Preliminary Effects of Patch-Burn Grazing on a High-Diversity Prairie Restoration

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Patch-burn grazing provides a method for simulating pre-European disturbance regimes in grasslands.

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The Nature Conservancy has been restoring marginal cropland to high-diversity grassland/wetland restorations along the Central Platte River in Nebraska since 1994 (Whitney 1997, Steinauer and others 2003). Each planting consists of locally harvested seed from 150 to 225 plant species. Many of our older restorations have now reached the point where they require stewardship to maintain and improve the diversity of the established plant communities. Because the combination of fire and cattle grazing is an important part of our stewardship program for remnant prairies, we have begun investigating its potential role in managing our restored plant communities as well.

The Nature Conservancy initiated a patch-burn grazing system on some of its large, bison-grazed grasslands in the Great Plains in the late 1980s (Steuter and others 1990). While the method varies, the basic idea is to annually burn part of a grassland (on a scheduled derived from an estimated aboriginal fire-return interval) and then give grazers, such as bison, access to both the burned and unburned portions of the pasture. In general, bison spend the majority of their time grazing in the most recently burned portion, less time in the portions burned in prior years, and very little time in the remaining portion during the grazing season. Thus, burning results in intense grazing pressure during the first year after the fire, which opens up space between the dominant grasses for new growth of forbs, particularly short-lived annuals and biennials. Those "weedy" forbs become dominant during the next year or two and then slowly subside under competition from the recovering perennial grasses. The periodic intense disturbance is also likely to help other longer-lived plants establish new individuals through seedlings. While the method was first employed on grasslands larger than 5,000 acres (2,000 ha) using bison, a number of people are now testing its potential to manage much smaller sites using cattle as the grazers (Fuhlendorf and Engle 2001). Initial results from these studies have been very promising, with cattle in small pastures following much the same patterns as bison in larger enclosures.

Grazing by cattle is viewed by many prairie enthusiasts as a negative force in high-quality grasslands, and particularly harmful to conservative forb species. This view is perpetuated by the poor quality of the generally small pastures that are scattered within the eastern range of the tallgrass prairie. However, poor-quality pastures are the result of long-term, continuous overgrazing, not cattle grazing in general. In fact, the use of large ruminants as a management tool may be the most flexible method available to prairie managers because of the cattle's selective nature.

In this study, we investigated the effects of the patch-burn grazing system in restored prairie along the Central Platte River, near Grand Island, Nebraska. Specifically, we wanted to look at the grazing selection by cattle of various forb species

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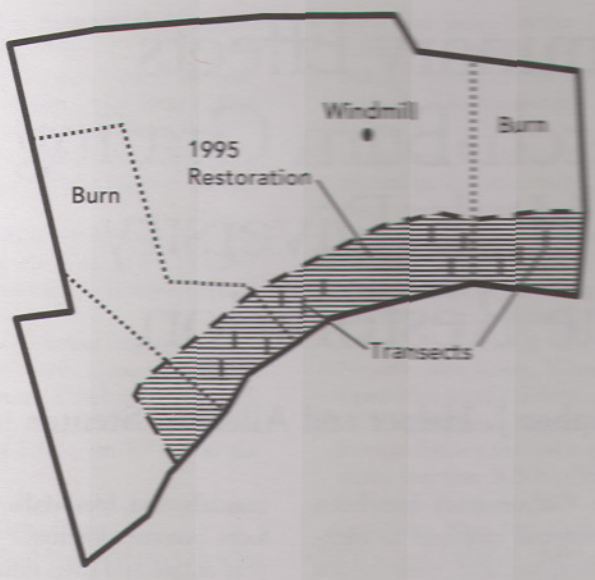


Figure 1. Map of the study area showing approximate locations of transects. Twelve transects were laid out—half in the burned sites and half in the unburned sites.

and compare the effects on forbs in the burned and unburned portions of a prairie. In addition, we wanted to begin to evaluate the usefulness of the patch-burn grazing system for managing small prairies with cattle and fire.

Methods

The study took place in the summer and fall of 2002 in a wet-mesic site along the Central Platte River with follow-up data collection in 2003. The site is located within the Central Mixed-Grass ecoregion but, because of the site's proximity to groundwater, the native vegetation is dominated by tallgrass prairie plants, such as big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), Illinois bundleflower (*Desmanthus illinoisensis*), and Maximillian sunflower (*Helianthus maximillianii*).

The 2002 study site consisted of 185 acres (75 hectares), about a third of which consisted of restored prairies planted in 1995 and 1997. However, we only tracked plant-burning-grazing effects in the 1995 planting. Within the 185-acre site, we conducted two 25-acre (10-ha) prescribed burns in the spring of 2002 (Figure 1). Both burns covered restored and remnant portions of the site. The site was grazed with 15 cow/calf pairs (0.6 Animal Unit Months/acre) between May 10 and October 15. The cattle had unrestricted access to the entire site, including both the burned and unburned portions, for the entire season. We constructed several small exclosures on the site to allow us to look at ungrazed portions of both the burned and unburned treatments.

Within the 1995 restoration planting, we set up monitoring transects in both the burned and unburned areas to track the effects of grazing on nine prairie forbs. Those species were Illinois bundleflower, prairie clover (*Dalea purpurea* and *D. candida*), Canada milkvetch (*Astragalus canadensis*), rigid sunflower (*Helianthus laetiflorus*), Maximillian sunflower, tall boneset (*Eupatorium altoides*), heath aster (*Aster ericoides*), entire-leaved rosinweed (*Silphium integrifolium*), and rigid goldenrod (*Solidago rigida*). Five individuals of each species were marked along twelve 30 m x 4 m transects (six in burned areas and six in unburned; Figure 1). We marked each individual plant with a small piece of red wire around the base of the plant and recorded its location within the transect. We visited the plants about every ten days through the grazing period. If a plant had been grazed, we counted the grazed tips and marked them with red fingernail polish to allow us to determine if the plant had been re-grazed between our visits.

Results

The 2002 growing season turned out to be an unusually dry season that followed on the heels of two dry years. Specifically, we received about 44 percent of the average rainfall in June and 30 percent in July. Between May 26 and August 9, there were only two rainfall events of 0.4 inches (1 cm) or more. This had a severe impact on the vegetation at our site because of both the lack of rainfall and the resultant low groundwater level, which is normally within several feet of the surface. Most of the plants within the site went into dormancy during part of that summer.

The cattle followed our predictions early in the season by grazing mainly in the burned areas, but as the drought progressed, they began to spend more and more time grazing in unburned areas as well. However, even when much of the grass in the burned plots had gone dormant in July, the cattle still spent a high proportion of their time grazing there, to the point of eating the dried grass rather than the greener grass in the nearby unburned plots. Nevertheless, the unburned plots received more grazing than we would have expected in a year of normal precipitation, although it was much less than the burned plots.

The cattle grazed the unburned portions of the restorations more than the remnant prairie. They were likely attracted to the higher proportion of big bluestem and Indiangrass in the restorations. The remnants had strong components of switchgrass (*Panicum virgatum*) and Kentucky bluegrass (*Poa pratensis*), both of which are generally less preferred by cattle. In addition, there was a fairly continuous layer of previous years' standing dead grass in the remnant prairie, compared to a patchier layer in the restoration. Despite the level of grazing, enough ungrazed biomass was left in the unburned portions of the restoration after the end of the season to easily carry a fire next spring.

Of the nine species we tracked during the study, rigid goldenrod and tall boneset received no grazing at all in any of the treatments. Three other species—Maximillian sunflower, rigid sunflower, and rosinweed—were not grazed until very late in the season. Rigid sunflower was first grazed

in mid-August, and Maximillian sunflower in early September. Both species had been affected by the drought and about two-thirds of the plants in each species had gone into early dormancy by late summer. About 90 percent of those that were still green were grazed. Other than one apparently anomalous event, no grazing was seen on rosinweed until early October, and then only a small number were grazed. About 36 percent of rosinweed plants in burned plots were grazed and 12 percent in unburned plots. The results on heath aster were difficult to interpret because unlike all the other species that we monitored, it was difficult to distinguish cattle grazing from that of other grazers and browsers. There was some defoliation on some plants nearly every time we looked, but while some of it was almost certainly from cattle, much of it may have been from other species.

The remaining three species—Illinois bundleflower, the two prairie clovers, and Canada milkvetch—were all grazed earlier and more frequently than the other six species. However, none of the forbs we tracked were grazed during the first ten-day period of the study. After that initial period we began to see some grazing of bundleflower, prairie clover, and milkvetch, primarily in the burned plots.

Illinois bundleflower

Half of the bundleflower plants in the burned plots were grazed during the second period, but none in the unburned plots. The percentage of bundleflower plants grazed in the burned areas stayed fairly constant through the end of June and then began to drop off, presumably as re-growth slowed. During the five sampling periods before plants began to go dormant (late June), more than 20 percent of the plants in the burned plots had yet to be grazed, while others were recorded as being grazed up to four times. Thus, grazing pressure was patchy, even in the heavily used, burned plots. Grazing on bundleflower in the unburned areas increased through mid-July, corresponding roughly with the pattern we saw of cattle using those unburned areas more frequently.

Figure 2. July 16, 2002. The unburned/grazed portion of the restoration. Note the tall stature of both the grasses and forbs, showing the very low rate of grazing taking place. *Photos by Chris Helzer/The Nature Conservancy*

Figure 3. July 16, 2002. The burned/grazed portion of the restoration. Note the short-cropped grass next to the tall, ungrazed forbs.

Prairie clovers

There was no apparent difference in cattle grazing preference between the two species of prairie clover, so we combined them to ensure that we had adequate abundance in our plots. No grazing was seen on prairie clover until our second sampling period, by which time the grass in the burned areas had been cropped closely to the ground. Until a good proportion of the plants began going dormant in July, there were always much higher percentages of prairie clover plants grazed in burned areas compared to unburned. As with bundleflower, grazing on prairie clover plants was patchy during the first five sampling periods, even in burned plots, with some plants receiving repeated grazing and others none at all. Additional data showed that plants in

grazed plots generally had more flowers than those in exclosures, and plants in unburned/grazed plots tended to have more flowers than those in burned/grazed plots (Helzer and Steuter, unpublished data).

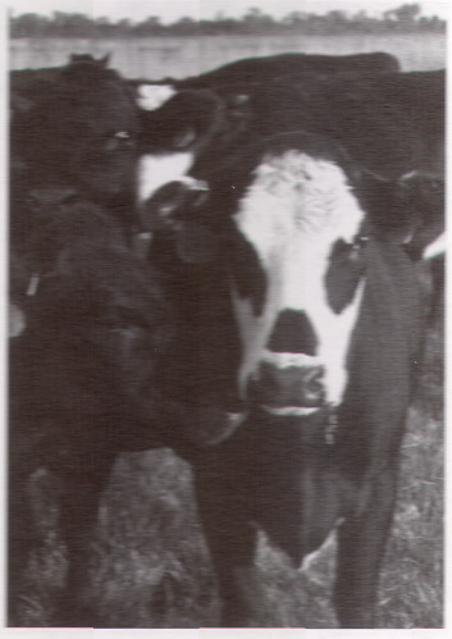
Canada milkvetch

Canada milkvetch plants were grazed less frequently than either prairie clover or bundleflower. However, we were only able to collect data from one of the two burn patches because of a lack of abundance of this species. Therefore, our data is much less robust for Canada milkvetch. Like prairie clover, milkvetch plants were grazed much more often in burned plots than unburned. As with bundleflower and prairie clover, some plants were grazed repeatedly during the first five sampling periods, while others received no grazing at all.

In general, the cattle in our study seemed to greatly prefer grass to forbs of any kind and to prefer grazing burned areas to unburned (Figures 2 and 3). During the first week of grazing none of the forbs we tracked (or any others casually observed) were grazed at all. As the season wore on and grass became less available because regrowth was severely limited by a lack of moisture, grazing on forbs increased, first in burned and then in unburned areas. Some forbs, such as the three legumes (bundleflower, prairie clover, and milkvetch), were grazed fairly frequently throughout the season, particularly in burned plots, but others (the sunflowers and rosinweed) were ungrazed until late in the season. The latter situation raises the question of whether those three plant species were particularly attractive to cattle during the late summer season or whether they were grazed because more preferred forages were not available. Because the plants were less mature and leafy earlier in the season it seems likely that they were grazed later because preferred forages were unavailable at that time.

2003 Data

In order to address the question of whether or not forb grazing was tied to the availability of grass forage, we collected additional data in 2003 on two remnant prairies close to the 2002 study site. Both



prairies were grazed with the patch-burn method and 25 percent of each was burned in the spring of the year. The 195-acre (78-ha) Caveny tract was grazed at a low stocking rate (0.47 AUMs/acre) and the 115-acre (46-ha) Brown tract at a high stocking rate (1.47 AUMs/acre). We tracked purple prairie clover plants in both the burned and unburned portions using the same methods as the 2002 study. In 2003, May and June weather was cool and wet, but in July the drought returned in full force and by late July both pastures were extremely dry. Unfortunately, we were unable to collect data after the end of July, unlike 2002, when we tracked grazing patterns through October.

Grazing was patchy throughout the season in the burned portion of the Caveny tract (light stocking rate) and very light on the unburned portion. By late July, the burned area consisted of patches of full-size big bluestem in bloom intermixed with patches of very short grass. At the Brown tract (heavy stocking rate) the grass in the burned patch was nearly uniformly short early in the growing season and remained short during the entire study period, while the unburned patch was grazed only lightly.

There was a large difference between the two sites in the percentage of grazed purple prairie clover plants (Figure 4). On the Caveny tract, where the stocking rate was low, the cattle grazed very few prairie clover plants in either the burned or unburned portion. However, on the Brown tract where the stocking rate was much higher, there was a high percentage of prairie clover plants grazed within the burned portion of the site. Although this data was preliminary and did not cover an entire season, it seems to support a correlation between grazing on forbs and the availability of grass, or at least a correlation between forb grazing and grazing intensity.

Next Steps

The severe drought during this short study makes it difficult to make generalizations from this data. We will continue to test the patch-burn grazing system on small high-diversity sites. Using improved experimental designs will help us get a better grasp both on how cattle graze in high-

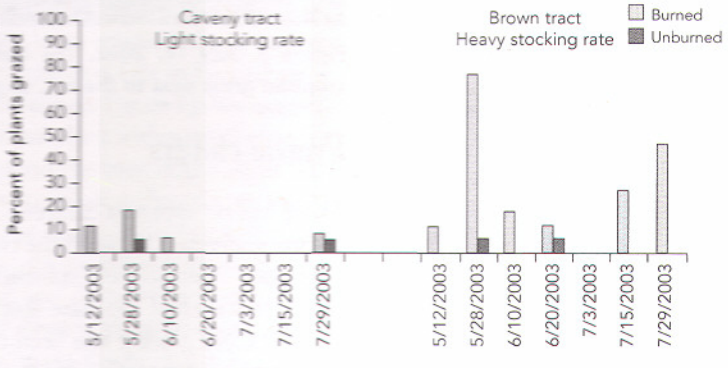


Figure 4. 2003 data collected from two remnant prairies, one grazed with a light stocking rate and one with a heavy stocking rate. The figure shows the percent of purple prairie clover plants grazed per sampling period within each prairie.

diversity grassland and on the long-term responses of the plant community. We will continue to experiment with animal stocking rates to help clarify the relationship between available grass forage and the rate of forb grazing. We also hope to examine grazing behavior on restored sites compared to remnant prairies, and to look at forb selection in other kinds of grazing systems.

Maintaining high plant diversity in restored and remnant prairies will continue to be a tremendous challenge in the foreseeable future. Rather than being categorically bad for prairies, cattle may be one of our most flexible and valuable tools for managing that diversity. This study shows that under some conditions cattle select grasses rather than forbs, and that their selectivity can be managed by adjusting stocking rates. However, there is still much to learn and we need to continue experimentation with grazing on various kinds of sites. Unfortunately, we also need to work to remove the stigma that has been attached to grazing by many prairie conservationists who have seen only the negative effects of overgrazing on plant communities. Not until that stigma is removed can we truly move forward and realize the full potential of cattle grazing for prairie conservation.

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