Effects of continuous grazing and exclusion on the structure of modified Flooding Pampa grassland in Argentina

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Introduction

The breeding of beef cattle is the predominant activity in the Flooding Pampa wet grasslands. The stocking rate of this region is increasing because of livestock displaced by agriculture in other regions. This increased load has been achieved through the alteration of grassland with the use of herbicides and fertilizers or replacement thereof by pasture (Cahuepé and Hidalgo 2005). The large herbivores grazing cause changes in species composition and diversity (*Hall et al.* 1986) in both the original and the modified grassland. The aim of this study was to evaluate the effects of different stocking rates under continuous grazing and exclusion of grazing on the floristic composition and diversity of wet mesophytes prairie, modified during 10 years by the application of herbicides.

Methods

The experiment was conducted at El Amanecer farm (UNLP), located in Vieytes, Argentina (57° 07'W and 35° 01'S) during 2011 and 2012. A wet mesophytes prairie was modified with 5 l/ha of glyphosate and 1 l/ha of 2.4-D to promote germination and establishment of winter annual forages, mainly *Lolium multiflorum*, *Bromus catharticus* and *Gaudinia fragilis*. Three treatments were carried out. Two grazing treatments expressed in cow equivalent (EV) (Cocimano *et al.* 1975) were: high stocking rate (HSR), 3 EV/ha (4.4 animals/ha) and low stocking rate (LSR) with an average load of 2 EV/ha (3 animals/ha) and the third treatment was grazing exclusion (GE). Grazing was performed continuously from early June to late October in 2011 and from mid-May to late October in 2012. Frame score 3 rearing heifers for early mating where used. The initial weight was 169.5 ± 0.11 kg in 2011 and 186.0 ± 0.20 kg in 2012. In each season (autumn, winter and spring) method of Braun Blanquet (1950), recording the number of three floristic census were made by treatment using the species present (NS), total vegetation cover (TVC), grass cover (GC), legumes (LC) of non-graminaceous monocots (MC), dicotyledonous forbs (DC), bare soil (BS) and litter presence (L). Specific diversity index (H) of Shannon-Weaver was established. The design was a randomized block with three replications. All results were analyzed by ANOVA and Tukey test.

Results

During the experimental period both years showed very different weather conditions (Fig. 1).

The TVC did not differ between treatments. In 2011 was significantly higher ($P<0.0001$) than in 2012. The BS was lower ($P<0.0001$) in GE that HSR and LSR, with no difference between stoking rate and between years. The L was significantly higher ($P<0.001$) in GE versus HSR and LSR, being lower in 2011 ($P<0.0001$) than 2012. In GE, the NS and H were lower ($P<0.0001$) than HSR and LRS, and during 2011 compared to 2012 ($P<0.004$) (Table 1).

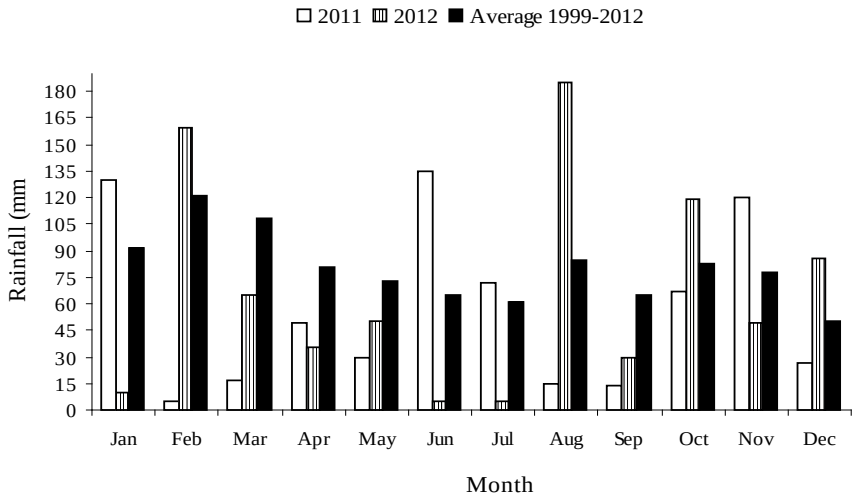

Figure 1. Monthly rainfall (mm) recorded during 2011 and 2012, and 1999-2012 average rainfall at El Amanecer farm.

Table 1. Effects of treatment, season and year on total vegetation cover (TVC), bare soil (BS) and litter (L), expressed as a percentage, and on the number of species (NS) and species diversity (H).

Parameters measured	Treatments			Seasons			Years	
	HSR	LSR	GE	Autumn	Winter	Spring	2011	2012
TVC (%)	80.4 ± 0.9 a	80.1 ± 1.0 a	80.5 ± 1.5 a	89.0 ± 1.1 b	75.1 ± 1.1 a	77.0 ±0.9 a	84.0 ±1.1 b	76.7 ±0.7 a
BS (%)	15.0 ± 0.9 b	13.1 ± 0.9 b	8.0 ± 1.4 a	8.3 ± 1.0 a	13.5 ± 1.0 b	14.3 ± 0.9 b	11.4 ± 1.0 a	13.0 ±0.6 a
L (%)	5.0 ± 1.0 a	6.1 ± 1.0 a	12.0 ± 1.5 b	2.9 ± 1.2 a	11.1 ± 1.1 b	8.6 ± 0.9 b	4.5 ± 1.1 a	10.5 ±0.7 b
NS	8.0 ± 0.3 c	6.0 ± 0.3 b	4.0 ± 0.4 a	6.0 ± 0.3 b	4.5 ± 0.3 a	6.5 ± 0.2 b	5.0 ± 0.3 a	6.0±0.2 b
H	1.5 ± 0.03 c	1.1 ± 0.04 b	0.8 ± 0.05 a	1.1 ± 0.04 b	0.1 ± 0.04 a	1.2 ± 0.03 c	1.0 ± 0.04 a	1.24±0.0 b

Letters: different means for $P = 0.01$.

Table 2. Effects of treatment, season and year on the cover of grass (GC), legumes (LC), non-grass monocots (MC) and dicotyledonous forbs (DC), expressed as a percentage.

	Treatments			Seasons			Years	
(%)	HSR	LSR	GE	Autumn	Winter	Spring	2011	2012
GC	67.5 ± 0.8 a	73.0 ± 0.9b	77.0 ± 1.4 c	80.0 ± 1.5 c	73.0 ± 1.1 b	69.0 ± 0.9 a	76.5 ± 1.1 b	69.1 ± 0.7 a
LC	1.0 ± 0.1 b	0.8 ± 0.1 ab	0.2 ± 0.2 a	0.01 ± 0.1	0.3 ± 0.1 a	1.3 ± 0.1 b	0.4 ± 0.2 a	1.0 ± 0.1 b
MC	1.0 ± 0.06 c	0.5 ± 0.06 b	0.1 ± 0.09 a	0.1 ± 0.1 a	0.5 ± 0.07 b	0.8 ± 0.06 c	0.6 ± 0.07 a	0.5 ± 0.05a
DC	9.0 ± 0.5 c	3.1 ± 0.6 b	1.0 ± 0.9 a	2.5 ± 0.7 b	2.4 ± 0.7 a	5.0 ± 0.5 b	5.3 ± 0.7 b	3.4 ± 0.4 a

Letters: different means for $P = 0.01$.

Although there were no differences between treatments in the TVC, when analyzing the compartments was found that stocking rate has consequences on the GC, being significantly lower under grazing and different between HSR and LSR ($P<0.0001$). The seasons and years also affected the GC. In autumn it was higher ($P<0.006$) than in winter and spring, and in 2011 it was higher ($P<0.02$) than in 2012. LC and MC were favored by grazing in spring ($P<0.01$). LC showed an increase in 2012 compared to 2011 ($P<0.001$). The DC increased with stoking rate ($P<0.0001$). Furthermore it was higher in autumn and spring ($P<0.02$) and in 2011 compared to 2012 ($P<0.0001$) (Table 2).

Conclusions

In GE few species dominated with greater cover of grasses and litter, whereas under grazing, dicots cover and bare soil had increase, in detriment of grasses. Results showed that the intensification of grazing (HSR) can increase the presence of weeds as *Cardus acanthoides* and *Ammi majus* and the loss of winter grass cover. These changes would be accentuated when there is high variability in rainfall (2012). LSR had intermediate values, and its floristic composition would be more stable and sustainable in time.

References

Braun Blanquet J (1950) Sociología vegetal. ACME Agency. Buenos Aires. 444p.

Burkart SE, MF Garbulsky, CM Ghersa, JP Guerschman, RJC León, M Oesterheld, SB Perelman (2005) Las comunidades potenciales del pastizal pampeano bonaerense. pp. 379-399. En: M Oesterheld, MR Aguiar, CM Ghersa y JM Paruelo (eds.). La heterogeneidad de la vegetación de los agroecosistemas. Un homenaje a Rolando León. Editorial Facultad de Agronomía. UBA.

Cahuepé MA, LG Hidalgo (2005) La Pampa inundable: el uso ganadero como base de la sustentabilidad social, económica y ambiental. pp. 401-412. En: M. Oesterheld, MR Aguiar, CM. Ghersa y JM Paruelo (eds.). La heterogeneidad de la vegetación de los agroecosistemas. Un homenaje a Rolando León. Editorial Facultad de Agronomía. UBA.

Cocimano M, Lange A, Menvielle E (1975) Estudios sobre equivalencias ganaderas. *Productión Animal (AAPA)* **4,** 161-190.

Sala OE, Oesterheld M, León RJC, Soriano A (1986) Grazing effects upon plant community structure in subhumid grasslands of Argentina. *Vegetation* **67,** 27-32.