Spatial Heterogeneity in Forage Quality, Quantity and Vegetation Structure Determines Where Cattle Graze in Patch-burned Rangeland

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Heterogeneity in forage and vegetation structure can enhance rangeland quality for livestock and wildlife. We seek to increase heterogeneity by applying a rotational patch burn-grazing treatment to pastures with seasonlong grazing. Low vegetation structure and high forage quality in recently burned patches should attract livestock and maintain structural contrast during the season. We present preliminary data from our first year of treatment comparing forage and vegetation structure across recently burned and unburned patches.

Introduction

Disturbance-driven heterogeneity is important to maintain rangelands that evolved with disturbances such as fire and grazing (Bowman et al., 2009; Kay, 1998). Historically, rangeland management in the Great Plains has minimized disturbance or made it spatially even.

By combining seasonlong grazing with a yearly rotation of spatially discrete fires, patch-burn grazing creates contrast in forage quality, forage quantity and vegetation structure between recently burned and unburned patches within a pasture (Fuhlendorf et al., 2017).

Grazers are often more attracted to recently burned patches than to unburned patches (Archibald et al., 2005; Fuhlendorf and Engle, 2004). This "magnet effect" comes from greater protein content and lower fiber in recently burned patches, creating higher forage quality despite lower plant biomass, compared with unburned patches (Fuhlendorf et al., 2017; Sensenig et al., 2010).

Preference for the burned patch allows other patches to accumulate biomass and increase vegetation height and density, creating contrasting patches throughout the pasture (Powell et al., 2018). The contrasting vegetation structure created by patch burning enhances habitat diversity for grassland-dependent wildlife (Hovick et al., 2012).

Objectives

Our objectives are to determine the effectiveness of patch burn-grazing in northern mixed grass prairie and to monitor forage quality, forage biomass, grazer occupancy and vegetation structure during a four-year patch burn rotation, which began in spring 2017. We predict that grazer occupancy will be higher in the recently burned patches, even though they might have lower available forage; forage in recently burned patches will have higher protein and lower fiber content; recently burned patches will have lower vegetation structure than unburned patches; but contrast in vegetation structure and forage quality will decrease with time.

Procedures

We sampled eight burned pastures at the CGREC (see Figure 1). Four pastures received an entire 40-acre patch burn in the spring, while in the other four pastures, the 40 acres were split in half, with one half burned in the spring and the other half in the summer.

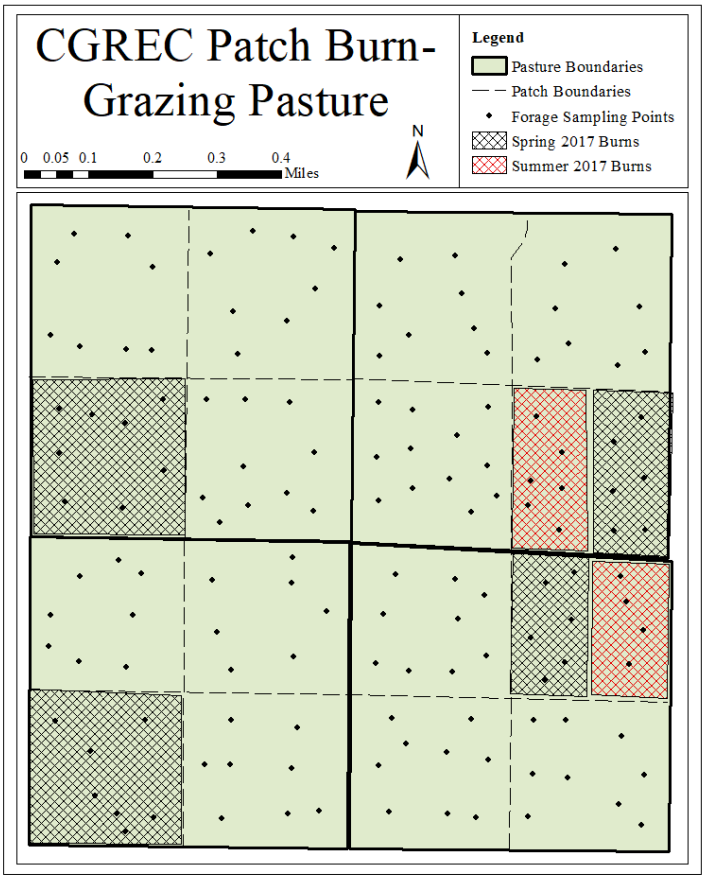

Figure 1. Map depicting one pasture in the patch-burn grazing study at CGREC in 2017.

Cow-calf pairs grazed at a stocking rate to achieve an average 50 percent degree of disappearance from mid-May to mid-October and a carrying capacity of 0.85 to 0.94 animal unit months (AUMs)/acre (variability was due to difference in ecological site composition).

Forage Quantity and Quality

We measured forage production as total above-ground plant biomass clipped from 25-centimeter (cm) by 25-cm quadrats at predetermined points along transects in each patch per pasture once per month into the grazing season. At each forage sampling point, we counted fecal pats within 5 meters (m) of the point to determine grazer usage of each patch.

All forage samples were dried for 48 hours in a 150° C drying oven, weighed and ground in a Wiley mill through a 1-millimeter (mm) screen. We used near infrared spectroscopy (NIR) to determine crude protein and fiber content based on calibrations for hay-alfalfa because we still are developing rangeland-specific calibrations for NIR. Here we use crude protein as our measure of forage quality.

Vegetation Structure

Laid out to quantify grassland bird habitat, transects for vegetation structure were placed 15 m off either side of existing bird transects in each pasture. Measurements were taken every 15 m, for 20 observations per transect.

At each point, percentages of plant functional and structural groups were estimated visually with a canopy cover index. Groups included Kentucky bluegrass, smooth brome, native and introduced cool-season grasses, native and introduced warm-season grasses, native and introduced legumes, native and introduced forbs, native and introduced woody plants, bare ground and standing dead. We also measured visual obstruction using a graduated Robel pole (Robel, 1970) at each measurement point to estimate vegetation density.

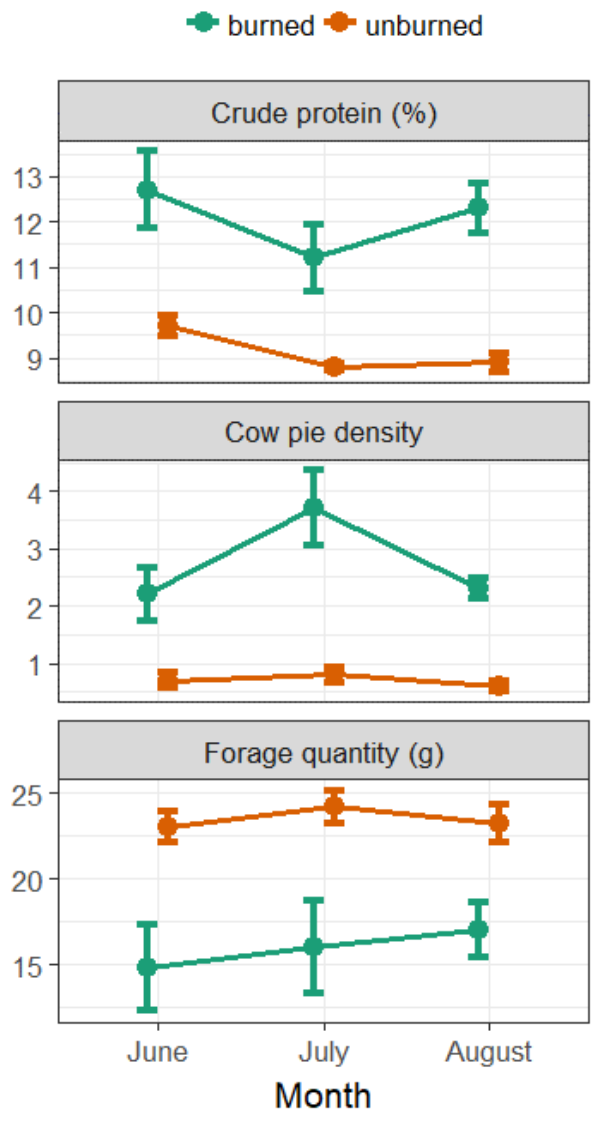

Figure 2. Graphs comparing average quality (% crude protein per sample), grazer preference (fecal pats per 100 m^2 circle around each sample point) and quantity (grams per sample) for burned vs. unburned patches.

Results

Forage biomass was predictably lower in recently burned patches than in unburned patches. As the growing season progressed, biomass in the burned patches steadily increased, while biomass in the unburned patches was relatively stable (Figure 2). Crude protein percentages were much higher in recently burned patches and also were higher in low-biomass samples (Figure 3).

Average counts of fecal pats were comparatively high in burned patches and very low in unburned patches, indicating higher livestock usage of recent burns (Figure 2). This attraction was less pronounced in August, toward the end of the growing season, likely because forage quantity was decreasing.

We also found a difference in vegetation structure, with burned patches having lower structure (shorter plants) and unburned patches having slightly higher structure (taller plants).

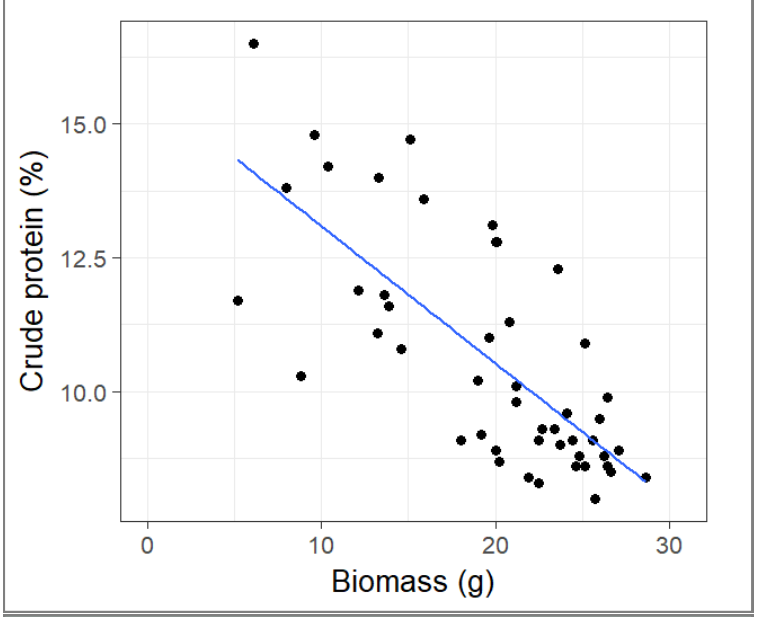

Figure 3. Graph depicting the inverse relationship between biomass and crude protein content over the grazing season.

Discussion

In preliminary analysis of livestock usage data, livestock show a preference for recently burned patches vs. unburned patches, despite those patches having lower available forage. This is likely due to the increased forage quality in the burned patches.

We expect to continue seeing this preference exhibited as we analyze other forage quality parameters such as fiber and lignin content because this attraction has been documented in similar studies (Powell et al., 2018; Sensenig et al., 2010). While producers might be concerned that this attraction will diminish as the time since fire increases, our data indicate that is not the case. Cattle remain attracted to recently burned patches and continue to avoid unburned patches (Figure 2).

As our study progresses and we rotate burns through the remaining patches, we expect to see continued grazer attraction to the most recently burned patch in each pasture, and greater landscape-level contrast in forage quality, forage quantity and structure driven by this gradient in time-since-fire.

We expect this gradient will create a patchy mosaic of available forage and habitat that will change as the burn patches shift. Although patches are intensively grazed for a season, the subsequent seasons of rest ensure the long-term sustainability of the forage base.

Photos by Micayla Lakey, NDSU

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