



Land Management Strategies to Control Kentucky Bluegrass Invasion

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*Early-intensive and patch-burn grazing are being tested as management strategies for the control of Kentucky bluegrass (*Poa pratensis*), an invasive exotic perennial grass. Preliminary results suggest that both early-intensive and patch-burn grazing can increase forage quality and production in Kentucky bluegrass-invaded sites. However, livestock performance under these management strategies should be considered because one may be more sustainable than the other. Treatments will continue for the next several years to make detailed comparisons and conclusions regarding the effects of our various grazing treatments.*

Introduction

Land fragmentation, fire suppression and outdated land management strategies among other land use changes, have allowed and amplified the spread of invasive species (D'Antonio and Vitousek 1992). Once established, invasive species displace natives and alter ecosystem processes such that novel ecosystems with no historical precedent are created (Hobbs et al. 2009). Kentucky bluegrass, an exotic cool-season perennial grass, is one such invader in the Northern Great Plains. Its invasion has reduced diversity and altered plant community structures and functions (Toledo et al. 2014).

Kentucky bluegrass begins growth in early spring before native species, spreads tillers quickly and develops a thick sod that suppresses germination of later-emerging species (Toledo et al. 2014). Although its forage quality is high in the spring during active growth, it goes dormant during the summer, which decreases its forage value (Hockensmith et al. 1997). As Kentucky bluegrass abundance increases, rangeland forage production shifts to an earlier period and forage quality is lost throughout the growing season. Furthermore, plant communities dominated by Kentucky bluegrass experience less annual forage production, compared with historic native communities (Toledo et al. 2014).

Without appropriate management, a Kentucky bluegrass invasion will result in uniform rather than diverse plant communities across the landscape, with impaired forage quality and production (Toledo et al. 2014). Grazing intensity, in particular, can have important impacts on the structure and composition of the plant community by

affecting forage utilization, and therefore, forage production (Bryan et al. 2000). Thus, early-intensive grazing should suppress actively growing Kentucky bluegrass which will reduce competition for later-emerging native species when grazing is absent.

Historically, grassland plant communities of the Great Plains were influenced by disturbances, namely fire, grazing and their interaction (Samson et al. 2004). The variabilities and interaction of fire and grazing, coupled with the inherent climate variability, resulted in a structurally and compositionally diverse plant community (Fuhlendorf and Engle 2004). However, the composition of the Northern Great Plains grassland ecosystem changed dramatically as European colonization replaced bison with domestic cattle and suppressed natural wildfires (Samson and Knopf 1994).



Thatch created by Kentucky bluegrass.

Preliminary research on the effects of prescribed burns on Kentucky bluegrass invasions provide some indication that fire may be an effective management tool. In the Kansas tallgrass prairie, a four-year study with annual burns experienced a reduction in Kentucky bluegrass cover from 30 to 7 percent (Abrams 1988). A short-term study in South Dakota found a similar decrease in Kentucky bluegrass the first year following a prescribed burn. However, Kentucky bluegrass cover returned to pre-treatment levels two years after fire (Bahm et al. 2011). Therefore, additional disturbance is necessary to maintain the benefits of burning in the year following prescribed fire.

Patch-burn management has yet to be studied for its potential to control Kentucky bluegrass, but it does promote structural

and compositional diversity of the plant community (Fuhlendorf and Engle 2001). In the southern tallgrass prairie, a study found that patch-burn management suppressed the invasion of a different exotic species. Furthermore, the use of prescribed fire is associated with an increase in forage quality, while patch-burn grazing has the potential to increase livestock weight gains (Limb et al. 2011).

The objectives of this study are to determine if: (1) early-intensive grazing followed by summer rest can shift the balance of the plant community toward native species, (2) patch-burn grazing will reduce Kentucky bluegrass and promote native species abundance and diversity, and (3) livestock weight gains will differ between management strategies.



Steers grazing a pasture invaded by Kentucky bluegrass.

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Procedures

This study is being conducted at the Central Grasslands Research Extension Center in Stutsman County northwest of Streeter, N.D. Various grazing experiments have occurred on the study site in previous years, but the site received only light summer grazing in 2009 and 2010 prior to the initiation of management strategies associated with this study.

In 2011, three of 12 pastures of roughly 30 to 40 acres each were assigned season-long grazing while another three were assigned early-intensive grazing. In 2014, patch-burn grazing was assigned to three of the 12 pastures with the remaining assigned as idle pastures not to be grazed. Livestock are not rotated among pastures, and each pasture receives the same treatment each year.

Season-long grazed pastures receive moderate stocking rates between 0.96 and 1.85 animal unit months per acre (AUMs/acre) and involve grazing the cattle mid-May through August. Early-intensive grazed pastures receive the same stocking rate

to achieve a similar grazing pressure as season-long grazed pastures. However, early-intensive grazing accomplishes this in a shorter period of time by removing cattle after 1.2 months.

Patch-burn grazed pastures incorporate the same stocking rate and length of grazing as season-long grazed pastures but incorporate a patch-burn treatment. Beginning in 2014, one-fourth of each pasture has been burned in late fall after a heavy frost or early spring after snow melt such that, after four years, each patch-burn-assigned pasture will have been burned in its entirety.

Changes in the plant community are monitored by sampling the relative canopy cover (see Glossary, page 25) of all plant species, litter, bare ground, rock, and fecal pat in 20 0.5- x 0.5-meter frames along 40 meter transects at four locations within each pasture. Annual forage production is determined by clipping standing forage at the peak of production in late July from within three caged grazing exclosures at four locations within each pasture. Clipped samples are harvested, oven-dried and weighed.

Livestock weight gain is monitored by weighing cattle before and after they are placed on their respective grazing treatment pastures. Livestock weight gain data for 2016 has yet to be analyzed and is not included in the results of this report.

These sampling procedures differ from those conducted on the early-intensive and season-long grazed pastures from 2009 to 2013, so results prior to initiation of the patch-burn grazing treatment cannot be compared.

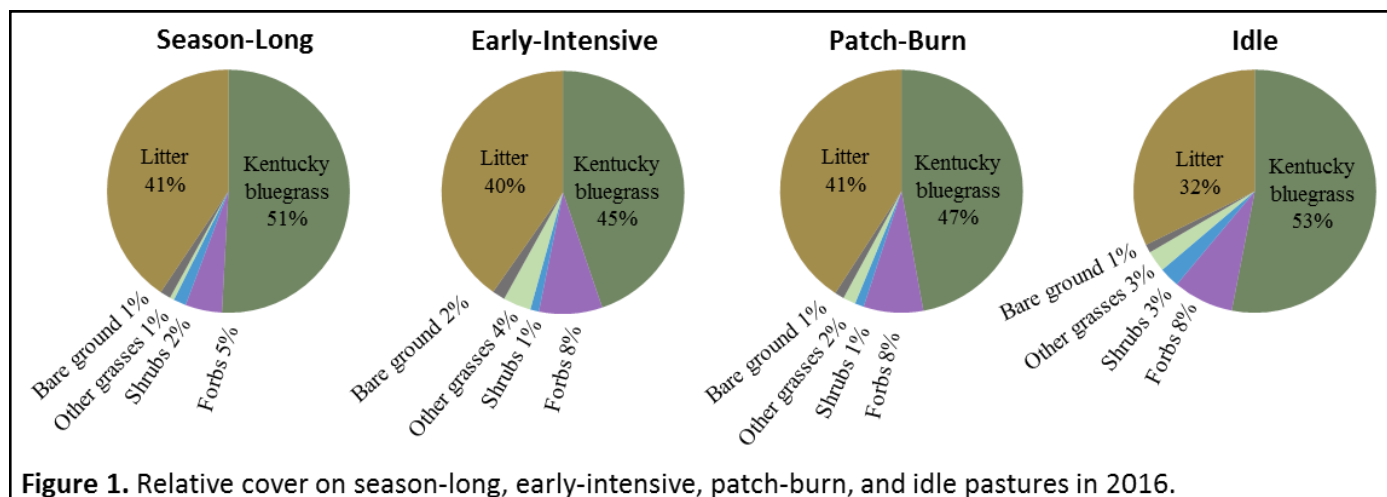


Prescribed fire on one of the patch-burn grazed pastures.

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Results

In 2011, vegetation sampling indicated the dominance of Kentucky bluegrass at our study site; it was present on 90 percent of sampled sites and its relative canopy cover averaged about 30 percent. Patch-burn grazing was initiated in 2014, so vegetation sampling for this project officially



began in 2015. Procedures and data collection varied slightly between 2015 and 2016, which prevents analysis between those study years. Here, we present preliminary results with data collected in 2016.

Relative Canopy Cover. Relative canopy cover in 0.5- x 0.5-m frames was sampled between July 5 and Aug. 3 in 2016. Figure 1 details the average relative canopy cover on season-long, early-intensive, patch-burn and idle pastures for 2016. Richness, evenness, and diversity analyses (see Glossary) for 2016 are detailed in Figure 2. Plant species

richness was the highest for early-intensive ($S=35$, $SE=0.35$) and patch-burn grazed pastures ($S=34.42$, $SE=4.17$) while richness was significantly lower in season-long ($S=25.75$, $SE=2.43$) and idle pastures ($S=31.38$, $SE=4.68$). Diversity and evenness were the highest in early-intensive grazed pastures followed by idle, patch-burn, and then season-long grazed pastures.

Annual Forage Production. Annual forage production sampling occurred during peak-production in mid-August 2016. Table 1 details the average annual production of

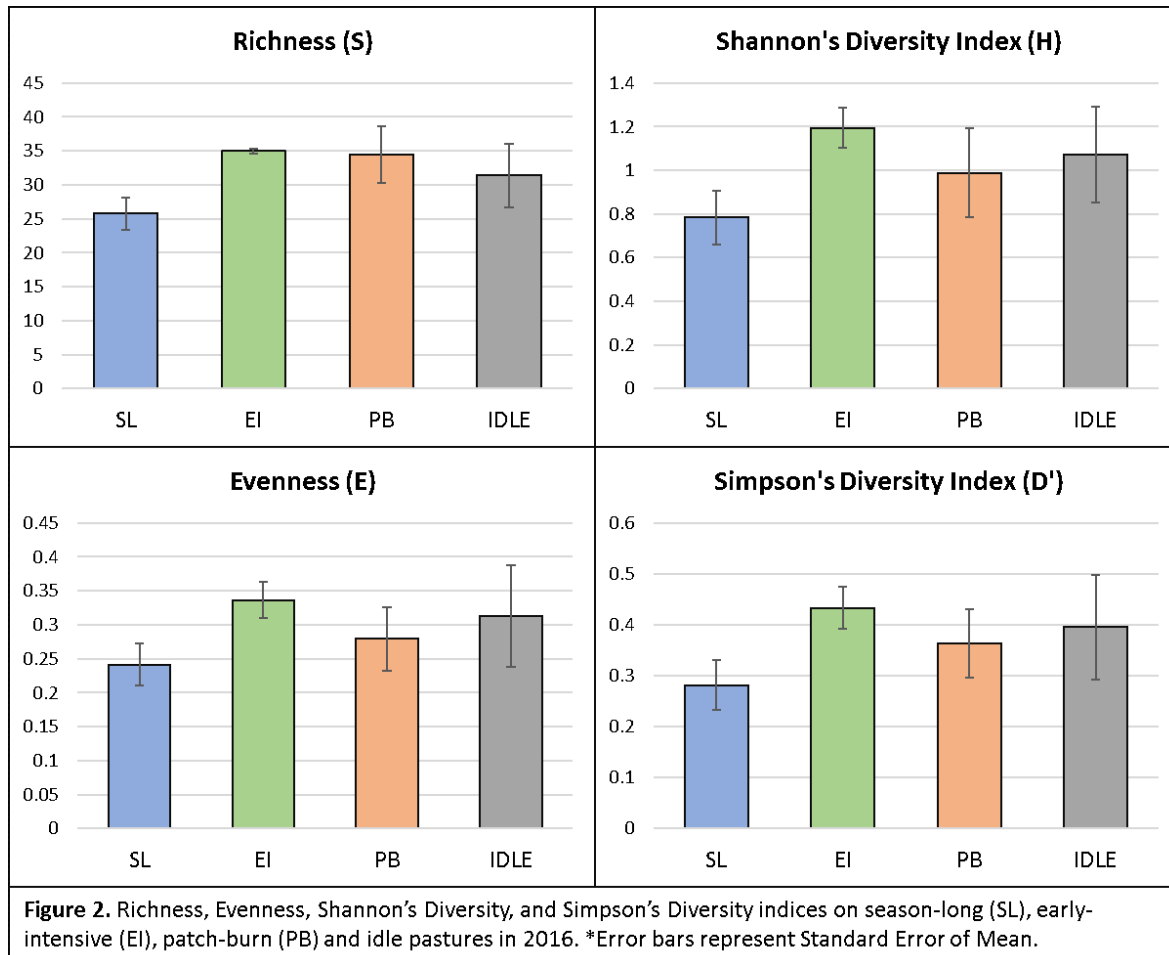


Table 1. Annual biomass production on season-long, early-intensive, patch-burn and idle pastures in 2016 ($P \leq 0.05$).

Average annual biomass production (lbs./acre)			
Season-long	Early- intensive	Patch- burn	Idle
5,875 $\pm$ 571	6,748 $\pm$ 546	5,379 $\pm$ 378	4,625 $\pm$ 175

season-long, early-intensive, patch-burn and idle treatments in 2016 ($P \leq 0.05$). The control produced significantly less annual forage production than all grazing treatments, while early-intensive grazed pastures produced the highest average.

Discussion

Kentucky bluegrass invasion is creating homogeneous plant communities with reduced forage quality and production in the Northern Great Plains (Toledo et al. 2014). Our results are consistent with expectations that any grazing management strategy results in more structural and compositionally diverse plant community than in ungrazed pastures. Because Kentucky bluegrass gains a competitive advantage by emerging earlier than native species, we expect early-intensive grazing to shift the balance toward later-emerging native species.

Preliminary results from 2016 suggest that our early-intensive grazing treatment has increased diversity and production of the plant community. However, livestock performance should be considered because livestock weight gains may suffer. As 2016 data is analyzed and the project continues, we can make conclusions regarding impacts of our grazing treatments on

livestock weight gains and suggest any potential need for nutritional supplements.

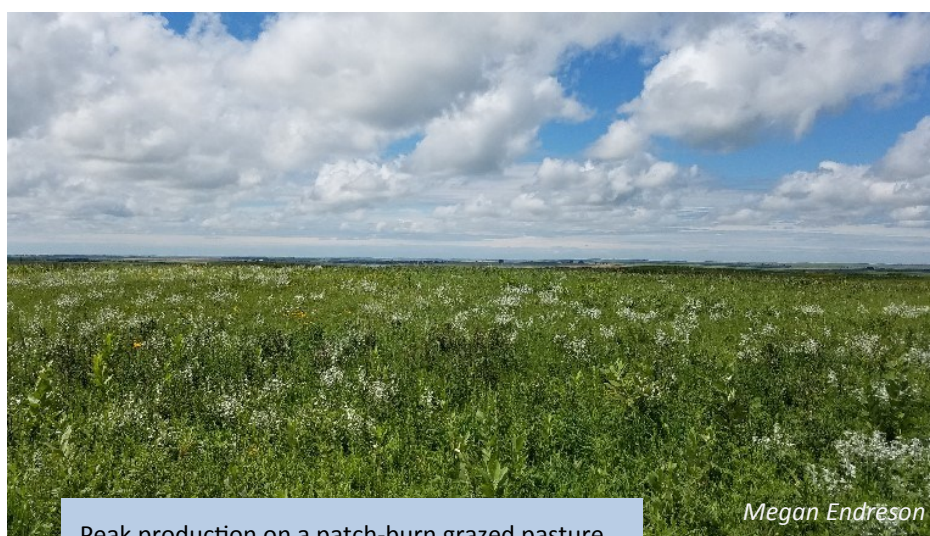
Because patch-burn management is associated with increased structural and compositional diversity of the plant community, we expect diversity and forage production in our patch-burn grazed pastures to increase throughout the course of this project. Furthermore, we expect grazing after burning to

enhance the benefits of patch-burning, which could have an additive effect on forage quality and production.

Cattle weight gains also are expected to increase, as suggested in previous research (Limb et al. 2011). Preliminary results from 2016 on relative canopy cover and production suggest that patch-burn grazing has increased the quality and production of forage but has not surpassed that of early-intensive grazing yet.

At this stage of the project, Kentucky bluegrass remains dominant in each pasture. If our grazing management procedures were ceased, the abundance of Kentucky bluegrass would increase quickly without disturbance. Furthermore, the effects of patch-burn grazing will become clearer as additional patches are burned.

At this time, only two patches within each pasture have burned. Treatments and monitoring will continue during the next several years. 2018 will mark the first full cycle of our patch-burn procedures in patch-burn grazed pastures. At that time, we expect to make detailed comparisons and conclusions regarding the different effects of our various grazing treatments.



Peak production on a patch-burn grazed pasture.

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Glossary

Canopy cover – a vertical projection of the outline of each plant.

The portion of a framed area covered by all individuals of a species is the relative canopy cover of the species.

Richness – the number of species in a sample representative of the ecological community.

Abundance – the number of individuals of a species in a sample that represents its relative representation in the ecological community.

Evenness – a measure of the relative abundance of all species in the sample.

Diversity – a measure used to describe the composition of the ecological community that takes into account the number of species (richness) and the relative abundance of each (evenness). Diversity is often calculated in two ways:



Shannon's diversity index – a measure of diversity calculated from a mathematical formula that includes richness and evenness and considers all species in the sample. Higher values indicate a more diversity with higher richness and evenness, whereas lower values indicate a less diverse ecological community. Index values are rarely greater than 4.

Simpson's diversity index – the probability that two randomly sampled individuals are of the same species. The index is a measure of diversity also calculated from a mathematical formula that includes richness and abundance, but is weighted more towards the most abundant or dominant species. Index values range from 0 to 1 with higher values indicating less diversity (in the sense of evenness) as a single or few species have increased abundance. A value of 0, on the other hand, would indicate infinite diversity.