SELECTIVE SHEEP GRAZING IN AN HETEROGENEOUS WHEATGRASS DOMINATED PASTURE RELATED TO STOCKING RATE.

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ABSTRACT
It has been hypothesized that patch and community selection are driven by forage quality and/or quantity. We assess the relationship between vegetation characteristics and community and patch selection by sheep under continuous grazing at different stocking rates in an heterogeneous pasture. Our results suggest that when communities strongly differed in nutritive value sheep recurrently select the higher quality community in spite of its low biomass. However, sheep do not completely exclude the poorer quality community, generating a patchy vegetation pattern.

KEYWORDS
sheep selectivity, community, patch, vegetation characteristics, stocking rate

INTRODUCTION
Biomass quantity and nutritive value play and important role in animal selection. It has been hypothesized that forage quality and quantity drive selection between patches and communities, where the grazing goals are foraging efficiency optimization and nutrient maximization, respectively (Senft el al., 1987). The importance of biomass quantity and nutritive value in the animal selection of communities has been demonstrated (Senft et al., 1982; Arnold, 1987). In contrast, the selection among communities at different stocking rates has not received the same consideration.

Grazing produces changes in the vegetation structure of the communities, determining areas with high and low utilization. The highly utilized areas have more nutritive value (Bakker et al., 1983; Illius et al., 1987). Therefore, these differences can influence the herbivore grazing behavior. This study assesses community and patch selection by sheep grazing at different stocking rates in an heterogeneous pasture.

MATERIALS AND METHODS
The study was carried out from May 1989 to January 1990 at Balcarce (37º45 S, 58º17 W), Argentina, in a 6.5 ha heterogeneous old pasture under sheep continuous grazing, with three stocking rates (12.5, 8.75 and 4.4 Corriedale lambs/ha) and two replicates. In the pasture we delimited two main communities: one (**W-SG**) dominated by of tall wheatgrass (T*hinopyrum ponticum*) and salt grass (*Distichlis spicata* and *D. scoparia*), and the other (**R**) by perennial ryegrass (*Lolium perenne*). **W-SG** represented approximately the 65% of the total area.

Vegetation measurements were made monthly from September. At this time grazing had already printed a mosaic of highly (**HUP**) and lightly (**LUP**) utilized patches in **W-SG**. Vegetation attributes registered in both communities were height, total and live biomass, biomass density, live:dead biomass ratio, and nitrogen concentration. In **W-SG** we also estimated these attributes for each patch type, and its relative area (a detailed description of vegetation characteristics was given by Siffredi, 1993).

The grazing activity of each animal was observed every 25 min from dawn to sunset during three days. We registered the community and patch type where animals were grazing. Community and patch selection were determined by a selectivity index (SI). $SI_i := P_i/Pa_i$, where P_i = percentage of animals eating in $community_i$ or $patch_i$; and Pa_i= surface percentage of $community_i$ or $patch_i$. SI=1 means that the number of animals grazing in a community or patch type did not differ from the expected by chance. The t-test was used to determine whether SI values differed from one. Community and patch vegetation attributes were analysed by Principal Component Analysis (PCA). The values of the first axes obtained by PCA were correlated with the SI values.

RESULTS AND DISCUSSION
Sheep consistently selected the community **R** ($SI_R > 1$, $p < 0,05$) independently of the stocking rate (Table 1). Both communities differed in biomass quantity and quality through time. **R** had significantly less live biomass but higher nitrogen concentration (Fig. 1; see PC1, which explained 70% of the variance among samples). Averaged through dates and stocking rates, live biomass reached 23 vs 57g DM m2 and nitrogen concentration 2.4 vs 1.6% in **R** and **W–SG**, respectively. Differences in quality between communities increased throughout spring, because of the drop in quality of **W-SG**. In both communities the live:dead biomass ratio increased through time and as stocking rate decreased (Fig. 1, see PC2, 24%). This gradient was more consistent in **W-SG**. The correlation between the IS and PC1 ($r^2=0.72$, $p < 0.05$) indicated that sheep consistently select the community with higher nitrogen concentration in spite of their lower amount of biomass.

While **R** was uniformly used, patchy grazing determined a mosaic of closely grazed and almost ungrazed patches in **W-SG**. Averaged through stocking rates **HUP** had lesser live biomass (57 vs 103 g DM m2), but higher live:dead biomass ratio (6.3 vs 1.4) and nitrogen concentration (2.1 vs 1,5%) than **LUP**. Differences between patches increased as stocking rate decreased (Siffredi, 1993). At all the stocking rates, sheep recurrently return to **HUP** although they represented low percentages (from 5 to 30 % in low and high stocking rates, respectively) of the total surface. **HUP** selection was stronger at low stocking rates and it was increasing as the growing season progressed (Table 1).

The PCA for patch samples determined axes similar to those of communities samples (data no showed). PC1 (explained 60 % of the variance) pointed out the contrast in nitrogen concentration and amount of live biomass between **HUP** and **LUP**. PC2 (34 %) indicated a gradient in live:dead biomass ratio, which increased in both patches as growth season progressed. Values of patch indexes selection were directly related to PC2 ($r2=0.72$, $p<0.05$), suggesting that sheep selectivity by **HUP** increased through grazing season as the differences between **HUP** and **LUP** increased. It has been stated that patch grazing determines nutritional facilitation (McNaughton, 1984; Illius et al., 1987). Localized foraging would modify sward structure and quality to produce grazing lawns more suitable for subsequent grazing.

Our results suggest that when communities strongly differed in nutritive value sheep recurrently select that with higher quality, in spite of its low biomass. However, sheep do not completely exclude the poorer quality community, generating a patchy vegetation pattern.

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Figure 1

Scatter diagram of vegetation samples of two communities continuosly grazed by sheep at three stocking rates. Codes: = 4.4, = 8.7 and =12.5 lambs per hectare). Black= wheatgrass–saltgrass community; grey= perennial ryegrass community. Letters indicate months.