Effects of Sheep Grazing on Grasshopper Population Dynamics and Rangeland Vegetation

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Problem: In much of the Northern Great Plains, grasshopper populations tend to increase with grazing intensity, drought, and bare ground. Grasshopper outbreaks on rangeland result in competition with livestock for limited vegetation and lead to dispersal into crops. Traditional pesticide control programs for rangeland grasshoppers are often ineffective in protecting vegetation, as well as economically and environmentally unsound. Although it appears differing types of livestock grazing can lead to either increases or decreases in grasshopper populations, we don't understand how the timing and intensity of livestock grazing affects grasshopper population fluctuations. Differences in livestock grazing can affect factors such as microclimate conditions for grasshoppers and vegetation characteristics that can affect grasshopper population dynamics. The goal of this study was to examine how the timing and intensity of sheep grazing affected grasshopper population dynamics, vegetation characteristics, and nitrogen availability. A secondary goal was to examine how outbreak densities of grasshoppers affect rangeland vegetation and grasshopper populations both during an outbreak and in the year following it.

Procedures: The experiment was conducted on a site highly dominated by western wheatgrass. There was a severe grasshopper outbreak in 2000, with over 100 grasshoppers per square yard in early summer. Cages made from mesh screening (9 x 12 foot) were used in the experiment. Livestock grazing treatments consisted of no sheep grazing, early season grazing, late season grazing, and repeated sheep grazing. Each of the grazing treatments had cages initiated at the field density of 110 grasshoppers per square yard and at a reduced density of 35 grasshoppers per square yard. Grazing treatments were accomplished by placing two ewes in a given cage for approximately 1 hour. Grasshopper populations in the cages were assessed every 7 to 10 days. Grass biomass was sampled biweekly in uncaged areas and inside each cage at the end of the experiment and analyzed for crude protein content. Ion exchange capsules were buried in each cage to assess the availability of nitrogen for plants. In 2001, the number of grasshoppers hatching in each cage was measured.

Findings: In 2000, grasshopper numbers outside cages dropped rapidly from 110 per square yard to less than 1 per square yard over the course of a month (Figure 1). Grasshopper survival in the experiment was affected more by initial grasshopper density than by grazing treatments. Measurements of cage vegetation, grasshopper survival, and grasshopper size were all consistent with higher food limitation of grasshoppers in the field density treatment cages. Although sheep grazing did not have large effects on grasshopper survival in cages, it appeared to increase food limitation for grasshoppers as surviving grasshoppers were smaller. Additional effects of sheep grazing on grasshopper populations likely exist when grasshoppers are less abundant, as even the reduced grasshopper density treatment was representative of an extreme grasshopper outbreak.

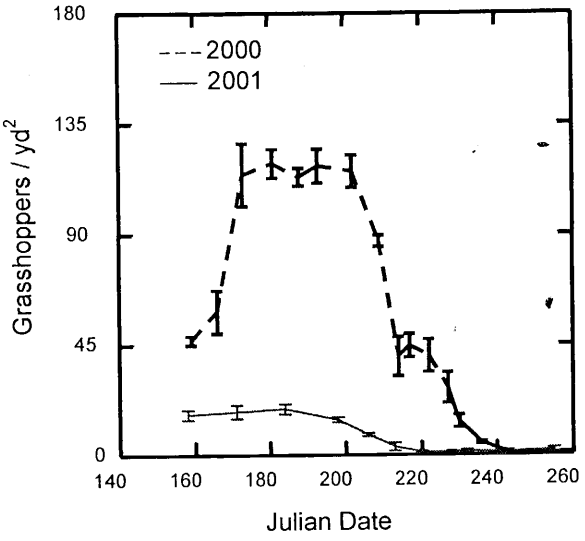

Figure 1. Grasshopper densities in uncaged control areas in 2000 (– –) and 2001 (—). (July 1 ~ Julian Date 183).

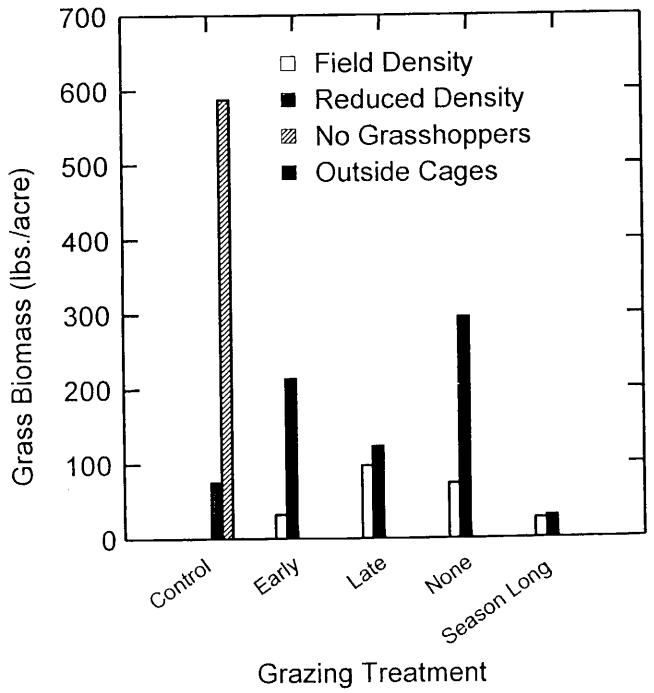

Figure 2. Green grass biomass remaining in cages and uncaged control areas at the end of the summer in 2000.

Grasshoppers removed much of the available grass biomass both in uncaged areas and in cages with field grasshopper densities (Figure 2). Cages with no grasshoppers had over eight times more grass remaining at the end of the summer than in cages initiated with 110 grasshoppers per yd^2 (Figure 2). Field density cages had less grass remaining and lower crude protein content of grasses than reduced density cages. The amount of grass removed by grasshoppers in 2000 was much higher than that removed by any of the sheep grazing treatments. During a severe grasshopper outbreak, grasshoppers had a larger effect on rangeland vegetation than livestock grazing.

Grasshopper populations at the site crashed in 2001, as densities were more than six times lower than in 2000

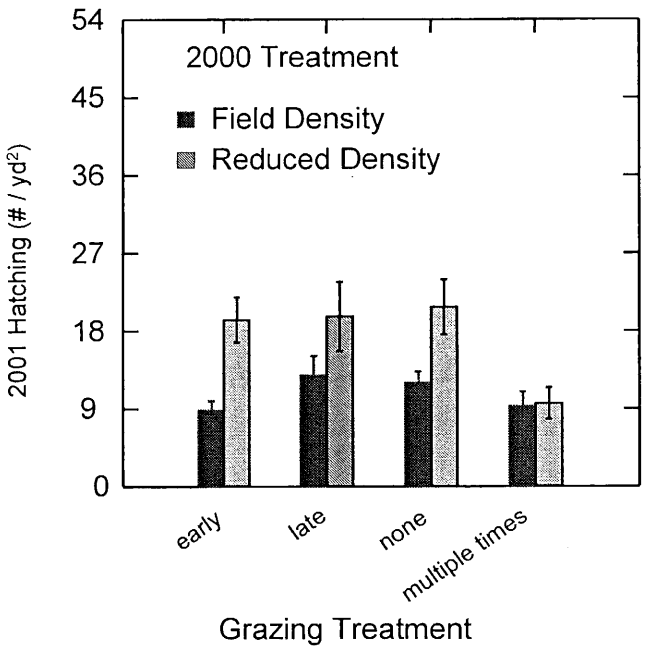

Figure 3. 2001 grasshopper hatchout in each field season treatment from 2000.

(Figure 1). Some grasshopper species were more strongly affected by the severe food limitation in 2000. For example, the large headed grasshopper, a late season species, declined from nearly 80% of the grasshopper community to only 15% in 2001. Few grasshoppers were able to lay eggs in the field density cages in 2000 (Figure 3) before they died, as fewer grasshoppers hatched in 2001 in field density cages than in cages with reduced densities in 2000. There were no large effects of sheep grazing treatments on the number of grasshoppers hatching in cages in 2001 (Figure 3).

Although there was no effect of sheep grazing on crude protein content of remaining grass in 2000, cages with sheep grazing had higher grass crude protein content in 2001. Cages with sheep grazing also had increased amounts of nitrate in the ion-exchange resin capsules, indicating more nitrogen was available for plants in 2001. Therefore, livestock grazing affected vegetation quality and nitrogen availability in the second year of the experiment. Although sheep grazing did not have large effects on grasshopper population dynamics during a severe grasshopper outbreak, the effects of livestock grazing on vegetation quality and nitrogen availability evident in the second year of the experiment are likely to indirectly affect grasshopper population dynamics.

Future Direction:

These continuing experiments will address how livestock grazing and the subsequent changes in plant physiology affect patterns of grasshopper herbivory.

Relevant Publications:

Branson, D.H. and M.H. Haferkamp. 2002. Multi-year effects of the timing and intensity of sheep grazing on grasshopper populations. Soc. Range Manage. Abstracts 55: 288. (Abstr.).

Branson, D.H. and M.H. Haferkamp. 2002. Grasshopper and sheep herbivory impacts on grasshopper population dynamics, vegetation and nitrogen availability: Results from a two year experiment. Bull. Ecol. Soc. Amer. 83:S324. (Abstr.).

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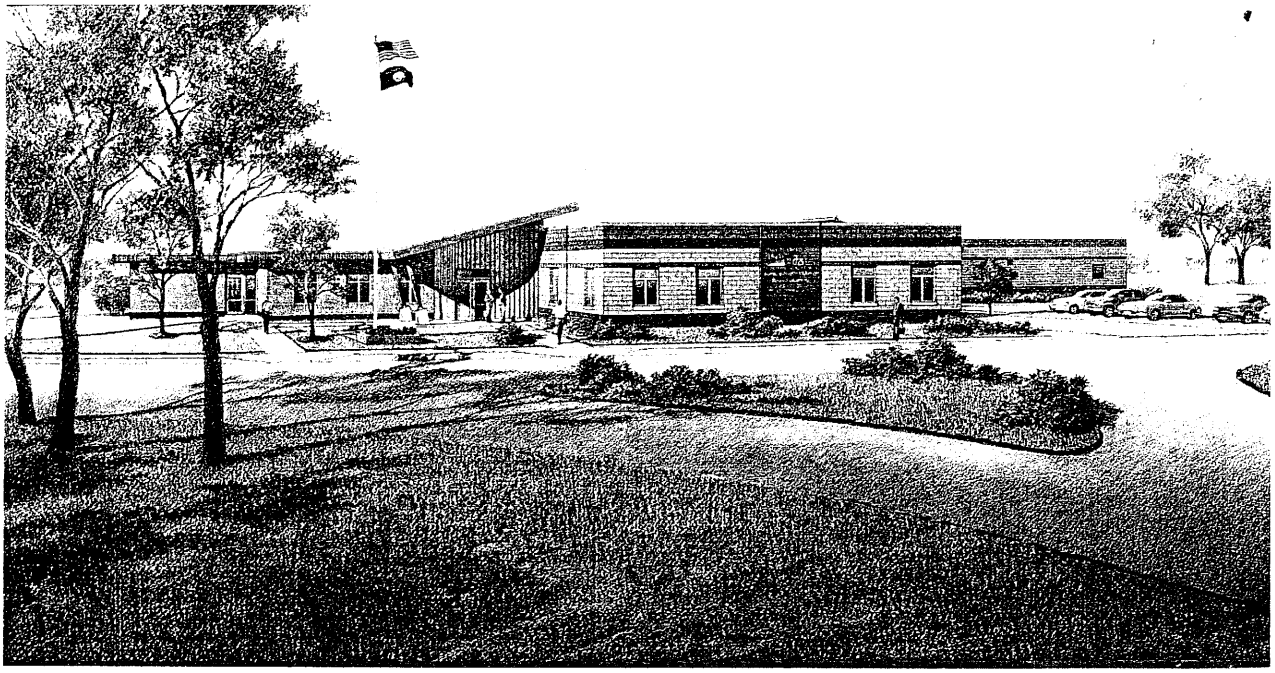

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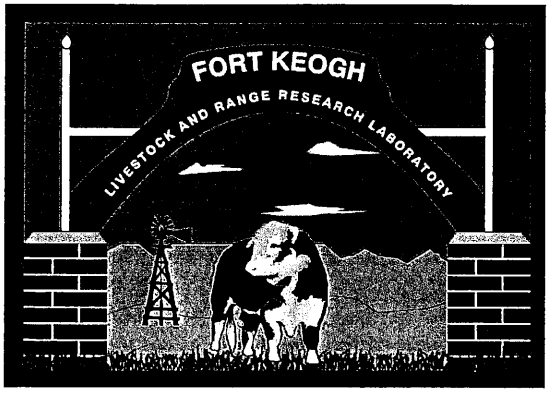

Edited by E.E. Grings.

Front page drawing of how the new building will look was provided by Jacobs Architectural Firm.