

Rangeland Resources

South Africa, Lesotho and Swaziland

Grassland

The grassland biome (Plates 5 and 6) is situated mainly in the central, high lying regions of South Africa, Lesotho and Swaziland and occupy some 350 000km². The biome spans a rainfall gradient from “ca. 400 to >1200mm yr⁻¹, a temperature gradient from frost-free to snow-bound in winter, ranges in altitude from sea level to >3300m, and occurs on a spectrum of soil types from humic clays to poorly structured sands.” (O'Connor and Bredenkamp, 1997). Although the general structure is fairly uniform, there is a wide range in floristic composition, associated environmental variables, dynamics and management options. There is a strong dominance of hemicytopytes of the Poaceae. Standing biomass is moisture dependant, and decreases with the rainfall gradient. Herbivory from domestic and wild herbivores has a decisive impact on standing biomass and species composition.

The biome was originally defined on climatic factors and is limited to summer and strong summer rainfall areas with a summer aridity index between 2.0 and 3.9 (Rutherford and Westfall, 1986). Frost is common and occurs for 30 -180 days per annum. The most common soil in the biome, accounting for 50% of the area, is the red-yellow-grey latosol plinthic catena. This is followed by black and red clays and solonetzic soils, freely drained latosols, and black clays (Rutherford and Westfall, 1986).

The concepts “sweet” and “sour” refer to the palatability of the grasses, dwarf shrubs and trees to domestic livestock. Although difficult to define in strict scientific sense, these terms have retained their use throughout the farming community, being applied to both individual species and to components of the landscape. “Sweet veld” usually occurs on eutrophic soils under arid and semi-arid conditions. These soils are generally derived from the shales, mudstones and sandstones of the Karoo Supergroup. “Sour veld” is associated with the acid soils of quartzite and andesitic origin, and occurs in higher (>600mm) rainfall and high elevation (>1400m). Ellery *et al*, (1995)

have suggested that the concept is driven by the C:N ratios of the grasses, and the "sweetveld" has a lower C:N ratio than "sourveld".

Arid savanna

The arid savanna biome (Plate 7) extends across portions of the western parts of southern Africa, including portions of Namibia, Botswana, South Africa and Zimbabwe. This vegetation is strongly associated with the deep sands of the Kalahari. The vegetation comprises a woody layer (mainly single-stemmed, seasonally deciduous trees and shrubs), with a ground layer of grasses and forbs. The standing biomass of shrubs and trees is 16-20 tonnes ha⁻¹ Rutherford, (1982). The dominant grasses are C₄ and comprise the most important production component for domestic livestock. A strong summer seasonality in the rainfall encourages woody shrub production. The savanna biome is the region where large portions of the national beef production occur under extensive conditions.

Semi-arid savanna

The semi-arid savanna (Plate 8) comprises the extensive woodlands of Zimbabwe and the north eastern portions of South Africa. In the basins of the Zambezi and Limpopo rivers, where the nutrient rich substrata of the sedimentary Karoo system are exposed, the vegetation comprises tall (>15m) or shrub mopani trees (e.g. *Colophospermum mopane*) and riparian shrubs. At higher elevation in the interior of Zimbabwe, the dominant structure is a dense woodland dominated by trees (e.g. *Brachystegia* spp. and *Julbernardia* spp.) Further south, on the granitic substrata of the Mpumalanga lowveld of South Africa, one encounters a woodland consisting of single stemmed trees such as *Sclerocarya caffra* (maroela), *Diospyros* spp, and *Acacia* spp.

Thicket

The thicket biome (Plate 9) occurs in the drainage lines and ridges of the south eastern coastal region and inland to the Great Escarpment. The thicket comprises a dense cover of succulent shrubs, woody shrubs and small trees, with a height of 1.5-3.0m. The woody shrubs are multi-stemmed, seasonally deciduous C₃ plants. In the xeric portions of the thicket biome (300-450mm), there is a large component of facultative CAM type leaf succulents (e.g. *Portulacaria afra*), stem

succulents (*Euphorbia* spp.) and many species of small succulent shrubs (*Aloe*, *Crassula*).

Savanna dynamics

There is evidence of woody shrub encroachment throughout the savanna and other biomes (Hoffman and O'Connor 1999). A number of explanations have been suggested for the increase in woody shrub biomass, including:

- i) reduced fire frequency (Trollope, 1980),
- ii) the removal of grass biomass by domestic herbivory with the resultant success of woody shrubs (du Toit, 1967), and
- iii) the C₃ shrubs having a competitive advantage over C₄ grasses under elevated CO₂ conditions (Bond and Midgley, in press).

Graziers attempt to control the woody encroachment by clearing-felling, burning followed by intensive browsing by goats; and chemical control. The latter seems to be the favoured approach, with an estimated R10 million spent annually on herbicides in South Africa. Woody encroachment has a significant impact on rangeland grazing in Namibia. The biome is occupied by both commercial and communal graziers and the woody encroachment problem is more severe in land under communal tenure, although multiple use ensures that wood is used for fuel, construction and traditional purposes.

Vegetation dynamics in the African savanna are driven by a number of variables, including rainfall amount, rainfall uncertainty, frost, fire, herbivory, ambient CO₂ levels and soil moisture. Depending on the seasonal environmental conditions and management history, a grassland at the boundary of the savanna biome can change from a monolithic physiognomy, to one dominated by shrubs and trees. O'Connor and Bredenkamp, (1997) summarise five hypotheses which account for the possible exclusion of woody elements from grasslands.

Nama-karoo

The Nama-karoo (Plate 10) characterises the central and western regions of South Africa and southern Namibia. The biome is dominated by a steppe type vegetation, comprising a mixture of shrubs, dwarf shrubs, and annual and perennial grasses. The biome is associated with the moderate rainfall regions (250-450mm per annum) and is ideal

for sheep and goat production. The summer seasonality of the rainfall in the eastern parts of the biome means that there is often abundant grass production during the growing season and graziers are able to optimize production during this time. In the winter months, the dwarf shrubs maintain their crude protein at around 8%, providing excellent forage. The nutrient-rich substrata provided by the mudstones, sandstones and dolerites mean that this production is sustainable. There were earlier suggestions that large scale structural transformations were taking place in this biome (Acocks, 1964), with the dwarf shrubs supposedly spreading into the adjoining grasslands of the central Free State in South Africa. This process has not continued in the way envisaged, and the relatively high rainfall of the 1990's has promoted grass production in the eastern portions of the biome. In the western portions of the biome, there are alarming trends in woody encroachment with two species in particular (*Acacia mellifera* and *Rhigozum trichotomum*) thickening up in regions with a long history of domestic herbivory. Production of mutton and fibre continues to thrive in the Nama-karoo. During the recent past there has also been an increase in the area of land set aside for informal conservation, with many farmers capitalizing on the unique landscapes and indigenous fauna of the biome to develop eco-tourism operations. Important indigenous herbivores, which contribute to red meat production, include springbok, blesbok, kudu, gemsbok and wildebeest.

Succulent Karoo

The succulent karoo (Plate 11) occurs in the winter rainfall regions of the southern and south-western portions of South Africa. The flora of the biome comprises mainly shrubs (0.5-1.5m) and dwarf shrubs (<0.5m) with succulent leaves and stems. The climate of the region is arid to semi-arid (100-350mm per annum), with a strong winter seasonality. The succulent karoo is well known for its high floristic diversity, part of which is a function of its proximity to the adjacent floristically-rich fynbos biome, but also the unique climatic environment (low, seasonal (winter) rainfall with relatively low uncertainty (co-efficient of variation = 30-45%)). Some of the areas with high floristic diversity (e.g Richtersveld and Namaqualand) receive a large portion of their precipitation in the form of coastal advective fog during the coolest months of the year. There are many unique families (e.g. Mesembryanthemaceae), taxa (several species of the genus

Pachypodium) and growth forms (leaf and stem succulents). This diversity has made the biome ideal for the development of an eco-tourism industry which promotes the floristic uniqueness of the region. The arid conditions mean that the region is most suited to extensive livestock production and the flora of the biome has been subjected to herbivory from domestic goats and ostriches. These herbivores form the main suite of animals responsible for much of the direct impact on the vegetation of the biome. In recent times there are known changes in the species composition, with some landscapes currently dominated by species unpalatable to domestic livestock e.g. (*Pteronia incana* and *P.pallens*). The productivity of the biome has been largely affected by these changes, and many graziers now depend on irrigated pastures to sustain livestock production.

Desert

The largest desert is the Namib (Plate 12), which extends across central Namibia. The Namib comprises both sandy and rocky deserts, with the characteristic red sand dunes being the most widely known. Here the most prominent grasses include *Stipagrostis* and *Aristida* spp, with the drought tolerant dune melon *Acanthosicyos* and unique endemic *Welwitschia mirabilis* being the most widely known forbs. The rocky desert contains woody phreatic shrubs (*Euclea* spp., *Rhus* spp., *Acacia* spp.) which are able to utilise the moisture trapped in the rocks and survive the dry periods.

Fynbos

The fynbos (Plate 13) occurs in the winter rainfall regions of the southern and south western portions of South Africa, being associated with the moderate to high rainfall (450-1000mm) region. The vegetation of the biome is dominated by sclerophyllous shrubs and trees. The natural vegetation of the fynbos biome, with its unique and rich floristic diversity, has little or no forage value. Much of the natural vegetation has been cleared to enable production of wheat, oats, rye, barley, canola and lupins. The crop residues provide large areas of post-harvesting stubble for sheep production during the dry summer months. Within the biome, irrigated pastures are also a major contributor to sheep production.

Forest

Forest occurs in patches along the southern coastal zone, in the cooler southern facing slopes of the Great Escarpment, and in the high rainfall regions of the Drakensberg. Forest is not significant in livestock production in South Africa.

Zimbabwe (Gambiza and Nyama, 2000)

The vegetation of Zimbabwe (Plate 14) can be broadly classified into grassland, woodland and savanna with grassland and evergreen forest in the Eastern Highlands. The Eastern Highlands receive the highest rainfall in Zimbabwe and characteristically include *Widdringtonia* and *Podocarpus* species. The grasslands associated with the forest areas are dominated by *Themeda triandra* or *Loudetia* spp.

The drainage systems of the northern and western areas, particularly along the Zambezi river, are surrounded by *Colophospermum mopane* woodland. *C. mopane* commonly occurs in warm dry conditions. Soils may be alkaline and where they are deep and well-drained, trees are tall and well-developed. The woodland extends into the central regions of the country via the river systems.

The escarpment in the northern areas is dominated by *Brachystegia boehmii* or *B. allenii* woodland. This vegetation commonly occurs at altitudes of 900 – 1200m with an average of 600mm rainfall per annum.

The central areas of Zimbabwe are predominantly deciduous *Brachystegia* woodlands associated with *Julbernardia globiflora* or *J. paniculata*. The *Julbernardia* species tolerate higher altitudes than *Brachystegia* spp. and a wider range of rainfall conditions.

The southern portion of Zimbabwe mainly consists of savanna-type vegetation. The southern quarter of the country characterised by dry *Colophospermum mopane* savanna. This vegetation surrounds the rivers which drain into the Limpopo and Save rivers, the two major catchments of the south and eastern regions of the country.

In the west, two regions of *Acacia savanna* occur, separated by *Baikiaea* woodland. The latter is a degraded deciduous forest which is limited to Kalahari sand with rainfall not exceeding 600mm. Between the *Acacia* savanna and the *Colophospermum mopane* savanna, is an

area characterised by *Terminalia* woodland. *Terminalia spinosa* is indicative of low rainfall areas, where annual precipitation is less than 600mm, and porous, highly erodable soils.

Grassland

Four main grassland types occur in Zimbabwe, though none of them occur extensively. In the high rainfall areas of the mountainous eastern region, grasslands dominated by *Themeda triandra* or *Loudetia* spp. occur between the forest vegetation. Small fairly isolated areas of *Hyparrhenia hirta* grassland are found in the central northern area around Harare. A grassland dominated by *Loudetia* occurs in three narrow pockets which stretch from north to south around Harare and south of Gweru. The fourth grassland type is characterised by *Andropogon* and occurs slightly east of the central area.

Montane grassland occurs in the eastern border where rainfall is above 1000 mm and altitude above 1 600 m. It is a short perennial sour grassveld with a grazing capacity of 1 LSU to 3 ha. *Themeda triandra* dominates on fertile red clays and *Loudetia simplex* on sandy granite soils. Other common grass species are *Andropogon schirensis*, *Monocymbium cerasiiforme*, *Eragrostis racemosa* *Trachypogon spicatus*, *Alloteropsis semialata*, *Digitaria apiculata*, *D. monodactyla* and *Bewisia biflora*. *Cymbopogon validus*, *Eragrostis* species and the shrub *Senecio sceleratus* dominate when mountain grassland is overgrazed.

Hyparrhenia tall grassveld occurs in areas receiving between 750 mm and 1125 mm at an altitude ranging from 1200 m to 1675 m. This is a sourveld varying from *Brachystegia spiciformis* woodland to open perennial grassland on the country's watershed. It has a grazing capacity of 1 LSU to 2.5-3.5 ha. Common grasses include *Hyparrhenia filipendula*, *Hyperthelia dissoluta*, *Heteropogon contortus*, *Brachiaria brizantha*, *Digitaria milaniana*, *Eragrostis racemosa*, *Andropogon schinzii*, *Schizachyrium semiberbe*, *S. jeffreysii* and *Aristida congesta*. *Aristida vestita* and *Perotis patens* are characteristic species on infertile granite sands. *Hyparrhenia* species and *Themeda triandra* dominate on fertile red clays and clay loams. This veld type is relatively resistant to overgrazing. However, *Heteropogon contortus*, *Sporobolus pyramidalis*, *Melinis repens*, *Eragrostis* spp., *Aristida* spp., *Cynodon dactylon* and shrubs (e.g. *Eriosema englerianum* and

Dolichos malosanus) become dominant when the veld is overgrazed. *Hyparrhenia* other species grassland occurs mainly on the watershed at altitudes above 1 200 m where rainfall is less than 750 mm. This is a sourveld of tall perennial grasses varying from tree savanna to more open savanna on the drier parts of the country's main watershed. It has a grazing capacity of 1 LSU to 4-5 ha. The common grass species are similar to the previous type. The grass cover is, however, less dense and several additional species such as *Eragrostis jeffreysii* and *E. gummiflua* appear in this type. Associated woody species are *Terminalia sericea*, *Burkea africana*, *Combretum* spp and *Acacia* species. In overgrazed veld, grass species that become dominant are similar to those outlined in the previous type excluding *Sporobolus pyramidalis*. *Eragrostis rigidior* also increases in abundance in overgrazed areas.

Heteropogon other species grassland is a mixed veld of medium height perennial grasses with some annuals in tree savanna or tree bush savanna, occurring between *Hyparrhenia* veld and *Eragrostis* veld. It has a grazing capacity of 1 LSU to 5-6 ha. Common grass species are *Heteropogon contortus*, *Themeda triandra*, *Cymbopogon plurinodis*, *Hyparrhenia filipendula*, *Bothriochloa insculpta* and *Eragrostis superba*. It is sensitive to over-grazing. *Cymbopogon plurinodis*, *H. contortus*, *B. insculpta* and various annuals and woody species (e.g. *Acacia karroo*) increase in abundance in overgrazed veld.

Eragrostis other species grassveld. It occurs on light textured soils at altitudes between 450 m and 1 050 m with rainfall ranging between 375 mm and 500 mm. This is sweet to mixed veld with predominantly medium height perennial grasses and a high proportion of annuals in tree bush savanna. Annuals increase in drought years. It has a grazing capacity of 1 LSU: 7.5-10 ha. Common grasses are *Eragrostis rigidior*, *E. superba*, *Schizachyrium jeffreysii*, *Heteropogon contortus*, *Schmidtia pappaphoroides*, *Pogonarthria squarrosa*, *Brachiaria nigropedata*, *Urochloa pullulans*, *Digitaria pentzii*, *Enneapogon cenchroides* and *Aristida* species. Associated woody species are *Terminalia sericea*, *Combretum* spp., *Commiphora* spp., *Acacia* spp., *Colophospermum mopane*, *Grewia* spp. and in the northern part of the country *Brachystegia boehmii* and *B. spiciformis*. It is sensitive to

overgrazing. *Enneapogon cenchroides*, *E. rigidior* and various annuals increase in abundance in overgrazed veld.

Aristida other species grassveld occurs at altitudes between 900 m and 1200 m. Rainfall ranges from 500 mm to 750 mm. It is a sour to mixed veld of short and tall perennial and annual grasses in woodland on Karoo sandstone and Kalahari sands in western Zimbabwe. It has a grazing capacity of 1 LSU: 10-16 ha. Common grasses are *Aristida graciliflora*, *A. pilgeri*, *Digitaria pentzii*, *D. perrottetti*, *Triraphis schlechteri*, *Heteropogon melanocarpus*, *Eragrostis pallens*, *Schizachyrium jeffreysii*, *S. semiberbe*, *Pogonarthria fleckii* and *Panicum maximum*. Associated woody species are *Baikiaea plurijuga*, *Pterocarpus angolensis*, *Julbernardia globiflora*, *Brachystegia spiciformis*, *B. boehmii*, *Burkea africana*, *Terminalia sericea*, *Guibourtia coleosperma* and *Combretum* species. The poisonous suffrutex *Dichapetalum cymosum* is common.

Extremely sensitive to overgrazing. *Aristida* spp., *Triraphis schlechteri*, *Eragrostis pallens*, various annuals and forbs increase in abundance in overgrazed veld.

Cenchrus other species grassveld occurs on heavy clay basaltic soils at altitudes ranging from 450 m to 1 000 m where rainfall varies from 325 mm to 400 mm. This is sweetveld in a tree bush savanna with medium-height perennial grasses and a high proportion of annual grasses. Perennials decrease in dry years. It has a grazing capacity of 1 LSU: 7.5-10 ha. Common grasses are *Cenchrus ciliaris*, *Bothriochloa radicans*, *Chloris myriostachya*, *Pennisetum* spp. *Panicum maximum* and *Enneapogon cenchroides*. Associated woody species are *Colophospermum mopane*, *Grewia* species and *Acacia* species. It is sensitive to overgrazing. *Enneapogon cenchroides* and various annuals increase in abundance in overgrazed veld.

Aristida-Dactyloctenium-Eragrostis other species grassveld occurs in the Zambezi and Limpopo River Valleys below 600 m where annual rainfall ranges between 300 mm and 600 mm. This is sweetveld mainly in woodland or bush scrub savanna with mainly sparse short annual grasses. It has a grazing capacity of 1 LSU: 12-20 ha. Common grasses are *Aristida adscensionis*, *Eragrostis viscosa*, *Dactyloctenium giganteum*, *Chloris virgata* and on deeper soils with more moisture *Urochloa* spp., *Panicum* spp., *Cenchrus ciliaris* and *Digitaria* species.

Associated woody species are *Combretum celestroides*, *Adansonia digitata*, *Commiphora* spp., *Schrebera* spp. and *Colophospermum mopane*. Extremely sensitive to overgrazing. Annual species increase in abundance in overgrazed veld. Large areas of bare ground are formed because of overgrazing.

Namibia

Based on landforms and growing periods, eight major agro-ecological zones have been differentiated in Namibia (Plate 15). In addition, there are locally important river canyons and undifferentiated rocky hills (de Pauw *et al*, 1998). The major zones are:

- Central plateau
- Damaraland landscapes
- Ekuma plains and Etosha pan
- Escarpment
- Kalahari sands plateau
- Kalkveld
- Kaokoland landscapes
- Namib sand seas and desert plains.

In line with the decreasing rainfall from north-east to west and south, growing periods range from 120 days in the Caprivi (north-east) to no growing period in the desert areas. Except for the north-east and central northern areas, the agricultural potential of Namibia is thus restricted to livestock farming.

Biodiversity perspective

The region is without question one of the centres of highest endemism in the world. The high structural variation in vegetation, attributable largely to the steep environmental gradients in the sub-continent, and the high climatic uncertainty, is one of the most obvious features of this diversity. The fynbos of the South Western Cape has the highest floristic diversity of any region on earth. In regions where floras meet, for example in the South Eastern Cape, the floras from five different biomes interface with one another, providing a mosaic of grassland, thicket, semi-arid shrubland, fynbos and Afro-montane forests. This provides both structural and floristic diversity which is invariably complemented by high faunal diversity. It is this faunal diversity, comprising a wide range of ungulate species, which has the greatest

impact on rangeland. In recent years in the region there has been a rapid increase in the numbers of land managers who use the bio-diversity to their advantage. Eco-tourism, focusing on the exploration of the region's unique bio-diversity, has flourished. Many commercial ranchers have converted their land-use from domestic livestock to wild herbivore production. (Plate 16).