The use of Livestock GPS trackers to determine the grazing patterns of herded and free ranging cattle in the communal rangelands of the Eastern Cape Province, South Africa.

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Abstract
This study was set in the Eastern Cape Province of South Africa which is predominantly rural and where livelihood sustainability is largely dependent on agricultural outputs including livestock production. Land in many of the rural, former homeland areas is held under communal land tenure which means access, utilisation and management is on a collective basis. A number of grazing strategies have been applied over the last hundred years including camp rotational grazing system. However, due to a number of factors including the absence of the communal rangeland and camp boundary fence, most villages do not have a rangeland management strategy in place. Instead, unregulated continuous grazing occurs, where animals are led to the communal rangeland in the morning and collected in the evening. According to the communal farmers they do not prefer this grazing practice as it promotes selective grazing, leading to grass species composition change, invasion of alien plants and soil erosion. Hence, there is a need to explore a rangeland management strategy that will promote optimal utilization of the communal grazing. This study was, was therefore aimed at assessing the impact of herding on livestock grazing patterns using Livestock GPS Trackers impact of herding on livestock grazing patterns using Livestock GPS Trackers within three sub-villages namely, Guquka, Gilton and Sompondo. The objectives was to compare the herbaceous species composition within areas frequently visiting by herded livestock as opposed to those that were free ranging. Results showed that the grazing patterns of both the herded and free ranging cattle in Guquka and Sompondo were focused on areas close to the homesteads, arable fields and foothills. However, cattle from three households (two herded) in Gilton, did graze areas that are up the slope. Herbaceous species composition results showed that the frequently grazed areas were dominated by *Eragrostis plana*, *Cynodon dactylon*, *Themeda triandra*, *Sporobolus africanus*, and *Sporobolus fimbriatus*. The types of species encountered in areas frequently grazed by herded and free ranging cattle did not differ much. These finding can be an indicator of the long term grazing pressure on areas both the herded and free-ranging animals frequently visited by livestock from the three villages.

Introduction
This study was set in the former homeland of Ciskei located in the Eastern Cape Province of South Africa. The Eastern Cape as a Province is predominantly rural and livelihoods of many rural communities are linked to agricultural outputs including livestock production. Livestock is a key commodity of human well-being and provides social benefits such as food, income, nutrients, employment, traction and others (Herrero et al. 2009). Sustainability of livestock, greatly relies on well managed rangelands. The management and utilisation of natural resources in many of the rural, former homeland areas collective basis (Ainslie 1998). Due to the complexities associated with collective management of communal rangelands, including over exploitation of the grazing resource through overstocking and absence of a rangeland management strategy, it has been reported that these lands are severely degraded and their carrying capacity is decreasing at an alarming rate (Bado and Bationo 2018; Snyman and du Preez 2005; Vetter 2005; Tafere and Woldenhanna 2012). A number of grazing strategies have been applied over the last hundred years including seasonal herding and camp rotational grazing system. However, due to a number of factors including the absence of the communal rangeland and camp boundary fence, most villages do not have a rangeland management strategy in place. Instead, unregulated continuous grazing occurs, where animals are led to the communal rangeland in the morning and collected in the evening. According to the communal farmers they do not prefer this grazing practice as it promotes selective grazing, leading to severe soil erosion, the loss of grass cover (especially palatable grazing species), increased runoff and poor water infiltration have been cited as effects resulting from this degradation (Palmer and Ainslie 2005; Snyman and du Preez 2005; Moyo et al. 2008; Vetter 2013). Hence, there is a need to explore a rangeland management strategy that will promote optimal utilization of the communal grazing.

Methods

Study Site

Three sub-villages namely, Guquka, Gilton and Sompondo forming part of the Amakhuzeni Tribal Authority located in Alice, Eastern Cape were selected for this study. The area receives 450 to 600 mm rainfall annually, with average temperature of 19^0C in winter and 28^0C in summer. The vegetation types is the Amathole Montane Grassland; Bisho Thornveld; Eastern Cape Escarpment Thicket.

Establishing Grazing patterns and species composition

Cattle from ten households (one animal per household representing the herd) were fitted with GPS Tracker collars in the wet season of 2017. Five of these households had agreed to herd for eight weeks, while the other five were asked to continue with standard management practice which was allowing their cattle to free range. After eight weeks the collars were removed from the livestock. Data was only retrieved from 9 trackers was downloaded using the CatLog software and stored in comma delimited ASCII text format (*.csv) and Google Earth Keyhole Markup Language (kml) files. The kml files were then displayed on Google Earth Pro where a series of points represented the livestock grazing patterns. The GPS points were used to create grazing density maps in ArcGIS 10.2, indicating which areas within the communal rangeland were most preferred by the animals fitted with GPS trackers. The preferred areas were regarded as those that were visited frequently on different occasions by the same animal over the weeks the collars were on the livestock. The areas were marked and digitized from the density maps, and herbaceous species composition data was collected from them.

A point to tuft method was used to determine the herbaceous plant species composition from the frequently grazed areas. At each sampling site, three 100 m line transect were established up the slope and the nearest rooted perennial herbaceous plant (grasses, trees and dwarf shrubs) were sampled at one meter intervals. Grasses and Karoo bush species were grouped according to their frequency of occurrence and their grazing status as Decreaser, Increaser I, II or III.

Results and Discussion

Livestock Grazing Patterns

Data was retrieved from cattle from nine households and two of these only had data for 19 days, this can be attributed to malfunction and battery failure. Results showed that the grazing patterns of both the herded and free ranging cattle were focused on areas close to the homesteads, arable fields, foothills and slopes of the communal rangelands of Guquka, Gilton and Sompondo (Figure 1). A total of 22 frequently grazed areas were identified from the density maps that were created using data from the GPS trackers (Figure 2). The Google Earth Image in Figure 2 shows the exact locations of the frequently grazed areas by both the herded and free-ranging animals from the different sub-villages. The areas identified as frequently grazed in Guquka, reveal that both herded and free ranging spent most of their time over the eight week period around the homesteads and arable fields. While cattle from Gilton and the one from Sompondo spent most of their time within their communal rangeland both on the foothills and slopes (Figure 2). None of the animals went further up to the mountains where good grazing was perceived to be in abundance (Finca 2020). Grazing animals closer to the homestead can be attributed to fear of stock theft for free ranging cattle. While for herded livestock, it could be the lack of herding knowledge from the herder's side since they are used to unregulated grazing practice.

Species composition within frequently grazed areas

The herbaceous species composition was determined from the 22 frequently grazed areas (Figure 2). A total of 16 species were encountered from all the frequently grazed areas and the most dominant species included E.plana, C.dactylon, T.triandra (herded) and S.africanus (free-ranging) (Table 1). The types of species encountered in areas frequently grazed by herded and free ranging cattle did not differ much. These finding can be an indicator of the long term grazing pressure on areas both the herded and free-ranging animals frequently visited during the eight week period they had the GPS collars on.

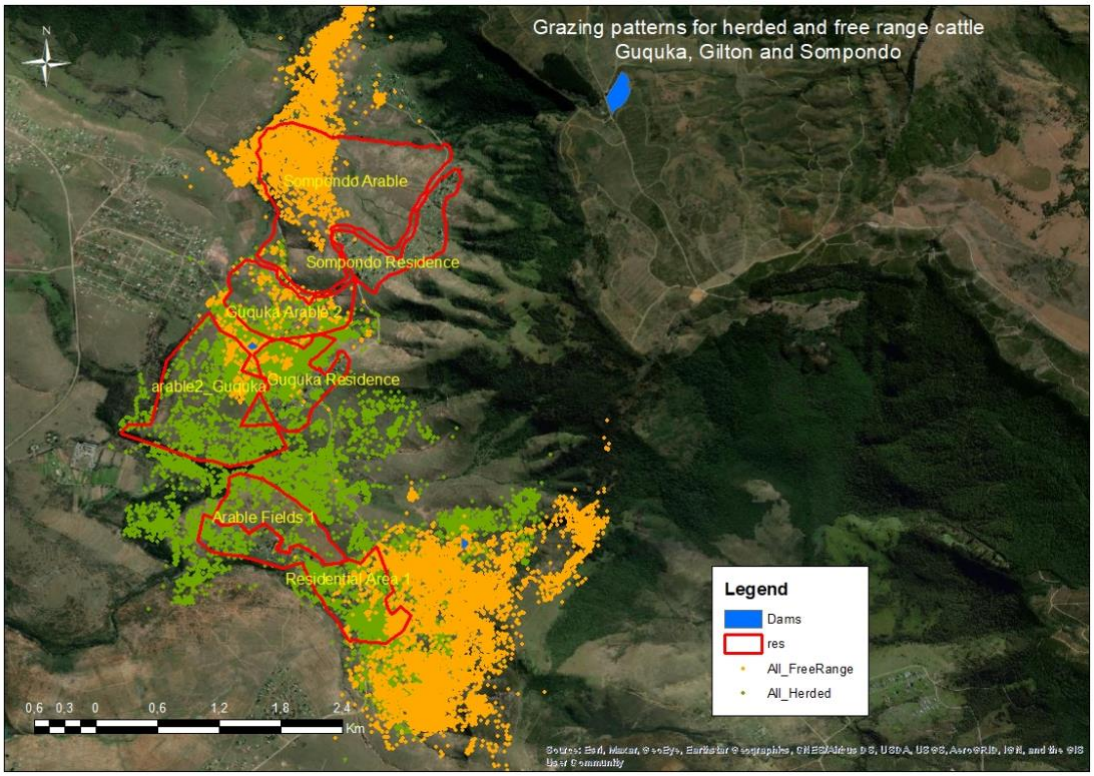

Figure 1: Google Earth image showing how the communal grazing of Guquka, Gilton and Sompondo was used by both the herder (orange) and free ranging (green) cattle.

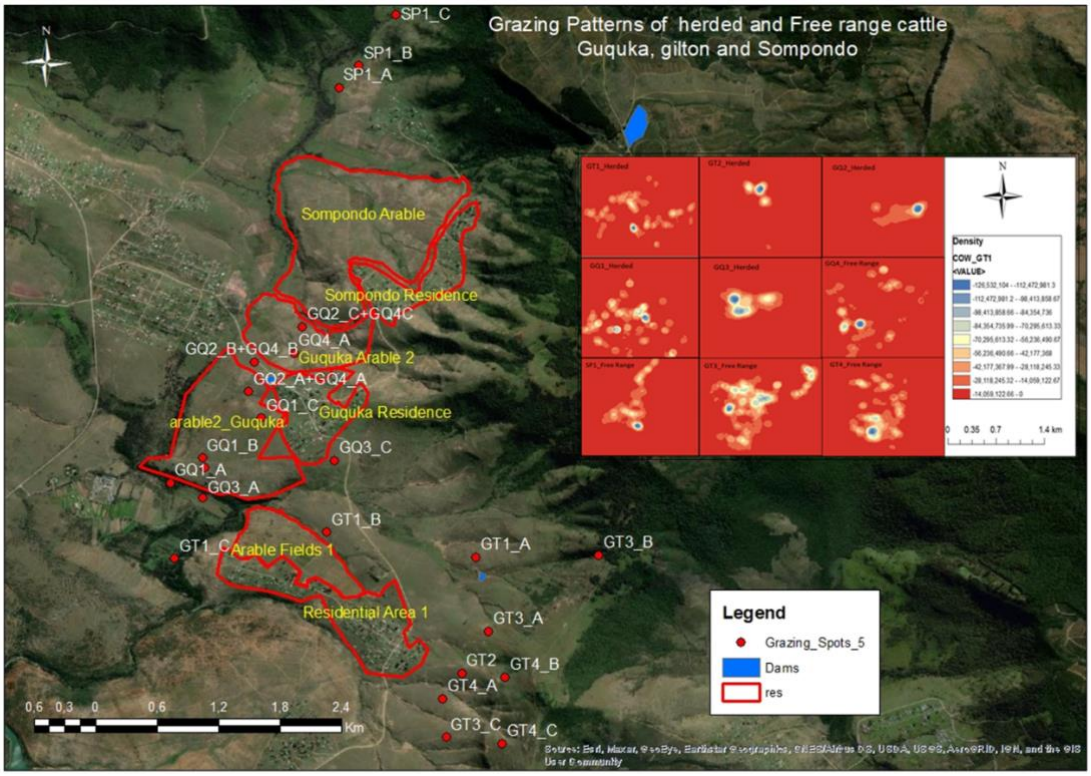

Figure 2: Google Earth Image showing the frequently grazed areas within the communal rangeland, residential area and arable fields in Guquka, Gilton and Sompondo sub-villages. Insert map is the collection of density maps for the five herded (3 in Guquka and 2 in Gilton) and 4 free ranging (1 in Guquqa, 1 in Sompondo and 2 in Gilton) cattle showing the frequently grazed areas, represented by blue, light blue and bright cream colours.

Table 1: Overall Species Composition within the frequently grazed areas in Guquka, Gilton and Sompondo for herded and free ranging cattle

Overall Species Composition within frequently grazed spots					
Herded Cattle			**Free Ranging Cattle**		
Species	**Frequency of occurrence (%)**	**Grazing Status**	**Species**	**Frequency of occurrence (%)**	**Grazing Status**
E. plana	**21,0**	**Increaser II**	***C. dactylon***	**23,2**	**Increaser II**
C. dactylon	**19,3**	**Increaser II**	***E. plana***	**21,8**	**Increaser II**
T. triandra	**14,8**	**Decreaser**	***S. africanus***	**12,7**	**Increaser III**
S. africanum	10,6	Increaser III	Karoo bush	10,1	Increaser II
H. contortus	9,9	Increaser II	*T. triandra*	6,9	Decreaser
Karoo bush	5,4	Increaser II	*H. contorotus*	5,6	Increaser II
M. cafra	4,5	Increaser II	*S. fimbratus*	5,4	Increaser III
S. fimbriatus	2,8	Decreaser	*M. caffra*	3,4	Increaser II
E. chloromelas	2,1	Increaser II	*D. eriantha*	3,4	Decreaser
A. congesta	2,1	Increaser II	*E. cloromelus*	1,9	Increaser II
E. capensis	2,0	Increaser II	*H. hirta*	1,7	Increaser I
D. eriantha	1,8	Decreaser	*E. capensis*	1,3	Increaser II
P. dilatatum	1,4	Exotic	*A. conjesta*	1,0	Increaser II
M. capensis	0,9	Increaser II	*P. dilatatum*	0,9	Exotic
S. sphacelata	0,7	Decreaser	*S. sphacelata*	0,5	Decreaser
H. hirta	0,6	Increaser I	*M.capensis*	0,1	Increaser I

Conclusions

The findings of this study suggest that areas that both the herded and free-ranging animals frequently visited during the eight week period that they had the GPS collars on have long term grazing pressure. Hence, there was no difference in the species encountered from the communal rangeland of all three sub-villages. Moreover, due to the fact that there was an overlap in terms of where the herded and free ranging cattle were grazing, it can be deduced that in this case herding did not influence livestock grazing patterns in all three sub-villages.

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