Cumulative Growth of Forage Production in a Patch-burn Grazing System

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Summary

Rotational grazing intervals of two, four and six weeks are evaluated in a patch-burn grazing system to understand the impact on cumulative forage production.

Introduction

Patch-burn grazing is the application of prescribed fire to focus livestock grazing on a portion of a grazing unit. The objective is to increase the diversity and structure of vegetation in a way that benefits wildlife and maintains livestock production. By burning on a portion of the acreage on an annual basis, a mosaic of heterogeneity can be created for grassland-dependent wildlife while also maintaining production and economic benefits for livestock producers.

The concept of grazing strategies dates back to the turn of the 20th century. Combined pressures of agricultural and livestock production, urbanization, deforestation and extreme weather events such as droughts generated an institutional and scientific response to severe rangeland degradation. The movement of livestock between two or more subunits of rangeland such that alternating periods of grazing and no grazing occur within a single growing season is defined as rotational grazing (Heitschmidt and Taylor, 1991).

Rotational grazing became established as the norm, and various direct and indirect benefits resulted when coupled with the ability of managers to observe and adapt (Briske et al., 2011). Prior to the 20th century, much of the Great Plains evolved with disturbances such as fire and grazing. While rotational grazing has continued to be modified and widely adapted, burning largely has been suppressed.

Research quantifying the impacts of using fire to benefit herbivores dates back to the 1960s. Scientists applied fire treatments to understand how fire influenced grazing behavior, animal growth and the plant community. Improvement to forage palatability and nutritive value, the abundance of herbaceous plants and weight gains of cattle were documented (Duvall and Whitaker, 1964; Hilmon and Hughes, 1965; Angell et al., 1986).

Despite a reduction in plant biomass when compared with unburned patches, post-fire forage growth was attractive to grazers because the plant material was higher in protein content and lower in fiber (Fuhlendorf et al., 2017; Sensenig et al., 2010). Current research has documented that fire and grazing could increase the productivity of important native forage species such as little bluestem (*Schizachrium scoparium*) and western wheatgrass (*Pascopyrum smithii*) (Vermeire et al., 2004; Limb et al., 2011).

Since the time of its institution, the merits of rotational grazing have been highly debated by researchers and livestock producers. The term born during a period of widespread range degradation was applied to many management concepts such as rest-rotation, deferred rotation and season-long grazing (Society for Range Management, 1998).

The persistence of the rotational grazing debate is due in part to terminological confusion. A review of literature would suggest that contrasting interpretations exist regarding the efficacy of rotational grazing (Briske et al., 2011). However, rotational grazing continues to be valued by producers (Budd and Thorpe, 2009).

Many popular news outlets, trade magazines and conservation agencies promote the application of rotational grazing for production, conservation and ecological benefits (Goodloe, 1969; Norton, 1998; Teague et al., 2004, 2008). A closer look at experimental evidence suggests that regional and local conditions have much to do with results achieved. Factors such as stocking rates, seasonal distribution of rainfall, soil type, topography and time between deferment periods may influence the outcome greatly (Sampson, 1951; Vermeire et al., 2008).

The detrimental or beneficial effects of grazing systems are largely determined by how, where and when grazing is used. Livestock play a major role in regulating forage production through the defoliation of plants (Huntly, 1991).

Defoliation can promote shoot growth; however, overgrazing can reduce plant production significantly

(Hyder, 1972; Rogler, 1951). In this study, rotational grazing intervals are evaluated in a patch-burn grazing system to understand the impact on cumulative forage production.

Procedures

A randomized block design was initiated in 2019 with three grazing treatments each replicated four times to monitor cumulative growth of forage production in a patch-burn grazing system at the Central Grasslands Research Extension Center. Rotational grazing intervals of two, four and six weeks (with an equivalent rest period) were assigned to treatments.

Caged grazing exclosures, measuring 8 by 16 feet, were located in a 20- or 40-acre patch burn that had been completed in the spring prior to grazing turnout. A control was established to represent non-grazed, season-long forage production.

Soil type and vegetation communities were similar among replicates, as defined by the Natural Resources Conservation Service's ecological site descriptions and equivalent land use histories. The loamy sites frequently consisted of Kentucky bluegrass (*Poa pratensis*), smooth brome (*Bromus inermis*), western wheatgrass (*Pascopyrum smithii*), blue grama (*Bouteloua gracilis*), goldenrod (*Solidago* spp.), Flodman's thistle (*Cirsium flodmanii*) and more.

Cow-calf pairs grazed at a moderate stocking rate designed to achieve 30% utilization from May 22 to Oct. 23 and May 19 to Oct. 22 during 2019 and 2020, respectively. The degree of disappearance within the patch-burn area where the grazing exclosures were located, however, was 72% for graminoids and 11% for forbs during 2019, while the degree of disappearance during 2020 was 80% for graminoids and 69% for forbs.

Cumulative Growth of Forage Production

Herbage production was collected following each grazing interval from areas that were predetermined and marked with global positioning system (GPS) technology. Three 0.25-meter $(m)^2$ frames were used to estimate forage production per treatment in the grazing exclosure and its paired plot (grazed). Clippings were separated by graminoids and forbs, oven-dried at 122 F for 48 hours and weighed.

Upon collection of samples, the grazing exclosure was removed and installed at the nearby paired (grazed) plot, which then was allowed to recover from grazing (two, four or six weeks). The data collected at the end of each grazing interval represented forage production from in and out of the grazing exclosure, the difference of which is assumed consumed by livestock.

Consumption, regrowth and the final forage clipping, which was exposed to grazing for its assigned grazing period (two, four or six weeks), were compiled to determine cumulative forage production. The control was sampled every four weeks throughout the growing season.

Results and Discussion

The livestock at the Central Grasslands Research Extension Center express a preference for burned patches versus unburned patches, despite the burned patches having a lower amount of available forage at the beginning of the growing season. As the growing season progresses, cattle tend to use the recently burned areas less (Wanchuk and McGranahan, 2019).

A study conducted at the center during 2017-2018 indicated that livestock are attracted to burned patches because of increased forage quality (Lakey and McGranahan, 2018). The differences in forage quality between the burned and unburned patches are likely more noticeable during the beginning of the growing season.

Year One

Cumulative growth of forage production at the two- and four-week grazing intervals was statistically different (P = 0.0474) from the control during the 2019 growing season (Figure 1). Means followed by the same letter within Figure 1 are not different at P > 0.05.

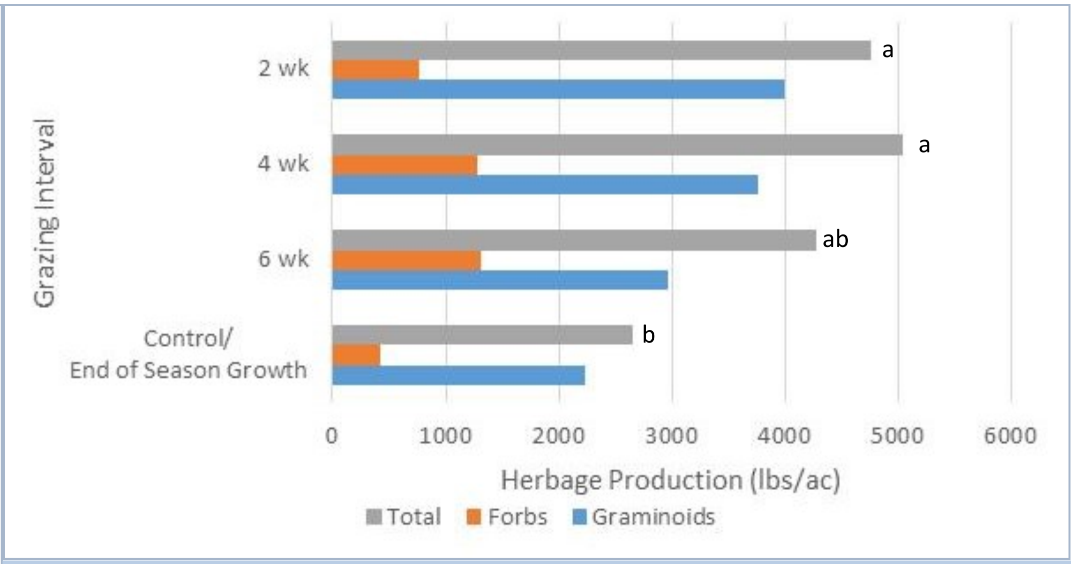

Figure 1. Cumulative growth of forage production in a patch-burn grazing system at the Central Grasslands Research Extension Center during 2019.

Year Two

Cumulative growth of forage production was not statistically different (P = 0.3474) for the grazing treatments during 2020 (Figure 2).

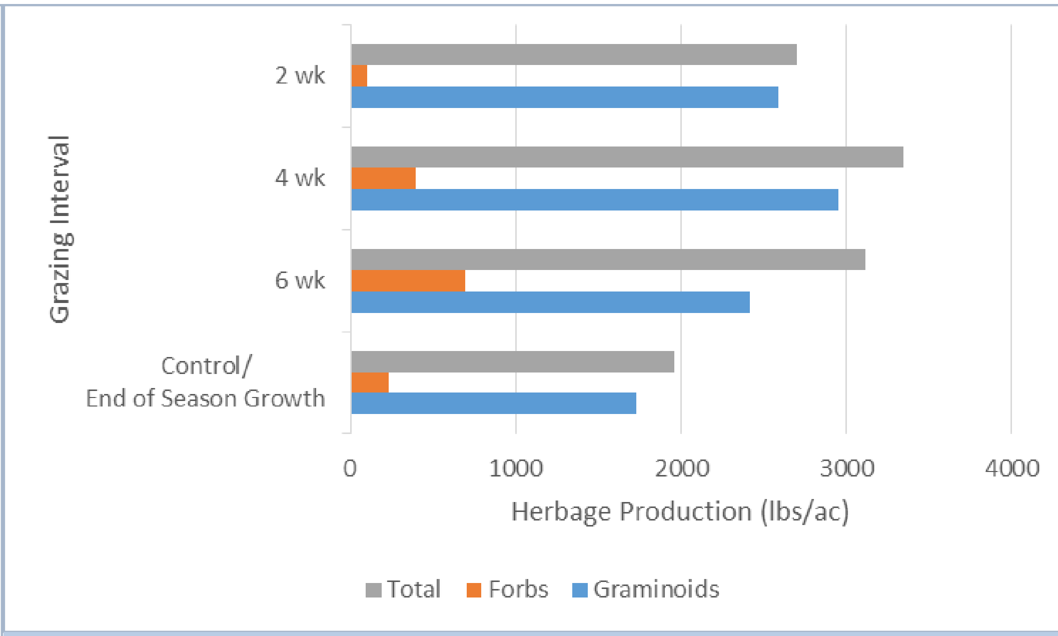

Figure 2. Cumulative growth of forage production in a patch-burn grazing system at the Central Grasslands Research Extension Center during 2020.

Disturbance-driven heterogeneity is important to maintain rangelands in the northern Great Plains that evolved with disturbances such as fire and grazing (Bowman et al., 2009; Kay, 1998). The response of herbage production to these disturbances may be decreased growth, equal growth or increased growth of graminoids and forbs.

While statistical differences occurred between grazing treatments during the 2019 growing season, the same level of significance was not maintained during the following season. What is important to note is that the growing season conditions during 2019 and 2020 were different (Table 1).

Rainfall during 2019 exceeded the 30-year average for each month during the growing season by a range of .06 to 2.40 inches. In direct contrast, the only month during 2020 where rainfall exceeded normal was August. Departures from normal during the 2020 growing season ranged from minus 0.64 to minus 2.06 inches of rainfall.

Table 1. Average monthly rainfall levels and seasonal totals (inches) by month and year at Central Grasslands Research Extension Center during 2019 and 2020 growing season.

	Monthly Rainfall (inches)[1]		
Month	**2019**	**2020**	**30-year average**
May	2.99	1.81	2.45
June	3.47	1.35	3.41
July	4.15	2.13	3.20
August	2.52	2.73	2.31
September	4.44	.31	2.04
October	2.59	.22	1.36
Seasonal total	**20.16**	**8.55**	**14.77**

[1]Data obtained from the North Dakota Agricultural Weather Network, 2020

The differences in growing season conditions are apparent when evaluating forage production. The highest amount of cumulative forage production in a patch-burn grazing system at Central Grasslands during 2019 and 2020 was 5,052 and 3,349 pounds/acre, respectively. Although significant difference was not detected between grazing treatments during 2020, responses to grazing intervals appear to be a driver for plant response and cumulative growth.

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