

Effects of Prescribed Burning on Woody and Herbaceous Vegetation in Black Oak Sand Savannas at Hoosier Prairie Nature Preserve, Lake County, Indiana

JOHN A. BACONE AND THOMAS W. POST
Indiana Department of Natural Resources
605B State Office Building
Indianapolis, Indiana 46204

Introduction

Black oak sand savannas were common components of the Indiana Presettlement landscape. Betz (3) estimates that the total acreage of savanna and associated sand prairie in Indiana before settlement was 647,000 hectares. Homoya et al. (5), using data from Potzger et al. (9) estimates 514,000 hectares. The United States Public Land Survey notes of 1835 (11) describe areas where savannas are known to exist today as "barrens", that is areas of "open" timber, scattered with "scrubs" for undergrowth. Characteristic trees in these "barrens", according to the survey, were black oaks (*Quercus velutina*) and white oaks (*Quercus alba*). Distances between witness trees were often fifty feet or more. Bacone and Campbell (2) determined that "barrens" as described above are what are referred to as savannas today. They described black oak sand savannas as occurring on sandy soil with a ground cover composed primarily of dry sand prairie species. Maintenance of these communities, both here in Indiana (2) and in other states such as Ohio (8), Illinois (7), Wisconsin (4) and Missouri (6), is attributed primarily to fire.

Today remnants of these savanna communities can still be located in Lake, Newton, Jasper, Porter, Pulaski and Starke Counties. However, most areas have been degraded due to various disturbances such as grazing and/or altered fire regimes.

Hoosier Prairie Nature Preserve is a 135 hectare area owned by the Indiana Department of Natural Resources, and managed by the Division of Nature Preserves. The preserve is a complex of sand prairie, black oak sand savanna, sedge meadow and marsh natural communities, located in the Chicago Lake Plain Section of the Northwestern Morainial Natural Region (5).

The black oak sand savannas at Hoosier Prairie occur on the higher areas, on Brems and Plainfield fine sand. Characteristic woody species include black oak, white oak, sumac (*Rhus copallina*, *R. glabra*) sweetfern (*Comptonia peregrina*), and late low blueberry (*Vaccinium vacillans*). Typical herbaceous species include: little bluestem (*Andropogon scoparius*), pennsylvania sedge (*Carex pennsylvanica*), tall coreopsis (*Coreopsis tripteris*), woodland sunflower (*Helianthus divaricatus*), and bracken fern (*Pteridium aquilinum latiusculum*).

Rare vascular flora associated with the remnant savannas at Hoosier Prairie Nature Preserve include: pink corydalis (*Corydalis sempervirens*), northern cranesbill (*Geranium bicknellii*), sweet fern (*Comptonia peregrina*), and bog clubmoss (*Lycopodium inundatum*).

Due to the increasing problem of woody species invasion by oaks, willows (*Salix* spp.), aspen (*Populus tremuloides*), sumacs, and other species, prescribed burning is being used as a means of maintaining savanna communities. Since its acquisition in 1977, portions of Hoosier Prairie have been burned every year. Depending on weather conditions, burns occur either in spring or fall. This paper will describe the effects of prescribed burning on woody and herbaceous vegetation at Hoosier Prairie Nature Preserve.

Nomenclature follows Swink and Wilhelm (10).

Methods

Two 10m × 10m plots were established in savanna areas of Hoosier Prairie prior to any controlled burning of the area. Each 10m × 10m plot was subdivided into twenty-

five 2m × 2m plots. In each of these smaller plots, all woody stems at subcanopy height or higher (one meter) for each species were tallied. Within each of these smaller plots a 0.67m² circular hoop was randomly thrown to determine herbaceous species presence. All plots were sampled yearly (during midsummer) regardless of whether or not the area had received a controlled burn.

The purpose of the plots was to record and detect changes to the vegetation by the prescribed burning treatment. As such, the 10m × 10m plots were not located randomly but specifically placed within savanna communities which were randomly selected. Plot #1 (north savanna) was located in a relatively uniform, level area. In this plot, sumac was frequent in the understory. In contrast, part of plot #2 (south savanna) was on a slight slope, where aspen was frequent. Moisture conditions were slightly drier in plot #1 than in plot #2.

Results and Discussion

Plot #1. The area containing this block has been burned four times in the last eight years. Three of the burns were conducted in the spring and one was conducted in the fall. This plot was originally sampled following the first prescribed burn. No pre-burn data was available. The number of woody stems increased after a single burn but decreased after two consecutive burns (Table 1). The effects of burning on other woody species

TABLE 1. Results of Prescribed Burning at Hoosier Prairie - North Savanna

	*1978	1979	1980	*1981	*1982	1983	*1984	1985
Woody								
Total # Stems	no sample	158	no sample	245	156	161	217	243
# stems/plot		6.32		9.8	6.24	6.44	9.08	9.72
Herbaceous								
Total #		271	no sample	343	363	319	336	342
#ssp/plot		10.84		13.8	14.5	12.8	13.4	13.68
#ssp		38		40	49	38	40	38

* denotes prescribed burn between growing seasons (fall or spring)

found in this plot are as follows: smooth sumac (*Rhus glabra*) has been able to resprout and maintain its original frequency, while willow (*Salix humilis*) and black oak sprouting has declined. The one clump of wild black cherry (*Prunus serotina*) has increased sprouting somewhat in the plot.

The herbaceous flora of plot #1 showed an increase in the number of species/plot and total number of species in the sample after a one and two year burn cycle. The numbers then dropped slightly and maintained themselves after the initial upsurge in numbers.

Plot #2. This area has been burned five times in the last eight years. Three of the burns were conducted in the spring. The first sampling took place prior to any prescribed burning, and this plot had probably not been burned for at least five years prior to sampling. After the initial burn, both total number of woody stems and woody stems/plot increased dramatically (Table 2). After a second successive burn, the number of woody stems dropped and continued to drop through a two year no burn cycle. Then, following burning, the number of stems increased again. In contrast to Plot #1, sprouting increased following two consecutive burns. This increase was due primarily to willow sprouting. Perhaps the willows were stimulated by the fact that the burn took place in very late spring, after leafout had been initiated.

TABLE 2. Results of Prescribed Burning at Hoosier Prairie - South Savanna

	1978	*1979	*1980	1981	1982	*1983	*1984	*1985
Woody								
Total # Stems	220	789	526	384	344	698	795	552
# stems/plot	8.8	31.5	21	15.36	13.84	28	31.8	22.08
Herbaceous								
Total #	160	287	287	246	307	407	357	344
#ssp/plot	6.4	11.5	11.5	9.8	12.2	16.3	14.3	13.76
#ssp	28	54	48	46	49	46	51	55

* denotes prescribed burn between growing seasons (fall or spring)

For specific woody species this pattern of burning has maintained black chokeberry (*Pyrus melanocarpa*), stimulated an initial increase in trembling aspen (*Populus tremuloides*) but eventually reduced it to pre-burn levels, reduced black oak sprouting and stimulated both prairie willow (*Salix humilis*) and other willows (*Salix* sp.)

Burning in general has increased both the number of herbaceous species/plot and the total number of species observed. However, a slight downward trend was observed after the last two prescribed burns.

Overall trends regarding herbaceous species in both of these plots show quantitative increases for *Aster azureus*, *Comandra richardsiana*, *Helianthus mollis*, *Potentilla simplex*, *Rubus flagellaris*, *R. hispidus*, and *Solidago juncea*. Herbaceous species showing little or no change include: *Aster umbellatus*, *Carex pensylvanica*, *Comptonia peregrina*, *Coreopsis tripteris*, *Euphorbia corollata*, *Fragaria virginiana*, *Parthenium integrifolium*, *Pteridium aquilinum*, *Sorghastrum nutans*, *Spirea tomentosa* and *Vaccinium vacillans*. Species showing a decrease include *Arenaria lateriflora*, *Baptisia leucantha* and *Gaylussacia baccata*.

After prescribed burning was begun at the preserve, two plants not noted before were observed as occurring on the prairie. These were *Geranium bicknellii* and *Corydalis sempervirens*. This is consistent with Swink and Wilhelm's (10) comment that both plants occur in sandy soils after a fire. These plants are both listed as endangered in Indiana (1).

Summary

Woody and herbaceous vegetation are being monitored in black oak sand savanna communities at Hoosier Prairie to determine effects of prescribed burning. Eight years of data showed that occasional burning increased the number of woody stems that are resprouting. Burns of at least two years in succession appear to be necessary to cause a decline in the sprouting of most woody species.

Periodic burning in general (whether frequent or occasional) appears to have a positive effect on herbaceous vegetation as measured by relative frequency (species/plot) and overall number of species observed.

It is too early to speculate on the long term effects of burning on the woody understory in these savannas, but burning appears to be benefiting the herbaceous vegetation.

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Literature Cited

1. Aldrich, J.R., J.A. Bacone, and M.A. Homoya. 1986. List of extirpated, endangered, threatened, and rare vascular plants in Indiana: an update. Proceedings Indiana Academy of Science. In press.
2. Bacone, J.A. and R.K. Campbell. 1983. Presettlement vegetation of Lake County, Indiana. *In* Proceedings of the Seventh North American Prairie Conference, August 4-6, 1980. Southwest Missouri State University, Springfield, Missouri. 321 p.
3. Betz, R.F. The prairies of Indiana. 1978. *In* Proceedings of the Fifth Midwest Prairie Conference. Iowa State University, Ames, Iowa. 230 p.
4. Curtis, J.C. 1959. The vegetation of Wisconsin. The University of Wisconsin Press, Madison, Wisconsin. 656 p.
5. Homoya, M.A., D.B. Abrell, J.R. Aldrich and T.W. Post. 1985. The natural regions of Indiana. Proceedings Indiana Academy of Science. In press.
6. Iffrig, G. and P. Nelson. 1983. Savannah stewardship in Missouri state parks. Missouri Prairie Journal, Vol. 5, No. 1-2.
7. Madany, M.H. 1981. A floristic survey of savannas in Illinois. *in* Proceedings of the Sixth North American Prairie Conference. August 12-17, 1978. Ohio State University, Columbus, Ohio. 278 p.
8. Moseley, E.L. 1928. Flora of the oak openings west of Toledo. Proceedings of the Ohio Academy of Science. Vol. 8, Part 3, Special Paper #20.
9. Potzger, J.E., M.E. Potzger and J. McCormick. 1956. The forest primeval of Indiana as recorded in the original U.S. land surveys and an evaluation of previous interpretations of Indiana vegetation. Butler Univ. Bot. Stud. 13: 95-111.
10. Swink, F. and G. Wilhelm. 1979. Plants of the Chicago Region. The Morton Arboretum, Lisle, IL. 922 p.
11. United State Public Land Survey. 1835. Field notes for townships twenty-nine, thirty, and thirty-one north and east of the 2nd principal meridian. Indiana State Archives, Indiana State Library, Indianapolis, Indiana.