotho Basalt Shrubland

VT 58 *Themeda–Festuca* Alpine Veld (49%), VT 48 *Cymbopogon–Themeda* Veld (sandy) (43%) (Acocks 1953). LR 45 Afro Mountain Grassland (87%) (Low & Rebelo 1996).

Distribution Lesotho: Almost all confined to the Maseru and Mafeteng Districts. Relatively limited area on lower-altitude basalt along the southwestern end of the Front Range from around Bushman's Pass in the north to around Matelile/Malealea in the south and including the lower basalt slopes of the broad Makhaleng River Valley, including the Ramabanta area. Altitude 1 680–2 400 m, mostly 1 780–1 820 m.

Vegetation & Landscape Features Gentle to sometimes steep lower mountain slopes of basalt supporting medium-tall extensive shrublands alternating in places with patches of grassland. Overwhelmingly dominated by a shrubby form of *Leucosidea sericea*, whose dominance is not limited to drainage lines.

L.W. Powrie

Figure 8.21 Gd 9 Western Lesotho Basalt Shrubland: Dense shrubland dominated by *Leucosidea sericea*, with some *Rhus pyroides* at an altitude of 2 025 m northwest of Ha Ramabanta, Lesotho.

Geology & Soils The Jurassic basalts of the Drakensberg Group (Karoo Supergroup) dominate this area. Soils are shallow to sometimes deep, with a significantly high organic content.

Climate Summer rainfall, with very little rain in winter. MAT is the highest of the four main grassland types on basalt. Snow is of limited duration in winter. See also climate diagram for Gd 9 Western Lesotho Basalt Shrubland (Figure 8.11).

Important Taxa Tall Shrubs: *Leucosidea sericea* (d), *Buddleja loricata*, *Rhamnus prinoides*, *Rhus pyroides*. Low Shrubs: *Chrysocoma ciliata* (d), *Felicia muricata*, *Hebenstretia dura*, *Helichrysum splendidum*, *Jamesbrittenia stricta*, *Rhus divaricata*. Graminoids: *Digitaria eriantha* (d), *Eleocharis dregeana*, *Festuca caprina*, *Hyparrhenia hirta*, *Merxmuellera stereophylla*, *Pennisetum thunbergii*. Herbs: *Ajuga ophrydis*, *Conium chaerophylloides*, *Cysticapnos pruinosa*, *Felicia petiolata*, *Galium capense* subsp. *garipense*, *Geranium magniflorum*, *G. robustum*, *Helichrysum aureum* var. *monocephalum*, *Ipomoea oblongata*, *Manulea crassifolia* subsp. *crassifolia*, *Myosotis afropalustris*, *Pimpinella caffra*, *Polygala gracilenta*, *P. rhinostigma*, *Rumex lanceolatus*, *Salvia repens* var. *repens*, *Sebaea repens*, *Senecio glaberrimus*, *Stachys dregeana*. Geophytic Herbs: *Bulbine frutescens*, *Corycium dracomontanum*, *Dierama robustum*, *Dipcadi viride*, *Gladiolus permeabilis* subsp. *edulis*, *Kniphofia ritualis*.

Biogeographically Important Taxa (both Drakensberg endemics) Herbs: *Alepidea pilifera*, *Diascia integerrima*.

Conservation Least threatened. Target 28%. None conserved in statutory conservation areas. About 16% already transformed, mainly by cultivation. Being close to major concentrations of human settlements in the lowlands, it has probably been subjected to prolonged grazing pressure. Although erosion is high in places, it appears far less eroded than the surrounding lowlands. Although a number of alien plants are concentrated around settlements, they do not appear to have had a major impact on the vegetation yet. *Aloe polyphylla* has a relatively high market value for collectors and has vanished from virtually all sites in the Front Range of the Maloti (Anonymous 2000).

Remarks This unit approximates the southern part of what has been regarded as the Foothills Ecological Zone (Anonymous 2000), although this zone often includes the sandstone belt below the basalt. Very little is known about this unit and future research should attempt to determine to what extent it may be a derived type. Of interest is that some of the typical species (*Leucosidea sericea*, *Rhamnus pyroides*, *Buddleja saligna*) are indicative of forest precursors (C.J. Geldenhuys, personal communication). *L. sericea* tends to invade formerly disturbed (overgrazed) wet grasslands. It is not only the case in Lesotho, but also in the bordering regions where, for instance, Eastern Free State Wet Grassland and Drakensberg Montane meet (Qwaqwa and Golden Gate Highlands National Parks, Van Rheenen's Pass near Harrismith).

References Anonymous (2000), Kobisi (2005).

Gd 10 Drakensberg Afroalpine Heathland

VT 58 *Themeda–Festuca Alpine* Veld (99%) (Acocks 1953). LR 46 Alti Mountain Grassland (81%) (Low & Rebelo 1996).

Distribution Lesotho and very marginally also in KwaZulu-Natal Province: The highest plateaus and mountain ridges above an altitude of about 2 900 m in northeastern Lesotho. This includes the highest mountain in southern Africa (Thabana-Ntlenyana, 3 482 m). Further away from the edge of the Drakensberg Escarpment it is particularly extensive in the area of the Tlaeen Pass and Pass of Guns (between Mokhotlong and Oxbow) with good examples visible on the Kotisephola Pass (between Sani Pass top and Mokhotlong), Mafika-Lisiu Pass (between Lejone and Pitseng) and Matebeng Pass (between Sehlabathebe and Sehonghong). Altitude range 2 900–3 400 m, mainly 2 980–3 110 m.

Vegetation & Landscape Features Rolling plateaus with steep slopes in places. Very variable but short vegetation from shrub-dominated areas, for example by *Helichrysum trilineatum*, to grassland with shrubs, to grassland with few shrubs. The most dominant grass is *Merxmuellera disticha* (Herbst 1971, Herbst & Roberts 1974b, Morris et al. 1993). Cushion plants (e.g. *H. sessilioides*) and plants forming low mats (e.g. *H. praecurrens*) are common. As elsewhere in the highlands of Lesotho, *Chrysocoma ciliata* is common in disturbed areas and even in some apparently little disturbed areas. Many Lesotho Mires are embedded in this unit. The medium-tall grass *M. drakensbergensis* extends well away from watercourses and drainage lines.

Geology & Soils The area occurs entirely on basalt of the Drakensberg Group (Karoo Supergroup). Soils are Mollisols indicating an Udic moisture regime and frigid temperature regime. Frost action is important in alpine soil formation (Mokuku 1991). The freezing and thawing of the soil heaves the soil material, resulting in gradual removal of finer soil particles downslope, mainly from the existing micro-erosion terraces. Soils derived

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Figure 8.22 Gd 10 Drakensberg Afroalpine Heathland: Moist heathland dominated by *Erica dominans* and *E. glaphyra* on the summit of the Eastern Buttress, Amphitheatre area, with the steep cliffs of the uKhahlamba Basalt Grassland (Gd 7) in the background.

from the basalt have fairly even proportions of coarse sand, fine sand, silt, clay and, importantly, organic matter (around 20%). In many areas the soil is shallow, with surface rock, including some areas with mostly rock rubble, for example on Thabana-Ntlenyana (Killick 1990).

Climate Summer rainfall, but subject to some precipitation from cold fronts in winter. MAP has a considerable range, with 1 609 mm at the top of the Organ Pipes Pass on the Escarpment at 2 927 m elevation, and only 634 mm at a point 365 m higher at 3 292 m, but between 15 and 20 km away from the Escarpment edge (Killick 1979). There is thus a rapid decline in MAP from near (2–3 km) the edge of the Escarpment (but further in the Oxbow area) to the interior even at higher elevations (Bawden & Carrol 1968, Chakela 1999). The mean annual temperature of about 4.0°C is lower than that of any of the other vegetation units. Frost occurs probably more than half the year, including occasionally in summer. Letseng-la-Terae, at an altitude of 3 000 m, holds the record for the lowest temperature ever recorded in Lesotho (–20.4°C in June 1967). See also climate diagram for Gd 10 Drakensberg Afroalpine Heathland (Figure 8.11).

Important Taxa Low Shrubs: *Chrysocoma ciliata* (d), *Anisodontea julii* subsp. *pannosa*, *Erica glaphyra*, *Pentzia cooperi*, *Selago flanaganii*, *Syncolostemon macranthus*. Graminoids: *Merxmuellera drakensbergensis* (d), *Pentaschistis aurea* subsp. *pilosogluma*.

Biogeographically Important Taxa ([D]Drakensberg endemic, [Dg]Drakensberg endemic extending to Griqualand East) Low Shrubs: *Erica dominans*[D] (d), *Eumorphia sericea* subsp. *sericea*[D] (d), *Helichrysum trilineatum*[D] (d), *Clutia nana*[D], *Erica frigida*[D], *E. thodei*[Dg], *Euryops decumbens*[D], *E. montanus*[D], *Felicia drakensbergensis*[D], *Gnidia propinqua*[D], *Helichrysum milfordiae*[D], *H. witbergense*[D], *Inulanthera thodei*[D]. Succulent Shrub: *Delosperma nubigenum*[D]. Herbs: *Cotula lineariloba*[D], *Felicia uliginosa*[D], *Glumicalyx lesuticus*[D] (Lesotho endemic), *Helichrysum basalticum*[D], *H. bellum*[D], *H. palustre*[D], *Heliophila alpina*[D], *Lobelia galpinii*[D], *Sebaea thodeana*[D]. Geophytic Herbs: *Romulea luteoflora* var. *sanisensis* (specific link to Hantam-Roggeveld CE), *Saniella verna*[D] (generic link to Hantam-Roggeveld CE). Graminoid: *Ehrharta longigluma*[D].

Endemic Taxa Low Shrubs: *Euryops acraeus*, *Helichrysum pagophilum*, *Muraltia flanaganii*. Herbs: *Aster erucifolius*, *Cotula radicalis*, *Helichrysum lineatum*, *H. praecurrens*, *Jamesbrittenia jurassica*, *Manulea platystigma*, *Psammotropha obtusa*, *Zaluzianskya chrysops*, *Z. turritella*. Geophytic Herbs: *Disa basutorum*, *Hesperantha alborosea*, *H. altimontana*, *Wurmbea pusilla*.

Conservation Least threatened. Target 27%. About 2% statutorily conserved in the uKhahlamba Drakensberg Park as well as in the upper parts of the Bokong Nature Reserve. The planned Maloti-Drakensberg Transfrontier Park could conserve almost all the area of this unit. Very little has been transformed, but grazing pressure in summer is high. Already in 1938, Staples & Hudson referred to a considerable increase in *Helichrysum trilineatum*, *Passerina montana* and an *Erica* species and a *Pentzia* species 'in places above 9500 feet' (2 896 m). Although the increase in *H. trilineatum* may be promoted by its poor palatability to stock, it may be partly counteracted by its use 'as fuel, the branches burning readily when green' (Hilliard 1983).

Remarks The *Erica–Helichrysum–Eumorphia* sedge heath of Jacot Guillarmod (1971), although occasionally found on cold wet slopes below the 2 900 m, is 'the climax community over most of the area only above 2 900 metres'. Morris et al. (1993) supported the notion of general altitudinal limit of 2 900 m for this unit, but also suggested that it extends to somewhat lower altitudes on southern slopes. This unit also comprises the *Merxmuellera drakensbergensis–Festuca caprina* high-altitude Austro-afro Alpine grassland of Du Preez & Bredenkamp (1991). The often common *Themeda triandra* in the eastern grasslands of southern Africa is rare in this unit. Families rich in geophytes (Iridaceae, Hyacinthaceae, Orchidaceae) appear to lose significance with increasing altitude (Herbst & Roberts 1974b), yet orchids are prominent along the Escarpment edge (Killick 1990). The strong diminishing precipitation gradient from the Escarpment edge inland probably helps explain the apparent contradictions between especially earlier accounts of the flora and vegetation based on studies on the edge of the Escarpment and what is observed further into Lesotho. It could be argued that the narrow strip on top of the Escarpment would be better grouped (as a subtype) with the uKhahlamba Basalt Grassland.

References Killick (1963, 1978a, b, 1990), Edwards (1967), Jacot Guillarmod (1971), Herbst & Roberts (1974b), White (1978), Hilliard & Burtt (1987), Du Preez & Bredenkamp (1991), Morris et al. (1993), Hill (1996), Van Wyk & Smith (2001), Kobisi (2005).

Dry Highveld Grassland

Highveld grasslands are found on the extensive central plateau of South Africa. The topography is flat to undulating, occasionally broken by small mountains, typically found in the Free State, or incised river valleys, such as the Orange, Vaal and Olifants Rivers. The major environmental factor controlling vegetation patterns and the recognition of different vegetation types is

annual rainfall, which forms an east to west gradient of decreasing moisture across the Highveld.

Dry Highveld Grassland prevails in the western regions of the Grassland Biome where annual rainfall is below 600 mm per annum (Figure 8.23). These grasslands therefore fall into the 'sweet' grassland type with a predominance of chloridoid grasses. These areas are found mostly within the Free State, North-West and Eastern Cape Provinces in a north-south band. The grassland types are mostly plains grasslands distinguished primarily on substrate characteristics, but also include the topographically complex, steep mountain grasslands of the Karoo Escarpment. Also included within Dry Highveld Grassland are a number of intrazonal units containing shrubland on koppies or woodland on other substrates (Figure 8.24). These shrublands form a distinctive structural vegetation type within the matrix of grasslands and are restricted to rocky slopes and outcrops where the surface rockiness is high and where soils are mostly shallow and stony.

Gh 1 Karoo Escarpment Grassland

VT 60 Karroid *Danthonia* Mountain Veld (69%) (Acocks 1953). LR 44 South-eastern Mountain Grassland (69%) (Low & Rebelo 1996).

Distribution Eastern, Northern and Western Cape Province: Occurs on the Karoo Escarpment, running in an east-west direction from Molteno to Noupoort in the north, and from Somerset East in a northwesterly direction towards Nieu-Bethesda. Also found on the north-facing slopes of the Winterberg Mountains around Tarkastad. The westernmost locality is on the highest-altitude flat-topped mesas of the Escarpment in the Karoo National Park near Beaufort West. Altitude about 1 100–2 502 m at the summit of the Kompasberg.

Vegetation & Landscape Features Mountain summits, low mountains and hills with wiry, tussock grasslands, usually dominated by *Merxmuellera disticha*. Other common species include the grasses typical of dry grasslands (genera *Eragrostis*,

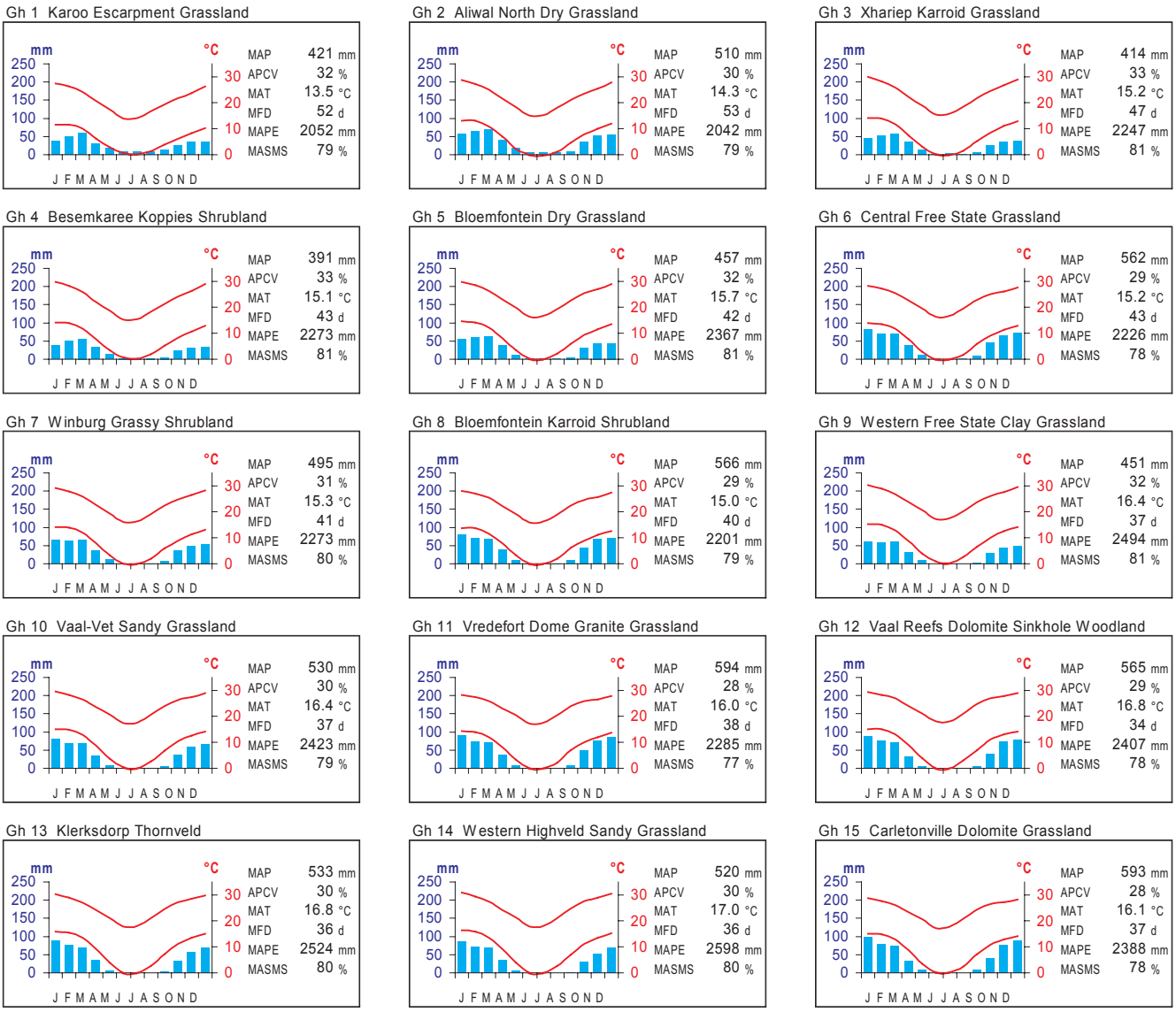

Figure 8.23 Climate diagrams of the Dry Highveld Grassland Bioregion units. Blue bars show the median monthly precipitation. The upper and lower red lines show the mean daily maximum and minimum temperature respectively. MAP: Mean Annual Precipitation; APCV: Annual Precipitation Coefficient of Variation; MAT: Mean Annual Temperature; MFD: Mean Frost Days (days when screen temperature was below 0°C); MAPE: Mean Annual Potential Evaporation; MASMS: Mean Annual Soil Moisture Stress (% of days when evaporative demand was more than double the soil moisture supply).

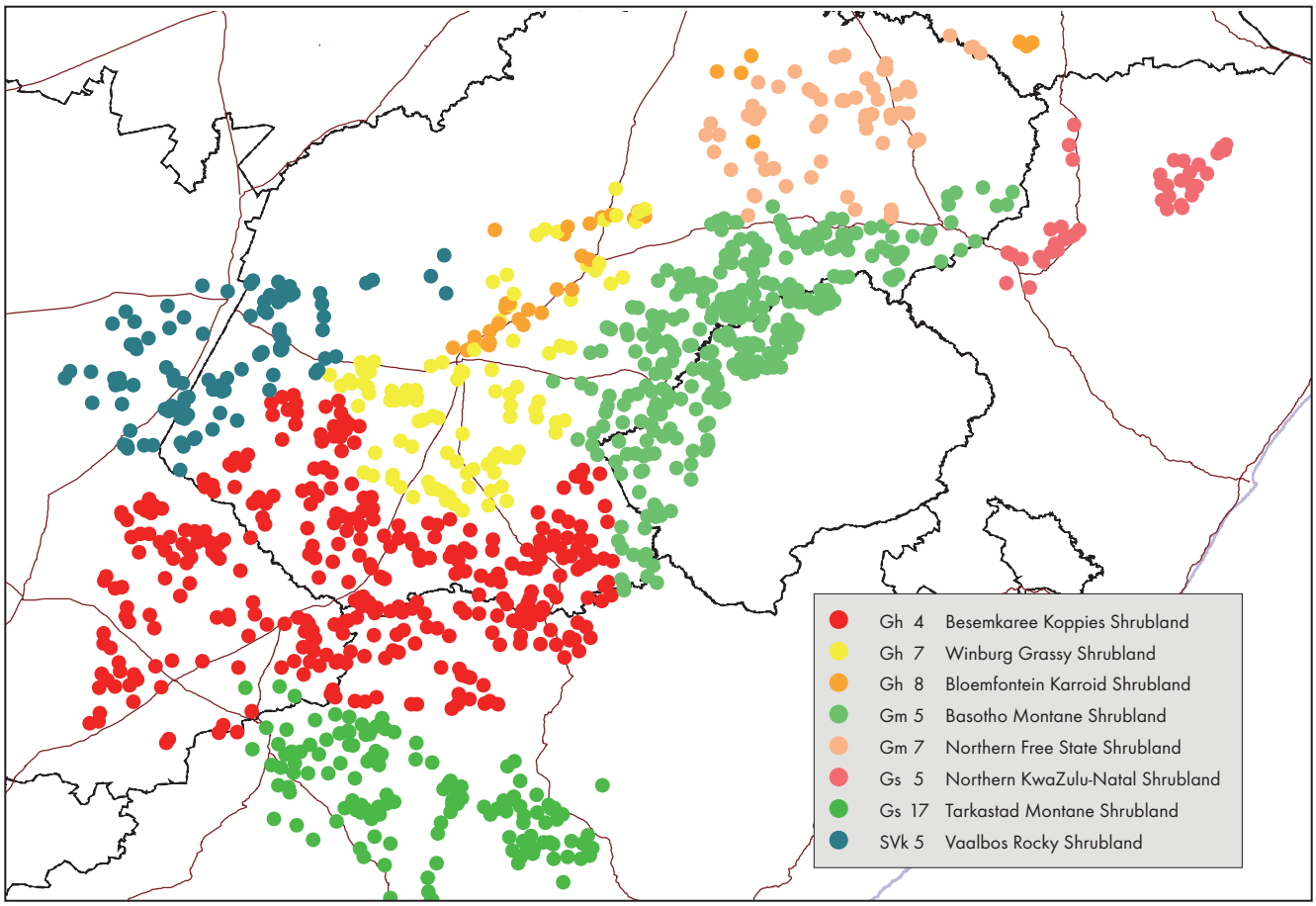

Figure 8.24 Simplified map of patches of various shrubland units (see the legend) occupying special geological and topographical situations within the Grassland Biome.

Tetrachne, *Karroochloa*, *Helictotrichon*, *Melica*, *Tragus*, *Elionurus* and *Aristida*). An important low shrub component occurs throughout this grassland unit.

Geology & Soils Shallow soils typical of Ib, Fb and Fc land types on mudstones and sandstones of the Beaufort Group (Karoo Supergroup). Jurassic dolerite intrusions form ridges in the area.

Climate Rainfall showing minor (possibly insignificant) peaks in March and November–December. Very dry winters. MAP 300–580 mm, increasing from west to east as well as with increasing elevation. The coefficient of variation of MAP 27–36% across the unit. The incidence of frost is from less than 20 to more than 100 days, the higher values occurring at higher elevation. There may be a number of days of snow per year, especially at higher elevations and near the edge of the Great Escarpment. See also climate diagram for Gh 1 Karoo Escarpment Grassland (Figure 8.23).

Important Taxa Graminoids: *Aristida congesta* (d), *A. diffusa* (d), *Cynodon incompletus* (d), *Ehrharta calycina* (d), *Eragrostis chloromelas* (d), *Heteropogon contortus* (d), *Merxmuellera disticha* (d), *Themeda triandra* (d), *Tragus koelerioides* (d), *Cymbopogon pospischilii*, *Cynodon dactylon*, *Elionurus muticus*, *Eragrostis curvula*, *E. lehmanniana*, *E. obtusa*, *Eustachys paspaloides*, *Karroochloa purpurea*, *Melica decumbens*, *Panicum stapfianum*, *Tetrachne dregei*. Herbs: *Berkheya pinnatifida*, *Convolvulus sagittatus*, *Dianthus caespitosus* subsp. *caespitosus*, *Diascia capsularis*, *Dimorphotheca zeyheri*, *Galium capense* subsp. *capense*, *Gazania krebsiana* subsp. *krebsiana*, *Hebenstretia dentata*, *Helichrysum nudifolium* var. *nudifolium*, *H. tysonii*, *Lasiospermum bipinnatum*, *Lepidium africanum* subsp. *africanum*, *Rumex lanceolatus*, *Senecio asperulus*. Geophytic Herbs: *Boophone disticha*, *Cheilanthes bergiana*, *C. hirta*, *Eucomis autumnalis* subsp. *autumnalis*, *Haemanthus humilis* subsp. *humilis*, *Oxalis depressa*. Succulent Herb: *Tripteris aghillana* var. *integrifolia*. Low Shrubs: *Chrysocoma ciliata* (d), *Felicia muricata* (d), *Anthospermum rigidum* subsp. *pumilum*, *Atriplex semibaccata* var. *appendiculata*, *Elytropappus rhinocerotis*, *Erica caespitosa*, *E. caffrorum* var. *caffrorum*, *E. woodii*, *Eriocephalus eximius*, *Euryops annae*, *E. anthemoides* subsp. *astrotrichus*, *E. candollei*, *E. floribundus*, *E. oligoglossus* subsp. *oligoglossus*, *Felicia filifolia* subsp. *filifolia*, *Helichrysum asperum* var. *albidulum*, *H. dregeanum*, *H. lucilioides*, *H. niveum*, *H. rosum*, *H. zeyheri*, *Indigofera sessilifolia*, *Limeum aethiopicum*, *Nemesia fruticans*, *Passerina montana*, *Selago albida*, *S. saxatilis*, *Senecio burchellii*, *Sutera pinnatifida*, *Wahlenbergia albens*. Succulent Shrubs: *Euphorbia clavarioides* var. *clavarioides*, *E. mauritanica*. Tall Shrubs: *Cliffortia arborea*, *Diospyros austro-africana*, *Rhus lucida*.

Biogeographically Important Taxa ([C]Camdebo endemic, [D]Link to Drakensberg Alpine CE) Graminoids: *Pentaschistis cirrhulosa*[D], *P. microphylla*[D]. Low Shrubs: *Helichrysum sessile*[D], *Pentzia cooperi*[D]. Succulent Shrub: *Delosperma congestum*[D]. Succulent Herb: *Duvalia modesta*[C].

Endemic Taxa Graminoid: *Schoenoxiphium rufum* var. *dregeanum*. Herbs: *Lithospermum diversifolium*, *Wahlenbergia sphaerica*. Geophytic Herbs: *Kniphofia acraea*, *Syringodea pulchella*. Low Shrubs: *Euryops dentatus*, *E. trilobus*, *Helichrysum scitulum*, *Selago bolusii*. Succulent Shrub: *Delosperma gramineum*.

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Figure 8.25 Gh 1 Karoo Escarpment Grassland: Dry grassland with *Merxmuellera stricta* in the Sneeuberg (a view towards the summit reaching 2 100 m) in the Graaff-Reinet area (Eastern Cape), with shrubby species such as *Rhus dregeana*, *Melolobium microphyllum* and *M. candicans* scattered on the slopes.

Conservation Least threatened. Target 24%. Nearly 3% statutorily conserved in the Mountain Zebra and Karoo National Parks as well as in the Tsolwana and Karoo Nature Reserves. Slightly higher portions also protected in game farms and private nature reserves, such as Buchanon, Asanta Sana, Samara, Karoo Safaris, Hoeksfontien, Glen Harry, Oudekraal and Rupert. Erosion moderate (49%) and high (42%).

Remark 1 This unit occurs across a wide geographical area with associated floristic variability. The biome classification of this unit is controversial since both Karoo and Grassland elements are strongly represented in the species composition. However, the presence of many (and dominant) C_3 grasses surrounded by vegetation containing C_4 grasses as well as the remarkable share of fynbos-related elements (*Elytropappus rhinocerotis*, *Erica caffra*, *Cliffortia ramosissima*, *Ursinia montana*, *Pentzia cooperi*, *Euryops* species, *Passerina montana*, *Cliffortia arborea* and also a new species of *Erica*—E.G.H. Oliver, personal communication) supports the decision to classify this vegetation within the Grassland Biome (see also Acocks 1988, Low & Rebelo 1996).

Remark 2 The mountain ranges with this arid type of grassland are one of the centres of diversification of the genus *Euryops* (Nordenstam 1968).

References Acocks (1953, 1988), Van der Walt (1980), Palmer (1991a, b), Low & Rebelo (1996), Rubin & Palmer (1996), Hoare (1997), Hoare & Bredenkamp (2001), Brown & Bezuidenhout (2005).

Gh 2 Aliwal North Dry Grassland

VT 50 Dry *Cymbopogon–Themeda* Veld (47%), VT 49 Transitional *Cymbopogon–Themeda* Veld, (33%) (Acocks 1953). LR 37 Dry Sandy Highveld Grassland (69%) (Low & Rebelo 1996).

Distribution Eastern Cape and Free State Provinces: In the broad surrounds of Aliwal North, running in an east-west direction along the northern foothills of the Stormberg Plateau, extending northwards up the Caledon River Valley in the Free State to around Wepener and De Wetsdorp. Altitude 1 320–1 660 m.

Vegetation & Landscape Features Broken terrain and irregular plains supporting open grassland with patches of dwarf karroid shrubs (similar to Gh 3 Xhariep Karroid Grassland). The dominance of grasses *Themeda triandra* and *Tetrachne dregei* is notable. In years of low precipitation the dwarf karroid shrubs become more visible, especially during the winter months and early spring.

Geology & Soils Alternating layers of mudstone and sandstone of the Tarkastad Subgroup (Beaufort Group, Karoo Supergroup) dominate the undulating topography. In areas protected from erosion, a sandy layer also covers the clayey subsoils. About two thirds of the soils of the area is dominated by soils with diagnostic pedocutanic and prismacutanic (dark clayey) B-horizons of the Db land type. In this land type the dominant soil forms are Estcourt, Rensburg and Oakleaf forms. Dominant land type Db, followed by Da.

Climate Overall MAP 510 mm, reaching 600 mm in Wepener (northeastern region of the unit), falling predominantly during summer. MAT around 14°C, with more than 50 days of frost. See also climate diagram for Gh 2 Aliwal North Dry Grassland (Figure 8.23).

Important Taxa Graminoids: *Aristida adscensionis* (d), *A. congesta* (d), *Cymbopogon pospischilii* (d), *Cynodon incompletus* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. lehmanniana* (d), *E. obtusa* (d), *Heteropogon contortus* (d), *Microchloa caffra* (d), *M. kunthii* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tragus koelerioides* (d), *Aristida diffusa*, *Cynodon dactylon*, *Cyperus usitatus*, *Digitaria eriantha*, *Eragrostis capensis*, *E. curvula*, *E. plana*, *Helictotrichon turgidulum*, *Sporobolus fimbriatus*, *Tetrachne dregei*, *Trichoneura grandiglumis*, *Triraphis andropogonoides*. Herbs: *Berkheya onopordifolia* var. *onopordifolia*, *Galium capense* subsp. *capense*, *Gazania krebsiana* subsp. *krebsiana*, *Helichrysum rugulosum*, *Hermannia coccocarpa*, *Indigofera alternans*, *Jamesbrittenia aurantiaca*, *Lotononis listii*, *Nolletia ciliaris*, *Pseudognaphalium luteo-album*, *Salvia stenophylla*, *Selago densiflora*, *Trichogyne verticillata*. Geophytic Herb: *Oxalis depressa*. Low Shrubs: *Helichrysum dregeanum* (d), *Pentzia globosa* (d), *Anthospermum rigidum* subsp. *pumilum*, *Atriplex semibaccata* var. *appendiculata*, *Berkheya annectens*, *Chrysocoma ciliata*, *Euryops annae, E. oligoglossus* subsp. *oligoglossus, Felicia muricata*, *Helichrysum niveum*, *H. rosum*, *Nenax microphylla*, *Selago saxatilis*, *Senecio burchellii*.

Conservation Least threatened. Target 24%. Only small patch statutorily conserved in the Caledon Nature Reserve. Some 12% already transformed for cultivation and building of dams (Rolandseck, Smithfield, Welbedacht). This grassland is also prone to karoo-bush encroachment when overgrazed. Erosion moderate (43%), low (34%) and high (22%).

Remarks This vegetation unit is interspersed with rock outcrops capped with dolerite upon which Gh 4 Besemkaree Koppies Shrubland is found. It also borders on the Orange River, along which a riverine shrubland/thicket is found and forms the transition between high-altitude grassland vegetation and low-altitude karroid shrublands.

References Acocks (1953, 1988), Werger (1973a, b, 1980), Du Preez & Bredenkamp (1991), Malan (1993, 1998), Hoare (1997), Hoare & Bredenkamp (2001).

Gh 3 Xhariep Karroid Grassland

VT 36 False Upper Karoo (90%) (Acocks 1953). LR 52 Eastern Mixed Nama Karoo (90%) (Low & Rebelo 1996).

Distribution Free State Province and very slightly into the Northern Cape Province: Southern regions including the vicinity of Luckhoff (west), Edenburg (north), Gariep Dam (south) and Smithfield (east). Altitude 1 260–1 560 m.

Vegetation & Landscape Features Extensive, even or slightly undulating bottomland flats forming a matrix of large landscape patches interrupted by high dolerite sills, koppies and conspicuous ring dykes (bearing Gh 4 Besemkaree Koppies Shrubland) and supporting low- to medium-height, open grassland intermingled with small patches of dwarf karroid shrubs. The grass element becomes more visible, especially in summer, particularly in years of high precipitation. The open grassland intermingled with patches of dwarf karroid shrubs resembles the physiognomy of the Gh 2 Aliwal North Dry Grassland, although many of the species show a greater affinity for the slightly lower rainfall than in the latter grassland unit. Low cover of grasses such as *Themeda triandra*, *Cymbopogon pospischilii* and *Digitaria eriantha* is indicative of the relatively low rainfall. In years of low precipitation, dwarf karroid shrubs become more prominent and barren patches of soil become more visible, especially during the winter months and early spring.

Geology & Soils Alternating layers of mudstone and sandstone mostly of the Permian Adelaide Subgroup (Beaufort Group, Karoo Supergroup). Part of the area is covered with soils with diagnostic pedocutanic and prismacutanic (dark clayey) B-horizons and belongs to soil forms such as Estcourt, Rensburg and Oakleaf. In some areas, especially towards the more arid west, patches of calcrete on the soil surface are notable—here the soil forms such as Kimberley and Plooysburg prevail (dwarf karroid shrubs usually concentrate on these areas of limestone-rich patches). The entire area has been classified as Da or Db land types.

Climate Seasonal climatic region, with summer rainfall peaking in early autumn, and with overall relatively low MAP (slightly above 410 mm). Some of the localities can, however, reach mean yearly rainfall values as high as 580 mm (Edenburg). MAT around 15°C, but winter frost very common (around 50 days on average). See also climate diagram for Gh 3 Xhariep Karroid Grassland (Figure 8.23).

Important Taxa Graminoids: *Aristida adscensionis* (d), *A. canescens* (d), *A. congesta* (d), *Chloris virgata* (d), *Cynodon incompletus* (d), *Eragrostis chloromelas* (d), *E. lehmanniana* (d), *E. obtusa* (d), *Fingerhuthia africana* (d), *Panicum coloratum* (d), *P. stapfianum* (d), *Themeda triandra* (d), *Tragus koelerioides* (d), *Aristida diffusa*, *Cymbopogon pospischilii*, *Digitaria eriantha*, *Eragrostis curvula*, *Sporobolus fimbriatus*. Herbs: *Gazania krebsiana* subsp. *krebsiana* (d), *Convolvulus boedeckerianus*, *Dimorphotheca zeyheri*, *Hermannia coccocarpa*, *Indigofera alternans*, *Lepidium africanum* subsp. *africanum*, *Lessertia pauciflora*, *Rumex lanceolatus*, *Salvia stenophylla*, *Selago densiflora*. Geophytic Herbs: *Moraea pallida* (d), *Oxalis depressa*. Succulent Herb: *Tripteris aghillana* var. *integrifolia*. Low Shrubs: *Chrysocoma ciliata* (d), *Eriocephalus ericoides* (d), *E. spinescens* (d), *Felicia filifolia* subsp. *filifolia* (d), *F. muricata* (d), *Pentzia globosa* (d), *P. incana* (d), *Amphiglossa triflora*, *Aptosimum elongatum*, *Atriplex semibaccata* var. *appendiculata*, *Berkheya annectens*, *Gnidia polycephala*, *Helichrysum asperum* var. *albidulum*, *H. dregeanum*, *H. lucilioides*, *Lycium cinereum*, *Melolobium candicans*, *Nenax microphylla*, *Oligomeris dregeana*, *Osteospermum spinescens*, *Rosenia humilis*, *Selago saxatilis*, *Wahlenbergia albens*, *W. nodosa*. Succulent Shrubs: *Euphorbia clavarioides* var. *clavarioides*, *Hertia pallens*, *Ruschia hamata*, *R. rigida*, *Salsola calluna*, *S. glabrescens*. Tall Shrub: *Rhus ciliata*.

Endemic Taxa Herb: *Manulea flanaganii*. Succulent Shrubs: *Phyllobolus rabiei*, *Ruschia calcarea*.

Conservation Least threatened. Target 24%. About 2.5% statutorily conserved in Gariep Dam, Tussen Die Riviere, Kalkfontein Dam, Oviston, Wurasdam and Rolfontein Nature Reserves. Some 4% already transformed by cultivation and dam-building (Bethulie, Gariep, Kalkfontein, Straussfontein and Tierpoort Dams). This dry grassland is prone to encroachment of low, unpalatable karroid shrubs when exposed to heavy grazing. Erosion moderate (71%) and low (19%).

L. Mucina

Figure 8.26 Gh 3 Xhariep Karroid Grassland: Herb-rich dry grassland with prominent species of *Helichrysum* near Donkerpoort (southwest of Springfontein, southern Free State).

Remarks Xhariep Karroid Grassland occupies a central position along a rainfall gradient between Gh 5 Bloemfontein Dry Grassland (to the north) and dwarf karroid shrub-dominated NKu 4 Eastern Upper Karoo (to the south). Most of the unit was viewed by Acocks (1953) as a karoo type of vegetation that had originally been grassland.

References Acocks (1953, 1988), Werger (1973a, b, 1980), Du Preez & Bredenkamp (1991), Malan (1993, 1998), Malan et al. (1994).

Gh 4 Besemkaree Koppies Shrubland

VT 36 False Upper Karoo (79%) (Acocks 1953). LR 52 Eastern Mixed Nama Karoo (76%) (Low & Rebelo 1996).

Distribution Northern Cape, Free State and Eastern Cape Provinces: On plains of Eastern Upper Karoo (between Richmond

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Figure 8.27 Gh 4 Besemkaree Koppies Shrubland: Open shrublands of *Rhus erosa* on a dolerite koppie near Smithfield (Free State).

and Middelburg in the south and the Orange River) and within dry grasslands of the southern and central Free State. Extensive dolerite-dominated landscapes along the upper Orange River belong to this unit as well. Extends northwards to around Fauresmith in the northwest and to the Wepener District in the northeast. Altitude 1 120–1 680 m.

Vegetation & Landscape Features Slopes of koppies, butts and tafelbergs covered by two-layered karroid shrubland. The lower (closed-canopy) layer is dominated by dwarf small-leaved shrubs and, especially in precipitation-rich years, also by abundant grasses, while the upper (loose canopy) layer is dominated by tall shrubs, namely *Rhus erosa*, *R. burchellii*, *R. ciliata*, *Euclea crispa* subsp. *ovata*, *Diospyros austro-africana* and *Olea europaea* subsp. *africana*.

Geology & Soils Dolerite koppies and sills embedded within Karoo Supergroup sediments. The dolerite dykes and sills are igneous intrusions that are the result of extensive volcanic activity, which accompanied the break-up of Gondwana in the Jurassic. In places the slopes of mesas and butts carrying this vegetation type have a mixed geology where dolerites occur together with sandstones and mudstones of the Ecca and Beaufort Groups. Fb land type covers almost 60% of the area, followed by Ib.

Climate Due to the large extent of the area, the rainfall pattern differs slightly from west to east. Seasonal summer rainfall prevails when the patches are found embedded within other units of the Grassland Biome, but the southern and southwestern regions show hints of bimodal climate patterns typical of the Nama-Karoo. Far more importantly, despite an overall MAP of almost 400 mm, MAP ranges from about 280 mm in the west (De Aar) to more than double, 580 mm, in the east (Edenburg). Much of the rainfall is of convectional origin. MAT 15°C. See also climate diagram for Gh 4 Besemkaree Koppies Shrubland (Figure 8.23).

Important Taxa Small Trees: *Cussonia paniculata*, *Ziziphus mucronata*. Tall Shrubs: *Diospyros austro-africana* (d), *Euclea crispa* subsp. *ovata* (d), *Olea europaea* subsp. *africana* (d), *Rhus burchellii* (d), *R. ciliata* (d), *R. erosa* (d), *Buddleja saligna*, *Diospyros lycioides* subsp. *lycioides*, *Ehretia rigida*, *Grewia occidentalis*, *Gymnosporia polyacantha*, *Tarchonanthus minor*. Low Shrubs: *Asparagus suaveolens* (d), *Chrysocoma ciliata* (d), *Amphiglossa triflora*, *Aptosimum elongatum*, *Asparagus striatus*, *Diospyros pallens*, *Eriocephalus ericoides*, *E. spinescens*, *Euryops empetrifolius, Felicia filifolia* subsp. *filifolia*, *F. muricata*, *Helichrysum dregeanum*, *H. lucilioides*, *Hermannia multiflora*, *H. vestita*, *Lantana rugosa*, *Limeum aethiopicum*, *Lycium cinereum*, *Melolobium candicans*, *M. microphyllum*, *Nenax microphylla*, *Pegolettia retrofracta*, *Pentzia globosa*, *Rhigozum obovatum*, *Selago saxatilis*, *Stachys linearis*, *S. rugosa*, *Sutera halimifolia*, *Wahlenbergia albens*. Succulent Shrubs: *Aloe broomii*, *Chasmatophyllum musculinum*, *C. verdoorniae*, *Cotyledon orbiculata* var. *dactylopsis*, *Pachypodium succulentum*. Graminoids: *Aristida adscensionis* (d), *A. congesta* (d), *A. diffusa* (d), *Cenchrus ciliaris* (d), *Cymbopogon caesius* (d), *Cynodon incompletus* (d), *Digitaria eriantha* (d), *Eragrostis curvula* (d), *E. lehmanniana* (d), *Heteropogon contortus* (d), *Setaria lindenbergiana* (d), *Themeda triandra* (d), *Tragus koelerioides* (d), *Cymbopogon pospischilii*, *Enneapogon scoparius*, *Eragrostis chloromelas*, *E. obtusa*, *Eustachys paspaloides*, *Fingerhuthia africana*, *Hyparrhenia hirta*, *Sporobolus fimbriatus*. Herbs: *Convolvulus sagittatus*, *Dianthus caespitosus* subsp. *caespitosus*, *Gazania krebsiana* subsp. *krebsiana*, *Hibiscus pusillus*, *Indigofera alternans*, *I. rhytidocarpa*, *Lepidium africanum* subsp. *africanum*, *Pollichia campestris*. Herbaceous Climber: *Argyrolobium lanceolatum*. Geophytic Herbs: *Albuca setosa*, *Asplenium cordatum*, *Cheilanthes bergiana*, *C. eckloniana*, *Freesia andersoniae*, *Haemanthus humilis* subsp. *humilis*, *Oxalis depressa*, *Pellaea calomelanos*. Succulent Herbs: *Aloe grandidentata*, *Crassula nudicaulis*, *Duvalia caespitosa, Euphorbia pulvinata, Huernia piersii, Stapelia grandiflora, S. olivacea, Tridentea gemmiflora*.

Endemic Taxa Small Tree: *Cussonia* sp. nov. (*P.J. du Preez 3666* BLFU). Succulent Shrubs: *Euphorbia crassipes*, *Neohenricia sibbettii*, *N. spiculata*.

Conservation Least threatened because largely excluded from intensive agricultural activities. Target 28%. About 5% statutorily conserved in the Rolfontein, Tussen Die Riviere, Oviston, Gariep Dam, Caledon and Kalkfontein Dam Nature Reserves. In addition a small patch is also protected in the private Vulture Conservation Area. About 3% of the area has been lost through building of dams (Bethulie, Egmont, Gariep, Kalkfontein, Vanderkloof and Welbedacht Dams). Erosion moderate (68%), high (20%) and low (10%).

Remarks The diversity of the shrub component is lower than in the Gm 5 Basotho Montane Shrubland—a similar shrubland unit occurring on the Drakensberg foothills. The density of shrubs marking the slopes of the koppies decreases along a northeast-southwest gradient. On the southern edges of the distribution area of this unit, shrubs retreat to drainage lines and onto the base of dolerite caps, while the slopes themselves remain covered by dwarf shrublands of the NKu 4 Eastern Upper Karoo. In the northeastern areas which receive a higher rainfall, the sheltered sites have larger trees such as *Rhus lancea* and *Celtis africana*.

References Acocks (1953, 1988), Werger (1973a, b, 1983), Jooste (1989), Du Preez (1991), Du Preez & Bredenkamp (1991), Malan (1993, 1998), Malan et al. (1994, 1998, 1999), Lloyd & Badenhorst (1995, 1996), Müller (2002), Botha (2003).

Gh 5 Bloemfontein Dry Grassland

VT 36 False Upper Karoo (60%) (Acocks 1953). LR 52 Eastern Mixed Nama Karoo (58%) (Low & Rebelo 1996).

Distribution Free State Province: South-central part of the province, with Bloemfontein more or less centrally. Extending from Petrusburg in the west to the Rustfontein Dam in the east and from Reddersburg in the south to the Soetdoring Nature Reserve in the north. Altitude 1 200–1 480 m, but mostly 1 320–1 420 m.

Vegetation & Landscape Features Slightly undulating bottomland landscape covered with tall, dense grassland alternating with patches of karroid scrub occurring especially over calcrete.

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Figure 8.28 Gh 5 Bloemfontein Dry Grassland: Typical central Free State grasslands (dominated by *Themeda triandra* in well-managed facies) along the N1 road south of Leeukop near Bloemfontein.

Geology & Soils Sedimentary mudstones and layers of sandstone mainly of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup). Volksrust Formation mudstones of the Ecca Group (also Karoo Supergroup) dominate the western part of the area. Deep (>300 mm) layer of red sand (aeolian origin) covers the more clayey B-horizons. Soil forms such as arable Hutton, Bainsvlei and Bloemdal occur here and are typical of the Ca land type. The Ea land type has shallow gravelly soils underlain by dolerite sills. Ca and Ae land types are nearly equally represented.

Climate Summer-rainfall region, with MAP around 450 mm. Most of the rainfall is of convectional origin and peaks in late summer. Overall MAT is within warm-temperate ranges (nearly 16°C), with high incidence of frost in winter. See also climate diagram for Gh 5 Bloemfontein Dry Grassland (Figure 8.23).

Important Taxa Graminoids: *Anthephora pubescens* (d), *Aristida congesta* (d), *A. diffusa* (d), *Cynodon dactylon* (d), *Digitaria argyrograpta* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. lehmanniana* (d), *E. obtusa* (d), *E. plana* (d), *E. superba* (d), *E. trichophora* (d), *Heteropogon contortus* (d), *Panicum stapfianum* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tragus koelerioides* (d), *Aristida stipitata* subsp. *graciliflora*, *Chloris virgata*, *Cymbopogon pospischilii*, *Pogonarthria squarrosa*, *Sporobolus fimbriatus*, *Trichoneura grandiglumis*, *Triraphis andropogonoides*. Herbs: *Selago densiflora* (d), *Berkheya onopordifolia* var. *onopordifolia*, *Blepharis integrifolia* var. *clarkei*, *Chamaesyce inaequilatera*, *Commelina africana*, *Dicoma macrocephala*, *Gazania krebsiana* subsp. *krebsiana*, *Geigeria ornativa*, *Harpagophytum procumbens*, *Helichrysum caespititium*, *Heliotropium ciliatum*, *Hermannia comosa*, *H. tomentosa*, *Indigofera alternans*, *Lactuca dregeana*, *Lotononis listii*, *Monsonia burkeana*, *Nolletia ciliaris*, *Pollichia campestris*. Geophytic Herbs: *Oxalis depressa* (d), *Haemanthus humilis* subsp. *humilis*. Succulent Herb: *Tripteris aghillana* var. *integrifolia*. Low Shrubs: *Chrysocoma ciliata* (d), *Felicia filifolia* subsp. *filifolia* (d), *Pentzia globosa* (d), *P. incana* (d), *Amphiglossa triflora*, *Anthospermum rigidum* subsp. *pumilum*, *Asparagus striatus*, *Felicia muricata*, *Gnidia polycephala*, *Helichrysum dregeanum*, *Nenax microphylla*, *Osteospermum leptolobum*, *Polygala hottentotta*, *Selago saxatilis*. Succulent Shrub: *Hertia pallens*.

Conservation Endangered. Target 24%. Only a small portion is statutorily conserved in the Soetdoring Nature Reserve. More than 40% already transformed, e.g. for crop production (mainly Ae and Ca land types) as well as by urban (and related) development (the largest part of this vegetation unit on the Ae land type is situated in the Genl De Wet military training area, west of Bloemfontein). Especially those grasslands on shallow gravelly soils as well as the low-lying areas on clayey soils are prone to karoo-bush encroachment when overgrazed. Erosion low (50%), very low (37%) or moderate (13%).

Remarks This unit differs from the southern and western units (Gh 3 Xhariep Karroid Grassland, Gh 2 Aliwal North Dry Grassland and NKu 3 Northern Upper Karoo) in that a thicker sandy layer (>300 mm) covers the calcrete subsoils. This limits the distribution of dwarf karroid shrub species to a large extent. The deeper sandy soils also provide suitable habitat for psammophytes such as *Harpagophytum procumbens* and *Dicoma macrocephala*. The units to the east and north (Gh 6 Central Free State Grassland, Gh 9 Western Free State Clay Grassland) receive relatively higher rainfall, which supports denser grasslands.

References Acocks (1953, 1988), Malan (1993, 1998), Malan et al. (1995), Dingaan (1999).

Gh 6 Central Free State Grassland

VT 49 Transitional *Cymbopogon–Themeda* Veld (50%) (Acocks 1953). LR 39 Moist Cool Highveld Grassland (78%) (Low & Rebelo 1996).

Distribution Free State Province and marginally into Gauteng Province: A broad zone from around Sasolburg in the north to Dewetsdorp in the south. Other major settlements located within this unit include Kroonstad, Ventersburg, Steynsrus, Winburg, Lindley and Edenville. Altitude 1 300–1 640 m, most of the area at 1 400–1 460 m.

Vegetation & Landscape Features Undulating plains supporting short grassland, in natural condition dominated by *Themeda triandra* while *Eragrostis curvula* and *E. chloromelas* become dominant in degraded habitats. Dwarf karoo bushes establish in severely degraded clayey bottomlands. Overgrazed and trampled low-lying areas with heavy clayey soils are prone to *Acacia karroo* encroachment.

Geology & Soils Sedimentary mudstones and sandstone mainly of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup)

as well as those of the Ecca Group (Karoo Supergroup) found in the extreme northern section of this grassland, giving rise to vertic, melanic and red soils (typical forms are Arcadia, Bonheim, Kroonstad, Valsrivier and Rensburg)—typical of Dc land type (dominating the landscape). The less common intrusive dolerites of the Jurassic Karoo Dolerite Suite support dry clayey soils typical of the Ea land type.

Climate Summer-rainfall seasonal precipitation region, with MAP 560 mm. Much of the rainfall is of convectional origin and peaks in December to January. The overall MAT around 15°C. Incidence of frost relatively high (43 days on average). See also climate diagram for Gh 6 Central Free State Grassland (Figure 8.23).

P.J. du Preez

Figure 8.29 Gh 7 Winburg Grassy Shrubland: An *Olea europaea* subsp. *africana* shrubland on slopes of a dolerite koppie north of Bloemfontein (central Free State).

Important Taxa Graminoids: *Aristida adscensionis* (d), *A. congesta* (d), *Cynodon dactylon* (d), *Eragrostis chloromelas* (d), *E. curvula* (d), *E. plana* (d), *Panicum coloratum* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tragus koelerioides* (d), *Agrostis lachnantha*, *Andropogon appendiculatus*, *Aristida bipartita*, *A. canescens*, *Cymbopogon pospischilii*, *Cynodon transvaalensis*, *Digitaria argyrograpta*, *Elionurus muticus*, *Eragrostis lehmanniana*, *E. micrantha*, *E. obtusa*, *E. racemosa*, *E. trichophora*, *Heteropogon contortus*, *Microchloa caffra*, *Setaria incrassata*, *Sporobolus discosporus*. Herbs: *Berkheya onopordifolia* var. *onopordifolia*, *Chamaesyce inaequilatera*, *Conyza pinnata*, *Crabbea acaulis*, *Geigeria aspera* var. *aspera*, *Hermannia depressa*, *Hibiscus pusillus*, *Pseudognaphalium luteo-album*, *Salvia stenophylla*, *Selago densiflora*, *Sonchus dregeanus*. Geophytic Herbs: *Oxalis depressa*, *Raphionacme dyeri*. Succulent Herb: *Tripteris aghillana* var. *integrifolia*. Low Shrubs: *Felicia muricata* (d), *Anthospermum rigidum* subsp. *pumilum*, *Helichrysum dregeanum*, *Melolobium candicans*, *Pentzia globosa*.

Conservation Vulnerable. Target 24%. Only small portions enjoy statutory conservation (Willem Pretorius, Rustfontein and Koppies Dam Nature Reserves) as well as some protection in private nature reserves. Almost a quarter of the area has been transformed either for cultivation or by building of dams (Allemanskraal, Erfenis, Groothoek, Koppies, Kroonstad, Lace Mine, Rustfontein and Weltevrede). No serious infestation by alien flora has been observed, but encroachment of dwarf karoo shrubs becomes a problem in the degraded southern parts of this vegetation unit. Erosion low (45%), moderate (30%) or very low (20%).

Remarks On cool moist southern slopes, elements of the Gm 4 Eastern Free State Sandy Grassland are notable. Stands of Gh 7 Winburg Grassy Shrubland are present on outcrops (dykes and sills) of dolerite embedded within this grassland.

References Acocks (1953, 1988), Müller (1986), Du Preez & Bredenkamp (1991), Fuls et al. (1992), Müller (2002).

Gh 7 Winburg Grassy Shrubland

VT 50 Dry *Cymbopogon–Themeda* Veld (63%) (Acocks 1953). LR 37 Dry Sandy Highveld Grassland (63%) (Low & Rebelo 1996).

Distribution Free State Province: Series of larger patches between Trompsburg through Bloemfontein and Winburg to Ventersburg. Altitude 1 300–1 660 m, mainly 1 360–1 440 m.

Vegetation & Landscape Features Solitary hills, slopes and escarpments of mesas creating a mosaic of habitats ranging from open grassland to shrubland. Tall shrubs and sometimes small trees are sheltered against frequent periods of frost during the winter months and regular veld fires in late winter to early spring. The medium-height evergreen shrublands are dominated by a combination of *Olea europaea* subsp. *africana*, *Euclea crispa* subsp. *crispa*, *Gymnosporia buxifolia*, *Diospyros lycioides*, *Rhus burchellii*, *R. ciliata*, *R. erosa* (mainly in the south), *Clutia pulchella* and *Grewia occidentalis*. Trees such as *R. lancea*, *Celtis africana* and *Ziziphus mucronata* are found in more deeply incised drainage lines.

Geology & Soils Extensive dolerite sills forming ridges, plateaus and slopes of koppies, and small escarpments marking the erosion terraces. The sills cover alternating layers of mudstone and sandstone of sedimentary origin (Adelaide Subgroup of the Beaufort Group). Prominent soil forms are the stony Mispah and gravel-rich Glenrosa derived from Jurassic dolerite. Dominating land type Ea, with Dc also present in places.

Climate Summer-rainfall region, with MAP around 500 mm. Much of the rainfall is of convectional origin. Overall MAT is slightly higher than 15°C, with more than 40 days of frost in winter. See also climate diagram for Gh 7 Winburg Grassy Shrubland (Figure 8.23).

Important Taxa Small Trees: *Acacia karroo*, *Celtis africana*, *Cussonia paniculata*, *Pittosporum viridiflorum*, *Rhus lancea*, *Scolopia zeyheri*, *Ziziphus mucronata*. Tall Shrubs: *Buddleja saligna* (d), *Euclea crispa* subsp. *ovata* (d), *Gymnosporia polyacantha* (d), *Olea europaea* subsp. *africana* (d), *Rhus burchellii* (d), *R. erosa* (d), *Diospyros lycioides* subsp. *lycioides*, *Grewia occidentalis*, *Gymnosporia buxifolia*, *Tarchonanthus camphoratus*. Low Shrubs: *Helichrysum dregeanum* (d), *Pentzia globosa* (d), *Anthospermum rigidum* subsp. *pumilum*, *Asparagus cooperi*, *A. laricinus*, *Berkheya annectens*, *Chrysocoma ciliata*, *Clutia pulchella*, *Euryops empetrifolius, Felicia filifolia* subsp. *filifolia*, *F. muricata*, *Nenax microphylla*, *Osyris lanceolata*, *Rosenia humilis*, *Selago saxatilis*, *Solanum tomentosum* var. *coccineum*. Graminoids: *Aristida adscensionis* (d), *A. congesta* (d), *A. diffusa* (d), *Cymbopogon pospischilii* (d), *Cynodon dactylon* (d), *C. incompletus* (d), *Eragrostis chloromelas* (d), *E. lehmanniana* (d), *E. micrantha* (d), *E. obtusa* (d), *E. trichophora* (d), *Eustachys*

paspaloides (d), *Heteropogon contortus* (d), *Panicum stapfianum* (d), *Setaria lindenbergiana* (d), *S. sphacelata* (d), *Sporobolus fimbriatus* (d), *Themeda triandra* (d), *Tragus koelerioides* (d), *Digitaria argyrograpta*, *Elionurus muticus*, *Enneapogon scoparius*, *Eragrostis plana*, *E. superba*, *Tragus berteronianus*, *T. racemosus*, *Triraphis andropogonoides*. Herbs: *Berkheya onopordifolia* var. *onopordifolia*, *Hermannia coccocarpa*, *Indigofera alternans*, *Mohria caffrorum*, *Pupalia lappacea*, *Salvia repens*. Geophytic Herbs: *Oxalis corniculata*, *O. depressa*. Succulent Herb: *Crassula lanceolata*.

Conservation Least threatened. Target 28%. Almost 2% statutorily conserved in the Willem Pretorius Nature Reserve. More than 10% transformed for cultivation and by urban sprawl. Erosion low (57%), very low (24%) and moderate (18%).

Remarks The vegetation of this unit differs considerably in species composition and structure, from analogous shrubland typical of koppies south and southwest of Bloemfontein (Gh 4 Besemkaree Koppies Shrubland), in having some afromontane elements and a more mesic character. Dolerite hills along the Sand River as well as those found in the Willem Pretorius Nature Reserve are home to some sourveld shrub species, such as *Elaeodendron transvaalense*, *Scolopia zeyheri*, *Rhus leptodictya* and *Helinus integrifolius*.

References Acocks (1953, 1988), Du Preez (1979), Roussouw (1983), Müller (1986), Du Preez (1991), Malan (1993, 1998), Malan et al. (1994, 1995), Dingaan (1999), Müller (2002).

Gh 8 Bloemfontein Karroid Shrubland

VT 50 Dry *Cymbopogon–Themeda* Veld (47%), VT 49 Transitional *Cymbopogon–Themeda* Veld, (35%) (Acocks 1953). LR 37 Dry Sandy Highveld Grassland (64%) (Low & Rebelo 1996).

Distribution Free State and Mpumalanga (only in the southwest) Provinces: An archipelago of isolated patches found on koppies, butts and ridges embedded mainly within dry highveld grasslands in the region extending over large distances between Bloemfontein in the southwest, Verkeerdevlei and Lindley in the southeast, Standerton in the northeast as well as Heilbron and Bultfontein in the northwest. Altitude 1 320–1 840 m, mostly 1 400–1 440 m.

Vegetation & Landscape Features Plateaus or slightly sloping flanks of dolerite outcrops supporting low shrubland dominated by dwarf small-leaved karroid and succulent shrubs. Grasses are restricted to depressions and crevices filled with fine soils. Remarkable is the presence of abundant geophytic herbs. Solitary shrubs or small shrub groups with *Diospyros austro-africana*, *Euclea crispa* subsp. *ovata*, *Rhus burchellii*, *R. ciliata* and *R. erosa* are occasionally present, especially in habitats where root penetration into deeper crevices is possible.

Geology & Soils Restricted to Jurassic dolerite intrusions (sills) embedded within sediments of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup). Typical feature of this habitat is a shallow (only 1–5 cm thick) layer of sand of aeolian origin that overlies sheets of dolerite. Dominant land type is Ea, followed by Dc and Fa (the last-named on the Karoo Supergroup sediments).

Climate Summer-rainfall area, with MAP close to 570 mm and from 550 mm (Bloemfontein) to 650 mm (Standerton). Much of the rainfall is of convectional origin. MAT 15°C, indicating a warm-temperate climatic regime. Winters can be very cold and frost incidence is high (40 days). See also climate diagram for Gh 8 Bloemfontein Karroid Shrubland (Figure 8.23).

Important Taxa Tall Shrubs: *Diospyros austro-africana*, *Euclea crispa* subsp. *ovata*, *Rhus burchellii*, *R. erosa*, *R. tridactyla*. Low Shrubs: *Eriocephalus ericoides* (d), *Euryops empetrifolius* (d), *Anthospermum rigidum* subsp. *pumilum*, *Asparagus suaveolens*, *Felicia muricata*, *Helichrysum dregeanum*, *Heliophila suavissima*, *Jamesbrittenia pristisepala*, *Nenax microphylla*, *Pentzia globosa*, *Phyllanthus parvulus*, *Selago albida*. Succulent Shrubs: *Chasmatophyllum musculinum* (d), *Euphorbia mauritanica* (d), *Ruschia spinosa* (d), *Stomatium mustellinum* (d), *Cotyledon orbiculata* var. *dactylopsis*, *Euphorbia rectirama*, *Kalanchoe paniculata*, *Othonna protecta*, *Pachypodium succulentum*, *Ruschia hamata*, *R. unidens*, *Sarcocaulon salmoniflorum*, *Stapelia grandiflora*. Succulent Woody Climber: *Sarcostemma viminale*. Graminoids: *Aristida diffusa* (d), *Eragrostis nindensis* (d), *Heteropogon contortus* (d), *Oropetium capense* (d), *Aristida adscensionis*, *A. congesta*, *Cymbopogon caesius*, *C. pospischilii*, *Cyperus rupestris* var. *rupestris*, *Digitaria eriantha*, *Enneapogon scoparius*, *Eragrostis chloromelas*, *E. obtusa*, *E. superba*, *E. trichophora*, *Eustachys paspaloides*, *Melinis repens* subsp. *repens*, *Microchloa caffra*, *Themeda triandra*, *Tragus koelerioides*, *T. racemosus*. Herbs: *Berkheya onopordifolia* var. *onopordifolia*, *B. rigida*, *Chamaesyce inaequilatera*, *Commelina africana*, *Gazania linearis* var. *linearis*, *Geigeria aspera* var. *aspera*, *G. filifolia*, *Hermannia coccocarpa*. Geophytic Herbs: *Cheilanthes ecklo-niana* (d), *Albuca setosa*, *Dipcadi ciliare*, *D. viride*, *Nerine laticoma*, *Pellaea calomelanos*, *Trachyandra saltii*. Succulent Herbs: *Senecio radicans* (d), *Adromischus trigynus*, *Aloe grandidentata*, *Anacampseros telephiastrum*, *Avonia ustulata*, *Crassula nudicaulis*, *Duvalia corderoyi*, *Orbea cooperi*, *Orbeopsis lutea*, *Tripteris aghillana* var. *integrifolia*.

Endemic Taxon Geophytic Herb: *Brachystelma glenense*.

P.J. du Preez

Figure 8.30 Gh 8 Bloemfontein Karroid Shrubland: Dolerite rocky sheet with pockets of shallow soil supporting low grassy karroid shrubland with prominent succulent shrubs, xerophilous ferns, bulbous herbs and the prominent grass *Eragrostis nindensis;* near the entrance to the Free State National Botanical Garden in Bloemfontein (central Free State).

Conservation Some sites of this vegetation are exposed to considerable urban developmental pressures, especially within the borders of the Mangaung Municipality (see Haasbroek 2003). Target 28%. None conserved in statutory conservation areas, but small portions are found on the premises of the Free State National Botanical Garden in Bloemfontein. About 10% already transformed, mainly by cultivation. Erosion low (66%) and very low (24%).

J.P.H. Acocks

Figure 8.31 Gh 9 Western Free State Clay Grassland: Dry grassland with abundant karroid elements near Uitkyk (Boshof District, Free State) as photographed in the 1960s.

Remarks Potts & Tidmarsh (1937) were the first to describe this vegetation and to recognise the fact that it is a unique 'island' of succulent-dominated karroid shrub community in the Grassland Biome. They named the identified units *Mesembryanthemum spinosum–Euphorbia mauritanica* Scrub, and *Euryops sulcatus–Euphorbia mauritanica* Scrub (Potts & Tidmarsh 1937). Dingaan & Du Preez (2002) and Haasbroek (2003) recently surveyed this unique vegetation. Although there is a strong affinity to some of the vegetation units of the arid west (Upper Karoo Hardeveld, Western Upper Karoo and Northern Upper Karoo), it also has a notable grass component including *Oropetium capense*, *Eragrostis nindensis*, *Aristida congesta*, *E. trichophora*, *E. lehmanniana*, *Heteropogon contortus*, *Themeda triandra* and *Digitaria eriantha*. We suggest that the occurrence of a karroid shrubland within highveld grasslands relates to physiological drought due to shallow soils, high runoff, high evaporation rates and impeded infiltration of rainwater. These factors create a soil-controlled microhabitat for vegetation, which might be considered a relict of drier (and presumably colder) past climatic periods.

References Potts & Tidmarsh (1937), Acocks (1953, 1988), Mostert (1958), Müller (1986), Du Preez & Bredenkamp (1991), Dingaan (1996), Dingaan & Du Preez (2002), Haasbroek (2003).

Gh 9 Western Free State Clay Grassland

VT 50 Dry *Cymbopogon–Themeda* Veld (52%) (Acocks 1953). LR 37 Dry Sandy Highveld Grassland (81%) (Low & Rebelo 1996).

Distribution Free State Province: Region covering part of the western Bloemfontein District (south), Boshof (southwest), Hertzogville (west), Wesselsbron (north) and Brandfort (east) and consisting of three main areas, of which the southern and middle sections are separated by a slightly elevated area (dolerite hills) between Hertzogville, Boshof and Soutpan. The Vet River Valley separates the middle and northern sections and all three sections are separated from one another by belts of Gh 10 Vaal-Vet Sandy Grassland. Altitude 1 200–1 420 m.

Vegetation & Landscape Features Restricted to flat bottomlands which support dry, species-poor grassland with a high number of salt pans (playas) embedded. Dwarf karoo shrublands surround the playas in disturbed habitats.

Geology & Soils Deposits of sandstone, mudstone and shale (Volksrust Formation, Ecca Group) underlie extensive areas of flat to undulating plains, interrupted by dolerite sills in places. No rivers or streams drain away from these plains, and all the water drains into the numerous playas (pans)—a unique feature of this landscape. Dry, clayey, duplex soils typical of land types Da, Db and Dc. Fc land type also occurs.

Climate Seasonal rainfall concentrated from November–March (overall MAP 450 mm). Cool temperate regime with MAT 16–17°C. Occurrence of frost frequent. See also climate diagram for Gh 9 Western Free State Clay Grassland (Figure 8.23).

Important Taxa Graminoids: *Aristida adscensionis* (d), *A. bipartita* (d), *Cynodon dactylon* (d), *Eragrostis chloromelas* (d), *E. lehmanniana* (d), *Panicum coloratum* (d), *Themeda triandra* (d), *Aristida congesta*, *Cymbopogon pospischilii*, *Digitaria eriantha*, *Eragrostis bicolor*, *E. curvula*, *E. micrantha*, *E. obtusa*, *E. plana*, *E. superba*, *E. trichophora*, *Heteropogon contortus*, *Setaria nigrirostris*, *Tragus berteronianus*, *T. koelerioides*, *T. racemosus*. Herbs: *Berkheya onopordifolia* var. *onopordifolia*, *Chamaesyce inaequilatera*, *Gnaphalium declinatum*, *Indigofera alternans*, *Kohautia cynanchica*, *Nidorella microcephala*, *Platycarpha parvifolia*, *Salvia stenophylla*, *Selago paniculata*, *Stachys spathulata*. Geophytic Herbs: *Bulbine narcissifolia*, *Oxalis depressa*. Succulent Herb: *Tripteris aghillana* var. *integrifolia*. Low Shrubs: *Lycium cinereum* (d), *Pentzia globosa* (d), *Amphiglossa triflora*, *Aptosimum elongatum*, *Berkheya annectens*, *Felicia filifolia* subsp. *filifolia*, *F. muricata*, *Gnidia polycephala*, *Helichrysum dregeanum*, *Melolobium candicans*, *Nenax microphylla*, *Rosenia humilis*, *Selago saxatilis*. Succulent Shrub: *Hertia pallens*.

Conservation Least threatened. Target 24%. None conserved in statutory conservation areas. Almost 20% already transformed for maize and wheat cultivation. A species of *Prosopis* appears as occasional invasive alien. Erosion very low (38%), low (30%) and moderate (28%).

Remarks The vegetation of the salt pans embedded within this grassland unit is treated as a separate vegetation unit AZi 10 Highveld Salt Pans.

References Kooij (1990), Kooij et al. (1990a).

Gh 10 Vaal-Vet Sandy Grassland

VT 50 Dry *Cymbopogon–Themeda* Veld (47%), VT 48 *Cymbopogon–Themeda* Veld (sandy) (24%) (Acocks 1953). LR 37 Dry Sandy Highveld Grassland (74%) (Low & Rebelo 1996).

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 1 220–1 560 m, generally 1 260–1 360 m.

Vegetation & Landscape Features Plains-dominated landscape with some scattered, slightly irregular undulating plains and hills. Mainly low-tussock grasslands with an abundant karroid element. Dominance of *Themeda triandra* is an important feature of this vegetation unit. Locally low cover of *T. triandra* and the associated increase in *Elionurus muticus*, *Cymbopogon pospischilii* and *Aristida congesta* is attributed to heavy grazing and/or erratic rainfall.

Geology & Soils Aeolian and colluvial sand overlying sandstone, mudstone and shale of the Karoo Supergroup (mostly the Ecca Group) as well as older Ventersdorp Supergroup andesite and basement gneiss in the north. Soil forms are mostly Avalon, Westleigh and Clovelly. Dominant land type Bd, closely followed by Bc, Ae and Ba.

Climate Warm-temperate, summer-rainfall climate, with overall MAP of 530 mm. High summer temperatures. Severe frost (37 days per year on average) occurs in winter. See also climate diagram for Gh 12 Vaal-Vet Sandy Grassland (Figure 8.23).

Important Taxa Graminoids: *Anthephora pubescens* (d), *Aristida congesta* (d), *Chloris virgata* (d), *Cymbopogon caesius* (d), *Cynodon dactylon* (d), *Digitaria argyrograpta* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. lehmanniana* (d), *E. plana* (d), *E. trichophora* (d), *Heteropogon contortus* (d), *Panicum gilvum* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tragus berteronianus* (d), *Brachiaria serrata*, *Cymbopogon pospischilii*, *Digitaria eriantha*, *Eragrostis curvula*, *E. obtusa*, *E. superba*, *Panicum coloratum*, *Pogonarthria squarrosa*, *Trichoneura grandiglumis*, *Triraphis andropogonoides*. Herbs: *Stachys spathulata* (d), *Barleria macrostegia*, *Berkheya onopordifolia* var. *onopordifolia*, *Chamaesyce inaequilatera*, *Geigeria aspera* var. *aspera*, *Helichrysum caespititium*, *Hermannia depressa*, *Hibiscus pusillus*, *Monsonia burkeana*, *Rhynchosia adenodes*, *Selago densiflora*, *Vernonia oligocephala*. Geophytic Herbs: *Bulbine narcissifolia*, *Ledebouria marginata*. Succulent Herb: *Tripteris aghillana* var. *integrifolia*. Low Shrubs: *Felicia muricata* (d), *Pentzia globosa* (d), *Anthospermum rigidum* subsp. *pumilum*, *Helichrysum dregeanum*, *H. paronychioides*, *Ziziphus zeyheriana*.

Endemic Taxon Herb: *Lessertia phillipsiana*.

Conservation Endangered. Target 24%. Only 0.3% statutorily conserved in the Bloemhof Dam, Schoonspruit, Sandveld, Faan Meintjies, Wolwespruit and Soetdoring Nature Reserves. More than 63% transformed for cultivation (ploughed for commercial crops) and the rest under strong grazing pressure from cattle and sheep. Erosion very low (85.3%) and low (11%).

References Louw (1951), Morris (1973, 1976), Bredenkamp & Bezuidenhout (1990), Kooij et al. (1990b, 1992), Bezuidenhout et al. (1994a).

Gh 11 Vredefort Dome Granite Grassland

VT 48 *Cymbopogon–Themeda* Veld (sandy) (49%), VT 61 Bankenveld (25%) (Acocks 1953). LR 34 Rocky Highveld Grassland (95%) (Low & Rebelo 1996).

Distribution Free State and North-West Provinces: Central portion of the Vredefort Dome around Parys and Vredefort. Altitude 1 340–1 520 m.

Vegetation & Landscape Features Slightly undulating plains with mainly short, *Themeda triandra*-dominated grassland, though mostly grazed and often degraded. One of the most scenic landscapes of the Highveld, with the Vaal River cutting through the mountainous landscape (Savanna Biome) of the Vredefort Dome. Big boulders of granite are conspicuous in the area, creating microhabitats for a diversity of plant species.

Geology & Soils Granite and gneiss at the core of the Vredefort Dome underlie this area and includes the Inlandsee Gneiss. Various soil types including the Hutton, Mispah and Avalon forms, representing plinthic soils, which can be dystrophic and/or mesotrophic (Ba land type) or eutrophic (Bc land type). Red soils are generally widespread.

Climate Warm-temperate, summer-rainfall region, with overall MAP of 594 mm. Summer temperatures are high. Severe frost (38 days per year on average) occurs in winter. See also climate diagram for Gh 11 Vredefort Dome Granite Grassland (Figure 8.23).

Important Taxa Graminoids: *Aristida congesta* (d), *Chloris virgata* (d), *Cynodon dactylon* (d), *Digitaria eriantha* (d), *Elionurus muticus* (d), *Eragrostis biflora* (d), *E. lehmanniana* (d), *E. trichophora* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tragus berteronianus* (d), *Aristida diffusa*, *Brachiaria serrata*, *Cymbopogon pospischilii*, *Eragrostis chloromelas*, *E. gummiflua*, *E. racemosa*, *E. superba*, *Heteropogon contortus*, *Hyparrhenia hirta*, *Trichoneura grandiglumis*, *Triraphis andropogonoides*. Herbs: *Barleria macrostegia*, *Berkheya setifera*, *Chamaesyce inaequilatera*, *Crabbea acaulis*, *Helichrysum rugulosum*, *Hermannia depressa*, *Ipomoea oblongata*, *I. obscura*, *Lepidium capense*, *Lotononis listii*, *Selago densiflora*, *Vernonia oligocephala*. Herbaceous Climber: *Rhynchosia totta*. Low Shrubs: *Felicia muricata* (d), *Anthospermum rigidum* subsp. *pumilum*, *Deverra burchellii*, *Polygala hottentotta*.

Conservation Endangered. Target 24%. None conserved in statutory conservation areas and almost half already transformed by cultivation (maize fields), by urban development or by road-building. Erosion is very low (96%).

S.S. Cilliers

Figure 8.32 Gh 11 Vredefort Dome Granite Grassland: *Melinis repens*-dominated grassland on granite (with a granite dome in the background) of the Vredefort Dome—an ancient large asteroid impact site near Potchefstroom (border region of the Free State and North-West Provinces).

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.

References Du Preez (1986), Bezuidenhout et al. (1988, 1994c), Bredenkamp et al. (1989), Du Preez & Venter (1990), Bezuidenhout (1993).

Gh 12 Vaal Reefs Dolomite Sinkhole Woodland

VT 61 Western variation of the Bankenveld (55%), VT 48 *Cymbopogon–Themeda* veld (45%) (Acocks 1988). LR 34 Rocky Highveld Grassland (55%), LR 37 Dry Sandy Highveld Grassland (45%) (Low & Rebelo 1996).

Distribution North-West and Free State Provinces: 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 1 280–1 380 m.

Vegetation & Landscape Features Slightly undulating landscape dissected by prominent rocky chert ridges and supporting a grassland-woodland vegetation complex. The most typical vegetation feature is the woodland, which occurs naturally in clumps around sinkholes, especially in places of dolomite outcrops.

Geology & 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. More than 50% of the main soil types are relatively shallow (50–150 mm) and rocky, with the dominant soil forms Mispah, Glenrosa and shallow Hutton. The latter soils are associated with the Fa land type.

Climate Warm-temperate summer-rainfall region, with overall MAP around 560 mm. The summer temperatures are high. Severe frequent frost occurs in winter. See also climate diagram for Gh 12 Vaal Reefs Dolomite Sinkhole Woodland (Figure 8.23).

Important Taxa Small Trees: *Acacia erioloba* (d), *Celtis africana* (d), *Rhus lancea* (d), *Acacia caffra*, *A. karroo*, *A. robusta* subsp. *clavigera*. Tall Shrubs: *Diospyros lycioides* subsp. *lycioides* (d), *Ehretia rigida* (d), *Grewia flava* (d). Low Shrubs: *Asparagus suaveolens* (d), *Gymnosporia heterophylla* (d), *Pavonia burchellii* (d), *Sida dregei* (d), *Anthospermum hispidulum*, *Asparagus laricinus*, *Diospyros pallens*, *Felicia muricata*, *Indigofera heterotricha*, *Menodora africana*, *Phyllanthus incurvus*, *Triumfetta sonderi*, *Ziziphus zeyheriana*. Geoxylic Suffrutex: *Elephantorrhiza elephantina*. Woody Climber: *Asparagus africanus*. Graminoids: *Aristida congesta* (d), *Digitaria eriantha* (d), *Eragrostis biflora* (d), *E. curvula* (d), *Themeda triandra* (d), *Anthephora pubescens*, *Aristida canescens*, *Bewsia biflora*, *Brachiaria nigropedata*, *B. serrata*, *Chloris pycnothrix*, *Cymbopogon caesius*, *C. pospischilii*, *Cynodon dactylon*, *Cyperus margaritaceus*, *Diheteropogon amplectens*, *Elionurus muticus*, *Eragrostis chloromelas*, *E. lehmanniana*, *E. racemosa*, *E. superba*, *Eustachys paspaloides*, *Heteropogon contortus*, *Melinis repens* subsp. *repens*, *Panicum coloratum*, *Setaria sphacelata*, *Triraphis andropogonoides*. Herbs: *Commelina africana* (d), *Barleria macrostegia*, *Chamaecrista mimosoides*, *Chamaesyce inaequilatera*, *Chascanum hederaceum*, *Crabbea angustifolia*, *Cyanotis speciosa*, *Dicoma anomala*, *Hermannia depressa*, *Indigofera daleoides*, *I. torulosa* var. *angustiloba*, *Ipomoea obscura*, *Justicia anagalloides*, *Nidorella hottentotica*, *Osteospermum muricatum* subsp. *longiradiatum*, *Pollichia campestris*, *Pterodiscus speciosus*, *Vernonia oligocephala*. Geophytic Herb: *Albuca setosa*.

Conservation Vulnerable. Target 24%. Only a small patch conserved in the statutory conservation area of Sterkfontein Caves (part of the Cradle of Humankind World Heritage Site)—the legendary archaeological site associated with the discovery of a skeleton of *Australopithecus africanus*. The proposed 'Highveld National Park' is supposed to conserve a considerable area of this vegetation unit. Aesthetically this is one of the most scenic landscapes in the western Grassland Biome and certainly deserves high conservation priority. Almost a quarter has been transformed already—mainly by mining, cultivation, urban sprawl and road-building. The region of this unit contains possibly the highest concentration of mines of any other vegetation in South Africa. Erosion is generally very low.

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 Gh 15 Carletonville Dolomite Grassland is needed.

References Louw (1951), Acocks (1953, 1988), Morris (1973), Coetzee (1974), Van Wyk (1983), Van Wyk & Bredenkamp (1986), Bezuidenhout (1993), Bezuidenhout et al. (1994b, c, e), Siebert & Siebert (2005).

S.S. Cilliers

Figure 8.33 Gh 12 Vaal Reefs Dolomite Sinkhole Woodland: Isolated woodland patches composed of trees *Acacia erioloba* and *Celtis africana* and shrubs such as *Grewia flava*, *Ehretia rigida* and *Asparagus laricinus* indicating the position of a dolomite sinkhole, surrounded by tall grassland with *Themeda triandra* (near Potchefstroom, North-West Province).

Gh 13 Klerksdorp Thornveld

VT 50 Dry *Cymbopogon–Themeda* Veld (44%), VT 19 Sourish Mixed Bushveld (29%) (Acocks 1953). LR 37 Dry Sandy Highveld Grassland (70%) (Low & Rebelo 1996).

Distribution North-West Province: In two sets of patches, one in the Wolmaransstad, Ottosdal and Hartbeesfontein region, and the other from the Botsolano Game Park north of Mafikeng to the vicinity of Madibogo in the south. Altitude 1 260–1 580 m.

Vegetation & Landscape Features Plains or slightly irregular undulating plains with open to dense *Acacia karroo* bush clumps in dry grassland.

Geology & Soils Shale, slate and quartzite of the Pretoria Group with interlaid diabase sills and Hekpoort lava supporting relatively shallow and rocky soils (Glenrosa and Mispah forms), typical of the Fb land type. Equally represented are eutrophic red plinthic soils (Hutton form), derived mainly from a thick succession of volcanics and sediments of the Ventersdorp Supergroup (Bc land type). Bd and Ae of minor occurrence.

Climate Warm-temperate, summer-rainfall region, with overall MAP of 533 mm. Summer temperatures are high. Frequent frosts occur in winter. See also climate diagram for Gh 13 Klerksdorp Thornveld (Figure 8.23).

Important Taxa Small Trees: *Acacia karroo* (d), *A. caffra*, *Celtis africana*, *Rhus lancea*, *Ziziphus mucronata*. Tall Shrubs: *Acacia hebeclada*, *Diospyros lycioides* subsp. *lycioides*, *Ehretia rigida*, *Grewia flava*, *Gymnosporia buxifolia*, *Rhus pyroides*, *Tarchonanthus camphoratus*. Woody Climber: *Asparagus africanus*. Low Shrubs: *Asparagus laricinus* (d), *A. suaveolens* (d), *Felicia muricata* (d), *Anthospermum hispidulum*, *A. rigidum* subsp. *pumilum*, *Aptosimum elongatum*, *Gnidia capitata*, *Gomphocarpus fruticosus* subsp. *fruticosus*, *Helichrysum dregeanum*, *Leucas capensis*, *Pavonia burchellii*, *Pentzia globosa*, *Solanum supinum* var. *supinum*, *Triumfetta sonderi*, *Ziziphus zeyheriana*. Graminoids: *Aristida congesta* (d), *Cynodon dactylon* (d), *Eragrostis lehmanniana* (d), *E. trichophora* (d), *Microchloa caffra* (d), *Panicum coloratum* (d), *Sporobolus fimbriatus* (d), *Themeda triandra* (d), *Andropogon schirensis*, *Anthephora pubescens*, *Aristida junciformis* subsp. *galpinii*, *A. stipitata* subsp. *graciliflora*, *Brachiaria nigropedata*, *B. serrata*, *Bulbostylis burchellii*, *Cymbopogon pospischilii*, *Digitaria eriantha*, *Diheteropogon amplectens*, *Elionurus muticus*, *Eragrostis curvula*, *E. obtusa*, *E. racemosa*, *E. superba*, *Eustachys paspaloides*, *Heteropogon contortus*, *Setaria sphacelata*, *Sporobolus africanus*, *Tragus berteronianus*, *Trichoneura grandiglumis*, *Triraphis andropogonoides*. Herbs: *Acalypha angustata*, *Acanthospermum australe*, *Berkheya onopordifolia* var. *onopordifolia*, *B. setifera*, *Blepharis integrifolia* var. *clarkei*, *Chamaesyce inaequilatera*, *Chascanum adenostachyum*, *Dicoma macrocephala*, *Helichrysum nudifolium* var. *nudifolium*, *Hermannia lancifolia*, *Hibiscus pusillus*, *Justicia anagalloides*, *Lippia scaberrima*, *Nidorella microcephala*, *Nolletia ciliaris*, *Pollichia campestris*, *Rhynchosia adenodes*, *Salvia radula*, *Selago densiflora*, *Teucrium trifidum*, *Tolpis capensis*. Geophytic Herbs: *Bulbine narcissifolia*, *Ledebouria marginata*, *Ornithogalum tenuifolium* subsp. *tenuifolium*, *Raphionacme hirsuta*. Herbaceous Climber: *Rhynchosia venulosa*.

Conservation Vulnerable. Target 24%. Only about 2.5% conserved in the statutory Mafikeng Game Reserve, private Botsolano Game Park and Faan Meintjes Nature Reserve. Almost a third already transformed for cultivation and by urban sprawl. This vegetation unit has a high grazing capacity and this leads to overutilisation and degradation, and subsequent invasion of *Acacia karroo* into adjacent dry grassland. Due to the great habitat and floristic diversity and for aesthetical reasons, the landscape deserves to be conserved.

References Louw (1951), Morris (1973, 1976), Bredenkamp & Bezuidenhout (1990), Bezuidenhout (1993), Bezuidenhout et al. (1994c, d).

Gh 14 Western Highveld Sandy Grassland

VT 50 Dry *Cymbopogon–Themeda* Veld (61%) (Acocks 1953). LR 37 Dry Sandy Highveld Grassland (74%) (Low & Rebelo 1996).

Distribution North-West Province: From Mafikeng to Schweizer-Reneke in the south and from Broedersput and Kameel in the west to Lichtenburg and Ottosdal in the east. Altitude 1 280–1 520 m, main area at 1 340–1 380 m.

Vegetation & Landscape Features Flat to gently undulating plains with short, dry grassland, with some woody species occurring in bush clumps.

Geology & Soils Basaltic lavas of the Klipriviersberg Group and andesitic lavas of the Allanridge Formation (both Ventersdorp Supergroup) covered by aeolian sand (western part of the area) or calcrete, with the eutrophic plinthic soils, which are mainly yellow apedals (Avalon and Pinedene) and rarely red apedals (Hutton) or Clovelly in bottomlands. Bd land type dominant.

Climate Warm-temperate, summer-rainfall region, with overall MAP of 520 mm. Summer temperatures are high. Severe frequent frost occurs in winter. See also climate diagram for Gh 14 Western Highveld Sandy Grassland (Figure 8.23).

Important Taxa Graminoids: *Anthephora pubescens* (d), *Aristida congesta* (d), *A. diffusa* (d), *Cymbopogon pospischilii* (d), *Cynodon dactylon* (d), *Eragrostis lehmanniana* (d), *E. trichophora* (d), *Panicum coloratum* (d), *Pogonarthria squarrosa* (d), *Setaria sphacelata* (d), *Sporobolus africanus* (d), *Themeda triandra* (d), *Aristida adscensionis*, *A. canescens*, *A. stipitata* subsp. *graciliflora*, *Brachiaria serrata*, *Digitaria argyrograpta*, *D. eriantha*, *Diheteropogon amplectens*, *Elionurus muticus*, *Eragrostis chloromelas*, *E. curvula*, *E. gummiflua*, *E. racemosa*, *Eustachys paspaloides*, *Heteropogon contortus*, *Melinis nerviglumis*, *Sporobolus discosporus*, *S. fimbriatus*, *Trichoneura grandiglumis*, *Triraphis andropogonoides*. Herbs: *Gazania krebsiana* subsp. *krebsiana* (d), *Stachys spathulata* (d), *Barleria macrostegia*, *Berkheya onopordifolia* var. *onopordifolia*, *Chamaecrista mimosoides*, *Chamaesyce inaequilatera*, *Dicoma anomala*, *D. macrocephala*, *Helichrysum callicomum*, *Hermannia depressa*, *H.*

E.M. Daemane

Figure 8.34 Gh 13 Klerksdorp Thornveld: *Acacia karroo*-dominated thickets in a grassland matrix of the eastern highveld near Klerksdorp (North-West Province).

tomentosa, *Kyphocarpa angustifolia*, *Lippia scaberrima*, *Monsonia burkeana*, *Nolletia ciliaris*, *Osteospermum muricatum* subsp. *longiradiatum*, *Pollichia campestris*, *Rhynchosia adenodes*, *Sebaea grandis*, *Trichodesma angustifolium* subsp. *angustifolium*, *Vernonia oligocephala*. Geophytic Herb: *Boophone disticha*. Low Shrubs: *Anthospermum rigidum* subsp. *pumilum* (d), *Aptosimum elongatum*, *Felicia muricata*, *Gnidia capitata*, *Helichrysum paronychioides*, *Indigofera comosa*, *Leucas capensis*, *Polygala hottentotta*, *Sida dregei*, *Solanum panduriforme, Stoebe plumosa*. Tall Shrubs: *Acacia hebeclada*, *Diospyros lycioides* subsp. *lycioides*.

Conservation Endangered. Target 24%. Only a very small portion statutorily conserved (Barberspan Nature Reserve). More than 60% has been ploughed. Nonarable parts are on shallow aeolian soils which become easily overutilised through grazing. Erosion is very low. About 95% of this land is suitable for cultivation, but the low rainfall makes it a high-risk area for agriculture. Therefore the natural vegetation is often restricted to nonarable bush clumps, shallow soils, aeolian sands and pans.

D.B. Hoare

Figure 8.35 Gh 15 Carletonville Dolomite Grassland: Grassy rocky outcrop at Vlakplaats, west of Valhalla near Centurion (Gauteng) with prominent grasses such as *Loudetia simplex, Hyparrhenia hirta, Brachiaria serrata* and *Heteropogon contortus* and scattered shrubs including *Euclea undulata, Rhus magalismontanum, Zanthoxylum capense* and *Diospyros lycioides*.

Remarks Many endorheic pans (AZi 10 Highveld Salt Pans; see the chapter on Inland Azonal Vegetation in this book) are embedded within this grassland, especially in the north.

References Morris (1973, 1976), Bezuidenhout (1993), Bezuidenhout et al. (1993, 1994c).

Gh 15 Carletonville Dolomite Grassland

VT 61 Bankenveld (65%) (Acocks 1953). LR 34 Rocky Highveld Grassland (88%) (Low & Rebelo 1996).

Distribution North-West (mainly) and Gauteng and marginally into the Free State Province: In the region of Potchefstroom, Ventersdorp and Carletonville, extending westwards to the vicinity of Ottoshoop, but also occurring as far east as Centurion and Bapsfontein in Gauteng Province. Altitude 1 360–1 620 m, but largely 1 500–1 560 m.

Vegetation & Landscape Features Slightly undulating plains dissected by prominent rocky chert ridges. Species-rich grasslands forming a complex mosaic pattern dominated by many species.

Geology & Soils Dolomite and chert of the Malmani Subgroup (Transvaal Supergroup) supporting mostly shallow Mispah and Glenrosa soil forms typical of the Fa land type, dominating the landscapes of this unit. Deeper red to yellow apedal soils (Hutton and Clovelly forms) occur sporadically, representing the Ab land type.

Climate Warm-temperate, summer-rainfall region, with overall MAP of 593 mm. Summer temperatures high. Severe frequent frost occurs in winter. See also climate diagram for Gh 15 Carletonville Dolomite Grassland (Figure 8.23).

Important Taxa Graminoids: *Aristida congesta* (d), *Brachiaria serrata* (d), *Cynodon dactylon* (d), *Digitaria tricholaenoides* (d), *Diheteropogon amplectens* (d), *Eragrostis chloromelas* (d), *E. racemosa* (d), *Heteropogon contortus* (d), *Loudetia simplex* (d), *Schizachyrium sanguineum* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon schirensis*, *Aristida canescens*, *A. diffusa*, *Bewsia biflora*, *Bulbostylis burchellii*, *Cymbopogon caesius*, *C. pospischilii*, *Elionurus muticus*, *Eragrostis curvula*, *E. gummiflua*, *E. plana*, *Eustachys paspaloides*, *Hyparrhenia hirta*, *Melinis nerviglumis*, *M. repens* subsp. *repens*, *Monocymbium ceresiiforme*, *Panicum coloratum*, *Pogonarthria squarrosa*, *Trichoneura grandiglumis*, *Triraphis andropogonoides*, *Tristachya leucothrix*, *T. rehmannii*. Herbs: *Acalypha angustata*, *Barleria macrostegia*, *Chamaecrista mimosoides*, *Chamaesyce inaequilatera*, *Crabbea angustifolia*, *Dianthus mooiensis*, *Dicoma anomala*, *Helichrysum caespititium*, *H. miconiifolium*, *H. nudifolium* var. *nudifolium*, *Ipomoea ommaneyi*, *Justicia anagalloides*, *Kohautia amatymbica*, *Kyphocarpa angustifolia*, *Ophrestia oblongifolia*, *Pollichia campestris*, *Senecio coronatus*, *Vernonia oligocephala*. Geophytic Herbs: *Boophone disticha*, *Habenaria mossii*. Low Shrubs: *Anthospermum rigidum* subsp. *pumilum*, *Indigofera comosa*, *Pygmaeothamnus zeyheri* var. *rogersii*, *Rhus magalismontana*, *Tylosema esculentum*, *Ziziphus zeyheriana*. Geoxylic Suffrutices: *Elephantorrhiza elephantina*, *Parinari capensis* subsp. *capensis*.

Endemic Taxon Succulent Shrub: *Delosperma davyi*.

Conservation Vulnerable. Target 24%. Small extent conserved in statutory (Sterkfontein Caves—part of the Cradle of Humankind World Heritage Site, Oog Van Malmanie, Abe Bailey, Boskop Dam, Schoonspruit, Krugersdorp, Olifantsvlei, Groenkloof) and in at least six private conservation areas. Almost a quarter already transformed for cultivation, by urban sprawl or by mining activity as well as the building of the Boskop and Klerkskraal Dams. Erosion very low (84%) and low (15%).

References Louw (1951), Morris (1973, 1976), Coetzee (1974), Coetzee & Werger (1975), Van Wyk (1983), Van Wyk & Bredenkamp (1986), Bezuidenhout & Bredenkamp (1990), Scogings & Theron (1990), Bezuidenhout et al. (1994b, c, f), Bredenkamp et al. (1994), Grobler (2000), Hartmann (2001), Siebert & Siebert (2005), Grobler et al. (2006).

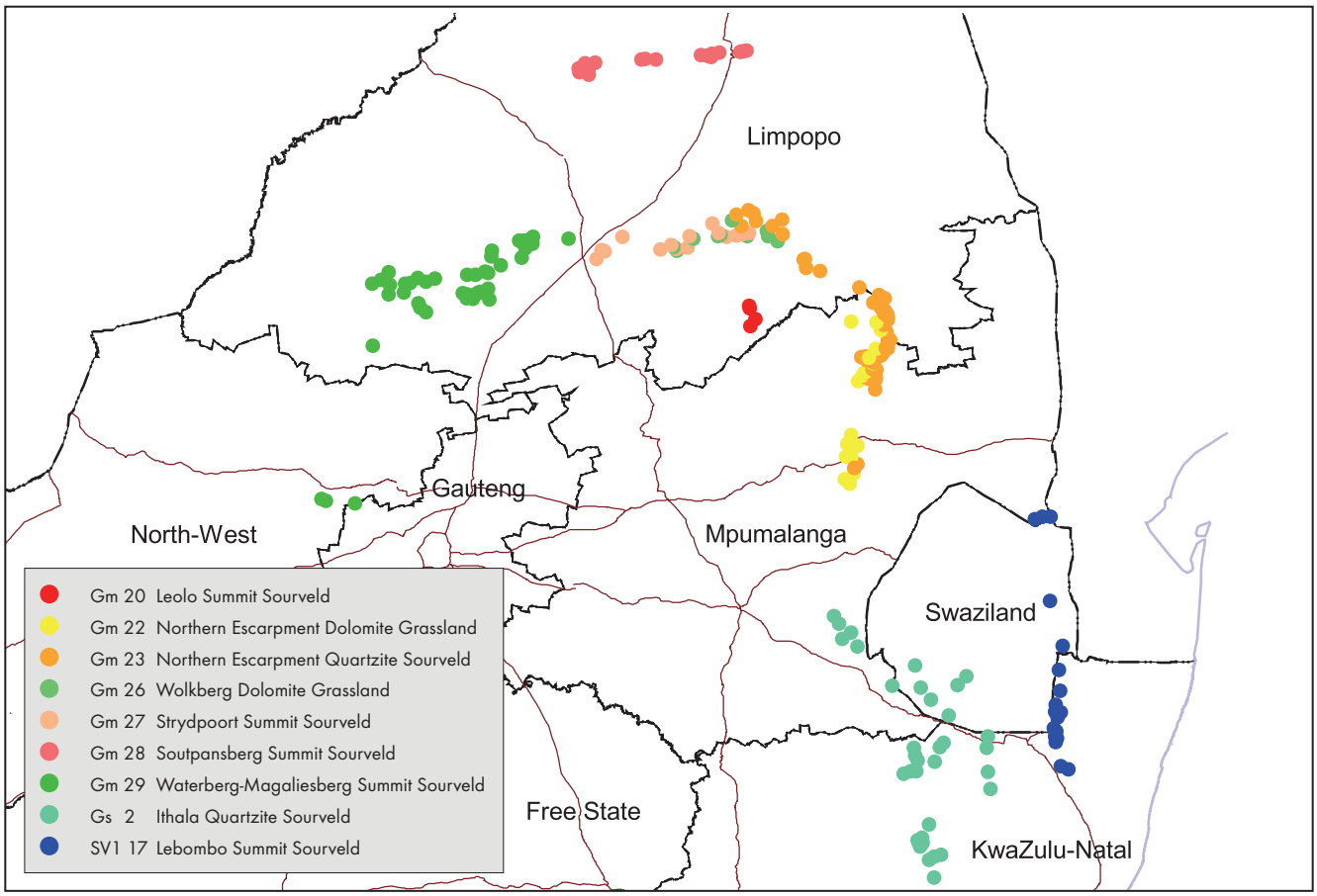


Figure 8.37 Position of the 'sourveld' grassland units, usually straddling the border of the Grassland and Savanna Biomes in the northern and northeastern regions of South Africa and Swaziland.

Mesic Highveld Grassland

Mesic Highveld Grassland is found mainly in the eastern, precipitation-rich regions of the Highveld, extending as far as the Northern Escarpment (Figure 8.36). These are considered to be 'sour' grasslands, and are dominated primarily by andropogonoid grasses. The different grassland units are distinguished on the basis of geology and other substrate properties, as well as elevation, topography and rainfall.

Shrublands are found on outcrops of rock within Mesic Highveld Grassland (Figure 8.24), where the surface topography creates habitats in which woody vegetation is favoured above grasses. This may include protection from fire and grazing or conditions under which woody plants can access subterranean water supplies. Generally, the higher the surface rock cover, the higher the cover of woody vegetation relative to herbaceous vegetation. The rocky outcrops are mostly of volcanic origin, e.g. dolerite, and are more resistant to weathering in addition to having more nutrient-rich soils.

Summit grasslands are a unique subgroup of the Mesic Highveld Grassland. They are sourvelds found on the summit of the mountain ranges that occur embedded within the Savanna Biome north of the 25° S latitude (Figure 8.37). There is a physical separation between these grasslands and other grassland vegetation in the core biome area of the central Highveld due to the presence of extensive areas of savanna woodlands in between. They are therefore extrazonal grassland vegetation units. The climate in these areas is generally warm and moist and it is the lack of well-developed soils as well as the unique geological influences on these mountains that determines the presence of grassland vegetation instead of savanna in these areas, although the local increased elevation also simulates conditions found in the core Grassland Biome. Due to the substrate factors, the grasslands in these areas often have unique floristic elements and high levels of endemism.

Gm 1 Zastron Moist Grassland

VT 48 *Cymbopogon–Themeda* Veld (sandy) (77%) (Acocks 1953). LR 40 Moist Cold Highveld Grassland (80%) (Low & Rebelo 1996).

Distribution Eastern Cape and Free State Provinces and Lesotho: Surrounds of Zastron, extends just short of Van Stadensrus (north) to Mohales Hoek (northeast) and Rouxville (west). A narrow corridor extends south towards Jamestown and Dordrecht. Altitude 1 400–1 720 m.

Vegetation & Landscape Features Undulating plains, broken in places due to sandstone outcrops forming extensive terraces. These plains bear a mosaic of moist open sour grassland with affinity to Gm 4 Eastern Free State Sandy Grassland, on elevated areas above sandstone outcrops and Gm 3 Eastern Free State Clay Grassland in low-lying eroded areas as well as mudstone outcrops.

Geology & Soils Relatively deep sandy layer over the sandstone layers of the Tarkastad Subgroup (Molteno and Elliot Formations) of the Beaufort Group (Karoo Supergroup). Typical soil forms present on these sandstone terraces are Clovelly and Avalon. Clayey soils, which were formed by weathering and leaching processes, are concentrated in low-lying drainage lines,

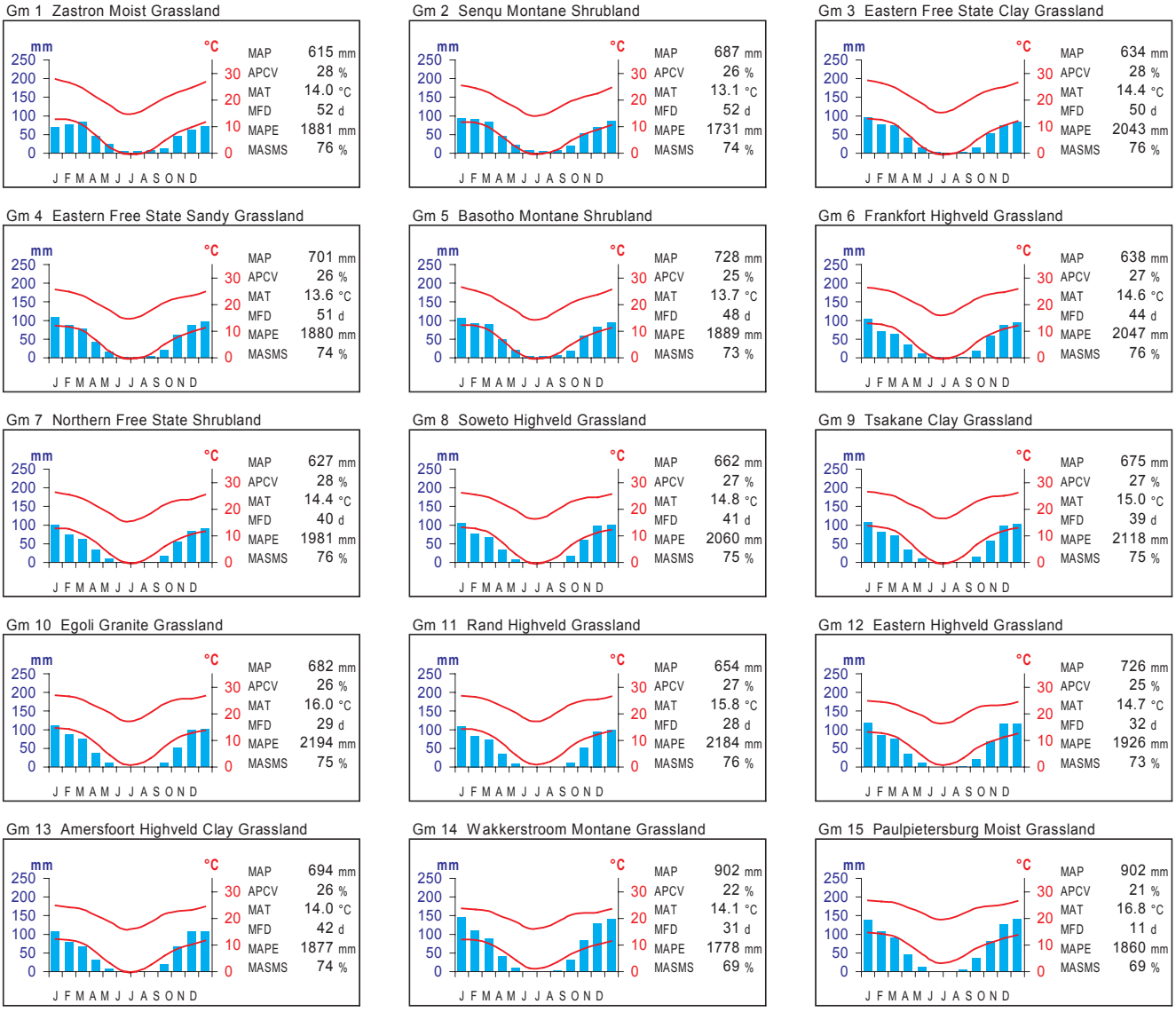
L. Mucina

Figure 8.38 Gm 1 Zastron Moist Grassland: Grasslands at the foot of Aasvoëlberg (2 208 m) near Zastron (Free State), with open shrublands of Gh 4 Besemkaree Koppies Shrubland on the slopes.

valley bottoms and depressions. Db land type dominates, with typical soil forms such as Estcourt and Oakleaf forms present. Fb and Ca land types of minor importance.

Climate Summer rainfall which peaks in March. MAP 615 mm. MAT of 14°C indicates cool-temperate climate. The inland position of the unit results in high thermic continentality: summers are very hot, while winter can be bitterly cold. Frost is a common phenomenon. See also climate diagram for Gm 1 Zastron Moist Grassland (Figure 8.36).

Important Taxa Graminoids: *Aristida congesta* (d), *Cymbopogon pospischilii* (d), *Digitaria argyrograpta* (d), *Eragrostis chloromelas* (d), *Microchloa caffra* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Andropogon appendiculatus*, *Brachiaria serrata*, *Cynodon incompletus*, *Cyperus obtusiflorus* var. *obtusiflorus*, *Elionurus muticus*, *Eragrostis capensis*, *E. curvula*, *E. lehmanniana*, *E. plana*, *E.*



racemosa, *Festuca scabra*, *Harpochloa falx*, *Heteropogon contortus*, *Panicum gilvum*, *Sporobolus africanus*, *Tetrachne dregei*, *Trichoneura grandiglumis*, *Triraphis andropogonoides*. Herbs: *Berkheya onopordifolia* var. *onopordifolia*, *Dianthus thunbergii*, *Gazania krebsiana* subsp. *krebsiana*, *Helichrysum rugulosum*, *Hermannia depressa*, *Limeum argute-carinatum*, *Nolletia ciliaris*, *Salvia stenophylla*, *Senecio erubescens* var. *crepidifolius*, *Trichogyne paronychioides*, *Wahlenbergia denticulata*. Geophytic Herb: *Moraea pallida*. Low Shrubs: *Helichrysum dregeanum* (d), *Anthospermum rigidum* subsp. *pumilum*, *Chrysocoma ciliata*, *Felicia muricata*, *Helichrysum asperum* var. *albidulum*, *H. niveum*, *Selago saxatilis*, *Senecio burchellii*.

Endemic Taxon Geophytic Herb: *Dierama jucundum*.

Conservation Vulnerable. Target 24%. None conserved in statutory conservation areas and only very small portion protected in private Vulture Conservation Area. Almost a third already transformed by cultivation or by urban sprawl. Erosion high (45%), moderate (26%), very high (19%) and low (10%).

Remarks This unit is a mosaic of sweet and sour grassland communities interspersed with rock outcrops capped with dolerite and supporting Gh 4 Besemkaree Koppies Shrubland, or capped by sandstone and supporting Gm 5 Basotho Montane Shrubland. The slopes of the higher mountains such as Aasvoëlberg, Elandsberg, Vegkop and the like in the Zastron District support Gm 5 Basotho Montane Shrubland containing some afromontane elements. This is the only area in the Free State where extensive stands of *Aloe ferox* are found. It is furthermore, together with the Gm 2 Senqu Montane Shrubland, the highest above sea level and furthest inland localities in the distribution range of *A. ferox*. Karroid shrublands are present in areas (such as Sterkspruit) that have suffered heavy overgrazing.

References Acocks (1953, 1988), Werger (1980), Du Preez & Bredenkamp (1991), Malan (1998), Malan et al. (1999).

Gm 2 Senqu Montane Shrubland

VT 48 *Cymbopogon–Themeda* Veld (sandy) (48%), VT 58 *Themeda–Festuca* Alpine Veld (47%) (Acocks 1953). LR 45 Afro Mountain Grassland (50%) (Low & Rebelo 1996).

Distribution Lesotho as well as in Eastern Cape and Free State Provinces (only marginal patches): Mainly in the lower Senqu Valley, particularly in the Moyeni (Quthing)–Mount Moorosi regions, strongly attenuating upstream northwards in the direction of Thaba-Tseka. Extends into South Africa mainly south of the Orange River (continuation of the Senqu River from Lesotho) in the Herschel District. This shrubland unit covers the

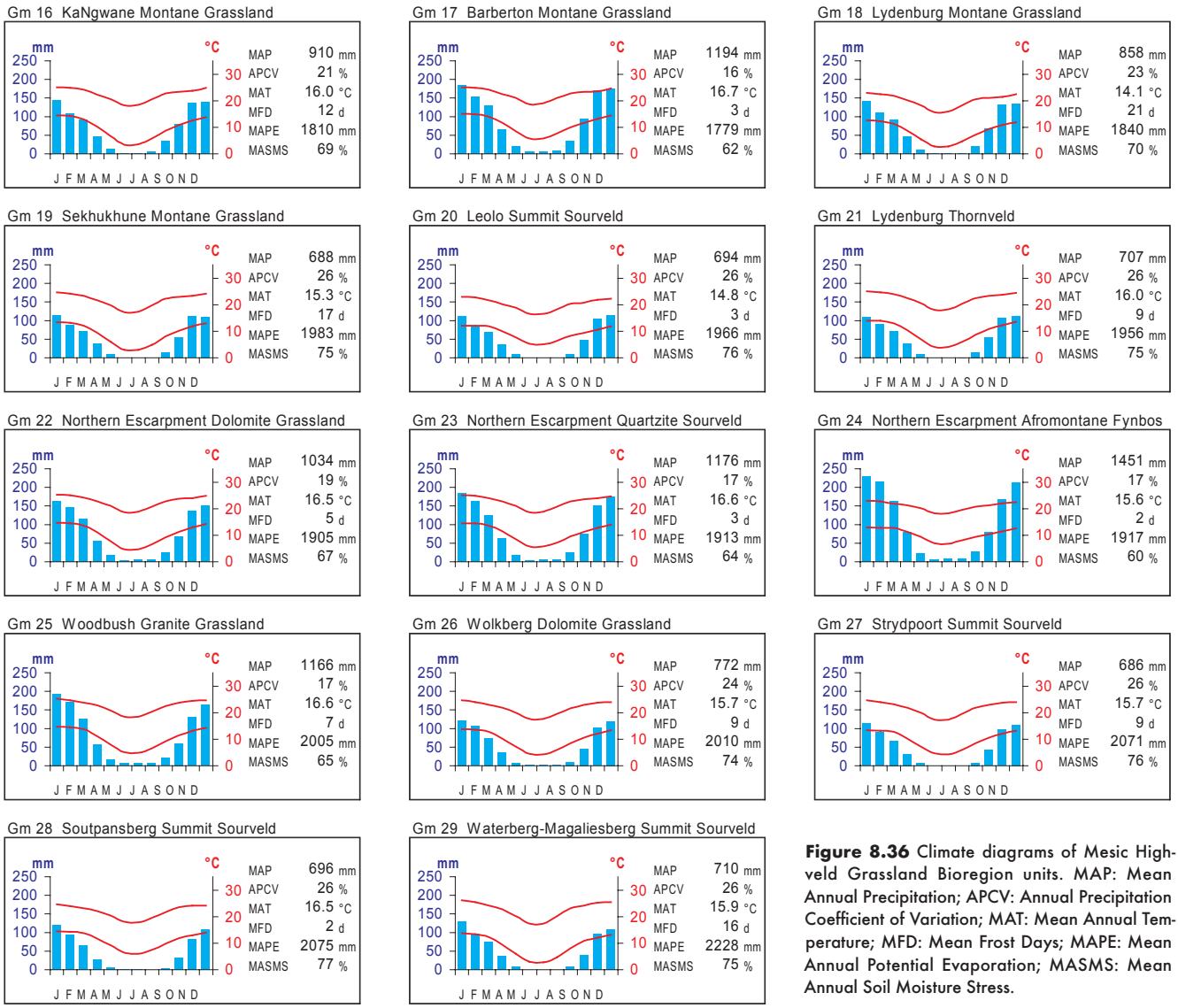


Figure 8.36 Climate diagrams of Mesic Highveld Grassland Bioregion units. MAP: Mean Annual Precipitation; APCV: Annual Precipitation Coefficient of Variation; MAT: Mean Annual Temperature; MFD: Mean Frost Days; MAPE: Mean Annual Potential Evaporation; MASMS: Mean Annual Soil Moisture Stress.

M.C. Rutherford

Figure 8.39 Gm 2 Senqu Montane Shrubland: Steep northern slopes of Thaba Moorosi dominated by *Aloe ferox* and shrubs including *Rhus erosa* and *Olea europaea* subsp. *africana* in the lower valley of the Quthing River shortly before it joins the Senqu River, north of the town of Mount Moorosi, Lesotho.

valley slopes of the Senqu River as well as its numerous tributaries. Altitude 1 600–1 900 m, with outliers found as low as 1 440 m and reaching 1 960 m in places.

Vegetation & Landscape Features Restricted to steep, boulder-strewn slopes of valleys and deep gullies, supporting open-canopy montane shrubland. The shrub species diversity decreases towards low-lying, southwestern areas. The vegetation is dominated by evergreen shrubs, namely *Rhus erosa*, *Olea europaea* and *Diospyros austro-africana*. In a few sheltered inaccessible areas the shrubland turns into thicket with *Kiggelaria africana*, *Leucosidea sericea* and *Rhamnus prinoides*.

Geology & Soils Karoo Supergroup sedimentary rocks of the Clarens, Elliot and Molteno Formations as the Senqu River cuts through the landscape in the low-lying southwestern regions. Intrusive Drakensberg Group (Jurassic) basalts at high altitudes at the interface with the Gd 8 Lesotho Highland Basalt Grassland. Dominant land type Fa, followed by the Ea. The most common soil forms that dominate these land types are Mispah and Glenrosa.

Climate Summer rainfall, with overall MAP of 687 mm. Much of the rainfall is convectional. Cool-temperate thermic pattern (MAT around 13°C), with 52 days of frost incidence. See also climate diagram for Gm 2 Senqu Montane Shrubland (Figure 8.36).

Important Taxa Succulent Tree: *Aloe ferox* (d). Small Trees: *Acacia karroo*, *Celtis africana*, *Cussonia paniculata*, *Kiggelaria africana*, *Pittosporum viridiflorum*. Tall Shrubs: *Diospyros austro-africana* var. *rubriflora* (d), *D. lycioides* subsp. *lycioides* (d), *Euclea coriacea* (d), *Rhamnus prinoides* (d), *Rhus divaricata* (d), *R. erosa* (d), *Buddleja loricata*, *B. salviifolia*, *Clutia pulchella*, *Euclea crispa* subsp. *crispa*, *Grewia occidentalis*, *Gymnosporia heterophylla*, *Heteromorpha arborescens* var. *abyssinica*, *Myrsine africana*, *Olea europaea* subsp. *africana*, *Passerina montana*, *Polygala virgata* var. *decora*, *Rhus burchellii*, *R. dentata*, *R. pyroides*, *Tarchonanthus minor.* Low Shrubs: *Artemisia afra* (d), *Chrysocoma ciliata* (d), *Felicia filifolia* (d), *Helichrysum melanacme* (d), *Agathosma ovata*, *Anthospermum rigidum* subsp. *pumilum*, *Clutia hirsuta*, *Eriocephalus tenuifolius*, *Euryops oligoglossus* subsp. *oligoglossus*, *Gomphocarpus fruticosus* subsp. *fruticosus*, *Gomphostigma virgatum*, *Helichrysum odoratissimum*, *H. zeyheri*, *Heliophila carnosa*, *Indigofera nigromontana*, *Lantana rugosa*, *Melolobium candicans*, *Morella serrata*, *Muraltia saxicola*, *Nenax microphylla*, *Polygala uncinata*, *Printzia auriculata*, *Rhus dregeana*, *Rubus ludwigii*, *Senecio pterophorus*, *Solanum tomentosum*, *Stachys rugosa*. Succulent Shrubs: *Aloe broomii*, *Chasmatophyllum musculinum*, *C. verdoorniae*, *Delosperma ashtonii*, *D. concavum*, *D. congestum*, *D. hirtum*, *D. obtusum*, *Euphorbia clavarioides* var. *clavarioides*, *E. pulvinata*. Semiparasitic Shrub: *Osyris lanceolata*. Semiparasitic Epiphytic Shrub: *Viscum hoolei*. Graminoids: *Eragrostis curvula* (d), *Hyparrhenia hirta* (d), *Agrostis subulifolia*, *Andropogon appendiculatus*, *Aristida bipartita*, *A. congesta*, *A. diffusa*, *A. junciformis* subsp. *galpinii*, *Brachiaria nigropedata*, *Cymbopogon nardus*, *C. pospischilii*, *Elionurus muticus*, *Eragrostis capensis*, *E. chloromelas*, *E. pallens*, *E. plana*, *E. planiculmis*, *E. racemosa*, *E. trichophora*, *Harpochloa falx*, *Helictotrichon longifolium*, *Heteropogon contortus*, *Hordeum capense*, *Hyparrhenia anamesa*, *Koeleria capensis*, *Melica decumbens*, *M. racemosa*, *Melinis nerviglumis*, *Merxmuellera disticha*, *Microchloa caffra*, *Pennisetum macrourum*, *P. sphacelatum*, *Pentaschistis setifolia*, *Setaria sphacelata*, *Sporobolus africanus*, *S. centrifugus*, *S. fimbriatus*, *Stipagrostis uniplumis* var. *neesii*, *Streblochaete longiarista*, *Tetrachne dregei*, *Themeda triandra*, *Trachypogon spicatus*, *Tragus racemosus*, *Tristachya leucothrix*. Woody Climber: *Clematis brachiata*. Herbs: *Aster bakerianus*, *Berkheya setifera*, *Chamaesyce inaequilatera*, *Commelina africana*, *Convolvulus thunbergii*, *Dicoma anomala*, *Erucastrum strigosum*, *Geigeria filifolia*, *Gerbera piloselloides*, *Haplocarpha scaposa*, *Helichrysum caespititium*, *H. chionosphaerum*, *Hermannia coccocarpa*, *H. depressa*, *H. gerrardii*, *Lobelia flaccida*, *Monsonia angustifolia*, *Nemesia rupicola*, *Rhynchosia pentheri*, *Salvia stenophylla*, *Sebaea natalensis*, *Selago galpinii*, *Senecio asperulus*, *S. bupleuroides*, *S. subcoriaceus*, *Tribulus terrestris*, *Ursinia saxatilis*. Herbaceous Climbers: *Dolichos linearis*, *Kedrostis nana*. Geophytic Herbs: *Albuca setosa*, *Androcymbium burkei*, *Asclepias gibba*, *A. multicaulis*, *Bulbine abyssinica*, *B. capitata*, *B. frutescens*, *Cheilanthes eckloniana*, *C. viridis*, *Ledebouria cooperi*, *Moraea pallida*, *Pellaea calomelanos*, *Raphionacme hirsuta*, *Schizoglossum bidens* subsp. *bidens*, *Zantedeschia albomaculata* subsp. *albomaculata.* Succulent Herbs: *Aloe maculata*, *A. pratensis*, *Crassula capitella*, *C. lanceolata* subsp. *lanceolata*, *C. muscosa*, *C. nudicaulis*. Semiparasitic Herbs: *Alectra capensis*, *Thesium costatum* var. *juniperinum*.

Biogeographically Important Taxa ([D]Drakensberg endemic, [Dg]Drakensberg endemic extending to Griqualand East) Low Shrubs: *Euryops tysonii*[D], *Relhania acerosa*[Dg], *R. dieterlenii*[D]. Herbs: *Diascia integerrima*[D], *Helichrysum elegantissimum*[D].

Conservation Least threatened. Target 28%. None conserved in statutory conservation areas. Some 14% already transformed for cultivation. Wood collection is putting this vegetation under severe pressure. Accessible areas have been severely degraded and the shrubland has been reduced. Erosion (ranging across large scales of intensity), caused by degradation of the shrubland vegetation, has resulted in the formation of dongas that cut back into the valleys, destroying the remaining riparian

vegetation in places. Much of the upper reaches of this vegetation unit will disappear should the planned further phases (II, III and IV) of the Lesotho Highlands Water Project be implemented and result in the construction of the Mashai, Tsoelike and Ntoahae Dams.

Remarks This unit is possibly one of the driest of the moist grassland units, some areas with MAP below 600 mm and possibly in places even less than 550 mm (Anonymous 2000). Upstream along the Senqu River, at the Koma-Koma Causeway, the area appears almost hyper-arid, although it is difficult to assess the contribution of the high impact of human and animal pressures. This unit is also recognised by Anonymous (2000) as one of four 'ecological zones' of Lesotho.

References Boucher & Tlale (1999a, b), Anonymous (2000).

Gm 3 Eastern Free State Clay Grassland

VT 48 *Cymbopogon–Themeda* Veld (sandy) (83%) (Acocks 1953). LR 39 Moist Cool Highveld Grassland (73%) (Low & Rebelo 1996).

Distribution Free State Province and marginally in Lesotho: Low-lying areas of the eastern regions of the province, covering the vicinities of Wepener (south), Petrus Steyn (north), Excelsior and east of Winburg (west) and Warden (east) and a thin extension between Maseru and Fouriesburg. Altitude 1 380–1 740 m.

Vegetation & Landscape Features Flat to gently rolling land surfaces covered with grassland dominated by *Eragrostis curvula*, *Themeda triandra*, *Cymbopogon pospischilii*, *Eragrostis plana*, *Setaria sphacelata*, *Elionurus muticus* and *Aristida congesta*. Overgrazing in certain areas and selective grazing of the grassland create a patchy appearance, with dominant and diagnostic species associated with small to large patches of a few hectares in diameter. A wide range of grazing regimes on the macro-scale and within grazing units in the area on the micro-scale, create this fragmentation (Fuls 1993).

Geology & Soils Mudstones and sandstones of the Adelaide Formation (Beaufort Group) underlie this flat to slightly undulating terrain in the north, while the Tarkastad Formation (Beaufort Group) dominates the geology in the south. Dolerite dykes and sills as well as sandstone outcrops, resistant to weathering, form isolated hills and ridges (Gm 5 Basotho Montane Shrubland) that create a broken landscape, especially in the southern parts of the unit. Sepane, Arcadia, Estcourt and Rensburg forms dominate the moist bottomlands while the Glenrosa, Bonheim, Avalon, Clovelly and Mayo forms dominate the outcrops and slightly elevated areas. Major land types Ca and Bd.

Climate Summer-rainfall region, with MAP around 630 mm. Much of the precipitation falls in form of thunderstorms between November and March. One of the coldest regions of the Highveld. Frost is very frequent in winter. See also climate diagram for Gm 3 Eastern Free State Clay Grassland (Figure 8.36).

Important Taxa Graminoids: *Andropogon appendiculatus* (d), *Aristida congesta* (d), *Brachiaria serrata* (d), *Cymbopogon pospischilii* (d), *Cynodon dactylon* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. plana* (d), *Harpochloa falx* (d), *Heteropogon contortus* (d), *Microchloa caffra* (d), *Miscanthus capensis* (d), *Panicum gilvum* (d), *Pennisetum sphacelatum* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tristachya leucothrix* (d), *Aristida junciformis* subsp. *galpinii*, *Eragrostis capensis*, *E. gummiflua*, *E. racemosa*, *Panicum stapfianum*, *Setaria nigrirostris*, *Trichoneura grandiglumis*. Herbs: *Vernonia oligocephala* (d), *Ajuga ophrydis*, *Berkheya onopordifolia* var. *onopordifolia*, *Chamaesyce inaequilatera*, *Cineraria lyratiformis*, *Crabbea acaulis*, *Geigeria aspera* var. *aspera*, *Haplocarpha scaposa*, *Helichrysum rugulosum*, *Hermannia depressa*, *Hibiscus microcarpus*, *Monsonia burkeana*, *Nolletia ciliaris*, *Selago densiflora*, *Sonchus dregeanus*, *S. nanus*, *Tolpis capensis*. Geophytic Herbs: *Boophone disticha*, *Crinum bulbispermum*, *Kniphofia ritualis*, *Ledebouria macowanii*. Herbaceous Climber: *Rhynchosia totta*. Low Shrubs: *Helichrysum dregeanum* (d), *Anthospermum rigidum* subsp. *pumilum*, *Felicia muricata*, *Pentzia globosa*, *Stoebe plumosa*. Succulent Shrub: *Euphorbia clavarioides* var. *clavarioides*.

Conservation Endangered. Target 24%. Only a small portion statutorily conserved (Willem Pretorius Nature Reserve). More than half already transformed by cultivation or building of dams (Allemanskraal, Armenia, Egmont, Loch Lomond, Lovedale, Mushroom Valley and Newberry Dams). Erosion very low (34%), low (30%) and moderate (26%).

L. Mucina

Figure 8.40 Gm 3 Eastern Free State Clay Grassland: Tall grasslands in the broad valley of the Klerkspruit near Bothasberg south of Kestell (eastern Free State). The peaks of the Rooiberge (Golden Gate Highlands National Park) are visible in the background.

Remarks Several clusters of AZf 3 Eastern Temperate Freshwater Wetlands (playas) occur in an area between Lindley, Bethlehem, Warden and Petrus Steyn. These playas are probably the remains of palaeodrainage lines (Seaman 1987).

References Scheepers (1975), Seaman (1987), Du Preez (1991), Fuls (1993).

Gm 4 Eastern Free State Sandy Grassland

VT 56 Highland Sourveld to *Cymbopogon–Themeda* Veld Transition (Eastern Free State Highveld) (42%), VT 48 *Cymbopogon–Themeda* Veld (sandy) (31%) (Acocks 1953). LR 40 Moist Cold Highveld Grassland (60%) (Low & Rebelo 1996).

Distribution Free State Province, Lesotho and marginally into KwaZulu-Natal Province: Ladybrand (west) to the base of foothills of the Drakensberg (Maloti) and the Escarpment in the vicin-

ity of Harrismith (east) and Mafeteng (south). The towns of Marquard, Paul Roux, Bethlehem, Memel and Vrede bound this unit on its northern border. Altitude 1 520–1 800 m, but reaching 2 020 m in places.

Vegetation & Landscape Features Flat to slightly undulating and undulating terrain with streams and rivers that drain the foothills of the Drakensberg. Closed grassland dominated by *Eragrostis curvula*, *Tristachya leucothrix* and *Themeda triandra*. Other dominant grasses include *E. capensis*, *E. racemosa*, *Cymbopogon pospischilii*, *Elionurus muticus*, *Eragrostis plana* and *Aristida junciformis*. Numerous herb species (especially Asteraceae: species of *Helichrysum*, *Vernonia*, *Berkheya*) increase alpha diversity considerably. Embedded within many hills and small mountains carrying Gm 5 Basotho Montane Shrubland. Due to wide range of grazing and fire regimes, the grassland has a patchy appearance.

Geology & Soils Mudstones, sandstones and shale of the Beaufort Group (Tarkastad Formation in the south and Adelaide Formation in the north). Glenrosa, Bonheim, Avalon and Mayo soil forms dominate the outcrops and slightly elevated areas while Sepane, Arcadia and Rensburg soil forms are typical for moist bottomlands. Major land types Bb, Bd and Ca.

Climate Summer-rainfall region, with MAP around 700 mm. Much of the precipitation falls in form of thunderstorms between November and March. Great differences between the average temperatures in winter and summer as well as very frequent occurrence of frost confirm a continental climate. See also description of climate for Gm 3 Eastern Free State Clay Grassland and climate diagram for Gm 4 Eastern Free State Sandy Grassland (Figure 8.36).

Important Taxa Graminoids: *Aristida junciformis* subsp. *galpinii* (d), *Cymbopogon pospischilii* (d), *Digitaria monodactyla* (d), *D. tricholaenoides* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. curvula* (d), *E. plana* (d), *E. racemosa* (d), *Harpochloa falx* (d), *Heteropogon contortus* (d), *Hyparrhenia hirta* (d), *Microchloa caffra* (d), *Monocymbium ceresiiforme* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tristachya leucothrix* (d), *Andropogon appendiculatus*, *A. schirensis*, *Aristida congesta*, *A. diffusa*, *Brachiaria serrata*, *Cymbopogon caesius*, *Cynodon dactylon*, *Cyperus obtusiflorus* var. *flavissimus*, *C. obtusiflorus* var. *obtusiflorus*, *Diheteropogon amplectens*, *Ehrharta capensis*, *Eragrostis capensis*, *Helictotrichon natalense*, *H. turgidulum*, *Koeleria capensis*, *Panicum gilvum*, *Setaria nigrirostris*, *Trachypogon spicatus*, *Trichoneura grandiglumis*. Herbs: *Barleria monticola* (d), *Berkheya onopordifolia* var. *onopordifolia* (d), *B. speciosa* (d), *Dicoma anomala* (d), *Helichrysum psilolepis* (d), *Acalypha angustata*, *A. peduncularis*, *Ajuga ophrydis*, *Anthospermum herbaceum*, *Berkheya pinnatifida*, *B. setifera*, *Crabbea acaulis*, *Cycnium racemosum*, *Dianthus basuticus*, *Haplocarpha scaposa*, *Hebenstretia dentata*, *H. dura*, *Helichrysum ammitophilum*, *H. aureonitens*, *H. caespititium*, *H. cephaloideum*, *H. herbaceum*, *H. nudifolium* var. *nudifolium*, *H. nudifolium* var. *pilosellum*, *H. oreophilum*, *H. rugulosum*, *H. spiralepis*, *Hermannia depressa*, *Hirpicium armerioides*, *Ipomoea crassipes*, *I. pellita*, *Kohautia amatymbica*, *Lactuca inermis*, *Nolletia ciliaris*, *Pelargonium luridum*, *Pentanisia prunelloides* subsp. *prunelloides*, *Selago densiflora*, *S. galpinii*, *Senecio coronatus*, *S. erubescens* var. *crepidifolius*, *S. inornatus*, *Sonchus nanus*, *Tolpis capensis*, *Trifolium burchellianum*, *Vernonia natalensis*, *V. oligocephala*. Geophytic Herbs: *Boophone disticha*, *Crinum bulbispermum*, *Cyrtanthus stenanthus*, *Drimiopsis maculata*, *Eucomis autumnalis* subsp. *autumnalis*, *Gladiolus dalenii*, *G. papilio*, *Hypoxis rigidula* var. *pilosissima*, *Ledebouria ovatifolia*, *Watsonia lepida*, *Xysmalobium involucratum*, *X. undulatum*. Herbaceous Climber: *Rhynchosia totta*. Low Shrubs: *Helichrysum melanacme* (d), *Anthospermum rigidum* subsp. *pumilum*, *Euphorbia striata* var. *cuspidata*, *Gnidia kraussiana*, *Helichrysum dasycephalum*, *Polygala hottentotta*, *Tephrosia capensis* var. *acutifolia*.

Biogeographically Important Taxon (Low Escarpment endemic) Low Shrub: *Heteromma krookii*.

Conservation Endangered. Target 24%. Around 2% statutorily conserved in the Qwaqwa and Golden Gate Highlands National Parks as well as in the Sterkfontein Dam Nature Reserve. Almost half already transformed for cultivation (maize), building of dams (e.g. Sterkfontein, Loch Athlone, Saulspoort). *Cirsium vulgare*, *Cosmos bipinnatus* (forming spectacular displays along road verges and on old fields), *Hypochaeris radicata*, *Plantago virginica*, *Tagetes minuta*, *Verbena bonariensis*, *V. brasiliensis*, *Richardia brasiliensis*, *Guilleminea densa* and others are frequent alien invaders and diminish the agricultural and biodiversity value of these grasslands. Erosion low (44%), very low (22%), moderate (19%) or high (15%).

Remark The abundance of many species of *Helichrysum* is conspicuous.

References Scheepers (1975), Potgieter (1982), Du Preez (1991), Eckhardt (1993), Fuls (1993), Fuls et al. (1993a), Kay et al. (1993), Eckhardt et al. (1995), Smit et al. (1995c).

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Figure 8.41 Gm 4 Eastern Free State Sandy Grassland: Species-rich grassland with *Helichrysum psilolepis* (and other seven congeners) on the Qwaqwa Campus of the University of the Free State at Phuthaditjhaba (eastern Free State).

Gm 5 Basotho Montane Shrubland

VT 48 *Cymbopogon-Themeda* Veld (sandy) (58%) (Acocks 1953). LR 40 Moist Cold Highveld Grassland (67%) (Low & Rebelo 1996).

Distribution Free State Province, Lesotho and very marginally into KwaZulu-Natal Province: Foothills of the west-facing Drakensberg (also Maloti) and mainly on the slopes of mesas over a wide area

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Figure 8.42 Gm 5 Basotho Montane Shrubland: Mosaic of grassland and shrubland with *Euclea crispa* and *Diospyros austro-africana* (*Buddleja salviifolia* and *Myrsine africana* in deeper kloofs) on Clarens sandstone at the foot of the northern slopes of the Qwaqwa Mountain near Phuthaditjhaba (eastern Free State).

in the vicinity of Zastron in the southwest, the surrounds of Mafeteng, Hobhouse, Maseru, Roma, Ladybrand, Clocolan, Excelsior, Ficksburg, Butha-Buthe, Fouriesburg, Paul Roux, Bethlehem, Phuthaditjhaba as far as Harrismith in the northeast. This shrubland unit covers extensive areas in deeply incised river valleys of western Lesotho, especially those opening towards the south and west. Altitude 1 480–1 940 m.

Vegetation & Landscape Features Steep talus slopes and kloofs of the mesas and other mountain flanks supporting tall, in places very dense shrubland dominated by broad-leaved mesophyllous shrubs such as *Rhus erosa*, *Olea europaea* subsp. *africana*, *Euclea crispa* subsp. *crispa*, *Buddleja salviifolia*, *Leucosidea sericea*, *Rhus burchellii*, *Rhamnus prinoides*, *Scutia myrtina* and *Gymnopentzia buxifolia*. Mesas are often encircled by striking upper cliffs of Clarens Sandstone.

Geology & Soils The upper layers of the mudstones and sandstones of the Molteno, Elliot and Clarens Formations (Stormberg Group, Karoo Supergroup). The variations in weathering rates of the rocks resulted in the formation of numerous terraces along the slopes. In places the dolerite dykes cut through the thick sandstones, resulting in the formation of sheltered ravines. The soil surface is strewn with sandstone rocks and boulders. Ib land type, characterised by miscellaneous soil forms, specially the Mispah, and Glenrosa forms, is dominant. Other land types of minor occurrence are Fa, Bb and Db.

Climate This unit receives more than 720 mm of MAP. Wepener and Harrismith score 629 and 624 mm, respectively, while some patches found closer to the Maloti Mountain range (such as on Qwaqwa Mountain near Phuthaditjhaba) may receive more than 1 400 mm in particularly wet years. Most of the rain falls in summer and much of it as convectional rain, with torrential storms. The overall MAT is 13.7°C. Summers are wet and hot, while winters are (as a rule) dry and with frequent frost. Snowfall is a rare event. See also climate diagram for Gm 5 Basotho Montane Shrubland (Figure 8.36).

Important Taxa Tall Shrubs: *Buddleja salviifolia* (d), *Euclea crispa* subsp. *ovata* (d), *Olea europaea* subsp. *africana* (d), *Diospyros whyteana*, *Heteromorpha arborescens* var. *abyssinica*, *Leucosidea sericea*, *Rhamnus prinoides*, *Rhus dentata*, *Tarchonanthus minor*. Low Shrubs: *Anthospermum rigidum* subsp. *pumilum*, *Euphorbia striata* var. *cuspidata*, *Felicia filifolia* subsp. *filifolia*, *F. muricata*, *Gnidia capitata*, *Myrsine africana*. Graminoids: *Andropogon appendiculatus* (d), *A. schirensis* (d), *Aristida congesta* (d), *Cymbopogon pospischilii* (d), *Cynodon dactylon* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. plana* (d), *E. racemosa* (d), *Heteropogon contortus* (d), *Hyparrhenia hirta* (d), *Microchloa caffra* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tristachya leucothrix* (d), *Aristida diffusa*, *Brachiaria serrata*, *Digitaria tricholaenoides*, *Eragrostis capensis*, *E. curvula*, *Harpochloa falx*, *Pennisetum sphacelatum*, *Setaria nigrirostris*. Herbs: *Ajuga ophrydis*, *Cineraria lyratiformis*, *Conyza podocephala*, *Dicoma anomala*, *Haplocarpha scaposa*, *Helichrysum caespititium*, *H. nudifolium* var. *nudifolium*, *H. rugulosum*, *Hermannia depressa*, *Hibiscus microcarpus*, *Ipomoea crassipes*, *Nolletia ciliaris*, *Pollichia campestris*, *Selago densiflora*, *Senecio erubescens* var. *crepidifolius*, *Tolpis capensis*, *Vernonia oligocephala*. Geophytic Herb: *Hypoxis rigidula* var. *pilosissima*. Herbaceous Climber: *Rhynchosia totta*.

Endemic Taxa Herbs: *Lessertia tenuifolia*, *Leucaena latisiliqua*.

Conservation Vulnerable. Target 28%. Only about 2% statutorily conserved in the Qwaqwa National Park, Golden Gate Highlands National Park and Sterkfontein Dam Nature Reserve. Erosion occurs at a wide range of intensity, including high (33%), moderate (26%) and very low (16%).

Remarks This shrubland unit is embedded in wet/moist grasslands such as the Eastern Free State Sandy Grassland and Zastron Moist Grassland. Locally, in deep, sheltered kloofs, this shrubland on rare occasions comes into contact with Northern Afrotemperate Forests. The unit includes the historically significant mesa of Thaba Bosiu in Lesotho.

References Müller (1986), Du Preez (1991), Du Preez & Bredenkamp (1991), Malan (1998), Malan et al. (1998, 1999), Müller (2002).

Gm 6 Frankfort Highveld Grassland

VT 53 *Themeda* Veld to *Cymbopogon–Themeda* Veld Transition (patchy) (79%) (Acocks 1953). LR 39 Moist Cool Highveld Grassland (95%) (Low & Rebelo 1996).

Distribution Free State and marginally Mpumalanga Provinces: Northeastern Free State—south and southeast of the Vaal Dam in the vicinity of Heilbron, Frankfort and Vrede. Altitude 1 460–1 800 m (mostly below 1 660 m).

Vegetation & Landscape Features Flat to slightly undulating and undulating terrain, with grassland dominated by *Eragrostis curvula* and *Themeda triandra*, accompanied by *E. capensis*, *E. plana*, *E. racemosa*, *Cymbopogon pospischilii*, *Elionurus muticus* and *Aristida junciformis*.

Geology & Soils Mudstone or shale with sandstone of the Adelaide Subgroup (Beaufort Group) with Jurassic Karoo dolerite intrusions. Soils are Glenrosa, Bonheim and Avalon, with Mayo forms dominating the outcrops and slightly elevated

areas, while the Sepane, Arcadia and Rensburg forms dominate the moist bottomlands. Much of the area (three quarters) is classified as Ea, while the rest is Ca land type.

Climate Summer-rainfall region, with MAP of 638 mm (much of which falls in the form of thunderstorms). MAT 14–15°C, indicating a cool to warm-temperature climate, characterised by great temperature differences between summer and winter (thermic continentality due to the deep-inland situation and high altitude of the unit). Occurrence of frost is frequent in winter. See also climate diagram for Gm 6 Frankfort Highveld Grassland (Figure 8.36).

P.J. du Preez

Figure 8.43 Gm 7 Northern Free State Shrubland: Shrubland on the slopes of a solitary koppie, Houtkop (1 751 m), south of Reitz (eastern Free State).

Important Taxa Graminoids: *Aristida bipartita* (d), *A. diffusa* (d), *Brachiaria serrata* (d), *Cymbopogon pospischilii* (d), *Cynodon dactylon* (d), *Digitaria tricholaenoides* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. curvula* (d), *E. plana* (d), *E. racemosa* (d), *Harpochloa falx* (d), *Heteropogon contortus* (d), *Hyparrhenia hirta* (d), *Setaria nigrirostris* (d), *S. sphacelata* (d), *Themeda triandra* (d), *Tristachya leucothrix* (d), *Andropogon appendiculatus*, *Aristida congesta*, *A. junciformis* subsp. *galpinii*, *Cymbopogon caesius*, *Cynodon hirsutus*, *Diheteropogon amplectens*, *Eragrostis capensis*, *Helictotrichon turgidulum*, *Koeleria capensis*, *Melinis nerviglumis*, *Microchloa caffra*, *Panicum stapfianum*, *Pennisetum sphacelatum*. Herbs: *Dicoma anomala* (d), *Vernonia oligocephala* (d), *Berkheya onopordifolia* var. *onopordifolia*, *B. pinnatifida*, *Crabbea acaulis*, *Geigeria aspera* var. *aspera*, *Haplocarpha scaposa*, *Helichrysum nudifolium* var. *nudifolium*, *H. rugulosum*, *Hermannia depressa*, *Jamesbrittenia aurantiaca*, *Kohautia amatymbica*, *Rhynchosia effusa*, *Selago densiflora*. Geophytic Herbs: *Boophone disticha*, *Hypoxis rigidula* var. *pilosissima*. Herbaceous Climber: *Rhynchosia totta*. Low Shrubs: *Anthospermum hispidulum*, *A. rigidum* subsp. *pumilum*, *Berkheya annectens*, *Solanum panduriforme*.

Conservation Vulnerable. Target 24%. None conserved in statutory conservation areas. More than a third already transformed for cultivation (maize) or flooded by dams (Vaal Dam). Erosion is very low (95%).

References Eckhardt et al. (1993a, b), Fuls et al. (1993c).

Gm 7 Northern Free State Shrubland

VT 48 *Cymbopogon–Themeda* Veld (sandy) (40%), VT 53 *Themeda* Veld to *Cymbopogon–Themeda* Veld Transition (patchy) (34%) (Acocks 1953). LR 39 Moist Cool Highveld Grassland (89%) (Low & Rebelo 1996).

Distribution Free State Province and marginally also into Mpumalanga Province: Northeastern regions of the Free State in the surrounds of Lindley (southwest), Bethlehem, Reitz, Frankfort and Vrede (northeast). Altitude 1 460–1 800 m, mostly 1 540–1 640 m.

Vegetation & Landscape Features Mainly restricted (as isolated pockets) to south-facing slopes of koppies, butts and tafelbergs as well as steep slopes of deeply incised rivers, where sandstone outcrops occur. Typically a two-layered, closed-canopy shrubland dominated by tall shrubs such as *Rhamnus prinoides*, *Leucosidea sericea*, *Buddleja salviifolia*, *Rhus dentata*, *Euclea crispa* subsp. *crispa*, *Diospyros lycioides* and *Kiggelaria africana*. The lower layer is sparse grassland.

Geology & Soils Outcrops of especially Adelaide Subgroup (Beaufort Group, Karoo Supergroup) sandstones and to a lesser extent dolerite sills that protect sedimentary layers of sandstone, mudstone and siltstone from erosion. Soil forms that are typical of these rocky outcrops are the Glenrosa and Mispah forms. Ea land type is dominant (more than 50% of the area), accompanied by Dc and Bb.

Climate Summer-rainfall region, with 627 mm MAP. Much of the rainfall is convectional. The frost incidence is around 40 days. See also climate diagram for Gm 7 Northern Free State Shrubland (Figure 8.36).

Important Taxa Small Trees: *Kiggelaria africana* (d), *Cussonia paniculata*. Tall Shrubs: *Diospyros austro-africana* (d), *D. lycioides* subsp. *lycioides* (d), *Heteromorpha arborescens* var. *abyssinica* (d), *Leucosidea sericea* (d), *Rhamnus prinoides* (d), *Buddleja salviifolia*, *Calpurnia villosa*, *D. whyteana*, *Euclea crispa* subsp. *crispa*, *E. undulata*, *Grewia occidentalis*, *Melianthus dregeanus*, *Rhus dentata*, *R. pyroides*. Woody Climbers: *Asparagus asparagoides* (d), *Clematis oweniae*, *Dioscorea sylvatica*. Low Shrubs: *Anthospermum rigidum* subsp. *pumilum*, *Clutia affinis*, *C. hirsuta*, *C. pulchella*, *Euphorbia striata* var. *cuspidata*, *Felicia muricata*, *F. petiolata*, *Garuleum woodii*, *Indigofera filipes*, *I. woodii*, *Myrsine africana*, *Rhus discolor*, *Rubus rigidus*, *Senecio burchellii*, *S. harveianus*, *Solanum panduriforme*, *Sutera polelensis* subsp. *polelensis*. Succulent Shrub: *Crassula dependens*. Semiparasitic Shrub: *Osyris lanceolata*. Graminoids: *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *Hyparrhenia hirta* (d), *Microchloa caffra* (d), *Themeda triandra* (d), *Aristida congesta*, *A. diffusa*, *A. junciformis* subsp. *galpinii*, *Brachiaria serrata*, *Cymbopogon pospischilii*, *Eragrostis capensis*, *E. curvula*, *E. gummiflua*, *E. plana*, *Harpochloa falx*, *Helictotrichon turgidulum*, *Heteropogon contortus*, *Koeleria capensis*, *Melinis nerviglumis*, *Panicum gilvum*, *Pennisetum sphacelatum*, *Schoenoxiphium rufum*, *Setaria sphacelata*, *Tragus racemosus*, *Tristachya leucothrix*. Herbs: *Ajuga ophrydis*, *Centella asiatica*, *Chamaesyce inaequilatera*, *Cineraria aspera*, *Commelina africana*, *Convolvulus dregeanus*, *Conyza podocephala*, *Cyathula cylindrica*, *Erucastrum austroafricanum*, *Geranium schlechteri*, *Helichrysum cephaloideum*, *H. rugulosum*,

Hermannia depressa, *Hibiscus aethiopicus* var. *ovatus*, *Lactuca inermis*, *Pollichia campestris*, *Pseudognaphalium undulatum*, *Rubia horrida*, *Salvia runcinata*, *Senecio hieracioides*, *S. isatideus*, *Solanum retroflexum*, *Stachys hyssopoides*, *S. natalensis*, *Trifolium africanum*, *Vernonia natalensis*. Geophytic Herbs: *Agapanthus campanulatus*, *Asclepias multicaulis*, *Cheilanthes quadripinnata*, *Eucomis autumnalis* subsp. *autumnalis*, *Hypoxis hemerocallidea*, *Mohria caffrorum*, *Oxalis corniculata*, *Pellaea calomelanos*, *Zantedeschia albomaculata* subsp. *albomaculata*. Succulent Herbs: *Crassula lanceolata*, *C. setulosa* var. *setulosa*.

Conservation Least threatened. Target 28%. None conserved in statutory conservation areas. Erosion very low (65%), low (23%) and moderate (12%).

References Fuls (1993), Fuls et al. (1993a, b), Eckhardt et al. (1997).

Gm 8 Soweto Highveld Grassland

VT 52 *Themeda* Veld (Turf Highveld) (56%) (Acocks 1953). LR 35 Moist Clay Highveld Grassland (51%) (Low & Rebelo 1996).

Distribution Mpumalanga, Gauteng (and to a very small extent also in neighbouring Free State and North-West) Provinces: In a broad band roughly delimited by the N17 road between Ermelo and Johannesburg in the north, Perdekop in the southeast and the Vaal River (border with the Free State) in the south. It extends further westwards along the southern edge of the Johannesburg Dome (including part of Soweto) as far as the vicinity of Randfontein. In southern Gauteng it includes the surrounds of Vanderbijlpark and Vereeniging as well as Sasolburg in the northern Free State. Altitude 1 420–1 760 m.

Vegetation & Landscape Features Gently to moderately undulating landscape on the Highveld plateau supporting short to medium-high, dense, tufted grassland dominated almost entirely by *Themeda triandra* and accompanied by a variety of other grasses such as *Elionurus muticus*, *Eragrostis racemosa*, *Heteropogon contortus* and *Tristachya leucothrix*. In places not disturbed, only scattered small wetlands, narrow stream alluvia, pans and occasional ridges or rocky outcrops interrupt the continuous grassland cover.

D.B. Hoare

Figure 8.44 Gm 8 Soweto Highveld Grassland: Typical mesic highveld grassland with *Themeda triandra* and several *Eragrostis* species still found in some parts of southern Gauteng in natural condition.

Geology and Soils Shale, sandstone or mudstone of the Madzaringwe Formation (Karoo Supergroup) or the intrusive Karoo Suite dolerites which feature prominently in the area. In the south, the Volksrust Formation (Karoo Supergroup) is found and in the west, the rocks of the older Transvaal, Ventersdorp and Witwatersrand Supergroups are most significant. Soils are deep, reddish on flat plains and are typically Ea, Ba and Bb land types.

Climate Summer-rainfall region (MAP 662 mm). Cool-temperate climate with thermic continentality (high extremes between maximum summer and minimum winter temperatures, frequent occurrence of frost, large thermic diurnal differences, especially in autumn and spring). See also climate diagram for Gm 8 Soweto Highveld Grassland (Figure 8.36).

Important Taxa Graminoids: *Andropogon appendiculatus* (d), *Brachiaria serrata* (d), *Cymbopogon pospischilii* (d), *Cynodon dactylon* (d), *Elionurus muticus* (d), *Eragrostis capensis* (d), *E. chloromelas* (d), *E. curvula* (d), *E. plana* (d), *E. planiculmis* (d), *E. racemosa* (d), *Heteropogon contortus* (d), *Hyparrhenia hirta* (d), *Setaria nigrirostris* (d), *S. sphacelata* (d), *Themeda triandra* (d), *Tristachya leucothrix* (d), *Andropogon schirensis*, *Aristida adscensionis*, *A. bipartita*, *A. congesta*, *A. junciformis* subsp. *galpinii*, *Cymbopogon caesius*, *Digitaria diagonalis*, *Diheteropogon amplectens*, *Eragrostis micrantha*, *E. superba*, *Harpochloa falx*, *Microchloa caffra*, *Paspalum dilatatum*. Herbs: *Hermannia depressa* (d), *Acalypha angustata*, *Berkheya setifera*, *Dicoma anomala*, *Euryops gilfillanii, Geigeria aspera* var. *aspera*, *Graderia subintegra*, *Haplocarpha scaposa*, *Helichrysum miconiifolium*, *H. nudifolium* var. *nudifolium*, *H. rugulosum*, *Hibiscus pusillus*, *Justicia anagalloides*, *Lippia scaberrima*, *Rhynchosia effusa*, *Schistostephium crataegifolium*, *Selago densiflora*, *Senecio coronatus*, *Vernonia oligocephala*, *Wahlenbergia undulata*. Geophytic Herbs: *Haemanthus humilis* subsp. *hirsutus*, *H. montanus*. Herbaceous Climber: *Rhynchosia totta*. Low Shrubs: *Anthospermum hispidulum*, *A. rigidum* subsp. *pumilum*, *Berkheya annectens*, *Felicia muricata*, *Ziziphus zeyheriana*.

Conservation Endangered. Target 24%. Only a handful of patches statutorily conserved (Waldrift, Krugersdorp, Leeuwkuil, Suikerbosrand, Rolfe's Pan Nature Reserves) or privately conserved (Johanna Jacobs, Tweefontein, Gert Jacobs, Nikolaas and Avalon Nature Reserves, Heidelberg Natural Heritage Site). Almost half of the area already transformed by cultivation, urban sprawl, mining and building of road infrastructure. Some areas have been flooded by dams (Grootdraai, Leeukuil, Trichardtsfontein, Vaal, Willem Brummer). Erosion is generally very low (93%).

References Bredenkamp (1975, 1976, 1977), Bredenkamp & Theron (1978), Bezuidenhout & Bredenkamp (1991a).

Gm 9 Tsakane Clay Grassland

VT 48 *Cymbopogon-Themeda* Veld (sandy) (58%) (Acocks 1953). LR 39 Moist Cool Highveld Grassland (64%) (Low & Rebelo 1996).

Distribution Gauteng and Mpumalanga Provinces: In patches extending in a narrow band from Soweto to Springs, broadening southwards to Nigel and from there towards Vereeniging, as well

as north of the Vaal Dam and between Balfour and Standerton (including Willemsdal). Altitude 1 480–1 680 m.

Vegetation & Landscape Features Flat to slightly undulating plains and low hills. Vegetation is short, dense grassland dominated by a mixture of common highveld grasses such as *Themeda triandra*, *Heteropogon contortus*, *Elionurus muticus* and a number of *Eragrostis* species. Most prominent forbs are of the families Asteraceae, Rubiaceae, Malvaceae, Lamiaceae and Fabaceae. Disturbance leads to an increase in the abundance of the grasses *Hyparrhenia hirta* and *Eragrostis chloromelas*.

Geology & Soils The most significant rock is the basaltic lava of the Klipriviersberg Group (Ventersdorp Supergroup), together with the sedimentary rocks of the Madzaringwe Formation of the Karoo Supergroup. Soils typical of Ba and Bb land types.

Climate Strongly seasonal summer rainfall, with very dry winters. MAP 630–720 mm. The overall MAT of 15°C indicates a transition between a cool-temperate and warm-temperate climate. The incidence of frost frequent, increasing towards the southeast. See also climate diagram for Gm 9 Tsakane Clay Grassland (Figure 8.36).

Important Taxa Graminoids: *Brachiaria serrata* (d), *Cynodon dactylon* (d), *C. hirsutus* (d), *Digitaria ternata* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. patentipilosa* (d), *E. plana* (d), *E. racemosa* (d), *Heteropogon contortus* (d), *Hyparrhenia hirta* (d), *Microchloa caffra* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Abildgaardia ovata*, *Andropogon schirensis*, *Cymbopogon caesius*, *Diheteropogon amplectens*, *Melinis nerviglumis*, *Panicum gilvum*, *Setaria nigrirostris*. Herbs: *Acanthospermum australe*, *Ajuga ophrydis*, *Eriosema salignum*, *Euryops transvaalensis* subsp. *transvaalensis, Gerbera viridifolia*, *Helichrysum nudifolium* var. *nudifolium*, *H. rugulosum*, *Hermannia depressa*, *Lotononis macrosepala*, *Nidorella hottentotica*, *Pentanisia prunelloides* subsp. *latifolia*, *Peucedanum caffrum*, *Rotheca hirsuta*, *Selago paniculata*, *Senecio coronatus*, *S. inornatus*, *Sonchus nanus*, *Vernonia oligocephala*. Geophytic Herbs: *Aspidoglossum ovalifolium*, *Hypoxis rigidula* var. *pilosissima*. Semiparasitic Herb: *Striga asiatica*. Low Shrubs: *Anthospermum rigidum* subsp. *pumilum*, *Chaetacanthus setiger*, *Tephrosia capensis* var. *acutifolia*. Semiparasitic Shrub: *Thesium impeditum*.

Conservation Endangered. Target 24%. Only 1.5% conserved in statutory reserves (Suikerbosrand, Olifantsvlei, Klipriviersberg, Marievale) and a small portion also in private nature reserves (Avalon, Ian P. Coetser, Andros). More than 60% transformed by cultivation, urbanisation, mining, dam-building and roads. Large portions of Alberton, Springs, Tsakane and part of Soweto (all south and east of Johannesburg) were built in the area of this vegetation unit. Urbanisation is increasing and further expansion of especially the southern suburbs of Johannesburg and the towns of the East Rand (especially the Brakpan District) will bring further pressure on the remaining vegetation. Erosion very low (87%) and low (11%) across the entire unit.

Remark 1 Grasslands in a part of this unit have been described as *Helichrysum rugulosum–Conyza podocephala* Grassland by Coetzee et al. (1995).

Remark 2 The unit contains a number of small pans, many of which have been disturbed, drained or are overgrazed and trampled.

References Acocks (1953, 1988), Bredenkamp (1975, 1976, 1977), Bredenkamp & Theron (1980), Coetzee et al. (1995).

Gm 10 Egoli Granite Grassland

VT 61 Bankenveld (100%) (Acocks 1953). LR 34 Rocky Highveld Grassland (100%) (Low & Rebelo 1996).

Distribution Gauteng Province: Johannesburg Dome extending in the region between northern Johannesburg in the south, and from near Lanseria Airport and Centurion (south of Pretoria) to the north, westwards to about Muldersdrif and eastwards to Tembisa. Altitude 1 280–1 660 m.

Vegetation & Landscape Features Moderately undulating plains and low hills supporting tall, usually *Hyparrhenia hirta*-dominated grassland, with some woody species on rocky outcrops or rock sheets. The rocky habitats show a high diversity of woody species, which occur in the form of scattered shrub groups or solitary small trees.

Geology & Soils Archaean granite and gneiss of the Halfway House Granite at the core of the Johannesburg Dome supporting leached, shallow, coarsely grained, sandy soil poor in nutrients of Glenrosa form. Small area is built by ultramafics. Dominant land types Bb and Ba.

Climate Strongly seasonal summer-rainfall region, with very dry winters. MAP 620–800 mm (overall average 680 mm). The coefficient of variation in MAP from 24–27% across the unit. Incidence of frost frequent, but higher in the south than the north. See also climate diagram for Gm 10 Egoli Granite Grassland (Figure 8.36).

Important Taxa Graminoids: *Aristida canescens* (d), *A. congesta* (d), *Cynodon dactylon* (d), *Digitaria monodactyla* (d), *Eragrostis capensis* (d), *E. chloromelas* (d), *E. curvula* (d), *E. racemosa* (d), *Heteropogon contortus* (d), *Hyparrhenia hirta*

D.B. Hoare

Figure 8.45 Gm 10 Egoli Granite Grassland: Rocky outcrop at Knoppieslaagte, west of Valhalla near Centurion (Gauteng) with *Aloe greatheadii*, *Hypoxis rigidula*, *Pygmaeothamnus zeyheri*, *Thesium magalismontanum* and *Crassula capitella* and grasses such as *Elionurus muticus*, *Tristachya leucothrix*, *Melinis repens* and *Trachypogon spicatus*.

(d), *Melinis repens* subsp. *repens* (d), *Monocymbium ceresiiforme* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tristachya leucothrix* (d), *Andropogon eucomus*, *Aristida aequiglumis*, *A. diffusa*, *A. scabrivalvis* subsp. *borumensis*, *Bewsia biflora*, *Brachiaria serrata*, *Bulbostylis burchellii*, *Cymbopogon caesius*, *Digitaria tricholaenoides*, *Diheteropogon amplectens*, *Eragrostis gummiflua*, *E. sclerantha*, *Panicum natalense*, *Schizachyrium sanguineum*, *Setaria nigrirostris*, *Tristachya rehmannii*, *Urelytrum agropyroides*. Herbs: *Acalypha angustata*, *A. pedunculares*, *Becium obovatum*, *Berkheya insignis*, *Crabbea hirsuta*, *Cyanotis speciosa*, *Dicoma anomala*, *Helichrysum rugulosum*, *Justicia anagalloides*, *Kohautia amatymbica*, *Nidorella hottentotica*, *Pentanisia prunelloides* subsp. *latifolia*, *Pseudognaphalium luteo-album*, *Senecio venosus*. Geophytic Herbs: *Cheilanthes deltoidea*, *C. hirta*. Small Tree: *Vangueria infausta*. Tall Shrub: *Rhus pyroides*. Low Shrubs: *Anthospermum hispidulum*, *A. rigidum* subsp. *pumilum*, *Gnidia capitata*, *Helichrysum kraussii*, *Ziziphus zeyheriana*. Succulent Shrub: *Lopholaena coriifolia*.

D.B. Hoare

Figure 8.46 Gm 11 Rand Highveld Grassland: Grasslands south of Bronkhorstspruit (Mpumalanga) dominated by grasses such as *Themeda triandra*, *Elionurus muticus*, *Diheteropogon amplectens* and *Tristachya leucothrix*.

Conservation Endangered. Target 24%. Only about 3% of this unit is conserved in statutory reserves (Diepsloot and Melville Koppies Nature Reserves) and a number of private conservation areas including Motsetse and Isaac Stegmann Nature Reserves, Kingskloof Natural Heritage Site, Melrose and Beaulieu Bird Sanctuaries as well as the Walter Sisulu National Botanical Garden. More than two thirds of the unit has already undergone transformation mostly by urbanisation, cultivation or by building of roads. Current rates of transformation threaten most of the remaining unconserved areas. There is no serious alien infestation in this unit, although species such as *Eucalyptus grandis*, *E. camaldulensis* and *E. sideroxylon* are commonly found. Erosion is moderate and very low.

Remark 1 This grassland is considered by some to be primary, though is heavily utilised, poor in species and degraded, and often resembles secondary grassland that developed on old fields.

Remark 2 So-called Witwatersrand serpentine sourveld (Reddy et al. 2001)—rocky grasslands on ultramafic rocks of a greenstone belt of uncertain origin—falls within this vegetation unit. Unlike in the Barberton region (see SVl 13 Barberton Serpentine Sourveld), the floristic composition of the Witwatersrand serpentines does not support separation of the ultramafic sourveld as a separate unit. So far no endemic taxa have been discovered on the Witwatersrand serpentines, the floristic composition of which is similar to that of the surrounding granite grassland.

References Acocks (1953, 1988), Grobler (2000), Ellery et al. (2001), Reddy et al. (2001).

Gm 11 Rand Highveld Grassland

VT 61 Bankenveld (64%) (Acocks 1953). LR 34 Rocky Highveld Grassland (45%), LR 38 Moist Sandy Highveld Grassland (21%) (Low & Rebelo 1996).

Distribution Gauteng, North-West, Free State and Mpumalanga Provinces: In areas between rocky ridges from Pretoria to Witbank, extending onto ridges in the Stoffberg and Roossenekal regions as well as west of Krugersdorp centred in the vicinity of Derby and Potchefstroom, extending southwards and northeastwards from there. Altitude 1 300–1 635 m, but reaches 1 760 m in places.

Vegetation & Landscape Features Highly variable landscape with extensive sloping plains and a series of ridges slightly elevated over undulating surrounding plains. The vegetation is species-rich, wiry, sour grassland alternating with low, sour shrubland on rocky outcrops and steeper slopes. Most common grasses on the plains belong to the genera *Themeda*, *Eragrostis*, *Heteropogon* and *Elionurus*. High diversity of herbs, many of which belong to the Asteraceae, is also a typical feature. Rocky hills and ridges carry sparse (savannoid) woodlands with *Protea caffra* subsp. *caffra*, *P. welwitschii*, *Acacia caffra* and *Celtis africana*, accompanied by a rich suite of shrubs among which the genus *Rhus* (especially *R. magalismonata*) is most prominent.

Geology & Soils Quartzite ridges of the Witwatersrand Supergroup and the Pretoria Group as well as the Selons River Formation of the Rooiberg Group (last two are of the Transvaal Supergroup), supporting soils of various quality (shallow Glenrosa and Mispah forms especially on rocky ridges), typical of Ba, Bc, Bb and Ib land types.

Climate Strongly seasonal summer-rainfall, warm-temperate region, with very dry winters. MAP is 654 mm, ranging between 570 mm and 730 mm, slightly lower in the western regions. The coefficient of variation of MAP is 28% in the west and 26–27% in the east, and varies only slightly from 25% to 29% across the unit. The incidence of frost is higher in the west (30–40 days) than in the east (10–35 days). See also climate diagram for Gm 11 Rand Highveld Grassland (Figure 8.36).

Important Taxa Graminoids: *Ctenium concinnum* (d), *Cynodon dactylon* (d), *Digitaria monodactyla* (d), *Diheteropogon amplectens* (d), *Eragrostis chloromelas* (d), *Heteropogon contortus* (d), *Loudetia simplex* (d), *Monocymbium ceresiiforme* (d), *Panicum natalense* (d), *Schizachyrium sanguineum* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya biseriata* (d), *T. rehmannii* (d), *Andropogon schirensis*, *Aristida aequiglumis*, *A. congesta*, *A. junciformis* subsp. *galpinii*, *Bewsia biflora*, *Brachiaria nigropedata*, *B. serrata*, *Bulbostylis burchellii*, *Cymbopogon caesius*, *Digitaria tricholaenoides*, *Elionurus muticus*, *Eragrostis capensis*, *E. curvula*, *E. gummiflua*, *E. plana*,

E. racemosa, *Hyparrhenia hirta*, *Melinis nerviglumis*, *M. repens* subsp. *repens*, *Microchloa caffra*, *Setaria nigrirostris*, *Sporobolus pectinatus*, *Trichoneura grandiglumis*, *Urelytrum agropyroides*. Herbs: *Acanthospermum australe* (d), *Justicia anagalloides* (d), *Pollichia campestris* (d), *Acalypha angustata*, *Chamaecrista mimosoides*, *Dicoma anomala*, *Helichrysum caespititium*, *H. nudifolium* var. *nudifolium*, *H. rugulosum*, *Ipomoea crassipes*, *Kohautia amatymbica*, *Lactuca inermis*, *Macledium zeyheri* subsp. *argyrophylum*, *Nidorella hottentotica*, *Oldenlandia herbacea*, *Rotheca hirsuta*, *Selago densiflora*, *Senecio coronatus*, *Sonchus dregeanus*, *Vernonia oligocephala*, *Xerophyta retinervis*. Geophytic Herbs: *Boophone disticha*, *Cheilanthes hirta*, *Haemanthus humilis* subsp. *humilis*, *Hypoxis rigidula* var. *pilosissima*, *Ledebouria ovatifolia*, *Oxalis corniculata*. Succulent Herb: *Aloe greatheadii* var. *davyana*. Low Shrubs: *Anthospermum rigidum* subsp. *pumilum*, *Indigofera comosa*, *Rhus magalismontana, Stoebe plumosa*. Succulent Shrub: *Lopholaena coriifolia* (d). Geoxylic Suffrutex: *Elephantorrhiza elephantina*.

T. Steyn

Figure 8.47 Gm 12 Eastern Highveld Grassland: Grasslands of the Warburton area (Mpumalanga) with species of *Berkheya* and *Ipomoea* prominent in the foreground.

Biogeographically Important Taxa (all Northern sourveld endemics) Geophytic Herbs: *Agapanthus inapertus* subsp. *pendulus*, *Eucomis vandermerwei*. Succulent Herb: *Huernia insigniflora*. Low Shrub: *Melhania randii*.

Endemic Taxa Herbs: *Melanospermum rudolfii*, *Polygala spicata*. Succulent Herbs: *Anacampseros subnuda* subsp. *lubbersii*, *Frithia humilis*. Succulent Shrubs: *Crassula arborescens* subsp. *undulatifolia*, *Delosperma purpureum*. Small Trees: *Encephalartos lanatus*, *E. middelburgensis*.

Conservation Endangered. Target 24%. Poorly conserved (only 1%). Small patches protected in statutory reserves (Kwaggavoetpad, Van Riebeeck Park, Bronkhorstspruit, Boskop Dam Nature Reserves) and in private conservation areas (e.g. Doornkop, Zemvelo, Rhenosterpoort and Mpopomeni). Almost half has been transformed mostly by cultivation, plantations, urbanisation or dam-building. Cultivation may also have had an impact on an additional portion of the surface area of the unit where old lands are currently classified as grasslands in land-cover classifications and poor land management has led to degradation of significant portions of the remainder of this unit (D.B. Hoare, personal observation). Scattered aliens (most prominently *Acacia mearnsii*) occur in about 7% of this unit. Only about 7% has been subjected to moderate to high erosion levels.

Remark This vegetation unit is very varied and geographically disjunct and requires further investigation.

References Acocks (1953, 1988), Bezuidenhout (1988), Bezuidenhout & Bredenkamp (1991b), Coetzee (1993), Coetzee et al. (1994, 1995), Smit et al. (1997), Burgoyne et al. (2000), Grobler (2000), Grobler et al. (2006).

Gm 12 Eastern Highveld Grassland

VT 61 Bankenveld (42%), VT 57 North-Eastern Sandy Highveld (33%) (Acocks 1953). LR 38 Moist Sandy Highveld Grassland (69%) (Low & Rebelo 1996).

Distribution Mpumalanga and Gauteng Provinces: Plains between Belfast in the east and the eastern side of Johannesburg in the west and extending southwards to Bethal, Ermelo and west of Piet Retief. Altitude 1 520–1 780 m, but also as low as 1 300 m.

Vegetation & Landscape Features Slightly to moderately undulating plains, including some low hills and pan depressions. The vegetation is short dense grassland dominated by the usual highveld grass composition (*Aristida*, *Digitaria*, *Eragrostis*, *Themeda*, *Tristachya* etc.) with small, scattered rocky outcrops with wiry, sour grasses and some woody species (*Acacia caffra*, *Celtis africana*, *Diospyros lycioides* subsp *lycioides*, *Parinari capensis*, *Protea caffra*, *P. welwitschii* and *Rhus magalismontanum*).

Geology & Soils Red to yellow sandy soils of the Ba and Bb land types found on shales and sandstones of the Madzaringwe Formation (Karoo Supergroup). Land types Bb (65%) and Ba (30%).

Climate Strongly seasonal summer rainfall, with very dry winters. MAP 650–900 mm (overall average: 726 mm), MAP relatively uniform across most of this unit, but increases significantly in the extreme southeast. The coefficient of variation in MAP is 25% across most of the unit, but drops to 21% in the east and southeast. Incidence of frost from 13–42 days, but higher at higher elevations. See also climate diagram for Gm 12 Eastern Highveld Grassland (Figure 8.36).

Important Taxa Graminoids: *Aristida aequiglumis* (d), *A. congesta* (d), *A. junciformis* subsp. *galpinii* (d), *Brachiaria serrata* (d), *Cynodon dactylon* (d), *Digitaria monodactyla* (d), *D. tricholaenoides* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. curvula* (d), *E. plana* (d), *E. racemosa* (d), *E. sclerantha* (d), *Heteropogon contortus* (d), *Loudetia simplex* (d), *Microchloa caffra* (d), *Monocymbium ceresiiforme* (d), *Setaria sphacelata* (d), *Sporobolus africanus* (d), *S. pectinatus* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *T. rehmannii* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon appendiculatus*, *A. schirensis*, *Bewsia biflora*, *Ctenium concinnum*, *Diheteropogon amplectens*, *Eragrostis capensis*, *E. gummiflua*, *E. patentissima*, *Harpochloa falx*, *Panicum natalense*, *Rendlia altera*, *Schizachyrium sanguineum*, *Setaria nigrirostris*, *Urelytrum agropyroides*. Herbs: *Berkheya setifera* (d), *Haplocarpha scaposa* (d), *Justicia anagalloides* (d), *Pelargonium luridum* (d), *Acalypha angustata*, *Chamaecrista*

mimosoides, *Dicoma anomala*, *Euryops gilfillanii, E. transvaalensis* subsp. *setilobus, Helichrysum aureonitens*, *H. caespititium*, *H. callicomum*, *H. oreophilum*, *H. rugulosum*, *Ipomoea crassipes*, *Pentanisia prunelloides* subsp. *latifolia*, *Selago densiflora*, *Senecio coronatus*, *Vernonia oligocephala*, *Wahlenbergia undulata*. Geophytic Herbs: *Gladiolus crassifolius*, *Haemanthus humilis* subsp. *hirsutus*, *Hypoxis rigidula* var. *pilosissima*, *Ledebouria ovatifolia*. Succulent Herb: *Aloe ecklonis*. Low Shrubs: *Anthospermum rigidum* subsp. *pumilum*, *Stoebe plumosa*.

Conservation Endangered. Target 24%. Only very small fraction conserved in statutory reserves (Nooitgedacht Dam and Jericho Dam Nature Reserves) and in private reserves (Holkranse, Kransbank, Morgenstond). Some 44% transformed primarily by cultivation, plantations, mines, urbanisation and by building of dams. Cultivation may have had a more extensive impact, indicated by land-cover data. No serious alien invasions are reported, but *Acacia mearnsii* can become dominant in disturbed sites. Erosion is very low.

References Acocks (1953, 1988), Turner (1989), Coetzee (1993), Coetzee et al. (1994, 1995), Smit et al. (1997).

A. Lindström

Figure 8.48 Gm 13 Amersfoort Highveld Clay Grassland: Short grasslands with *Themeda triandra* and various *Helichrysum* species in the area between Volksrust and Ermelo (Mpumalanga).

Gm 13 Amersfoort Highveld Clay Grassland

VT 54 *Themeda* Veld to Highland Sourveld Transition (43%), VT 57 North-Eastern Sandy Highveld (29%) (Acocks 1953). LR 41 Wet Cold Highveld Grassland (30%), LR 38 Moist Sandy Highveld Grassland (29%) (Low & Rebelo 1996).

Distribution Mpumalanga and KwaZulu-Natal Provinces: This unit extends in a north-south band from just south of Ermelo, down through Amersfoort to the Memel area in south. Altitude 1 580–1 860 m.

Vegetation & Landscape Features Comprised of undulating grassland plains, with small scattered patches of dolerite outcrops in areas. The vegetation is comprised of a short closed grassland cover, largely dominated by a dense *Themeda triandra* sward, often severely grazed to form a short lawn.

Geology & Soils Restricted to vertic clay soils derived from dolerite that is intrusive in the Karoo sediments of the Madzaringwe Formation in the north and the Volksrust Formation and the Adelaide Subgroup in the south. Dominant land type Ca, while Ea land type is of subordinate importance.

Climate Rainfall mainly in early summer, from 620 mm in the west to 830 mm in the east (MAP 694 mm). MAT 14ºC, with temperatures higher in the west than the east. Winters are cold and summers are mild. Incidence of frost very high. Also see climate diagram for Gm 13 Amersfoort Highveld Clay Grassland (Figure 8.36).

Important Taxa Graminoids: *Andropogon appendiculatus* (d), *Brachiaria serrata* (d), *Digitaria monodactyla* (d), *D. tricholaenoides* (d), *Elionurus muticus* (d), *Eragrostis capensis* (d), *E. chloromelas* (d), *E. plana* (d), *E. racemosa* (d), *Harpochloa falx* (d), *Heteropogon contortus* (d), *Microchloa caffra* (d), *Panicum natalense* (d), *Setaria nigrirostris* (d), *S. sphacelata* (d), *Themeda triandra* (d), *Trichoneura grandiglumis* (d), *Tristachya leucothrix* (d), *Abildgaardia ovata*, *Andropogon schirensis*, *Aristida bipartita*, *A. congesta*, *A. junciformis* subsp. *galpinii*, *A. stipitata* subsp. *graciliflora*, *Bulbostylis contexta*, *Chloris virgata*, *Cymbopogon caesius*, *C. pospischilii*, *Cynodon dactylon*, *Digitaria diagonalis*, *D. ternata*, *Diheteropogon amplectens*, *Eragrostis curvula*, *Koeleria capensis*, *Panicum coloratum*, *Setaria incrassata*. Herbs: *Berkheya setifera* (d), *Vernonia natalensis*, *V. oligocephala* (d), *Acalypha peduncularis*, *A. wilmsii*, *Berkheya insignis*, *B. pinnatifida*, *Crabbea acaulis*, *Cynoglossum hispidum*, *Dicoma anomala*, *Haplocarpha scaposa*, *Helichrysum caespititium*, *H. rugulosum*, *Hermannia coccocarpa*, *H. depressa*, *H. transvaalensis*, *Ipomoea crassipes*, *I. oblongata*, *Jamesbrittenia silenoides*, *Pelargonium luridum*, *Pentanisia prunelloides* subsp. *latifolia*, *Peucedanum magalismontanum*, *Pseudognaphalium luteo-album*, *Rhynchosia effusa*, *Salvia repens*, *Schistostephium crataegifolium*, *Sonchus nanus*, *Wahlenbergia undulata*. Herbaceous Climber: *Rhynchosia totta*. Geophytic Herbs: *Boophone disticha*, *Eucomis autumnalis* subsp. *clavata*, *Hypoxis villosa* var. *obliqua*, *Zantedeschia albomaculata* subsp. *macrocarpa*. Tall Shrubs: *Diospyros austro-africana*, *D. lycioides* subsp. *guerkei*. Low Shrubs: *Anthospermum rigidum* subsp. *pumilum* (d), *Helichrysum melanacme* (d), *Chaetacanthus costatus*, *Euphorbia striata* var. *cuspidata*, *Gnidia burchellii*, *G. capitata*, *Polygala uncinata*, *Rhus discolor*. Succulent Shrub: *Euphorbia clavarioides* var. *truncata*.

Conservation Vulnerable. The conservation target is 27% but none is protected. Some 25% of unit is transformed, predominantly by cultivation (22%). The area is not suited to afforestation. Silver and black wattle (*Acacia* species), and *Salix babylonica* invade drainage areas. Erosion potential is very low (57%) and low (40%).

Remarks Overgrazing leads to invasion of *Stoebe vulgaris* (aptly named bankrupt bush). Parts of this unit were once cultivated and now lie fallow and have been left to re-vegetate with pioneer species. These transformed areas are not picked up by satellite for transformation coverage and the percentage of grasslands still in a natural state may be underestimated.

References Acocks (1953, 1988), Breytenbach (1991), Smit (1992), Breytenbach et al. (1993), Smit et al. (1995a, c).

Gm 14 Wakkerstroom Montane Grassland

VT 57 North-Eastern Sandy Highveld (57%) (Acocks 1953). LR 38 Moist Sandy Highveld Grassland (49%), LR 41 Wet Cold Highveld Grassland (27%) (Low & Rebelo 1996).

Distribution KwaZulu-Natal and Mpumalanga Provinces: Occurring from the Escarpment just north of Sheepmoor (north), to southeast of Utrecht, and then from the vicinity of Volksrust in the west to Mandhlangampisi Mountain near Luneburg in the east. Altitude 1 440–2 200 m.

Vegetation & Landscape Features This unit is a less obvious continuation of the Escarpment that links the southern and northern Drakensberg escarpments. It straddles this divide and is comprised of low mountains and undulating plains. The vegetation comprises predominantly short montane grasslands on the plateaus and the relatively flat areas, with short forest and *Leucosidea* thickets occurring along steep, mainly east-facing slopes and drainage areas. *L. sericea* is the dominant woody pioneer species that invades areas as a result of grazing mismanagement.

Geology & Soils The mudstones, sandstones and shale of the Madzaringwe and Volksrust Formations (Karoo Supergroup) were intruded by voluminous Jurassic dolerite dykes and sills. Ac land type dominant, while Fa and Ca are of subordinate importance.

Climate Rainfall peaks in midsummer. Rainfall 800–1 250 mm per year (MAP 902 mm). This unit experiences an orographic effect which results in a locally higher precipitation than the adjacent areas. Winters very cold and summers mild (MAT 14°C). See also climate diagram for Gm 14 Wakkerstroom Montane Grassland (Figure 8.36).

Important Taxa Small Trees: *Canthium ciliatum*, *Protea subvestita*. Tall Shrubs: *Buddleja salviifolia* (d), *Leucosidea sericea* (d), *Buddleja auriculata*, *Diospyros lycioides* subsp. *guerkei*, *Euclea crispa* subsp. *crispa*, *Rhus montana*, *R. rehmanniana*, *R. transvaalensis*. Low Shrubs: *Asparagus devenishii* (d), *Cliffortia linearifolia* (d), *Helichrysum melanacme* (d), *H. splendidum* (d), *Anthospermum rigidum* subsp. *pumilum*, *Clutia natalensis*, *Erica oatesii*, *Felicia filifolia* subsp. *filifolia*, *Gymnosporia heterophylla*, *Helichrysum hypoleucum*, *Hermannia geniculata*, *Inulanthera dregeana*, *Metalasia densa*, *Printzia pyrifolia*, *Rhus discolor*, *Rubus ludwigii* subsp. *ludwigii*. Graminoids: *Andropogon schirensis* (d), *Ctenium concinnum* (d), *Cymbopogon caesius* (d), *Digitaria tricholaenoides* (d), *Diheteropogon amplectens* (d), *Eragrostis chloromelas* (d), *E. plana* (d), *E. racemosa* (d), *Harpochloa falx* (d), *Heteropogon contortus* (d), *Hyparrhenia hirta* (d), *Microchloa caffra* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Aristida junciformis* subsp. *galpinii*, *Brachiaria serrata*, *Diheteropogon filifolius*, *Elionurus muticus*, *Eragrostis capensis*, *Eulalia villosa*, *Festuca scabra*, *Loudetia simplex*, *Rendlia altera*, *Setaria nigrirostris*. Herbs: *Berkheya onopordifolia* var. *glabra* (d), *Cephalaria natalensis* (d), *Pelargonium luridum* (d), *Acalypha depressinerva*, *A. peduncularis*, *A. wilmsii*, *Aster bakerianus*, *Berkheya setifera*, *Euryops transvaalensis* subsp. *setilobus*, *Galium thunbergianum* var. *thunbergianum*, *Geranium ornithopodioides*, *Helichrysum cephaloideum*, *H. cooperi*, *H. monticola*, *H. nudifolium* var. *nudifolium*, *H. oreophilum*, *H. simillimum*, *Pentanisia prunelloides* subsp. *latifolia*, *Plectranthus laxiflorus*, *Sebaea leiostyla*, *S. sedoides* var. *sedoides*, *Selago densiflora*, *Vernonia hirsuta*, *V. natalensis*, *Wahlenbergia cuspidata*. Geophytic Herbs: *Hypoxis costata* (d), *Agapanthus inapertus* subsp. *intermedius*, *Asclepias aurea*, *Cheilanthes hirta*, *Corycium dracomontanum*, *C. nigrescens*, *Cyrtanthus tuckii* var. *transvaalensis*, *Disa versicolor*, *Eriospermum cooperi* var. *cooperi*, *Eucomis bicolor*, *Geum capense*, *Gladiolus ecklonii*, *G. sericeovillosus* subsp. *sericeovillosus*, *Hesperantha coccinea*, *Hypoxis rigidula* var. *pilosissima*, *Moraea brevistyla*, *Rhodohypoxis baurii* var. *confecta*. Semiparasitic Herb: *Striga bilabiata* subsp. *bilabiata*.

Biogeographically Important Taxa ([L]Low Escarpment endemic, [N]Northern sourveld endemic) Low Shrubs: *Bowkeria citrina*[L], *Lotononis amajubica*[L], *Protea parvula*[N]. Succulent Herb: *Aloe modesta*[N].

Endemic Taxa Herbs: *Helichrysum aureum* var. *argenteum*, *Selago longicalyx*. Geophytic Herbs: *Kniphofia* sp. nov. ('*laxiflora* Form C'), *Nerine platypetala*. Woody Climber: *Asparagus fractiflexus*.

Conservation Least threatened. Conservation target 27%, less than 1% is statutorily protected in the Paardeplaats Nature Reserve. There are 10 South African Natural Heritage Sites in this unit, although very little of it is formally protected. Land use pressures from agriculture are low (5% cultivated) probably owing to the colder climate and shallower soils. The area is also suited to afforestation, with more than 1% under *Acacia mearnsii* and *Eucalyptus* plantations. The black wattle (*Acacia mearnsii*) is an aggressive invader of riparian areas. Erosion very low (78%) and low (19%).

M.C. Lötter

Figure 8.49 Gm 14 Wakkerstroom Montane Grassland: Frost-tolerant grasslands of the Wakkerstroom area (Mpumalanga) with herbs *Senecio scitus* and *Helichrysum nudifolium* and dominated by the grass *Themeda triandra*.

Remarks This unit represents the northernmost distribution limit for many plant taxa that occur on the Drakensberg Escarpment (e.g. *Helichrysum hypoleucum* and *Protea subvestita*) to the south, as well as the southernmost limit for plants occurring on the Northern Escarpment (e.g. *Protea parvula*). It also contains many of its own endemics and is under investigation as a possible centre of endemism. The higher rainfall and more temperate climate on a somewhat raised escarpment have possibly been conducive to the evolution of local endemics. Unlike its adjacent units, the

Wakkerstroom Montane Grassland is largely devoid of *Pteridium aquilinum*.

References Acocks (1953, 1988), Codd (1968), Eckhardt et al. (1997).

Gm 15 Paulpietersburg Moist Grassland

VT 64 Northern Tall Grassveld (Transition between Piet Retief Sourveld and Southern Tall Grassveld) (60%) (Acocks 1953). LR 43 North-eastern Mountain Grassland (86%) (Low & Rebelo 1996). BRG 11 Moist Transitional Tall Grassveld (53%) (Camp 1999a).

Distribution KwaZulu-Natal and Mpumalanga Provinces: Broad surrounds of Piet Retief, Paulpietersburg and Vryheid, extending westwards to east of Wakkerstroom. Occurs in the uppermost catchments of the Phongolo River. Altitude 920–1 500 m.

A. Lindström

Figure 8.50 Gm 15 Paulpietersburg Moist Grassland: Short grassland along the old Piet Retief–Wakkerstroom road (northern KwaZulu-Natal) interrupted by drainage lines supporting shrublands with *Leucosidea sericea*.

Vegetation & Landscape Features Mainly undulating with moderately steep slopes, but valley basins are wide and flat and mountainous areas occur mostly along the northern and eastern boundary. Tall closed grassland rich in forbs and dominated by *Tristachya leucothrix*, *Themeda triandra* and *Hyparrhenia hirta*. Evergreen woody vegetation is characteristic on rocky outcrops.

Geology & Soils This area is underlain by Archaean granite and gneiss partly covered by Karoo Supergroup sediments (Madzaringwe Formation) and intruded by Karoo Dolerite Suite dykes and sills. Dominant soils on the sedimentary parent material are yellow apedal, well drained, with a depth of >800 mm and a clay content of >35%, representing the soil series: Hutton, Clovelly and Griffin. Shortlands soils are dominant on dolerite. Dominant land type Ac, with Fa and Ba of subordinate importance.

Climate Summer rainfall, with MAP 900 mm. Warm-temperate climate, MAT close to 17°C, with fairly frequent frosts. See also climate diagram for Gm 15 Paulpietersburg Moist Grassland (Figure 8.36).

Important Taxa Graminoids: *Alloteropsis semialata* subsp. *eckloniana* (d), *Andropogon schirensis* (d), *Brachiaria serrata* (d), *Ctenium concinnum* (d), *Cymbopogon caesius* (d), *Digitaria tricholaenoides* (d), *Eragrostis racemosa* (d), *Harpochloa falx* (d), *Heteropogon contortus* (d), *Hyparrhenia hirta* (d), *Loudetia simplex* (d), *Microchloa caffra* (d), *Monocymbium ceresiiforme* (d), *Rendlia altera* (d), *Setaria nigrirostris* (d), *Themeda triandra* (d), *Tristachya leucothrix* (d), *Andropogon appendiculatus*, *Cynodon hirsutus*, *Diheteropogon amplectens*, *D. filifolius*, *Elionurus muticus*, *Eragrostis chloromelas*, *E. curvula*, *E. plana*, *Festuca scabra*, *Melinis nerviglumis*, *Panicum ecklonii*, *P. natalense*, *Trachypogon spicatus*, *Urelytrum agropyroides*. Herbs: *Argyrolobium speciosum* (d), *Cissus diversilobata* (d), *Dicoma zeyheri* (d), *Eriosema kraussianum* (d), *Geranium wakkerstroomianum* (d), *Helichrysum nudifolium* var. *nudifolium* (d), *Ipomoea oblongata* (d), *Pelargonium luridum* (d), *Acalypha glandulifolia*, *A. peduncularis*, *Acanthospermum australe*, *Aster bakerianus*, *Becium filamentosum*, *Berkheya setifera*, *Dicoma anomala*, *Euryops laxus, E. transvaalensis* subsp. *setilobus*, *E. transvaalensis* subsp. *transvaalensis, Helichrysum rugulosum*, *H. simillimum*, *Indigofera hilaris* var. *hilaris*, *I. velutina*, *Kohautia amatymbica*, *Pearsonia grandifolia*, *Pentanisia prunelloides* subsp. *latifolia*, *Senecio bupleuroides*, *S. coronatus*, *S. inornatus*, *S. isatideus*, *S. latifolius*, *Sonchus nanus*, *Thunbergia atriplicifolia*, *Vernonia capensis*, *V. natalensis*, *Xerophyta retinervis*. Herbaceous Climber: *Rhynchosia totta*. Geophytic Herbs: *Chlorophytum haygarthii* (d), *Gladiolus aurantiacus* (d), *Agapanthus inapertus* subsp. *intermedius*, *Asclepias aurea*, *Cheilanthes hirta*, *Cyrtanthus tuckii* var. *transvaalensis*, *Hypoxis colchicifolia*, *H. costata*, *H. rigidula* var. *pilosissima*, *Moraea brevistyla*, *Pteridium aquilinum*, *Watsonia latifolia*, *Zantedeschia rehmannii*. Succulent Herbs: *Aloe ecklonis*, *A. maculata, Lopholaena segmentata*. Small Trees: *Canthium ciliatum* (d), *Dombeya rotundifolia*, *Vangueria infausta*. Succulent Tree: *Aloe marlothii* subsp. *marlothii*. Tall Shrubs: *Calpurnia sericea* (d), *Rhus rehmanniana* (d), *Diospyros lycioides* subsp. *guerkei*, *Euclea crispa* subsp. *crispa*. Low Shrubs: *Rhus discolor* (d), *Anthospermum rigidum* subsp. *pumilum*, *A. rigidum* subsp. *rigidum*, *Clutia monticola*, *Diospyros galpinii*, *Erica oatesii*, *E. woodii*, *Hermannia geniculata*, *Indigofera arrecta*, *Otholobium wilmsii*, *Polygala uncinata*, *Pseudarthria hookeri*, *Rubus rigidus*. Succulent Shrub: *Euphorbia pulvinata*.

Biogeographically Important Taxa (all Low Escarpment endemics) Succulent Herb: *Aloe modesta*. Low Shrubs: *Bowkeria citrina*, *Hemizygia macrophylla*, *Lotononis amajubica*.

Endemic Taxon Succulent Shrub: *Aloe reitzii* var. *vernalis*.

Conservation Vulnerable. Target 24%. Only very small portion statutorily conserved in Witbad, Vryheid Mountain, Paardeplaats and Phongola Bush Nature Reserves. Some private reserves protect small patches (Rooikraal, Mhlongamvula, Kombewaria). About one third already transformed by plantations or cultivated land. Heavy livestock grazing and altered fire regimes have greatly reduced the area of grasslands of high conservation value. Aliens such as species of *Acacia*, *Eucalyptus* and *Pinus* are of major concern in places. Erosion very low (80%) or low (13%).

References Acocks (1953, 1988), Eckhardt et al. (1996a, c), Eckhardt (1998), Camp (1999a).

Gm 16 KaNgwane Montane Grassland

VT 63 Piet Retief Sourveld (57%) (Acocks 1953). LR 43 North-eastern Mountain Grassland (98%) (Low & Rebelo 1996).

Distribution Mpumalanga and Swaziland, and marginally into northern KwaZulu-Natal: Occurs along the gentle slopes of the

J.C. Manning

Figure 8.51 Gm 16 KaNgwane Montane Grassland: Lush mesophilous grassland with rich post-fire display of herbs (*Gerbera viridifolia, Chascanum latifolium*) near Piet Retief (Mpumalanga).

Escarpment, from the Phongolo Valley in the south, northwards to the Usutu Valley and to the uppermost Lomati Valley near Carolina, including the western grassland areas of Swaziland. Altitude 880–1 740 m.

Vegetation & Landscape Features Largely comprised of undulating hills and plains that occur on the eastern edge of the Escarpment. This unit is transitional between the Highveld and Escarpment and contains elements of both. The vegetation structure is comprised of a short closed grassland layer with many forbs, and a few scattered shrubs on the rocky outcrops.

Geology & Soils Mostly on granite of the Mpuluzi Granite (Randian Erathem), Archaean gneiss giving rise to melanic soils, with intrusions of diabase. Land types Ac, Fa and Ba.

Climate Early summer rainfall, with MAP 910 mm, ranging between 800 and 1 250 mm. This unit has a wide range of frost frequency (3–20 days per year), with most frost days occurring in the western regions. See also climate diagram for Gm 16 KaNgwane Montane Grassland (Figure 8.36).

Important Taxa Graminoids: *Alloteropsis semialata* subsp. *eckloniana* (d), *Brachiaria serrata* (d), *Cyperus obtusiflorus* (d), *Diheteropogon amplectens* (d), *D. filifolius* (d), *Eragrostis racemosa* (d), *Heteropogon contortus* (d), *Hyparrhenia hirta* (d), *Loudetia simplex* (d), *Monocymbium ceresiiforme* (d), *Rendlia altera* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *Andropogon schirensis*, *Bewsia biflora*, *Bulbostylis burchellii*, *Ctenium concinnum*, *Cymbopogon caesius*, *Cyperus obtusiflorus* var. *obtusiflorus*, *Digitaria diagonalis*, *D. tricholaenoides*, *Eragrostis chloromelas*, *E. plana*, *Eulalia villosa*, *Panicum ecklonii*, *P. natalense*, *Paspalum scrobiculatum*, *Schizachyrium sanguineum*, *Setaria nigrirostris*, *S. sphacelata*. Herbs: *Ipomoea oblongata* (d), *Acalypha peduncularis*, *A. villicaulis*, *Alepidea setifera*, *Argyrolobium speciosum*, *Aster harveyanus*, *Berkheya setifera*, *Corchorus confusus*, *Cyathula cylindrica*, *Dicoma zeyheri*, *Dimorphotheca jucunda*, *Eriosema cordatum*, *Euryops laxus, E. transvaalensis* subsp. *setilobus*, *Helichrysum adenocarpum*, *H. cephaloideum*, *H. nudifolium* var. *nudifolium*, *Mohria caffrorum*, *Pentanisia angustifolia*, *P. prunelloides* subsp. *latifolia*, *Ruellia patula*, *Schistostephium crataegifolium*, *Senecio panduriformis*, *Sonchus wilmsii*, *Thunbergia atriplicifolia*, *Vernonia natalensis*, *V. oligocephala*. Geophytic Herbs: *Agapanthus inapertus* subsp. *inapertus*, *Boophone disticha*, *Cheilanthes deltoidea*, *C. hirta*, *Eucomis montana*, *Gladiolus ecklonii*, *Habenaria dregeana*, *Hypoxis iridifolia*, *H. rigidula* var. *pilosissima*, *Moraea pubiflora*, *Pteridium aquilinum*, *Watsonia latifolia*, *Zantedeschia albomaculata* subsp. *macrocarpa*. Succulent Herbs: *Aloe integra*, *A. kniphofioides*. Small Trees: *Acacia caffra*, *Faurea rochetiana*, *Pachystigma macrocalyx*. Tree Fern: *Cyathea dregei*. Tall Shrubs: *Calpurnia glabrata*, *Cephalanthus natalensis*, *Diospyros lycioides* subsp. *guerkei*, *Vernonia tigna*. Low Shrubs: *Heteromorpha involucrata* (d), *Anthospermum rigidum* subsp. *rigidum*, *Asparagus cooperi*, *A. virgatus*, *Athrixia phylicoides*, *Diospyros scabrida* var. *cordata*, *Gymnosporia heterophylla*, *Indigofera comosa*, *Myrsine africana*, *Rhus discolor*, *Schistostephium rotundifolium*.

Biogeographically Important Taxa ([BC]Barberton endemic, [N]Northern sourveld endemic) Herbs: *Hemizygia modesta*[BC], *H. thorncroftii*[BC], *Selago stewartii*[BC]. Geophytic Herb: *Watsonia watsonioides*[N]. Succulent Herb: *Kleinia galpinii*[N]. Low Shrub: *Hemizygia albiflora*[N].

Endemic Taxa Herbs: *Lotononis difformis*, *L. spicata*, *Streptocarpus occultis*. Low Shrub: *Syncolostemon comptonii*.

Conservation Vulnerable. The conservation target 27% with only 0.4% protected within any formally proclaimed nature reserves (Malalotja, Nooitgedacht Dam and Songimvelo). A number of private conservation areas protect small patches of this unit. It is well suited for afforestation and 30% has already been converted to plantations of alien trees. A further 6% is under cultivation. Erosion potential very low (55%) and low (7%).

Remark This area occurs on the southern edge of the Barberton Centre of Endemism.

References Acocks (1953, 1988), De Frey (1999), Van Wyk & Smith (2001).

Gm 17 Barberton Montane Grassland

VT 9 Lowveld Sour Bushveld (41%), VT 8 North-Eastern Mountain Sourveld (34%) (Acocks 1953). LR 21 Sour Lowveld Bushveld (54%) (Low & Rebelo 1996).

Distribution Mpumalanga Province and northwestern Swaziland: From Barberton westwards towards Nelshoogte, northwards along the high-lying grassland areas towards Kaapmuiden and Malelane, and southeast towards Piggs Peak. It generally occurs at high altitudes in the Barberton region, ranging from 760 m in the north to 1 640 m in the southwest.

Vegetation & Landscape Features This unit occurs along the high mountains above Barberton, which rise above the surrounding Lowveld. The terrain is steep, rugged and accessibility is limited. The dominant vegetation is short rocky grassland and gradually becomes woodland along the lower slopes.

Geology & Soils Barberton Supergroup schists, gneiss, felspathic quartzites and various lavas of the Figtree, Moodies, and Onverwacht Formations. Land types Fa (60%) and Ac (20%).

Climate Early summer rainfall, concentrated between November and March. MAP varies between 950 mm in the

west, to 1 470 mm in the east (overall MAP 1 194 mm). Frosts are very infrequent during winter (3 days per year) and increase towards the west (10 days). Hot dry winds occur from August to October. See also climate diagram for Gm 17 Barberton Montane Grassland (Figure 8.36).

Important Taxa Small Trees: *Faurea galpinii*, *F. rochetiana*, *F. saligna*, *Rapanea melanophloeos*. Tree Fern: *Cyathea dregei*. Tall Shrubs: *Cephalanthus natalensis* (d), *Euryops brevipapposus, Gerrardina foliosa*, *Protea gaguedi*. Low Shrubs: *Phymaspermum athanasioides* (d), *Clutia pulchella*, *Erica cerinthoides*, *E. drakensbergensis*, *E. woodii*, *Helichrysum odoratissimum*, *Heteromorpha involucrata*, *Leucospermum gerrardii*, *Protea simplex*, *Psoralea glabra, Schistostephium rotundifolium, Siphonoglossa linifolia*. Succulent Shrub: *Aloe vryheidensis*. Graminoids: *Alloteropsis semialata* subsp. *ecklo-niana* (d), *Andropogon schirensis* (d), *Ctenium concinnum* (d), *Eragrostis racemosa* (d), *Eulalia villosa* (d), *Loudetia simplex* (d), *Monocymbium ceresiiforme* (d), *Rendlia altera* (d), *Themeda triandra* (d), *Brachiaria serrata*, *Brachypodium flexum*, *Digitaria monodactyla*, *Diheteropogon amplectens*, *Hyparrhenia hirta*, *Ischyrolepis schoenoides*, *Melinis nerviglumis*, *Panicum ecklonii*, *P. natalense*, *Pentaschistis natalensis*, *Setaria nigrirostris*, *Trachypogon spicatus*, *Tristachya leucothrix*. Herbs: *Acalypha caperonioides*, *A. glandulifolia*, *Euryops laxus, Helichrysum adenocarpum*, *H. nudifolium* var. *oxyphyllum*, *H. pallidum*, *Selago procera*, *Xerophyta retinervis*. Geophytic Herbs: *Agapanthus inapertus* subsp. *intermedius*, *Cheilanthes hirta*, *Eucomis montana*, *Haemanthus montanus*, *Ledebouria sandersonii*, *Merwilla natalensis*, *Satyrium cristatum*.

Biogeographically Important Taxa ([BC]Barberton endemic, [N]Northern sourveld endemic, [P]Pondoland link) Small Trees: *Encephalartos paucidentatus*[N], *Faurea galpinii*[N], *Protea comptonii*[N]. Tall Shrub: *Tricalysia capensis* var. *galpinii*[N]. Low Shrubs: *Asparagus rigidus*[N], *Helichrysum milleri*[N], *H. mimetes*[N], *H. reflexum*[N], *Hemizygia parvifolia*[N], *Heteromorpha pubescens*[N], *Kotschya parvifolia*[N], *Melhania randii*[N], *Protea parvula*[N], *Syncolostemon eriocephalus*[N]. Succulent Shrubs: *Aloe chortolirioides* var. *chortolirioides*[N], *A. suprafoliata*[N]. Herbs: *Senecio rhyncholaenus*[P] (d), *Hemizygia foliosa*[N], *H. modesta*[BC], *H. thorncrofti*[BC], *H. transvaalensis*[N], *Inezia integrifolia*[N], *Monsonia transvaalensis*[N], *Pearsonia aristata*[N], *Phymaspermum argenteum*[N], *Selago stewartii*[BC], *S. villosa*[N], *Streptocarpus galpinii*[N], *Thorncroftia longiflora*[N]. Geophytic Herbs: *Agapanthus inapertus* subsp. *hollandii*[N], *Aspidonepsis shebae*[N], *Cyrtanthus thorncroftii*[N], *Gladiolus varius*[N], *Watsonia occulta*[N], *W. watsonioides*[N]. Succulent Herbs: *Aloe craibii*, *Kleinia galpinii*[N].

Endemic Taxa Small Trees: *Encephalartos heenanii*, *Protea caffra* subsp. *falcata*, *P. roupelliae* subsp. *hamiltonii*. Tall Shrub: *Tinnea barbata*. Herbs: *Euryops discoideus, Helichrysum calocephalum*, *Hemizygia stalmansii*, *Holothrix culveri*, *Streptocarpus pogonites*, *Thorncroftia thorncroftii*. Geophytic Herb: *Disa intermedia*. Succulent Herb: *Aloe albida*.

Conservation Vulnerable. The conservation target of 27% has almost been reached as 26% of this unit is protected within nature reserves (Songimvelo Game Reserve and Mountainlands Nature Reserve). Almost 40% has been transformed by plantations. Erosion potential very low (75%) and low (9%).

Remarks This vegetation unit occurs within the Barberton Centre of Plant Endemism and the endemics are predominantly comprised of herbaceous plants on a dystrophic substrate. Pockets of forests occur in fire-protected areas.

References Acocks (1953, 1988), Stalmans et al. (1999), Van Wyk & Smith (2001).

Gm 18 Lydenburg Montane Grassland

VT 57 North-Eastern Sandy Highveld (53%) (Acocks 1953). LR 43 North-eastern Mountain Grassland (73%) (Low & Rebelo 1996).

Distribution Mpumalanga Province: From just above Pilgrim's Rest in the north, southwards and westwards skirting Lydenburg, extending to Dullstroom, to Belfast and Waterval Boven in the south. It includes both the Steenkampsberg and Mauchsberg. Altitude 1 260–2 160 m.

Vegetation & Landscape Features High-altitude plateaus, undulating plains, mountain peaks and slopes, hills and deep valleys of the Northern Escarpment region, supporting predominantly very low grasslands on the high-lying areas. Height of the grass sward increases on the lower slopes. The grassland is very rich in forb species.

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Figure 8.52 Gm 17 Barberton Montane Grassland: A mosaic of short grassland and rocky shrubland with *Burchellia bubalina, Helichrysum reflexum, Psychotria capensis* and *Aloe albida* on the Saddleback Mountain, southeast of Barberton (Mpumalanga).

Geology & Soils The soils are mostly derived from shale and quartzite as well as lavas and dolomites of the Pretoria Group of the Transvaal Supergroup (Vaalian Erathem). Land types Ac and Fa cover areas of approximately equal size.

Climate Orographic precipitation and mists throughout most months of the year support a unique flora, including rich mesophytic plants such as the Orchidaceae. MAP 858 mm (660–1 180 mm), augmented by the frequent mists. Frost days 21 days per year, varying greatly between 3 and 40, generally more frost to the west. See also climate diagram for Gm 18 Lydenburg Montane Grassland (Figure 8.36).

Important Taxa Small Trees: *Protea roupelliae* subsp. *roupelliae* (d), *Faurea*

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Figure 8.53 Gm 18 Lydenburg Montane Grassland: Short rocky mistbelt grassland with *Rhus tumulicola*, *Vernonia hirsuta* and species of *Berkheya* and *Helichrysum* at Kemps Heights, 17 km southeast of Lydenburg (Mpumalanga).

galpinii. Low Shrubs: *Phymaspermum acerosum* (d), *Anthospermum rigidum* subsp. *rigidum*, *Cliffortia repens*, *Erica cerinthoides*, *E. woodii*, *Felicia filifolia* subsp. *filifolia*, *Gnidia caffra*, *Helichrysum odoratissimum*, *H. swynnertonii*, *Heteromorpha involucrata*, *Polygala uncinata*, *Tenrhynea phylicifolia*. Succulent Shrubs: *Lopholaena disticha* (d), *Delosperma lydenburgense*. Graminoids: *Andropogon schirensis* (d), *Aristida junciformis* subsp. *galpinii* (d), *Brachiaria serrata* (d), *Digitaria monodactyla* (d), *D. tricholaenoides* (d), *Diheteropogon filifolius* (d), *Harpochloa falx* (d), *Heteropogon contortus* (d), *Hyparrhenia hirta* (d), *Loudetia simplex* (d), *Monocymbium ceresiiforme* (d), *Setaria nigrirostris* (d), *Sporobolus centrifugus* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Aristida sciurus*, *Bulbostylis oritrephes*, *Ctenium concinnum*, *Cymbopogon caesius*, *Diheteropogon amplectens*, *Elionurus muticus*, *Eragrostis capensis*, *E. chloromelas*, *E. curvula*, *E. gummiflua*, *E. plana*, *E. racemosa*, *E. scleranthe*, *Eulalia villosa*, *Ischyrolepis schoenoides*, *Koeleria capensis*, *Microchloa caffra*, *Panicum ecklonii*, *P. natalense*, *Pentaschistis natalensis*, *Rendlia altera*, *Schizachyrium sanguineum*, *Sporobolus pectinatus*, *Tristachya rehmannii*. Herbs: *Senecio gerrardii* (d), *Acalypha angustata*, *A. depressinerva*, *Alepidea longifolia*, *Dicoma anomala*, *Dimorphotheca jucunda*, *D. spectabilis*, *Eriosema kraussianum*, *Gerbera ambigua*, *Haplocarpha scaposa*, *Helichrysum caespititium*, *H. chionosphaerum*, *H. nudifolium H. rugulosum*, *H. spiralepis*, *H. subglomeratum*, *H. umbraculigerum*, *Monopsis decipiens*, *Myosotis afropalustris*, *Pelargonium luridum*, *Pentanisia prunelloides* subsp. *latifolia*, *Polygala amatymbica*, *Psammotropha myriantha*, *Rhynchosia monophylla*, *Schistostephium crataegifolium*, *Sebaea erosa*, *S. sedoides* var. *confertiflora*, *Selago procera*, *Senecio laevigatus*, *Vernonia hirsuta, V. natalensis*, *V. oligocephala*, *Wahlenbergia undulata*, *Zornia capensis*. Herbaceous Climber: *Rhynchosia totta*. Geophytic Herbs: *Gladiolus longicollis* subsp. *platypetalus* (d), *Agapanthus inapertus* subsp. *inapertus*, *A. inapertus* subsp. *intermedius*, *Chlorophytum haygarthii*, *Corycium dracomontanum*, *C. nigrescens*, *Disa fragrans* subsp. *fragrans*, *D. versicolor*, *Disperis renibractea*, *Gladiolus ecklonii*, *Habenaria dives*, *H. dregeana*, *H. lithophila*, *Haemanthus humilis* subsp. *hirsutus*, *Holothrix scopularia*, *Hypoxis costata*, *H. galpinii*, *H. rigidula* var. *pilosissima*, *Merwilla natalensis*, *Pachycarpus transvaalensis*, *Raphionacme galpinii*, *Satyrium longicauda*, *Zantedeschia albomaculata* subsp. *macrocarpa*. Succulent Herbs: *Aloe dyeri*, *A. graciliflora, A. longibracteata*, *Crassula vaginata*.

Biogeographically Important Taxa (all Northern sourveld endemics) Herbs: *Graderia linearifolia*, *Helichrysum truncatum*, *Hemizygia foliosa*, *Inezia integrifolia*, *Monsonia transvaalensis*, *Selago compacta*, *S. villosa*, *Streptocarpus galpinii*, *Tetraselago wilmsii*. Geophytic Herbs: *Agapanthus inapertus* subsp. *hollandii*, *A. inapertus* subsp. *parviflorus*, *A. inapertus* subsp. *pendulus*, *Gladiolus calcaratus*, *G. exiguus*, *Watsonia occulta*. Succulent Herb: *Aloe affinis*. Low Shrubs: *Helichrysum albilanatum*, *H. mariepscopicum*, *H. milleri*, *H. reflexum*, *H. rudolfii*, *Hemizygia albiflora*, *H. subvelutina*, *Sutera polelensis* subsp. *fraterna*.

Endemic Taxa Low Shrubs: *Erica atherstonei*, *E. holtii*, *Helichrysum lesliei*, *H. summo-montanum*. Succulent Shrub: *Khadia alticola*. Herbs: *Crotalaria monophylla*, *Cymbopappus piliferus*, *Knowltonia transvaalensis* var. *pottiana*, *Pearsonia hirsuta*, *Streptocarpus cyaneus* subsp. *longi-tommii*, *S. hilburtianus*. Geophytic Herbs: *Disa alticola*, *D. amoena*, *D. clavicornis*, *Eucomis vandermerwei*, *Gladiolus cataractarum*, *G. exiguus*, *G. malvinus*, *Kniphofia rigidifolia*, *Riocreuxia aberrans*, *Schizochilus cecilii* subsp. *transvaalensis, S. lilacinus, Watsonia occulta, W. wilmsii*. Succulent Herb: *Crassula setulosa* var. *deminuta*.

Conservation Vulnerable. The conservation target is 27%, with 2.4% formally protected within reserves (Gustav Klingbiel, Makobulaan, Mt Anderson, Ohrigstad Dam, Sterkspruit and Verlorenvlei) as well as in a number of private conservation areas (Buffelskoof, Crane Creek, ETTC, In-de-Diepte, Kaalboom, Kalmoesfontein, Mbesan, Mondi Indigenous Forest, Mt Sheba, Waterval etc.). The level of transformation is relatively high at 23%, with mostly alien plantations (20%) and cultivated lands (2%). Erosion potential very low (74%) and low (12%).

Remark 1 This unit has an afromontane flora with links to the Zimbabwean highlands in the north (e.g. *Morella microbracteata*, *Selago procera*, *Helichrysum swynnertonii*) and the southern Drakensberg in the south (e.g. *Polypodium vulgare*, *Helichrysum spodiophyllum*, *Selago compacta*, *Holothrix scopularia*). It has also been proposed as a centre of plant endemism. Over 2 266 plant taxa have been identified in an area roughly corresponding to that of the Lydenburg Montane Grassland, with a list of 51 endemics. The recognition of two subcentres was also proposed, namely the Long Tom Pass and the Steenkampsberg Subcentres. The flora varies between these two areas, with the Long Tom Pass region having several elements linking it to escarpment flora of the north, while the Steenkampsberg has several elements linking it to the flora in the south, as in Wakkerstroom and southern Drakensberg. Elements linking the Long Tom Pass to the north (Wolkberg and northwards) include *Helichrysum rudolfii*, *H. mariepscopicum*, *Dierama adelphicum*, *Schizochilus cecilii* subsp. *transvaalensis* and *Kniphofia splendida*. The elements linking the Steenkampsberg to the south include *Aloe modesta*, *Helichrysum subglomeratum*, *Brunsvigia natalensis*, *Habenaria tysonii* and *Disperis oxyglossa*. Furthermore, in the Long Tom Pass area, *Psoralea latifolia* and *Lopholaena disticha* are replaced by *Otholobium wilmsii* and *L. segmentata*.

Remark 2 Small forests and shrub-like thickets are common along drainage lines, faults, and narrow diabase dykes (which are common in this unit).

References Acocks (1953, 1988), Deall (1985), Bloem (1988), Deall et al. (1989), Bloem et al. (1993), Burgoyne (1995), Emery et al. (2002).

Gm 19 Sekhukhune Montane Grassland

VT 61 Bankenveld (49%), VT 57 North-Eastern Sandy Highveld (40%) (Acocks 1953). LR 18 Mixed Bushveld (59%) (Low & Rebelo 1996).

Distribution Mpumalanga Province: continuous undulating norite hills in the Roossenekal region, from Stoffberg in the south, northwards through Mapochs Gronde to Schurinksberg in the north, with the Steelpoort River in the west. Altitude 1 300–1 960 m.

Vegetation & Landscape Features Major chains of hills transect the area and have a north-south orientation, creating moderately steep slopes with predominantly eastern and western aspects. Large norite boulders and stones cover the shallow soils on the hillsides. Dense, sour grassland occur on slopes of mountains and undulating hills, with scattered clumps of trees and shrubs in sheltered habitats. Turf and clay soils characterise the open plains between the chains of hills and culminate in a open plain in the Stoffberg area. Dense, tall grassland is found on the plains and encroachment by indigenous or invasion by alien microphyllous tree species is common in places.

Geology & Soils The area mostly overlies the mafic intrusive rocks of the Upper and Main Zones of the Rustenburg Layered Suite, which is economically the most important part of the Bushveld Igneous Complex (Vaalian Erathem). The west of this area is dominated by diorite and gabbro (often magnetite-rich) of the Roossenekal Subsuite, whereas the east is dominated by gabbro and norite of the Dsjate Subsuite. In the extreme north-east of the area are metasediments of the Pretoria Group (also Vaalian Erathem) that were metamorphosed by the intrusion of the Bushveld Igneous Complex. Substrates of the undulating hills are generally heterogeneous rocky areas with miscellaneous soil types and those of the southern plains have diagnostic horizons that are vertic, melanic or red-structured. Dominant soil forms have a high clay content and include Arcadia, Mayo, Milkwood, Mispah, Shortlands and Steendal. Ea land type covers 40% of the area, with minor occurrences of Ib and Ab.

Climate This unit experiences a similar climate to the adjacent Lydenburg Montane Grassland, although frost incidence decreases towards the north. Summer-rainfall regime with the MAP from about 720 mm in the east to 600 mm in the west, much of the rain falling in the form of thunderstorms in summer from November to January. Mean daily temperature ranges from a minimum of 2.8°C in winter to a maximum of 24.9°C in summer. Daily temperatures vary considerably at different localities, with higher temperatures on the plains and lower temperatures on higher-lying plateaus. See also climate diagram for Gm 19 Sekhukhune Montane Grassland (Figure 8.36).

Important Taxa Small Trees: *Protea caffra* subsp. *caffra* (d), *Acacia caffra*, *Apodytes dimidiata* subsp. *dimidiata*, *Canthium suberosum*, *Cussonia transvaalensis*, *Seemannaralia gerrardii*. Woody Climbers: *Rhoicissus tridentata* (d), *Jasminum quinatum*, *Triaspis glaucophylla*. Tall Shrubs: *Euclea crispa* subsp. *crispa* (d), *Brachylaena ilicifolia*, *Diospyros austro-africana*, *Euclea linearis*, *Pavetta zeyheri*. Low Shrubs: *Gnidia caffra* (d), *Senecio microglossus* (d), *Dyschoriste rogersii*, *Elephantorrhiza praetermissa*, *Leonotis leonurus, Polygala uncinata*, *Rhus discolor*, *R. tumulicola* var. *meeuseana*, *R. wilmsii*. Geoxylic Suffrutex: *Elephantorrhiza elephantina*. Graminoids: *Aristida junciformis* subsp. *galpinii* (d), *Diheteropogon amplectens* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. racemosa* (d), *Heteropogon contortus* (d), *Microchloa caffra* (d), *Monocymbium ceresiiforme* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tristachya leucothrix* (d), *Andropogon schirensis*, *Aristida aequiglumis*, *Brachiaria serrata*, *Cymbopogon caesius*, *Digitaria diagonalis*, *D. monodactyla*, *Ehrharta capensis*, *Eragrostis capensis*, *E. nindensis*, *E. plana*, *Hyparrhenia hirta*, *Loudetia simplex*, *Panicum natalense*, *Setaria nigrirostris*, *Trachypogon spicatus*, *Triraphis andropogonoides*. Herbs: *Acalypha punctata* (d), *Berkheya setifera* (d), *Rotheca hirsuta* (d), *Senecio latifolius* (d), *Tephrosia purpurea* subsp. *leptostachya* (d), *Berkheya insignis*, *Gerbera jamesonii*, *Helichrysum nudifolium* var. *nudifolium*, *Ipomoea crassipes*, *Jamesbrittenia silenoides*, *Macledium zeyheri* subsp. *argyrophylum*, *Pegolettia lanceolata*, *Pentanisia prunelloides* subsp. *prunelloides*, *Senecio coronatus*, *Vernonia galpinii*, *V. natalensis*, *V. oligocephala*, *Xerophyta retinervis*. Geophytic Herbs: *Hypoxis rigidula* var. *pilosissima* (d), *Cheilanthes hirta*, *Eucomis montana*, *Hypoxis hemerocallidea*, *Pachycarpus transvaalensis*. Succulent Herb: *Kleinia stapeliiformis*.

Biogeographically Important Taxa ([N]Northern sourveld endemic, [SK]Sekhukhune endemic) Small Trees: *Euclea sekhukhuniensis*[SK], *Lydenburgia cassinoides*[SK], *Rhus sekhukhuniensis*[SK]. Woody Climber: *Rhoicissus sekhukhuniensis*[SK]. Tall Shrub: *Vitex obovata* subsp. *wilmsii*[N]. Low Shrubs: *Dyschoriste perrottetii*[SK], *Grewia vernicosa*[N], *Helichrysum uninervium*[N], *Jamesbrittenia macrantha*[SK], *Melhania randii*[N]. Succulent Shrub: *Aloe castanea*[N], Herbs: *Berkheya densifolia*[N], *Cyanotis pachyrrhiza*[N], *Graderia linearifolia*[N], *Ipomoea bathycolpos* var. *sinuatodentata*[SK], *Rhynchosia rudolfii*[N], *Tetraselago wilmsii*[N]. Geophytic Herbs: *Gladiolus sekukuniensis*[SK], *Zantedeschia pentlandii*[SK]. Succulent Herb: *Huernia insigniflora*[N].

Endemic Taxa Succulent Shrubs: *Aloe reitzii* var. *reitzii*, *Delosperma deilanthoides*. Geophytic Herbs: *Resnova* sp. nov. ('*megaphylla*'), *Zantedeschia pentlandii*.

Conservation Vulnerable. Conservation target 24%. Approximately 30% of this area is under commercial or subsistence cultivation. Vast areas are mined for vanadium using strip mining, and in recent years mining of gabbro has increased substantially (Siebert et al. 2002c). There is no formal conservation in the region, although many farmers have embarked on ecotourism initiatives. Erosion very low (56%), moderate (18%) and high (16%).

Remarks This vegetation comprises the Roossenekal Subcentre of the Sekhukhuneland CE (Van Wyk & Smith 2001) with numerous endemic plant species, many of which are not yet described. The Roossenekal area comprises heterogeneous rocky habitats (Siebert et al. 2003) and numerous floristic links with other grassland areas have been identified. In terms of floristic diversity, species richness and vegetation structure, this vegetation is related to Gm 11 Rand Highveld Grassland, Gm 18 Lydenburg Montane Grassland and Gm 17 Barberton Montane Grassland (Siebert et al. 2002b, Bredenkamp & Brown 2003). A floristic link exists with other mesic mountainous areas in South Africa (Mpumalanga and KwaZulu-Natal) and Swaziland and is supported by the following species: *Dyschoriste rogersii*, *Eucomis montana*, *Jamesbrittenia silenoides*, *Pachycarpus transvaalensis*, *Pegolettia lanceolata*, *Seemannaralia gerrardii* and *Thesium multiramulosum*. Floristic links also exist with the Northern Cape, namely *Amphiglossa triflora* and *Nuxia gracilis*, and the Eastern Cape, namely *Brachylaena ilicifolia* and *Maytenus albata*. Species such as *Euclea linearis* and *Melhania randii* are shared with the Great Dyke in Zimbabwe that is located on similar ultramafic rock (Siebert et al. 2001).

References Acocks (1953, 1988), Siebert (2001), Siebert et al. (2001, 2002a, b, c, 2003), Van Wyk & Smith (2001), Bredenkamp & Brown (2003).

Gm 20 Leolo Summit Sourveld

VT 57 North-Eastern Sandy Highveld (88%) (Acocks 1953). LR 18 Mixed Bushveld (100%) (Low & Rebelo 1996).

Distribution Limpopo Province: Discontinuous summits on the Leolo Mountain range, which forms an extension to the norite massif of the Dwars River Mountains further south. Sekhukhune is the major town in the vicinity and lies on the western foot slopes of the mountain. The unit is restricted to altitudes of 1 700–1 920 m.

Vegetation & Landscape Features Summit plateaus on a major mountain range with steep slopes. Large norite boulders and stones cover the shallow soils on the hillsides and plateau. Dense, sour grassland occurs on the high-altitude upper slopes and summit of the mountain; scattered clumps of trees and shrubs occur in sheltered, rocky habitats on the plateau.

Geology & Soils Underlain by the banded gabbros, norites and anorthosites of the Dsjate Subsuite of the Rustenburg Layered Suite (part of the Vaalian Bushveld Igneous Complex). The Dsjate Subsuite forms part of the Main Zone of the Rustenburg Layered Suite. Substrates of the undulating plateau are soils of especially the Mayo and Oakleaf forms in the flat areas, with miscellaneous rocky soil forms, such as Glenrosa and Mispah, occurring on the mountain slopes. Dominant soil forms have a high clay content. The almost exclusive land type is Fb.

Climate This area experiences a similar climate to the Gm 18 Lydenburg Montane Grassland. MAP 694 mm with about half of the rain falling as thunderstorms in summer from November to January. Mean daily temperatures on the summit are considerably lower than those of the surrounding Steelpoort River Valley. See also climate diagram for Gm 20 Leolo Summit Sourveld (Figure 8.36).

Important Taxa Small Trees: *Cussonia transvaalensis*, *Greyia radlkoferi*, *Maytenus albata*, *Protea caffra* subsp. *caffra*, *P. roupelliae* subsp. *roupelliae*. Tall Shrubs: *Euryops brevipappo-sus* (d), *Vernonia myriantha* (d), *Buddleja auriculata*, *B. saligna*, *Euclea crispa* subsp. *crispa*, *Leucosidea sericea*, *Pavetta zeyheri*. Low Shrubs: *Helichrysum splendidum* (d), *Clutia pulchella*, *Gnidia caffra*, *Polygala uncinata*, *P. virgata*, *Rhus discolor*, *Senecio microglossus*. Succulent Shrub: *Aloe arborescens*. Geoxylic Suffrutex: *Elephantorrhiza elephantina*. Graminoids: *Diheteropogon amplectens* (d), *Elionurus muticus* (d), *Eragrostis capensis* (d), *E. curvula* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tristachya leucothrix* (d), *Brachiaria serrata*, *Hyparrhenia hirta*, *Sporobolus centrifugus*. Herbs: *Hirpicium bechuanense* (d), *Pentanisia prunelloides* subsp. *prunelloides* (d), *Acalypha punctata*, *Anagallis huttonii*, *Berkheya insignis*, *Jamesbrittenia silenoides*, *Lotononis foliosa*, *Manulea parviflora*, *Pegolettia lanceolata*, *Rotheca hirsuta*, *Senecio latifolius*, *Xerophyta viscosa*. Geophytic Herb: *Hypoxis rigidula* var. *pilosissima*.

Biogeographically Important Taxa ([N]Northern sourveld endemic, [SK]Sekhukhune endemic, [Z]Link to Zimbabwe) Tall Shrub: *Vitex obovata* subsp. *wilmsii*[N]. Woody Climber: *Rhoicissus sekhukhuniensis*[SK]. Low Shrubs: *Asparagus sekukuniensis*[SK], *Grewia vernicosa*[N], *Helichrysum rudolfii*[N], *H. uninervium*[N], *Hibiscus barnardii*[SK], *Jamesbrittenia macrantha*[SK], *Melhania randii*[N], *Plectranthus venteri*[Z]. Herbs: *Berkheya densifolia*[N], *Cyanotis pachyrrhiza*[N], *Nemesia zimbabwensis*[Z]. Herbaceous Climber: *Cyphia transvaalensis*[N]. Geophytic Herbs: *Gladiolus sekukuniensis*[SK], *Zantedeschia jucunda*[SK]. Succulent Herb: *Aloe affinis*[N].

Conservation Vulnerable. Target 24%. Although sparsely populated, very little of the Grassland Biome on the Leolo Mountains has remained undisturbed due to extensive subsistence agriculture. Threatened by the mining of granite for dimension stone. Although the moist summit of the Leolo Mountains has important value as a water source to the surrounding arid valleys, it has never been regarded as a conservation priority. Erosion very high (48%) and moderate (45%).

Remark 1 This vegetation comprises the Leolo Subcentre of the Sekhukhuneland CE (Van Wyk & Smith 2001), with several taxa still pending description. Interesting biogeographical patterns have been documented for *Triaspis glaucophylla* (link to the Waterberg), *Limosella maior* (link to the Drakensberg) and *Nemesia zimbabwensis* (link to Mount Inyangani in Zimbabwe; Siebert & Van Wyk 2005).

Remark 2 Leolo Summit Sourveld is a high-altitude variant of Sekhukhune Montane Grassland, with the main difference being its much shorter vegetation structure and poorer floristic diversity (Siebert et al. 2002b). It also shares many species with the high-altitude areas of the Lydenburg Montane Grassland, as both are characterised by wetlands and vast seepage areas rich in organic matter.

References Acocks (1953, 1988), Siebert (2001), Van Wyk & Smith (2001), Siebert et al. (2002a, b, c, 2003), Siebert & Van Wyk (2005).

Gm 21 Lydenburg Thornveld

VT 19 Sourish Mixed Bushveld (28%), VT 8 North-Eastern Mountain Sourveld (22%) (Acocks 1953). LR 43 North-eastern Mountain Grassland (80%) (Low & Rebelo 1996).

M.C. Lötter

Figure 8.54 Gm 21 Lydenburg Thornveld: A late spring view of a thornveld in the Lydenburg surrounds, with *Acacia karroo, Rhus pyroides, Celtis africana, Senecio microglossus, Argyrolobium wilmsii* and *Aloe longibracteata*.

Distribution Mpumalanga Province: Situated in a broad band between the high-lying mountains from just north of Ohrigstad, tapering southwards through Lydenburg to as far south as the area in the vicinity of the Kwena Dam. Altitude 1 160 –1 660 m.

Vegetation & Landscape Features This unit occurs at lower levels at the foot of the mountains and on undulating plains. This is open, frost-hardy woodland. Structurally this unit comprises closed grassland which is almost always wooded, sometimes densely so in rocky areas and less so in frost-ridden valleys where *Acacia karroo* is still able to persist. Many woody plants have evolved a suffrutex habit (*Argyrolobium wilmsii*), where aerial parts die back to an underground rootstock during cold winters.

Geology & Soils Red clay soils mostly derived from shales of the Pretoria Group (including the Silverton and Timeball Hill Formations). Shales occasionally intersected with bands of quartzite or andesite. Land types Ba, Fa, Ib and Ae, with predominantly Mispah, Glenrosa or Hutton soil forms.

Climate This unit occurs in the rainshadow of the Escarpment, where the climate is much drier and the winters are very cold (MAT 16°C). The rainfall is generally lower than in surrounding areas since it falls within a rainshadow. Rainfall 580–810 mm (MAP 707 mm). Most of this unit experiences fairly infrequent frost. See climate diagram for Gm 21 Lydenburg Thornveld (Figure 8.36).

Important Taxa Small Trees: *Acacia robusta* subsp. *robusta* (d), *Cussonia transvaalensis* (d), *Acacia caffra*, *A. karroo*, *Combretum erythrophyllum*, *Cussonia paniculata*, *Dombeya rotundifolia*. Tall Shrubs: *Diospyros lycioides* subsp. *guerkei*, *Euclea crispa* subsp. *crispa*, *Ormocarpum kirkii*, *Rhamnus prinoides*, *Vernonia crataegifolia*. Woody Climbers: *Jasminum quinatum* (d), *Acacia ataxacantha*. Low Shrubs: *Rubus transvaaliensis* (d), *Senecio microglossus* (d), *Anthospermum rigidum* subsp. *pumilum*, *Lippia javanica*, *Nemesia fruticans*, *Polygala nodiflora*, *Rhus gerrardii*. Succulent Shrubs: *Euphorbia clavarioides* var. *truncata*, *Lopholaena coriifolia*. Geoxylic Suffrutex: *Elephantorrhiza elephantina*. Graminoids: *Aristida canescens* (d), *A. congesta* (d), *A. diffusa* (d), *Brachiaria serrata* (d), *Bulbostylis burchellii* (d), *Digitaria tricholaenoides* (d), *Eragrostis racemosa* (d), *Heteropogon contortus* (d), *Microchloa caffra* (d), *Schizachyrium sanguineum* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *Andropogon schirensis*, *Bewsia biflora*, *Cymbopogon caesius*, *Diheteropogon amplectens*, *Elionurus muticus*, *Eragrostis chloromelas*, *E. gummiflua*, *E. patentissima*, *E. plana*, *Eulalia villosa*, *Hyparrhenia hirta*, *Melinis repens* subsp. *repens*, *Monocymbium ceresiiforme*, *Panicum natalense*, *Schizachyrium ursulus*, *Setaria nigrirostris*, *S. sphacelata*, *Sporobolus centrifugus*, *S. pyramidalis*, *Themeda triandra*, *Tristachya biseriata*, *T. rehmannii*. Herbs: *Acalypha glandulifolia*, *Dicoma anomala*, *Eriosema kraussianum*, *Geigeria burkei* subsp. *burkei*, *Helichrysum cephaloideum*, *H. rugulosum*, *Kohautia amatymbica*, *Macledium zeyheri* subsp. *argyrophylum*, *Rotheca hirsuta*, *Schistostephium crataegifolium*, *Senecio bupleuroides*, *S. coronatus*, *Vernonia oligocephala*. Geophytic Herbs: *Hypoxis multiceps*, *H. rigidula* var. *pilosissima*. Succulent Herbs: *Aloe fosteri*, *A. greatheadii* var. *davyana*, *Kleinia stapeliiformis*.

Endemic Taxa Low Shrubs: *Argyrolobium wilmsii* (d), *Adenia wilmsii*. Geophytic Herb: *Gladiolus rufomarginatus*.

Conservation Vulnerable. The conservation target is 27% and 2% is protected (Gustav Klingbiel and Ohrigstad Dam Nature Reserves). A total of 22% of this unit has been transformed, mainly by dryland and irrigated cultivation. Rainfall generally too low for plantations. Erosion from very low (45%), low (26%) and moderate (18%).

Remark It is a transition zone between the high-lying grasslands and the warmer and drier bushveld areas.

References Acocks (1953, 1988).

Gm 22 Northern Escarpment Dolomite Grassland

VT 8 North-Eastern Mountain Sourveld (70%) (Acocks 1953). LR 43 North-eastern Mountain Grassland (75%) (Low & Rebelo 1996).

Distribution Mpumalanga Province: From the high-lying dolomite grasslands of the Abel Erasmus Pass and Motlatse (Blyde) River (Vaalhoek) areas in the north, it extends southwards in a broad dolomite band along the Northern Escarpment, to as far south as the vicinity of Kaapsehoop. Altitude 1 000–1 620 m.

Vegetation & Landscape Features Very species-rich grasslands that occur along the Escarpment dolomite belt. The grasslands are characterised by a very diverse shrub layer which varies in height and density. The herbaceous component becomes more dense northwards as the climate becomes drier.

Geology & Soils Malmani dolomites of the Chuniespoort Group (Transvaal Supergroup) which overlies the Black Reef Quartzite Formation. Soils usually have a high pH, are rich in calcium and magnesium, and with low phosphorus status.

M. Stalmans

Figure 8.55 Gm 22 Northern Escarpment Dolomite Grassland: Rocky dolomite grassland on the Farm Dientjie (Blyde River Canyon National Park, Mpumalanga) with the grass *Loudetia simplex* and scattered woody species such as *Cussonia paniculata*, *Protea caffra*, *Ziziphus mucronata* and *Smilax kraussiana*.

Deep Hutton and Griffin soil forms are common. Land types Fa, Ab and Ac.

Climate Summer rainfall, varying from 700 mm in the north, increasing southwards to 1 420 mm (MAP 1 034 mm). Most of this unit occurs in the mistbelt, with increased precipitation. Warm-temperate climate, with low frequency of frost. Temperature increases northwards, ranging from MAT of 15°C in the south to 17°C in the northern regions of the unit. See also climate diagram for Gm 22 Northern Escarpment Dolomite Grassland (Figure 8.36).

Important Taxa Small Trees: *Seemannaralia gerrardii* (d), *Cussonia natalensis*, *Faurea rochetiana*, *F. saligna*, *Hippobromus pauciflorus*, *Ozoroa albicans*, *Protea caffra* subsp. *caffra*, *P. roupelliae* subsp. *roupelliae*. Tall Shrubs: *Pavetta lanceolata* (d), *Diospyros lycioides* subsp. *sericea*, *Protea gaguedi*, *Rhus rehmanniana*, *Tarchonanthus parvicapitulatus*. Low Shrubs: *Argyrolobium transvaalense*, *Athrixia arachnoidea*, *Chaetacanthus burchellii*, *Erica drakensbergensis*, *Helichrysum splendidum*, *Pelargonium dolomiticum*, *Phymaspermum acerosum*, *Rhus tumulicola* var. *meeuseana*, *Schistostephium rotundifolium*, *Stoebe plumosa*, *Tenrhynea phylicifolia*. Graminoids: *Cymbopogon caesius* (d), *C. nardus* (d), *Elionurus muticus* (d), *Eragrostis capensis* (d), *Hyparrhenia filipendula* (d), *Loudetia simplex* (d), *Monocymbium ceresiiforme* (d), *Schizachyrium sanguineum* (d), *Trichopteryx dregeana* (d), *Tristachya leucothrix* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon schirensis*, *Digitaria maitlandii*, *Diheteropogon filifolius*, *Eragrostis plana*, *E. racemosa*, *Festuca costata*, *Melinis nerviglumis*, *M. repens* subsp. *repens*, *Rendlia altera*, *Sporobolus africanus*, *S. pectinatus*, *Stiburus alopecuroides*, *Themeda triandra*. Herbs: *Hypodematium crenatum* (d), *Barleria ovata*, *Conostomium natalense*, *Dicoma anomala*, *Helichrysum miconiifolium*, *H. thapsus*, *Pearsonia sessilifolia* subsp. *marginata*, *P. sessilifolia* subsp. *sessilifolia*, *Rhynchosia monophylla*, *Senecio panduriformis*, *Vernonia natalensis*, *Xerophyta retinervis*. Geophytic Herbs: *Cheilanthes pentagona* (d), *Pteris vittata* (d). Succulent Herbs: *Aloe fouriei*, *Crassula sarcocaulis*.

Biogeographically Important Taxa ([N]Northern sourveld endemic, [W]Wolkberg endemic) Low Shrubs: *Berkheya pauciflora*[W], *Heteromorpha pubescens*[N]. Herbs: *Hemizygia transvaalensis*[N] (d), *Phymaspermum argenteum*[N], *Scabiosa transvaalensis*[W].

Endemic Taxa Small Tree: *Ozoroa* sp. nov. ('*laetans*'). Low Shrubs: *Salvia dolomitica* (d), *Pelargonium album*. Succulent Shrub: *Aloe alooides*. Semiparasitic Shrub: *Thesium davidsonae*. Geophytic Herbs: *Gladiolus macneilii, G. pavonia*, *Ledebouria parvifolia*.

Conservation Endangered. Target 27%. Only 2% protected within the Blyde River Canyon National Park, but larger portion protected in private Driekop Caves and London heritage sites in the north and in the Mooifontein and Mondi Cycad Reserve heritage sites in the south. More than half of this unit has been transformed (52%), mainly by plantations (47%) and cultivated lands (5%). Erosion potential very low (17%), low (51%) and moderate (28%).

Remarks Large variation in altitude and rainfall results in differences in species composition. These dolomites support species usually associated with the Wolkberg Centre of Plant Endemism, although some species are also shared with the Sekhukhune Centre of Plant Endemism (e.g. *Dombeya autumnalis*).

References Acocks (1988), Matthews (1991), Matthews et al. (1992a, b, 1993, 1994), Siebert (2001), Van Wyk & Smith (2001).

Gm 23 Northern Escarpment Quartzite Sourveld

VT 8 North-Eastern Mountain Sourveld (72%) (Acocks 1953). LR 21 Sour Lowveld Bushveld (53%) (Low & Rebelo 1996).

Distribution Limpopo and Mpumalanga Provinces: Occurring along the high-altitude crests of the Northern Escarpment, from Haenertsburg in the north, southeastwards, then bending southwards past Blyde River Canyon, Graskop and as far south as the vicinity of Kaapsehoop. Altitude 1 000–1 740 m.

Vegetation & Landscape Features The landscape is characteristically very rugged, with steep east-facing cliffs. This escarpment is intersected in some areas with large east-flowing rivers. Short, closed grassland rich in forb species with scattered trees and shrubs. This unit is very rocky and occurs on weather-resistant quartzite. The nutrient-poor soils lead to a lower biomass which, together with the rocky landscape, results in a reduced frequency and intensity of fires. It therefore has slightly more woody elements than the adjacent units.

Geology & Soils Black Reef Group and Wolkberg Group quartzite (formed 2.5 gya and occurring at the base of the Transvaal Supergroup), covered with shallow rocky soils of the Mispah form. Dominant land type Ab, with Ib, Fa and Ac of subordinate importance.

Climate Summer rainfall, but orographic effects enhance precipitation (overall regional MAP 1 176 mm). Mist common along the highest areas. Warm-temperate climate (MAT 16.6°C), with infrequent frost. See also climate diagram for Gm 23 Northern Escarpment Quartzite Sourveld (Figure 8.36).

M.C. Lötter

Figure 8.56 Gm 23 Northern Escarpment Quartzite Sourveld: Complex of short grassland with scattered woody vegetation (*Protea roupelliae, P. rubropilosa, Schefflera umbellifera* and *Erica caffrorum*) occurring on quartzitic outcrops of the Wolkberg summit on the eastern escarpment.

Important Taxa Small Trees: *Protea roupelliae* subsp. *roupelliae* (d), *Faurea galpinii*, *F. rochetiana*, *Syzygium cordatum* var. *cordatum*. Tree Fern: *Cyathea dregei*. Tall Shrub: *Vernonia myriantha*. Low Shrubs: *Athrixia phylicoides*, *Clutia monticola*, *Crotalaria doidgeae*, *Erica woodii*, *Euryops pedunculatus*, *Helichrysum kraussii*, *H. obductum*, *H. wilmsii*, *Phymaspermum acerosum*, *P. bolusii*, *Rhus tumulicola* var. *meeuseana*. Succulent Shrubs: *Lopholaena coriifolia* (d), *Aloe arborescens*, *Crassula sarcocaulis*. Graminoids: *Aristida junciformis* subsp. *galpinii* (d), *Loudetia simplex* (d), *Melinis nerviglumis* (d), *Monocymbium ceresiiforme* (d), *Panicum ecklonii* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon appendiculatus*, *Cymbopogon nardus*, *Digitaria maitlandii*, *Diheteropogon filifolius*, *Elionurus muticus*, *Festuca costata*, *Hyparrhenia poecilotricha*, *Ischyrolepis schoenoides*, *Juncus lomatophyllus*, *Koeleria capensis*, *Merxmuellera drakensbergensis*, *Microchloa caffra*, *Pentaschistis natalensis*, *Rendlia altera*, *Schizachyrium sanguineum*, *Sporobolus pectinatus*, *Stiburus alopecuroides*, *Themeda triandra*, *Trichopteryx dregeana*. Herbs: *Rhynchosia woodii* (d), *Acalypha glandulifolia*, *Anisopappus smutsii*, *Aster harveyanus*, *Berkheya echinacea*, *Craterocapsa tarsodes*, *Dicoma anomala*, *Eriosema angustifolium*, *Geigeria burkei* subsp. *burkei*, *Gerbera ambigua*, *Helichrysum acutatum*, *H. appendiculatum*, *H. cephaloideum*, *H. nudifolium* var. *pilosellum*, *H. oreophilum*, *H. umbraculigerum*, *Indigofera sanguinea*, *Kohautia amatymbica*, *Lobelia flaccida*, *Monsonia attenuata*, *Pearsonia sessilifolia* subsp. *marginata*, *Rabdosiella calycina*, *Selago hyssopifolia*, *Senecio panduriformis*, *S. scitus*, *Vernonia centaureoides*, *V. natalensis*, *V. poskeana*, *Wahlenbergia squamifolia*. Herbaceous Climber: *Rhynchosia caribaea*. Geophytic Herbs: *Asplenium aethiopicum*, *Cheilanthes hirta*, *Pteridium aquilinum*, *Schizocarphus nervosus*. Succulent Herbs: *Crassula alba*, *C. vaginata*, *Craterostigma wilmsii*.

Biogeographically Important Taxa ([N]Northern sourveld endemic, [W]Wolkberg endemic) Small Trees: *Protea rubropilosa*[N] (d), *Encephalartos paucidentatus*[N]. Tall Shrub: *Tricalysia capensis* var. *galpinii*[N]. Low Shrubs: *Asparagus rigidus*[W], *Berkheya carlinopsis* subsp. *magalismontana*[N], *Helichrysum mimetes*[N], *H. reflexum*[N], *H. rudolfii*[N], *H. uninervium*[N], *Hemizygia parvifolia*[N], *H. rehmannii*[W], *H. subvelutina*[N], *Kotschya parvifolia*[N], *Protea parvula*[N], *Sutera polelensis* subsp. *fraterna*[N], *Syncolostemon eriocephalus*[N]. Succulent Shrub: *Aloe chortolirioides* var. *woolliana*[N]. Semiparasitic Shrubs: *Thesium gracilentum*[W], *T. multiramulosum*[N]. Herbs: *Anisopappus junodii*[W], *Cyanotis pachyrrhiza*[N], *Hemizygia transvaalensis*[N], *Monsonia transvaalensis*[N], *Pearsonia aristata*[N], *Scabiosa transvaalensis*[W]. Geophytic Herbs: *Agapanthus inapertus* subsp. *hollandii*[N], *A. inapertus* subsp. *parviflorus*[N], *Aspidonepsis shebae*[N], *Brachystelma stellatum*[N], *Cyrtanthus thorncroftii*[N], *Disa extinctoria*[N], *Gladiolus calcaratus*[N], *G. exiguus*[N], *G. varius*[N], *G. vernus*[N], *Ledebouria minima*[N], *Tulbaghia transvaalensis*[N]. Succulent Herbs: *Aloe affinis*[N], *A. thompsoniae*[W].

Endemic Taxa Small Trees: *Encephalartos brevifoliolatus*, *E. cupidus*, *E. nubimontanus*, *Protea laetans*. Low Shrubs: *Erica rivularis*, *Euclea dewinteri*, *Hemizygia rugosifolia*, *Lopholaena festiva*. Graminoid: *Schoenoxiphium schweickerdtii*. Herbs: *Cineraria hederifolia*, *Inezia speciosa*, *Monopsis kowynensis*, *Monsonia lanuginosa*, *Schistostephium artemisiifolium*, *Streptocarpus decipiens*. Geophytic Herbs: *Brachystelma pachypodium*, *Crocosmia mathewsiana*, *Cyrtanthus huttonii*, *C. junodii*, *Dierama adelphicum*, *Disa aristata*, *Drimiopsis davidsonae*, *Ledebouria* sp. nov. ('*rupestris*'), *L. galpinii*, *L. petiolata*, *Schizochilus crenulatus*, *Tulbaghia coddii*, *T. simmleri*, *Watsonia strubeniae*. Succulent Herb: *Aloe nubigena*.

Conservation Vulnerable. The conservation target is 27% and 15% is protected within the Lekgalameetse and Blyde River Canyon National Park. As much as 38% of this unit has been transformed mainly by plantations (37%), with limited cultivated areas. Estimated erosion potential levels very low (39%), low (47%) and moderate (14%).

Remark 1 This vegetation type closely coincides with the Wolkberg Centre of Endemism and is rich in endemic plants. Although this centre does incorporate the dolomites of Gm 22 Northern Escarpment Dolomite Grassland and SVcb 25 Poung Dolomite Mountain Bushveld, it is also comprised of two subcentres, namely the Serala and Blyde Subcentres. The Serala Subcentre is found to the north of the Olifants River along the Northern Escarpment, with approximately 36 endemics and near-endemics. The Blyde Subcentre is found to the south of the Olifants River along the Northern Escarpment, with approximately 15 endemic or near-endemic species.

Remark 2 Patches of FOz 4 Northern Mistbelt Forest are common in protected rocky areas.

References Smith (1972), Deall (1985), Deall et al. (1989), Stalmans (1990), Matthews (1991), Matthews et al. (1991, 1992a, 1993, 1994), Stalmans & Mentis (1993), Van Wyk & Smith (2001), Emery et al. (2002), Brown et al. (2005).

Gm 24 Northern Escarpment Afromontane Fynbos

VT 8 North-Eastern Mountain Sourveld (92%) (Acocks 1953). LR 2 Afromontane Forest (41%), LR 21 Sour Lowveld Bushveld (22%) (Low & Rebelo 1996).

M.C. Lötter

Figure 8.57 Gm 24 Northern Escarpment Afromontane Fynbos: Montane fynbos shrublands with *Aloe arborescens*, *Cliffortia serpyllifolia*, *Hemizygia albiflora*, *Syncolostemon eriocephalus*, *Eumorphia davyi*, *Podocarpus latifolius* and *Cyrtanthus huttonii* on the summit of Mariepskop (Blyde River Canyon National Park, Mpumalanga).

Distribution Limpopo and Mpumalanga Provinces: Restricted distribution from the peaks of Thabakgolo Mountains above Penge, southwards along highest peaks only, through Mariepskop and as far south as Graskop. Also found in fragments on the summits of the Blouberg and Soutpansberg Mountains (the latter unmapped). Altitude 1 640–1 900 m, with outliers found as low as 1 300 m.

Vegetation & Landscape Features The dominant structural form is shrubland comprised of sclerophyllous shrubs and herbs, many with ericoid growth forms. It occurs in fragmented patches of high-lying quartzite ridges that experience frequent mist. Terrain is very rocky and fires are very rare.

Geology & Soils Predominantly quartzite of the Black Reef Formation and the Wolkberg Group but also on the westerly Timeball Hill Formation and other quartzitic formations of the Pretoria Group (Transvaal Supergroup). The overwhelmingly dominant land type is Ib, with Ac having a subordinate position.

Climate Summer rainfall generally greater than 1 400 mm, augmented by mist during large parts of the year. Temperature cooler than surrounding areas (MAT 15.6°C). Frosts infrequent. See climate diagram for Gm 24 Northern Escarpment Afromontane Fynbos (Figure 8.36).

Important Taxa ([B]Also on Blouberg) Small Trees: *Protea caffra* subsp. *caffra*[B], *P. roupelliae* subsp. *roupelliae*[B]. Tall Shrub: *Psoralea latifolia*. Succulent Shrub: *Aloe arborescens* (d). Low Shrubs: *Anthospermum hispidulum* (d), *Cliffortia nitidula* (d), *C. serpyllifolia* (d), *Erica natalitia* var. *natalitia* (d), *Hypericum revolutum* (d), *Passerina montana* (d), *Cliffortia linearifolia*[B], *Erica revoluta*, *E. simii*[B], *Euryops pedunculatus*, *Helichrysum obductum*, *H. splendidum*, *H. wilmsii*, *Macowania tenuifolia*, *Morella pilulifera*[B], *Myrsine africana*, *Otiophora cupheoides*, *Phylica paniculata*[B], *Phymaspermum acerosum*, *Schistostephium rotundifolium*. Graminoids: *Ischyrolepis schoenoides* (d), *Scleria transvaalensis* (d), *Cyperus pseudoleptocladus*. Herbs: *Plectranthus rubropunctatus* (d), *Blechnum punctulatum*. Geophytic Herb: *Drimia elata*[B].

Biogeographically Important Taxa ([W]Wolkberg endemic, [N]Northern sourveld endemic, [B]Also on Blouberg, [Z]Link to Zimbabwe) Small Trees: *Faurea galpinii*[N], *Protea rubropilosa*[W], *Widdringtonia nodiflora*[B,Z]. Low Shrubs: *Helichrysum rudolfii*[N] (d), *Hemizygia albiflora*[N] (d), *Asparagus rigidus*[W], *Helichrysum mariescopicum*[N], *Leucospermum saxosum*[Z], *Syncolostemon eriocephalus*[N]. Herb: *Anisopappus junodii*[W] (d). Geophytic Herbs: *Agapanthus inapertus* subsp. *pendulus*[N]. Succulent Herb: *Aloe nubigena*[W].

Endemic Taxa Low Shrub: *Eumorphia davyi*. Herb: *Stachys reticulata*. Geophytic Herb: *Gladiolus saxatilis*.

Conservation The conservation target of 27% has been superseded since 56% of the unit enjoys formal protection in the Blyde River Canyon National Park and Mac Mac Conservation Area. The patches on the summits of Blouberg and Soutpansberg also enjoy formal and private protection. The landscape is rugged and soils shallow, therefore very little transformation of this unit has occurred. Transformation levels currently stand at 0.7% (plantations). Erosion very low (35%), low (44%) and moderate (20%).

Remarks This vegetation unit contains a unique combination of plant species with convergent growth forms and taxonomic links to that of the Fynbos Biome with genera such as *Cliffortia*, *Erica*, *Passerina*, *Phylica*, *Protea*, *Ischyrolepis* and *Stoebe*, typical of dystrophic soils. This unit also incorporates a suite of other taxa from the Grassland and Afrotemperate Forest Biomes. Forestry management has increased the exclusion of fires from certain areas and subsequently increased the occurrence of the afromontane fynbos vegetation. Under these conditions, this vegetation type may be a precursor to forest, but establishment of forest may be possible only if the soil is deep enough and the impact of desiccation and frosts can be avoided.

References Van der Schijff (1963), Smith (1972), Matthews (1991).

Gm 25 Woodbush Granite Grassland

VT 8 North-Eastern Mountain Sourveld (93%) (Acocks 1953). LR 43 North-eastern Mountain Grassland (61%) (Low & Rebelo 1996).

Distribution Limpopo Province: Occurs on the Woodbush Plateau and its outliers, to the north of the Wolkberg, on the Groot Letaba watershed west of Duiwelskloof, Tzaneen and Lenyenye. Altitude 1 080–1 800 m.

Vegetation & Landscape Features Mountainous plateau covered by grassland, showing increased low-shrub density on steep south- and east-facing slopes.

Geology & Soils Archaean granite, gneiss and greenstone basement: Turfloop granite (Randian) and relicts of Goudplaats gneiss (Swazian) and occasional dolerite dykes or sills, and quartz veins. Dominant land type Ab, with Hutton (Glenrosa and Shortlands) soils.

Climate Summer rainfall, with MAP from 700 mm in the east to 1 500 mm in the west (MAP 1 166 mm), with peak in January. Some precipitation may also occur in winter. Mist is common and there is an orographic effect on the Escarpment. Temperature is generally lower in the west than in the east (overall MAT 16.6°C). Frost infrequent. See also climate diagram for Gm 25 Woodbush Granite Grassland (Figure 8.36).

Important Taxa Graminoids: *Eragrostis plana* (d), *E. racemosa* (d), *Hyparrhenia hirta* (d), *Microchloa caffra* (d), *Monocymbium ceresiiforme* (d), *Paspalum scrobiculatum* (d), *Stipa dregeana* var. *dregeana* (d), *Themeda triandra* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon schirensis*, *Cymbopogon nardus*, *Festuca costata*, *Panicum natalense*, *Rendlia altera*. Herbs: *Berkheya echinacea*, *Chamaecrista mimosoides*, *Helichrysum cephaloideum*, *H. nudifolium* var. *pilosellum*, *Hypolepis sparsisora*, *Selago procera*, *Vernonia oligocephala*. Geophytic Herbs: *Asplenium sandersonii* (d), *Agapanthus inapertus* subsp. *inapertus*, *Asplenium lobatum*, *Merwilla natalensis*, *Pteridium aquilinum*. Succulent Herb: *Aloe lettyae*. Tall Shrub: *Tricalysia lanceolata*. Low Shrubs: *Asparagus virgatus*, *Dicliptera clinopodia*, *Eriosema nutans*, *Euryops pedunculatus*, *Hypericum revolutum*, *Protea simplex*.

Biogeographically Important Taxa ([N]Northern sourveld endemic, [Z]Link to Zimbabwe) Succulent Herb: *Huernia insigniflora*[N]. Low Shrub: *Eriosema buchananii*[Z].

Endemic Taxa Herb: *Wahlenbergia brachiata*. Geophytic Herbs: *Chlorophytum radula*, *Kniphofia crassifolia* (extinct). Low Shrub: *Indigofera rehmannii*.

Conservation Critically endangered. Conservation target (27%) can hardly be met since only about 10% of this unit is still in a natural state. There are no conservation areas protecting patches of this unit. The major land transformation is due to silviculture (69%) and to a much lesser degree to cultivation and urban development. Erosion potential very low (7%), low (88%) and moderate (5%). Frequent alien plants include *Acacia mearnsii*, *A. dealbata*, *Prunus serotina*, *Lilium formosanum*, *Agrimonia procera*, *Solanum mauritianum* and

Acanthospermum australe. The vegetation is subject to bush encroachment (from both scrub forest and sour bushveld) exacerbated by exclusion of fire.

Remark 1 This unit is distinct from the Gm 26 Wolkberg Dolomite Grassland, mainly due to the combination of the plateau topography, different geology and soils, and the prevalence of fog frequently precipitating over the plateau. The landscape is similar to higher-lying parts of the Figtree Plateau in the Sabie-White River area.

Remark 2 It is likely that the lower mapped area around Duiwelskloof falls within the sour bushveld rather than in this grassland unit.

References Acocks (1953, 1988), P.J.D. Winter (unpublished data).

Gm 26 Wolkberg Dolomite Grassland

VT 8 North-Eastern Mountain Sourveld (87%) (Acocks 1953). LR 43 North-eastern Mountain Grassland (98%) (Low & Rebelo 1996).

Distribution Limpopo Province: Occurs along the summit of the Strydpoort and Wolkberg Mountains, from the Lekgalameetse Nature Reserve in the east, along the dolomite belt to Mogodi in the west. Altitude 1 260–1 840 m.

Vegetation & Landscape Features Series of broad mountain ridges, broad elevated plateaus and adjacent slopes covered with species-rich short, closed grasslands rich in forbs, often dominated by *Loudetia simplex* and *Diheteropogon amplectens*.

Geology & Soils Malmani dolomites of the Chuniespoort Group (Transvaal Supergroup) form the underlying geology of this area. Dominant land types Ib and Ab, with Fa of subordinate importance.

Climate Summer-rainfall regime, 560–980 mm (MAP 772 mm). The adjacent Escarpment catches most of the orographic precipitation (fog, orographic rain), hence this area falls within a rainshadow. Frost infrequent. See also climate diagram for Gm 26 Wolkberg Dolomite Grassland (Figure 8.36).

Important Taxa Small Trees: *Acacia davyi* (d), *Vitex rehmannii* (d), *Acacia caffra*, *Combretum molle*, *Cussonia paniculata*, *C. transvaalensis*, *Dombeya rotundifolia*, *Faurea rochetiana*, *F. saligna*, *Greyia radlkoferi*, *Lippia javanica*, *Protea caffra* subsp. *caffra*, *P. roupelliae* subsp. *roupelliae*. Tall Shrub: *Protea gaguedi*. Low Shrubs: *Asparagus schroederi, Chrysanthemoides monilifera*. Succulent Shrub: *Aloe vryheidensis*. Graminoids: *Andropogon schirensis* (d), *Brachiaria serrata* (d), *Diheteropogon amplectens* (d), *Heteropogon contortus* (d), *Loudetia simplex* (d), *Monocymbium ceresiiforme* (d), *Rendlia altera* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Bewsia biflora*, *Elionurus muticus*, *Eragrostis capensis*, *E. chloromelas*, *E. racemosa*, *Panicum natalense*, *Sporobolus pectinatus*, *Trachypogon spicatus*. Herbs: *Dicoma anomala*, *Gerbera ambigua, Ipomoea atherstonei*, *Oxygonum dregeanum*, *Xerophyta retinervis, X. schlechteri*. Succulent Herb: *Aloe fosteri*. Semiparasitic Herb: *Buchnera longespicata*.

Biogeographically Important Taxa (all Northern sourveld endemics) Low Shrubs: *Berkheya pauciflora*, *Heteromorpha pubescens*. Herbaceous Climber: *Cyphia transvaalensis*.

Endemic Taxa Succulent Shrubs: *Aloe dolomitica*, *Euphorbia restricta*. Herbs: *Barleria dolomitica*, *Becium citriodorum*, *B. coddii*, *Dicliptera fionae*, *Lotononis pariflora*.

Conservation Least threatened. The conservation target of 27% has been superseded since more than 48% of this unit is formally protected within the Bewaarkloof and Lekgalameetse Nature Reserves as well as the Wolkberg Wilderness Area. Only a very small portion of this unit has been transformed by plantations. Erosion potential very low (49%), low (36%) and moderate (16%).

Remarks This unit forms the core of the Wolkberg CE, divided further into two subcentres—the Serala and Blyde Subcentres (Van Wyk & Smith 2001).

References Acocks (1953, 1988), Stalmans (1990), Matthews et al. (1993), Stalmans et al. (1997), Van Wyk & Smith (2001).

M. Stalmans

Figure 8.58 Gm 26 Wolkberg Dolomite Grassland: Rocky grassland on dolomite on the Farm The Downs near Makwens in the Lekgalameetse Nature Reserve (Mpumalanga) with *Aloe marlothii*, *Boophone disticha* and the shrub *Parinari curatellifolia*.

Gm 27 Strydpoort Summit Sourveld

VT 8 North-Eastern Mountain Sourveld (62%) (Acocks 1953). LR 43 North-eastern Mountain Grassland (59%) (Low & Rebelo 1996).

Distribution Limpopo Province: A series of isolated patches in high-lying areas of the Strydpoortberge, from Bewaarkloof in the east as far as the mountains just above Mokopane (Potgietersrus) in the west. Altitude largely 1 440–1 800 m, but up to 1 940 m.

Vegetation & Landscape Features Short to tall grasslands along rocky summits and mountain slopes. The landscape has a very broken topography with deeply incised valleys. The slopes are steep and rocky, and sparsely wooded.

Geology and Soils Acidic sandy soil derived from sandstone, quartzite and shale of the Wolkberg Group and the Black Reef Formation as well as the

Pretoria Group in the westernmost parts. In the eastern half of this area a large part is underlain by the Penge Banded Iron Formation of the Chuniespoort Group. All of the above form part of the Transvaal Supergroup. Dominant land type Ib.

Climate Strongly seasonal, with precipitation in summer. Rainfall 530–870 mm (MAP 686 mm). Frost infrequent. See also climate diagram for Gm 27 Strydpoort Summit Sourveld (Figure 8.36).

Important Taxa Small Trees: *Acacia caffra* (d), *Combretum molle* (d), *Cussonia paniculata* (d), *Englerophytum magalismontanum* (d), *Protea caffra* subsp. *caffra* (d), *Cussonia transvaalensis*, *Faurea saligna*, *Mundulea sericea*, *Protea roupelliae* subsp. *roupelliae*, *P. rubropilosa*, *Vangueria infausta*. Tall Shrub: *Rhus dentata*. Woody Climbers: *Ancylobotrys capensis*, *Rhoicissus tridentata*. Low Shrubs: *Rhus magalismontana* (d), *Aeschynomene rehmannii*, *Anthospermum hispidulum*, *Chrysanthemoides monilifera* subsp. *septentrionalis*, *Justicia betonica*, *Leonotis ocymifolia*, *Polygala hottentotta*. Graminoids: *Aristida transvaalensis* (d), *Loudetia simplex* (d), *Monocymbium ceresiiforme* (d), *Schizachyrium sanguineum* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon chinensis*, *Bulbostylis burchellii*, *Diheteropogon amplectens*, *D. filifolius*, *Elionurus muticus*, *Eragrostis racemosa*, *Sporobolus pectinatus*. Herbs: *Acalypha angustata*, *Helichrysum nudifolium* var. *nudifolium*, *Monsonia attenuata*, *Pearsonia sessilifolia* subsp. *sessilifolia*, *Rhynchosia monophylla*, *Selaginella dregei*, *Vernonia galpinii*, *V. natalensis*, *Xerophyta retinervis*. Herbaceous Climber: *Rhynchosia totta*. Succulent Herbs: *Aloe fosteri*, *Crassula swaziensis*, *Kleinia stapeliiformis*.

Biogeographically Important Taxa ([N]Northern sourveld endemic, [W]Wolkberg endemic) Small Trees: *Encephalartos eugene-maraisii*[N], *Protea rubropilosa*[W]. Tall Shrub: *Vitex obovata* subsp. *wilmsii*[N]. Low Shrubs: *Berkheya carlinopsis* subsp. *magalismontana*[N], *Helichrysum uninervium*[N]. Succulent Herbs: *Aloe affinis*[N], *A. thompsoniae*[W].

Endemic Taxa Succulent Shrub: *Thorncroftia media*. Semiparasitic Shrub: *Thesium gracilentum*. Herb: *Aster nubimontis*.

Conservation Least threatened. Target 24%. About 17% of the area enjoys statutory protection in the Bewaarkloof Nature Reserve. A further small portion is protected in the Wolkberg Wilderness Area. Transformation levels are very low. Erosion potential also very low (73%), low (17%) and moderate (10%).

Remark This unit shares several elements with the Gm 29 Waterberg-Magaliesberg Summit Sourveld, such as *Encephalartos eugene-maraisii* and *Vitex obovata* subsp. *wilmsii*.

References Stalmans & De Klerk (1991, 1992).

Gm 28 Soutpansberg Summit Sourveld

VT 20 Sour Bushveld (77%) (Acocks 1953). LR 11 Soutpansberg Arid Mountain Bushveld (98%) (Low & Rebelo 1996).

Distribution Limpopo Province: Confined to the higher-lying crests and plateaus situated above 1 200 m above sea level and include the highest peaks on the Soutpansberg (Letjuma, 1 747 m) and still higher Blouberg (2 051 m).

Vegetation & Landscape Features Rugged summit crests and adjacent steep rocky slopes supporting a mosaic of low, wiry, closed grasslands and scattered closed-canopy bush clumps. The extent of the bush clumps within the grasslands depends largely on the extent of rock outcrops, rock boulders and the local soil depth. Due to frequent mist the surface of rocks and woody vegetation support rich epilithic and epiphytic lichen and bryophyte flora.

Geology & Soil Sandstone, quartzite and shale of Mokolian age (Soutpansberg Group, Wyllie's Poort Formation) giving rise to extremely shallow, coarse-sand Glenrosa and Mispah soils. These soils drain quickly, leading to leached and acidic conditions. The impermeable rock beds on the relatively flat plateaus often prevent water from draining away, leading to the formation of temporary rock pools. The deeper soils may function as sponges, slowly releasing water to feed mountain streams over prolonged periods. Dominant land type Ib, with Fa of minor importance.

Climate Summer rainfall, with most rain falling between November and February. Van Wyk & Smith (2001) mention precipitation to be as high as 2 000 mm on the highest peaks. The higher-lying crests and ridges are exposed to strong winds. During the summer months, these winds carry moisture in from the Indian Ocean, covering the vegetation in mist almost daily. During the prolonged dry season, the prevailing winds cause dehydration and desiccation of the soils and vegetation (Hahn 2002). Frost infrequent and MAT 16–17°C. See also climate diagram for Gm 28 Soutpansberg Summit Sourveld (Figure 8.36).

Important Taxa ([B]Also Blouberg) Small Trees: *Acacia caffra* (d), *Combretum molle* (d), *Englerophytum magalismontanum* (d), *Protea caffra* subsp. *caffra* (d), *Cussonia natalensis*, *Faurea saligna*[B], *Mundulea sericea*, *Protea roupelliae* subsp. *roupelliae*, *Vangueria infausta*. Tall Shrubs: *Euryops brevipapposus*[B], *Hyperacanthus amoenus*, *Rhus dentata*. Woody Climber: *Ancylobotrys capensis*. Low Shrubs: *Aeschynomene rehmannii*, *Anthospermum hispidulum*, *Erica woodii*[B], *Justicia betonica*, *Leonotis ocymifolia*, *Myrsine africana*, *Passerina montana*, *Polygala hottentotta*. Succulent Shrub: *Cotyledon barbeyi*. Graminoids: *Aristida transvaalensis* (d), *Monocymbium ceresii-*

D. Gwynne-Evans

Figure 8.59 Gm 28 Soutpansberg Summit Sourveld: Local endemic shrub *Callilepis caerulea* (Asteraceae) on a ridge of the Soutpansberg (Limpopo Province).

forme (d), *Schizachyrium sanguineum* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Andropogon chinensis*, *Bulbostylis burchellii*, *Diheteropogon amplectens*, *Eragrostis racemosa*, *Ischyrolepis schoenoides*[B], *Panicum maximum*, *Pentaschistis natalensis*[B], *Tristachya rehmannii*. Herbs: *Acalypha angustata*, *Helichrysum nudifolium* var. *nudifolium*, *H. subglomeratum*[B], *Rhynchosia monophylla*, *Selaginella dregei*, *Tephrosia purpurea* subsp. *leptostachya*, *Vernonia galpinii*, *Waltheria indica*, *Xerophyta retinervis*. Herbaceous Climber: *Rhynchosia totta*. Geophytic Herb: *Agapanthus inapertus* subsp. *intermedius*[B]. Succulent Herb: *Crassula swaziensis*.

Biogeographically Important Taxa ([B]Also on Blouberg, [N]Northern sourveld endemic, [S]Soutpansberg endemic) Low Shrubs: *Berkheya carlinopsis* subsp. *magalismontana*[N], *Eriocephalus longifolius*[N]. Herb: *Tetraselago wilmsii*[N]. Geophytic Herbs: *Agapanthus dyeri*[N,B], *Cyrtanthus thorncroftii*[N]. Succulent Herb: *Aloe vossii*[S].

M.C. Rutherford

Figure 8.60 Gm 29 Waterberg-Magaliesberg Summit Sourveld: Grassland on the summit of the Magaliesberg viewed from an altitude of 1 770 m in the Magaliesberg Conservation Area, south of the Krom River near Rustenburg (North-West Province).

Endemic Taxa Tall Shrub: *Callilepis caerulea*. Low Shrubs: *Rhus magalismontana* subsp. *coddii* (d). Succulent Shrubs: *Delosperma zoutpansbergense*, *Khadia borealis*. Succulent Herb: *Aloe soutpansbergensis*.

Conservation Least threatened. Target 24%. About 18% statutorily conserved in the Blouberg and Happy Rest Nature Reserves and further in the private Soutpansberg Conservancy. Some of the area is transformed by *Eucalyptus* and *Pinus* plantations. Overgrazing by cattle and donkeys and inappropriate introduction of game from savanna plains are recognised as further threats to this vegetation unit. Erosion very low (52%) and low (39%).

Remarks This unit is part of the Soutpansberg Centre of Endemism (Van Wyk & Smith 2001). Pockets of Gm 24 Northern Escarpment Afromontane Fynbos and FOz 4 Northern Mistbelt Forest border on this summit grassland sourveld.

References Scholes (1979), Van Wyk & Smith (2001), Hahn (2002).

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 (not mapped) and Magaliesberg. Altitude 1 500–2 088 m in the Waterberg, 1 853 m in the Magaliesberg and 1 687 m in the Pilanesberg.

Vegetation & 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 *Landolphia capensis* are common and typical of this sourveld vegetation type.

Geology and Soils Acidic sandy, loamy to gravel soil derived from coarse, clastic sedimentary sandstone, quartzite, conglomerate or shale of the Kransberg Subgroup (Waterberg Group, Mokolian Erathem). Ib and Fa land types (both 42%) are co-dominant, with Ac covering a smaller area (12%).

Climate Summer rainfall, with MAP 710 mm. Cool-temperate climate (MAT close to 16°C) due to higher altitude. Frost fairly infrequent. See also climate diagram for Gm 29 Waterberg-Magaliesberg Summit Sourveld (Figure 8.36).

Important Taxa ([R]Mainly on rocky outcrops) Small Trees: *Englerophytum magalismontanum* (d), *Protea caffra* subsp. *caffra* (d), *P. roupelliae* subsp. *roupelliae* (d), *Acacia caffra*, *Brachylaena rotundata*, *Combretum moggii, C. molle*, *Faurea saligna*, *Vangueria infausta*, *Zanthoxylum capense*. Tall Shrubs: *Elephantorrhiza burkei*, *Indigofera comosa*[R], *Protea gaguedi*, *Rhus dentata*. Woody Climber: *Ancylobotrys capensis* (d). Low Shrubs: *Lopholaena coriifolia*[R] (d), *Passerina montana* (d), *Rhus magalismontana* (d), *Acalypha angustata*, *Aeschynomene rehmannii*, *Anthospermum hispidulum*, *A. rigidum* subsp. *rigidum*, *Erica drakensbergensis*, *Euryops pedunculatus, Myrothamnus flabellifolius*[R], *Myrsine africana*, *Polygala hottentotta*, *Protea welwitschii*, *Rhynchosia nitens*, *Tephrosia longipes*. Succulent Shrubs: *Euphorbia clavarioides* var. *truncata*[R], *E. schinzii*[R], *Raphionacme burkei*[R]. Semiparasitic Shrubs: *Thesium transvaalense*, *T. utile*. Geoxylic Suffrutices: *Elephantorrhiza elephantina*, *Parinari capensis*. Graminoids: *Aristida transvaalensis* (d), *Bulbostylis burchellii* (d), *Coleochloa setifera*[R] (d), *Diheteropogon amplectens* (d), *Eragrostis nindensis*[R] (d), *Loudetia simplex* (d), *Melinis nerviglumis* (d), *Schizachyrium sanguineum* (d), *Trachypogon spicatus* (d), *Tristachya biseriata* (d), *Andropogon schirensis*, *Aristida aequiglumis*, *Brachiaria serrata*, *Cymbopogon caesius*, *Cyperus rupestris*[R], *Digitaria brazzae*, *Eragrostis racemosa*, *E. stapfii*[R], *Microchloa caffra*[R], *Monocymbium ceresiiforme*, *Panicum natalense*, *Themeda triandra*, *Tristachya rehmannii*. Herbs: *Selaginella dregei* (d), *Acalypha angustata*, *Commelina africana*, *C. erecta*, *Helichrysum nudifolium* var. *nudifolium*, *Indigofera hedyantha*, *I. melanadenia*, *Ipomoea ommaneyi*, *Nidorella hottentotica*, *Oldenlandia herbacea*, *Pseudognaphalium undulatum*, *Rhynchosia monophylla*, *Vernonia galpinii*, *Xerophyta retinervis*[R]. Herbaceous Climber: *Rhynchosia totta*. Geophytic Herbs: *Albuca setosa*[R], *Lapeirousia sandersonii*[R], *Ledebouria marginata*, *Pellaea calomelanos*. Succulent Herb: *Crassula lanceolata* subsp. *transvaalensis.*

Biogeographically Important Taxa ([N]Northern sourveld endemic, [R]Mainly on rocky outcrops) Small Tree: *Encephalartos*

eugene-maraisii[N]. Low Shrubs: *Berkheya carlinopsis* subsp. *magalismontana*[N], *Eriocephalus longifolius*[N], *Helichrysum uninervium*[N]. Succulent Shrubs: *Adromischus umbraticola*[N], *Aloe peglerae*[N]. Herb: *Cyanotis pachyrrhiza*[N]. Geophytic Herb: *Ledebouria minima*[N]. Succulent Herbs: *Frithia pulchra*[N,R], *Khadia acutipetala*[N,R].

Conservation Least threatened. Target of 24% has already been achieved since more than 27% of the unit is statutorily conserved in the Marekele National Park, Entabeni Nature Reserve, Magaliesberg Nature Area (including the Rustenburg Nature Reserve). The unmapped portion in the Pilanesberg Game Park is fully conserved. A further 4% enjoys protection in private conservation areas. Only a very small area transformed. Erosion low (60%) and very low (34%).

Remark 1 Embedded within this sourveld there are abundant rocky sheets found on exposed mountain tops and ridges, supporting sparse edaphic grassland/herbland with classical resurrection plants such as *Myrothamnus flabellifolius* and *Selaginella dregei*. It is here where succulents (some endemic) of the genera *Frithia*, *Khadia* and *Delosperma* (Aizoaceae), *Adromischus* (Crassulaceae), *Anacampseros* (Portulacaceae) and numerous low succulent representatives of *Euphorbia* are found.

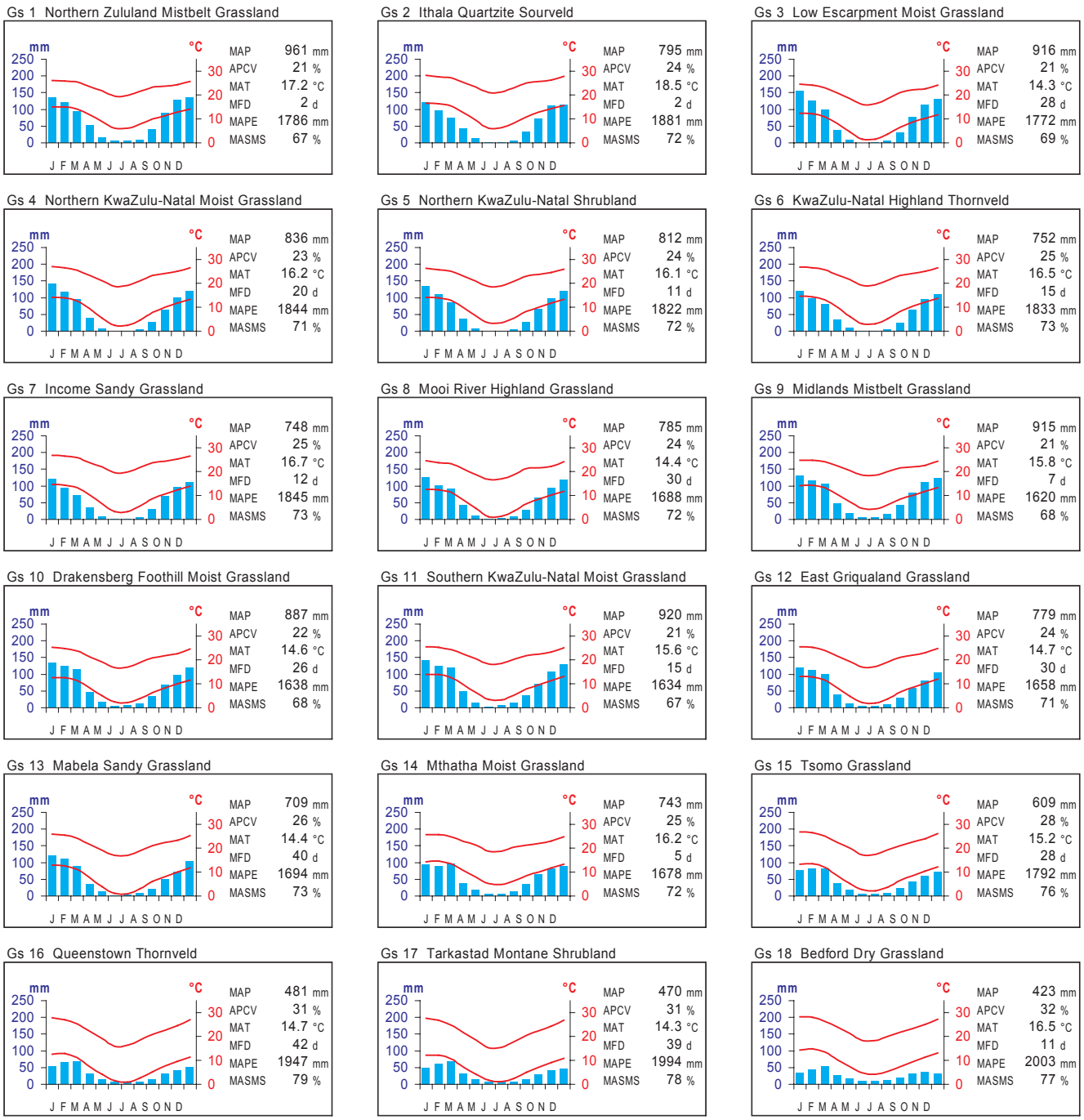

Figure 8.61 Climate diagrams of the Sub-Escarpment Grassland Bioregion units. Blue bars show the median monthly precipitation. The upper and lower red lines show the mean daily maximum and minimum temperature respectively. MAP: Mean Annual Precipitation; APCV: Annual Precipitation Coefficient of Variation; MAT: Mean Annual Temperature; MFD: Mean Frost Days (days when screen temperature was below 0°C); MAPE: Mean Annual Potential Evaporation; MASMS: Mean Annual Soil Moisture Stress (% of days when evaporative demand was more than double the soil moisture supply).

Remark 2 We are aware of the existence of patches of this unit on the highest summits of the Pilanesberg near Rustenberg in the North-West Province, but have not been able to map them due to lack of sufficient data.

References Acocks (1953, 1988), Coetzee (1974, 1975), Coetzee & Werger (1975), Van der Meulen (1979a, b), Westfall (1981), Burgoyne et al. (2000), Van Staden (2002), Bredenkamp & Brown (2003), Van Staden & Bredenkamp (2005).

I. Johnson

Figure 8.62 Gs 1 Northern Zululand Mistbelt Grassland: Species-rich grasslands on the Ngome Mountain between Nongoma and Vryheid.

Sub-Escarpment Grassland

Sub-Escarpment Grassland is found on the rolling hills and flat plains of the foothills of the Drakensberg and Northern Escarpment. The physical nature of these areas is determined by the rate at which the landscape ascends into the main Escarpment region as well as the degree to which the landscape has been shaped by geomorphological forces. The result is a diversity of land forms, including rolling hills, such as the Valley of a Thousand Hills in KwaZulu-Natal, and flat plains such as those found south of the Amathole Mountains. A strong decrease in rainfall can be observed in the Sub-Escarpment Grassland from northeast to southwest (Figure 8.61). In areas with undulating landscapes, common in Transkei and KwaZulu-Natal, the orographic influence of the rising landscape furthermore results in regular mists in these areas and thus the formation of numerous mistbelt regions.

Gs 1 Northern Zululand Mistbelt Grassland

VT 64 Northern Tall Grassveld (Transition between Piet Retief Sourveld and Southern Tall Grassveld) (46%), VT 8 North-Eastern Mountain Sourveld (36%) (Acocks 1953). LR 25 Natal Central Bushveld (59%) (Low & Rebelo 1996). BRG 11 Moist Transitional Tall Grassveld (47%), BRG 7 Northern Mistbelt (31%) (Camp 1999a).

Distribution KwaZulu-Natal Province: Crests and slopes of the Ngome Mountain range and the Ngoje Mountain surrounding Louwsburg as well as some smaller mountainous areas of Langkrans, KwaCeza, KwaNtimbankulu and Nhlazatshe. Altitude 780–1 540 m.

Vegetation & Landscape Features Gentle to steep upper slopes of mountains formed by hard dolerite dykes dominated by relatively forb-rich, tall sour *Themeda triandra* grasslands.

Geology & Soils Shales and sandstones of the Madzaringwe and Pietermaritzburg Formations (both Karoo Supergroup) as well as intrusive rocks of the Karoo Dolerite Suite. Dominant soil forms are Hutton, Clovelly and Griffin and are well drained, having 15–35% clay in the A-horizon. Dominant land type Ac, followed in importance by Fa and Ab.

Climate Summer rainfall, with overall MAP around 960 mm, reaching 1 130 mm in places. Moisture-laden air frequently blows in from the southeast and is forced up 400–500 m over the mountains, creating 'mistbelt' conditions (particularly in spring and summer) that contribute to precipitation. MAT is 17.2°C (16–17.4°C) and mean annual range of evaporation is close to 1 790 mm. See also climate diagram for Gs 1 Northern Zululand Mistbelt Grassland (Figure 8.61).

Important Taxa Graminoids: *Themeda triandra* (d), *Tristachya leucothrix* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon schirensis*, *Aristida monticola*, *Brachiaria serrata*, *Cymbopogon nardus*, *Cyperus albostriatus*, *Ehrharta erecta* var. *erecta*, *Elionurus muticus*, *Eragrostis plana*, *E. racemosa*, *Hyparrhenia hirta*, *Loudetia simplex*, *Microchloa caffra*, *Monocymbium ceresiiforme*, *Panicum deustum*, *Paspalum scrobiculatum*, *Rendlia altera*, *Schizachyrium sanguineum*, *Setaria nigrirostris*, *Sporobolus africanus*, *Trachypogon spicatus*. Herbs: *Aeschynomene micrantha*, *Conostomium natalense*, *Helichrysum chionosphaerum*, *H. nanum*, *H. nudifolium* var. *oxyphyllum*, *H. nudifolium* var. *pilosellum*, *H. umbraculigerum*, *Hermannia grandistipula*. Geophytic Herbs: *Cheilanthes hirta*, *Oxalis smithiana*, *Watsonia latifolia*. Small Tree: *Apodytes dimidiata* subsp. *dimidiata*. Low Shrubs: *Asparagus virgatus*, *Clutia pulchella*. Succulent Shrub: *Aloe arborescens*.

Biogeographically Important Taxon (Low Escarpment endemic) Herb: *Melanospermum italae*.

Endemic Taxa Herbs: *Dracosciadium italae*, *Helichrysum ingomense*, *Selago barbula*. Geophytic Herbs: *Brachystelma ngomense*, *Dierama erectum*, *Schizoglossum ingomense*.

Conservation Vulnerable. Target 23%. Only about 3% statutorily conserved in the Ithala Nature Reserve and in the Ntendeka Wilderness Area of the Ngome State Forest (Scott-Shaw et al. 1996, Scott-Shaw 1999). Some 22% has been transformed for plantations or cultivated land. Threats to the remaining grasslands are heavy selective grazing by livestock and extensive annual burning. Spread of alien *Acacia mearnsii* and *Eucalyptus* species is of serious concern. Erosion very low (47%), moderate (29%), low (14%) and high (10%).

Remarks This vegetation unit surrounds a large patch of Northern Midlands Mistbelt Forest (Von Maltitz et al. 2003) at Ngome. Camp (1999a) indicated that a striking difference between this unit and his BRG 5 and BRG 7 (constituting Midlands Mistbelt Grassland) is the lack of *Aristida junciformis* subsp. *junciformis*. A number of endemic species confined to the region of the Northern Zululand Mistbelt Grassland add to this differentiation.

References Acocks (1953, 1988), Scott-Shaw et al. (1996), Camp (1999a), Scott-Shaw (1999),

Gs 2 Ithala Quartzite Sourveld

VT 64 Northern Tall Grassveld (Transition between Piet Retief Sourveld and Southern Tall Grassveld) (34%), VT 10 Lowveld (32%) (Acocks 1953). LR 43 North-eastern Mountain Grassland (54%) (Low & Rebelo 1996). BRG 20 Dry Zululand Thornveld (42%), BRG 16 Dry Lowland Tall Grassveld (9%) (Camp 1999c, d).

Distribution KwaZulu-Natal and Mpumalanga Provinces and Swaziland: Confined to large quartzite patches that occur from Amsterdam, southwards east of Piet Retief and through Mahamba, to the Paris Dam and Ithala Game Reserve, with isolated outcrops near Magudu. Altitude 440–1 360 m.

Vegetation & Landscape Features Low mountain ranges and undulating hills with rocky lowlands. The general pattern is a mosaic of woody shrubs and small trees in rocky areas, interspersed in the grass layer. Vegetation structure varies according to altitude and rockiness, but the basal density of the grass sward is relatively low. This unit occurs in the zone between Grassland and Savanna where the dominant grassland gives way to woodland as elevation decreases. The grasslands are species-rich covering a variety of altitudes but sharing common species unique to the dystrophic quartzite geology.

Geology & Soils Quartzite of the Mozaan Group (Pongola Supergroup) of the Randian age supporting shallow soils typical of Fb (prevalent) and Fa (marginal) land types.

Climate Rainfall peaks in midsummer. MAP from about 1 200 mm in the west to 570 mm in the east (MAP 795 mm). Frost does occur, but is infrequent. See also climate diagram for Gs 2 Ithala Quartzite Sourveld (Figure 8.61).

Important Taxa Small Trees: *Combretum molle* (d), *Englerophytum magalismontanum* (d), *Syzygium legatii* (d), *Acacia caffra*, *A. davyi*, *Cassipourea swaziensis*, *Cussonia natalensis*, *Dombeya cymosa*, *Faurea rochetiana*, *F. saligna*, *Ficus burtt-davyi*, *Lannea discolor*, *Pachystigma macrocalyx*, *Pavetta edentula*, *Protea caffra* subsp. *caffra*, *P. roupelliae* subsp. *roupelliae*, *Pterocarpus angolensis*. Tall Shrubs: *Morella pilulifera* (d), *Pavetta gracilifolia* (d), *Protea gaguedi*, *Rhus pallens*, *R. pentheri*. Woody Climber: *Jasminum multipartitum*. Low Shrubs: *Gymnosporia tenuispina* (d), *Helichrysum lepidissimum* (d), *Lopholaena platyphylla*. Succulent Shrub: *Crassula sarcocaulis*. Graminoids: *Heteropogon contortus* (d), *Hyperthelia dissoluta* (d), *Loudetia simplex* (d), *Monocymbium ceresiiforme* (d), *Panicum natalense* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Bothriochloa insculpta*, *Diheteropogon amplectens*, *Melinis nerviglumis*, *Pogonarthria squarrosa*, *Sporobolus pectinatus*. Herbs: *Anisopappus smutsii* (d), *Xerophyta retinervis*. Succulent Herb: *Aloe cooperi* subsp. *cooperi*. Succulent Herbaceous Climber: *Ceropegia sandersonii*.

Biogeographically Important Taxa ([L]Low Escarpment endemic, [N]Northern sourveld endemic) Small Tree: *Protea comptonii*[N]. Tall Shrub: *Tricalysia capensis* var. *galpinii*[N] (d). Low Shrub: *Hemizygia macrophylla*[L]. Succulent Shrub: *Aloe suprafoliata*[N] (d). Herbs: *Melanospermum italae*[L], *Thorncroftia longiflora*[N]. Geophytic Herb: *Gladiolus vernus*[N].

Endemic Taxa Tall Shrub: *Euclea natalensis* subsp. *magutensis*. Succulent Shrub: *Aloe dewetii*. Graminoid: *Danthoniopsis scopulorum*. Geophytic Herb: *Gladiolus scabridus*.

Conservation Least threatened. The target of 27% has not been reached. A total of 10% of this unit is protected within the Ithala Game Reserve. Land use pressures on this unit are low, probably because of its low nutrient status and rocky nature. Approximately 5% is under plantations and a further 5% has been transformed into cultivated land. Soil erosion potential is low.

Remarks This naturally fragmented vegetation unit is characterised by its rocky and nutrient-poor soils which support a unique assemblage of plant species. It shares some species with the nutrient-poor soils of the Northern Escarpment (e.g. *Syzygium legatii*) and Barberton areas (e.g. *Thorncroftia longiflora*, *Protea comptonii*). These latter units have a higher MAP.

References Acocks (1953, 1988), M.C. Lötter (unpublished data).

Gs 3 Low Escarpment Moist Grassland

VT 44 Highland Sourveld and Dohne Sourveld (54%) (Acocks 1953). LR 41 Wet Cold Highveld Grassland (54%) (Low & Rebelo 1996). BRG 8 Moist Highland Sourveld (70%) (Camp 1999b).

M.C. Lötter

Figure 8.63 Gs 2 Ithala Quartzite Sourveld: Sparse rocky grassland with shrubby *Englerophytum magalismontanum*, *Aloe suprafoliata* and *Acacia karroo* on quartzite ridges in the Ithala Game Reserve (northern KwaZulu-Natal).

Distribution KwaZulu-Natal, Free State and Mpumalanga Provinces: Slopes of the Drakensberg, on both sides of the provincial boundary from Oliviershoek (near Harrismith) to Volksrust. Altitude 1 300–2 000 m.

Vegetation & Landscape Features Complex mountain topography. Steep, generally east- and south-facing slopes, with a large altitudinal range. Supporting tall, closed grassland with *Hyparrhenia hirta* and *Themeda triandra* dominant. *Protea caffra* communities and patches of *Leucosidea* scrub feature at higher altitudes.

Geology & Soils Ecca and Beaufort Groups (Karoo Supergroup) mudstone or shale. Soils are mainly of the Hutton form, but also shallower forms such as Glenrosa and Mispah. Half of the area is classified as Fa land type, while the rest is shared among Ac, Bb and Ad land types.

Climate Summer rainfall, with peak from December to January. Frequent fog adds

to the overall precipitation. MAP is almost 920 mm and mean annual evaporation reaches 1 770 mm. MAT of 14.3°C and almost 30 days of frost indicate that the unit is found close to the lower limit of warm-temperate climate. See also climate diagram for Gs 3 Low Escarpment Moist Grassland (Figure 8.61).

Important Taxa Graminoids: *Alloteropsis semialata* subsp. *eckloniana* (d), *Andropogon schirensis* (d), *Diheteropogon filifolius* (d), *Eragrostis plana* (d), *Hyparrhenia hirta* (d), *Monocymbium ceresiiforme* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *Andropogon appendiculatus*, *Brachiaria serrata*, *Brachypodium flexum*, *Cynodon dactylon*, *C. transvaalensis*, *Digitaria diagonalis*, *D. monodactyla*, *D. tricholaenoides*, *Diheteropogon amplectens*, *Eragrostis capensis*, *E. chloromelas*, *E. curvula*, *E. gummiflua*, *E. racemosa*, *Harpochloa falx*, *Hyparrhenia tamba*, *Koeleria capensis*, *Loudetia simplex*, *Panicum ecklonii*, *P. natalense*. Herbs: *Acanthospermum australe* (d), *Vernonia natalensis* (d), *Acalypha depressinerva*, *Adenocline acuta*, *Berkheya rhapontica* subsp. *rhapontica*, *Corchorus confusus*, *Crabbea acaulis*, *Cucumis zeyheri*, *Eriosema cordatum*, *Graderia scabra*, *Haplocarpha scaposa*, *Helichrysum miconiifolium*, *H. oreophilum*, *H. psilolepis*, *H. rugulosum*, *H. spiralepis*, *Kohautia amatymbica*, *Lotononis procumbens*, *Nidorella anomala*, *Pentanisia prunelloides* subsp. *latifolia*, *Selago densiflora*, *Senecio venosus*, *Zaluzianskya microsiphon*. Herbaceous Climber: *Rhynchosia totta*. Geophytic Herbs: *Corycium dracomontanum*, *C. nigrescens*, *Gladiolus crassifolius*, *Habenaria dives*, *Hypoxis hemerocallidea*, *H. multiceps*, *H. rigidula* var. *pilosissima*, *Pteridium aquilinum*. Low Shrubs: *Anthospermum rigidum* subsp. *pumilum*, *Chaetacanthus burchellii*, *Clutia pulchella*, *Gnidia kraussiana*, *Helichrysum hypoleucum*, *H. infaustum*, *Phyllanthus glaucophyllus*.

Biogeographically Important Taxon (Low Escarpment endemic) Low Shrub: *Heteromma krookii*.

Endemic Taxon Geophytic Herb: *Holothrix majubensis*.

Conservation Least threatened. Target 23%. Only 2% statutorily conserved in the Sterkfontein Dam Nature Reserve (Free State) and Ncandu Nature Reserve (KwaZulu-Natal). About 6% has been transformed by plantations or cultivated land. Alien *Acacia dealbata* occurs in places. Erosion very low (56%) and low (38%).

Remark A series of patches of Northern KwaZulu-Natal Mistbelt Forests (see Von Maltitz et al. 2003) are embedded within this type of grassland in sub-escarpment regions and deep-kloof positions.

References Acocks (1953, 1988), Edwards (1967), Smit (1992), Smit et al. (1992, 1993b, 1995a, b), Camp (1999b).

Gs 4 Northern KwaZulu-Natal Moist Grassland

VT 65 Southern Tall Grassveld (70%) (Acocks 1953). LR 43 North-eastern Mountain Grassland (53%) (Low & Rebelo 1996). BRG 11 Moist Transitional Tall Grassveld (54%) (Camp 1999a).

Distribution KwaZulu-Natal Province: Northern and northwestern regions of the Province, where it forms a discontinuous rim around the upper Thukela Basin and is situated almost entirely within the catchment of the Thukela River. It lies between the drier Gs 6 KwaZulu-Natal Highland Thornveld and the moist upland vegetation of mainly Gs 3 Low Escarpment Moist Grassland to the north and Gs 10 Drakensberg Foothill Moist Grassland to the west. The most extensive areas are in the vicinity of Winterton, Bergville, Fort Mistake, Dannhauser, Dundee, north of Ladysmith and west of Newcastle. At higher altitudes this unit is usually surrounded by Gs 3 Low Escarpment Moist Grassland in the north and Gs 10 Drakensberg Foothill Moist Grassland in the west and south. At lower altitudes Gs 6 KwaZulu-Natal Highland Thornveld and SVs 2 Thukela Thornveld usually occur to the east. Altitude 1 040–1 440 m.

Vegetation & Landscape Features Hilly and rolling landscapes supporting tall tussock grassland usually dominated by *Themeda triandra* and *Hyparrhenia hirta*. Open *Acacia sieberiana* var. *woodii* savannoid woodlands encroach up the valleys, usually on disturbed (strongly eroded) sites.

Geology & Soils Mudstones, sandstones and shales of the Beaufort and Ecca Groups of the Karoo Supergroup predominate and are intruded by dolerites of Jurassic age. Land types Bb, Ac, Fa and Ca.

Climate Summer rainfall, with overall MAP of 840 mm (710–1 120 mm; Camp 1999a), mainly as summer thunderstorms. Mist occurs frequently on hilltops in spring and early summer, but summer droughts are also frequent. Summers are warm to hot, with maximum temperature recorded in the hottest month of January (Bergville MAT 27.8°C). MAT is around 16°C, but some localities may reach 17°C. Frosts are severe and occur about 20 days per year. Mean annual evaporation recorded at Bergville is 1 895 mm. See also climate diagram for Gs 4 Northern KwaZulu-Natal Moist Grassland (Figure 8.61).

Important Taxa Graminoids: *Alloteropsis semialata* subsp. *eckloniana* (d), *Aristida congesta* (d), *Cynodon dactylon* (d), *Digitaria tricholaenoides* (d), *Elionurus muticus* (d), *Eragrostis patentissima* (d), *E. racemosa* (d), *Harpochloa falx* (d), *Hyparrhenia hirta* (d), *Themeda triandra* (d), *Tristachya leucothrix* (d), *Abildgaardia ovata*, *Andropogon appendiculatus*, *A. eucomus*, *A. schirensis*, *Aristida junciformis* subsp. *galpinii*, *Brachiaria serrata*, *Cymbopogon caesius*, *C. pospischilii*, *Cynodon incompletus*, *Digitaria monodactyla*, *D. san-*

P.J. du Preez

Figure 8.64 Gs 4 Northern KwaZulu-Natal Moist Grassland: Savannoid grasslands with *Acacia sieberiana* var. *woodii* near Weenen (northern KwaZulu-Natal).

guinalis, *Diheteropogon amplectens*, *D. filifolius*, *Eragrostis chloromelas*, *E. plana*, *E. planiculmis*, *E. sclerantha*, *Festuca scabra*, *Heteropogon contortus*, *Hyparrhenia dregeana*, *Melinis nerviglumis*, *Microchloa caffra*, *Panicum natalense*, *Paspalum scrobiculatum*, *Setaria nigrirostris*, *Sporobolus africanus*. Herbs: *Acanthospermum australe* (d), *Argyrolobium speciosum* (d), *Eriosema kraussianum* (d), *Geranium wakkerstroomianum* (d), *Pelargonium luridum* (d), *Acalypha peduncularis*, *Chamaecrista mimosoides*, *Dicoma anomala*, *Euryops transvaalensis* subsp. *setilobus*, *Helichrysum caespititium*, *H. rugulosum*, *Hermannia depressa*, *Ipomoea crassipes*, *Pearsonia grandifolia*, *Pentanisia prunelloides* subsp. *latifolia*, *Sebaea grandis*, *Senecio inornatus*, *Thunbergia atriplicifolia*, *Zaluzianskya microsiphon*. Geophytic Herbs: *Chlorophytum haygarthii* (d), *Gladiolus aurantiacus* (d), *Asclepias aurea*, *Cyrtanthus tuckii* var. *transvaalensis*, *Gladiolus crassifolius*, *Hypoxis colchicifolia*, *H. multiceps*, *Moraea brevistyla*, *Zantedeschia rehmannii*. Succulent Herbs: *Aloe ecklonis*, *Lopholaena segmentata*. Low Shrubs: *Anthospermum rigidum* subsp. *pumilum*, *Erica oatesii*, *Hermannia geniculata*. Succulent Shrub: *Euphorbia pulvinata*.

Biogeographically Important Taxa (both Low Escarpment endemics) Succulent Herb: *Aloe modesta*. Low Shrub: *Bowkeria citrina*.

Conservation Vulnerable. Target 24%. Only about 2% statutorily conserved in the uKhahlamba Drakensberg Park as well as in the Chelmsford, Spioenkop, Moor Park, Wagendrift, Ncandu Nature Reserves. More than a quarter has already been transformed either for cultivation, plantations and urban sprawl or by building of dams (Chelmsford, Driel, Kilburn, Mtoti, Wagendrift, Windsor and Woodstock). Alien *Acacia dealbata*, *Rubus*, *Eucalyptus* and *Populus* are invasive in places. Bush encroachment is common. Erosion very low (53%), low (2%) and moderate (20%).

References Acocks (1953, 1988), Smit (1992), Smit et al. (1993a, 1995a, c), Camp (1999a).

Gs 5 Northern KwaZulu-Natal Shrubland

VT 65 Southern Tall Grassveld (68%) (Acocks 1953). Interior *Acacia caffra* Scrub and Tree Veld & *Diospyros lycioides* Scrub (Edwards 1967). LR 25 Natal Central Bushveld (60%) (Low & Rebelo 1996). BRG 11 Moist Transitional Tall Grassveld (42%), BRG 12 Moist Tall Grassveld (34%) (Camp 1999a, c).

Distribution KwaZulu-Natal Province: A widely scattered group of patches. Embedded within Sub-Escarpment Grassland units of Gs 4, Gs 6 and Gs 7, from Ladysmith in the west to Vryheid in the northeast. Large portions of this unit are found in the surrounds of Newcastle. Altitude 1 100–1 540 m.

Vegetation & Landscape Features Small dolerite koppies and steeper slopes of ridges with sparse grass cover and typical occurrence of scattered shrubland pockets (and locally also thickets). *Acacia caffra*, *A. natalitia*, *Clerodendrum glabrum*, *Diospyros lycioides*, *Rhus pyroides*, *R. pentheri*, *Scutia myrtina* etc. are the most prominent shrubs and small trees.

Geology & Soils Karoo Sequence sediments underlie this area: Madzaringwe Formation shale and sandstones are found in the east and Adelaide Subgroup and Volksrust Formation mudrocks occur in the west. The most significant feature is the intrusive dolerite dykes and sills which give rise to heavy clayey soils. Fa and Fb land types have an equal importance, followed by Ea.

Climate Summer rainfall, with MAP 800 mm. Overall MAT of 16.1°C indicates a transition between cool- and warm-temperate climates. Frost fairly infrequent. See also climate diagram for Gs 5 Northern KwaZulu-Natal Shrubland (Figure 8.61).

Important Taxa Small Trees: *Acacia caffra* (d), *A. natalitia* (d), *A. sieberiana* var. *woodii*, *Cussonia paniculata*, *Euclea crispa* subsp. *crispa*, *Heteromorpha arborescens* var. *abyssinica*, *Hippobromus pauciflorus*, *Scutia myrtina*, *Ziziphus mucronata*. Tall Shrubs: *Diospyros lycioides* subsp. *lycioides* (d), *Rhus rehmanniana* var. *rehmanniana* (d), *Acokanthera oppositifolia*, *Asparagus setaceus*, *Canthium mundianum*, *Cephalanthus natalensis*, *Clerodendrum glabrum*, *Diospyros whyteana*, *Euclea natalensis* subsp. *angustifolia*, *Leonotis leonurus*, *Lippia javanica*, *Pavetta gardeniifolia* var. *gardeniifolia*, *Rhus dentata*, *R. lucida*, *R. pentheri*, *R. pyroides*, *Scolopia zeyheri*. Woody Climbers: *Clematis brachiata*, *Dalbergia obovata*, *Dioscorea sylvatica*, *Jasminum breviflorum*, *Rhoicissus tridentata*. Succulent Woody Climber: *Sarcostemma viminale*. Low Shrubs: *Barleria obtusa* (d), *Anthospermum rigidum* subsp. *pumilum*, *Artemisia afra*, *Chaetacanthus burchellii*, *Euryops pedunculatus, Grewia hispida*, *Phyllanthus glaucophyllus*, *Pygmaeothamnus chamaedendrum*. Succulent Shrub: *Euphorbia clavarioides* var. *clavarioides*. Graminoids: *Cymbopogon caesius* (d), *Eragrostis racemosa* (d), *Hyparrhenia hirta* (d), *Themeda triandra* (d), *Bothriochloa insculpta*, *Cymbopogon nardus*, *Eragrostis curvula*, *E. plana*, *Hyparrhenia dregeana*, *Setaria sphacelata*. Herbs: *Acalypha caperonioides*, *A. punctata*, *Aster bakerianus*, *Commelina africana*, *Conyza obscura*, *Corchorus confusus*, *Crabbea angustifolia*, *Dicoma anomala*, *Eriosema cordatum*, *Helichrysum rugulosum*, *Ipomoea oblongata*, *Monsonia angustifolia*, *Selago densiflora*, *Stachys natalensis*. Geophytic Herbs: *Cheilanthes hirta*, *C. quadripinnata*, *Hypoxis rigidula* var. *pilosissima*, *Ledebouria ovatifolia*, *Oxalis obliquifolia*, *Pellaea calomelanos*, *Raphionacme hirsuta*. Succulent Herbs: *Aloe maculata*, *Crassula alba*.

Biogeographically Important Taxon (endemic to northern KwaZulu-Natal) Herb: *Cissus cussonioides*.

Endemic Taxon Tall Shrub: *Calpurnia woodii*.

Conservation Least threatened. Target 23%. Less than 1% statutorily conserved in the Spioenkop Nature Reserve. About 3% transformed by cultivation. Erosion very low (35%), moderate (29%), low (22%) and high (10%).

Remark This vegetation is floristically similar to sourveld of the Highveld region (e.g. Suikerbosrand) on the one hand and to montane shrublands of the Drakensberg area on the other.

References Smit et al. (1995b), Eckhardt et al. (1997), Eckhardt (1998), Robesson (1998).

Gs 6 KwaZulu-Natal Highland Thornveld

VT 65 Southern Tall Grassveld (57%) (Acocks 1953). *Acacia sieberiana* Tree Veld (Edwards 1967). LR 25 Natal Central Bushveld (72%) (Low & Rebelo 1996). BRG 13 Dry Tall Grassveld (89%) (Camp 1999c).

Distribution KwaZulu-Natal Province: A series of several patches in the central-northern regions of KwaZulu-Natal, where it occurs on both dry valleys and moist upland. The most extensive area is found in the region from Ladysmith, Winterton, Estcourt and Colenso, between Mooi River and Greytown, between Pomeroy and Babanago, and further north in a triangle between Vryheid, Paulpietersburg and Louwsburg as well as a large patch around Newcastle. Altitude 920–1 440 m.

Vegetation & Landscape Features Hilly, undulating landscapes and broad valleys supporting tall tussock grassland usually dominated by *Hyparrhenia hirta*, with occasional savannoid woodlands with scattered *Acacia sieberiana* var. *woodii* and in small pockets also with *A. karroo* and *A. nilotica*.

Geology & Soils A variety of Karoo Supergroup rocks occur in the area, including the Dwyka, Ecca and Beaufort Groups and marginally also Jurassic dolerite intrusions. Yellow-brown soils over plinthic subsoil and shallow duplex soils are common. Red and black heavy soils are derived from dolerites and show high resistance to erosion. The unit falls within various land types, including Ca, Fb, Fa, Db and Bb.

Climate Summer rainfall. MAP about 750 mm (79 rain days per year; Camp 1999c). The midwinter months of June and July have 2.6 rain days on average. Much of the summer precipitation comes in form of thunderstorms (63 and 56 thunderstorm days per year for Ladysmith and Estcourt, respectively). Mist is uncommon (14 days of mist per year for both Ladysmith and Estcourt). MAT 15.6–19.0°C (overall average 16.5°C). Summers are warm to hot, winters are cool. There are 15 frost days per year. The mean annual evaporation recorded at Estcourt is 1 725 mm, while the range for the entire vegetation unit is 1 706–1 918 mm (Camp 1999c), the overall average 1 830 mm. See also climate diagram for Gs 6 KwaZulu-Natal Highland Thornveld (Figure 8.61).

Important Taxa Small Trees: *Acacia sieberiana* var. *woodii* (d), *A. natalitia*, *A. nilotica*, *Cussonia spicata*, *Ziziphus mucronata*. Tall Shrub: *Dichrostachys cinerea*. Low Shrubs: *Barleria obtusa* (d), *Anthospermum rigidum* subsp. *pumilum*, *Chaetacanthus setiger*, *Gymnosporia heterophylla*. Semiparasitic Shrub: *Thesium costatum*. Graminoids: *Abildgaardia ovata* (d), *Andropogon eucomus* (d), *Aristida bipartita* (d), *A. congesta* (d), *Chloris virgata* (d), *Cynodon dactylon* (d), *Elionurus muticus* (d), *Eragrostis capensis* (d), *E. chloromelas* (d), *E. plana* (d), *E. racemosa* (d), *E. superba* (d), *Heteropogon contortus* (d), *Hyparrhenia hirta* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tristachya leucothrix* (d), *Andropogon appendiculatus*, *Brachiaria serrata*, *Cymbopogon caesius*, *C. marginatus*, *C. pospischilii*, *Cyperus obtusiflorus* var. *obtusiflorus*, *Digitaria monodactyla*, *D. tricholaenoides*, *Diheteropogon amplectens*, *Eragrostis curvula*, *E. gummiflua*, *E. patentissima*, *Harpochloa falx*, *Microchloa caffra*, *Panicum natalense*, *Setaria nigrirostris*, *Sporobolus africanus*, *S. pyramidalis*. Herbs: *Hermannia depressa* (d), *Becium filamentosum*, *Chamaecrista mimosoides*, *Euryops transvaalensis* subsp. *setilobus, Haplocarpha scaposa*, *Helichrysum rugulosum*. Herbaceous Climber: *Rhynchosia totta*. Geophytic Herb: *Haemanthus montanus*. Succulent Herbs: *Aloe dominella*, *A. greenii*, *Orbea woodii*.

Endemic Taxa Low Shrub: *Barleria greenii*. Succulent Shrub: *Aloe gerstneri*. Succulent Herb: *Aloe inconspicua*.

Conservation Least threatened. Target 23%. Only about 2% statutorily conserved in the Spioenkop, Weenen, Ntinini, Wagendrift, Moor Park and Tugela Drift Nature Reserves. More than 16% has been transformed for cultivation and by urban sprawl as well as by building of dams (Craigie Burn, Spioenkop, Wagendrift and Windsor). Alien *Opuntia*, *Eucalyptus*, *Populus*, *Acacia* and *Melia* are becoming invasive in places, but probably the greatest threat to the remaining natural areas of this unit is bush encroachment. Erosion very low (34%), low (29%), moderate (2%) and high (12%).

Remarks The presence of sparse woodlands with *Acacia* are considered a management problem and ascribed to 'bush encroachment' (Edwards 1967, Camp 1999c). One may, however, argue that the region of this vegetation unit has always been a natural mosaic of open tall grassland and sparse woodland (with virtually the same species composition as the neighbouring grassland), with progressive encroachment of woody elements into grassland, especially in heavily disturbed areas.

References Acocks (1953, 1988), Edwards (1967), Adams (1996), Morris & Tainton (1996), Roos & Allsopp (1997), Robesson (1998), Camp (1999c), Scott-Shaw (1999).

Gs 7 Income Sandy Grassland

VT 66 Natal Sour Sandveld (68%) (Acocks 1953). LR 25 Natal Central Bushveld (85%) (Low & Rebelo 1996). BRG 14 Sour Sandveld (76%) (Camp 1999c).

Distribution KwaZulu-Natal Province: In a large triangle between Newcastle, Vryheid and Dundee and larger polygon in the Wasbank area in northern KwaZulu-Natal. Altitude 880–1 340 m (mainly 1 120–1 240 m).

Vegetation & Landscape Features Very flat extensive areas with generally shallow, poorly drained, sandy soils supporting low, tussock-dominated sourveld forming a mosaic with wooded grasslands (with *Acacia sieberiana* var. *woodii*) and on well-drained sites with the trees *A. karroo*, *A. nilotica*, *A. caffra* and *Diospyros lycioides*. On disturbed sites *A. sieberiana* var. *woodii* can form sparse woodlands. *Aristida congesta*, *Cynodon dactylon* and *Microchloa caffra* are common on shallow soils (Camp 1999c).

Geology & Soils Sandstones and shale of the Madzaringwe Formation (Ecca Group of Karoo Supergroup) supporting poorly drained sandy soils, mostly of the Glenrosa form. Most important land types Ca, Bb and Fb.

Climate Region of summer rainfall, with most precipitation occurring between October and March (overall MAP 750 mm; range 650–800 mm), much of which falls as thundershowers often accompanied by hail. MAT is just below 17°C, and mean annual evaporation 1 845 mm. Frost moderate (Camp 1999c). See also climate diagram for Gs 7 Income Sandy Grassland (Figure 8.61).

Important Taxa Graminoids: *Andropogon appendiculatus* (d), *Brachiaria serrata* (d), *Cynodon dactylon* (d), *Digitaria monodactyla* (d), *D. tricholaenoides* (d), *Eragrostis curvula* (d), *E. gummiflua* (d), *E. plana* (d), *E. racemosa* (d), *Heteropogon contortus* (d), *Hyparrhenia hirta* (d), *Loudetia simplex* (d), *Paspalum scrobiculatum* (d), *Tristachya leucothrix* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon eucomus*, *A. schirensis*, *Aristida congesta*, *A. junciformis* subsp. *galpinii*, *Cymbopogon caesius*, *Diheteropogon amplectens*, *D. filifolius*, *Elionurus muticus*, *Eragrostis capensis*, *E. chloromelas*, *E. planiculmis*, *E. scleranthа*, *Harpochloa falx*, *Melinis repens* subsp. *repens*, *Microchloa caffra*, *Monocymbium ceresiiforme*, *Panicum natalense*, *Perotis patens*, *Pogonarthria squarrosa*, *Setaria nigrirostris*, *Sporobolus africanus*, *Stiburus conrathii*, *Themeda triandra*, *Trichoneura grandiglumis*. Herbs: *Helichrysum rugulosum* (d), *Berkheya onopordifolia* var. *glabra*, *B. setifera*, *Chamaecrista mimosoides*, *Dicoma anomala*, *Euryops transvaalensis* subsp. *setilobus*, *Helichrysum caespititium*, *H. cephaloideum*, *H. simillimum*, *Hermannia depressa*, *H. transvaalensis*, *Kohautia amatymbica*, *K. virgata*, *Macledium zeyheri* subsp. *argyrophylum*, *Pentanisia prunelloides* subsp. *latifolia*, *Senecio coronatus*, *Zornia capensis*. Herbaceous Climber: *Rhynchosia totta*. Geophytic Herb: *Hypoxis rigidula* var. *pilosissima*. Low Shrubs: *Anthospermum rigidum* subsp. *pumilum*, *Stoebe plumosa*.

Conservation Vulnerable. Target 23%. None conserved in statutory conservation areas. Some 27% has been transformed for cultivation, plantations and by urban sprawl. Small portion of the area has been lost to the building of dams (Klipfontein, Mvunyane). No serious invasions of aliens have been observed (probably due to low nutrient status of soils). Erosion moderate (38%), high (30%) and low (15%).

Remarks The differences between this unit and the Gs 13 Mabela Sandy Grassland (in East Griqualand), lie especially in some climatic and vegetation patterns. Cedarville (in Gs 13 Mabela Sandy Grassland) is much colder (MAT 14°C), shows lower transpiration, has higher incidence of frost and hence lacks indigenous trees.

References Acocks (1953, 1988), Eckhardt et al. (1996a, b), Eckhardt (1998), Camp (1999c).

Gs 8 Mooi River Highland Grassland

VT 44 Highland Sourveld and Dohne Sourveld (77%) (Acocks 1953). LR 42 Moist Upland Grassland (48%), LR 43 North-eastern Mountain Grassland (27%) (Low & Rebelo 1996). BRG 9 Dry Highland Sourveld (99%) (Camp 1999b).

Distribution KwaZulu-Natal Province: Centre of occurrence in the Mooi River Basin, several scattered large patches near Underberg and Greytown, and on the Helpmekaar Plateau southeast of Dundee. Altitude 1 340–1 620 m.

Vegetation & Landscape Features Mainly rolling and partly broken landscape, covered in grassland dominated by short bunch grasses. *Heteropogon contortus*, *Themeda triandra* and *Tristachya leucothrix* are dominant in well-managed veld.

Geology & Soils A mosaic of generally shallow and poorly drained soils derived from sedimentary rocks, mostly of the Adelaide Subgroup (Beaufort Group) of the Karoo Sequence. Deep well-drained apedal soils of the intrusive igneous rocks of the Karoo Dolerite Suite also occur. Almost half of the area is classified as Ac land type, followed by Bb and to lesser extent also Fa.

Climate The region has a MAP of 785 mm, falling mostly in summer. Mist and snow are not frequent. Overall MAT is slightly higher than 14°C. Light, but relatively frequent (30 days per year) frosts may occur for six months in the year (Camp 1999b). See also climate diagram for Gs 8 Mooi River Highland Grassland (Figure 8.61).

Important Taxa Graminoids: *Diheteropogon filifolius* (d), *Eragrostis curvula* (d), *E. plana* (d), *E. racemosa* (d), *Heteropogon contortus* (d), *Microchloa caffra* (d), *Monocymbium ceresiiforme* (d), *Panicum ecklonii* (d), *P. gilvum* (d), *Sporobolus africanus* (d), *Themeda triandra* (d), *Tristachya leucothrix* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon schirensis*, *Aristida junciformis* subsp. *galpinii*, *Brachiaria serrata*, *Cynodon dactylon*, *Digitaria monodactyla*, *D. tricholaenoides*, *Diheteropogon amplectens*, *Eragrostis capensis*, *E. chloromelas*, *Harpochloa falx*, *Pycreus flavescens*, *P. niger* subsp. *niger*, *Setaria nigrirostris*. Herbs: *Acalypha depressinerva*, *Becium filamentosum*, *Berkheya setifera*, *Conyza pinnata*, *Didymodoxa caffra*, *Geranium ornithopodioides*, *Pentanisia prunelloides* subsp. *latifolia*, *Plectranthus laxiflorus*, *Salvia repens*, *Schistostephium crataegifolium*, *Sebaea grandis*, *Senecio gregatus*, *Vernonia natalensis*. Herbaceous Climbers: *Rhynchosia caribaea* (d), *R. totta*. Geophytic Herb: *Oxalis purpurea*. Low Shrubs: *Anthospermum rigidum* subsp. *pumilum*, *Senecio burchellii*.

Conservation Vulnerable. Target 23%. Only a tiny part statutorily conserved in the Swamp Nature Reserve. Almost a quarter of the area has been transformed for cultivation (maize, beef and dairy farming) or plantations. Alien woody plants such as *Acacia dealbata*, *Rubus* species, *Melia azedarach*, *Sesbania punicea*, *Populus x canescens*, *P. alba* and *Eucalyptus* species are invaders in some places. Erosion is very low (70%) and low (25%).

Remark This unit is a dry version of Gs 10 Drakensberg Foothill Moist Grassland, generally occurring in an adjacent rainshadow area.

References Acocks (1953, 1988), Camp (1999b).

Gs 9 Midlands Mistbelt Grassland

VT 45 Ngongoni Veld of Natal Mist-belt (38%), VT 44 Highland Sourveld and Dohne Sourveld (33%) (Acocks 1953). LR 42 Moist Upland Grassland (41%), LR 47 Short Mistbelt Grassland (37%) (Low & Rebelo 1996). BRG 5 Moist Midlands Mistbelt, BRG 6 Dry Midlands Mistbelt (Camp 1999a).

Distribution KwaZulu-Natal and Eastern Cape Provinces: KwaZulu-Natal Midlands—scattered in broad belt in the form of several major patches including Melmoth-Babanango area, Kranskop and Greytown, Howick Lions River, Karkloof, Balgowan, Cedara, Edendale, Hilton, Richmond, the Ixopo-Highflats area, Mount Malowe in the Umzimkhulu enclave of the Eastern Cape Province and the Harding-Weza area. The southwesternmost section in the Eastern Cape Province falls in the Bulembu, Gxwaleni, Longweni and Flagstaff areas. Altitude 760–1 400 m.

Vegetation & Landscape Features Hilly and rolling landscape mainly associated with a discontinuous east-facing scarp formed by dolerite intrusions (south of the Thukela River). Dominated by forb-rich, tall, sour *Themeda triandra* grasslands transformed by the invasion of native 'Ngongoni grass (*Aristida junciformis* subsp. *junciformis*). Only a few patches of the original species-rich grasslands remain.

Geology & Soils Apedal and plinthic soil forms derived mostly from Ecca Group (Karoo Supergroup) shale and minor sandstone and less importantly from

P.J. du Preez

Figure 8.65 Gs 8 Mooi River Highland Grassland: Patch of Sub-Escarpment Grassland near Mooi River (western KwaZulu-Natal) dominated by grasses such as *Themeda triandra, Harpochloa falx, Tristachya leucothrix* and *Hyparrhenia hirta* supporting a rich herb flora.

Jurassic dolerite dykes and sills. Dominant land type Ac, followed by Fa.

Climate Summer rainfall, with MAP of 915 mm, range 730–1 280 mm. Heavy and frequent occurrence of mist provides significant amounts of additional moisture (Cedara near Pietermaritzburg has 46 misty days per year). Some of the rain is in the form of cold frontal activity, mainly in winter, spring and early summer. Thunderstorms are common in summer and autumn (Cedara: 60 days of thunderstorms per year). Mean annual evaporation 1 463–1 797 mm (Camp 1999a). MAT 15.8°C, absolute minimum temperature was recorded in this region in June (–10.8°C). Frosts are generally moderate, but occasional severe frost may also occur. Further climatic conditions include short-term drought spells, hail and hot northwestern berg winds occurring particularly in spring and early summer. See also climate diagram for Gs 9 Midlands Mistbelt Grassland (Figure 8.61).

J.E. Granger

Figure 8.66 Gs 9 Midlands Mistbelt Grassland: Grasslands in the Lions River region near Howick (KwaZulu-Natal) with common herbs such as *Senecio bupleuroides*, *Helichrysum pallidum* and *Alepidea longifolia*.

Important Taxa Graminoids: *Andropogon appendiculatus* (d), *Aristida junciformis* subsp. *galpinii* (d), *Diheteropogon filifolius* (d), *Eragrostis plana* (d), *Hyparrhenia hirta* (d), *Sporobolus africanus* (d), *Themeda triandra* (d), *Tristachya leucothrix* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon schirensis*, *Brachiaria serrata*, *Cymbopogon caesius*, *C. nardus*, *Digitaria diagonalis*, *D. tricholaenoides*, *Diheteropogon amplectens*, *Elionurus muticus*, *Eragrostis capensis*, *E. curvula*, *E. racemosa*, *Eulalia villosa*, *Harpochloa falx*, *Heteropogon contortus*, *Loudetia simplex*, *Microchloa caffra*, *Monocymbium ceresiiforme*, *Panicum aequinerve*, *P. ecklonii*, *P. natalense*, *Paspalum dilatatum*, *P. scrobiculatum*, *P. urvillei*, *Setaria nigrirostris*, *S. sphacelata*, *Sporobolus centrifugus*, *Trachypogon spicatus*. Herbs: *Acalypha glandulifolia*, *Acanthospermum australe*, *Berkheya rhapontica* subsp. *aristosa*, *B. setifera*, *Commelina africana*, *Conyza pinnata*, *Eriosema salignum*, *Helichrysum cephaloideum*, *H. simillimum*, *Indigastrum fastigiatum*, *Kohautia amatymbica*, *Nidorella auriculata*, *Pentanisia prunelloides* subsp. *latifolia*, *Sebaea sedoides* var. *schoenlandii*, *Spermacoce natalensis*, *Thunbergia atriplicifolia*, *Vernonia dregeana*, *V. natalensis*, *Wahlenbergia undulata*. Herbaceous Climber: *Vigna nervosa*. Geophytic Herbs: *Pteridium aquilinum* (d), *Corycium nigrescens*, *Drimia macrocentra*, *Eriospermum ornithogaloides*, *Gladiolus ecklonii*, *Habenaria dives*, *H. dregeana*, *Hypoxis multiceps*, *H. rigidula* var. *pilosissima*, *Rhodohypoxis baurii* var. *baurii*, *R. baurii* var. *platypetala*, *Satyrium longicauda*. Low Shrubs: *Helichrysum sutherlandii*, *Leonotis ocymifolia*, *Otholobium caffrum*.

Biogeographically Important Taxa (both Southern distribution limit) Herb: *Anisopappus smutsii*. Succulent Herb: *Aloe kniphofioides*.

Endemic Taxa Herbs: *Acalypha entumenica*, *Selago longiflora*. Geophytic Herbs: *Asclepias woodii*, *Albuca xanthocodon*, *Dierama luteoalbidum*, *Kniphofia latifolia*, *Pachycarpus rostratus*, *Watsonia canaliculata*. Low Shrubs: *Helichrysum citricephalum*, *Syncolostemon latidens*.

Conservation Endangered (one of the most threatened vegetation types of KwaZulu-Natal). Target 23%. Only a small fraction (about 0.5%) statutorily conserved in number of reserves such as Ngeli, Impendle, Blinkwater, Qudeni, Doreen Clark, Karkloof and Queen Elizabeth Park—still heavily underrepresented in conservation plans (see also analysis of 'Natal Mistbelt' by Scott-Shaw et al. (1996). More than half already transformed for plantations, cultivated land or by urban sprawl. Uncontrolled fires and poorly regulated grazing by livestock add to threats to this unique grassland. Some aliens (including *Solanum mauritianum*, species of *Rubus*, *Acacia*, *Pinus* and *Eucalyptus*) are of concern in places. Erosion is very low (68%) and low (24%).

Remark 1 As pointed out by Camp (1999a), the difference between BRG 5 (Moist Midlands Mistbelt) and BRG 6 (Dry Midlands Mistbelt) lies basically in precipitation: the latter occurring in regions receiving between 738–825 mm, while the former receives more than 800 mm on average per year as a rule. Both BRGs are considered by Camp (1999a) as different moisture phases of the same vegetation type. The consideration of 800 mm is very informative from the point of view of moisture status of soils and might also be of agricultural importance. However, the lack of striking differences in vegetation patterns does not justify separation of the BRGs as distinct vegetation units. Extensive patches of the Eastern Mistbelt Forests in KwaZulu-Natal and Transkei Mistbelt Forests in the Eastern Cape (for the concepts see Von Maltitz et al. 2003) are embedded within the region of the Midlands Mistbelt.

Remark 2 The Mistbelt of KwaZulu-Natal is an important, although still not a formally recognised, centre of endemism (see Van Wyk & Smith 2001).

References Acocks (1953, 1988), Colvin (1984), Scott-Shaw et al. (1996), Camp (1999a), Scott-Shaw (1999).

Gs 10 Drakensberg Foothill Moist Grassland

Mountain Tussock Veld (Bews 1917). VT 44 Highland Sourveld and Dohne Sourveld (90%) (Acocks 1953). LR 42 Moist Upland Grassland (82%) (Low & Rebelo 1996).

Distribution KwaZulu-Natal and Eastern Cape Provinces: Broad arc of Drakensberg piedmonts covering the surrounds of Bergville in the north, Nottingham Road, Impendle, Bulwer in the east, and Kokstad, Mount Currie, Underberg (KZN) and the surrounds of Mt Fletcher, Ugie, Maclear and Elliot (Eastern Cape) in the southwest. Altitude 880–1 860 m.

Vegetation & Landscape Features Moderately rolling and mountainous, much incised by river gorges of drier vegetation types and by forest, and covered in forb-rich grassland dominated by short bunch grasses including *Themeda triandra* and *Tristachya leucothrix*.

Geology & Soils Geology is dominated by mudstones and sandstones of the Tarkastad Subgroup and the Molteno Formation (Karoo Supergroup) as well as intrusive dolerites of Jurassic age. The dominant soils on the sedimentary parent material are well drained, with a depth of more than 800 mm and clay content from 15–55%, representing soil forms such as Hutton, Clovelly, Griffin and Oatsdale. On the volcanic parent material (dolerite) the soils are represented by forms such as Balmoral, Shortlands and Vimy. Most common land types Ac and Fa.

Climate Summer rainfall, with MAP almost 890 mm. MAT of 14.6°C and 26 frost days per year are indicative of a cooler, submontane form of warm-temperate climate. See also the climate diagram Gs 10 Drakensberg Foothill Moist Grassland (Figure 8.61).

Important Taxa Graminoids: *Diheteropogon filifolius* (d), *Elionurus muticus* (d), *Eragrostis capensis* (d), *E. chloromelas* (d), *E. curvula* (d), *E. plana* (d), *E. racemosa* (d), *Heteropogon contortus* (d), *Microchloa caffra* (d), *Monocymbium ceresiiforme* (d), *Panicum natalense* (d), *Rendlia altera* (d), *Sporobolus africanus* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *Agrostis lachnantha*, *Alloteropsis semialata* subsp. *eckloniana*, *Aristida junciformis* subsp. *galpinii*, *Brachiaria serrata*, *Digitaria tricholaenoides*, *Harpochloa falx*, *Hyparrhenia hirta*, *Panicum ecklonii*, *Paspalum dilatatum*. Herbs: *Helichrysum simillimum* (d), *Senecio retrorsus* (d), *Acalypha depressinerva*, *Ajuga ophrydis*, *Berkheya rhapontica* subsp. *aristosa*, *Conyza pinnata*, *Dicoma anomala*, *Euryops laxus, Haplocarpha scaposa*, *Helichrysum chionosphaerum*, *H. cooperi*, *H. herbaceum*, *H. nudifolium* var. *pilosellum*, *H. subglomeratum*, *H. umbraculigerum*, *Hesperantha ingeliensis*, *Kohautia amatymbica*, *Mohria caffrorum*, *Pentanisia prunelloides* subsp. *latifolia*, *Schistostephium crataegifolium*, *Sebaea sedoides* var. *schoenlandii*, *S. sedoides* var. *sedoides*, *Senecio asperulus*, *Vernonia natalensis*, *Wahlenbergia undulata*. Herbaceous Climber: *Rhynchosia totta*. Geophytic Herbs: *Oxalis depressa* (d), *Cheilanthes deltoidea*, *C. hirta*, *Chlorophytum acutum*, *Disperis renibractea*, *Habenaria dregeana*, *H. lithophila*, *Haemanthus humilis* subsp. *hirsutus*, *Hesperantha coccinea*, *Hypoxis rigidula* var. *pilosissima*, *Ledebouria sandersonii*, *Moraea modesta*, *Nerine bowdenii*, *Oxalis corniculata*, *Rhodohypoxis baurii* var. *platypetala*, *Watsonia pillansii*, *Xysmalobium tysonianum*, *Zantedeschia albomaculata* subsp. *albomaculata*. Small Trees: *Protea roupelliae* subsp. *roupelliae* (d), *Encephalartos ghellinckii*. Low Shrubs: *Anthospermum rigidum* subsp. *pumilum*, *Chrysocoma ciliata*, *Felicia filifolia* subsp. *filifolia*, *Gnidia kraussiana*, *Helichrysum odoratissimum*, *H. sutherlandii*, *Rhus discolor*, *Senecio burchellii*.

Biogeographically Important Taxa ([D]Drakensberg endemic, [Dg]Drakensberg endemic extending to Griqualand East) Geophytic Herb: *Schizochilus bulbinella*[Dg]. Graminoid: *Schoenoxiphium burttii*[D].

Endemic Taxa Herbs: *Alchemilla incurvata*, *Argyrolobium sericosemium*, *Diascia esterhuyseniae*, *Stachys rivularis*. Geophytic Herbs: *Brachystelma molaventi*, *Dioscorea brownii*, *Ornithogalum baurii*. Succulent Shrub: *Delosperma wiunii*.

Conservation Least threatened. Target 23%. Only 2–3% statutorily conserved in the uKhahlamba Drakensberg Park, Ntsikeni Wildlife Reserve as well as in the Karkloof, Mount Currie, Coleford, Fort Nottingham, Impendle, Ngeli, and Umgeni Vlei Nature Reserves. Almost 20% already transformed for cultivation, plantations and by urban sprawl. Alien woody species of *Rubus* and *Acacia dealbata* and *Solanum mauritianum* may become invasive in places. Erosion is very low (49%), low (28%) and moderate (17%).

Remarks Due to the considerable concentration of local endemics as well as Drakensberg endemics, this unit might be reclassified as a Gd grassland unit after detailed analysis and its area included within the realm of the Drakensberg Alpine CE.

References Bews (1917), Acocks (1953, 1988), Killick (1963), Hurt et al. (1993), Camp (1999b), KZN DAEA (2003).

Gs 11 Southern KwaZulu-Natal Moist Grassland

VT 65 Southern Tall Grassveld (48%), VT 44 Highland Sourveld and Dohne Sourveld (35%) (Acocks 1953). LR 43 North-eastern Mountain Grassland (44%), LR 42 Moist Upland Grassland (36%) (Low & Rebelo 1996). BRG 11 Moist Transitional Tall Grassveld (77%) (Camp 1999a, c).

Distribution KwaZulu-Natal and Eastern Cape Provinces: Interior valley basins at Creighton, Malenge and Centocow in the south and the upper Mkomazi River and Howick in the north. Altitude 880–1 480 m.

Vegetation & Landscape Features Gently sloping valley bottoms of tall mixed veld dominated by *Hyparrhenia hirta* and sparsely scattered *Acacia sieberiana*. *Themeda triandra* is the dominant grass on veld that has been well managed and many species of Gs 10 Drakensberg Foothill Moist Grassland are well represented and include *Diheteropogon filifolius*, *Harpochloa falx* and *Trachypogon spicatus*. Overgrazed areas become dominated by 'mtshiki' species such as *Eragrostis curvula*, *E. plana*, *Sporobolus africanus* and *S. pyramidalis*. Selective overgrazing causes certain wiregrass species (*Elionurus muticus* and *Aristida junciformis*) to become abundant (Camp 1999a, c).

Geology & Soils Karoo Supergroup mudstones dominate this area, those of the Volksrust Formation occurring to the south and those of the Adelaide Subgroup to the north. Jurassic dolerite dykes are also present. The dominant soils are mottled and poorly drained, with a depth of 300–500 mm; the clay content ranges from 15–35%, representing soil forms such as Wasbank, Wesselnek, Longlands and Cartref, and Oatsdale on well drained soils. Half of the area is classified as Ac land type, with Fa and Ab of minor occurrence.

Climate Summer rainfall, with MAP of 920 mm. Cooler form of warm-temperate climate (MAT 15.6°C; 15 frost days a year). See also climate diagram for Gs 11 Southern KwaZulu-Natal Moist Grassland (Figure 8.61).

Important Taxa Graminoids: *Alloteropsis semialata* subsp. *eckloniana* (d), *Andropogon appendiculatus* (d), *A. schirensis* (d), *Cynodon incompletus* (d), *Digitaria ternata* (d), *Eragrostis chloromelas* (d), *E. curvula* (d), *E. plana* (d), *Hyparrhenia hirta* (d), *Microchloa caffra* (d), *Paspalum dilatatum* (d), *Setaria nigrirostris* (d), *Sporobolus africanus* (d), *Tristachya leucothrix* (d), *Brachiaria serrata*, *Cyperus albostriatus*, *Digitaria sanguinalis*, *D. tricholaenoides*, *Elionurus muticus*, *Heteropogon contortus*, *Panicum aequinerve*, *Pycreus rehmannianus*, *Setaria sphacelata*, *Themeda triandra*, *Trachypogon spicatus*. Herbs: *Acrotome inflata* (d), *Conyza pinnata* (d), *Acanthospermum australe*, *Ajuga ophrydis*, *Berkheya setifera*, *Chamaecrista mimosoides*, *Cynoglossum lanceolatum*, *Eriosema kraussianum*, *Helichrysum nudifolium* var. *nudifolium*, *Lobelia erinus*, *Spermacoce natalensis*, *Vernonia natalensis*. Herbaceous Climber: *Rhynchosia totta*. Geophytic Herbs: *Oxalis corniculata* (d), *O. smithiana* (d),

Pteridium aquilinum (d), *Cheilanthes bergiana*, *Zantedeschia albomaculata* subsp. *albomaculata*. Low Shrubs: *Asparagus virgatus*, *Erica caffrorum* var. *caffrorum*, *Rubus cuneifolius*.

Endemic Taxon Low Shrub: *Erica psittacina*.

Conservation Vulnerable. Target 23%. About 4% statutorily conserved in the Impendle, Midmar, Igxalingenwa and Ingelabantwana Nature Reserves as well as in the Soada Forest Nature Reserve and in the uKhahlamba Drakensberg Park. More than one third already transformed for cultivation, plantations, by urban sprawl and building of dams (Midmar). Several woody aliens (*Solanum mauritianum*, *Arundo donax*, *Eucalyptus* species, *Melia azedarach*, *Sesbania punicea*, *Populus alba*) occur in these grasslands, but their impact is only of local importance. Erosion is very low (47%) and low (46%).

L. Mucina

Figure 8.67 Gs 12 East Griqualand Grassland: Over-grazed, species-poor grasslands on sandy soils on slopes prone to erosion near Mount Frere (northeastern Eastern Cape). The grasslands at higher altitudes belong to Gs 10 Drakensberg Foothill Moist Grassland—a transitional type between Sub-Escarpment and Drakensberg Grasslands.

References Acocks (1953, 1988), Camp (1999a, c), KZN DAEA (2003).

Gs 12 East Griqualand Grassland

VT 44 Highland Sourveld and Dohne Sourveld (58%) (Acocks 1953). LR 42 Moist Upland Grassland (90%) (Low & Rebelo 1996).

Distribution KwaZulu-Natal and Eastern Cape Provinces: Major portion of this unit covers most of East Griqualand (with Kokstad and Matatiele as centres). Altitude 920–1 740 m.

Vegetation & Landscape Features Hilly country with slopes covered by grassland in places, with patches of bush clumps with *Leucosidea sericea* (only wet sites) or *Diospyros lycioides*, *Acacia karroo* and *Ziziphus mucronata* in low-lying and very dry sites.

Geology & Soils Mudstone and sandstone of the Beaufort Group of the Karoo Sequence predominate, but sedimentary rocks of the Molteno, Elliot and Clarens Formations are also present. The dominant soils on the sedimentary parent material are well drained, with a depth of 500–800 mm and clay content from 15–55%. The soils are of Hutton, Clovelly, Oatsdale forms on sediments and Shortlands on dolerite. Most common land types Fa and Ac.

Climate The region has mostly summer rainfall, with MAP of 780, mm ranging from 620–816 mm. Kokstad records 88 rain days in a year and three of those occur in the midwinter (June–July). Both mist and snow occur less frequently than in Gd 4 Southern Drakensberg Highland Grassland (Kokstad 26 misty days per year) and much of the rain comes in the form of thunderstorms (Kokstad 45 days). MAT 12.9–15.6°C (overall MAT 14.7°C). Moderately severe frosts occur 30 days in a year. Mean annual evaporation 1 457–1 723 mm (Camp 1999b). See also climate diagram for Gs 12 East Griqualand Grassland (Figure 8.61).

Important Taxa Graminoids: *Alloteropsis semialata* subsp. *eckloniana* (d), *Aristida congesta* (d), *A. junciformis* subsp. *galpinii* (d), *Brachiaria serrata* (d), *Digitaria tricholaenoides* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. plana* (d), *E. racemosa* (d), *Harpochloa falx* (d), *Heteropogon contortus* (d), *Hyparrhenia hirta* (d), *Melinis nerviglumis* (d), *Microchloa caffra* (d), *Paspalum dilatatum* (d), *Sporobolus africanus* (d), *Themeda triandra* (d), *Tristachya leucothrix* (d), *Abildgaardia ovata*, *Andropogon appendiculatus*, *Cynodon incompletus*, *Cyperus obtusiflorus* var. *obtusiflorus*, *Digitaria ternata*, *Eragrostis capensis*, *Eulalia villosa*, *Hemarthria altissima*, *Setaria nigrirostris*, *Trachypogon spicatus*, *Urochloa panicoides*. Herbs: *Acanthospermum australe*, *Centella asiatica*, *Conyza podocephala*, *Haplocarpha scaposa*, *Helichrysum herbaceum*, *H. nudifolium* var. *pilosellum*, *Hermannia depressa*, *Hibiscus aethiopicus* var. *ovatus*, *Ipomoea crassipes*, *Kohautia amatymbica*, *Lessertia harveyana*, *Pentanisia prunelloides* subsp. *latifolia*, *Rhynchosia effusa*, *Senecio retrorsus*, *Stachys aethiopica*, *Tolpis capensis*, *Vernonia natalensis*. Herbaceous Climber: *Rhynchosia totta*. Geophytic Herbs: *Cheilanthes deltoidea*, *C. hirta*, *Haemanthus humilis* subsp. *hirsutus*, *Ledebouria sandersonii*, *Rhodohypoxis baurii* var. *baurii*, *Watsonia pillansii*, *Zantedeschia albomaculata* subsp. *albomaculata*. Low Shrubs: *Anthospermum rigidum* subsp. *pumilum* (d), *Chaetacanthus setiger*, *Erica caffrorum* var. *caffrorum*, *Felicia filifolia* subsp. *filifolia*, *F. muricata*, *Helichrysum dregeanum*, *Rubus rigidus*. Succulent Shrub: *Euphorbia clavarioides* var. *clavarioides*.

Biogeographically Important Taxon (Sub-Escarpment Grassland endemic) Small Tree: *Encephalartos friderici-guilielmi*.

Endemic Taxa Herbs: *Alepidea duplidens*, *Berkheya griquana*, *Wahlenbergia dentata*, *W. ingrata*.

Conservation Vulnerable. Target 23%. Only 0.2% is statutorily conserved in the Malekgonyane (Ongeluksnek) Wildlife Reserve and Mount Currie Nature Reserve. Over one quarter of the area has already been transformed for cultivation (maize), plantations and by urban sprawl. *Acacia dealbata* and *A. mearnsii* are invading these grasslands in some places. Erosion is low (31%), very low (30%) and moderate (30%).

References Acocks (1953, 1988), Hurt et al. (1993), Camp (1999b).

Gs 13 Mabela Sandy Grassland

VT 56 Highland Sourveld to *Cymbopogon-Themeda* Veld Transition (Eastern Free State Highveld) (95%) (Acocks 1953). LR 42 Moist Upland Grassland (100%) (Low & Rebelo 1996). BRG 14 Sour Sandveld (65%) (Camp 1999c).

Distribution KwaZulu-Natal and Eastern Cape Provinces: Cedarville Flats (basin draining into Umzimvubu River) in the region of Cedarville-Matatiele (southwestern KwaZulu-Natal) as well as a small area in a basin of Simi and Ramohlakoana in the Kinira River Valley in Transkei (west of Matatiele). Altitude 1 440–1 500 m, but up to 1 550 m in a few places.

Vegetation & Landscape Features Flat valley basins with a relatively high proportion of poorly drained soils with a generally low nutrient status. Dominated by species-poor, low tussock-dominated, sour grasslands without indigenous trees, with *Sporobolus pyramidalis* and *Aristida junciformis* as indicator species.

Geology & Soils Tarkastad Subgroup mudstones and sandstones underlie this area to the east as do the Molteno and Elliot Formation sandstones and minor mudstones in the west (all of the Karoo Supergroup). The dominant soils are poorly drained, with a depth of 200–300 mm and a clay content of less than 15%. They are classified into soil forms of Katspruit and Longlands and Oatsdale, Vimy and Clovelly (in well-drained habitats). Most common land types Ia and Ca.

Climate Summer rainfall, with MAP of around 710 mm and mean evaporation up to 1 700 mm. MAT 14.4°C. Frost very frequent (40 days per year). See also the climate diagram Gs 13 Mabela Sandy Grassland (Figure 8.61).

Important Taxa Graminoids: *Abildgaardia ovata* (d), *Andropogon eucomus* (d), *Cynodon dactylon* (d), *C. incompletus* (d), *Elionurus muticus* (d), *Eragrostis patentissima* (d), *Heteropogon contortus* (d), *Paspalum distichum* (d), *Pennisetum clandestinum* (d), *Setaria sphacelata* (d), *Sporobolus pyramidalis* (d), *Themeda triandra* (d), *Tristachya leucothrix* (d), *Aristida bipartita*, *A. congesta*, *A. junciformis* subsp. *galpinii*, *Brachiaria eruciformis*, *B. serrata*, *Cymbopogon pospischilii*, *Digitaria argyrograpta*, *D. monodactyla*, *D. ternata*, *D. tricholaenoides*, *Ehrharta calycina*, *Eragrostis capensis*, *E. chloromelas*, *E. gummiflua*, *E. plana*, *E. racemosa*, *Harpochloa falx*, *Hyparrhenia hirta*, *Imperata cylindrica*, *Microchloa caffra*, *Pennisetum thunbergii*, *Setaria nigrirostris*, *Sporobolus discosporus*, *Stipagrostis zeyheri* subsp. *sericans*, *Tragus racemosus*, *Trichoneura grandiglumis*. Herbs: *Acanthospermum australe*, *Monopsis decipiens*, *Psammotropha mucronata* var. *foliosa*. Geophytic Herbs: *Bulbine narcissifolia*, *Zantedeschia albomaculata* subsp. *albomaculata*. Geoxylic Suffrutex: *Elephantorrhiza elephantina*.

Conservation Vulnerable. Target 23%. Only a very small part statutorily conserved in the Malekgonyane (Ongeluksnek) Wildlife Reserve. More than 20% already transformed for cultivation (maize) and by urban sprawl. Threats to the remaining grasslands are heavy selective grazing by livestock, particularly in communal areas. Overgrazing increases the risk of local erosion.

Remark Much of the bottomland area is subject to floods and therefore extensive sites of AZf 3 Eastern Temperate Freshwater Wetlands are found embedded within this vegetation unit.

References Acocks (1953, 1988), Camp (1999c), KZN DAEA (2003).

Gs 14 Mthatha Moist Grassland

VT 44 Highland Sourveld and Dohne Sourveld (81%) (Acocks 1953). LR 42 Moist Upland Grassland (90%) (Low & Rebelo 1996).

Distribution Eastern Cape Province: Plains between Mthatha and Butterworth parallel to the coastline and excluding the river valleys that intrude landwards into this unit. Altitude 600–1 080 m.

Vegetation & Landscape Features Undulating plains and hills supporting species-poor, sour, wiry grassland with *Eragrostis plana* and *Sporobolus africanus*; although in good condition, it is more likely to be dominated by *Themeda triandra*.

Geology & Soils Mudstones of the Tarkastad and Adelaide Subgroups (Beaufort Group, Karoo Supergroup) underlie this area, with highly leached soils typical of the Fa land type.

Climate Summer rainfall, with MAP 600–970 mm. The coefficient of variation of MAP 25–30% across the unit, but drops to approximately 15% on the southeast-facing inland mountain slopes. Incidence of frost 2–14 days, but is higher further from the coast. See also climate diagram for Gs 14 Mthatha Moist Grassland (Figure 8.61).

Important Taxa Graminoids: *Cyperus obtusiflorus* var. *obtusiflorus* (d), *Elionurus muticus* (d), *Eragrostis curvula* (d), *Heteropogon contortus* (d), *Microchloa caffra* (d), *Paspalum dilatatum* (d), *Sporobolus africanus* (d), *Themeda triandra* (d), *Abildgaardia ovata*, *Alloteropsis semialata* subsp. *eckloniana*, *Aristida congesta*, *Brachiaria serrata*, *Chloris virgata*, *Cymbopogon marginatus*, *Cynodon dactylon*, *Cyperus haematocephalus*, *C. obtusiflorus* var. *flavissimus*, *Digitaria eriantha*, *D. ternata*, *Eragrostis capensis*, *E. plana*, *Eustachys paspaloides*, *Harpochloa falx*, *Hemarthria altissima*, *Hyparrhenia hirta*, *Panicum ecklonii*, *Paspalum scrobiculatum*, *Setaria nigrirostris*, *Tristachya leucothrix*. Herbs: *Senecio coronatus* (d), *Centella asiatica*, *Chamaecrista mimosoides*, *Cyanotis speciosa*, *Eriosema salignum*, *Falkia repens*, *Helichrysum rugulosum*, *Indigofera*

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Figure 8.68 Gs 14 Mthatha Moist Grassland: Over-grazed grassland on a stony slope near Tsolo (Eastern Cape). The yellow-flowered daisy is the unpalatable *Senecio coronatus* (Asteraceae).

hedyantha, *I. hilaris* var. *hilaris*, *Ipomoea crassipes*, *Lobelia flaccida*, *Pentanisia prunelloides* subsp. *latifolia*, *Senecio retrorsus*, *Sonchus dregeanus*, *Vernonia capensis*, *V. natalensis*, *Wahlenbergia stellarioides*. Herbaceous Climber: *Rhynchosia totta*. Geophytic Herbs: *Boophone disticha*, *Habenaria dives*. Small Tree: *Acacia natalitia*. Low Shrubs: *Senecio pterophorus* (d), *Coddia rudis*, *Erica caffrorum* var. *caffrorum*, *Felicia filifolia* subsp. *filifolia*, *Hermannia parviflora*.

Biogeographically Important Taxon (Sub-Escarpment Grassland endemic) Small Tree: *Encephalartos friderici-guilielmi*.

Conservation Endangered. Target 23%. Only a small fraction is statutorily conserved in the Luchaba and Nduli Wildlife Reserves. More than 40% transformed for cultivation and plantations or by dense rural human settlements. Previously cultivated or fallow lands possibly constitute an estimated additional 25% (Steenkamp et al. 2005). *Acacia mearnsii*, *Solanum mauritianum* and *Richardia humistrata* are the most important aliens. Erosion a serious problem, with high to very high erosion levels in 34% of the unit, moderate erosion in 35%, and the remainder having low and very low erosion.

Remarks There is a high level of utilisation of this unit leading to degradation and transformation and the vegetation shows various stages of overutilisation (Steenkamp et al. 2005). Shifting cultivation and the effects of development have caused continuous disturbance of the soil surface, which has led to secondary succession changes in the grassland (documented in Smits et al. 1999). Poor grazing management has led to the dominance of unpalatable grasses and invasion by weedy, mostly alien, forb species (Hoare 2002).

References Acocks (1953, 1988), Smits et al. (1999), Hoare (2002), Steenkamp et al. (2005).

Gs 15 Tsomo Grassland

VT 44 Highland Sourveld and Dohne Sourveld (49%), VT 22 Invasion of Grassveld by *Acacia karroo* (36%) (Acocks 1953). LR 42 Moist Upland Grassland (51%) (Low & Rebelo 1996).

Distribution Eastern Cape Province: In the region to the east of the Queenstown Basin. The villages of Tsomo, Cala and Engcobo define the eastern extent of this unit and Cathcart, Queenstown and Sterkstroom the western extent. This vegetation unit occupies the plains in between the mountain peaks and ridges in this region. Altitude 760–1 580 m.

Vegetation & Landscape Features Flat or gently undulating lowland plains intersected by mountains. The vegetation is a grassland or open thornveld, often grazed short or replaced by dwarf shrubland dominated by species of *Euryops*. Dominant and common species include omnipresent representatives of the genera *Cymbopogon*, *Elionurus*, *Eragrostis*, *Aristida* and *Themeda*. Asteraceae and Fabaceae are prominent among the forbs.

Geology & Soils Mudstones of the Tarkastad Subgroup (Karoo Supergroup) overlain mostly by soils of moderate depth typical of Fb and Db land types.

Climate Late summer rainfall, although some rain may fall at other times of the year. MAP 430–790 mm, increasing from west to east. The coefficient of variation in MAP 25–31% across the unit. Incidence of frost is variable (7–65 days), but is higher in the northwest. See also climate diagram for Gs 15 Tsomo Grassland (Figure 8.61).

Important Taxa Graminoids: *Aristida congesta* (d), *Cynodon dactylon* (d), *Digitaria argyrograpta* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. curvula* (d), *E. plana* (d), *Eustachys paspaloides* (d), *Heteropogon contortus* (d), *Hyparrhenia hirta* (d), *Microchloa caffra* (d), *Themeda triandra* (d), *Tragus berteronianus* (d), *Abildgaardia ovata*, *Andropogon appendiculatus*, *Aristida diffusa*, *Brachiaria serrata*, *Cymbopogon pospischilii*, *Eragrostis capensis*, *E. lehmanniana*, *E. racemosa*, *Harpochloa falx*, *Microchloa kunthii*, *Schoenoxiphium sparteum*, *Sporobolus africanus*, *Tristachya leucothrix*, *Urochloa panicoides*. Herbs: *Argyrolobium pauciflorum*, *Aster bakerianus*, *Berkheya onopordifolia* var. *onopordifolia*, *Commelina africana*, *Cyanotis speciosa*, *Gazania linearis* var. *linearis*, *Haplocarpha scaposa*, *Helichrysum rugulosum*, *Ipomoea crassipes*, *Pollichia campestris*, *Senecio retrorsus*, *Vernonia capensis*. Herbaceous Climber: *Rhynchosia totta*. Geophytic Herbs: *Oxalis depressa* (d), *Pelargonium sidoides*. Small Tree: *Acacia natalitia*. Low Shrubs: *Chaetacanthus setiger*, *Felicia muricata*, *Helichrysum odoratissimum*, *Senecio burchellii*, *Sutera pinnatifida*, *Tephrosia capensis* var. *acutifolia*. Tall Shrub: *Euryops floribundus* (d).

Conservation Vulnerable. Target 23%. None conserved in statutory conservation areas. Only 1% conserved in private reserves. Some 27% transformed mainly for cultivation and by dense concentrations of rural settlements. Increased occurrence of alien *Schkuhria pinnata* and *Tagetes minuta* indicates heavy disturbance. Erosion is a serious problem and it is high in 33% of this unit, moderate in 32%, and low and very low in 34% of the area.

Remarks The name is derived from the village of Tsomo, which falls entirely within this plains type vegetation, the others tending to occupy positions on adjacent slopes. There is high rural occupancy and utilisation of this unit, leading to degradation and transformation. A number of dams of medium size have also been built within this unit. The vegetation shows various stages of overutilisation and also a gradient from grassland to thornveld. Mountain ridges within this unit are often wooded

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Figure 8.69 Gs 15 Tsomo Grassland: Over-grazed grassland with abundant species of *Aristida* and *Elionurus muticus* and the invading unpalatable shrub *Euryops floribundus* (Asteraceae) near Tsomo (former Transkei, Eastern Cape).

and this woody component easily spreads into the surrounding vegetation where ecological conditions permit. Many of the other vegetation units in the region, both grassland and woody vegetation, grade into this one, so that there is a naturally high rate of species turnover.

References Acocks (1953, 1988), Hoare & Bredenkamp (2001).

Gs 16 Queenstown Thornveld

VT 22 Invasion of Grassveld by *Acacia karroo* (77%) (Acocks 1953). LR 44 South-eastern Mountain Grassland (52%) (Low & Rebelo 1996).

Distribution Eastern Cape Province: From the vicinity of Queenstown in the east to the vicinity of Tarkastad in the west, and Sterkstroom in the north. Altitude 980–1 500 m.

Vegetation & Landscape Features Flat bottomlands of intramountain basins with adjacent slopes supporting a complex of *Acacia natalitia* thornveld and grassland dominated by *Aristida congesta*, *Cymbopogon pospischilii*, *Eragrostis curvula* and *Tragus koelerioides*, with scattered shrubs and low *Acacia* in places (Hoare 1997, Hoare & Bredenkamp 1999).

Geology & Soil Sedimentary rocks of the Tarkastad Subgroup (Beaufort Group, Karoo Supergroup) overlain with clay-loam soils typical of Da and Fc land types.

Climate Rainfall peaks in late summer. MAP mainly 380 mm in the west, increasing to 640 mm in the east. The coefficient of variation in MAP from 28–34% across the unit. Incidence of frost is 22–58 days, higher in the northwest than the southeast. See also climate diagram for Gs 16 Queenstown Thornveld (Figure 8.61).

Important Taxa Small Tree: *Acacia natalitia* (d). Tall Shrub: *Euryops floribundus* (d). Low Shrubs: *Asparagus laricinus*, *Atriplex semibaccata* var. *appendiculata*, *Felicia filifolia* subsp. *filifolia*, *F. muricata*, *Helichrysum asperum* var. *albidulum*, *H. dregeanum*, *Melolobium microphyllum*, *Pentzia globosa*, *Sutera pinnatifida*, *Tephrosia capensis* var. *acutifolia*. Succulent Shrub: *Hertia pallens*. Graminoids: *Aristida canescens* (d), *A. congesta* (d), *A. diffusa* (d), *Cymbopogon pospischilii* (d), *Cynodon incompletus* (d), *Digitaria argyrograpta* (d), *D. eriantha* (d), *Eragrostis chloromelas* (d), *E. curvula* (d), *E. lehmanniana* (d), *E. obtusa* (d), *E. trichophora* (d), *Heteropogon contortus* (d), *Microchloa caffra* (d), *Panicum stapfianum* (d), *Themeda triandra* (d), *Tragus koelerioides* (d), *Brachiaria serrata*, *Cynodon dactylon*, *Cyperus usitatus*, *Elionurus muticus*, *Eustachys paspaloides*, *Microchloa kunthii*, *Sporobolus fimbriatus*, *Tragus racemosus*. Herbs: *Arctotis microcephala*, *Blepharis integrifolia* var. *clarkei*, *Commelina africana*, *Cyanotis speciosa*, *Gazania krebsiana* subsp. *krebsiana*, *Helichrysum pedunculatum*, *H. rugulosum*, *Hermannia depressa*, *Indigofera alternans*, *Salvia stenophylla*, *Senecio asperulus*, *Tribulus terrestris*. Herbaceous Climber: *Rhynchosia totta*. Geophytic Herbs: *Oxalis corniculata*, *O. depressa*.

Conservation Least threatened. Target 23%. Nearly 1% statutorily conserved in the Tsolwana Nature Reserve. Some 10% transformed primarily by cultivation and urbanisation. Urbanisation of this unit is expanding at a rapid rate and the amount of transformation due to this factor may be higher. Overgrazing in this vegetation unit is serious, especially by goats close to urban areas. Erosion is high (24%), moderate (54%), low and very low (22%).

Remark A core community of this vegetation landscape was described as the *Trago koelerioidis–Acacietum karroo* by Hoare (1997).

References Acocks (1953, 1988), Low & Rebelo (1996), Hoare (1997), Hoare & Bredenkamp (1999).

Gs 17 Tarkastad Montane Shrubland

VT 60 Karroid *Danthonia* Mountain Veld (25%), VT 22 Invasion of Grassveld by *Acacia karroo* (23%), VT 37 False Karroid Broken Veld (20%) (Acocks 1953). LR 52 Eastern Mixed Nama Karoo (37%), LR 44 South-eastern Mountain Grassland (33%) (Low & Rebelo 1996).

Distribution Eastern Cape and marginally into Northern Cape Province: Noupoort, Middelburg and a point west of Cradock define the western extent of this unit and Cathcart, Queenstown and Sterkstroom the eastern extent. The unit falls within the area between the Great Escarpment in the north, marked by the Bamboesberg and Stormberg Mountains, and the minor escarpment, marked by the Winterberg and Amathole Mountains in the south. Altitude 1 020–1 780 m.

Vegetation & Landscape Features Ridges, hills and isolated mountain slopes, characterised by high surface rock cover, this often consisting of large, round boulders. The vegetation is low, semi-open, mixed shrubland with 'white' grasses and dwarf shrubs forming a prominent component of the vegetation.

Geology & Soils Sedimentary rocks of the Tarkastad Subgroup (Beaufort Group, Karoo Supergroup), widely affected by intrusions of Jurassic dolerites forming numerous dykes and sills. Soils typical of land types Ib, Fb and Fc.

Climate Rainfall in late summer to autumn (peak in February–March). MAP 280–720 mm (overall MAP 470 mm),

D.B. Hoare

Figure 8.70 Gs 16 Queenstown Thornveld: *Acacia natalitia* thornveld near Sada and the Waterdown Dam south of Queenstown (Eastern Cape) with the undergrowth containing grasses such as *Cymbopogon pospischilii*, *Aristida congesta*, *Tragus koelerioides* and *Heteropogon contortus*.

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Figure 8.71 Gs 17 Tarkastad Montane Shrubland: The rare cycad *Encephalartos friderici-guilielmi* in the shade of *Cussonia paniculata* in montane shrubland close to the Waterdown Dam south of Sada (Eastern Cape).

increasing from west to east. Coefficient of variation of MAP from 22–35% across the unit (31% overall APCV), decreasing with distance eastwards. Incidence of frost 7–68 days (average: 39 days), increasing with proximity to the Escarpment. See also climate diagram for Gs 17 Tarkastad Montane Shrubland (Figure 8.61).

Important Taxa Succulent Tree: *Aloe ferox* (d). Small Tree: *Acacia karroo* complex. Tall Shrubs: *Diospyros austro-africana* (d), *Cadaba aphylla*, *Ehretia rigida*, *Rhus burchellii, Tarchonanthus minor*. Woody Climbers: *Asparagus racemosus*, *A. retrofractus*. Low Shrubs: *Euryops annae* (d), *Aptosimum elongatum*, *Asparagus striatus*, *Blepharis mitrata*, *B. villosa*, *Chrysocoma ciliata*, *Diospyros pallens*, *Eriocephalus ericoides*, *Felicia filifolia* subsp. *filifolia*, *F. muricata*, *Gymnosporia heterophylla*, *Helichrysum dregeanum*, *H. zeyheri*, *Hermannia filifolia*, *Indigofera sessilifolia*, *Lantana rugosa*, *Limeum aethiopicum*, *Melolobium microphyllum*, *Nenax microphylla*, *Pegolettia retrofracta*, *Pentzia globosa*, *Phymaspermum parvifolium*, *Rosenia humilis*, *Sutera pinnatifida*, *Wahlenbergia albens*. Succulent Shrubs: *Lycium schizocalyx*, *Pachypodium succulentum*, *Sarcocaulon camdeboense*. Semiparasitic Shrub: *Thesium hystrix*. Graminoids: *Aristida adscensionis* (d), *A. congesta* (d), *A. diffusa* (d), *Cynodon incompletus* (d), *Enneapogon scoparius* (d), *Eragrostis chloromelas* (d), *E. lehmanniana* (d), *E. obtusa* (d), *Heteropogon contortus* (d), *Tragus berteronianus* (d), *T. koelerioides* (d), *Chloris virgata*, *Cymbopogon pospischilii*, *Digitaria eriantha*, *Eragrostis curvula*, *Eustachys paspaloides*, *Fingerhuthia africana*, *Sporobolus fimbriatus*, *Themeda triandra*, *Tragus racemosus*. Herbs: *Commelina africana*, *Gazania krebsiana* subsp. *krebsiana*, *Hibiscus pusillus*, *Indigofera alternans*, *Lepidium africanum* subsp. *africanum*, *Tribulus terrestris*. Geophytic Herbs: *Asplenium cordatum*, *Boophone disticha*, *Cheilanthes deltoidea*, *C. hirta*, *Oxalis depressa*. Succulent Herb: *Crassula muscosa*.

Biogeographically Important Taxa ([SE]Sub-Escarpment Grassland endemic, [E]Eastern distribution limit) Small Tree: *Encephalartos friderici-guilielmi*[SE]. Low Shrubs: *Eriocephalus africanus*[E], *Senecio acutifolius*[E].

Conservation Least threatened. Target 28%. Around 1–2% conserved in statutory conservation areas (Commando Drift, Tsolwana Nature Reserves, Mountain Zebra National Park). About 2% transformed for cultivation or by building of dams (Kommandodrif and Waterdown). Erosion is moderate (51%), high (28%) and low (18%).

Remarks Physiographically similar landscapes to the north support Gh 4 Besemkaree Koppies Shrubland and to the west (along the Great Escarpment) NKu 2 Upper Karoo Hardeveld. These two units and the current unit are all shrublands primarily associated with dolerite intrusions. The Upper Karoo Hardeveld has lower rainfall, but the Besemkaree Koppies Shrubland is distinguishable climatically (on the basis of slightly lower minimum temperatures and higher summer rainfall) and floristically.

References Acocks (1953, 1988), Palmer (1988, 1989, 1991a, b), Rubin & Palmer (1996), Brown & Bezuidenhout (2000), De Klerk et al. (2003), Brown & Bezuidenhout (2005).

Gs 18 Bedford Dry Grassland

VT 21 False Thornveld of Eastern Province (40%), VT 68 Eastern Province Grassveld (25%) (Acocks 1953). Dry Bedford Grassland (Martens & Morris 1994, Martens et al. 1996). Moist Bedford Grassland (Martens et al. 1996). LR 15 Subarid Thorn Bushveld (71%) (Low & Rebelo 1996).

Distribution Eastern Cape Province: South of the Winterberg Mountains from Bruintjieshoogte and Somerset East in the west to Bedford and Adelaide, and to Fort Beaufort in the east. The eastern section lies north of the Great Fish River Valley. Altitude 480–990 m.

Vegetation & Landscape Features Gently undulating plains supporting open, dry grassland interspersed with *Acacia karroo* woodland vegetation (especially along the drainage lines). The grassland is relatively short (10–100 cm) and is dominated by *Digitaria argyrograpta*, *Tragus koelerioides*, *Eragrostis curvula* and *Cymbopogon caesius*. It contains a dwarf shrubby component of karroid origin in the southern and southwestern parts of its range.

Geology & Soils Loam or clay-loam soils typical of Fc (most of the region) as well as Db and Fb land types on the mudstones and sandstones of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup).

Climate Bimodal rainfall occurring in spring and late summer. MAP 310–550 mm. MAP is relatively uniform across this unit, but increases closer to the mountains and slightly from west to east. The coefficient of variation in MAP varies from 28–35% across the unit. Incidence of frost 3–31 days, higher towards the west than the east. See also climate diagram for Gs 18 Bedford Dry Grassland (Figure 8.61).

Important Taxa Graminoids: *Cynodon dactylon* (d), *C. incompletus* (d), *Cyperus usitatus* (d), *Digitaria argyrograpta* (d), *D. eriantha* (d), *Eragrostis capensis* (d), *E. chloromelas* (d), *E. curvula* (d), *E. obtusa* (d), *Heteropogon contortus* (d), *Microchloa caffra*

(d), *Panicum maximum* (d), *P. stapfianum* (d), *Sporobolus fimbriatus* (d), *Themeda triandra* (d), *Tragus koelerioides* (d), *Aristida congesta*, *A. diffusa*, *Cymbopogon caesius*, *C. pospischilii*, *Eragrostis plana*, *Eustachys paspaloides*, *Melica decumbens*, *Setaria sphacelata*, *Sporobolus nitens*. Herbs: *Cyanotis speciosa* (d), *Blepharis integrifolia* var. *clarkei*, *Chamaesyce inaequilatera*, *Commelina africana*, *Emex australis*, *Gazania krebsiana* subsp. *krebsiana*, *Helichrysum rugulosum*, *Hermannia althaeifolia*, *H. coccocarpa*, *Lepidium africanum* subsp. *africanum*. Geophytic Herbs: *Oxalis depressa*, *Pelargonium sidoides*. Succulent Herb: *Crassula expansa*. Small Tree: *Acacia karroo*. Low Shrubs: *Atriplex semibaccata* var. *appendiculata* (d), *Helichrysum dregeanum* (d), *Nenax microphylla* (d), *Asparagus striatus*, *Chrysocoma ciliata*, *Euryops anthemoides* subsp. *anthemoides, Felicia muricata*, *Garuleum latifolium*, *Hermannia althaeoides*, *Indigofera sessilifolia*, *Jamesbrittenia microphylla*, *Limeum aethiopicum*, *Lycium cinereum*, *Melolobium burchelli*, *Pelargonium aridum*, *Pentzia globosa*, *Selago fruticosa*, *S. saxatilis*, *Talinum arnotii*, *Tephrosia capensis* var. *acutifolia*. Succulent Shrubs: *Cotyledon orbiculata* var. *oblonga*, *Mestoklema tuberosum*.

Conservation Least threatened. Target 23%. None conserved in statutory conservation areas and only 1% conserved in private reserves (Kingsdale Game Farm, Woodlands Game Reserve, Glen Avon Falls Kloof and Kruizemuntfontein Natural Heritage Sites). Some 3% transformed for cultivation. Erosion high in 25% of this unit, moderate in 31% and low to very low in 44%.

Remarks Drainage lines within this unit contain *Acacia karroo*-dominated woodland and the incised river valleys intruding from the south of this unit contain AT 8 Kowie Thicket and NKl 4 Albany Broken Veld. The grasslands of this unit furthest from the mountain range have a strong karroid element which enters from the dry Great Fish River Valley. This grassland unit falls within the Albany CE, which contains an extensive endemic flora, especially of succulents. The Smaldeel area is considered to be an important goat production area (Martens & Morris 1994, Martens et al. 1996).

References Acocks (1953, 1988), Martens & Morris (1994), Martens et al. (1996), Hoare (1997), Hoare & Bredenkamp (1999).

9. Credits

The introductory text is a team effort by D.B. Hoare and L. Mucina, assisted by R.A. Ward (geology: Section 3.2) and L. Scott (palaeoecological patterns: Section 2.1). M.C. Rutherford extensively edited the introductory text and contributed especially to Sections 2.2 and 3.1.

The original subdivision of the Grassland Biome into bioregions was coined by L. Mucina and modified by M.C. Rutherford. The conceptual delimitation of the Drakensberg Grassland units as currently accepted in our chapter is the result of co-operation between D.B. Hoare (Southern Berg units), M.C. Rutherford (Lesotho units) and L. Mucina (other, especially Free State and KwaZulu-Natal Gd units). The units occurring (if only in part) in KwaZulu-Natal were delimited on the basis of K.G.T. Camp's map of resource units and their boundaries further modified by L. Mucina and C.R. Scott-Shaw. D.B. Hoare and L. Mucina co-authored the units Gd 2–4. The unit Gd 1 was coined and described by D.B. Hoare as sole author. The units Gd 6 and 7 were co-authored by C.R. Scott-Shaw, K.G.T. Camp and L. Mucina, while the units Gd 8–10 were co-authored by M.C. Rutherford and L. Mucina. P.J. du Preez and L. Mucina were instrumental in the circumscription of the units Gh 1–9. They were assisted by D.B. Hoare in units Gh 1 and 2 and by G.J. Bredenkamp in Gh 3, 5, 6 and 9. The units Gh 10–15 were described through a team effort by H. Bezuidenhout, L. Mucina, G.J. Bredenkamp and S.S. Cilliers. L.W. Powrie helped to delimit the unit Gh 4. The major effort in mapping delimitation and description of the Gm units was contributed by M.C. Lötter (units Gm 6, 8, 11–18 and 21–27, 29), L. Mucina (Gm 1–12, 15, 22–24, 26, 28 and 29), M.C. Rutherford (Gm 2, 4, 5, 8, 9, 11, 13–15, 18–21, 28 and 29) and G.J. Bredenkamp (Gm 4, 6, 8, 10–13, 16, 18–20, 22 and 23). D.B. Hoare contributed to units Gm 8–12, P.J. du Preez to units Gm 1, 3–7 and J.E. Burrows to Mpumalanga units Gm 14, 16–18, 21, 22 and 24. P.J.D. Winter defined Gm 25 and contributed map boundaries for Limpopo sections of units Gm 11, 23 and 25–27. M. Stalmans participated in four Mpumalanga (Gm 22 and 23) and Limpopo (26 and 27) units. S.J. Siebert and F. Siebert contributed substantially to the Sekhukhune Grassland units (Gm 19 and 20). The following colleagues each contributed to one Montane Grassland unit: K. Kobisi and L. Kose (Gm 2), L.W. Powrie (Gm 5), C.R. Scott-Shaw (Gm 15), L. Dobson (Gm 16), E. Schmidt (Gm 17), P.J.D. Winter (Gm 25) and T.H. Mostert (Gm 28). The major contributors to Gs units were K.G.T. Camp (whose boundaries were followed in many cases; co-author of Gs 1, 6–13), C.R. Scott-Shaw (co-author of Gs 1, 3, 4 and 6–13), M.C. Lötter (co-author of Gs 1, 3 and 7) and D.B. Hoare (author of mapping concepts and descriptions of the Eastern Cape units Gs 14–18). L. Mucina co-authored almost all Gs units (except Gs 2, 14 and 15), M.C. Rutherford contributed to Gs 4, 6, 12 and 16 and G.J. Bredenkamp to unit Gs 3. The Ithala Quartzite Sourveld unit (Gs 2) was coined by M.C. Lötter and J.E. Burrows. The species lists were compiled by L. Mucina on the basis of source data provided by particular authors of the descriptions of vegetation units. L.W. Powrie assisted with extraction of species lists from the SANBI databases (PRECIS, ACKDAT). M.C. Lötter and M. Stalmans assisted in checking the endemic status of species in Mpumalanga vegetation units, while C.R. Scott-Shaw helped with a similar check for KwaZulu-Natal units. E.G.H. Oliver kindly checked the *Erica* species in each vegetation unit. R.A. Ward kindly checked and corrected the sections on geology in all descriptions of the vegetation units. L.W. Powrie was instrumental in the preparation of working versions of mapping material for the contributors at various stages of the Project. G.J. Bredenkamp was technically assisted with GIS expertise by W.H. de Frey and R.A.J. Robesson during the initial mapping of the northern provinces. We also acknowledge the help of R.G. Bennett and C. Oellerman.

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Figure 8.3 was reproduced with kind permission of SANBI and Figure 8.4 with kind permission of the South African Association of Botanists. Figures 8.24 and 8.37 were created by L. Mucina with technical assistance of L.W. Powrie. Figure 8.9 was created jointly by L. Mucina and M.C. Lötter, with technical assistance of L.W. Powrie. The concept of the Lydenburg Centre of Endemism was suggested by M.C. Lötter. M.C. Rutherford and L.W. Powrie prepared the figures featuring the climate diagrams and also compiled the data for the conservation sections of descriptions of all vegetation units. The quantitative

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Plants

Plants, we adore you, the ones who cover the world!
Your species are distributed all around the world,
In rocky areas and in flood plains, you grow,
In wet soils and sandy soils, you grow,
Your seeds grow well,
In favourable conditions, your seeds grow,
In unfavourable conditions, your seeds persist.

So abundant, where do you get the feet to stretch?
So abundant, where do you get the tricks to grow?
The blanket that covers the whole world,
The beauty of the world,
You are not only beautiful, but also the king,
Human race and animals equally adore you.

Grow in abundance,
Like an orphan, be persistent, be strong, and carry on,
Grow in abundance, cover the world and bring resolutions,
Resolutions bringing end to poverty and diseases,
Emerging diseases of this world,
Such are the epidemics of HIV and AIDS.

by M.A. Dladla (English translation by E.M. Daemane)