Comparison of degradation gradients of a conventional vs a high pressure grazing system

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Abstract

Grazing management is important for general ecosystem health and sustainable livestock production. Historic grazing practices caused grassland degradation. Regenerative grazing practices can improve soil and plant health. This study aimed to determine if a high pressure grazing approach, in fact improves soil and plant health, compared to a conventional grazing system. A degradation gradient (away from watering places) approach were followed. The study site is situated in the Kalahari bushveld bioregion of the North West province of South Africa. Two adjacent farms were selected, one practicing a conventional four camp rotational grazing system, and the other practicing high pressure grazing with 50 camps in a radial layout. Plant species composition and soil properties (carbon, root biomass, minerals) were measured at three increasing distances away from the water. The results indicated an increase in veld condition away from the water in the conventional system, while the veld condition decreased slightly in the high pressure grazing system. Soil properties for the conventional system did not vary much at increasing distances away from the water. At the high pressure system, soil health was slightly better closer to the water. Soil health was generally better at the high pressure system, than at the conventional system. These results indicate that a high pressure grazing approach, where high animal numbers graze an area, evenly, for a short period of time, followed by a long resting period, is more beneficial to plant and soil health, than a conventional grazing approach where lower animal numbers, graze bigger areas for a longer time period. In the Kalahari bushveld of the North West province of South Africa, high pressure grazing systems has the potential to regenerate soil- and plant health.

Introduction

Sustainable grassland utilization by livestock always remains an important aspect amongst farmers and scienteists. Any rotional grazing method is better than a continuous grazing approach. The majority of rotational grazing systems has in the past been described as conventional systems where a few camps (3 to 4) were allocated per herd of animals. Camps are systematically grazed for 2 to three months at a time and then rested for 4 to 6 months. This approach proved to have negative impacts on the soil and vegetation due to, amongst others, selective grazing taking place and redefoliation of regrowth of the same plants, which decreased the growth vigour of such plants (Franke and Kotzé 2022; Malan 2022). A new grazing approach, high pressure grazing (high intensity grazing, mob grazing, etc) has become popular under the term regenerative grazing. With this approach more even vegetation utilization is achieved, as well as longer rest (recoveray) periods are achieveable. This approach regenerates plant health and soil health (Teague and Barnes 2017). The aim of this study was to to determine if a high pressure grazing (HPG) approach, in fact improves soil and plant health, compared to a conventional grazing (CG) system. A degradation gradient (away from watering places) approach were followed (Sandhage-Hofmann et al. 2015).

Methods

The study was conducted in the North West province of South Africa in the Kalahari bushveld bioregion (Mucina and Rutherford 2016). This vegetation type is situated in the Savanna biome and comprises of a herbaceous grass layer as well as a woody tree layer. The soil is a sandy soil with almost no clay. The annual average presipitation is 450 millimetres which mainly falls in the summer. Two adjacent farms were used, one applying a four camp conventional rotational grazing system, with 60 ha per camp and one centrally placed watering point, which are grazed with 40 cows for approximately 2 months and rested for 6 months. The other farm makes use of a high pressure grazing approach consisting of 50 camps (radial layout with one central watering point) of 9 hectares each which are grazed with 150 cows for one day at a time and rested for six months or longer.

Four replicates of vegetation and soil measurement were done at three distance away from watering points (100m, 500m and 900m). At each distance a 100m transect was measured out along which all the measurements were done. A line point (nearest plant) method was used to measure the botinaical composition at each transect. Plants were grouped according to in desireability and veld condition score ratings were allocated according to Vorster (1982) and Tainton (1999). The following soil parameters were measured at 3 pooled samples (1- 20 cm soil depth): Soil organic matter (SOM), total carbon (TC), active carbon (AC) (Nelson and Summers 1996), phosphorus (P) (Rodriguez et al., 1994), soil PH, calcium (Ca), manganese (Mg), potassium (K), sodium (Na) (The Non-Affiliated Soil Analyses Work Committee, 1990). The SPPS statistics for windows package was used for statistical analyses (IBM, 2017)

Results and Discussion

The vegetation results indicated an significant ($p<0.05$) increase in veld condition away from the water in the conventional system, while the veld condition decreased slightly, away form the water, in the high pressure grazing system (Figure 1). This indicates that the two grazing approaches had different effects on veld condition at increasing distances away from the water. In general, the veld condition was better under the high pressure grazing approach. This result is contrary to that of Chamane et al. (2017) for the mesic grassland of South Africa. Teague and Barnes (2017) however argued that in some cases, where hig pressure (mob) grazing were followed for extended periods, improved rangeland condition.

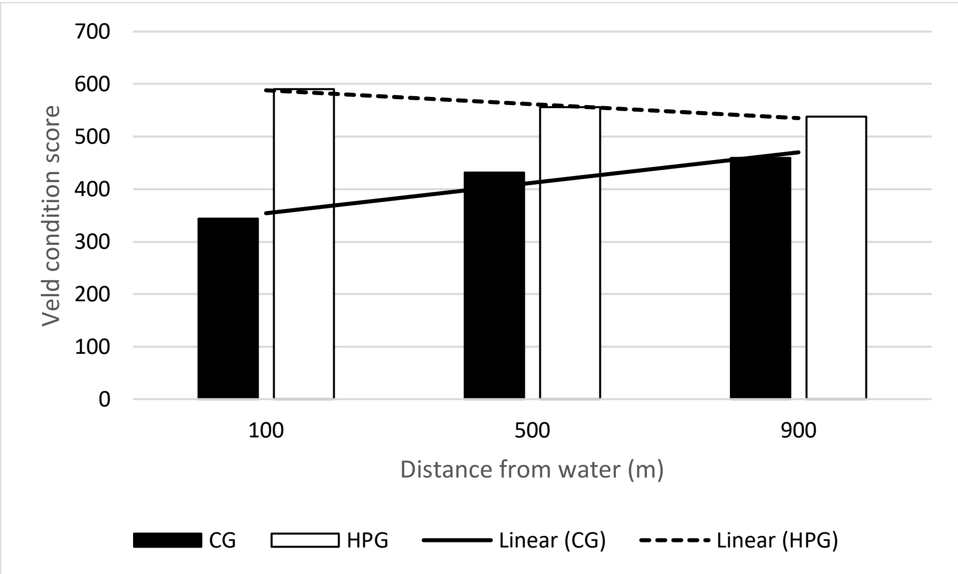

Figure 1. Veld condition scores for conventional grazing and high pressure grazing at increasing distances away from the water.

CG conventional grazing, HPG high pressure grazing

Soil properties for the conventional system showed little variation at increasing distances away from the water (Table 1). At the high pressure system, soil properties, like active carbon, total carbon; and minerals, like calcium and potassium, were better closer to the water. Soil "health" was generally better at the high pressure system, than at the conventional system, with active carbon at 449 kg ha $^{-1}$ compared to only 275 kg ha $^{-1}$ at the conventional system (Table 1). Total carbon was fairly low for both grazing approaches at 0.22% (CG) and 0.25% (HPG), probably due to the sandy soil of this area. The much higher active carbon in the HPG system indicates that the plants were photosynthetically much more active than at CG. Both Franke and Kotzé (2022) amd Hawkins et al. (2017) mention that similar studies showed varying results regarding the impact of HPG on soil carbon. Similarly, varying results were also achieved for soil minerals, with only calcium and potassium contents being significantly higher ($P<0.05$) at the HPG than at CG (Table 1).

Table 1. Soil parameters at different distances from the water for conventional and high pressure grazing approaches.

Parameters	Distance (m)	Conventional	High pressure	P-value
Soil biological properties				
♦SOM (%)	100	1.56 ± 0.11	1.69 ± 0.16	0.73
	500	1.31 ± 0.09	1.69 ± 0.09	0.07
	900	1.63 ± 0.13	1.62 ± 0.18	0.93
Mean		1.50	1.67	
Soil chemical properties				
AC (kg ha^{-1})	100	274.00± 19	523.00 ± 97	0.02*
	500	307.00 ± 27	401.00 ± 24	0.02*
	900	244.00 ± 12	424.00 ± 43	0.01*
Mean		275.00	449.33	
TC (%)	100	0.22 ± 0.01	0.31 ± 0.04	0.02*
	500	0.23 ± 0.02	0.24 ± 0.02	0.73
	900	0.21 ± 0.01	0.21 ± 0.01	1.00
Mean		0.22	0.25	
Soil pH	100	4.85 ± 0.10	5.47 ± 0.06	0.00*
	500	5.06 ± 0.18	5.23 ± 0.10	0.21
	900	4.86 ± 0.07	5.17 ± 0.16	0.01*
Mean		4.92	5.29	
P (kg ha^{-1})	100	126.00 ± 17	155.00 ± 22	0.62
	500	107.00 ± 19	99.00 ± 17	0.12
	900	158.00 ± 17	127.00 ± 11	0.31
Mean		130.33	127.00	
K (kg ha^{-1})	100	72.00 ± 7	179.00 ± 17	0.00*
	500	73.00 ± 7	142.00 ± 37	0.11
	900	78.00 ± 10	100.00 ± 10	0.15
Mean		74.33	140.33	
Ca (kg ha^{-1})	100	45.00 ± 12	252.00 ± 63	0.01*
	500	77.00 ± 16	120.00 ± 34	0.00*
	900	65.00 ± 18	99.00 ± 26	0.00*
Mean		62.33	157.00	
Mg (kg ha^{-1})	100	45.00 ± 8	57.00 ± 5	0.01*
	500	49.00 ± 9	61.00 ± 6	0.13
	900	53.00 ± 4	54.00 ± 7	0.10
Mean		49.00	57.33	
Na (kg ha^{-1})	100	18 .00 ± 1	39.00 ± 10	0.05
	500	28.00 ± 8	32.00 ± 5	0.17
	900	20.00 ± 2	36.00 ± 11	0.13
Mean		22.00	35.67	

♦SOM soil organic matter, AC active carbon, TC total carbon

* Indicates significant differences between grazing systems (P<0.05)

Conclusions and/or Implications

Although literature indicates vaying impacts of HPG approaches on vegetaion and soil health, our results indicates that a HPG, is in general more beneficial to plant and soil health, than a CG. A grassland degradation gradient were prominent in the CG approach, which was not the case for the HPG approach. It can therefore be postulated that in the Kalahari bushveld of the North West province of South Africa, high pressure grazing systems has the potential to regenerate soil- and plant health.

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