

Plant Community Response to Disturbances in Nebraska Sandhills Prairie

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Introduction

Historically, prairies were shaped by disturbances such as fire and soil moving by animals. These periodic disturbances interacted to affect abundances of prairie plant species. With the removal of many of these disturbances, various shifts in composition have occurred. Few studies have examined the effects of multiple disturbances in Sandhills prairie. We hypothesize that the re-implementation of several distinct disturbance events will have marked effects on the plant community with both ecological and grazing management implications.

Objective

To determine the effects of distinct disturbance events: mid-spring fire, soil disturbance, seed addition, and June supplemental water on prairie plant community composition in Nebraska Sandhills uplands across two years.



Methods

We implemented four distinct disturbances on south-facing slopes in Nebraska Sandhills prairie (Rock County, Valentine fine sands) in 2016 and 2017. Mid-spring (late April/early May) fire, disking, and disking plus seed addition (four drill-seeded native forb species) were followed by supplemental watering in June. Our study was a randomized complete block design with 1.5 x 3 m experimental units. We conducted end of season percentage canopy cover of individual plant species visually by use of Daubenmire frames to determine plant community composition. In addition, we clipped plots and sorted into major plant functional groups after the second growing season post disturbance. We used a glimmix procedure and least significant difference test in SAS (Sas Institute Inc., Cary, NC) to determine main and interactive effects in the first and second growing seasons.

Results

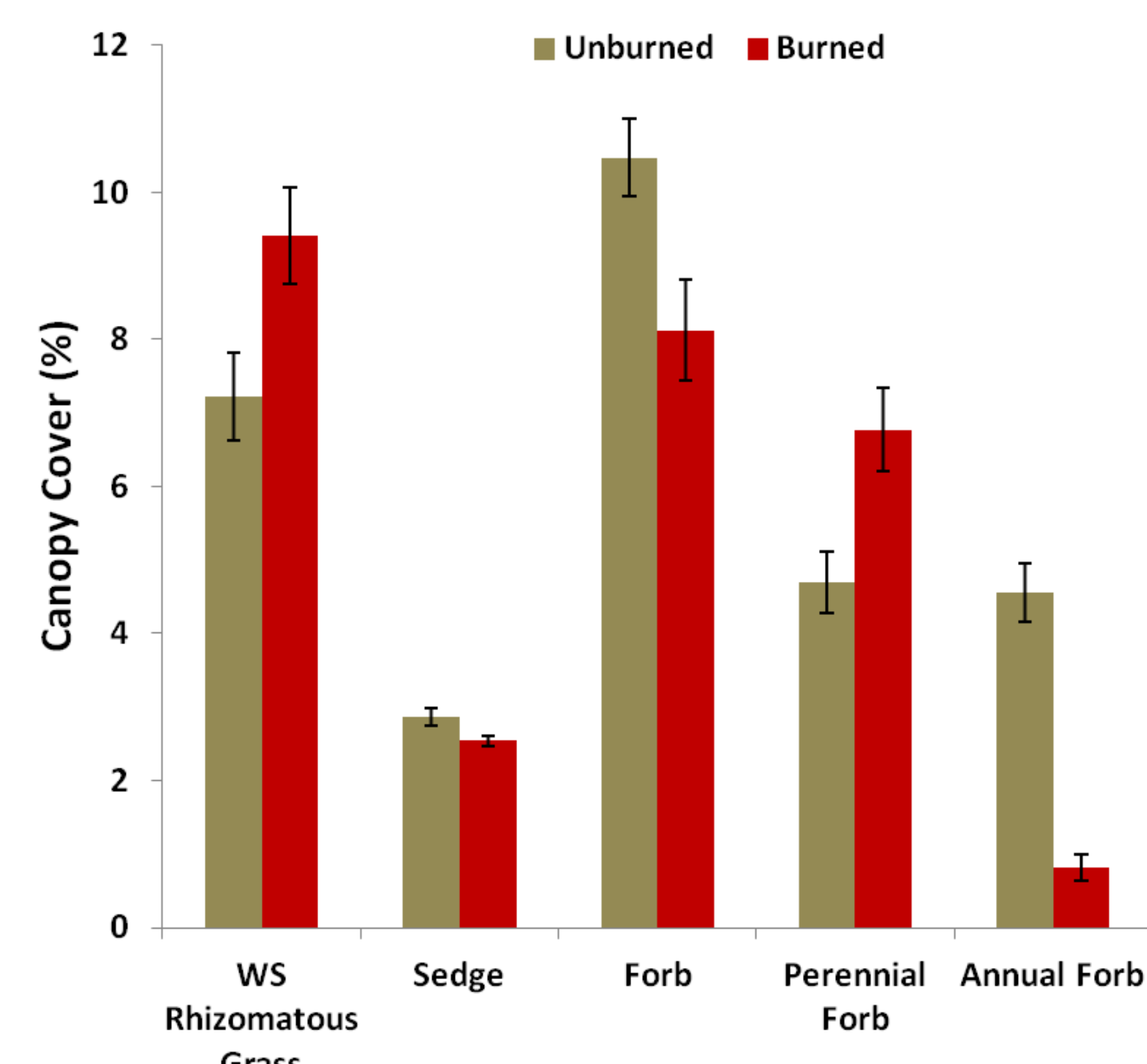


Fig. 1.* Effects of mid-spring fire on plant functional group canopy cover (%) first growing seasons post-disturbance in Nebraska Sandhills prairie.

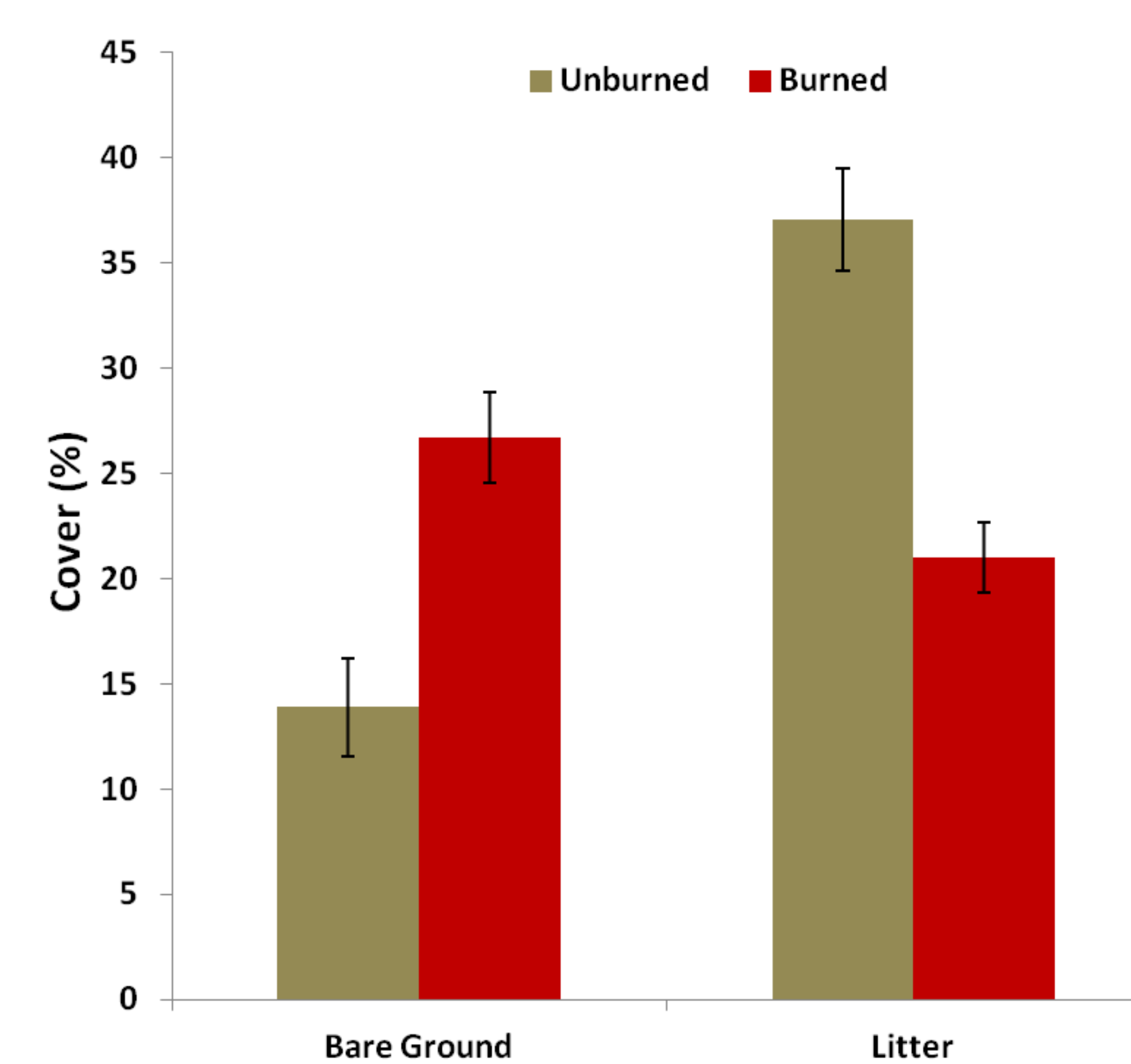


Fig. 2.* Effects of mid-spring fire on bare ground and litter cover (%) second growing season post-disturbance in Nebraska Sandhills prairie.

Table 1.** Four-way interaction of mid-spring fire, June supplemental water, mid-spring soil disturbance, and year on percentage of the seeded forb roundhead lespedeza (*Lespedeza capitata*) canopy cover in the first growing seasons post-disturbance in Nebraska Sandhills prairie.

		Roundhead Lespedeza %
2016, Burned, Watered, Disked plus Seeded		0.25a
All other treatment combinations		0.00b

Table 2.** Two-way interaction of June supplemental water and mid-spring soil disturbance on percentage of warm-season (WS) bunchgrass canopy cover in the second growing season post-disturbance in Nebraska Sandhills prairie.

Water	Soil Disturbance	WS Bunchgrass %
Unwatered	Undisked	10.34a
	Disked	6.71b
	Disked plus Seeded	7.94ab
Watered	Undisked	4.92b
	Disked	6.52b
	Disked plus Seeded	7.31ab

Table 3.** Two-way interaction of mid-spring fire and mid-spring soil disturbance on percentage of warm-season (WS) grass, and WS bunchgrass canopy cover in the second growing season post-disturbance in Nebraska Sandhills prairie.

Fire	Soil Disturbance	WS Grass %	WS Bunchgrass %
Unburned	Undisked	19.33a	11.37a
	Disked	12.25b	6.13b
	Disked plus Seeded	12.46b	6.29b
Burned	Undisked	17.46ab	9.04ab
	Disked	16.92ab	10.42ab
	Disked plus Seeded	19.79a	10.88ab

* Standard error bars in Figures 1-3 represent significant (P>0.05) main effects of fire between unburned and burned treatments.

**Similar letters in Tables 1-3 indicate no significant (P>0.05) difference between treatment combinations. "Disked plus Seeded" treatments received additional soil disturbance following disking (spring drill-seeded with a native perennial forb mix).



Discussion

The first growing season suppression of weedy annual forb species and increase in good forage value rhizomatous grasses is beneficial from a grazing management standpoint (Fig. 1). Establishment of native forbs, such as roundhead lespedeza, through spring seed addition is difficult given the semi-arid climate and sandy substrate (Table 1). June supplemental water led to a decrease in warm-season bunchgrass cover possibly due to competition with nearby species (Table 2). In the second growing season a continued loss of litter in exchange for increased bare ground is less desirable (Fig. 2), however there was an increase in palatable shrubs due to disking (Fig. 3). Additionally, in both years the water and fire treatments generally seem to have a mediating effect on the decrease in plant cover caused by increasing soil disturbance (Tables 2 & 3), providing evidence for ecological interaction between these disturbances in Sandhills prairie plant communities. Our study suggests that the roles of distinct disturbance events are interactive with fire playing the largest role ecologically.

Acknowledgments

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