Examining the Impact of Patch Burning on Livestock Grazing Patterns in Edwards Plateau, Texas

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The XXIV International Grassland Congress / XI International Rangeland Congress (Sustainable Use of Grassland and Rangeland Resources for Improved Livelihoods) takes place virtually from October 25 through October 29, 2021.

Proceedings edited by the National Organizing Committee of 2021 IGC/IRC Congress

Published by the Kenya Agricultural and Livestock Research Organization

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Key words: Grazing Pattern; Prescribed Burn; GPS Collar

Abstract

Production of sheep, goat, and cattle are major agricultural enterprises on West Texas rangelands, especially in the Edwards Plateau. In this region, the use of fire as a management tool was suppressed until recently. Although previous studies have been conducted to evaluate cattle use of burned versus unburned patches, there has been a lack of studies where combinations of livestock species grazing together on patch burned areas have been evaluated. The objective of this study is to examine grazing patterns of cattle, sheep and goats, both spatially and temporally, on areas where patch burning has been implemented. The study site is the Texas A&M AgriLife Research Ranch, Martin Ranch, located in Mesquite-Oak-Savanna ecosystem in Menard County of Texas, USA. In February 2019 and September 2020, patch burns were implemented on the ranch and represented about 29% of the total ranch area (480 out of 1655 ha). After the burns, animals from the resident herd were randomly selected and GPS collars were placed on 34 goats, 33 sheep, and 8 cows to reflect the proportion of animals in the resident herd. The GPS collars were set to collect movement data every 10 minutes during a fourteen-month period. Gates and fences for the entire ranch were opened and livestock were free to choose areas to graze. Data from the GPS's were evaluated to determine locations where the animals grazed and their preferences for different areas of the landscape. Initial observations indicate that cattle and sheep were more attracted by recent burned patches compared to goats. Livestock forage use patterns and time spent by species in the burned and unburned areas and among different vegetation land cover classes are presented. Information from this study will assist in providing information to producers on how implementation of patch burning would influence their management of these grazing lands.

Introduction

Fire is a natural disturbance that can influence ecosystem function. The intensity, frequency, size of fires over a long period of time has been described as the fire regime (Juryeliu 2004). Prior to European settlement, it is well documented that both wildfire, and fires started by humans, played key roles in shaping plant community and landscapes (Taylor 2003). Perennial grasses were the dominant species in the arid and semi-arid rangelands (Cory 1949). However, due to complex interactions of overgrazing, fire suppression, and climate change, grasslands have been converted to shrub land due to woody plant encroachment during the last 100 years (Archer 1989; Archer et al. 1988).

Prescribed fire is a planned fire; it also called "controlled burn" or "prescribed burn" (Service 2020). It is used to meet specific management objectives, such as woody plant encroachment. A prescription is a set of conditions that considers the safety of not only the public and fire crew staff, but also air temperature, humidity, wind direction, and probability of meeting the burn objective. Prescribed fire can be a useful tool on grassland and savanna landscapes as it can alter grazing by livestock and browsing wildlife because the animals prefer to select the recently burned areas to graze. This alters the spatial and temporal interactions between fire and grazing and has been defined as pyric herbivory (Fuhlendorf et al. 2009). The fire reduces forage availability for pyric herbivory in the short-term, but in the long term, fire increases grass production (Taylor 2003) and generally increases forage quality. The concepts of pyric herbivory have been introduced as an approach to increase functional diversity and provide opportunities to influence grazing regimes using fire to aid in distribution of grazing across the landscape instead of using fencing.

Production of sheep, goat, and cattle are major agricultural enterprises on rangelands, especially in the Edwards Plateau (USDA 2012). Previous studies (Fuhlendorf et al. 2009; Russell et al. 2012; Vermeire et al. 2004) have been conducted to evaluate cattle use of burned versus unburned patches and results from these studies indicated that livestock spend 75% of their time on recent burning patches (Fuhlendorf and Engle 2004). However, there has been a general lack of studies on the spatial and temporal interactions between

multiple kinds of livestock grazing together on the landscape. The objective of this study is to examine grazing patterns of cattle, sheep and goat, both spatially and temporally, on areas where patch burning has been implemented.

Methods and Study Site

The study site is the Texas A&M AgriLife Research Ranch, Martin Ranch (30.807518, -99.838896, Figure 1), located in Menard County, Texas which is characterized as Mesquite-Oak-Savanna ecosystem (TPWD 2021). The dominant soil series found at the Martin Ranch is the Tarrant soil series (70.6%). The Tarrant series consists of shallow cobbly clay soils over limestone bedrock. Other less dominant soils are Valera silty clay (15.9%), and Kavett silty clay (5.2%). Dominant herbaceous plants include Texas wintergrass (*Nassella leucotricha*), sideoats grama (*Bouteloua curtipendula*), and common curly mesquite (*Hilaria belangeri*). Dominant woody plants include live oak (*Quercus fusiformis*), honey mesquite (*Prosopis glandulosa*), and ashe juniper (*Juniperus ashei*) (McGinty et al. 1983).

The area of the Martin Ranch used for this part of study is approximately 1560 hectares. The elevation gradient ranges from 630 meters to 678 meters, and the slope ranges from 0 to 9%. The climate at the study area is characterized by hot summers and generally mild winter conditions. The average temperature of Menard Country for the year is 17.2°C (Information 2020).

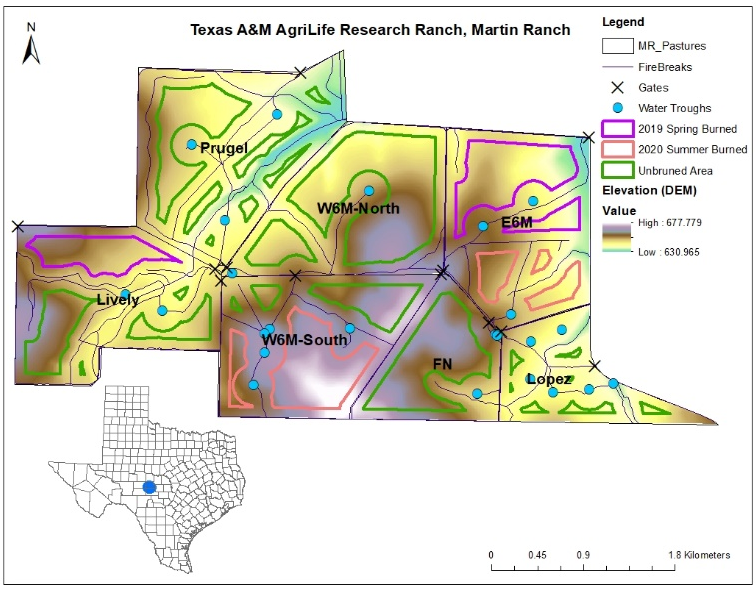

Figure 1. Texas A&M AgriLife Research Ranch, Martin Ranch.

The resident herd of livestock at the Martin Ranch includes 325 head of goat, 290 head of sheep, and 50 head of cattle. Prior to implementation of patch burning, the cow-calf, ewe-lamb, and doe-kid operations were separately managed under rotational grazing management at the ranch.

Patch burns were implemented on the study site in each of two years, February of 2019 and September of 2020 (Figure 1). Each burn represented about one-seventh of the total area of the ranch (240 ha). After each patch burning event, animals from the resident herd were gathered, by species, and held in holding pens. Researchers randomly selected 34 goats, 33 sheep, and 8 cows to fit with pre-made GPS collars (Knight et al. 2018). The GPS collars were set to collect movement data every 10 minutes and batteries were charged every five months. Gates and fences within the interior of the ranch were opened and livestock were free to choose areas to graze.

To reduce influence of other attractants for livestock use and movement, stratifications have been used to define core areas for assessing livestock use of the landscape. Soil information, water troughs, roads, and fence gate location data have been input as layers within a GIS. Buffers zones (200 m) were defined for all interior gates and water throughs, and 100 meters buffer lines defined for firebreaks/roads (Figure 1). Areas of the pastures not falling into these buffer areas were defined as core areas for livestock use.

At the end of each 5 month period, GPS collars were removed from the animals, and data downloaded. Within 7 days, the collars were again placed on livestock. Animals were randomly selected from the respective herds, collars placed on the animals, and then they were released. GPS data were processed and screened to

remove spurious points. The data were then evaluated to determine locations where the animals grazed and their landscape preferences. Livestock location data were clipped to those falling into the core areas (Figure 1), then intersected with land cover raster data which was developed using supervised classification of UAV multispectral images with 0.32 meters resolution. The multispectral images were classified into four vegetation types: bare ground (BG), grass (GR), small woody (SW, canopy cover less than 5 m^2), and large woody (LW, canopy cover greater than 5 m^2).

Results

The first burns were implemented in late February 2019, the second burns were implemented in September 2020 (Figure 1). The first post-burn GPS collar location data period was from June 2019 to September 2020, except for March to June 2020 due to pandemic travel restrictions. The second post-burn period was from October to November of 2020.

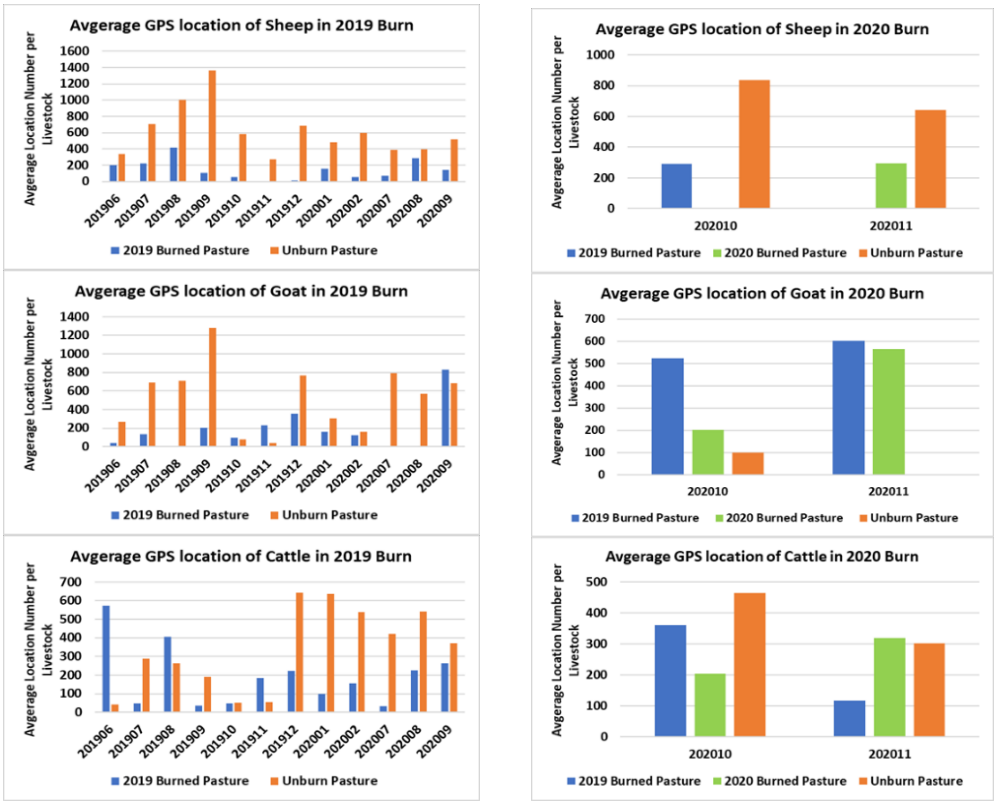

Figure 2. Livestock forage use pattern by burned vs. unburn pasture in 2019 (left) and 2020 (right) burns.

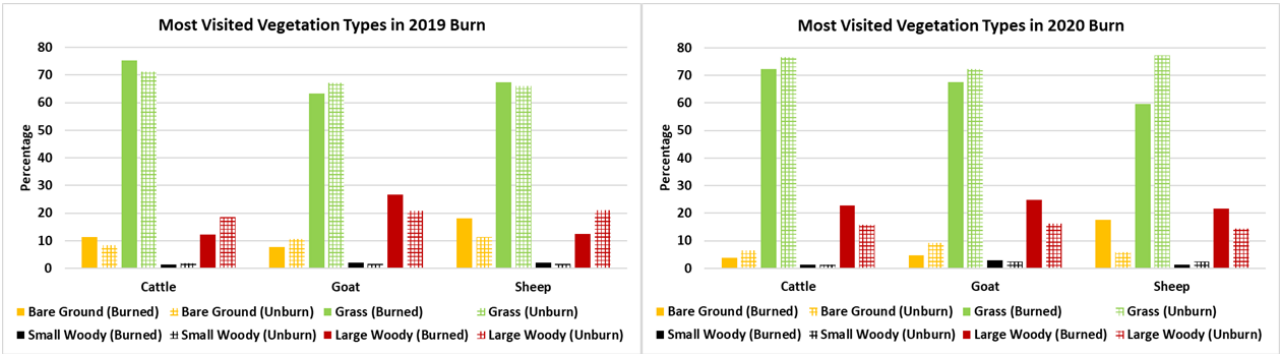

Figure 3. Percentage of Total GPS location distributed in four vegetation types on burned and unburned pastures in 2019 (left) and 2020 (right).

The average number of livestock GPS location shows cattle and sheep were more attracted to the most recent burned pastures compared to goats in both the 2019 and 2020 burn events (Figure 2). Cattle and sheep increased their visits on the 2020 burned pasture immediately after the burn. Then they reduced their use of the burned pasture and switched to unburned pasture as time since the burn was implemented increased. In 2020, goats grazed the recently burned pasture, however, for the 2019 burns, they chose unburned areas to

graze more frequently. During the peak biomass in August and September, all three kinds of livestock increased their visits to burned pastures.

For the four vegetation types on ranch, the grass (GR) type was the most visited type for all three species of livestock during whole day (66%-76% of forage use per day). Sheep and cattle increased visiting large woody from 3PM to midnight potentially because of resting, bedding, or seeking shade to avoid heat. Goats had greater use percentage of large woody vegetation types than sheep and cattle, but did not show significant differences by hours per day. Results from Resource Selection Function indicated vegetation types of grass (GR), large woody (LW), small woody (SW) and season significantly impact the livestock forage use pattern (Figure 3).

Discussion

This study provides an opportunity to evaluate how the different livestock species use the landscape after patch burning. Vermeire et al (2004) indicated cattle were strongly attracted to the burned patches and consumed grass standing crop. Results from our GPS collar data shows not only cattle but also sheep were attracted to the burned pastures, goats increased using burned pasture during the peak biomass season. Mosaic patch burning can be implemented as a rangeland grazing management tool to influence grazing patterns. This study will assist in providing information to producers on how implementation of patch burning would influence their management of these grazing lands. Future work will focus on interpolation of livestock distribution with larger temporal scale by species and seasons, in addition to paired comparisons of GPS locations with camera trap observations.

Acknowledgements

We appreciate the field and technical support from Grazingland Animal Nutrition Lab, Texas A&M AgriLife, Temple, TX, and Texas A&M AgriLife San Angelo Research and Extension Center.

References

Archer, S. 1989. Have southern Texas savannas been converted to woodlands in recent history? *The American Naturalist* 134:545-561.

Archer, S., C. Scifres, C. Bassham, and R. Maggio. 1988. Autogenic succession in a subtropical savanna: conversion of grassland to thorn woodland. *Ecological monographs* 58:111-127.

Cory, V. 1949. On some grasses, chiefly of the Edwards Plateau of Texas. *Field Laboratory* 17:41-52.

Fuhlendorf, S., and D. Engle. 2004. Application of The Fire–Grazing Interaction to Restore a Shifting Mosaic on Tallgrass Prairie. *Journal of Applied Ecology* 41:604-614.

Fuhlendorf, S. D., D. M. Engle, J. Kerby, and R. Hamilton. 2009. Pyric Herbivory: Rewilding Landscapes Through the Recoupling of Fire and Grazing. *Conserv Biol* 23:588-598.

Information, N. C. f. E. 2020. NOAA Land-Based Station Data. NOAA National Centers for Environmental Information: U.S. Department of Commerce, National Oceanic & Atmospheric Administration, National Environmental Satellite, Data, and Information Service.

Juryeliu, M. 2004. Health and Protection | Forest Fires (Prediction, Prevention, Preparedness and Suppression). *In:* J. Burley (ed.). Encycolpedia of Forest Sciences. p. 334-339.

Knight, C., D. Bailey, and D. Faulkner. 2018. Low-Cost Global Positioning System Tracking Collars for Use on Cattle. *Rangeland Ecology & Management* 71:506-508.

McGinty, A., F. E. Smeins, and L. B. Merrill. 1983. Influence of Spring Burning on Cattle Diets and Performance on the Edwards Plateau Rangeland. *Rangeland Ecology & Management* 36:175-178.

Russell, M. L., D. W. Bailey, M. G. Thomas, and B. K. Witmore. 2012. Grazing Distribution and Diet Quality of Angus, Brangus, and Brahman Cows in the Chihuahuan Desert. *Rangeland Ecology & Management* 65:371-381.

Service, N. P. 2020. *Wildland Fire: What is a Prescribed Fire?* Available at: https://www.nps.gov/articles/what-is-a-prescribed-fire.htm2020.

Taylor, C. 2003. Rangeland monitoring and fire: wildfires and prescribed burning, nutrient cycling, and plant succession. *Arid Land Research Management* 17:429-438.

TPWD. 2021. *Edwards Plateau Limestone Savanna and Woodland*. Available at: https://tpwd.texas.gov/landwater/land/programs/landscape-ecology/ems/emst/forests-woodlands-and-savannas/edwards-plateau-limestone-savanna-and-woodland2021.

USDA. 2012. *Focus on Livestock in the Southwest: Overview of climate change impacts on animal agriculture in the Southwestern United States*. Available at: https://www.climatehubs.usda.gov/hubs/southwest/topic/focus-livestock-southwest.

Vermeire, L. T., R. B. Mitchell, S. D. Fuhlendorf, and R. L. Gillen. 2004. Patch Burning Effect on Grazing Distribution. *Range Management* 57:248-252.