S. Afr. J. Agric. Ext. Grobler, Van Der Westhuizen, Snyman, Scholtz *et al*.
Vol. 51 No. 4, 2023: 75-86
10.17159/2413-3221/2022/v50n1a14407

Impact of Two Grazing Strategies on Rangeland Basal Cover and Beef Production in the Sourish Mixed Bushveld

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ABSTRACT

The sustainability of beef cattle producers in South Africa is greatly dependent on the availability of natural resources. The aim of the study was first to evaluate the effect of two different strategies in the utilisation of rangeland over four years (2011/12 – 2014/15) on the basal cover—secondly, the study compared animal production results from the two extensively managed rotational grazing strategies. Grazing strategies include a traditional rotational system (TRG), where approximately 60% of fodder was utilised, compared with light selective grazing (LSG), where about 30% of fodder was used. Basal cover for TRG ranged from 19% (2011/12) to 15% (2014/15) and for LSG from 18% (2011/12) to 16% (2014/15). The calving percentage varied between 62% and 73%. The calving percentage and cow and calf weight did not differ between the two grazing strategies, although differences between years were observed. Both grazing systems can be implemented successfully in the Sourish Mixed Bushveld without negatively affecting the rangeland. However, basal cover may

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be more vulnerable during drought conditions under a TRG system. The study further indicates that mainly small-scale farmers, where utilisation levels of rangelands are usually high, are more vulnerable to drought conditions.

Keywords: Rotational Grazing, Calving Percentage

1. INTRODUCTION

The production of beef cattle in South Africa is unique due to the dualistic nature of the country's agricultural system. There is a clear distinction between the commercial (formal) and the smallholder or communal (largely informal) sectors, where the former relies mainly on new technology and the latter on indigenous knowledge (Spies, 2011). Furthermore, commercial farmers own approximately 60% of South African cattle, and emerging or communal farmers own 40% (Meissner, Scholtz & Palmer, 2013). The sustainability of these diverse beef cattle producers depends greatly on the availability of natural resources that consist mainly of rangelands. With only 11% of available farmland in South Africa suitable for crop production (RMRD, 2012), the remainder is undoubtedly a vast resource, even if only 80% of this land is proclaimed suitable for extensive grazing (DAFF, 2012) due to limited cultivating potential (Meaker, 1984).

There is no doubt that the long-term economic viability of extensive animal production systems depends mainly on rangeland, and sustainable animal production would only be possible when the rangeland is in a productive state. For an extensive beef producer in South Africa to succeed in a globally competitive market, beef must be produced within a sustainable production system as cost-effectively as possible. It is, therefore, not surprising that South African beef farmers are turning to extension services to search for better ways to sustain rangelands while optimising beef production within diverse regions and climatic zones. The profitability of the livestock sector could be drastically increased if efficient rangeland management practices are implemented (Van der Westhuizen, Mohlapo, De Klerk, Majola, Snyman & Neser, 2020). Furthermore, currently, there seems to be a lack of research and consensus on the most appropriate rotational grazing system to be applied in the Sourish Mixed Bushveld. Thus, more system research is needed for extension services to advise on suitable grazing strategies for this area.

The study's first aim was to evaluate the effect of two commonly practised rotational grazing strategies on rangeland basal cover over four years (2011/12 – 2014/15). The grazing strategies included were a traditional rotational grazing system (TRG) and a light selective grazing system

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(LSG). Secondly, this study aimed to evaluate the effect of applying the two grazing strategies on animal production. This study formed part of a much larger project, which included an oestrus synchronisation protocol (Grobler, Scholtz, Neser, Greyling & Morey, 2019) and breeding heifers at either 14 months or 26 months, which did not affect the grazing strategies or animal production results (Grobler, 2016).

2. MATERIALS AND METHODS

2.1. Study Area

The study was conducted at the Roodeplaat Experimental Farm of the Agricultural Research Council (25°34'11.27''S; 28°22'05.36''E) on 900 ha of rangelands. Although results were obtained based on the simulation of an extensive commercial beef production system, results from this study can be equally relevant to the smallholder or communal beef producer. A study by Jacobo *et al*. (2006) confirmed that animals and rangeland would respond similarly on a small or large-scale farm.

The vegetation in the study area is enclosed in the Savanna Biome and Central Bushveld Bioregion and has been described as Savanna (Rutherford & Westfall, 1994), Sourish Mixed Bushveld (Veld Type 19) (Acocks, 1988), Clay Thorn Bushveld (Low & Rebelo, 1996) and Marikana Thornveld (Mucina & Rutherford, 2006). The following plant communities occur in the study area: *Vachellia tortilis* subsp. *heteracantha – Brachiaria nigropedata* low open woodland; *Vachellia tortilis* subsp. *heteracantha – Digitaria argyrograpta* short thicket and *Vachellia tortilis* subsp. *heteracantha – Bothriochloa bladhii* low open woodland (Panagos, 1995).

The growth season for the Sourish Mixed Bushveld commences in early summer, concurrently with the summer rainfall period. The breeding season for the cattle (Bonsmara) started in early January. It ended in March each year, resulting in the calving season beginning in early summer (October to December), coinciding with the natural veld's active growing season. Calves were weaned in the dry winter months between May and June as soon as the calf crop (the number of calves produced from a specified cow herd within a production cycle) reached an average age of seven months. Data is therefore presented for July to June to include an entire growing season and animal production cycle.

The rainfall pattern for the wet season commenced in September/October and ended in March/April, followed by a dry period from May to August. The highest rainfall occurred in December/January (Table 1). The mean annual rainfall during the four-year study period was 654 mm, ranging from 560 mm in 2011/12 to 747 mm in 2013/14. The mean long-term rainfall for Roodeplaat is approximately

650 mm, emphasising the relatively dry 2011/12 year. The mean daily minimum and maximum temperatures were 17ºC and 31ºC for January (mid-summer) and 2ºC and 21ºC for July (mid-winter), respectively. The warmest months of the year were January and February throughout the trial period (2011 – 2015), coinciding with the breeding season.

TABLE 1: Monthly Total Rainfall (mm) Over the Study Period at Roodeplaat, Pretoria (Agroclimatology Staff, 2015)

Year	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
2011/12	0	5	1	64	68	164	65	104	81	7	1	0	560
2012/13	0	0	74	109	81	154	90	32	79	98	1	0	718
2013/14	0	0	7	104	87	187	68	181	86	26	1	0	747
2014/15	0	1	1	30	95	175	136	34	72	44	0	1	589
Average	0	2	21	77	83	170	90	88	80	44	1	<1	654

2.2. Experimental Design

The experimental Bonsmara herd (n=92) was divided into two herds subjected to either TRG or LSG, the former utilising 60% and the latter 30% of the available grass dry matter before moving to the next grazing camp. Each of the two herds was divided into two sub-herds, consisting of 23 cows in each sub-herd. All four sub-herds had the same age, weight and previous calving-history structure. Animal weight and reproduction performance were measured throughout the study period. The vegetation of grazing camps was ascertained at the beginning of the study and randomly divided to ensure that similar vegetation compositions and grazing capacities were assigned to the different treatment groups. A stocking rate of 7ha/LSU, which concedes with the departmental grazing capacity of the area, was adhered to. All the camps were evaluated after the growing season to determine rangeland conditions.

2.2.1. Vegetation Data

For the duration of the study, the Point-based method was used to determine basal cover (Evans & Love, 1957). Basal cover refers to the area of ground covered by the living basal portions of plants (Trollope, Trollope & Bosch, 1990). Basal cover is more stable yearly and less sensitive to changes due to climatic fluctuation than canopy cover (Coulloudon, 1999). Although basal cover will also vary due to seasonal rainfall variations, it can be used as an indicator for sustainable ecosystem functioning (Van der Westhuizen, 2003). Three sample sites were randomly chosen at the beginning of the study within the camps allocated to each sub-herd. The 200-point nearest plant method was used at each survey site to capture data. The closest plant to each of the 200 one-metre intervals on the tape was recorded with the direction of the line running in the same direction as the slope. The nearest plant within a 50 cm radius was recorded at each point. If there were no living plant species within the radius, it was recorded as bare soil.

2.2.2. Animal Production Data Collection

Over the study period, the mean cow age within the different sub-herds changed due to mortalities and heifers becoming cows after calving. Therefore, all animal weight data was corrected for cow age and calf birth weight. Calf birth weight was also corrected for gender, and calves were weaned as soon as the calf crop average age was seven months. A 205-day corrected weaning weight was calculated to standardise the age at weaning. The days to calving were calculated by the number of days from when the cows were joined with the bulls until calving.

The data obtained for the TRG and LSG grazing systems were combined after it was tested for homogeneity of variances using Levene's test (John & Quenouille, 1977). An appropriate analysis of variance was done with factors: two grazing systems (TRG and LSG) over four years (2011/12, 2012/13, 2013/14 and 2014/15). The Shapiro-Wilk test was performed on the standardised residuals to test for deviations from normality (Shapiro & Wilk, 1965). In cases where significant deviation from normality was due to skewness, outliers were removed until the standardised residuals were normal or symmetrically distributed (Glass, Peckham & Sanders, 1972). The student's t-least Significant Difference (LSD) was calculated at a 5% significance level to compare means of significant source effects. All the above data analyses were performed using SAS version 9.3 statistical software (SAS, 1999).

3. RESULTS AND DISCUSSION

3.1. Basal Cover

The basal cover for the TRG system decreased from 19% in 2011/12 to 15% in 2014/15 and for the LSG system from 18% in 2011/12 to 16% in 2014/15 (Figure 1). An exceptionally high rainfall of 1062 mm was measured a year before the onset of the study. It could thus possibly explain the high basal cover percentage at the beginning of the study period. The basal cover percentage of the TRG system decreased significantly ($P<0.05$) from 2011/12 to 2014/15 (i.e. by 4%), whereas the basal

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cover for the LSG system decreased slightly (2%), although not significantly. The most significant decrease in basal cover percentage was recorded in the second year of the study (2012/13) for both grazing systems. This was observed a year after the exceptionally dry 2011/12 season when a total annual rainfall of 560 mm was measured (Table 1). The significant decrease in basal cover for the TRG treatment compared with the LSG may be due to the higher defoliation rates of plant grass leaves, indicating that higher intensities of grazing can negatively influence basal cover of rangelands during and after dry seasons. This data is in consent with long-term rangeland monitoring trials from the Molopo Thorn vegetation, during which the 1989/1990 season was very dry, and the basal cover of plants in ungrazed plots recovered completely the following growing season while grazed plots did not recover (Van der Westhuizen & Snyman, 2016). Bare patches were also more common in the grazed areas.

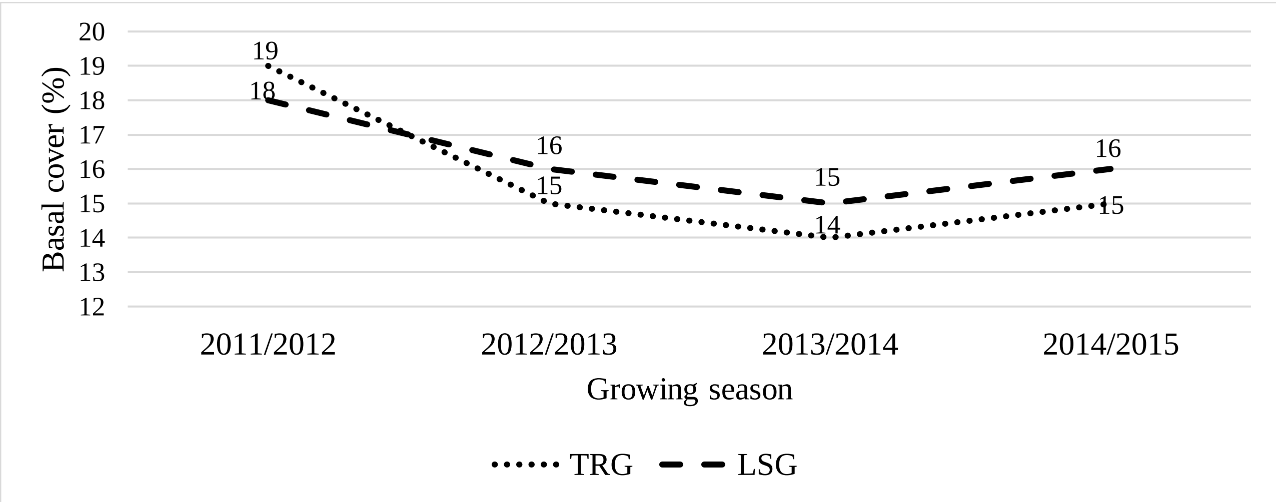

FIGURE 1: Mean Basal Cover Percentage of Vegetation in the Sourish Mixed Bushveld Subjected to a Traditional Rotational Grazing (TRG) and Light Selective Grazing (LSG) System Over Four Years

Although the study was conducted for a relatively short period of four years, results indicated that the TRG system negatively affected the vegetation's basal cover. This result shows that by applying a more traditional rotational grazing system, farmers in the Sourish Mixed Bushveld should be cognisant that this system probably poses a higher risk during droughts for the sustainability of animal production than LSG.

3.2. Animal Production

Average herd production results over the four-year study period are shown in Table 2. There were no significant differences (P<0.05) in animal production between the herds subjected to TRG or LSG over the study period. This signifies that the two grazing strategies applied did not impact animal production. The mean days to calving after the beginning of the breeding season were 304 days for TGR and 305 days for LSG. Cow weight at calving was 438kg for cows subjected to TRG and LSG. The mean calf birth weights were also similar for the two grazing systems, namely 38.2kg and 38.8kg for TGR and LSG, respectively. The mean cow weight at weaning was 488kg, and the calf 205 day weaning weight was 182kg. Calf weaning weight expressed as a percentage of cow weaning weight was 41%, lower than the recommended 45% (www.bonsmara.co.za). In a study by Van Der Westhuizen *et al.* (2020), the weaning weight of Bonsmara calves as low as 155kg was observed when no rangeland management system was applied. However, in the same study, weaning weights between 190kg and 229kg were recorded after successfully implementing a multi-camp grazing system.

TABLE 2: Herd Production Measurements for Traditional Rotational Grazing (TRG) and Light Selective Grazing (LSG) Systems, Averaged Over Four Years in the Sourish Mixed Bushveld

Herd	Days to calving (days)	Cow weight calving (kg)	Cow weight weaning (kg)	Calf birth weight (kg)	Calf 205 day weaning weight (kg)	Calf Av. daily gain (kg)
TGR	304	438	491	38.2	183	0.71
LSG	305	438	485	38.8	180	0.70
Mean	305	438	488	38.5	182	0.71

The mean calving percentage of the sub-herds subjected to either TRG or LSG varied between 62% and 73% over the four-year study period, which is in line with results from Patterson *et al*. (2005), who reported calving percentages of between 60% and 94% for different experimental herds. Deutscher (1991) reported 60% to 80% of pregnancy rates after synchronisation, using natural service by bulls. The calving percentage in 2014 was 62% and thus similar to the national calving percentage of 62% of the commercial beef sector of South Africa, and higher than the average calving percentage reported for both the emerging (48%) and communal (35%) sector (Scholtz & Bester, 2010). The calving percentage for 2011, 2012 and 2013 was respectively 73%, 71% and 69%, which are

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relatively higher than the national average. Although no significant difference was noted in the mean calving percentages of the two grazing strategies over the four years (P=0.15), the calving percentages differed significantly (P=0.01) between the different years. The current results show that the lower-than-average annual rainfall (especially in 2011/12 and 2014/15) had a more significant impact on animal production than the two different grazing strategies.

The results for the mean body condition score at breeding, i.e. for cows that weaned a calf the previous season, are shown in Table 3 for 2012 – 2014. Mean body condition scores differed significantly (P=0.0002) between the three years. The highest body condition score was achieved in 2014 for cows subjected to TRG and the lowest in 2013 for cows subjected to TRG. A significant difference was found between different years (P = 0.02) and grazing strategy over time (P = 0.007).

TABLE 3: Mean Body Condition Score ±SD for Cows at Breeding, Subjected to Either Traditional Rotational Grazing (TRG) or Light Selective Grazing (LSG) in the Sourish Mixed Bushveld

Grazing strategy	2012	2013	2014
TGR	$2.69 \pm 0.62^{c,d}$	2.61 ± 0.82^{d}	3.35 ± 0.38^{a}
LSG	$2.96 \pm 0.65^{b,c}$	$3.04 \pm 0.76^{a,b}$	$3.04 \pm 0.49^{a,b}$
Mean*	2.82 ± 0.64^{b}	2.86 ± 0.81^{b}	3.22 ± 0.45^{a}

^{a,b,c,d} Means with different superscripts differed (P≤0.05)

$*^{a,b}$ Means within the same row with different superscripts differed (P≤0.05)

4. RELEVANCE TO EXTENSION SERVICES

Results showed that when dry years follow a wet year, the TRG system could be, to a larger extent, more responsible for a decline in basal cover compared to LSG. Even though the study was carried out only over four years, the vegetation, in terms of basal cover during drought conditions, is more vulnerable to deterioration under a TRG system than an LSG. This is especially important when it comes to on-farm decision-making for sustainable production. In addition, neither TGR nor LSG had a negative effect on animal production when grazing capacity was adhered to. It must be noted that differences over the years were observed, which might indicate that weather conditions, in this case, rainfall, had a more significant impact on animal production than the grazing strategy. This emphasises the reality that small-scale farmers using an extensive beef production system and where the utilisation percentage of camps is very high will be especially vulnerable to extreme drought conditions.

5. CONCLUSION

The grazing strategy did not significantly influence animal production, including calving percentage and body condition score, over the four-year study period. However, significant differences between years ($P \leq 0.05$) for calving percentage and body condition score were observed. Results from the study suggest that when the stocking rate is adhered to, traditional rotational grazing or light selective grazing can be implemented successfully without negatively affecting animal production. However, rangeland may be more vulnerable during drought under a TRG system than an LSG system. It is, however, important to mention that the four-year study period was too short to make long-term recommendations regarding species compositions and rangeland conditions.

6. ACKNOWLEDGEMENTS

This work is based on research supported partly by Red Meat Research and Development South Africa (RMRD SA) and the National Research Foundation of South Africa (NRF), under grant UID 83933. The Grant-holder acknowledges that opinions, findings, conclusions or recommendations expressed in any publication generated by the NRF-supported research are that of the authors and that the NRF accepts no liability whatsoever.

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