The Influence of Burn Season on Small Mammal Abundance in Tall Grass Prairies

An Honors Thesis (HONR 499)

by

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January 2019

Expected Date of Graduation

May 2019

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Abstract

Understanding exactly how prescribed burns affect prairie habitat is important to many land managers. While much of the differences between burn and no burn have been researched, there has been less work on the differences between the different seasons of prescribed burns. What research there is primarily focuses on plant species and structure change. However, these changes do not always show direct changes in animal populations. In this study, I examined how the different burn seasons changed small mammal populations at Cooper Farm in Muncie, IN. I found that Deer Mice and White-footed Mice (*Peromyscus sp*.) were not affected by the season, but Meadow Voles (*Microtus pennsylvanicus*) were found more frequently in growing season burn plots.

Acknowledgements

I would like to thank Dr. Timothy Carter for this opportunity. He has done much to help me through my college career, and I have much more to thank him for than just my senior thesis.

I would also like to thank Dr. Randall Bernot and Dr. David LeBlanc for help with statistical analysis.

Process Analysis Statement

Small mammal trapping has been done at Cooper Farms for 13 years and has been used as the foundation for a few honors theses and many independent projects. This means that I have the experience from the students that have come before me when it comes to how I designed my project. However, I also had limitations on what was being done, and what I needed to do over the course of my project. The burn schedule of the prairie is set and cannot be influenced, and each plot had to be trapped at least two nights per season to maintain the long-term data collection. I started the project by researching the known differences of burn seasons and how it affects the plant structure in the prairies. I also studied hantavirus, as it was a potential risk when working with mice.

After looking through the literature on prairie burns, I discovered there was not much information on how the different seasons of prescribed burns change small mammal communities. There is a fair amount of research looking at the differences between unburned and burned site, and several studies looking at how plant structure changes based on the season. However, relatively few have focus on the small mammal communities during different burn seasons. This information is important, as mice are a lower trophic level of the food chain and highly influence the success of small predators.

My study worked in conjunction with several other students looking at different aspects of small mammals in this prairie system. The other groups included individuals looking at recapture rates, and hantavirus prevalence. This meant that I was part of a group that worked together trapping small mammals. We also had volunteers from the Wildlife Biology class, as

they were required to learn the process of trapping as part of the class. Many volunteers had very little field experience, and no trapping experience, making it a difficult process to describe exactly what to do and relying on them to do it. Setting up a grid of traps is very precise work, and when the grass is seven feet tall, it can be very difficult work. It was imperative to have people work together in an organized manner to achieve a grid that met the protocol of all our research. Additionally, we had to start at sunrise for the protection of the captured animals, making many volunteers less than willing to cooperate. These difficult conditions really posed many challenges that took a while to learn how to coordinate and accommodate.

Introduction

In the last 200 years, 99% of North American prairies have been converted to agriculture (Howe, 1994). Further, remaining grassland has been divided into small patches that are isolated by human barriers such as roads or farm fields (Smith, 1981). With so little remaining, prairies must be managed properly to maximize ecosystem health (Smith, 1981). One of the most important management techniques for prairies is prescribed burns. Burns return nutrients to the soil and control woody vegetation from encroaching on grasslands (Wright & Baily, 1982). Fire also increases above and below ground production and nutrient cycling efficiency (Ojima et al., 1993). Thus, prescribed burns aid managers in controlling unwanted invasive species and making habitat more suitable to native species (Ditomaso et al., 2006). Managers can incorporate prescribed burns in two different seasons, each with its own benefits.

Most prescribed burns occur in the dormant season (i.e., late fall, winter, or early spring), when most plants are not growing (Howe, 1994). In prairies, dormant season burns do not affect plant life cycles, as most of the above ground vegetation is dead during this time. Dormant season burns tend to favor the established perennial grasses which can out-compete annual forbs (Brockway et al., 2002) (Figure 1). In contrast, growing season burns (i.e., late spring or summer) are a newer practice that tends to have less intense fires due to green vegetation and higher humidity. Growing season burns can also be effective at controlling invasive species if timed properly, as both annual and perennial plants are most vulnerable right before they reproduce. Further, growing season burns allow less-dominant forb species to become more prevalent supressing perennial grasses (Howe, 1994). Given the differences

associated with burn season, each burn season creates a different microhabitat that may affect other prairie species.

The way prescribed burns affect wildlife will depend on each species preference to microhabitats and response to changes. Rodents especially tend to be sensitive to the differences between microhabitats (M'Closkey & Fieldwick, 1975). Meadow voles (*Microtus pennsylvanicus*), white-footed mice (*Peromyscus leucopus*), and deer mice (*Peromyscus maniculatus*) are rodents commonly found in Midwestern prairies, but each species often seeks out different microhabitats (M'Closkey & Fieldwick, 1975). In studies looking at species preference between burned and unburned areas, *M. pennsylvanicus* favored unburned plots, while both *P. leucopus* and *P. maniculatus* favored burned plots (Schramm & Willcutts, 1983). While several studies have tested rodent response to presence or absence of prescribed burns, few have compared rodent responses to the burn season. Rodents are an important part of a prairies' ecosystem dynamics and species diversity. For example, rodents change the vegetative composition of their habitat due to seed dispersal and predation (Howe & Brown, 2000).

The goal of this study is to quantify the effect of burn season on grassland vegetation composition and small mammal species abundance. Research will focus on *Microtus pennsylvanicus* and *P. leucopus* and *P. maniculatus* due to their prevalence in central Indiana. *M. pennsylvanicus* are expected to be more prevalent in growing season burns because their diet consists mainly of forb shoots (Lindroth & Batzli, 1984) (Figure 1). *Peromyscus* sp. are expected to be equally prevalent between the burns due to their versatile diet that consists mostly of arthropods and seeds (Wolff et al., 1985).

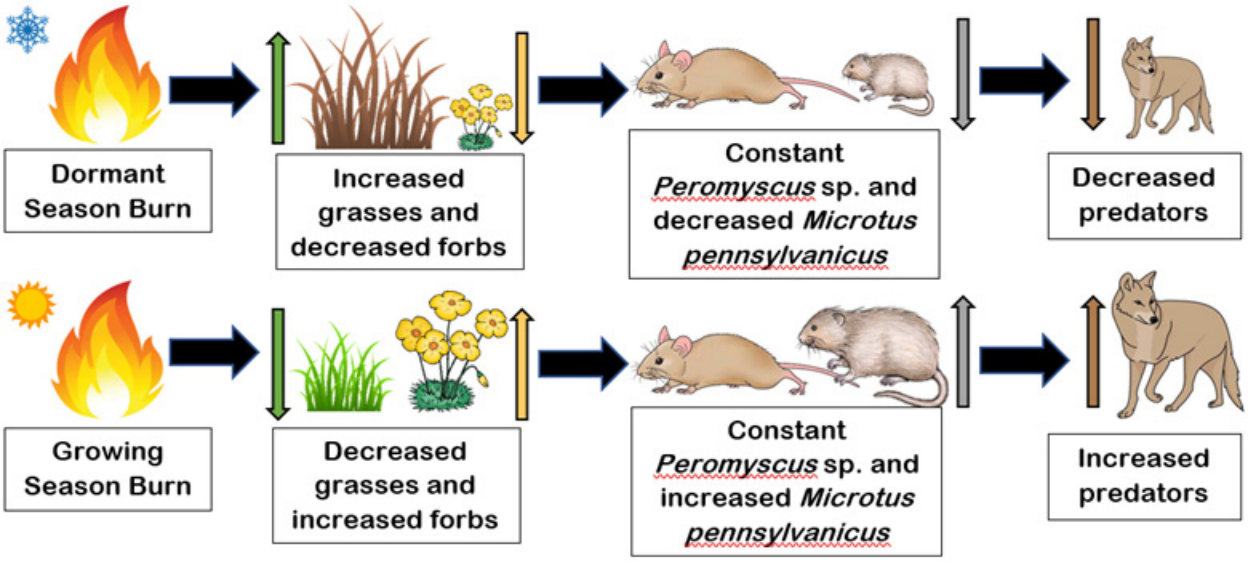

Figure 1: Proposed effects of different seasons of prescribed burns on tallgrass prairie ecosystem.

Methods

This study was conducted in east-central Indiana, USA. Sites were located on the Ball State University field station property Cooper Farm. Cooper Farm has 14 tall grass prairie plots of roughly one hectare each; seven are burned every other year in the dormant season, and seven are burned every other year in the growing season. Dormant season burns usually occur in early spring (April-May) and growing-season burns take place in late summer (July-August). Trapping occurred between the months of September and November of 2016 and 2017, and each plot was trapped for two consecutive nights once each year.

Fifty traps were set in a 7x7 grid orientated in the cardinal directions around the center point in each plot, with the extra trap set next to the center point. Traps were set in rows ten meters apart. A grid was used rather than strategic placement to maintain consistency across plots and years. A grid works well in a prairie due to its relatively uniform vegetation.

Sherman traps (H.B. Sherman Traps Inc; model 3310A) were used to live capture small mammals. All traps contained synthetic cotton to prevent hypothermia and were baited using sunflower seeds. These traps were set in random directions and were given an identifying code according to its location within the grid.

When a rodent was captured, it was identified, sexed, then released. White-footed mice (*Peromyscus leucopus*) and deer mice (*Peromyscus maniculatus*) were both recorded as *Peromyscus* sp. due to their similar characteristics (Rich et al., 1996). After release of each rodent, a 1 m^2 area around the capture location was assessed. Percentage of vegetative cover at three inches high; the density of grasses, forbs, and woody shrubs; and average vegetation height were accessed. The cover height of three inches was chosen due to the vegetation density at that height having the strongest impact on mouse presence (M'Closkey & Lajoie, 1975).

A Canonical Correspondence Analysis (CCA) in the Vegan Package in R was used to analyze the effects of both season of burn vegetation parameters on small mammal prevalence. This analysis was used because it combines environmental and species data into one analysis. We can expect Gaussian relationships between the small mammals and their ideal environment parameters. It also displays patterns that result from combinations of several explanatory variables.

For a direct comparison of the overarching question of this study, a Mann-Whitney U Test was used to determine if a species was more likely to be found in one burn type plot over another. Tests were only calculated on the two species the most likely to have a large enough sample sizes, *Peromyscus* sp. and *M. pennsylvanicus*.

Results

In 56 trap nights, I caught a total of 70 small mammals (Figure 2). The largest group caught was *Peromyscus* sp. with a total of 41 animals caught, 23 in dormant season plots, 18 in growing season plots. Four *Microtus pennslyvanicus* were captured in dormant season and 15 in growing season for a total of 19 voles. Other animals captured included 7 *Blarina Brevicada*, 5 of which were captured in growing season burns, 2 Sorex hoyi caught in growing season burns, and a single *Microtus ochrogaster* caught in a growing season burn.

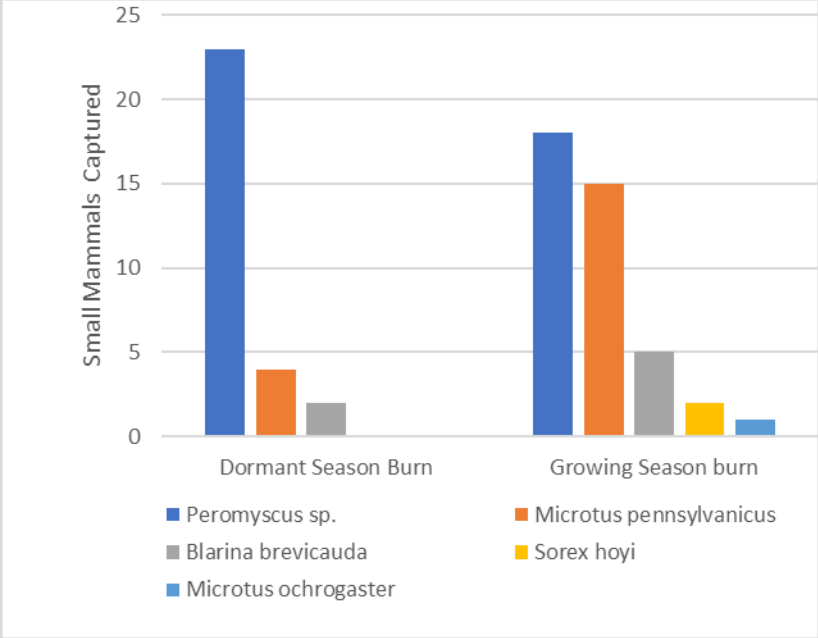

Figure 2: Animals caught in 56 trap nights.

Peromyscus sp. where captured relatively equally between the two types of plots (p=0.741). This suggests that *Peromyscus sp.* have no preference over burn type. Based on captures of *M. pennsylvanicus*, it appears they are more commonly be captured in growing season burn plots. Though it is not statstistically significant (p=0.068).

Overall, percentage of vegetation and percentage of grass are highly coorelated, as are percentage of forbs and percentage of woody plants (Figure 3). Vegetation and grass percentages are opposing forb and woody plant percentages, so when one group is high the other tends to be low. Vegitation height is not strongly alligned with either of these groups. Growing season burns tend to produce plots with slightly taller vegitation than dormant season burns, however neither of the burn seasons have much weight on this CCA (Figure 3). In general, none of the rodent species show a strong preference for any of these vegetative chararistics (Figure 3). All rodents leaned slightly toward higher percentages of grass and vegetation, besides for *Peromyscus* sp., which lean slightly in the opposite direction. Both voles in the *Microtus* genus favor vegetation height and growing season burns, while *Blarina brevicada* and *Sorex hoyi* favor dormant season burns. *Peromyscus* sp. did not show any preference for vegitation height or the burn season (Figure 3).

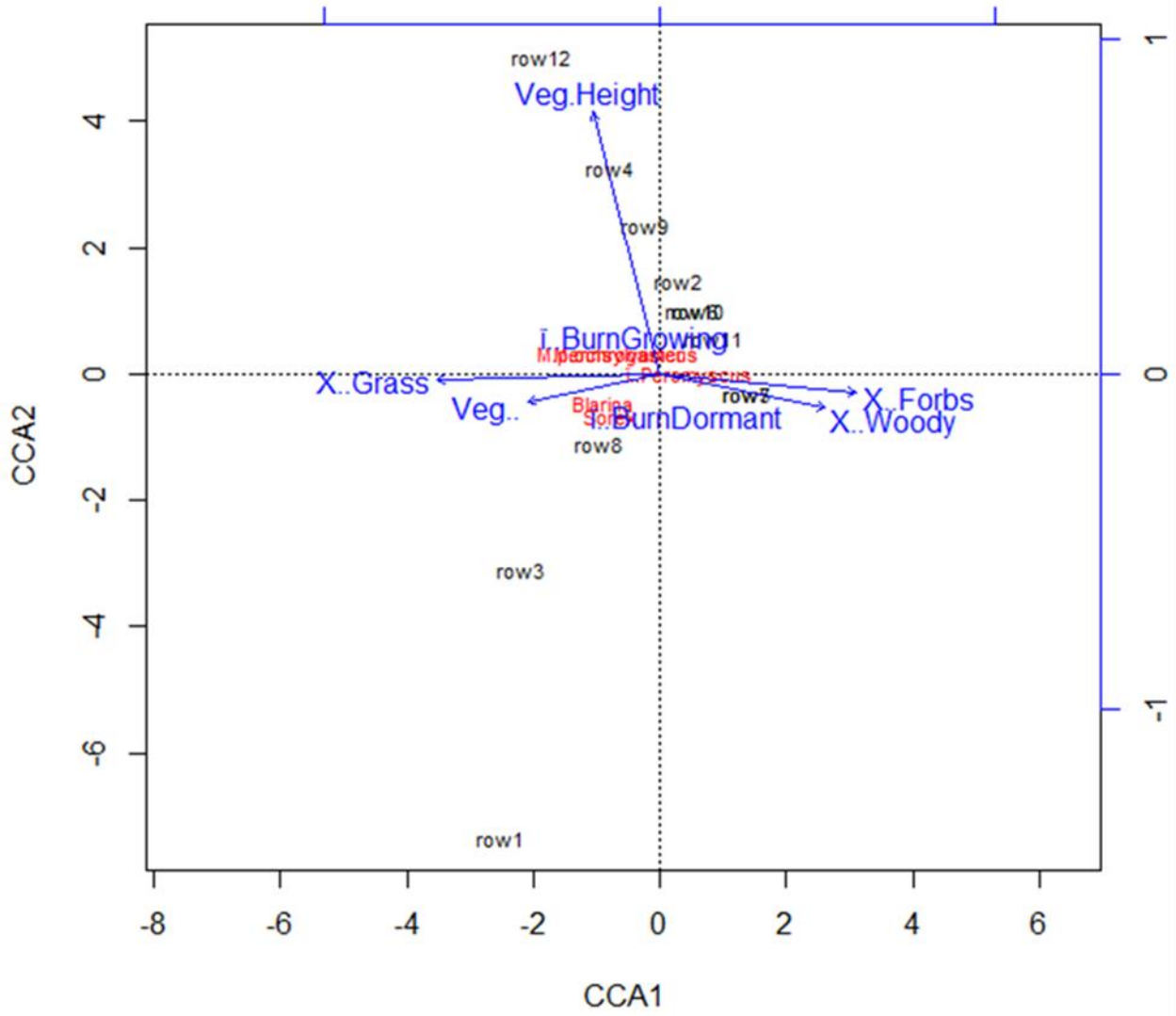

Figure 3: Species scores based on the first two axis of the CCA. Environmental measurements are in blue (Grass: Percentage of space occupied by grass, Veg: Percentage of space occupied by any vegetation, Veg.Height: Average height of vegetation, BurnGrowing: Growing season burn, BurnDormant: Dormant season burn, Forbs: Percentage of space occupied by forbs, Woody: Percentage of space occupied by woody plants), sites are in black, and species are in red (M.pennsylcanicus: *Microtus pennsylvanicus*, M. ochrogastor: *Microtus ochrogastor*, Peromyscus: *Peromyscus* sp., Blarina: *Blarina brevicada*, Sorex: *Sorex hoyi*).

Discussion

The results of this experiment mildly supported my hypothesis. *Peromyscus* sp. did not have a preference, and *M. pennsylvanicus* likely prefer growing season burns, though, a larger sample size would be needed to have a better understanding of actual trends of these species. However, based on rudimentary vegetation analysis, my proposed mechanism for this result was refuted. The growing season burns did not show an increase in forb percentage. This is likely due to the low power from limited sample size. Other problems included both sampling periods occurring shortly after growing season burns, and the likelihood of measurement errors from inaccurate estimations.

Future studies can tell us more about the relationship between small mammals and the vegetation in different seasons of burns. This could be highlighted by increasing sample size and doing a more in-depth analysis of the plots. My study had the possibility of creating bias as the growing season burns were the most recent plots to be burned in both seasons of data collection, while the dormant season burn always had at least most of a growing season to recover from the burn.

However, this study offers important information on the effects of different season burns on prairies that have not been previously studied. The results are especially beneficial for land managers deciding when to burn their grasslands. They can now consider how rodents are affected and thus promote the biodiversity of their prairie plots not only in the plant community, as is typical, but also in the animal community.

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Institutional Animal Care and Use Committee
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Muncie, IN 47306-0155
Phone: 765-285-5070

DATE: September 22, 2018

TO: Tim Carter

FROM: Ball State University IACUC

RE: IACUC Protocol #: 122330-8
TITLE: Mammal Trapping for Educational Purposes in BSU Classes (IACUC #08-04)
SUBMISSION TYPE: Continuing Review/Progress Report

ACTION: **APPROVED**
DECISION DATE: September 19, 2018
EXPIRATION DATE: September 18, 2021
REVIEW TYPE: Full Committee Review

The Institutional Care and Use Committee (IACUC) recently reviewed the above names protocol. Your protocol was **APPROVED**.

Approval Period: September 19, 2018 through September 18, 2021
Category:

- [X] Laboratory Research
- [X] Wildlife
- [ ] Non-Research
- [ ] Breeding Colony

Approved Animal Bio-Safety level (ABSL): [ ] **ABSL 1** [ ] **ABSL 2** [ ] **No Changes**

Bio safety committee (IBC) approval # *[enter if applicable]*

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Guide for the Care and Use of Laboratory Animals;

AVMA Guidelines on Euthanasia; and

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- When the project is complete or discontinued (Final Report/Study Closure)
- Report annual updates on the
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- If the project is to be modified (Modification/Amendment Form)
- If the project encounters problems (Adverse Events Form)

Please report any of the above situations to the IACUC through IRBNet. Please do so through your currently approved protocol number. Be sure to allow sufficient time for review and approval of requests. If you have any questions regarding this request, please contact John Mulcahy at 765-285-5106 or jmulcahy@bsu.edu.

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