MUNICIPAL COMMONAGE: LIVESTOCK, LIVELIHOODS AND LAND DEGRADATION IN GRAHAMSTOWN, SOUTH AFRICA

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ABSTRACT

Current government policy in South Africa emphasises municipal commonage in improving the livelihoods of poor urban residents. One way this is achieved is by providing a grazing resource for livestock owned by the urban poor. However, increased urbanisation, heavy stocking rates and ineffective management have raised concerns regarding degradation of these rangelands. This paper examines the ecological condition of the Grahamstown municipal commonage to assess the sustainability of this rangeland in improving livelihoods. Vegetation types on the commonage were mapped and their condition assessed separately by examining plant species composition in relevés. Canonical correspondence analysis revealed that areas closer to the township and areas included as commonage for longer periods were more degraded, being associated with unpalatable karroid shrubs and grass species which increase under conditions of over-utilisation. Rotational grazing and adaptive management such as reduction of stock during times of drought appear to be optimal measures to ensure the sustainability of the resource. Interviews with commonage users indicated that they are open to such measures. Ultimately, greater amounts of funding and power need to be bestowed on local authorities to ensure effective management of municipal commonage.

Keywords: adaptive management, degradation gradient, land redistribution, rangeland condition assessment, user perceptions.

INTRODUCTION

One of the most important challenges facing the post-apartheid South African government in 1994 was how to provide greater access to land and its resources for all the country's inhabitants (Bernstein 1996). One of the means of addressing this issue has been the Municipal Commonage Programme, initiated by the Department of Land Affairs in 1997 (DLA 1997). To date, municipal commonage accounts for the greatest transfer of land attributable to any one programme within the government's land redistribution programme, with a total of 420 812 ha being made available by 2003 (DLA 2003).

Municipal commonage is land granted by the state to towns for use by the local residents. "Traditional" or "old" commonage refers to land which was granted free of charge to towns at the time of their establishment in the 1800s. At this time people were far more dependent on pastoralism, and commonage was used by the town inhabitants primarily as a source of grazing for their livestock. With technological change and increased wealth, town inhabitants became less dependent on commonage, and municipalities began leasing out this land to commercial farmers to generate income (Anderson and Pienaar 2003; Ingle 2006). In the past, racial discrimination meant that municipal commonage was only available for use by white farmers. This changed in the early 1990s with the dismantling of the apartheid government, and black urban residents were afforded the right to access this land (Anderson and Pienaar 2003). As part of the new government's national land reform programme, the Department of Land Affairs purchased farmland from private owners, which was then transferred in ownership to municipalities to be included as commonage (DLA 1997). This "new" commonage supplemented the "traditional" commonage and together they make up what is recognised today as municipal commonage (Anderson and Pienaar 2003).

Current government policy for the use of municipal commonage differs significantly from that before 1994 (Atkinson 2005). It has been recognised that commonage can provide for a range of land uses such as grazing, food gardening, firewood collection, and medicinal plant harvesting (Anderson and Pienaar 2003). As a result, government has placed an emphasis on the use of municipal commonage for improving the livelihoods of poor urban residents and for local economic development. More specifically, "traditional" commonage is primarily set aside for subsistence use by the urban poor, while "new" commonage is primarily to be used as a springboard for emergent black commercial farmers (Atkinson 2005).

Although the commonage programme has been effective in transferring land to those previously disadvantaged by the apartheid regime, post-transfer rights allocation and management are virtually non-existent. This has resulted in an array of problems which are commonly associated with land reform projects. These include open access to grazing land, dominance by political or financial elites, the absence of women, and land and infrastructure degradation (Anderson and Pienaar 2003; Benseler 2003; Ingle 2006).

Beinart (2003) identifies rangeland degradation as one of the major challenges facing post-apartheid South Africa at the beginning of the twenty first century. The predominantly arid and variable climate makes South Africa's rangelands particularly susceptible to degradation. Coupled with this are the uniquely South African land tenure problems which have arisen as a result of this country's colonial and apartheid past. Most notable are the communal rangelands which are predominantly associated with the black homelands of the apartheid regime. These areas have been under-resourced and typically suffer from high population densities and stocking rates, with individuals who use the land having few rights to own or sell land (Meadows and Hoffman 2002). Such factors have led to sometimes severe degradation in these areas, with many communal rangelands being perceived as the most degraded lands in South Africa (Hoffman and Todd 2000; Hoffman and Ashwell 2001).

Certain parallels between communal rangelands and municipal commonage have been drawn, and concerns have been raised as to whether municipal commonage is a sustainable option for providing for the livelihoods of the urban poor and as a springboard for emergent farmers (Ingle 2006). The Department of Land Affair's commonage manual contains no guidelines on how to craft regulations or agreements that could work to secure individual rights of commonage users. In addition it provides inappropriate advice on options for regulating access to municipal commonage (Anderson and Pienaar 2003). Municipalities themselves do not have the necessary skills, experience and funding to implement effective management of municipal commonage on their own (Buso 2003). Coupled with this are increased rates of urbanization in many towns due to economic and political factors (Atkinson 2005), which has resulted in increased pressure on municipal commonage to supply goods and services to the urban poor.

The town of Grahamstown, in the Eastern Cape of South Africa, possesses a typical example of municipal commonage. The Grahamstown commonage is made up of "old" commonage which is mainly set aside for subsistence use by the urban poor, as well as "new" commonage, consisting of farms incorporated in 1994 and 2004, which are earmarked for emergent black farmers. The principle aim of this research project was to assess the ecological condition of the rangelands on the Grahamstown municipal commonage to assess the long-term sustainability of the commonage programme in improving livelihoods and providing local economic development.

The assessment of rangeland condition has received much attention in South Africa and has given rise to many varied techniques. Most of these techniques have been designed to assess the condition of rangelands in commercial farming areas. Judgment on vegetation condition is often made according to a subjectively chosen "ideal" or "benchmark" area which is deemed to be most desirable in terms of commercial farming objectives (Hurt and Bosch 1991; Jordaan *et al.* 1996). Authors such as Abel (1993), Scoones (1993), and Tapson (1993) have questioned the applicability of these methods for making decisions about rangelands under communal land tenure as farmer objectives in these areas are often different to those of commercial farmers. An important component of the research project was thus to determine the objectives of stock farmers and owners on the Grahamstown municipal commonage so that vegetation condition could be interpreted within this framework. In addition, local user perceptions of the ecological condition of the commonage were also investigated so that they could be compared with the scientific vegetation assessment method used.

The following key questions guided this study:

(a) How has the municipal commonage been used in the pre- and post-1994 eras?
(b) What are the main vegetation units which comprise the Grahamstown municipal commonage?
(c) What is the current condition of the commonage relative to benchmark sites in terms of species composition?
(d) What are the farming objectives of stock owners using the Grahamstown municipal commonage?
(e) How do local users perceive the condition of the municipal commonage?
(f) What are the implications of the above for municipal commonage management and policy formulation?

METHODS

Study area

The Grahamstown municipal commonage covers approximately 8741 ha of land immediately surrounding the city of Grahamstown (33°18'06"S 26° 32'09"E) in the Eastern Cape Province of South Africa (Figure 1). The commonage is made up of approximately 4397 ha of "traditional" or "old" commonage, which has been owned by the Grahamstown municipality since the establishment of the town in the early 1800s, and approximately 4686 ha of "new" commonage which consists of previously commercial farms that have been incorporated into the commonage as part of the government's land redistribution programme. The "new" commonage consists of two farms, totalling 1766 ha, which were incorporated in 1994 and six farms, totalling 2920 ha, incorporated in 2004.

Topographically, the area falls within a tract of ridges and valleys which lie between a peneplaned coastal belt to the south and the Fish River valley to the north. The altitude ranges from approximately 720 m on the highest ridges down to approximately 510 m in the valleys. Geologically, this region is situated at the eastern extremity of the Cape Fold Belt and the ridges straddling the northern and southern edges of the commonage are composed of quartzitic sandstones of the Witteberg Series. The low-lying areas are characterised by shales of the Dwyka Series of the Karoo Supergroup, and there is an area of Post-Cretaceous silcrete on the peneplain immediately surrounding the town (Dyer 1937).

Grahamstown falls within the semi-arid region of the Eastern Cape with a mean annual rainfall of 670 mm. Two major climate systems converge in this region (winter rainfall in the west and summer rainfall in the east) resulting in all-year rainfall, although there are maxima in spring and autumn. However, rainfall reliability is poor, with a co-efficient of variation of 32%, and droughts lasting several months are common (Palmer 2004). The study area is situated in an area of convergence of four major biomes in South Africa, namely fynbos, grassland, thicket and karoo (Mucina and Rutherford 2006) and is therefore biologically diverse.

Population trends in South Africa have shown an increase in the number of people moving from rural to urban areas. From 1996 to 2001, South Africa's rural population declined from 44.9% to 42.5% (830 000 people) (StatsSA 2001). Such increases in the rate of urbanisation have resulted in the intensification of pressure on municipal commonages, as more people rely on these areas for eking out a livelihood (Atkinson 2005). A survey conducted by the East Cape Agricultural Research Project (ECARP) in 2001 indicated that there were approximately 263 people who owned livestock and grazed them on the Grahamstown municipal commonage. The total amounts of livestock at that time were estimated to be approximately 1850 cattle, 1910 goats and an unknown number of donkeys. These numbers were above the recommended carrying capacity of 1862 large stock units which were subsequently calculated for the Grahamstown commonage (Palmer 2005). Current livestock numbers are unknown, although it is estimated that there are approximately 2000 cattle on the commonage (pers. comm. Bates 2008). It is therefore likely that livestock numbers on the commonage still exceed the recommended carrying capacity for the area.

Determination of past and present land use

Past and present land use was determined using a combination of interviews, site inspections and aerial photographs. The municipal commonage manager and 17 local commonage users were interviewed in order to determine how the land is currently being used. Site inspections and aerial photographs were also useful for determining current land use. The history of land use was determined by interviewing the municipal commonage manager and four previous owners of farms which have been incorporated into the Grahamstown commonage. Respondents were asked about the previous veld management systems employed and the types of livestock farmed. They were also asked about their opinions on the past and present condition of the vegetation on the commonage, and about problems experienced during their tenure. This information was synthesised in a land use map for the Grahamstown municipal commonage which was created using ArcView GIS version 3.3.

Identification of vegetation units and vegetation mapping

In order to effectively assess the vegetation condition of an area, it is important that the vegetation units be identified. Mucina and Rutherford (2006) provide a vegetation map of the Grahamstown area but it was found that their mapped vegetation units were at too coarse a scale for the purposes of this study. The vegetation map from the Subtropical Thicket Ecosystem Project (STEP) was also consulted but there were certain inconsistencies found between mapped vegetation units and vegetation on the ground. It was therefore necessary to create a refined vegetation map of the Grahamstown commonage.

To begin with, four relatively homogenous vegetation units (RHVUs) were identified using a combination of aerial photographs, existing vegetation maps for the area and ground-truthing. A total of 110 sample plots were placed in a stratified random manner throughout these RHVUs. In order to ensure that sample plots were large enough to contain plant species representative of each of the RHVUs, three species-area curves were determined in each (Appendix I). These curves were compiled by recording the number of species in nested plots, each plot being double the area of the previous one (Mueller-Dombois and Ellenberg 1974). It was not possible to create species-area curves for the thicket RHVU due to the impenetrable nature of this vegetation type. However, this was not needed as it has been shown that the optimal plot size for this vegetation type is 100 m^2 (Palmer 1981; Everard 1987; Palmer *et al.* 1988). The species-area curves obtained for the other RHVUs indicated that the minimal areas for sample plots in the remaining RHVUs were 50 m^2, 100 m^2 and 200 m^2 respectively. Dominant plant species composition and percentage cover were recorded within each sample plot, as well as percent bare ground and litter. In addition, certain abiotic variables were recorded. Altitude and aspect were determined using a GPS, and slope was visually estimated as flat, slight, moderate or steep. An estimate of soil depth was determined by driving a metal stake into the ground and measuring the depth at which the stake stopped penetrating the soil. This process was repeated at each corner of a sample plot and a mean soil depth calculated for each plot.

In order to assess the similarity in species composition between sample plots and the boundaries of the vegetation units, the sample plots were ordinated using detrended correspondence analysis (DCA) (Hill and Gauch 1980). DCA was used because it is suitable for data sets with relatively long gradients (Gauch 1982). Once the vegetation units had been identified, they were given names according to the nomenclature used by Mucina and Rutherford (2006).

A vegetation map of the Grahamstown municipal commonage was created using ArcView GIS version 3.3. The same program was used to calculate the areas of the different vegetation types using the XTools extension.

Vegetation condition assessment

The same sample plots that were used for mapping the vegetation on the Grahamstown commonage were also used to assess the vegetation condition. As mentioned above, a stratified random sampling approach was taken. Sample plots were stratified according to the different RHVUs. Within each RHVU, plots were further stratified to represent vegetation at different distances from the township, vegetation that had been part of the commonage for different lengths of time (i.e. "old" commonage, and "new" commonage incorporated in both 1994 and 2004), and vegetation protected from grazing and browsing pressure by commonage livestock. The areas protected from commonage livestock were located on the Grahamstown airfield and at the Grahamstown military base and are considered "benchmark" sites for the region. Sample plots were located randomly within the stratifications mentioned above. The same variables recorded for the vegetation mapping were recorded for the vegetation condition assessment. These included dominant species composition and cover, litter and bare ground cover, as well as environmental variables such as soil depth, aspect, slope and altitude at each sample plot.

During the fieldwork period, a large portion of the fire-prone Suurberg Quartzite Fynbos vegetation type on the commonage was accidentally burnt. It was therefore not possible to adequately sample this vegetation type and it was omitted from the vegetation condition assessment. A total of 91 sample plots were therefore used for the vegetation assessment, with 40 plots in the Bisho Thornveld vegetation type, 27 plots in the Albany Broken Veld vegetation type, and 24 plots in the Kowie Thicket vegetation type (see Table 1 in the results section for a description of the vegetation types).

Canonical correspondence analysis (CCA) (ter Braak 1986), a direct gradient analysis (constrained ordination) technique, was used to investigate whether there were any relationships between plant community composition and the measured environmental variables. Separate CCA analyses were conducted for the three different vegetation types studied. Plant community composition was reflected in a species by sample plot matrix, which was constrained by the environmental matrix. The environmental matrix consisted of sample plots by soil depth and plot altitude. Aspect and slope were found to be uniform within each vegetation type and they were therefore omitted from the environmental matrix. The only exception was in the Kowie Thicket vegetation type where five sample plots were located on different aspects to the rest of the plots. For simplicity, these sample plots were omitted from the CCA ordination. In addition to soil depth and altitude, two extra variables were included in the environmental matrix. These were the distance of each sample plot from the nearest edge of the township (distance), and the number of years that a particular sample plot area had been part of the Grahamstown commonage (sample plot age). Distance of each plot from the nearest edge of the township was determined using the distance tool in ArcView GIS version 3.3. Plot age was assigned according to whether the sample plot was in "old" commonage, "new" commonage either incorporated in 1994 or 2004, or outside of the commonage.

The programme PC-ORD version 4 was used for the CCA ordination and for obtaining ordination scores. Row and column scores in the community matrix were standardised by centering and normalising so that the resulting ordination diagrams could be interpreted as biplots (McCune and Grace 2002). Site scores were weighted mean species scores (WA scores) so that it was possible to infer from the ordination diagrams which species were likely to be present in which sample plots (ter Braak 1986). WA scores were used for the sample plots in the ordination diagrams as these scores are less sensitive to noise in the environmental data (McCune 1997). Monte Carlo tests were conducted to test the null hypotheses that there was no linear relationship between matrices, and that there was no structure in the main matrix and therefore no linear relationship between matrices. Monte Carlo tests were run for 999 randomisations and the resulting *p*-values for each ordination axis were used to evaluate the significance of each in the ordination (McCune and Grace 2002).

Grass species in the ordinations were assigned to classes according to their reaction to grazing pressure (Tainton 1999). These were decreasers species (species decreasing under conditions of under- or over-utilisation), increaser 1 species (species increasing under conditions of under-utilisation), and increaser 2 species (species increasing under conditions of over-utilisation). These classifications were based on extensive research conducted in the Eastern Cape region which has been synthesised in Danckwerts (1989). Species not classified in Danckwerts (1989) were classified according to Van Oudtshoorn (1999). In addition, grass species were assigned "forage factors", on a scale from nought to 10, which represent the agronomic value of a species in terms of its potential to provide grazable forage. These forage factors were obtained from Danckwerts (1989). Forage factors for those grass species not mentioned in Danckwerts (1989) were estimated according to grazing value descriptions for grasses from Van Oudtshoorn (1999). Karroid shrub species known to invade areas under conditions of over-utilisation were also noted in the ordinations, as well as invasive alien plant species. Bush and trees species were classed according to their acceptability to goats.

They were classed as either "acceptable" or "unacceptable" according to research conducted by Trollope (1981) in the thornveld areas of the Eastern Cape. Appendix II is a complete list of the species used for the commonage vegetation condition analysis and their assigned classes and forage factors according to different authors who have conducted research in the Eastern Cape region and elsewhere.

Examination of the CCA ordination biplots for the different vegetation types indicated which environmental variables were important in structuring plant communities. Furthermore, it was possible to detect the existence of degradation gradients by observing the relative positions of the different classes of plant species, particularly the karroid shrubs and increaser 2 species in relation to decreasers and increaser 1 species. Other factors such as the amount of bare ground and litter, the location of "acceptable" and "unacceptable" bush species and invasive aliens on the ordination diagram could also be used to detect gradients. If a gradient was detected, it was possible to observe approximately where the different sample plots were situated on the gradient. It was also possible to observe which plant species were most closely associated with which sample plots. An overall impression of the condition of the different vegetation types could thus be obtained.

Commonage users and user perceptions

A qualitative approach was used in order to obtain information regarding the users of the Grahamstown commonage and their perceptions of vegetation condition. This was achieved by conducting semi-structured interviews with livestock herders on the Grahamstown commonage. Herders were approached in the field while they were herding their livestock and asked whether they were willing to be interviewed. With the help of a translator, interviews were conducted in Xhosa (the native language in the Eastern Cape) to promote better understanding of the questions being asked and a richer dialogue. An attempt was made to approach herders from as wide an area of commonage as possible. A total of 17 herders were interviewed, 12 of which were operating on the "old" commonage and five of which were operating on the "new" commonage.

Questionnaires were designed in order to obtain information on herder experience, type and number of livestock herded, farming objectives and the reasons for keeping livestock, grazing practices, their perceptions of vegetation condition, their views on the reasons for the current vegetation condition, and problems experienced as livestock herders on the commonage (see Appendix III for a detailed version of the commonage user questionnaire).

RESULTS

Past and present land-use

Land-use on the Grahamstown municipal commonage falls into six categories, namely: land set aside for use by "emergent" black farmers; land set aside for subsistence use by the urban poor; a nature reserve; a military area; an airfield; and land classed as "other" which has no specific current use but allows for urban expansion in the future (Figure 1).

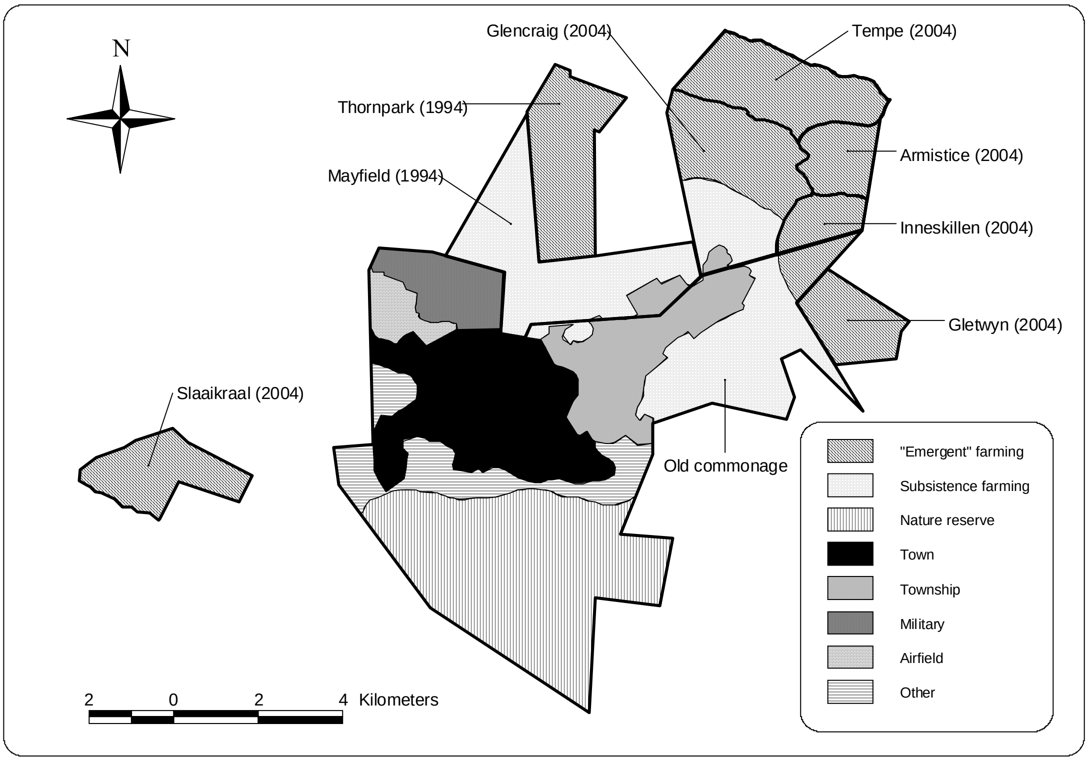

Figure 1 Land-use map of the Grahamstown municipal commonage. Bold lines denote previous farms and commonage borders, and thin lines denote land-use type borders. Labels are previous farm names, with the year they were incorporated into municipal commonage in parentheses.

The commonage set aside for subsistence use by the urban poor consists of a portion of old commonage, as well as the farm Mayfield (incorporated in 1994) and the southern portion of the farm Glencraig (incorporated in 2004)(Figure 1). The old commonage has a long history of use dating back to the establishment of Grahamstown. From the 1950s this land was leased to township dwellers for use as grazing, but from 1994 the land has been available to township residents free of charge. Prior to 1994 the farm Mayfield was used for farming dairy and beef cattle, and goats. Springbok were also kept on the farm. Glencraig farm was used for farming beef cattle, goats and merino sheep. The veld management system on both Mayfield and Glencraig prior to inclusion as commonage was one of rotational grazing and veld resting, using a multi-camp system. Rotation and resting intervals were determined largely by rainfall. At present, this veld management system is not possible on the land as fencing is either non-existent or in a state of disrepair. Other infrastructure, such as artificial water points are also in a state of disrepair, although a few earth dams do provide semi-permanent water. The urban poor currently use this commonage for keeping cattle and goats which range over the entire area and are typically looked after by herders. Some herders mentioned that they try to move their herds around the commonage in order to minimise overutilization of one particular area but stated that this was sometimes difficult due to the limited area available to them. Land-use on this area of commonage can be described as open-access with no rotational grazing or resting of the vegetation.

The commonage set aside for emergent farmers consists almost entirely of farms incorporated into the commonage since 1994. These farms are: Thornpark (incorporated in 1994); Gletwyn (2004); Inneskillen (2004); Armistice (2004); Tempe (2004); the northern portion of Glencraig (2004); and Slaaikraal (2004). There is, however, also a small portion of old commonage in the northeast which is also set aside for “emergent” farmers. Thornpark was run by the same owners as Mayfield with the same animals and management system. The farm Gletwyn was previously used for dairy and beef cattle production. Inneskillen and Armistice were run by the same family initially for the production of sheep, and later for dairy and beef cattle. Some wild game in the form of blesbok and zebra for venison were also kept on Armistice. Tempe and Glencraig were run by the same owner. Tempe was stocked with goats as this farm is made up almost entirely of thicket vegetation. The farm Slaaikraal was stocked with cattle. The veld management system for all of these farms was one of rotational grazing and veld resting, using a multi-camp system. Currently, all these farms are used to stock cattle and goats. Fencing infrastructure is still in place on the farms Gletwyn, Inneskillen, Armistice and Slaaikraal making resting and rotation viable. However, fencing is either non-existent or in a state of disrepair on the farms Glencraig, Tempe and Thornpark making this type of veld management system more difficult at these locations.

Identification of vegetation units

The spatial distribution of sample plots relative to the first and second axes of the DCA ordination confirm the existence of the four relatively homogenous vegetation units identified using aerial photographs and ground-truthing (Figure 2). These four vegetation units were named according to their vegetative composition and structure after Mucina and Rutherford (2006).

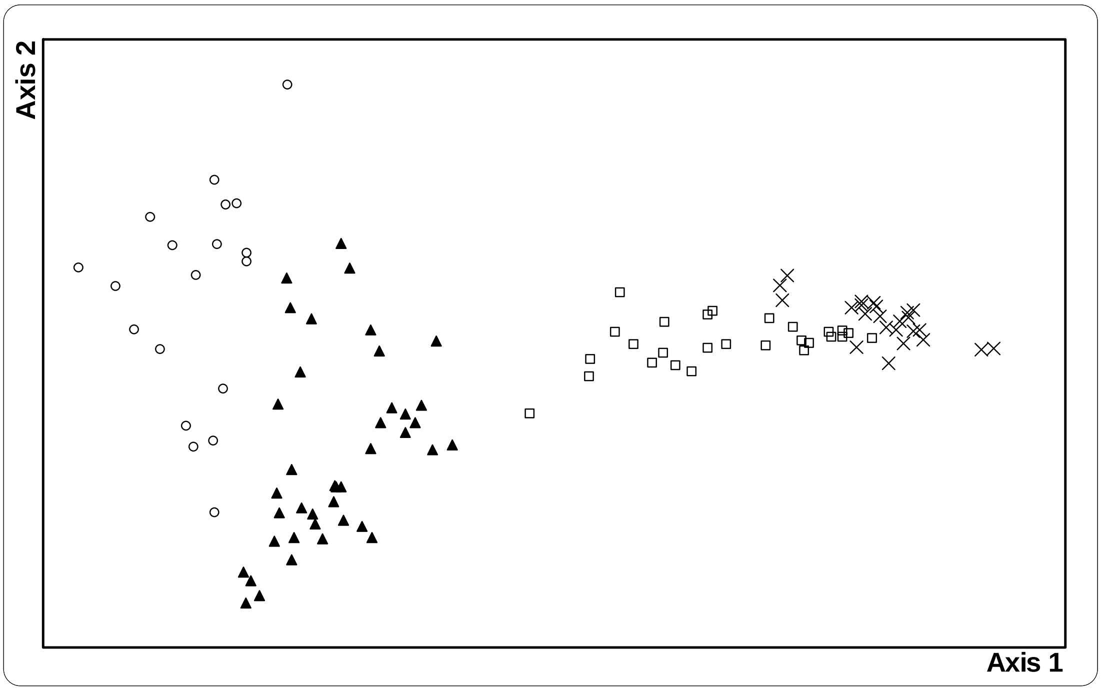

Figure 2 Spatial distribution of the sample plots on the first and second axes of a detrended correspondence analysis showing their separation into four vegetation units, Suurberg Quartzite Fynbos (○), Bisho Thornveld (▲), Albany Broken Veld (□) and Kowie Thicket (×).

Suurberg Quartzite Fynbos and Bisho Thornveld appear to be more closely affiliated with one another on the left of the ordination. Albany Broken Veld and Kowie Thicket also appear to be affiliated with one another with some slight overlap, possibly in ecotonal areas. The vegetation structure, land form and soil characteristics, and dominant plant species of the vegetation units are summarized in Table 1.

Table 1 Landform and soil characteristics, vegetation structure and dominant species of the four vegetation types on the Grahamstown municipal commonage.

Name	Landform and soil characteristics	Vegetation structure	Dominant species
Suurberg Quartzite Fynbos	Moderate to steep slopes N and S aspects Altitudinal range: 528 - 728 m Soil depth range: 0.07 - 0.35 m Geology: Quartzitic sandstone	Grassland with restioids and scattered shrubs.	Shrubs: *Leucadendron salignum.* Graminoids: *Tristachya leucothrix, Themeda triandra, Heteropogon contortus, Eragrostis capensis, Eragrostis curvula, Pentaschistis pallida Eulalia villosa, Thamnochortus sp., Elegia asperiflora, Bobartia orientalis.* Herbs: *Helichrysum felinum.*
Bisho Thornveld	Flat aspect Altitudinal range: 614 - 667 m Soil depth range: 0.07 - 0.45 m Geology: Dwyka shale	Grassland. Some scattered shrubs and small trees.	Small trees: *Acacia karroo.* Shrubs: *Solago corymbosa, Pteronia teretifolia, Aspalathus spinescens*. Graminoids: *Themeda triandra, Eragrostis capensis, Eragrostis curvula, Pentaschistis pallida Cynodon dactylon.* Herbs: *Helichrysum anomalum.*
Albany Broken Veld	Flat to slight slopes N and S aspects Altitudinal range: 590 - 678 m Soil depth range: 0.06 - 0.13 m Geology: Dwyka shale	Grassland/bush mosaic. Bush in characteristic closed-canopy clumps.	Small trees: *Cussonia spicata, Schotia afra* var. *afra, Euclea undulata, Scutia myrtina, Azima tetracantha, Sideroxylon inerme, Gymnosporia polyacantha.* Succulent trees: *Aloe ferox.* Shrubs: *Chrysocoma ciliata, Pteronia teretifolia, Felicia filifolia.* Graminoids: *Themeda triandra, Merxmuellera disticha, Eragrostis curvula, Cynodon dactylon.*
Kowie Thicket	Slight to moderate slopes N and S aspects Altitudinal range: 534 - 645 m Soil depth range: 0.2 - 0.5 m Geology: Dwyka shale	Dense closed-canopy bush.	Small trees: *Euclea undulata, Azima tetracantha, Scutia myrtina, Cussonia spicata, Schotia afra* var.*afra.* Succulent trees: *Aloe ferox.* Succulent shrubs: *Cotyledon orbiculata, Delosperma sp.* Graminoids: *Panicum maximum, Eragrostis curvula.*

Figure 3 is a map of the vegetation on the Grahamstown municipal commonage. The largest portion (45%) of the commonage consists of the Suurberg Quatzite Fynbos vegetation type (3901 ha). However, only 1288 ha are available for use by the urban poor, with the remainder (2613 ha) being set aside as a nature reserve. Bisho Thornveld covers approximately 21% (1805 ha) of the total commonage area. Of this total, 1626 ha are available for livestock grazing and other subsistence uses, with the remainder (178 ha) being used as an airfield. Albany Broken Veld covers approximately 18% (1583 ha) of the commonage. Of this total, 1385 ha are available for livestock and subsistence use, with the remainder (198 ha) falling within the Grahamstown military base. Kowie Thicket covers approximately 17% (1465 ha) of the commonage of which all is available for use by the urban poor. In total, there are 5765 ha of land on the Grahamstown municipal commonage available for the upliftment of poor urban dwellers. Of this total, 2350 ha are set aside for subsistence users, and 3415 ha are set aside for "emergent" farmers.

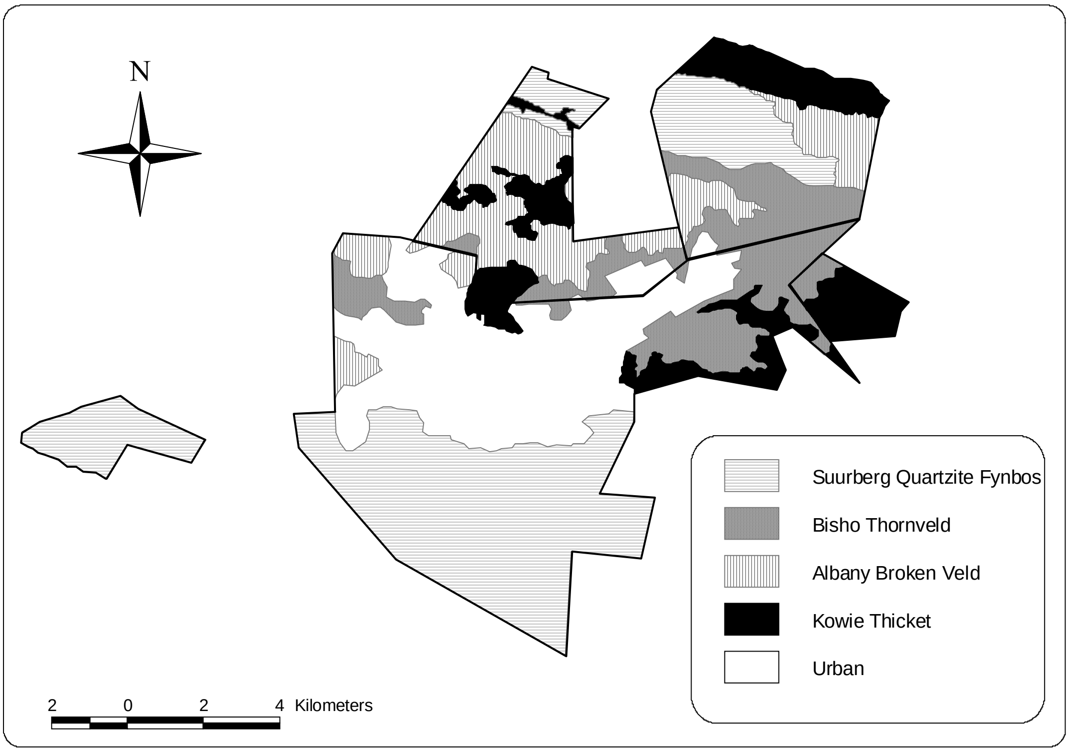

Figure 3 Vegetation map of the Grahamstown municipal commonage.

Vegetation condition assessment

Bisho Thornveld

The canonical correspondence analysis for Bisho Thornveld identified patterns of vegetation change that were clearly associated with the measured environmental variables (Table 2).

Table 2 Summary of the performance of the canonical correspondence analysis for the Bisho Thornveld in terms of the variance accounted for by each axis, species- environment correlations, and Monte Carlo test results.

	Axis 1	Axis 2	Axis 3	Total inertia
Eigenvalue	0.254	0.116	0.087	1.7579
Monte Carlo test (eigenvalues)	p = 0.001	p = 0.001	p = 0.001	
% of variance explained	14.4	6.6	5	
Species-environment correlation	0.934	0.872	0.818	
Monte Carlo test (spp-env corr.)	p = 0.001	p = 0.001	p = 0.001	

The first axis of the CCA ordination is defined primarily by distance from the township, with soil depth and age of commonage playing a lesser role, and altitude having a minor role. The second axis is defined almost equally by age of the commonage, soil depth and altitude (Table 3 and Figure 4).

Table 3 Inter-set correlations of the environmental variables with the ordination axes for the Bisho Thornveld.

	Correlation coefficients	
Variable	Axis 1	Axis 2
Distance	0.880	0.220
Age	-0.494	-0.590
Soil depth	0.564	-0.575
Altitude	0.195	0.553

Karroid elements and increaser 2 species (species increasing under conditions of overgrazing) tend to be associated with areas of older commonage which are situated closer to the township (Figures 4 and 5). These areas are also associated with more bare ground. It would also appear that areas with shallower soil depths are more heavily invaded by karroid elements. Areas of the commonage which are further away from the township and are either not available for grazing or have been incorporated as grazing land recently are characterised by increaser 1 (species increasing under conditions of under-utilisation) and decreaser species (species which decrease under conditions of over- or under-utilisation) as well as increased amounts of litter (Figure 4). Axis 1 of Figures 4 and 5 can, therefore, be interpreted as a degradation gradient, with over-utilised or degraded vegetation on the left, ranging through to under-utilised vegetation in better condition on the right.

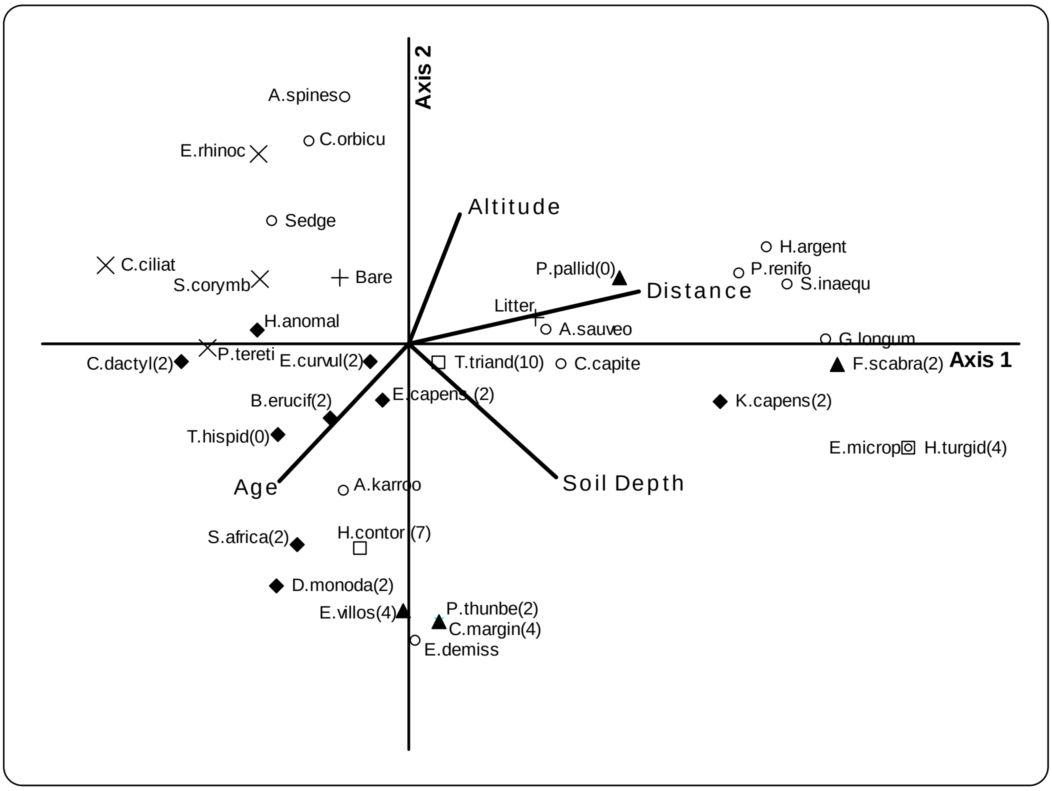

Figure 4 CCA ordination diagram of species and environmental variables for the Bisho Thornveld. □ = decreaser; ▲ = increaser 1; ♦ = increaser 2; × = karroid shrub; + = bare ground/litter; ○ = other. Grass forage factors are in parentheses.

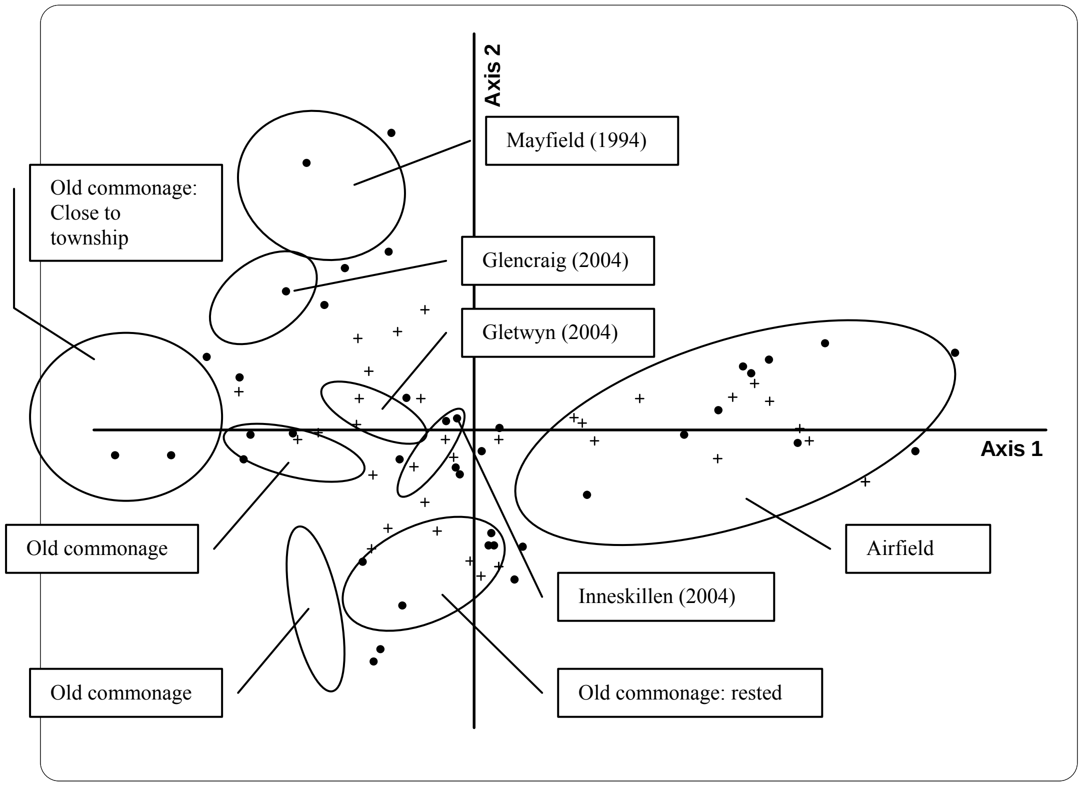

Figure 5 CCA ordination diagram of sample plots (WA scores) (●) and species (+) for Bisho Thornveld. Circles enclose clusters of similar aged sample plots at different locations (labelled) on the Grahamstown commonage. Species (+) correspond with Figure 4.

The majority of the sample plots in the Bisho Thornveld are situated on the left side of the CCA ordination diagram (Figure 5) indicating that the largest portion of this vegetation type is in a moderately to severely degraded state. The most heavily degraded sample plots are those which are closest to the township and which have been incorporated as municipal commonage for the longest time (far left of the CCA ordination diagram). A notable exception is the farm Glencraig which has only recently been included as commonage. Forage factors of the grass species associated with these areas are all low. The sample plots falling in approximately the centre of the CCA ordination are predominantly those occurring on land which was recently added to the commonage in 2004, although some of these sites are on an area of old commonage which has been rested for the last few years. These sites can be characterised as in fair to good condition with a mix of decreaser, increaser 1 and increaser 2 plant species being associated with them. In addition, forage factors of the grass species associated with these areas range from low to high. Sites on the Grahamstown airfield, which are excluded from livestock grazing, are associated with increaser 1 grass species indicating that this vegetation is under-utilised. It would also appear that protection from livestock utilisation has enabled a greater diversity of plant species classed as "other" to establish and survive in this area.

Albany Broken Veld

Results of the canonical correspondence analysis for the Albany Broken Veld vegetation type show that most of the variation (20.4%) explained is in the first axis. Axes 2 and 3 can largely be ignored as they explain little variance. Axis 3 also failed the Monte Carlo tests (Table 4).

Table 4 Summary of the performance of the canonical correspondence analysis for the Albany Broken Veld in terms of the variance accounted for by each axis, species-environment correlations, and Monte Carlo test results.

	Axis 1	Axis 2	Axis 3	Total inertia
Eigenvalue	0.294	0.080	0.052	1.4444
Monte Carlo test (eigenvalues)	p = 0.001	p = 0.026	p = 0.060	
% of variance explained	20.4	5.5	3.6	
Species-environment correlation	0.937	0.880	0.661	
Monte Carlo test (spp-env corr.)	p = 0.001	p = 0.015	p = 0.755	

The first axis is defined primarily by distance from the township with the age of the commonage playing a fairly important, but lesser role. Soil depth and altitude play a minor role in defining axis 1 (Table 5 and Figure 6). The second axis is defined almost exclusively by altitude (Table 5 and Figure 6).

As was the case in the Bisho Thornveld, karroid elements and increaser 2 species are predominantly associated with areas of Albany Broken Veld closer to the township and areas that have been part of the commonage for longer periods of time (Figures 6 and 7). These areas are also associated with more bare ground and the occurrence of the alien invasive *Opuntia aurantiaca*. Interestingly, the decreaser grass *Themeda triandra* is also associated with these areas. Sites further away from the township and more recently incorporated into the municipal commonage exhibit a greater diversity of bushes which are deemed acceptable or favourable for browsing (Figures 6 and 7). A good example is the occurrence of *Portulacaria afra,* a highly favoured browse species. The shade-loving decreaser grass species *Panicum maximum* is also associated with these more wooded areas. Again, it would appear that axis 1 of the CCA ordination diagram represents a degradation gradient. This time, however, the left-hand side of the ordination represents Albany Broken Veld in good condition, with a healthy diversity of palatable bush species. The condition then ranges through to Albany Broken Veld in poor condition on the right-hand side of the ordination which is characterised by the dominance of karroid shrubs and increaser 2 grasses, as well as invasion by the alien *Opuntia aurantiaca,* and the low occurrence of palatable bush species. Forage potentials of the majority of grasses associated with this area are also all low, with the exception of *Themeda triandra.*

Table 5 Inter-set correlations of the environmental variables with the ordination axes for the Albany Broken Veld vegetation type.

	Correlation coefficients	
Variable	Axis 1	Axis 2
Distance	-0.878	0.013
Age	0.533	0.233
Soil depth	0.288	-0.264
Altitude	0.091	0.813

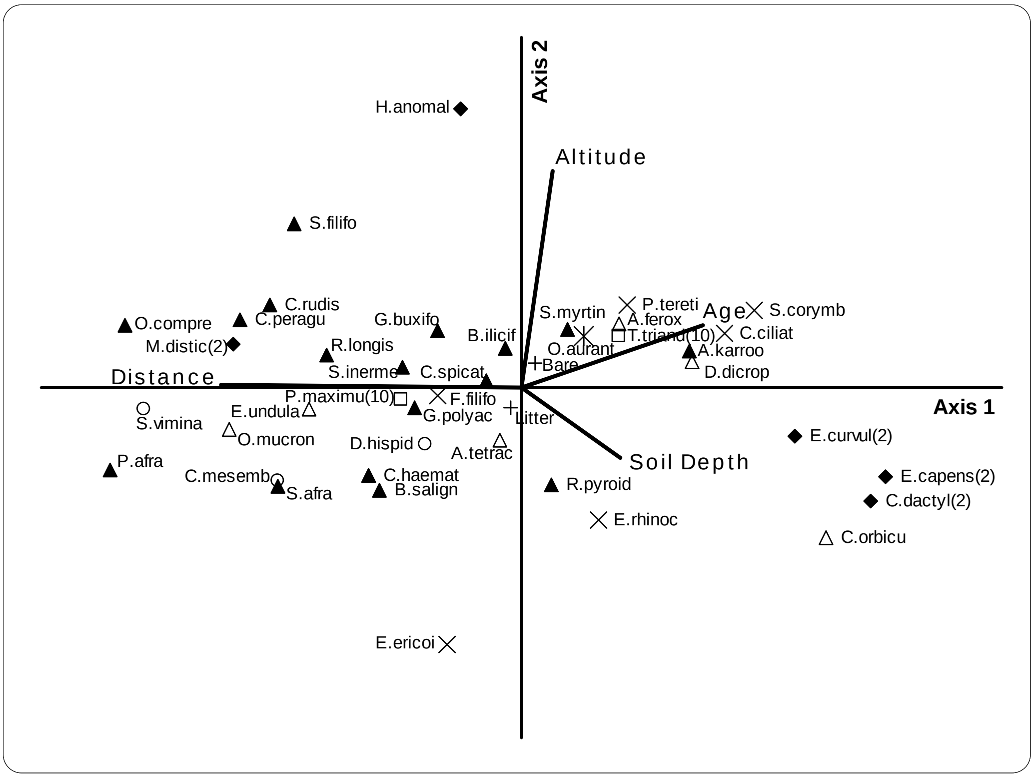

Figure 6 CCA ordination diagram of species and environmental variables for the Albany Broken Veld. □ = decreaser; ♦ = increaser 2; × = karroid shrub; ж = alien; Δ = unacceptable bush; ▲ = acceptable bush; + = bare ground/litter; ○ = other. Grass forage factors are in parentheses.

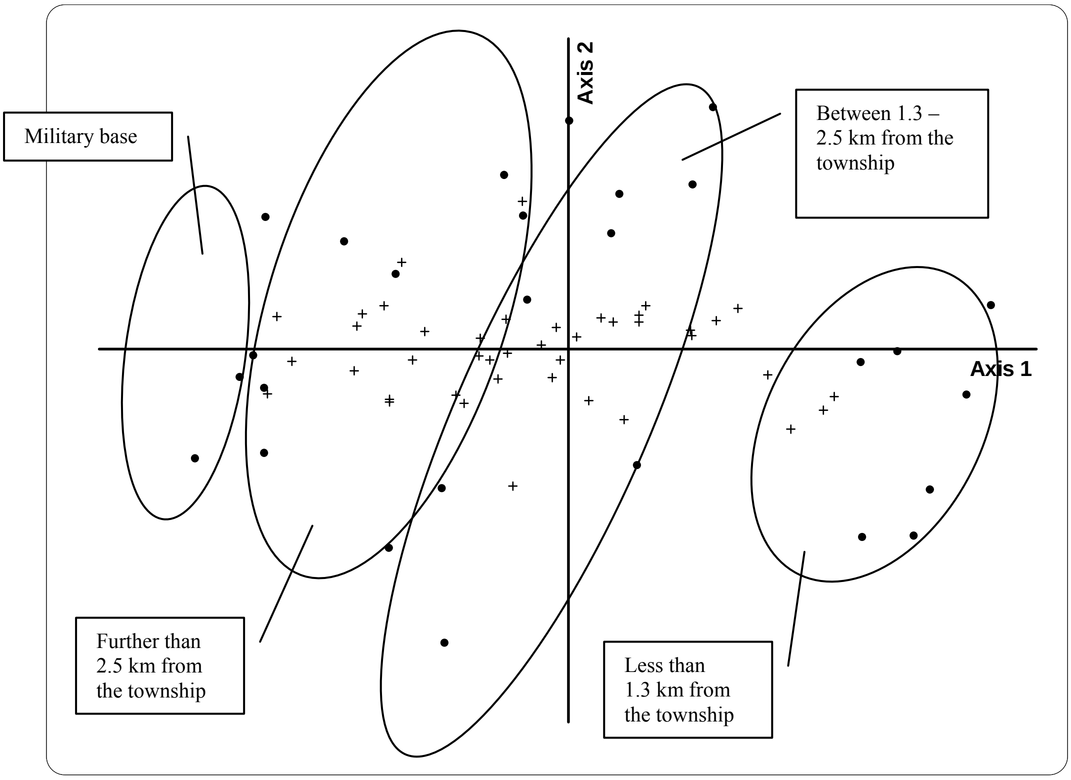

Figure 7 CCA ordination diagram of sample plots (WA scores) (●) and species (+) for Albany Broken Veld. Circles enclose clusters of sample plots at different locations (labelled) on the Grahamstown commonage. Species (+) correspond with Figure 6.

The sample plots in the Albany Broken Veld are spread fairly evenly over the degradation gradient represented by axis 1 (Figure 7). Areas within 2.5 km of the township tend to fall within the degraded end of the gradient, being more closely associated with increaser 2 and karroid species. Areas further than 2.5 km from the township tend to show improvements in condition with an increased occurrence of palatable bush species, and less increaser 2 and karroid species.

Kowie Thicket

Results of the canonical correspondence analysis for the Kowie Thicket vegetation type show that the first and second axes explain most of the variance. Although axis 2 has a high species-environment correlation, it failed the Monte Carlo test in this regard. The third axis can be ignored as it failed both Monte Carlo tests (Table 6).

Table 6 Summary of the performance of the canonical correspondence analysis for the Kowie Thicket in terms of the variance accounted for by each axis, species-environment correlations, and Monte Carlo test results.

	Axis 1	Axis 2	Axis 3	Total inertia
Eigenvalue	0.279	0.169	0.063	1.3989
Monte Carlo test (eigenvalues)	p = 0.001	p = 0.001	p = 0.254	
% of variance explained	19.9	12.1	4.5	
Species-environment correlation	0.958	0.882	0.808	
Monte Carlo test (spp-env corr.)	p = 0.001	p = 0.074	p = 0.259	

The first axis was defined primarily by both altitude and distance from the township, with age of commonage and soil depth playing similar lesser roles. The strongest environmental variable in defining the second axis was distance from the township (Table 7).

Table 7 Inter-set correlations of the environmental variables with the ordination axes for the thicket vegetation type.

	Correlation coefficients	
Variable	Axis 1	Axis 2
Distance	-0.709	-0.550
Age	0.433	0.386
Soil depth	-0.437	0.296
Altitude	0.864	-0.267

It does not appear that there is any strong evidence of the presence of a degradation gradient reflected in the CCA ordination diagram for the Kowie Thicket vegetation type. However, it is possible to discern that older areas of commonage that are closer to the township are associated with the karroid shrub *Chrysocoma ciliata*, the low forage potential increaser 2 grasses *Eragrostis curvula* and *Merxmuellera disticha*, and increased bare ground (Figure 8).

The CCA ordination diagram indicates that there are variations in Kowie Thicket which are influenced by altitude and possibly soil depth (Figure 8). These variations make it difficult to attribute any vegetation gradients to degradation caused by over-grazing or over-utilisation. Nevertheless, it would appear that most of the sample plots in the Kowie Thicket represent vegetation in at least fair to good condition, being associated with a fair diversity of bush species including *Portulacaria afra,* which is a favourite browse species (Figure 9).

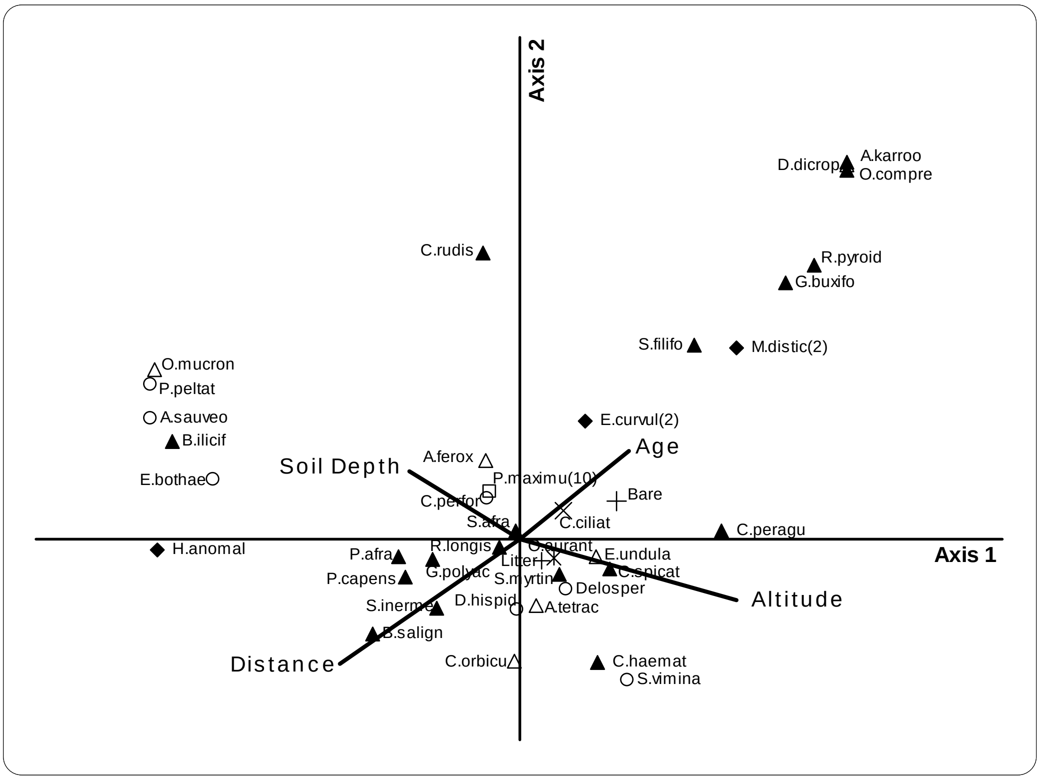

Figure 8 CCA ordination diagram of species and environmental variables for the Kowie Thicket. □ = decreaser; ♦ = increaser 2; × = karroid shrub; ж = alien; Δ = unacceptable bush; ▲ = acceptable bush; + = bare ground/litter; ○ = other. Grass forage factors are in parentheses.

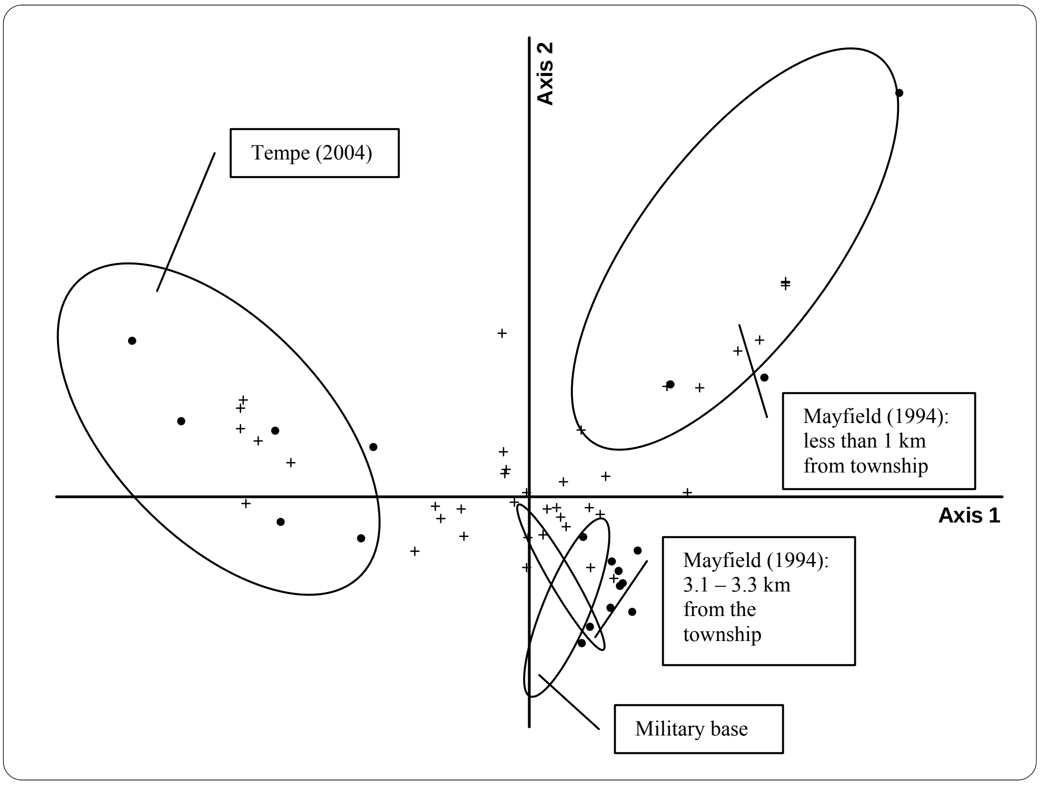

Figure 9 CCA ordination diagram of sample plots (WA scores) (●) and species (+) for the Kowie Thicket. Circles enclose clusters of sample plots at different locations (labelled) on the Grahamstown commonage. Species (+) correspond with Figure 6.

Commonage users and user perceptions

Of the 17 commonage users interviewed, five were owners of a herd, five were employed as herders to look after other people's stock, and seven were employed as herders but also had some of their own stock as part of the herd they were attending. The mean number of years experience for herders was 13 and ranged from a minimum of one year to a maximum of 28 years. The mean number of years that herders had been using the commonage was 10 with a minimum of 1 year and a maximum of 28 years.

Cattle and goats are the major livestock type kept by users of the commonage, although pigs are kept to a lesser degree. The total number of cattle kept by those users that were interviewed was approximately 226 with a mean of 13 animals per herder, and the largest herd consisting of approximately 70 animals. The number of goats for those users that were interviewed was approximately 137 with a mean of eight animals per herder, and the largest herd consisted of approximately 45 animals. Approximately 65% of the respondents stated that they would prefer to have a small herd of animals in good condition, while 6% of the respondents stated they would prefer to have a large herd of animals even if they were in bad condition. Approximately 29% of the respondents stated that they would prefer to have a large herd of animals in good condition. The majority of respondents (71%) stated that the livestock being herded was to be used for business and sales. Many of these respondents were unemployed and the livestock sales were used as a form of income. Other uses for the livestock were for traditional Xhosa customs (17% of respondents) and for providing milk and sour milk (17% of respondents).

All respondents felt that the vegetation on the commonage was in a good condition and attributed this to the recent good rains in the Grahamstown area. Respondents stated that indicators of commonage in good condition were healthy livestock, “green and thick” vegetation, and a good supply of water with dams being full. Indicators of commonage in bad condition were a “dusty and dry” environment with livestock in poor condition and the dams being empty. Forty seven percent of respondents use the same area of commonage for their livestock while 53% stated that they move their livestock around the commonage. Of the 53% who move their livestock, 78% move on a daily basis, while 11% move weekly and the remaining 11% move monthly. All stated that the reason for moving their livestock was to prevent the overutilization of one particular area of the commonage.

The major problem experienced by commonage users was stock theft with 58% of respondents mentioning this as a concern. Lack of fencing and theft of existing fencing was also mentioned by 24% of respondents as being a problem. They mentioned that the implications of this were that their livestock would sometimes wander off the commonage to prohibited areas, and it was easier for criminals to steal their animals. Six percent of respondents mentioned that periodic drought was a problem. Twenty nine percent of the respondents stated that they did not experience any problems with the municipal commonage at present.

The two major suggestions from commonage users on how the municipality could improve the commonage were to provide better fencing (59% of respondents) and to implement a camp system for rotational grazing (53% of respondents). Eighteen percent of the respondents also stated that it was desirable to expand the area of commonage to provide for more camps to aid in resting of the veld. Other suggestions included the provision of safety and security against stock theft, better water provision during times of drought, help with periodic burning of the commonage, and the removal of litter as they suffer livestock losses when their animals ingest plastic.

DISCUSSION

Vegetation condition

Results from the vegetation assessment of the Grahamstown municipal commonage indicate that there is currently some degree of vegetation degradation on the commonage with shifts in species composition to unpalatable increaser 2 and karroid species, particularly in the Bisho Thornveld and Albany Broken Veld vegetation types. These findings are in line with studies which have examined vegetation degradation on communal rangelands and found that plant species composition shifted to less palatable and lower forage value species (Evans *et al.* 1997; Ntlakaza 2003; O'Connor *et al.* 2003; Tefera *et al.* 2007). These shifts in species composition can be attributed either to high stocking rates or to the effects of variable rainfall depending on whether the rangeland is at equilibrium or non-equilibrium (Vetter 2005). Non-equilibrium dynamics are predicted to predominate in semi-arid to arid areas where the rainfall coefficient of variation exceeds 33% (Ellis *et al.* 1993; Ellis 1994). It would therefore be expected that the rangelands on the Grahamstown commonage experience such non-equilibrium dynamics, and it could be argued that plant species composition shifts here may be related more to rainfall than current stocking rates. However, results from this study indicate a strong piosphere effect with vegetation degradation being highest in areas closest to the township and decreasing with increased distance from the township. This trend is especially noticeable in the Bisho Thornveld and Albany Broken Veld vegetation types, although less so in the Kowie Thicket. If rainfall were solely responsible for the current plant species composition on the commonage then one would not expect to find such a pronounced piosphere, and it would thus seem obvious that such vegetation degradation is at least partly caused by heavy livestock utilisation in these areas. A similar phenomenon has been found around livestock watering points and settlements in other arid and semi-arid areas of southern Africa (Sullivan 1999; Leggett *et al.* 2003; Todd 2006).

It can be argued that this study has only looked at a "snapshot" in time in terms of plant species composition on the Grahamstown commonage. However, an attempt has been made to detect trends in vegetation condition by sampling areas that have been part of the commonage for varying lengths of time. Results for the Bisho Thornveld vegetation type suggest that the length of time a particular area has been part of the commonage does influence vegetation condition. Here, older commonage is generally associated with unpalatable increaser 2 and karroid plant species, whereas younger areas of commonage tend to possess a mix of increaser 2 and more favourable decreaser species. This is not always the case, however, as is illustrated by the farm Glencraig which was incorporated into the commonage in 2004, but is still regarded as being in poor condition. Care therefore needs to be taken in interpreting vegetation condition trend for areas incorporated as "new" commonage as these areas may have already been in a degraded state when they were sold to the Department of Land Affairs. This may reflect bad management by the previous white farmers, but may also be a consequence of economic and political factors which have influenced farming practises in the past (Nel and Davies 1999). Nevertheless, the farms Inneskillen and Gletwyn which were incorporated as commonage in 2004 are still characterised as being in fair to good condition in comparison to "old" commonage immediately adjacent to these areas which is more degraded. This tends to support the idea that areas that have been part of the commonage for longer periods of time are more degraded. Again, it would appear that stocking rate has played a role in determining vegetation condition on the commonage as rainfall, on its own, would be more likely to have affected plant species composition on the "old" commonage and previously white owned farms in a similar manner.

This is not to say that the Grahamstown commonage rangelands do not operate under non-equilibrium dynamics. Rather, it is likely that the system encompasses elements of both equilibrium and non-equilibrium models, with interactions between stocking rate and rainfall occurring (Vetter 2005). Low rainfall will tend to exacerbate the effects of high stocking rates on the commonage, and high rainfall will tend to mitigate them. This was shown by O'Connor *et al.* (2003) who found that the individual effects of communal or commercial tenure did not significantly influence plant compositional change, but the interaction of each with water availability did.

The responses of individual species to grazing have also been shown to be dependent on the abiotic environment. For example, *Themeda triandra* has been shown to behave as a decreaser in low rainfall areas and as an increaser in high rainfall areas (Bosch 1989; O'Connor *et al.* 2003). Other grass species have also been shown to vary in their response to grazing depending on the habitat or topographical position (Janse van Rensburg and Bosch

1990). The method of vegetation condition assessment employed in this study can therefore be criticised as it relies on the use of such grass species classifications. However, as far as possible for this study, grass species classifications were obtained from research conducted in the same vegetation types as those found on the Grahamstown commonage (Danckwerts 1989; Trollope *et al.* 2006) which should have minimised the occurrence of incorrect classifications. In addition, studies employing the degradation gradient method (a vegetation condition assessment technique regarded as being objective) in the grasslands of South Africa all show that karroid shrubs are associated with severely degraded vegetation (Bosch 1989; Bosch and Gauch 1991; Bosch and Kellner 1991). Therefore, regardless of the possible ambiguity of certain grass species classifications, it is still clear that areas of the Grahamstown commonage which are associated with karroid shrub species are in a degraded state. Such shifts in plant species composition are often associated with a shift to a new "domain of attraction" or rangeland state which are characteristic of non-equilibrium systems (Westoby *et al.* 1986; Stringham *et al.* 2003). Some shifts in state are fairly easily reversible, but shifts to a state where karroid shrubs dominate usually requires costly management intervention in order to create a transition back to a more productive vegetation state (Bosch and Gauch 1991; Bosch and Kellner 1991). Such a state in certain areas of the Grahamstown municipal commonage raises questions about the long-term sustainability of livestock production as a means of providing for poor urban dwellers under the current stocking rates and management system. Nevertheless, as the results of this study show, not all areas of the Grahamstown commonage are in a degraded state and there is still scope for improvement of livestock management on the commonage.

Commonage users, user perceptions and farming objectives

Results suggest that the livelihoods of people using the Grahamstown commonage for livestock are somewhat divergent, with some people possessing and herding their own livestock, and others employed to herd livestock by people who own stock and can afford to pay for herding. This study did not investigate these livelihood strategies in-depth, but a study of municipal commonage users in Philipolis in the Orange Free State by Atkinson and Buscher (2005) found that commonage users employ a diverse array of livelihood strategies. This is also true for livestock owners in the rural areas of the Eastern Cape who employ diverse livelihood strategies for survival (Ainslie 2005).

Livestock owners on the Grahamstown commonage mentioned a number of reasons for keeping livestock but there appears to be a strong bias towards keeping livestock to sell or use in business transactions (71% of respondents), suggesting that these commonage users may be open to more commercial farming enterprises. However, Atkinson and Buscher (2005) found that commonage users in Philipolis keep livestock for a wide variety of reasons, ranging from commercial ambitions to subsistence, recreational and cultural reasons. In addition, Ainslie (2005) warns of the failed attempts at pushing commercial agricultural goals onto rural households in the Eastern Cape, which have largely ignored the delicately balanced survivalist strategies of such groups. The same may apply to people using the Grahamstown commonage with their diverse livelihood strategies, but it may be true that people living in a more urban setting have adapted and changed their livelihood strategies and may therefore be more open to commercial ventures. This is an aspect which requires further research.

There are other factors which suggest that many users of the Grahamstown commonage are inclined towards a more commercial style of livestock farming. Firstly, the majority of respondents (65%) stated a preference for owning a smaller herd of cattle in better condition rather than a large herd of cattle in poorer condition. This contrasts with other studies which argue that pastoralists on communal rangelands prefer to have larger herds in order to derive a multitude of benefits (Abel and Blaikie 1989; Behnke and Abel 1996), many of which are non-consumptive (Shackleton *et al.* 2000). Perhaps, in the urban setting, there is less of a need for non-consumptive uses of livestock, such as for ploughing and draft, which enables livestock owners to sell their livestock more freely and possess smaller herds. Secondly, approximately half of the respondents stated that fencing to provide for a camp system for rotational grazing was desirable in order to prevent vegetation degradation and improve the Grahamstown commonage. It is important to note, however, that this study has only touched on these subjects and a more in-depth study is needed to better understand municipal commonage user needs and aspirations.

More than half of the livestock herders on the Grahamstown commonage stated that they move their livestock around in order to reduce overutilization of one particular area of the commonage. At the same time, some of these herders stated that the area available for movement is too small. The above statements indicate that herders have a good understanding of the consequences of overutilization of the vegetation. It is also interesting to note that the criteria which herders on the commonage use as indicators of vegetation condition are closely tied with non-equilibrium ideas of rangeland dynamics. For example, all herders felt that the commonage was currently in good condition and attributed this to the recent good rains. In addition, their indicators of vegetation in good condition were healthy livestock, “green and thick” vegetation, and a good supply of water. Their recognition that space is limited is extremely important and points to a major problem which causes degradation in non-equilibrium rangelands, namely the sedentarization of pastoralists (Vetter 2005). Another factor which upsets the effectiveness of droughts in reducing grazing pressure in non-equilibrium rangelands can be attributed to the fact that high livestock numbers are increasingly being maintained through the provision of supplementary feed and buying animals after droughts. Vetter and Bond (1999) and Vetter (2003) have shown that this is the case in the communal areas of the Hershel district in the Eastern Cape. There is no reason why this should not be happening in Grahamstown too, although further research is needed to confirm this.

Implications for management and policy

Results of this study suggest that current management approaches are ineffective in ensuring the long-term sustainability of the Grahamstown municipal commonage in terms of providing a resource for livestock users. This is largely attributable to a lack of skills and funds available to the local municipality, making effective management difficult (Manor 2001). Current thinking recognises that opportunistic stocking strategies are better alternatives to constant and conservative stocking rates which were advocated under the classical equilibrium paradigm (Mentis *et al.* 1989; Danckwerts *et al.* 1993). This is especially true for communal pastoralists who allow their herds to increase with good rainfall in order to buffer against the effects of stock losses during droughts (Vetter 2005). However, such opportunistic management strategies require skills and knowledge which are sensitive to ecological as well as social needs. It is therefore important that management initiatives are formulated by specialists from ecological and sociological backgrounds working closely with municipalities and the local communities which are using the resource. Another vital factor in an opportunistic management strategy is the implementation of an effective monitoring programme to assess the effectiveness of management actions. The present study lacks deeper insights into vegetation condition trends over time on the Grahamstown commonage as it has drawn primarily on plant species composition at one particular moment in time. Therefore, not only will monitoring programmes aid in assessing management decisions, but they will go far in helping to better understand vegetation condition trends on municipal commonages.

This study supports the findings of Atkinson and Buscher (2005) that livestock users employ a diversity of livelihood strategies, and it is therefore important that municipal commonage should provide an array of land tenure options for users to choose from. It is important that the aspirations, aims and knowledge of local users be taken into account by working closely with them so that a complementary set of land tenure and management options can be formulated.

In terms of ecological guidelines, this study suggests that the non-equilibrium dynamics of the Grahamstown commonage rangelands have been disrupted and that periodic drought is not effective in reducing livestock numbers to a degree which prevents vegetation degradation, particularly in areas closer to the township. Livestock owners need to be encouraged to make use of areas further away from the township. Many owners stated that stock theft is a major problem and they are forced to kraal their animals in the township at night. Improving security on the commonage may allow livestock owners to range more freely without having to return to the township with their livestock on a daily basis. The erection of separate camps on the commonage may provide a viable alternative to ensure utilisation of a wider area of the commonage and enable periodic resting of the vegetation. Research on grasslands in South Africa has shown the value of resting for improving vegetation composition and production (Müller *et al.* 2007; Tainton *et al.* 1999; Kirkman and Moore 1995). A camp system coupled with periods of vegetation resting may thus aid in reducing the piosphere effect which is currently evident around the township and improve the overall productivity of the vegetation on the commonage. However, if a camp system is employed on the Grahamstown commonage, it is important that separate camps follow boundaries of existing vegetation types to minimise the effects of selective utilisation. To relieve the pressures of high stocking rates, it is important for livestock owners on municipal commonage to have access to markets where animals can be sold. Haggblade *et al.* (1989) explain that both farm and non-farm activities, through a network of consumption and production links lead to economic growth and the enhancement of quality of life. The promotion of markets for livestock sale can therefore be viewed as fulfilling both social and ecological needs.

Ecological and social conditions in different municipalities are often unique and it is difficult, if not impossible, to prescribe one set of guidelines on how best to manage commonage rangelands. It is therefore vitally important that local municipalities are properly equipped to deal with their particular set of circumstances effectively. Manor (2001) identifies two vital aspects which currently hinder the ability of local municipalities to effectively manage their constituencies effectively, namely a lack of substantial resources (particularly financial), and the inadequate empowerment of these local authorities. Currently, the Department of Land Affairs is spending money on buying land for redistribution. Once this land is handed over to municipalities for inclusion as commonage it is possible for municipalities to apply for an infrastructure grant. However, this grant does not make additional funds available for post-implementation or operation and maintenance (DLA 1997) and municipalities have to draw from their own funds for this. It would appear that handing down such "unfunded mandates" to municipalities is a waste of the money spent by government on acquiring the land in the first place as the municipalities are unable to ensure the sustainability of these areas to provide for poor urban dwellers once they have been handed over. Post-land transfer funding for local municipalities from higher levels of government is therefore vital to ensure that money already spent on acquiring land for redistribution is not wasted. Secondly, substantial powers need to be devolved onto local municipalities from higher levels of government. At the same time, the devolution of power needs to be accompanied by accountability and maintenance of rule of law. Such devolution of power enables quicker responses because local councils can act without waiting for permission from higher up (Manor 2001). This is highly desirable in an opportunistic management system, which would be optimal for managing rangelands in semi-arid and arid environments, for example. Manor (2001) also mentions that the quantity and quality of management responses increase with the devolution of power to local authorities, and it also assists in the adaptation of local development programmes, which have been devised higher up, to local conditions.

Conclusion

This study indicates that certain areas of the Grahamstown municipal commonage, particularly those closer to the township, are in a severely degraded state. Vegetation condition trend was not investigated in-depth, but evidence from different ages of the commonage suggests that the extent of vegetation degradation may have spread since additional land has been incorporated into the commonage. These findings raise questions as to the long-term sustainability of the Grahamstown municipal commonage in providing grazing for livestock owned by poor urban residents, particularly under the present system of management. Optimal management to ensure sustainability of this rangeland resource require adaptive management strategies, and a close working relationship between the local authority, the local community as well as professionals in the lines of sociology and rangeland ecology. In addition, funding and the devolution of greater powers and accountability need to be bestowed on local authorities so that they can effectively manage these resources. Ultimately, though, government must realise that land reform is not enough on its own, and that it needs to be linked with a wider process of development and a long-term strategy that addresses issues more effectively at the level of local communities.

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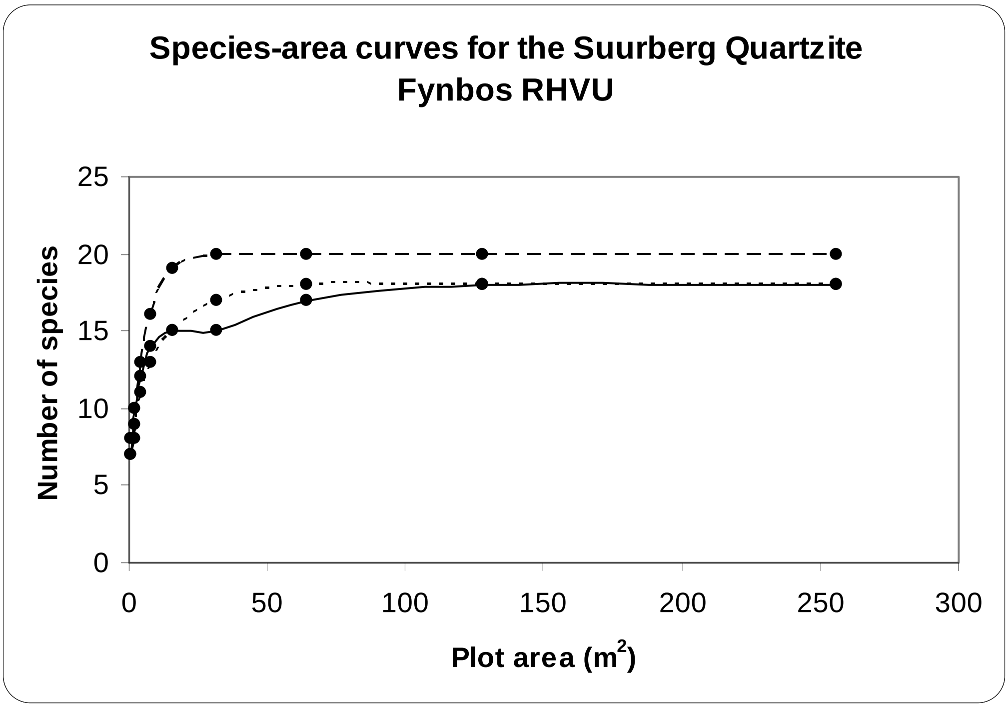
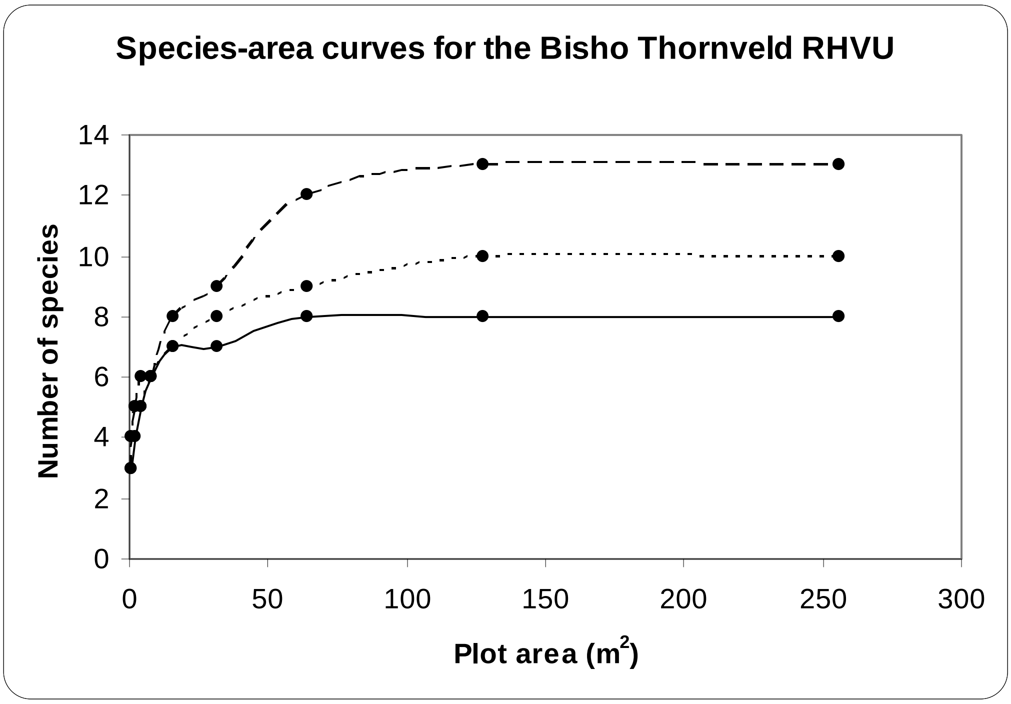
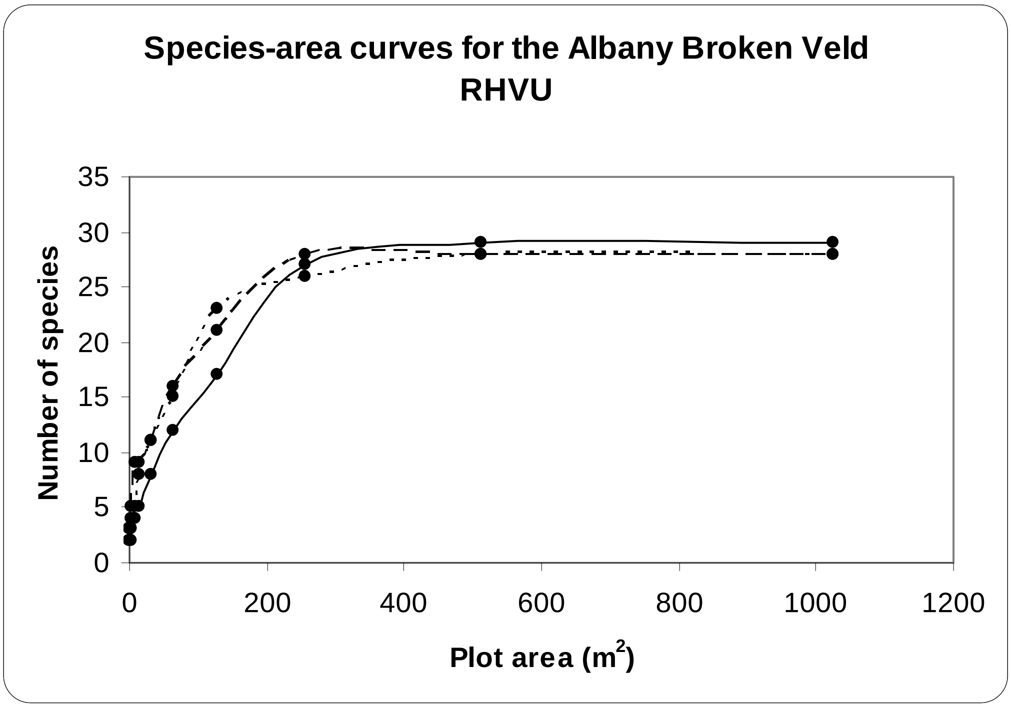
APPENDIX I: Species-area curves determined for three of the RHVUs on the Grahamstown municipal commonage






Species-area curves for the Albany Broken Veld RHVU
Number of species
Plot area (m2)
0
5
10
15
20
25
30
35
0
200
400
600
800
1000
1200

APPENDIX II: Species list of dominant plants encountered on the Grahamstown municipal commonage, including abbreviations used in the CCA ordinations, species classifications and forage factors, and references used for classifications.

Abbreviation	Scientific name	Classification	Grass forage factor	Reference
H.contor	Heteropogon contortus	Decreaser	7	Danckwerts (1989)
H.turgid	Helictotrichon turgidulum	Decreaser	4	Van Oudtshoorn (1999)
P.maximu	Panicum maximum	Decreaser	10	Danckwerts (1989)
T.triand	Themeda triandra	Decreaser	10	Danckwerts (1989)
C.margin	Cymbopogon marginatus	Increaser I	4	Van Oudtshoorn (1999)
E.villos	Eulalia villosa	Increaser I	4	Danckwerts (1989)
F.scabra	Festuca scabra	Increaser I	2	Danckwerts (1989)
M.nervig	Melinis nerviglumis	Increaser I	3	Van Oudtshoorn (1999)
P.pallid	Pentaschistis pallida	Increaser I	0	Van Oudtshoorn (1999)
P.thunbe	Pennisetum thunbergii	Increaser I	2	Van Oudtshoorn (1999)
T.leucot	Tristachya leucothrix	Increaser I	7	Van Oudtshoorn (1999)
B.erucif	Brachiaria eruciformis	Increaser II	2	Van Oudtshoorn (1999)
C.dactyl	Cynodon dactylon	Increaser II	4	Danckwerts (1989)
D.monoda	Digitaria monodactyla	Increaser II	2	Van Oudtshoorn (1999)
E.capens	Eragrostis capensis	Increaser II	2	Danckwerts (1989)
E.curvul	Eragrostis curvula	Increaser II	2	Danckwerts (1989)
H.anomal	Helichrysum anomalum	Increaser II	0	Danckwerts (1989)
H.felinu	Helichrysum felinum	Increaser II	0	Danckwerts (1989)
K.capens	Koeleria capensis	Increaser II	2	Danckwerts (1989)
M.distic	Merxmuellera disticha	Increaser II	2	Danckwerts (1989)
S.africa	Sporobolus africanus	Increaser II	2	Danckwerts (1989)
S.sphace	Setaria sphacelata var. torta	Increaser II	6	Van Oudtshoorn (1999)
T.hispid	Tribolium hispidum	Increaser II	0	Van Oudtshoorn (1999)
A.karroo	Acacia karroo	Acceptable bush	na	Trollope (1981)
B.ilicif	Brachylaena ilicifolia	Acceptable bush	na	Trollope (1981)
B.salign	Buddleja saligna	Acceptable bush	na	Trollope (1981)
C.haemat	Carissa haematocarpa	Acceptable bush	na	Trollope (1981)
C.peragu	Cassine peragua	Acceptable bush	na	Trollope (1981)
C.rudis	Coddia rudis	Acceptable bush	na	Trollope (1981)
C.spicat	Cussonia spicata	Acceptable bush	na	Trollope (1981)
G.buxifo	Gymnosporia buxifolia	Acceptable bush	na	Trollope (1981)
G.polyac	Gymnosporia polyacantha	Acceptable bush	na	Trollope (1981)
O.compre	Osyris compressa	Acceptable bush	na	Trollope (1981)
P.afra	Portulacaria afra	Acceptable bush	na	Trollope (1981)
P.capens	Pappea capensis	Acceptable bush	na	Trollope (1981)
R.longis	Rhus longispina	Acceptable bush	na	Trollope (1981)
R.pyroid	Rhus pyroides	Acceptable bush	na	Trollope (1981)
S.afra	Schotia afra	Acceptable bush	na	Trollope (1981)
S.inerme	Sideroxylon inerme	Acceptable bush	na	Trollope (1981)
S.myrtin	Scutia myrtina	Acceptable bush	na	Trollope (1981)
A.ferox	Aloe ferox	Unacceptable bush	na	Trollope (1981)
A.tetrac	Azima tetracantha	Unacceptable bush	na	Trollope (1981)
C.orbicu	Cotyledon orbiculata	Unacceptable bush	na	Trollope (1981)
D.dicrop	Diospyros dichrophylla	Unacceptable bush	na	Trollope (1981)
E.bothae	Euphorbia bothae	Unacceptable bush	na	Trollope (1981)
E.undula	Euclea undulata	Unacceptable bush	na	Trollope (1981)
O.mucron	Ozaroa mucronata	Unacceptable bush	na	Trollope (1981)

Abbreviation	Scientific name	Classification	Grass forage factor	Reference
C.ciliat	Chrysocoma ciliata	Dwarf karroid shrub	na	
E.ericoi	Eriocephalus ericoides	Dwarf karroid shrub	na	
E.rhinoc	Elytropappus rhinocerotis	Dwarf karroid shrub	na	
F.filifo	Felicia filifolia	Dwarf karroid shrub	na	
P.tereti	Pteronia teretifolia	Dwarf karroid shrub	na	
S.corymb	Solago corymbosa	Dwarf karroid shrub	na	
S.filifo	Senecio filifolius	Dwarf karroid shrub	na	
O.aurant	Opuntia aurantiaca	Invader	na	
C.capite	Crassula capitella	Succulent	na	
C.mesemb	Crassula mesembryanthemoides	Succulent	na	
C.perfor	Crassula perforata	Succulent	na	
D.hispid	Drosanthemum hispidum	Succulent	na	
Delosperm	Delosperma sp.	Succulent	na	
E.gorgon	Euphorbia gorgonis	Succulent	na	
G.longum	Glottiphyllum longum	Succulent	na	
S.vimina	Sarcostema viminale	Succulent	na	
A.aethio	Anthospermum aethiopicum	Other	na	
A.apicul	Agathosma apiculata	Other	na	
A.bipinn	Athanasia bipinnata	Other	na	
A.capens	Acrolophia capensis	Other	na	
A.cognat	Aristea cognata	Other	na	
A.polyph	Argyrolobium polyphyllum	Other	na	
A.sauveo	Asparagus sauveolens	Other	na	
A.spines	Aspalathus spinescens	Other	na	
B.orient	Bobartia orientalis	Other	na	
E.brevip	Euryops brevipapposa	Other	na	
E.demiss	Erica demissa	Other	na	
E.microp	Exomis microphylla	Other	na	
E.parvif	Elegia parviflora	Other	na	
Erica	Erica sp.	Other	na	
H.argent	Hypoxis argentea	Other	na	
L.salign	Leucadendron salignum	Other	na	
P.cyaner	Protea cyaneroides	Other	na	
P.myrtif	Polygala myrtifolia	Other	na	
P.peltat	Pelargonium peltatum	Other	na	
P.renifo	Pelargonium reniforme	Other	na	
P.simple	Protea simplex	Other	na	
P.veluti	Podalyria velutina	Other	na	
Phylica	Phylica sp.	Other	na	
S.argent	Struthiola argentea	Other	na	
S.inaequ	Senecio inaequidens	Other	na	
Sedge	Cyperus sp.	Other	na	
Watsonia	Watsonia sp.	Other	na	

APPENDIX III: Commonage user questionnaire

Date:
Questionnaire no.:
Location/RHVU:

1. Do you or your family own the livestock being herded, or are you a hired herder?

2. In total, how many years of your life have you been herding livestock?

3. How many years have you been using the municipal commonage for herding livestock?

4. What type of livestock are in your herd and how many of each (if possible)?
   Cattle ___
   Goats ___
   Sheep ___

5. For what reason(s) do you keep livestock? What do you use the livestock for?

6. Would you prefer to have a large herd of animals which are in bad condition or a small herd of animals which are in good condition?

7. Do you always use the same area to graze your livestock or do you move around the commonage? If you move around, is this on a daily, monthly or yearly basis, and which areas do you move to? What are the reasons for these movements?

8. Have you experienced a change in the vegetation on the commonage over the years? If so, what do you think are the reasons for this change?

9. Do you feel that the vegetation on the commonage is in good or bad condition? Does this apply to all areas or are some areas better/worse than others? If so, which areas are better and which areas are worse?

10. What are the indicators of an area in good condition?

11. What are the indicators of an area in poor condition?

12. Why do you think that the vegetation is in its present condition?

13. What problems do you experience as a user of the Grahamstown municipal commonage?

14. Could the municipal commonage be improved in any way for local users?