

VEGETATIONAL CHANGES OVER AN ELEVEN-YEAR PERIOD IN A REMNANT BLACKLAND PRAIRIE IN WALKER COUNTY, TEXAS

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ABSTRACT

Vegetational changes over an 11-year period (2005 to 2016) are recorded in a remnant blackland prairie in Walker Co., Texas using permanent vegetation monitoring plots as a basis for following future vegetation changes. This remnant prairie is privately owned and is part of working cattle and hay production ranch called Lone Oak Ranch. The remnant prairie area has been managed historically and currently to preserve and maintain this rare and globally imperiled habitat. Visually, vegetation within much of the prairie did not appear to change substantially in the 11-year period from 2005. However, along the periphery of the prairie and within the prairie itself woody encroachment has progressed substantially. Data collected in this study confirm that woody species encroachment has increased 65% from an average of 11,078 stems/ha to 18,322 stems/ha in all three plots combined. Along the periphery of the prairie, woody species increased 58% from an average of 30,501 to 48,167 stems/ha. Average absolute cover increased 79% from 177.3% to 317.7% total cover. In general, native prairie species such as little bluestem and indiagrass increased substantially while early successional native grasses such as bushy bluestem and old field three-awn decreased. Average herbaceous stem density increased 15.4% from an average of 265.3 stems/m² to 306.2 stems/m². Despite the increase in woody stems, overall, the prairie has not visually changed dramatically in the 11 years between samples.

Lone Oak Ranch includes one of the largest and most pristine (well-recovered, in part) blackland prairies known in the Pineywoods of East Texas (Keith, pers. observ.). Lone Oak Prairie is composed of approximately 120 acres of remnant and/or restored blackland prairie just west of Huntsville, Texas (Figure 1). Historical ground disturbance such as farming and intensive grazing has occurred throughout the property, but these historically disturbed areas have reverted naturally to a composition primarily of native herbaceous species typical for blackland prairies such as indiagrass (*Sorghastrum nutans*), little bluestem (*Schizachyrium scoparium*), meadow dropseed (*Sporobolus compositus*), silver bluestem (*Bothriochloa laguroides*), and Florida paspalum (*Paspalum floridanum*). Some areas have been encroached by the non-native invasive species (NNIS) King Ranch bluestem (*Bothriochloa ischaemum*); however, this species appears to be much less prominent than previously

observed and has decreased in areas where it was previously abundant. The surrounding forests are a matrix of pine-hardwood and bottomland hardwood forests with a dense shrub layer and sparse herbaceous understory.

Lone Oak Prairie is particularly susceptible to encroaching development. Interstate Hwy 45 and heavily traveled Hwy 30 to Bryan-College Station intersect less than a mile to the east of the property (Figure 1). The resulting development (including gas stations, restaurants, hotels, and a Wal-Mart) is typical of the structures found at such major intersections. A recently constructed local roadway (parallel to I-45) and the associated structures (including office buildings, retirement community, and a shopping mall) are located less than one-half mile to the east and south between I-45 and the property and are visible from the southeastern corner of the prairie. A subdivision and other residences are located less than one-half mile to the west. Some of the residences to the west are also visible from the property. To protect this rare habitat in perpetuity, the prairie, where the plots are established, was entered into a Grassland Reserve Program (GRP) conservation easement with the Natural Resources Conservation Service (NRCS) in 2007, with additional acreage being added in 2012.

The prairie habitat is defined as the Little Bluestem – Indiangrass Community Series (Texas Natural Heritage Program 1993). The plant association habitat can be more narrowly defined as the Little Bluestem – Missouri Coneflower (*Rudbeckia missouriensis*) – Narrowleaf Gumweed (*Grindelia lanceolata*) – Cusp Gayfeather (*Liatris mucronata*) Prairie or West Gulf Coastal Plain Fleming Calcareous Prairie (NatureServe 2016). This community type is ranked as a G1 community, meaning that it is considered “critically imperiled globally because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction with typically 5 or fewer occurrences or very few remaining individuals (<1,000) or acres (<2,000) or linear miles (<10)” (NatureServe 2016).

In order to assess long-term vegetational changes in Lone Oak Prairie as a result of management activities and natural succession, baseline vegetation data were initially collected in three permanent Fire Monitoring Handbook (FMH) vegetation plots established in 2005 (Keith & Hyde 2006; USDI 2003) (Figures 1-4). The current study reports a 2016 re-analysis of those same plots.

MATERIALS AND METHODS

The objective of this project was to determine vegetational changes to a blackland prairie over an eleven year period (USDI 2003) by re-sampling three brush FMH vegetation monitoring plots originally established and sampled in September 2005. Data collected during this study will continue to be used to monitor long term vegetation changes in a remnant blackland prairie that occur from management activities such as prescribed burning, mowing, woody species encroachment, and climate change. Prior to initial sampling, much of the prairie was cut for hay in 2003. Subsequently, the prairie has been mowed only twice since 2005 and has not been cut for hay since 2003. Plans for controlled burns have not been implemented because of the difficulties and costs of smoke management in the surrounding development.

Plot sampling for this study was conducted on 15 and 16 September 2016. Vegetation was analyzed and quantitatively described as outlined in USDI (2003) and FEAT/Firemon Integrated (FFI) software (FFI 2009) using the following specific protocols. Data for shrub transects were collected on a 5 m wide transect. All woody species, including trees, shrubs, and woody vines, were recorded. Point-line intercepts were counted for all species, including tree species that normally exceed 2 m tall. However, woody species over 2 m in height and in the canopy above the 2 m sampling rod, but not coming into contact with the rod, were not counted. Herbaceous data were collected using a 1 m square at three locations (9 m, 19 m, and 29 m) along the 30 meter transect. Digital photographs were taken in each plot following protocols outlined in USDI (2003).

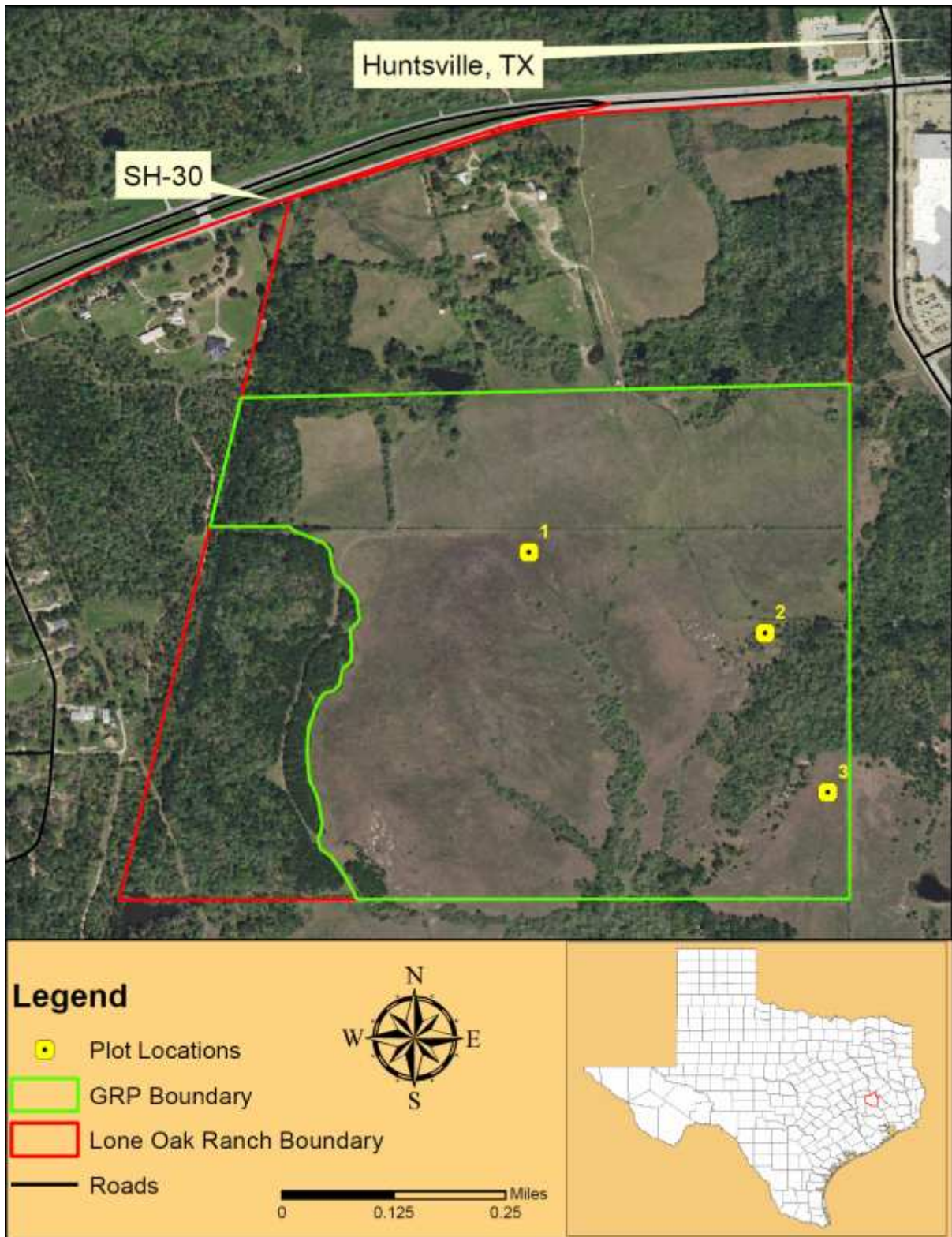


Figure 1. Fire Monitoring Handbook (FMH) vegetation monitoring plot locations on Lone Oak Ranch, part of the Grassland Reserve Program (GRP).

Plot 1 was established in a historically disturbed prairie where native herbaceous vegetation has recolonized (Figure 2). Plot 2 was established along the eastern edge of the prairie where woody species are encroaching into the grassland (Figure 3). Plot 3 was established in a near pristine portion of the prairie that is composed primarily of native herbaceous species (Figure 4). Nomenclature for species recorded in plots generally follows Diggs et al. (1999, 2006), FNA Editorial Committee (1993+), and Turner et al. (2003).

RESULTS

Table 1 shows all woody species recorded. Visually, vegetation within much of the prairie did not appear to change substantially in the 11-year period from 2005 (Figures 2 and 4). However, along the periphery of the prairie where Plot 2 is located, woody encroachment has progressed substantially (Figure 3). Data collected in this study confirm that woody species encroachment has increased 65% from an average of 11,078 stems/ha to 18,322 stems/ha in all three plots combined (Table 1). Along the periphery of the prairie in Plot 2, woody species increased from an average of 30,501 stems/ha to 48,167, an increase of 58% (Table 1). The two plots in the heart of the prairie also increased in woody stems with Plot 1 increasing 227 % from an average of 1,000 stems/ha to 3,266 stems/ha and Plot 3 woody stems increasing 104% from an average of 1,733 stems/ha to 3,533 stems/ha (Table 1). Without introduction of prescribed fires and/or mowing, this trend will most likely continue.

Table 2 shows absolute cover for all species recorded along the 30 m transects. Percentage values are absolute cover as recorded in point-line intercept transects. Absolute cover plots record all woody and herbaceous species within plots (Table 2). Average absolute cover increased 79% from 177.3% to 317.7% total cover (Table 2). These values reflect relatively dense vegetative cover with greater than one species being recorded at each 0.3 m point. An absolute cover value of 100% would indicate that an average of one species was recorded at each point. The highest cover value is recorded in Plot 1 (380%), and the lowest cover value is recorded in Plot 3 (277%) (Table 2). Average species richness (total number of species) for all plots is 34.3, increasing 23% from an average of 28 species (Table 2). In general, native prairie species such as little bluestem and indiangrass increased substantially while early successional native grasses such as bushy bluestem (*Andropogon glomeratus*) and old field three-awn (*Aristida oligantha*) decreased (Table 2). NNIS species Japanese brome increased substantially (4,150%), but King Ranch bluestem remained stable at 0.3% cover (Table 2). The large increase in cover of Japanese brome can probably be explained by above average rainfall in the spring, with 23.3 inches of precipitation occurring from February to May 2016, as compared to an average of 14.0 inches these months (NESDIS 2016). This annual species appears to fluctuate in abundance from year to year, depending on rainfall amounts (Keith, pers. observ.).

Table 3 shows herbaceous species recorded in three 1 m² plots. Herbaceous species recorded in plots includes all annual, biennial, and perennial species that die above ground each year and either reemerge from seed (annuals) or resprout from root bases (biennials and perennials). Herbaceous species richness and densities are often used to measure the health of ecosystems because of their susceptibility to competition from woody species encroachment in fire-suppressed habitats (Gotelli & Colwell 2001). Average herbaceous stem density recorded in plots in 2016 is 306.2 stems/m², increasing 15.4% from 265.3 stems/m² in 2005 (Table 3). The highest number of herbaceous stems was recorded in Plot 2 (321.7 stems/m²); the lowest number of stems was recorded in Plot 3 (294.7 stems/m²) (Table 3). Herbaceous species richness increased 5 % from an average of 33.7 species to 35.3 species (Table 3). Similarly to cover transects, Japanese brome increased 551% from 1.4 stems/m² to 9.3 stems/m². Conversely, King Ranch bluestem decreased 55% in Plot 3 (only plot it was recorded) from 4.2 stems/m² to 1.9 stems/m² (Table 3). Other notable species are highlighted in the tables (Tables 1, 2, 3).

DISCUSSION

Despite increasing woody species encroachment, the size and overall appearance of the prairie hasn't changed dramatically in the eleven years between sampling periods. Mowing of the prairie has been somewhat effective in slowing woody species encroachment; however, the overall number of woody stems has increased substantially. Continued expansion of native prairie grasses such as little bluestem and indiangrass continues but may have reduced the abundance of some forb species through interspecific competition. Both of these species greatly increased in overall cover and number of stems, while several prairie forb species have decreased. Early successional prairie species such as bushy bluestem and old field threawn continue to decrease in abundance as the prairie continues to recover from historical ground disturbance. NNIS species are still present, but don't appear to be a threat to change the overall composition of the prairie. Japanese brome, while increasing substantially from 2005, is a small component of the overall biomass of the prairie and fluctuates greatly from year to year. Monitoring of these vegetation plots will continue to determine whether implemented management practices are effective in maintaining this imperiled habitat.

Table 1. Density (stems/ha) for all woody species recorded in plots as recorded in 30 m X 5 m plots along the OP-30P transect. Species highlighted include those species increasing substantially highlighted in green and those decreasing highlighted in orange.

Species ↓ Year →	Average			#1	#1	#2	#2	#3	#3
	2005	2016	% Change	2005	2016	2005	2016	2005	2016
<i>Berchemia scandens</i>	689.0	977.7	41.9			2067	2933		
<i>Celtis laevigata</i>	89.0	177.7	99.6			267	533		
<i>Cornus drummondii</i>	2422.3	2133.3	-11.9			7267	6400		
<i>Crataegus crus-gallii</i>	244.3	311.0	27.3			733	933		
<i>Crataegus spathulata</i>	66.7	133.3	100.0			200	400		
<i>Diospyros virginiana</i>	66.7	155.7	133.5			200	467		
<i>Forestiera ligustrina</i>	755.7	2466.7	226.4			2267	7400		
<i>Frangula caroliniana</i>	177.7	100.0	-43.7			533	300		
<i>Gleditsia triacanthos</i>	66.7	66.7	0.0	67		133	200		
<i>Ilex decidua</i>	89.0	0.0	-100.0			267			
<i>Ilex vomitoria</i>	44.3	44.3	0.0			133	133		
<i>Juniperus virginiana</i>	89.0	66.7	-25.1	200		67	200		
<i>Ligustrum sinense</i>	44.3	89.0	100.8			133	267		
<i>Lonicera japonica</i>	66.7	577.7	766.5			200	1733		
<i>Lonicera sempervirens</i>	0.0	222.3	Inf				667		
<i>Parthenocissus quinquefolia</i>	0.0	22.3	Inf				67		
<i>Pinus taeda</i>	22.3	0.0	-100.0			67			
<i>Prunus mexicana</i>	22.3	22.3	0.0			67	67		
<i>Quercus virginiana</i>	89.0	0.0	-100.0			267			
<i>Rubus trivialis</i>	1399.7	3577.7	155.6	733	2933	2933	6067	533	1733
<i>Sideroxylon lanuginosum</i>	255.7	222.0	-13.2			300	333	467	333
<i>Smilax bona-nox</i>	1422.3	2533.3	78.1		133	4267	7000		467
<i>Symphoricarpos orbiculatus</i>	2822.0	4155.7	47.3		200	7733	11267	733	1000

Species ↓ Year →	Average			#1	#1	#2	#2	#3	#3
	2005	2016	% Change	2005	2016	2005	2016	2005	2016
Toxicodendron radicans	111.0	133.3	20.1			333	400		
Ulmus alata	0.0	44.3	Inf				133		
Viburnum rufidulum	0.0	22.3	Inf				67		
Vitis cinerea	22.3	44.3	98.5			67	133		
Zanthoxylum clava-herculis	0.0	22.3	Inf				67		
All species	11078.0	18322.0	65.4	1000	3266	30501	48167	1733	3533
Species Richness	9.7	10.7	10.3	3	3	23	25	3	4

Table 2. Percent absolute cover of all recorded species along a 30 m transect in all plots sampled. Cover measurements were recorded every 0.3 m along the 30 m transect. Substrate includes leaf litter, duff, rocks, and bare soil. Species highlighted include those species increasing substantially highlighted in green and those decreasing highlighted in orange.

Species ↓ Year →	Average			#1	#1	#2	#2	#3	#3
	2005	2016	% Change	2005	2016	2005	2016	2005	2016
Agalinis heterophylla	0.3	1.0	200.0				2.0	1.0	1.0
Ambrosia psilostachya	2.0	0.7	-66.7	3.0	2.0	3.0			
Ambrosia trifida	0.7	0.0	-100.0			2.0			
Amphiachyris dranunculoides	1.3	1.7	25.0	1.0	4.0	2.0	1.0	1.0	
Andropogon glomeratus	6.3	0.3	-94.7	5.0		7.0	1.0	7.0	
Aristida longespica	1.3	2.3	75.0	1.0	4.0	2.0	3.0	1.0	
Aristida oligantha	10.7	4.3	-59.4	23.0	11.0	9.0			2.0
Berchemia scandens	0.0	0.3	Inf				1.0		
Bothriochloa ischaemum	0.3	0.3	0.0					1.0	1.0
Bothriochloa laguroides	13.7	14.7	7.3	13.0	6.0	12.0	27.0	16.0	11.0
Brickellia eupatorioides	0.0	1.0	Inf		3.0				
Bromus japonicus	0.7	28.3	4150.0		36.0	2.0	16.0		33.0
Carex cherokeensis	5.3	16.3	206.3	9.0	25.0	2.0	23.0	5.0	1.0
Carex microdonta	2.0	17.7	783.3	3.0	44.0	2.0	8.0	1.0	1.0
Centaurea americana	0.0	1.7	Inf		3.0		2.0		
Chaerophyllum tainturieri	0.0	0.3	Inf		1.0				
Cornus drummondii	0.3	0.0	-100.0			1.0			
Croton monanthogynus	1.0	8.3	733.3	1.0	20.0	2.0	5.0		
Cuscuta indecora	2.3	0.3	-85.7			5.0	1.0	2.0	
Dalea compacta	0.0	0.3	Inf						1.0
Dalea multiflora	1.0	0.3	-66.7	1.0	1.0	2.0			
Desmanthus illinoensis	1.0	1.0	0.0		1.0	3.0			2.0

Absolute Cover (%) Species ↓ Year →	Average			#1	#1	#2	#2	#3	#3
	2005	2016	% Change	2005	2016	2005	2016	2005	2016
<i>Dichanthelium oligosanthes</i> spp. <i>scribnerianum</i>	5.3	6.0	12.5	7.0	8.0	8.0	6.0	1.0	4.0
<i>Digitaria cognata</i>	0.0	0.7	Inf				1.0		1.0
<i>Echinacea sanguinea</i>	0.0	0.3	Inf						1.0
<i>Eragrostis hirsuta</i>	0.0	2.0	Inf		1.0				5.0
<i>Eragrostis intermedia</i>	3.7	1.0	-72.7	5.0		6.0	3.0		
<i>Euphorbia bicolor</i>	6.0	16.0	166.7	11.0	28.0	7.0	12.0		8.0
<i>Eustoma grandiflorum</i>	0.0	0.3	Inf		1.0				
<i>Fimbristylis puberla</i>	0.0	0.7	Inf				2.0		
<i>Galactia volubilis</i>	0.0	0.3	Inf				1.0		
<i>Gleditsia triacanthos</i>	0.0	0.7	Inf				2.0		
<i>Grindelia lanceolata</i>	4.7	6.3	35.7	10.0	19.0	2.0		2.0	
<i>Hedyotis nigricans</i>	1.0	3.0	200.0		6.0	1.0	2.0	2.0	1.0
<i>Heliotropium tenellum</i>	0.0	1.0	Inf		3.0				
<i>Indigofera miniata</i>	0.3	0.0	-100.0			1.0			
<i>Iva annua</i>	13.3	5.3	-60.0	18.0	7.0	8.0	8.0	14.0	1.0
<i>Liatris mucronata</i>	0.3	0.0	-100.0					1.0	
<i>Monarda citriodora</i>	0.0	2.0	Inf		2.0		2.0		2.0
<i>Muhlenbergia capillaris</i>	0.3	0.0	-100.0			1.0			
<i>Neptunia lutea</i>	0.3	0.0	-100.0	1.0					
<i>Oenothera speciosa</i>	0.7	0.0	-100.0	1.0		1.0			
<i>Oxalis dillenii</i>	0.3	0.3	0.0	1.0			1.0		
<i>Panicum capillare</i>	0.0	3.7	Inf		11.0				
<i>Paspalum dilatatum</i>	0.0	2.0	Inf				4.0		2.0
<i>Paspalum floridanum</i>	3.7	7.0	90.9		2.0	9.0	15.0	2.0	4.0
<i>Paspalum pubiflorum</i>	0.0	1.0	Inf		3.0				
<i>Paspalum setaceum</i>	0.3	0.0	-100.0	1.0					
<i>Phalaris caroliniana</i>	0.0	0.7	Inf		1.0				1.0
<i>Plantago virginica</i>	0.0	0.3	Inf		1.0				
<i>Rubus trivialis</i>	2.3	7.3	214.3			7.0	15.0		7.0
<i>Rudbeckia missouriensis</i>	9.0	6.0	-33.3	8.0	11.0	10.0	6.0	9.0	1.0
<i>Salvia lyrata</i>	0.3	0.3	0.0				1.0	1.0	
<i>Schizachyrium scoparium</i>	28.7	68.7	139.5	5.0	36.0	30.0	79.0	51.0	91.0
<i>Setaria parviflora</i>	6.0	7.0	16.7	3.0	3.0	9.0	4.0	6.0	14.0
<i>Smilax bona-nox</i>	0.0	1.7	Inf				5.0		
<i>Solidago altissima</i>	2.3	2.0	-14.3	2.0	3.0	1.0		4.0	3.0
<i>Sorghastrum nutans</i>	9.0	27.7	207.4	6.0	29.0	2.0	12.0	19.0	42.0
<i>Sporobolus compositus</i>	23.0	19.7	-14.5	27.0	19.0	18.0	11.0	24.0	29.0

Absolute Cover (%)	Average			#1	#1	#2	#2	#3	#3
Species ↓ Year →	2005	2016	% Change	2005	2016	2005	2016	2005	2016
<i>Strophostyles leiosperma</i>	0.0	1.7	Inf				5.0		
<i>Symphyotrichum ericoides</i>	3.0	8.7	188.9	5.0	18.0		2.0	4.0	6.0
<i>Symphyotrichum praealtum</i>	0.0	2.3	Inf		6.0		1.0		
<i>Symphoricarpos orbiculatus</i>	2.3	2.3	0.0			7.0	6.0		1.0
<i>Verbena halei</i>	0.3	0.0	-100.0	1.0					
<i>Verbena xutha</i>	0.3	0.3	0.0	1.0	1.0				
Total	177.3	317.7	79.1	173.0	380.0	184.0	296.0	175.0	277.0
Species Richness	28.0	34.3	22.6	28	37	33	37	23	29
Substrate	2.0	0.0	-100.0	4.0	0.0	1.0	0.0	1.0	0.0

Table 3. Density (stems/m²) for all herbaceous species in plots sampled as recorded in three 1 m² plots along the OP-30P transect. Species highlighted include those species increasing substantially highlighted in green and those decreasing highlighted in orange.

Stems/m²	Average			#1	#2	#2	#2	#3	#3
Species ↓ Year →	2005	2016	% Change	2005	2016	2005	2016	2005	2016
<i>Acalypha gracilens</i>	0.0	0.2	Inf				0.7		
<i>Agalinis heterophylla</i>	0.0	0.3	Inf				1.0		
<i>Ambrosia psilostachya</i>	2.8	0.9	-68.2	1.7	2.7	4.0		2.7	
<i>Amphiachyris dranunculoides</i>	1.0	1.2	22.3		2.7	2.3	1.0	0.7	
<i>Andropogon glomeratus</i>	5.9	0.0	-100.0	5.3		8.3		4.0	
<i>Aristida longespica</i>	1.8	3.9	120.2			5.3	11.7		
<i>Aristida oligantha</i>	52.0	8.9	-82.9	119.3	17.3	28.3		8.3	9.3
<i>Asclepias linearis</i>	0.0	0.1	Inf		0.3				
<i>Asclepias viridis</i>	0.1	0.0	-100.0	0.3					
<i>Bothriochloa ischaemum</i>	4.2	1.9	-55.4					12.7	5.7
<i>Bothriochloa laguroides</i>	4.1	9.3	127.6	1.0	5.3	4.3	16.0	7.0	6.7
<i>Brickellia eupatorioides</i>	1.6	0.2	-85.7	4.0	0.7	0.7			
<i>Bromus japonicus</i>	1.4	9.3	551.2		3.7	4.3	7.0		17.3
<i>Carex cherokeensis</i>	4.5	25.8	477.1	3.0	10.3	0.7	33.3	9.7	33.7
<i>Carex microdonta</i>	2.1	30.8	1365.7	1.0	60.7	2.6	7.7	2.7	24.0
<i>Centaurea americana</i>	0.0	0.9	Inf		2.0		0.7		
<i>Chaerophyllum tainturieri</i>	0.0	0.9	Inf		1.7		1.0		
<i>Chamaesyce nutans</i>	1.1	0.1	-90.0			3.3			0.3
<i>Coreopsis tinctoria</i>	0.3	0.0	-100.0					1.0	
<i>Croton monanthogynus</i>	1.1	5.0	345.1	1.7	6.3	1.7	7.7		1.0
<i>Cuscuta indecora</i>	5.3	0.0	-100.0			1.3		14.7	
<i>Dalea compacta</i>	0.3	0.2	-33.0		0.7	0.7		0.3	

Stems/m ²	Average			#1	#2	#2	#2	#3	#3
Species ↓ Year →	2005	2016	% Change	2005	2016	2005	2016	2005	2016
<i>Dalea multiflora</i>	3.9	2.0	-48.7	8.0	6.0	3.7			
<i>Desmanthus illinoensis</i>	0.3	1.4	347.4		0.7	0.7	2.7	0.3	1.0
<i>Dichanthelium oligosanthes</i> subsp. <i>scribnerianum</i>	5.3	5.6	4.1	7.7	5.3	7.0	7.3	1.3	4.0
<i>Dichondra caroliniana</i>	0.1	0.7	506.1			0.3	1.0		1.0
<i>Digitaria cognata</i>	0.0	0.8	Inf						2.3
<i>Echinacea sanguinea</i>	0.2	0.8	247.8			0.7	2.3		
<i>Elymus virginicus</i>	0.0	0.4	Inf				1.3		
<i>Eragrostis intermedia</i>	12.0	17.0	41.7		10.0	36.0	41.0		
<i>Euphorbia bicolor</i>	2.6	2.9	13.0	4.0	3.7	2.0	4.0	1.7	1.0
<i>Eustoma grandiflorum</i>	0.0	0.4	Inf		1.3				
<i>Gaura brachycarpa</i>	0.9	0.0	-100.0	2.7					
<i>Grindelia lanceolata</i>	1.9	1.0	-47.4	4.0	3.0	0.7		1.0	
<i>Hedyotis nigricans</i>	3.6	3.4	-3.2	8.3	7.3	1.7	2.0	0.7	1.0
<i>Heliotropium tenellum</i>	0.9	2.2	150.4	2.3	6.3			0.3	0.3
<i>Indigofera miniata</i>	0.3	0.1	-67.0			1.0	0.3		
<i>Iva annua</i>	22.8	3.8	-83.4	27.7	5.7	15.3	4.3	25.3	1.3
<i>Liatris mucronata</i>	0.3	0.0	-100.0					1.0	
<i>Monarda citriodora</i>	0.0	2.7	Inf		3.7		2.7		1.7
<i>Neptunia lutea</i>	1.1	0.0	-100.0	0.7		2.7			
<i>Oenothera speciosa</i>	1.6	4.0	155.3		4.0	4.0	5.7	0.7	2.3
<i>Oxalis dillenii</i>	0.7	2.8	310.3	1.3	2.3	0.7	4.3		1.7
<i>Panicum capillare</i>	0.0	2.3	Inf		7.0				
<i>Paspalum dilatatum</i>	0.3	1.7	400.0			1.0			5.0
<i>Paspalum floridanum</i>	3.7	2.6	-30.3			11.0	7.7		
<i>Paspalum setaceum</i>	1.9	0.0	-100.0			5.7			
<i>Phalaris caroliniana</i>	0.0	1.4	Inf		1.3		0.7		2.3
<i>Plantago virginica</i>	0.0	4.1	Inf		11.7				0.7
<i>Polygonum aviculare</i>	0.0	0.1	Inf						0.3
<i>Polytaenia texana</i>	0.1	0.0	-100.0			0.3			
<i>Rudbeckia missouriensis</i>	7.0	4.0	-42.7	4.3	8.3	5.3	1.0	11.3	2.7
<i>Salvia azurea</i>	0.6	0.0	-100.0			1.7			
<i>Salvia lyrata</i>	0.4	1.1	151.1	0.3		0.7	2.7	0.3	0.7
<i>Schizachyrium scoparium</i>	29.3	76.1	159.5	7.3	50.0	21.7	83.3	59.0	95.0
<i>Setaria parviflora</i>	6.8	4.8	-29.4	6.3		11.7	11.7	2.3	2.7
<i>Silphium asteriscus</i>	0.0	0.1	Inf				0.3		
<i>Solidago altissima</i>	3.9	2.7	-31.7	0.7	1.3	5.7	3.3	5.3	3.3
<i>Sorghastrum nutans</i>	8.7	8.3	-3.9	1.3	5.3	5.7	5.3	19.0	14.3

Stems/m ² Species ↓ Year →	Average			#1	#2	#2	#2	#3	#3
	2005	2016	% Change	2005	2016	2005	2016	2005	2016
<i>Sporobolus compositus</i>	41.0	34.2	-16.5	36.3	26.7	47.0	32.7	39.6	43.3
<i>Stylosanthes leiosperma</i>	0.6	0.7	17.6			1.7	2.0		
<i>Symphytotrichum ericoides</i>	5.8	6.1	6.0	5.3	6.7	0.7	4.3	11.3	7.3
<i>Symphytotrichum praealtum</i>	1.8	3.7	106.4	2.3	10.0			3.0	1.0
<i>Symphytotrichum subulatum</i>	0.1	0.0	-100.0	0.3					
<i>Verbena halei</i>	5.3	0.1	-97.9	16.0	0.3				
<i>Warnockia scutellarioides</i>	0.0	0.1	Inf						0.3
All stems	265.3	306.2	15.4	284.5	302.3	264.1	321.7	247.2	294.7
Species Richness	33.7	35.3	5.0	30	37	42	36	29	33

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Figure 2. Plot 1: 15 September 2005 and 16 September 2016. The conspicuous, white-bracted species is *Euphorbia bicolor*.



Figure 3. Plot 2: 15 September 2005 and 15 September 2016. Notice woody encroachment to left of view increasing from 2005 to 2016.



Figure 4. Plot 3: 30 September 2005 and 16 September 2016. Prairie grasses visually more prominent in 2016.