Influence of grazing intensity on nutrient concentrations in grass tissue: Evidence from two savannah grass species

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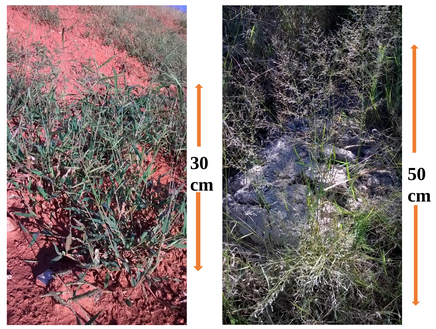
ABSTRACT

High grazing intensity can accelerate the recycling of animal nutrients on savannah rangelands through the deposition of dung and, subsequently, nutrient mineralisation, uptake and concentration in grass tissue. The actual magnitude of this influence can vary depending on the grazing system. This study derived grazing system-dependent magnitudes of the influence of grazing intensity on concentrations of major (N, P, K, Ca, Mg, Na) and trace (B, Co, Cu, Cr, Fe, Mn, Mo, Ni, Se, Zn) animal nutrients in above ground grass tissue. Two grass species were examined: *Brachiaria nigropedata*, a decreaser, and *Eragrostis lehmanniana*, an increaser. For the species, leaf, stem and flower samples were collected in close proximity from sampling points in wildlife and livestock grazing sites, and a no-grazing control site. Sampling was conducted at the end of the rainy season in the semi-arid savannah rangelands of north-western South Africa. The concentrations of the nutrients were determined in the laboratory using standard methods. *B. nigropedata* had higher nutrient concentrations than *E. lehmanniana*. Samples from high grazing intensity sites had higher nutrient concentrations than the control site, an effect more pronounced in *B. nigropedata*. Such sites also had low grass cover, a characteristic of grazing lawns. They included the open access communal rangelands and the vicinity of artificial water holes. The two species manifested inter-site covariance in nutrient concentrations, indicating that sites under high grazing intensity generally had high nutrient concentrations in grass tissue, and vice versa. The short, nutrient-rich grass in grazing lawns is attractive to grazers, which can widen the lawns by perpetuating high grazing intensity and low grass biomass. However, not all grazers are adapted to grazing short lawn grass, which can have implications on grazer diversity. The study concludes that grazing-induced increase in nutrient concentrations in grass tissue manifests more in inherently high-nutrient species.



Brachiaria nigropedata *Eragrostis lehmanniana*

Fig. 1. *In-situ* photos of the studied grass species.

INTRODUCTION

Grazers promote the recycling of plant nutrients (McNaughton et al. 1997), by depositing dung and urine (van der Waal et al. 2011). Decomposition releases the nutrients, to be taken up by grasses where they accumulate in tissue. Therefore, high grazing intensity can accelerate the recycling of the nutrients. Grazing lawns are a manifestation of high grazing intensity (Moe and Wegge 2008). Grass tissue in high grazing intensity sites, such as grazing lawns, can have high nutrient concentrations. Although there is general recognition of the potential effects of grazing intensity on nutrient concentrations in grass tissue, the effects may vary depending on the grazing system and grass species. This study aimed at evaluating the influence of the grazing system and grass species on the concentration of animal nutrients in grass tissue in relation to grazing intensity.

METHODS

Two common, palatable, savannah grass species were studied: *Brachiaria negropedata* and *Eragrostis lehmanniana* (Fig 1). They represented grass species of high and low nutrition, respectively. Sampling was conducted in five study sites located in South Africa (Fig. 2).

The grazing system characteristics of the study sites, and sample size (*n*) per site, were:

- Communal (year-long grazing), *n* = 14;
- Livestock ranch (rotational grazing), *n* = 14;
- Game reserve 1: MGR (year-long grazing), *n* = 17;
- Game reserve 2: BGR (year-long grazing), *n* = 20;
- Control (no grazing), *n* = 5.

The sampling was once-off, at the end of the rainy season (March) when the grasses were at full maturity. Above ground tissue samples of the grass species were harvested and analysed in the laboratory, using ICP-MS.

RESULTS AND DISCUSSION

For the same location, *B. Nigropedata* generally had higher nutrient concentrations than *E. lehmanniana*. The tissue nutrient concentrations were generally highest in the high grazing intensity communal rangeland, and lowest in the control site (Fig. 3). This was more pronounced in *B. nigropedata*. However, there was covariance in the concentrations of the nutrients since respective nutrients tended to manifest matching patterns of increase and decrease, respectively, between the study sites. This was particularly evident for the productivity-limiting N and P. Grazing lawns were evident in high grazing intensity sites, such as near water holes.

CONCLUSIONS

Grazing intensity-induced increases in grass tissue nutrient levels manifest uniformly in palatable grass species. Inherently high nutrient grass species manifest the grazing system-dependent variations in tissue nutrient concentrations more than low nutrient species.

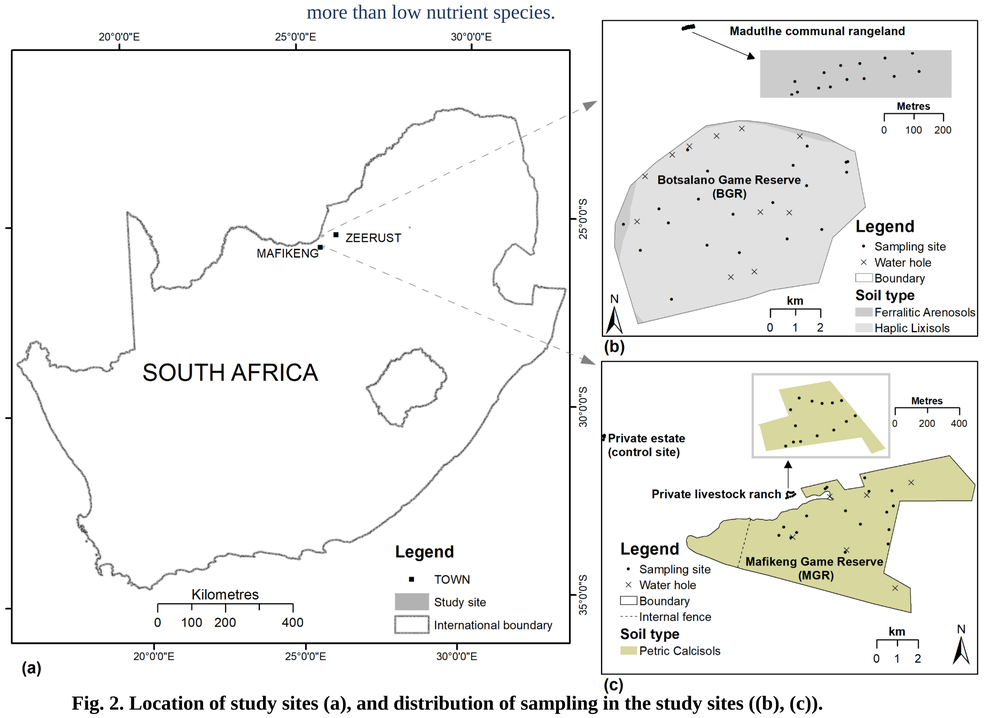


Fig. 2. Location of study sites (a), and distribution of sampling in the study sites ((b), (c)).

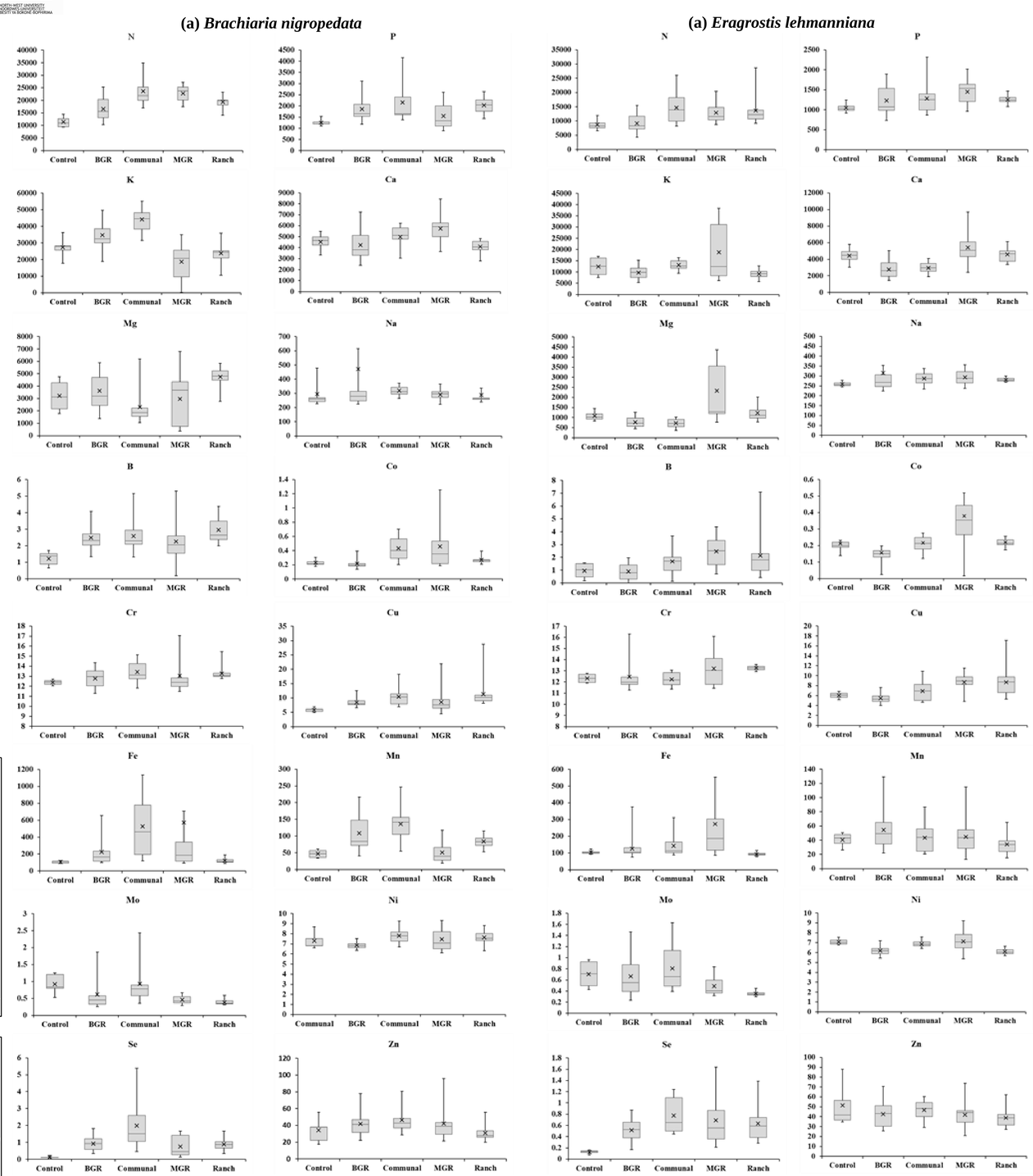


Fig. 3. Variations in nutrient concentrations (Y axes, mg/kg) per study site (X axes) in the two grass species. Where × = mean.

REFERENCES

McNaughton, S.J., Banyikwa, F.F. and McNaughton, M.M. 1997. Promotion of the cycling of diet-enhancing nutrients by African grazers. *Science*, 278(5344): 1798-1800.

Moe, S.R. and Wegge, P. 2008. Effects of deposition of deer dung on nutrient redistribution and on soil and plant nutrients on intensively grazed grasslands in lowland Nepal. *Ecol. Res.*, 23(1): 227-234.

van der Waal, C., Kool, A., Meijer, S.S., Kohi, E., Heitkönig, I.M., de Boer, W.F., et al. 2011. Large herbivores may alter vegetation structure of semi-arid savannas through soil nutrient mediation. *Oecologia*, 165(4): 1095-1107.