



Ephemerals to the rescue! Or not?

Saayman, N¹; Kirkman, K²; Swart, R³; Rheeder, CG⁴

¹ Western Cape Department of Agriculture, Elsenburg, South Africa, nelmarie.saayman@westerncape.gov.za; ² University of KwaZulu-Natal, Pietermaritzburg, South Africa; ³ Western Cape Department of Agriculture, Worcester, South Africa; ⁴ Western Cape Department of Agriculture, Lambert's Bay, South Africa

Key words: seasonal grazing; arid; plant cover; rainfall

Abstract

The vegetation along the west coast of South Africa is known for the floral displays by ephemerals during good winter rain seasons. Previous studies found that livestock will preferentially consume ephemerals over perennials when available and concluded that the presence of ephemerals allows for perennial forage plants to rest and set seed, regardless of grazing taking place during the growing season. Do these conclusions stand up to scrutiny?

A seasonal grazing trial in which paddocks were grazed for three monthly periods, was conducted at the Nortier Research Farm on the west coast of South Africa from September 1989 – September 1995. In this region, rainfall occurs primarily in the winter months of May through to August. The percentage canopy cover of the perennial plant species and ephemerals were determined every year at the start, June, and end, September, of the winter-grazing season.

Autumn rain determined the percentage cover of ephemeral plants by June. When both autumn and winter were dry, both ephemeral and perennial plant cover decreased during the winter grazing season. In wet winters, when ephemerals are in abundance, the perennial plant cover increased toward the end of the grazing season.

When ephemerals were abundant in winter, it allowed for perennial plants to regrow despite grazing. Farmers should take autumn rainfall into account in their fodder flow planning for the coming winter months. Dry autumn months resulted in fewer ephemerals being present, which resulted in livestock utilizing a greater amount of the perennial plants. As a result, they received minimal rest during winter and should receive rest from grazing during spring.

Introduction

The vegetation along the west coast region of South Africa is known for its floral displays by ephemerals during good winter rainy seasons (Van Rooyen et al. 1991). Ephemerals are herbaceous plants which are available for livestock grazing for only a few months during the wet season (Samuels et al. 2016). Livestock will preferentially consume ephemerals, which usually have a high nutritional value, over perennials when available. It is assumed that the presence of ephemerals, and their appeal to livestock, allows for perennial forage plants to rest and set

seed while ephemerals are abundant during the wet season (Samuels et al. 2016). However, it has not been tested whether ephemerals in abundance contributed to an improved canopy cover of perennial plants at the end of the grazing season.

The vegetation of the west coast region of South Africa is divided into two biomes, namely the Succulent Karoo to the north and Fynbos to the south (Mucina and Rutherford 2006). This arid region has a mediterranean climate with cool wet winters and hot dry summers and is recognized as a biodiversity hotspot (Mittermeier et al. 2011). The primary land use of the region is livestock grazing. Sustainable utilisation with livestock is thus very important to ensure the conservation of this highly biodiverse area.

The objective of this study was to 1) determine the effect of rainfall on the percentage cover of ephemerals and 2) determine if ephemerals in abundance have a positive impact on the canopy cover of perennial plant species grazed during the wet season.

Methods

The trial was conducted at the Nortier Research Farm on the west coast of South Africa in the Fynbos biome. The site has a mean annual rainfall of 200 mm, receiving 64% from May–August based on rainfall data recorded daily at the research farm. Nortier is situated in the West Strandveld bioregion, on undulating dune fields that supports tall dense shrubland, with dominant perennial plant species including *Ehrharta calycina*, *Eriocephalus racemosus*, *Roepera morgsana*, *Salvia lanceolata*, *Tetragonia fruticosa*, and *Willdenowia incurvata*, and ephemerals, mainly forbs, include *Oncosiphon suffruticosum*, *Senecio arenarius*, *Wahlenbergia annularis* and *Zaluzianskya affinis* (Mucina and Rutherford 2006).

A seasonal grazing trial ran from September 1989 – September 1995. Treatments included four grazing seasons (Spring, Summer, Autumn, Winter) and three stocking rates (Low, Moderate, High). Each paddock was grazed for three months and rested for nine months. There was a total of 12 treatments with two replicates each and in a completely randomised design. As the impact of grazing/browsing on vegetation can be measured by the change in the percentage canopy cover of plants (Du Toit 1998), plant surveys were undertaken using the descending point method (Roux 1963) to determine the percentage canopy cover of the perennial plant species and ephemerals. These surveys were undertaken every year in June at the start of the wet season and in September towards the end of the wet season in each of the paddocks. This coincided with the start and end dates of the winter grazing season.

Data were analysed using Pearson's correlation, ANOVA, Fischer's Least Significant Difference test, and linear regression analysis.

Results

The percentage cover of ephemerals in June is strongly correlated with the previous three months' rainfall ($r = 0.850$; $p < 0.0001$) regardless of grazing season, but especially with the previous month's rainfall ($r = 0.870$; $p < 0.0001$) (Table 1). No significant correlations ($p > 0.05$) were found between the cover of ephemerals and the previous three month's rainfall from surveys done in September, December, and March.

Table 1: Pearson’s correlation coefficients between percentage canopy cover of ephemerals present in June and the rainfall of the previous month and previous three months at Nortier Research farm. All correlations were highly significant ($p < 0.0001$).

Grazing season	Previous month	Previous three months
Autumn	$r = 0.849$	$r = 0.823$
Spring	$r = 0.899$	$r = 0.881$
Summer	$r = 0.921$	$r = 0.914$
Winter	$r = 0.901$	$r = 0.861$
Overall	$r = 0.870$	$r = 0.850$

A strong positive correlation ($r = 0.731$; $p < 0.0001$) was found between the change in the canopy cover of perennial plants from before, to after the grazing season and the percentage cover of ephemerals before grazing commenced in June in the winter grazed treatment. The better the cover of ephemerals are before grazing the more the cover of the perennial plants will improve during the winter grazing period.

The ANOVA showed significant differences in the changes in canopy cover of ephemerals ($p < 0.0001$; $F = 7.168$) and perennial plants ($p < 0.0001$; $F = 15.725$) between the years. When the veld is grazed during the growing season (winter) the ephemerals and perennials decreased significantly when the rainfall was less than 50% of the average in the autumn, such as in 1991, regardless of good winter rain (Fig. 1). There was also a non-significant decrease in cover of both ephemerals and perennials after grazing during the winter of 1992 following autumn rainfall of less than 40% of the average. This small decrease was most probably because of the carry-over effect of the 70% above average rainfall received during the previous winter (Fig. 1). In 1995 when the autumn and winter rain were less than 10% below average, the ephemerals slightly increased during the winter, but it was not enough to supply sufficient fodder for the animals to not utilise the perennial plants that decreased significantly compared to the years when average autumn and winter rainfall were received. The winter rain of 1995 was not sufficient to allow for regrowth of the perennials in the presence of grazing (Fig. 1). When above average autumn and winter rain was received there was an increase in canopy cover of ephemerals and perennials from June to September in the winter grazed treatment (Fig.1). The linear regression analysis however showed an interaction with stocking rate, where canopy cover of perennials ($p < 0.01$) and ephemerals was greater in the low than moderate and high stocking rates, and rainfall for the last three months influenced ephemeral cover ($p < 0.01$) (Data not shown).

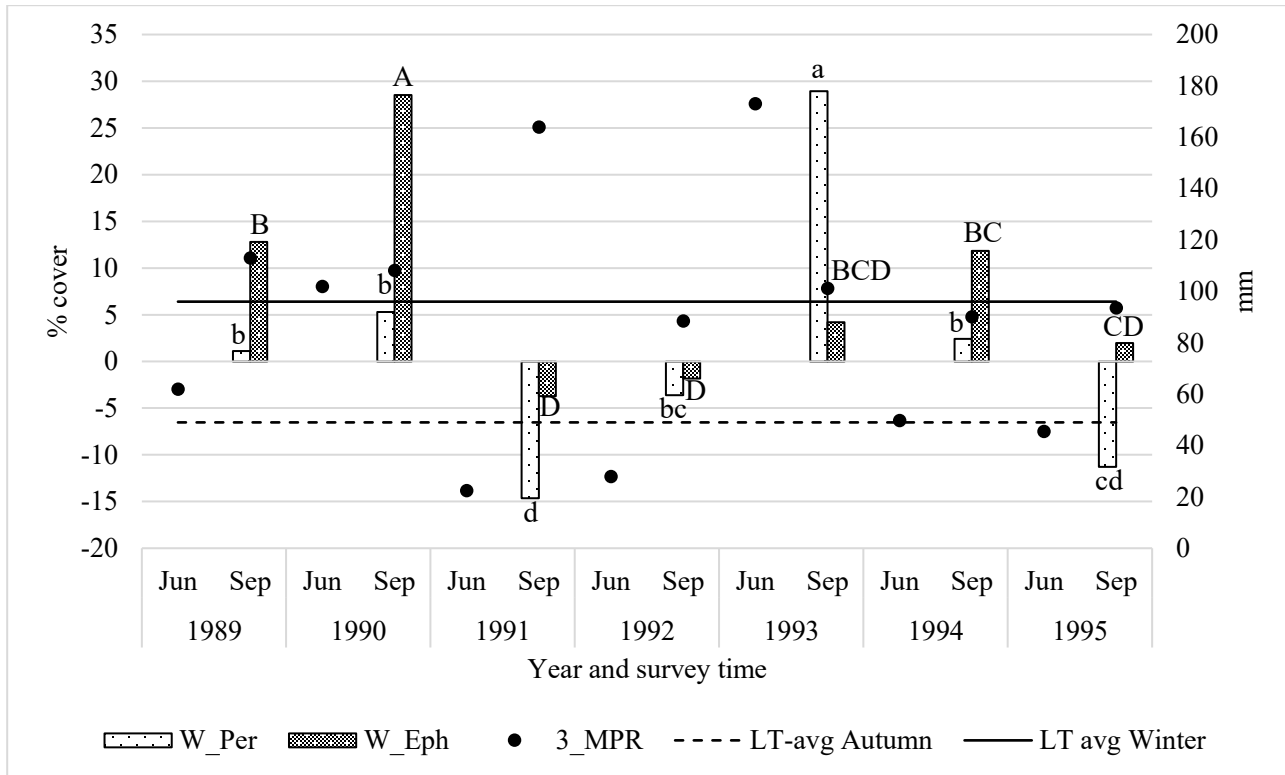


Fig. 1: The change in the percentage cover of the perennial plants and ephemerals, averaged across all stocking rates, during the winter (Jun -Aug) in the winter grazed treatments showing the rainfall (mm) in the three months prior to the surveys (3_MPR). W_Per = Winter-grazed treatment Perennial plants, W_Eph = Winter-grazed treatment Ephemerals; LT-avg Autumn = Long term average rainfall for Mar-May; LT-avg Winter = Long term average rainfall for Jun-Aug (Letters above bars indicate significant differences at the 0.05 level; small letters for perennials; capital letters for ephemerals)

Discussion

Different studies showed that rainfall of the preceding months plays an important role in the presence of ephemerals on the west coast of South Africa and other ecosystems across the world (Van Rooyen et al. 2018). In the transition zone between the Fynbos and Succulent Karoo on the west coast it is no different, as this study found a strong positive correlation between the cover of ephemerals present during June, at the start of the growing season, and the rainfall received during autumn and especially during the month of May. This is further supported by Van Rooyen et al. (1991) who found that ephemeral germination took place during autumn to mid-winter. Saayman et al. (2022) found that the grazing season and stocking rate are the drivers of vegetation change in this vegetation type, but it seems that for ephemerals, rainfall is the main driver of change (Van Rooyen et al. 2018) with only 5% of the change in ephemeral cover that is accounted for by grazing as found in another analysis in this study.

Ephemerals do not provide fodder for a long period of time and has little carry-over forage to the next season (Van Rooyen et al. 2018), but when present are preferred by livestock as a source of fodder over perennial plants (Samuels et al. 2016). This study found that after a dry autumn when the cover of the ephemerals was low at the start of the winter grazing season, little fodder from ephemerals was available and the livestock utilized the perennial plants more than they did during years with abundant ephemerals. In this situation, the cover of both the ephemerals and perennial plants decreased during the winter grazing season, ultimately lowering the cover of the perennial plants by the end of the grazing season (winter). In contrast, in wet years when ephemerals were

abundant, the cover of the perennial plants increased by the end of the grazing season, since livestock likely have preferentially grazed ephemerals, allowing perennial plants to grow and increase in cover (Samuels et al. 2016). Applying low stocking rates will also have a positive impact on the growth of perennials during winter grazing.

Conclusions and Implications

Ephemerals make a large contribution towards the fodder supply during winter and spring in the winter rainfall region of South Africa and are largely dependent on the rainfall received during the month of May. This study supports the notion that when ephemerals are present in abundance during the winter grazing period it allows for perennial plants to regrow and set seed.

Farmers should take the autumn rainfall into account in their grazing management planning for the coming winter months. Dry autumn months will result in fewer ephemerals. This implies less forage material from ephemerals and livestock will utilize more of the perennial plants, lowering its cover. Therefore, the plants won't get the anticipated rest during winter and should receive rest from grazing during spring.

Acknowledgements

This work was financially supported by the Western Cape Department of Agriculture.

References

- Du Toit PCV (1997) Grazing-index method procedures of vegetation surveys. *African Journal of Range and Forage Science* 14, 107-110.
- Mittermeier RA, Turner WR, Larsen FW, Brooks TM, Gascon C. (2011) Global biodiversity conservation; The critical role of hotspots. In 'Biodiversity hotspots' (Eds FE Zachos, JC Habel) pp. 3-22. (Springer-Verlag: Berlin)
- Mucina L, Rutherford MC (Eds) (2006) 'Strelitzia 19: The vegetation of South Africa, Lesotho and Swaziland.' (South African National Biodiversity Institute: Pretoria)
- Roux PW (1963) The descending-point method of vegetation survey. A point-sampling method for the measurement of semi-open grasslands and karoo vegetation in South Africa. *South African Journal of Agricultural Science* 6, 273-288.
- Saayman N, Morris C, Swart R, Rheeder C (2022) The role of rainfall and grazing on the vegetation of the West Strandveld. In 'Proceedings of the 57th Annual Congress of the Grassland Society of Southern Africa.' p. 72. (Grassland Society of Southern Africa: Middelburg, EC)
- Samuels I, Cupido C, Swarts MB, Palmer AR, Paulse JW (2016) Feeding ecology of four livestock species under different management in a semi-arid pastoral system in South Africa. *African Journal of Range and Forage Science* 33, 1-9.
- Van Rooyen MW, Grobbelaar N, Theron GK, Van Rooyen N (1991) The ephemerals of Namaqualand: effects of photoperiod, temperature and moisture stress on development and flowering of three species. *Journal of Arid Environments* 20, 15-29.
- Van Rooyen MW, le Roux A, van der Merwe H, van Rooyen N, Geldenhuys C (2018) Long-term vegetation change (>20 years) in the plains habitat on the Goegap Nature Reserve, Succulent Karoo, South Africa. *African Journal of Range and Forage Science* 35, 289-302.