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Vegetation of Saratoga Landing Blackland Prairie

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THE VEGETATION OF SARATOGA LANDING BLACKLAND PRAIRIE

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ABSTRACT

Saratoga Landing Blackland Prairie is a 75-ha site owned by the U.S. Army Corps of Engineers and managed cooperatively with the Arkansas Natural Heritage Commission to protect its blackland prairie community and rare plant species. The site is a complex of prairies and forests, as interpreted from aerial photos and maps. It was substantially prairie at the time of settlement, and forest cover did not increase greatly until after 1951, apparently due to effective suppression of wildfires after that time. Plot sampling characterizes an individual prairie on the site as being dominated by a herbaceous canopy, but with a substantial woody plant cover (15%-20%). Of the herbaceous vegetation, *Andropogon scoparius* is dominant, with lower seasonal production than the Grand Prairie of eastern Arkansas (147 g/m² vs. 800 g/m²). A recent prescribed burn resulted in a doubling of herbaceous end-of-season biomass, top-killing (but resprouting) of many woody plants, elimination of mulch and increased bare ground.

INTRODUCTION

The blackland prairie community of southwestern Arkansas is related to the similar communities of Texas, Mississippi and Alabama, as described by Collins *et al.* (1975), Jones and Patton (1966), and Rankin (1974). The original distribution, geology and soil, floristics and general vegetation of the Arkansas communities have been described by Foti (1989). The purpose of this study is to describe in detail the vegetation of a prairie and the complex of prairies within which it exists at Saragota Landing Blackland Prairie Natural Area. To the extent possible, the changes in vegetation due to disturbance and protection are also documented, particularly those related to a recent prescribed fire.

SARATOGA LANDING BLACKLAND PRAIRIE NATURAL AREA

The Saragota Landing Blackland Prairie Natural Area is a 75-ha complex of prairies and forest located in Hempstead and Howard counties, Arkansas, in sections 31 and 32, T11SR27W and sections 5 and 6, T12SR27W (Fig. 1). It is owned by the U.S. Army Corps of Engineers (Millwood Lake Project) and cooperatively managed by the Little Rock District, USCE and the Arkansas Natural Heritage Commission to protect and enhance the blackland prairie community and rare species that occur on the site.

The natural area is situated on the east side of Millwood Lake on a substrate of Saratoga Chalk. Located on the Saratoga Cuesta, slopes in prairies range to 30%. The area is a complex of communities including both dry prairie and dry-mesic forest. It was identified through a systematic inventory of potential natural areas of southwestern Arkansas begun by the Arkansas Natural Heritage Commission in 1985, the Coastal Plain Inventory.

The area has been grazed in the past but is recovering from that disturbance. Two primary indicators of disturbance remain: eroded gullies and woody plant invasion of prairies. Even with this evidence of disturbance, the site, when evaluated on the basis of size, diversity, amount of disturbance, and presence of special species, ranks among the best of the blackland prairie areas evaluated during the course of the Coastal Plain Inventory.

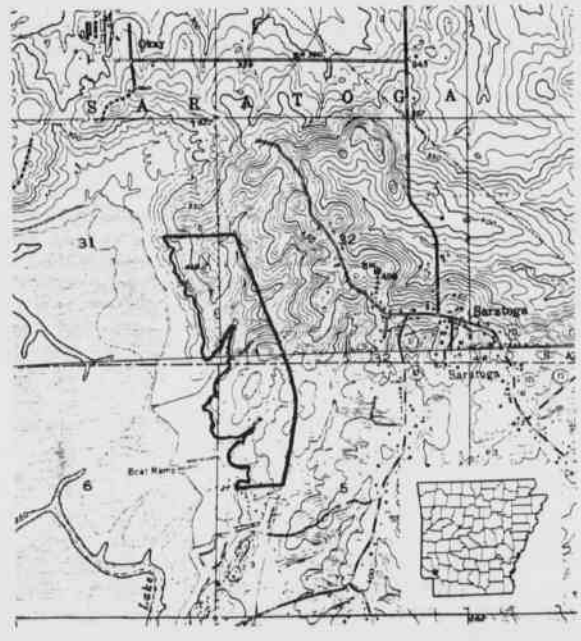

Figure 1. Saratoga Landing Blackland Prairie Natural Area, Howard and Hempstead counties, Arkansas, sections 5 and 6, T12SR27W and sections 31 and 32, T11SR27W.

METHODS

The study of Saratoga Landing Prairie vegetation involved qualitative description of the entire tract and quantitative description of an individual prairie. The distribution and size of prairies and change in these features over time was documented on the whole site and its surroundings through the field notes of the General Land Office (GLO)

Survey, and through aerial photographs taken in 1939, 1951, and 1964 by the Soil Conservation Service, and by the Arkansas Highway Department in 1974 and 1981. These sources were used to show the original character of the site and recent changes caused by grazing, fire and development.

Quantitative description of a single prairie within the complex was done to determine the amount and type of woody vegetation, along with the composition, cover and biomass of the herbaceous vegetation. Permanent sample plots were located along a 300 m transect line through one of the larger prairies on the tract. Ten plots were spaced randomly along the line at intervals of 15 m to 50 m. The center of each plot was marked with metal stakes 1 m long driven to within 15 cm of the end. Although the line was placed within a definable prairie, no attempt was made to avoid small groves of trees and brush. The line also passed under a powerline that crosses the site.

Each stake was used as the center of a 1/50-ha circular plot. An 8 m tape was used as the radius of the circle and provided a direct measurement to any plant near the periphery of the plot. This full 1/50-ha plot was used to estimate the foliage cover of woody plants and to count the total number of individuals of woody plants. The same plot center was used to locate 2 plots for sampling herbaceous vegetation. These plots were 1 m by 0.25 m with their nearest edge centered 2 m north and 2 m south of the main plot center. The areal cover (projection to the ground) by species was estimated within each of these plots, and then the vegetation was clipped, sorted by species or species group, oven-dried 24 hrs. and weighed.

Plots were initially sampled in September, 1987. Resampling occurred in September, 1989, after the prairie was burned under management prescription in March of that year. This second sample allowed preliminary investigation of the effect of fire on community composition and production.

Statistical tests were done using ABSTAT rel. 6.02 (Anderson-Bell, 11479 S. Pine Dr., Parker, CO 80134). The paired-T test was used to test for significance of differences in vegetation parameters between the 2 sample periods.

RESULTS

HISTORICAL VEGETATION OF THE SITE

The Arkansas blackland prairies were typically small, ranging from less than a hectare to a few hundred hectares in size, separated by fringes of trees, shrubs and vines along watercourses (Foti, 1989). Consistent with that pattern, the largest individual prairie on the Saratoga Landing Blackland Prairie Natural Area is about 15 ha. It is uncertain whether this reflects the presettlement condition, since the area has been grazed until acquired by the USCE about 1970. Fire has been excluded for decades according to an adjacent landowner. The past management has probably encouraged the establishment of woody plants, and therefore historical sources were examined to determine the condition originally and in the more recent past.

The GLO notes, made in 1819, before extensive settlement, on the mile that passes north-south through the northern part of the natural area (that is, the south ½ of the line between sections 31 and 32, T11S R27W) call it "broken third-rate prairie land not suited for cultivation." There were trees to mark the quarter section corner, so the area was not treeless. However, the distances to the 2 witness trees were 16 m to a 25 cm diameter white oak and 19 m to a 25 cm diameter black oak; therefore the landscape was open. The two mile lines running east-west a half-mile north of this quarter-corner (that is, between sections 30 and 31 and between sections 29 and 32, ½ mi. north of the natural area) both carry the general comment "mostly prairie". This notation was fairly uncommon in the vicinity, with prairie notations more often taking the form, "2 prairies" or "4 small prairies". Therefore the vicinity of today's natural area was substantially covered with prairie in 1819.

In 1939, when the first aerial photographs of the area were taken, the area was still primarily open prairie, with scattered trees over much of the area, and dense forest in parts, primarily along streams. The 1951 aerial photo of the area shows much the same pattern; however, the 1964 photo shows far more forest land than previously (Fig. 2). A major change in land-management apparently occurred during this interval, probably improved control of wildfires. However, changes in grazing patterns could have played a role. Later aerial photographs indicate that the encroachment of woody plants on the prairie has continued, but at a slower rate.

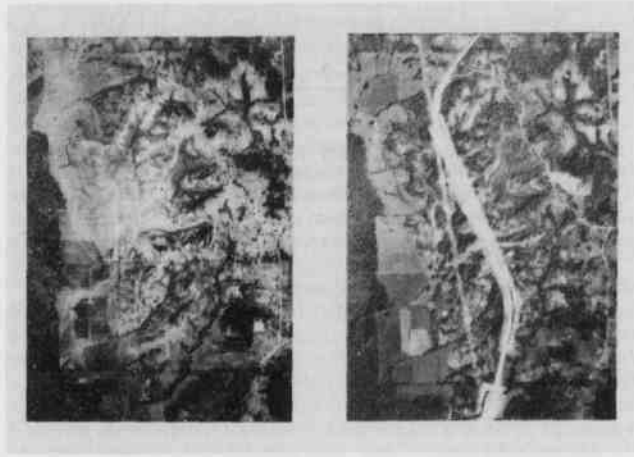

Figure 2. Aerial photos of Saratoga Landing Blackland Prairie area in 1951 (left) and 1964 (right). The area was substantially prairie (grazed) in 1951 and substantially forested in 1964. A powerline and a railroad were built between photographs. Cleared fields to the left are now in Millwood Lake. North is up in both photographs. Photos courtesy Soil Conservation Service.

VEGETATION OF AN INDIVIDUAL PRAIRIE

Woody Plant Cover

Woody plant cover on the 1/50 ha plots was estimated at 20.5% during the first sample period and declined after the fire to 15.0% (Table 1). This difference was not statistically significant.

Table 1. Woody plant cover. Years not significantly different ($p > .05$).

PLOT #	% COVER 1987	% COVER 1989
1	30	5
2	35	10
3	40	40
4	5	15
5	10	10
6	15	5
7	10	10
8	50	20
9	5	20
10	5	15
TOTAL	205	150
AVERAGE	20.5	15.0

Woody Plant Number

Woody plants were counted by species in the 1/50 ha plots (Table 2). The most abundant species was *Ilex decidua,* with an average of

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Table 2. Numbers of woody plants in 0.02 ha plots. ILEXDECI = *Ilex decidua;* RHAMCARO = *Rhamnus caroliniana;* JUNIVIRG = *Juniperus virginiana;* BERCHSCA = *Berchemia scandens.*

PLOT #	ILEXDECI		RHAMCARO		JUNIVIRG		BERCHSCA		OTHER	
	-number-									
	87	89	87	89	87	89	87	89	87	89
PLOT 1										
<1.5m	2	2	0	11	0	0	3	11	32	41
>1.5m	0	1	1	2	0	0	0	0	0	1
PLOT 2										
<1.5m	1	4	2	7	0	0	5	0	28	10
>1.5m	1	2	4	2	0	1	0	0	0	0
PLOT 3										
<1.5m	8	9	1	11	4	0	12	3	20	0
>1.5m	13	20	1	3	8	3	0	0	11	15
PLOT 4										
<1.5m	28	12	0	3	2	0	0	1	11	3
>1.5m	7	3	4	3	2	0	0	0	1	1
PLOT 5										
<1.5m	32	21	0	2	2	0	11	0	0	0
>1.5m	9	2	0	3	5	2	0	0	0	0
PLOT 6										
<1.5m	34	4	4	2	5	0	30	0	5	0
>1.5m	8	11	4	3	4	0	0	0	3	0
PLOT 7										
<1.5m	15	14	1	5	0	0	48	0	0	2
>1.5m	9	12	3	7	2	0	0	0	3	1
PLOT 8										
<1.5m	10	8	2	6	7	0	19	2	12	4
>1.5m	15	9	7	7	3	0	0	0	0	0
PLOT 9										
<1.5m	8	5	4	8	13	0	34	16	11	1
>1.5m	4	0	2	8	17	2	0	0	2	2
PLOT 10										
<1.5m	22	17	5	8	2	0	22	5	0	0
>1.5m	8	15	3	6	3	4	0	0	0	0
TOTAL #										
<1.5m	160	96	19	63	35	0	184	38	119	61
>1.5m	74	75	29	44	44	12	0	0	20	20
Statistical Significance										
<1.5m	n.s.		**		*		*		n.s.	
>1.5m	n.s.		n.s.		*		-		n.s.	

160 plants per plot shorter than 1.5 m and 74 plants >1.5 m per plot. *Berchemia scandens* was more numerous in the size class <1.5 m. *Rhamnus caroliniana* and *Juniperus virginiana* followed in abundance. Several other species occurred in lower numbers.

The prescribed fire adversely affected many woody plants; however, susceptibility varied greatly. Smaller individuals of the most abundant species, *I. decidua,* decreased by 40% (not significant). However, individuals taller than 1.5 m increased slightly (also n.s.). *Rhamnus* showed a highly significant increase in numbers of smaller plants and a substantial (but n.s.) increase in larger individuals as well. *Juniperus* and *Berchemia* both showed significant declines; all red cedars <1.5 m were killed. The other species as a group declined, but not significantly.

Most woody plants were top-killed, but many resprouted by the time of the second sample. For instance, all individuals of *Ilex* in the <1.5 m size class were sprouts, and all but 4 in the >1.5 m size class were sprouts. Of *Rhamnus,* only 16 of the 63 individuals <1.5 m were not obviously sprouts, along with 6 of the 44 individuals >1.5 m. *Juniperus* did not resprout, and it was not possible to tell whether *Berchemia* sprouted. Among the "other species", *Campsis radicans, Fraxinus* sp., *Maclura pomifera,* and *Diospyros virginiana* all showed some sprouting; *Quercus muehlenbergii, Viburnum rufidulum* and *Carya myristiciformis* did not.

Areal Cover of Herbaceous Vegetation, Mulch and Bare Ground

Estimated cover within 0.25m² plots shows *Andropogon scoparius* to be the dominant species (Table 3). Herbaceous plants other than grasses (forbs) covered less than 10% of the plots. Fire reduced *Andropogon* cover from 57% to 23% (highly significant) and total forb cover from 8% to 5% (n.s.).

Table 3. Foliage cover of herbacious vegetation in 0.25 m² plots. ANDSCOP = *Andropogon scoparius,* BERCHSC = *Berchemia scandens.* TOTFORB = total forbs, MSGRASS = miscellaneous grasses, MSWOODY = miscellaneous woody plants, BAREGND = bare ground

	ANDSCOP		MSGRASS		TOTFORB		BERCHSC		MSWOODY		MULCH		BAREGND	
	-percent cover-													
PLOT	87	89	87	89	87	89	87	89	87	89	87	89	87	89
1N	50	20			10	10		5					40	65
1S	40	20			10	15		5					50	60
2N	80	20			10	5							10	75
2S	15	10			5								80	85
3N	30	0								15	30		40	80
3S	10	10			10			5		10	60		20	75
4N	80	50			5		5						10	50
4S	35	25			5	20			5		20			55
5N	65	5			10	20					15		10	75
5S	65	10	10						10	20	15		10	70
6N	65	30			10						20		5	70
6S	50	40			15	5	10	5			10		5	50
7N	70	10		10	15	5							15	75
7S	60	20			10			5			10		20	75
8N	70	40					10				20			60
8S	65	40				5					10		25	55
9N	80	15			5						15			85
9S	65	20			15	5		5			15		5	70
10N	65	30			20						15			70
10S	70	40			10	10		5			5		15	45
AV87	57		1		8		1		1		13		18	
AV89		23		1		5		2		2		0		67
STATISTICAL SIGNIFICANCE OF CHANGE BETWEEN YEARS														
	**		n.s.		n.s.		n.s.		n.s.		**		**	

Prior to the fire, mulch (dead organic remains) covered 13% of the plots. After the fire, essentially no mulch cover remained. Conversely, before the fire, bare ground covered 18% of the plots while after the fire, bare ground had increased to 67%. Both of these changes were statistically highly significant.

Biomass of Herbaceous Vegetation and Mulch

Biomass at the end of the growing season is dominated by *Andropogon scoparius* (Table 4). The effect of the prescribed burn on *Andropogon* production was dramatic, with a highly significant increase from 53.2 g/m² before the burn to 120.4 g/m² after. The only other significant change was that of mulch, which declined from 51.4 g/m² before the burn to 2.4 g/m² afterward. Total forb production increased from 15.1 g/m² before the burn to 20.7 g/m² after. Total current-year production (exclusive of mulch) increased from 71.0 g/m² before the burn to 146.7 g/m² after.

Table 4. Biomass of herbaceous vegetation in 0.25 m² plots.

	A. scoparius		Total forb		S. nutans		B. scandens		Mulch	
	-biomass in grams-									
PLOT	1987	1989	1987	1989	1987	1989	1987	1989	1987	1989
1N	12.50	17.33	9.37	16.48					7.95	
1S	11.90	16.76	3.69	18.18					13.92	
2N	17.04	38.92	5.11	1.99					17.90	
2S	14.49	29.54	4.83	13.07					14.77	
3N	15.06								68.46	8.07
3S	10.23	28.12							12.50	
4N	14.20	70.74	7.10							
4S	5.11	36.93	1.14	3.98					4.54	
5N	18.75	17.32	2.27	30.96					11.65	
5S	9.09	30.96	9.94						19.60	
6N	10.79	43.18	8.52						5.40	
6S	15.91	49.43					3.41	3.41	11.36	
7N	20.17	18.75	0.85		10.23	20.74				
7S	15.62	34.65	1.99						32.95	
8N	9.94	41.48								
8S	0.85	29.26							36.08	4.06
9N	22.16	28.98	3.12							
9S	4.54	23.86	3.12	3.12				3.98		
10N	25.00	19.89	10.51							
10S	12.50	25.85	3.98	15.62						
TOT	265.85	601.95	75.54	103.40	10.23	20.74	3.41	7.39	257.08	12.13
	-g/m²-									
AV	53.17	120.39	15.11	20.68	2.05	4.15	0.68	1.48	51.42	2.43
STATISTICAL SIGNIFICANCE OF CHANGE BETWEEN YEARS										
	**		n.s.						**	
TOTAL ANNUAL PRODUCTION:			1987 - 71.01 g/m²							
			1989 - 146.70 g/m²						**	

Forbs were not identified to species in 1987, before the burn. In the sample after the burn, forbs were identified and are shown in Table 5. *Dalea purpurea* was the most abundant species, occurring on 5 plots and averaging 12.4 g/m², about 60% of the total forb biomass. Although total forb biomass increased somewhat, forbs disappeared from 6 of the 15 plots in which they occurred before the fire.

Table 5. Biomass of forbs in 0.25 m² plots.

	Total forb		Forb Composition - 1989 Only		
	-biomass in grams-				
PLOT	1987	1989	D. purpurea	Other - species	
1N	9.37	16.48	16.48		
1S	3.69	18.18	13.35	Rudbeckia hirta	4.83
2N	5.11	1.99	1.99		
2S	4.83	13.07		Grindelia lanceolata	13.07
3N					
3S					
4N	7.10				
4S	1.14	3.98		Rudbeckia hirta	3.98
5N	2.27	30.96	14.77	Liatris aspera	16.19
5S	9.94				
6N	8.52				
6S					
7N	0.85				
7S	1.99				
8N					
8S					
9N	3.12				
9S	3.12	3.12		Acacia angustissima	3.12
10N	10.51				
10S	3.98	15.62	15.62		
TOT	75.54	103.40	62.21		
		-g/m²-			
AV	15.11	20.68	12.44		

SUMMARY AND DISCUSSION

Saratoga Landing Blackland Prairie Natural Area was substantially covered with prairie at the time of settlement, with encroachment and invasion by woody vegetation occurring fairly recently (after 1951). Woody plant cover on a prairie within the natural area was about 20% in 1987. At that time, *Ilex decidua* was the most common woody species, following by *Berchemia scandens, Rhamnus caroliniana, Juniperus virginiana* and others of lower abundance. The dominant grass was *Andropogon scoparius,* with 57% cover and 53.2 g/m² net production over the growing season. Dead organic remains (mulch) covered 13% of the ground and contained 51.4 g/m² biomass. Bare ground had an areal cover of 18%.

In March of 1989, a prescribed burn of the prairie was conducted. In September of that year vegetation was again sampled. Total woody plant cover had decreased slightly (not statistically significant); species response was variable, and resprouting was common. *Juniperus* and *Berchemia* declined significantly; *Rhamnus* increased significantly, apparently due to prolific resprouting; others did not change significantly. However, most woody plants were top-killed; resprouting masked the adverse effect. Among herbaceous plants, seasonal net production doubled. However, the 146.2 g/m² annual production was only about 18% of that reported by Irving (1980) for a prairie in the Grand Prairie of eastern Arkansas, and 29% of that reported by Diamond (1980) for the Fayette Prairie, an outlier of the Texas blackland prairies. Mulch virtually disappeared and bare ground nearly quadrupled to 67%. The increase in bare ground was also contributed to by *Andropogon,* which decreased in cover at the same time it increased in biomass. Apparently basal leaves were reduced as culms became taller.

Most woody plants were adversely affected by the one prescribed fire, but most resprouted. Repeated fires will probably kill most woody plants. Both the response to the controlled fire and examination of aerial photos indicate that fire was important in maintaining these prairies prior to 1951, at which time effective fire supression may have become established. Grazing pressure may also have been reduced at that time. Removal of mulch and increase in area of bare ground by fire may accelerate erosion on these sloping sites, and frequent wildfires probably contributed to the eroded areas that exist on the blackland prairies. Prescribed fire appears to be an effective technique for managing these prairies, but should be undertaken cautiously because of the potential for erosion.

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