Introduction

The Egoli Granite Grassland is a type of grassland and a mapping unit (Gm10) classified under the Mesic Highveld Grassland Bioregion according to the new Vegetation Map of South Africa, Lesotho and Swaziland (Mucina et al. 2005). This grassland was mapped as Bankenveld (veld type 61) by Acocks (1988), and Rocky Highveld Grassland (Vegetation Type 34) by Bredenkamp & Van Rooyen (1996). Acocks (1988) describes the Bankenveld as a False Grassveld Type. The climax vegetation of this veld type should be, according to Acocks, an open savanna, that is a bushveld vegetation, but it has been changed to, and maintained as grassveld by regular veld fires. However, Bredenkamp & Brown (2003) consider Bankenveld vegetation as a mosaic of grassland and woodland communities controlled by (micro-)climatic conditions that exist in the topographically heterogeneous landscape in the transition zone between the Grassland and Savanna biomes.

From a conservation planning or urban development viewpoint, the range of structural and floristic variation is considered too large to define Bankenveld as a single unit, even on the reconnaissance level of vegetation investigation. Bredenkamp & Brown (2003) recognised 16 major vegetation types within Bankenveld. The Egoli Granite Grassland is considered as mainly belonging to the Hyparrhenia hirta Anthropogenic Grassland (Bredenkamp & Brown 2003).

Egoli Granite Grassland is restricted to the Gauteng Province of South Africa and is located north of the Roodepoort / Krugersdorp ridge complex and stretches over a distance of approximately 35 km to Centurion in the north. This grassland stretches over a distance of approximately 50 km in a westerly direction from the R21 highway in the east. The 28º longitude and 26º latitudi-
nal lines cross in the centre of this grassland (Fig. 1).

Due to high demand for developable land in Gauteng, and especially the Johannesburg / Pretoria corridor, the Egoli Granite Grassland is under extreme pressure. Large areas are already developed for residential, industrial and commercial purposes. This has led to the destruction of vast tracts of this grassland. At least 61% of Egoli Granite Grassland has been permanently transformed: 27% by urban development (Fig. 2); 17% by smallholdings; 12% by agriculture (cultivated lands); and 5% by other impacts such as exotic plantations, mining and planted pastures. An estimated additional 17% of Egoli Granite Grassland is degraded due to overgrazing and the influence of edge effects associated with a highly fragmented landscape (Fahrig 2003). Other effects, such as trampling, increased pollutants and the infestation of weeds and alien species also contribute to degradation of this grassland. It is therefore highly likely that the national target for conservation of this grassland type, i.e., 25% of the total extent, will never be realised.

Egoli Granite Grassland is extremely poorly conserved, with only 0.02% (26 ha) of the vegetation type currently protected, including 3 ha in Glen Austin Bird Sanctuary, 3 ha in Melville Koppies Nature Reserve, 9 ha in Ruimsig Nature Reserve, and 11 ha in the Walter Sisulu Botanical Gardens (Fig. 2). The current protection status of Egoli Granite Grassland is therefore completely inadequate, with only 0.1% of the national target actually achieved. In order to meet South Africa’s international obligations, it is imperative that the Gauteng provincial government put in place measures to improve the conservation status of Egoli Granite Grassland.

Any viable remnant patch of original Egoli Granite Grassland must therefore be protected from transforming land uses. In order to assess whether a valuable remnant patch will be affected by a proposed development, environmental consultants involved in vegetation impact assessments are required by the Gauteng Department of Agriculture, Conservation and Environment (GDACE) to assess the presence and condition of Egoli Granite Grassland on any site proposed for development.

As this grassland was only recently defined with the development of the new Vegetation Map of South Africa, Lesotho and Swaziland (Mucina et al. 2005), very little information on its floristic composition, condition, the
extent of the grassland, and the management thereof exists, causing some confusion among nature conservationists, environmental consultants and local authorities. The aim of this paper is therefore to provide an ecological overview of this grassland.

Physical Environment

This area is generally characterised by rocky undulating plains representing crests, slopes and valley bottoms with shallow, nutrient-poor soils. Shallow drainage lines and vlei-like wetland areas occur in the valley bottoms. Rockiness of the soil surface is a further common characteristic shared by most Bankenveld areas.

Mean monthly temperature in the study area is 16.8°C with a mean maximum of 22.6°C and a mean minimum of 10.8°C. The mean winter temperature is 13.8°C and mean summer temperature, 25.6°C (Weather Bureau 2000; Grobler et al. 2002). Mean annual rainfall in Gauteng is 670 mm (Gauteng 1997).

Old granitic and gneissic rocks at least 2 400 million years old (Kerfoot 1987) are exposed in the Egoli Granite Grassland area. The Halfway House Granites (Fig. 3) of the Johannesburg Dome are intensively weathered with deep drainage lines resulting in a gently rolling topography, with shallow, coarse, nutrient-poor, well-drained soils. The granite areas are mostly covered by grassland vegetation though patches of woodland vegetation are found at sheltered sites on hillslopes and rocky outcrops within this veld type (Grobler 2000; Grobler et al. 2002, 2006).

The Bb land type predominates over the entire region (Land Type Survey Staff 1984, 1985, 1987) (Fig.3). The residual granitic soils are very shallow and poorly drained. The A horizon is often sandy and light in colour with little organic matter and with an increase in clay content with depth. The soils are invariably acid and very rich in silica (Kerfoot 1987).

Vegetation

Current vegetation

This tall grassland occurs over vast areas, usually on shallow, leached soils on the Johannesburg Granite Dome. Disturbed grassland or other disturbed areas such as road reserves or old fields, not cultivated for some years, are also usually Hyparrhenia species-dominated and low in species richness. Although some of these tall grasslands appear to be quite natural, they are mostly associated with an anthropogenic influence from recent or even iron-age times.

These grasslands are characterised by the tall-growing dominant grass Hyparrhenia hirta and the invader dwarf shrub Seriphium plumosum (=Stoebe vulgaris), indicating its low successional status or degraded condition.

Dense Hyparrhenia species-dominated grassland mostly has low species richness, with only a few other species able to establish or survive in the shade of the dense sward of tall grass. Most of these species are relict pioneers or early seral species. The most prominent species include the grasses Cynodon dactylon, Eragrostis chloromelas, E. racemosa, E. curvula and Aristida congesta. Forbs are rarely encountered, though a few individuals of species such as Anthospermum hispidulum, Pseudognaphalium luteo-album, Conyza albida, C. podoccephala, Crabbea angustifolia, Helichrysum nudifolium and H. rugulosum are often present. The woody layer, which has a very low cover, consists of small clumps of indigenous trees and shrubs widely scattered within this grassland. The scanty woody species include the trees Rhus pyroides and Ziziphus mucronata, together with the scandent shrub Ziziphus zeyheriana. Declared alien invasive species such as Melia azedarach, Eucalyptus species, Pinus species and planted ornamentals are often present.

Typical species found in anthropogenic Hyparrhenia hirta-dominated Egoli Granite Grassland are indicated below:
- Trees and Shrubs

*Acacia caffra* (Thunb.) Willd.
*Eucalyptus* species
*Gymnosporia buxifolia* L. Szyszyl
*Melia azedarach* L.
*Olea europaea* L. ssp. *africana* (Mill.) P.S.Green
*Pinus* species
*Rhus lancea* L.f.
*Rhus leptodictya* Diels
*Rhus pyroides* Burch.
*Ziziphus mucronata* Willd.
*Ziziphus zeyheriana* Sond.

- Grasses

*Aristida bipartita* (Nees) Trin. & Rupr.
*Aristida canescens* Henrard
*Aristida congesta* Roem. & Schult. ssp. *barbicollis* (Trin. & Rupr.) De Winter
*Aristida congesta* Roem. & Schult. ssp. *congesta* (Roem. & Schult.) De Winter
*Cynodon dactylon* (L.) Pers.
*Diheteropogon amplectens* (Nees) Clayton
*Elionurus muticus* (Spreng.) Kunth
*Eragrostis chloromelas* Steud.
*Eragrostis curvula* (Schrad.) Nees
*Eragrostis gummiflua* Nees
*Eragrostis plana* Nees
*Eragrostis racemosa* (Thunb.) Steud.
*Eragrostis rigidior* Pilg.
*Heteropogon contortus* (L.) Roem. & Schult.
*Hyparrhenia filipendula* (Hochst.) Stapf
*Hyparrhenia hirta* (L.) Stapf
*Melinis repens* (Willd.) Zizka
*Pogonarthria squarrosa* (Roem. & Schult.) Pilg.
*Sporobolus africanus* (Poir.) Robyns & Tournay
*Trichoneura grandiglumis* (Nees) Ekman

- Forbs

*Acalypha angustata* Sond.
*Anthospermum hispidulum* E.Mey. ex Sond.
*Asparagus laricinus* Burch.
*Asparagus suaveolens* Burch.
*Bidens formosa* (Bonato) Sch.Bip.
*Bidens pilosa* L.
*Chamaecrista mimosoides* (L.) Greene
*Cirsium vulgar* (Savi) Ten.
*Commelina africana* L.
*Conyza albida* Spreng.
*Cucumis zeyheri* Sond.
*Cyperus* species
*Elephantorrhiza elephantina* (Burch.) Skeels
*Felicia muricata* (Thunb.) Nees
*Gazania krebsiana* Less.
*Geigeria burkei* Harv.
*Gomphocarpus frutescens* (L.) Aiton f.
*Helichrysum nudifolium* (L.) Less.
*Helichrysum rugulosum* Less.
*Hermannia depressa* N.E.Br.
*Hibiscus aethiopicus*
*Hypoixis rigidula*
*Lactuca species*
*Ledebouria marginata* (Baker) Jessop

Original vegetation

The original vegetation is thought to be typical Bankenveld (Acocks 1988) or Rocky Highveld Grassland (Bredenkamp & Van Rooyen 1996). Bredenkamp & Brown (1998) found a few relict sites which indicate that the original vegetation on the shallow granitic soils of the Johannesburg Granite Dome could have been a variant of the *Monocymbium ceressiforme-Loudetia simplex* Grassland (Bredenkamp & Brown 2003). This vegetation is found in areas where little or no disturbance is evident.

The herbaceous layer covers approximately 80% and is dominated by the grasses *Loudetia simplex*, *Trachypogon spicatus*, *Schizachyrium sanguineum*, *Monocymbium ceressiforme*, *Digitaria monodactyla*, *Eragrostis racemosa*, *Andropogon shirensis*, *Brachiaria serrata*, *Alloteropsis semialata*, *Bewsia biflora* and *Themeda triandra*.

The woody layer consists mainly of a few scattered individuals of the trees *Rhus pyroides*, *R. leptodictya*, *Ziziphus mucronata*, the dwarf shrubs *Protea welwitschii*, *Lopholaenium coriifolium*, and the geoxyllophyte *Parinari capensis* that are locally prominent. The grasses *Panicum natalense*, *Urelytrum agropyroides*, *Tristachya leucothrix*, *Cymbopogon excavatus* and *Elionurus muticus* are also abundant together with the forbs *Cyanotis speciosa*, *Bulbostylis burchellii*, *Crabbea acaulis*, *Anthospermum hispidulum* and *Senecio venosus*. The grass *Hyparrhenia hirta* is often present and may become more prominent at disturbed sites.

This grassland is characterised by a high species richness with a patchy dominance of
various grass species and a large variety of forbs (Louw 1970), representing a climax or close to climax condition. Grazing by cattle is often found in this vegetation type, but the dominance of sour grass species often results in a low nutrient status of the grass during winter (Kerfoot 1987; Bredenkamp & Van Rooyen 1996).

Typical species found in the original Egoli Granite Grassland are indicated below:

- **Trees and shrubs**
  - *Acacia caffra* (Thunb.) Wild.
  - *Celtis africana* Burm.f.
  - *Elephantorhiza elephantina* (Burch.) Skeels
  - *Gymnosporia buxifolia* L. Szysyal

- **Forbs**
  - *Acanthopanax dichotoma* Lam.
  - *Acanthopanax trifidus* Benth.
  - *Acanthopanax hookerianus* Hook.

- **Grasses**
  - *Aristida adscensionis* L.
  - *Aristida canescens* Nees
  - *Aristida congesta* Roem. & Schult. ssp. congesta
  - *Brachiaris serrata* (Thunb.) Stapf
  - *Cymbopogon excavatus* (Hochst.) Stapf ex Burtt Davy
  - *Cymbopogon pospischilli* (K.Schum.) C.E. Hubb
  - *Cynodon dactylon* (L.) Pers.
  - *Digitaria brazzae* (Franch.) Stapf
  - *Diheteropogon amplexens* (Nees) Clayton
  - *Elionurus mucus* (Spreng.) Kunth
  - *Eragrostis chloromelas* Steud.
  - *Eragrostis curvula* (Schrad.) Nees
  - *Eragrostis racemosa* (Thunb.) Steud.
  - *Harpochloa falx* (L.f.) Kuntze
  - *Heteropogon contortus* (L.) Roem. & Schult.
  - *Hyparrhenia hirta* (L.) Stapf
  - *Melinis repens* (Willd.) Zizka
  - *Monocymbium cerasiforme* (Nees) Stapf
  - *Panicum natalense* Hochst.
  - *Schizachyrium sanguineum* (Retz.) Alston
  - *Sporobolus pectinatus* Hack.
  - *Themeda triandra* Forssk.
  - *Trachypogon spicatus* (L.f.) Kuntze
  - *Trichoneura grandiglumis* (Nees) Ekman
  - *Tristachya leucothrix* Nees
  - *Tristachya rehmannii* Hack

- ** Shrubs**
  - *Aloe greatheadii* Schönländ
  - *Anthericum species*
  - *Anthospermum hispidulum* E.Mey. ex Sond.
  - *Asparagus suaveolens* Burch.
  - * Aster bakeranus* Burtt Davy ex C.A.Sm.
  - *Babiana hypogea* Burch.
  - *Becium obovatum* (E.Mey. ex Benth.) N.E.Br.
  - *Blepharis subvolubilis* C.B.Clarke
  - *Boophane disticha* (L.f.) Herb.
  - *Bulbostylis hispidula* (Vahl) R.W.Haines
  - *Chasmanan hederaceum* (Sond.) Moldenke var. hederaceum
  - *Chaetacanthus burchellii* Nees
  - *Chlorophytum fasciculatum* (Baker) Kattivu
  - *Crabbea acaulis* N.E.Br.
  - *Crabbea angustifolia* Nees
  - *Crассula capitella* Thunb. ssp. capitella
  - *Crimum bulbispermum* (Burm.f.) Milne-Redh. & Schweick.

**ISSN 0075-6458**

**Koedoe 49/2 (2006)**
Origin of the current vegetation

The shallow, nutrient-poor soils provide a habitat suited to the climax vegetation as discussed previously. Some nutrients are available in the topsoil, supplemented from fallen leaf litter and decomposition, and also from ashes of burned herbaceous layer (if there was a fire). Nutrients are quickly utilised by plants and are furthermore also quickly leached from the very coarse sandy soils. Nutrient cycling is therefore very rapid.

The system is quite stable and fairly predictable without much change caused by normal droughts or grazing. However, if overgrazed or disturbed to such an extent that degradation proceeds beyond a threshold, then recovery is very slow, due to reduced nutrient cycling and decreased nutrient availability and the vegetation may change to another domain of attraction (Bosch 1989), different from the original climax vegetation, representing a plagioclimax (Fig. 4). A change back to the original domain of attraction is unlikely if not impossible in the short and medium term. Due to the granitically derived shallow nutrient poor soils these systems are sensitive and intolerant to frequent impacts such as heavy grazing, ploughing, trampling and general domestic activities. Thus degradation occurs easily resulting in a change from the climax (high species richness) vegetation to an anthropogenic *Hyparrhenia hirta* (low species richness) dominated vegetation type.

Very often *Hyparrhenia* species-dominated grasslands occur on ancient lands in the Central Variation of the Bankenveld (Acocks 1988) and in the surroundings of archaeological sites (Bredenkamp & Brown 2003), where the inhabitants had a mosaic of cultivated lands and grazing of domestic stock. The more recent European settlers also had a profound effect on the natural vegetation as they developed the cities of Johannesburg and Pretoria following the discovery of gold more than a century ago. It seems that the degraded sites developed into *Hyparrhenia* species-dominated grasslands, which tend to be stable for a very long time. Moll (1965) and Smits et al. (1999) also indicated that *Hyparrhenia* species-dominated tall grasslands are anthropogenic in origin.

**Importance**

The substrate of the Johannesburg Granite Dome (Halfway House Granites, Fig. 3) is suitable for development. The area is well situated between Johannesburg, the economic powerhouse of South Africa, and Pretoria the administrative capital of the country. There is an enormous demand for developable land in this area, which has resulted in the loss of large tracts of the original Egoli Granite Grassland. Due to general disturbance, ploughing and degradation, an esti-
mated 60% of the remaining original Egoli Granite Grassland has been transformed to *Hyparrhenia hirta* dominated grassland. Only relatively small scattered pockets of the original grassland are still intact and these are considered rare and highly threatened. Due to its high species richness and restricted occurrence, this endemic grassland has a high conservation value.

Furthermore, the bottomland areas and wetlands within the Egoli Granite Grassland provide suitable habitat for various sensitive fauna species such as the Grass Owl *Tyto capensis* (Red Listed), Marsh Sylph *Metisella meninx* (Vulnerable), and the Giant Bullfrog *Pyxicephalus adspersus* (Near Threatened).

**Conclusion**

Egoli Granite Grassland is a poorly conserved, severely transformed, highly fragmented and degraded vegetation type. It is estimated that only 22% of the original extent of Egoli Granite Grassland remains in its original state. Many of these remnant areas are likely to be destroyed in the near future due to previously authorised developments (e.g. Cosmo City to the north-west of Johannesburg) or illegal activities. It is therefore essential that any viable remnant patch of original Egoli Granite Grassland is conserved.

Areas associated with transformed grassland, where *Hyparrhenia hirta* is dominant and species richness is low, have a low value with respect to achieving the national conservation target for Egoli Granite Grassland. It should be noted however, that *Hyparrhenia hirta* dominated grassland may be valuable for the conservation of sensitive fauna, e.g. Grass Owl (*Tyto capensis*) and Giant Bullfrog (*Pyxicephalus adspersus*).

A mixture of various grasses and high forb diversity renders the original Egoli Granite Grassland with a high conservation value and conservation of remnant areas is especially important since it is unlikely that the transformed anthropogenic grassland will return to the original climax vegetation.

Since Egoli Granite Grassland is endemic to Gauteng, its protection is both a provincial and national priority. It also forms part of a global ecoregion in crisis, an area where biodiversity and ecosystem services are at greatest risk and focused on-the-ground conservation action are required (Hoekstra *et al.* 2005).

**References**


Land Type Survey Staff. 1987. Land types of the maps 2526 Rustenburg, 2528 Pretoria. Memoirs on the Agricultural Natural Resources of South Africa 8: 1–391.


