Cattle in the Arb?

Suppression of Dominant Grasses by Cattle Grazing

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Introduction

Prairies and large ungulates have a long history of coevolution (Hartnett *et al*. 1997). As with fire, some prairie species are more resilient than others to grazing, and in the absence of treatment, these species often become suppressed by species less adapted to grazing. A growing body of evidence and our own observations in the arb prairies support the conclusion that certain species (particularly the C4 grasses *Andropogon gerardii* and *Sorghastrum nutans*) tend to become dominant, in some cases near monocultures, without grazing (Sluis, 2002). For managers trying to maintain a high diversity prairie, this is an undesirable outcome.

Historically, prairies in this region were grazed by large herds of bison. However, for a number of reasons, bison are impractical for many prairie managers today. Cattle are a commonly used alternative, and despite some differences in grazing preferences and other behaviors, their overall effect on the prairie community appears to be similar (Plumb and Dodd, 1993). Cattle can directly increase prairie diversity through selective grazing on dominant species which they find more palatable and by increasing the heterogeneity of their habitat through non-random grazing patterns (Fuhlendorf and Engle 2001).

During the summer of 2003 we conducted a trial experiment to determine the effectiveness of grazing to reduce dominance in the arb prairies.

Study Site and Methods

The site of this study was Hillside Prairie in the Carleton Arboretum. Approximately six acres of this restored prairie were enclosed using electric fencing and divided into six roughly equal-sized paddocks. This cellular enclosure design allowed us to provide brief, intense grazing treatment to each paddock, mimicking natural grazing patterns. In each paddock, either six small or two large exclosures were created to provide controls.

14 adolescent steers grazed the prairie from June 16th until June 27th, when the number was reduced to eight. These eight remained until July 28th. Paddocks 1-5 received two grazing treatments (each approximately 4 days long), separated by approximately a month. Paddock 6 was grazed only once.

There are many ways in which grazing could affect the prairie plant community, some of which are very subtle. We investigated a variety of measures chosen to represent the diversity of possible effects. Through the summer, I measured the median stalk height of five C4 individuals in each exclosure and associated treatment. Also continuously through the summer, I measured light availability in grazed and ungrazed plots at 0, 25 and 50 cm above the ground. In mid-August, I collected fruit from individuals of the prairie legume *Amorpha canascens*, and weighed and counted their fruit sets. At the end of the growing season (mid-September) I collected biomass samples from 15 grazed and 15 ungrazed 1m x 1m plots, sorted plants into grass and forb categories, and dried and measured samples.

Results

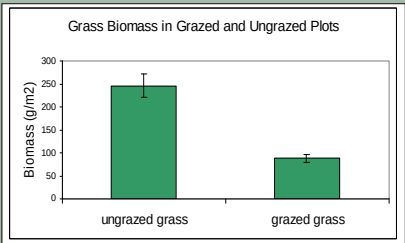
Grass biomass was significantly reduced by grazing while forb biomass was not significantly altered (figure 1). However, there was a trend towards increased forb biomass with grazing, but high variance and low values may have made it difficult to detect. Our biomass measurements also indicate that grasses make up only 4% of total biomass in the absence of grazing.

Light availability increased greatly with grazing (figure 2), particularly at ground level, which is most important for new seedlings. It is also interesting to note that the difference between grazed and control treatments decreased as time from grazing increased.

Height of C4 grass was reduced each time grazing was applied to a plot (figure 3). Each grazing treatment removed approximately 30 cm of plant height. However, grazing did not decrease the rate of growth, but rather contributed to a slight increase in growth rate in grazed plots.

The survey of *Amorpha canascens* fruiting effort indicated a massive increase in fruiting effort in grazed plots (figure 4). *A. canascens* plants were taller, larger and had a higher fruit set when subjected to grazing.

While forbs were generally avoided by cattle, certain species did prove quite palatable. In particular, cup plant (*Silphium perfoliatum*) was completely eaten in all grazed areas. The cattle also had a large unexpected impact on certain areas (see picture) where they spent a great deal of time and crushed most of the vegetation. These "denuded zones" were often bare for several weeks, but by the end of the summer most had become major colonization sites for weedy annuals.



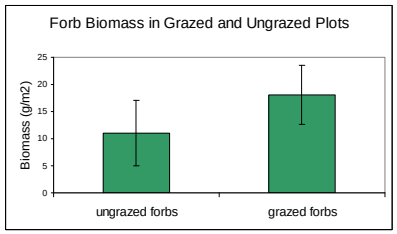


Figure 1: Dry biomass of forbs and grass in grazed and ungrazed plots. Biomass measurements were obtained by clipping 30 1x1m plots to the ground, sorting by type, and drying for 48 hours at 80 C. Grass biomass was significantly reduced by grazing (paired samples t test, $p < .001$). Forb biomass was low and highly variable, and there was no significant difference between treatments.

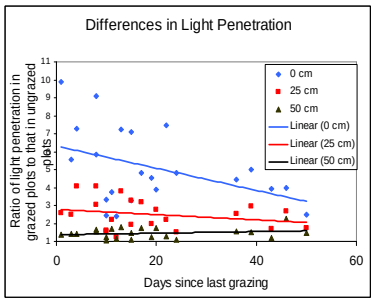


Figure 2: Light penetration in grazed plots relative to ungrazed plots, presented as a proportion of light penetrating at each control plot. Light measurements were taken using a 1m line quantum sensor at 0, 25 and 50 cm above the ground. At 50 cm, there is little difference between control and treatment plots, while differences were great at ground level (0 cm). As plots recover after being grazed, similarity between controls and treatments increased.

Works Cited
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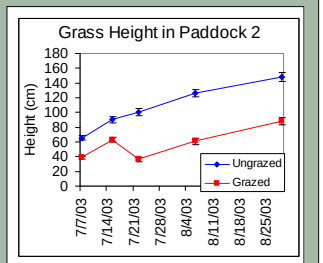

Figure 3: Heights of C4 grass in paddock 2, grazed once before measurements were taken, and once on July 16th. Each grazing treatment sets back grass height by approximately 30 cm. However, it is interesting to note that grazing does not seem to decrease the rate of growth.

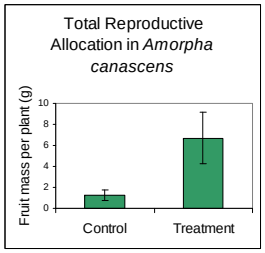

Figure 4: Total fruiting mass of individuals of lead plant (*Amorpha canascens*), estimated as fruit mass per inflorescence times inflorescences per plant. Individuals in grazed plots produced significantly more fruit mass than those in control plots (Mann-Whitney U test for non-parametric data, P = .009)

Discussion

Together, the four measures undertaken by this study present a coherent view of the effect of cattle grazing. Grass biomass is directly and substantially reduced, allowing greater light penetration in grazed plots. Forbs are able to take advantage of this greater light availability, and produce greater biomass and, in at least one case, far greater fruiting effort. All measures here indicate that grasses are being suppressed, allowing greater forb growth.

We also have direct evidence that cattle can increase diversity through generation of greater microhabitat heterogeneity, as exemplified by the creating of denuded zones. Future studies should measure diversity directly after several seasons, but early indications are that it will be higher

"Denuded zone" resulting from a concentration of cattle activity near the water supply.