

# An Ecological Analysis of the Plant Communities of Little Bluestem Prairie Nature Preserve: Pre-burning versus Post-burning

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## Introduction

Few studies have attempted to consider the changes in species importance percentages of herbaceous and woody plants after prescribed burning of prairie communities. Anderson (1977) considered changes in species frequency in a tallgrass prairie following burning. Also, Anderson (1980) investigated the influence of fire on invading black locust in an Illinois sand prairie.

This study describes the changes in herbaceous and woody species importances following prescribed burning of a remnant sand prairie community dominated by little bluestem grass [*Andropogon scoparium* (Michx.) Nash].

## Study Area

The study was conducted at Little Bluestem Prairie Nature Preserve located five miles north of Terre Haute, Indiana, along the west side of US Highway 41. Until about 1973 nearly 30 acres of untilled land remained in this tract, much of it virgin prairie. Industrial development since then has reduced the parcel to about 13 acres. Six acres of the remaining sand prairie are protected in the Little Bluestem Prairie Nature Preserve.

Little Bluestem Prairie is presently in danger of disappearing due to invasion of woody species from north of the plot, primarily black locust (*Robinia pseudoacacia* L.), wild cherry (*Prunus serotina* Ehrh.), and sassafras [*Sassafras albidum* (Nutt.) Nees]. These species were cut down between 1979 and 1985, and the stumps immediately sprayed with a basal herbicide (Tordon).

Vernal burning of Little Bluestem Prairie occurred on 19 March 1985. The entire invasion area and a portion of the sand prairie were burned. An unburned portion of the sand prairie community remained as a refuge for the plant and animal populations plus as a study control.

## Methods and Materials

Data from this study were collected on similar dates during May, July and September in both pre-burn and post-burn growth seasons (1984 and 1985). Data on stem density and plant cover were collected from 24 plots (each 1 × 1 meter) located stratified random throughout the prairie communities.

Relative density, cover and frequency values were averaged to obtain a species importance percentage according to the following formula:

$$\text{Percent Importance} = \text{Relative Density} + \text{Relative Cover} + \text{Relative Frequency}/3$$

Differences in importance values were used to calculate the percent change for a species from pre-burn to post-burn periods.

The Shannon Index of Diversity and Menhinick's Richness Index (Brower and Zar, 1977) were determined for each community both pre-burn and post-burn.

A community map was made by delineating community types on a photo-enlarged section of a topographic base map.

Kerosene drip torches were used to ignite and burn narrow strips of prairie. Backfiring against the wind was generally used in an effort to control the extent of burn. The burn crew used backpack pumps and fire mats to prevent fire spread into areas not scheduled for burning.

Fire temperatures were recorded using a method described by Fonteyn (1984). Pyrometers were made using frosted glass microscope slides and phase-change crayons with a melting range of 52°C-427°C at 14° intervals. The slides were marked with the crayons and covered with aluminum foil to prevent ash from distorting the crayon marks. At designated positions throughout each community, slides were placed on the vegetation, the ground surface and 2.5, 5.0, 7.5 and 10 centimeters below ground. Academy of Science, Vol. 95, job no. 9490, rdb, mcs, galley: 159

### Results

Four vegetation types occur at Little Bluestem Prairie Nature Preserve (Figure 1). They are: woody, slope, invasion and sand prairie. The woody community sur-

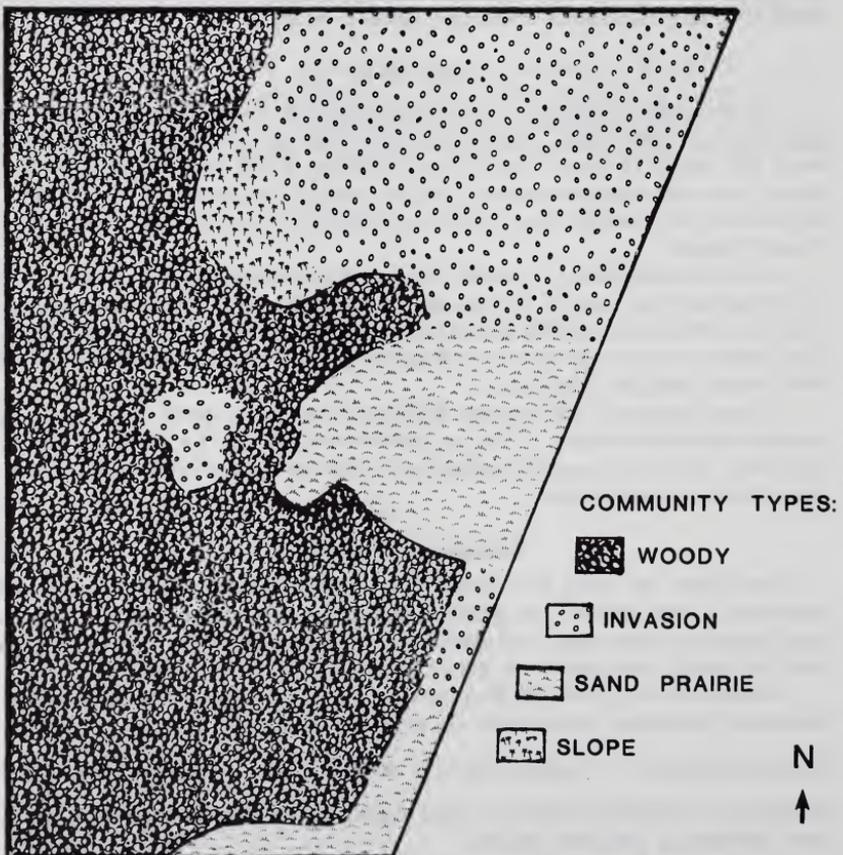


FIGURE 1. Community types map of Little Bluestem Nature Preserve. The entire tract contains about 13 acres.

rounding the prairie border is pre-dominated by small black oaks while woody areas sloping toward and on the floodplain are pre-dominated by silver maple, American sycamore, hackberry and red elm. The slope community is dominated by little bluestem grass and smooth horsetail. Big bluestem, butterfly weed and purple prairie clover also occur in the slope. Although the invasion community is dominated by little bluestem, several invading species occur such as black locust, wild cherry, sassafras and dewberry. Indian grass is also abundant in the invasion area. The sand prairie is dominated by little bluestem grass clumps surrounded by sand and/or lichen growth. Several prairie species occur in the sand prairie such as round-headed bush-clover, gaura and butterfly weed.

Table 1 summarizes the mean importance values for each community. *Andropogon scoparium*, the dominant species for each community, decreased post-burn in the invasion and sand prairie but increased slightly in the slope community. Other decreaseers were *Equisetum laevigatum*, *Rubus flagellaris* Willd. (slope), *Menispermum canadense* L., *Prunus serotina* Ehrh., and *Panicum* sp.

TABLE 1. Mean importance percentages for selected species in the major prairie community types at Little Bluestem Prairie. Importances are averages of the values obtained during the May, July and September sampling periods.

Species	Slope		Invasion		Sand Prairie		Control
	Pre	Post	Pre	Post	Pre	Post	Post
<i>Andropogon scoparium</i>	72.3	72.7	45.5	33.2	66.9	47.3	67.7
<i>Equisetum laevigatum</i>	11.6	6.9					2.8
<i>Cyperus</i> sp.	8.4	10.6				8.4	6.82
<i>Rubus flagellaris</i>	7.8	2.9	7.4	10.7			
<i>Sorghastrum nutans</i>			6.5	9.4			
<i>Menispermum canadense</i>			5.2	4.1			
<i>Rhus glabra</i>			1.6	6.5			
<i>Prunus serotina</i>			10.0	2.6			
<i>Euphorbia corollata</i>			5.0	6.3	4.9	5.1	
<i>Chrysopsis mariana</i>			9.6	10.5	2.5	0.9	1.5
<i>Strophostyles helvola</i>				2.6		7.1	1.4
<i>Lespedeza capitata</i>					4.0	5.7	
<i>Gaura biennis</i>					7.0	8.4	11.4
<i>Krigia virginica</i>		5.4	1.1		4.1	8.2	2.8
<i>Panicum</i> sp.					5.7	4.1	5.4
Total number of species	4	5	14	18	10	12	6

Several species increased in importance: *Cyperus* sp., *Rubus flagellaris* (invasion), *Sorghastrum nutans* (L.) Nash., *Rhus glabra* L., *Euphorbia corollata* L., *Chrysopsis mariana* (L.) Ell., *Lespedeza capitata* Michx., *Gaura biennis* L. and *Krigia virginica* (L.) Willd.

*Strophostyles helveola* (L.) Ell. was a new species in the post-burn invasion and sand prairie communities.

The species importance values were not constant from pre-burn to post-burn. Table 2 summarizes changes in species importance. Only species with greater than 4.00 importance percentages were used.

Several species did consistently decrease. *Andropogon scoparium* decreased significantly in the sand prairie and invasion communities, but importance values for the slope community increased slightly. Other decreaseers were *Rumex acetosella* L.,

TABLE 2. Percent change in species importance percentages from pre-burn to post-burn samplings. Percent change values were determined as follows: Pre-burn importance percentage minus post-burn importance percentages/100.

Species	Slope			Invasion			Sand Prairie		
	M	J	S	M	J	S	M	J	S
<i>Andropogon scoparium</i>	+ 3	+ 1	0	-35	-22	-20	-33	-23	-31
<i>Cyperus</i> sp.	+56	+14	+18						
<i>Equisetum laevigatum</i>	-39	-21	-62						
<i>Rubus flagellaris</i>	-100	-45	-39	+49	+23	+71			
<i>Sorghastrum nutans</i>				+124	+18	+6			
<i>Menispermum canadense</i>				+4	+16	+57			
<i>Rhus glabra</i>				—	+150	+195			
<i>Ipomoea pandurata</i>				+100	+48	-100			
<i>Ambrosia elatior</i>				+100	+76	-100			
<i>Campsis radicans</i>				+100	-27	-39			
<i>Prunus serotina</i>				-79	-72	-70			
<i>Euphorbia corollata</i>				+56	+19	+1	+100	-20	-46
<i>Chrysopsis mariana</i>				-11	+32	+18	-100	-65	+100
<i>Lespedeza capitata</i>							+100	+24	+92
<i>Gaura biennis</i>							+135	+1	-27
<i>Krigia virginica</i>							+88	+105	+105
<i>Rubus allegheniensis</i>							-11	-6	-19
<i>Panicum</i> sp.							-37	-13	-21
<i>Rumex acetosella</i>							-37	-5	

*Panicum* sp., *Rubus allegheniensis* Porter, *Prunus serotina*, *Rubus flagellaris* (slope) and *Equisetum laevigatum* A.Br.

Several important prairie species did increase: *Gaura biennis*, *Lespedeza capitata* and *Sorghastrum nutans*. *Rubus flagellaris*, an invading species, significantly increased in the invasion community.

Species diversity and richness increased post-burn in the invasion and sand prairie communities. Values for the control area for the 1985 season varied little from pre-burn sand prairie values (Table 3).

Fire temperatures varied greatly. Temperature ranges were the following: 79°C-427°C (slope), 121°C-427°C (invasion), 52°C-371°C (sand prairie), 52°C-371°C (woody ravine). No temperatures were recorded below the one-inche level. The below ground temperatures reached melting point levels only twice—both in the woody ravine. Therefore, fire did not directly increase soil temperature.

TABLE 3. Community richness and diversity values for both pre-burn and post-burn communities. Values are based on the respective May, July, and September sampling periods.

		Slope			Invasion			Sand Prairie			Control		
		M	J	S	M	J	S	M	J	S	M	J	S
Shanon Index	Pre	-192	-194	-194	-170	-169	-174	-183	-181	-188	-185	-189	-189
	Post	-189	-186	-186	-133	-148	-149	-143	-162	-159			
Species Richness	Pre	0.13	0.11	0.11	0.27	0.35	0.34	0.16	0.17	0.18	0.90	0.11	0.11
	Post	0.14	0.17	0.17	0.55	0.52	0.53	0.33	0.28	0.29			
Number of Species	Pre	4	4	4	10	14	14	8	10	8	5	6	6
	Post	4	5	5	15	18	18	10	12	11			

### Discussion

Increased importance was most dramatic for *Sorghastrum nutans*. This species occurs primarily in an area of pronounced black locust sprouting and was (is) in need of protection from the invading woody species. Differences were greatest between the May samples, possibly due to less biomass accumulation and a more rapid vernalization resulting from increased soil temperatures due to post-burn darkening of the soil surface.

Several studies have shown that *Andropogon scoparium* increases after burning (Kucera and Ehrenreich, 1962; Old, 1969; Anderson, 1977). However, little bluestem grass decreased in the sand prairie and invasion communities but remained nearly constant in the slope and control communities. Little Bluestem in the sand prairie and invasion area occurs in clumps surrounded by sand and/or lichen growth. Fire damage to the clumps apparently contributed to reduction of little bluestem. Although some importance reduction occurred for *Andropogon scoparium*, it remains vigorous and the dominant species in the prairie communities.

Subjective observations indicate a major increase in *Andropogon gerardii* Vitman var. *gerardii*. Big bluestem occurred prior to burning in only one small clump along the woody ravine and slope boundary. Post-burn counts were over ten times the previous season.

The spread of black locust and resprouting of wild cherry and dewberry remain a major problem. Additional herbicide treatment was reapplied to woody species in the invasion area during fall 1985, and results have yet to be determined.

Prior to settlement in Indiana, prairie vegetation represented nearly 13% of the state (Petty and Jackson, 1966). By as late as 1896 Blatchley (1896) described prairie areas in the Wabash River lowland ranging from three to eight miles wide. Today, only a few scattered remnants remain. Little Bluestem Prairie Nature Preserve protects only six acres of sand prairie, and these acres are endangered by woody invasion. Control methods will be continued, plus mammal and invertebrate studies are being conducted.

### Acknowledgment

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