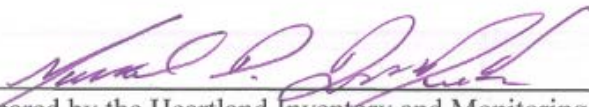
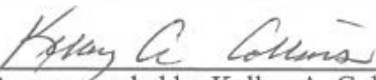


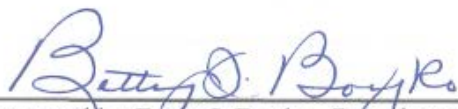


Treatment Recommendations for Prairie Landscape Areas at Fort Scott National Historic Site, Fort Scott, Kansas




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Introduction

Fort Scott National Historic Site (FOSC) was established in 1978 through public law 95-484 to commemorate its significant role in the opening of the west, as well as in the Civil War and strife in the State of Kansas that preceded it. The 17-acre site includes 20 historic structures, a parade ground and areas of rehabilitated tallgrass prairie as part of the larger cultural landscape. The prairie at FOSC provides the last remaining link between the historic structures and the historic landscape. Early accounts describe the natural resources of the area and their relevance to the fort's location:

Fort Scott lies within the Central Irregular Plains Ecoregion of Kansas. This ecoregion is further subdivided into the Osage Cuesta, Wooded Osage, and Cherokee Plains ecoregions of which Fort Scott lies within the Wooded Osage Plains (USEPA 2000). The Osage Cuesta ecoregion is characterized by east facing cuestas (ridges with steep, cliff like faces on one side and gentle slopes on the other), gently undulating plains, and perennial streams. The ridge of each cuesta is topped with resistant limestone, while thick layers of shale underlie the gentle slopes. The Wooded Osage Plains ecoregion is a broad transition region shifting from prairie to woodland. There is a greater presence of limestone in the subsurface bedrock within this subdivision than is present in the Osage Cuesta ecoregion.

The site for the military post was chosen for its strategic defensive position, its location with regard to neighboring American Indian tribes, and its access to abundant natural resources, particularly water and timber. Home to over 900 types of native vegetation, topographical reports indicated that the heavily wooded river and creek bottoms were plentiful with black walnut, sycamore, elm, and oak. A luxuriant undergrowth of shrubs including redbud, witch hazel, shadbush (Amelanchier Canadensis), currant, raspberry, prairie rose, and grapevines also lined the bottoms. The soil was a "dark chocolate-colored loam"; limestone-lined ravines and streambeds lay "bare on the ridges." Bituminous coal was found "immediately under the surface of the ground...sticking out from the banks of the Marmata [sic]." Joseph K. Barnes, "Medical Topography and Diseases of Fort Scott" in Report on the Sickness and Mortality Among the Troops in the Middle Division (1852). From: National Park Service 2010 - Cultural Landscape Report, Fort Scott National Historic Site.

Our recommendations apply to the rehabilitated prairie areas in the northeast and southwest portion of the site previously referred to as prairie units A and C (Figure 1). We concur with the FOSC Cultural Landscape Report (CLR) that the rehabilitated prairie adjacent to the infantry barracks be managed as part of the infantry quadrangle landscape area (Figure 2). The CLR calls for removal of the prairie vegetation and planting of turf grass in this area due to shade created by several mature trees which has made the establishment of prairie difficult. The CLR also recommends extending the prairie area in the southern portion of the site out to Wall Street and Skubitz Plaza. We contend that expanding the prairie is a low priority. Our recommendations, therefore, focus on managing and improving existing prairie areas.



Figure 1. Fort Scott National Historic Site, Fort Scott Kansas. Rehabilitated prairie areas are shown in yellow.

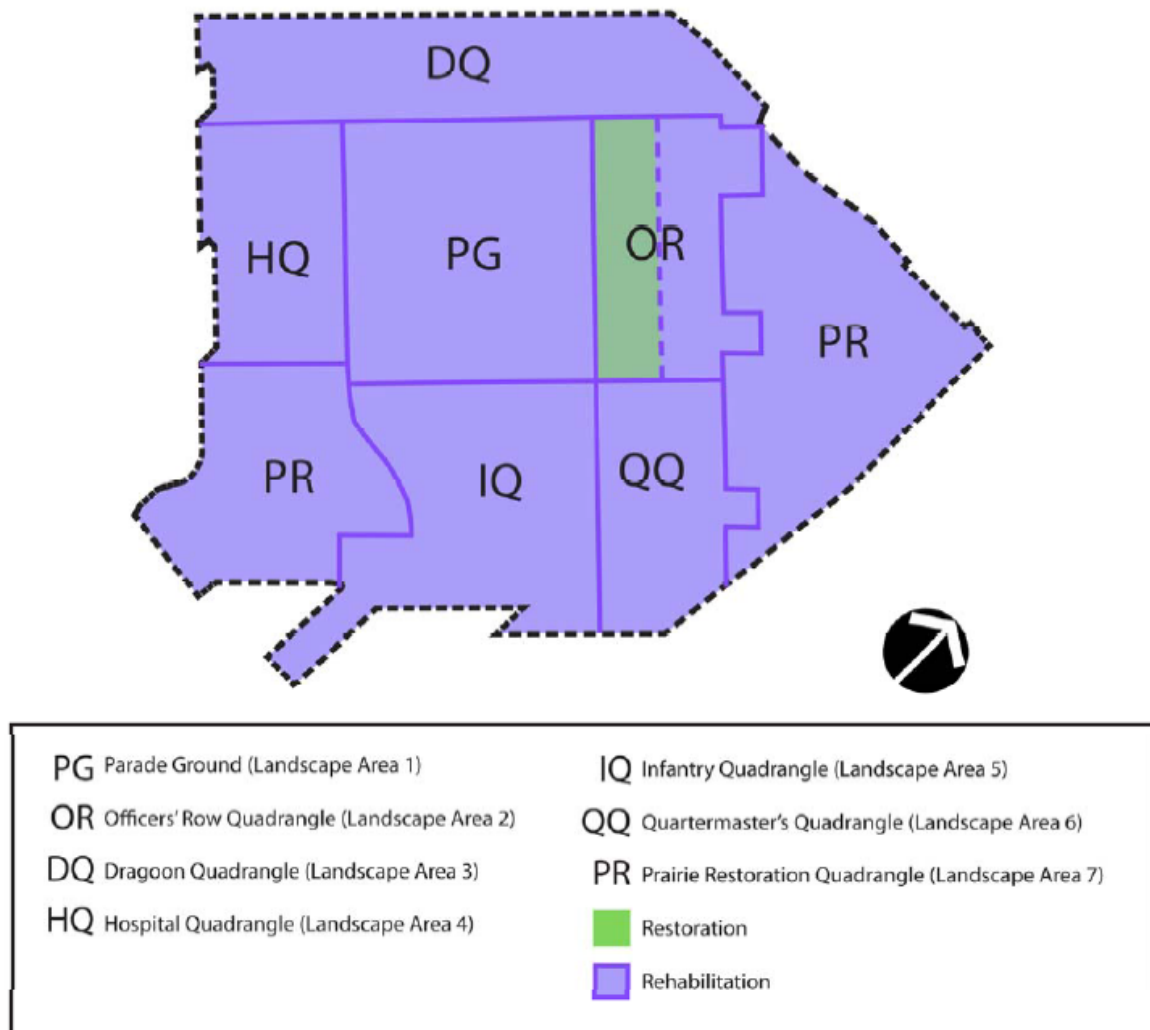


Figure 2. Landscape areas and treatment approaches for Fort Scott NHS, Fort Scott Kansas. Taken from 2010 Cultural Landscape Report for Fort Scott NHS.

Cultural Landscape Rehabilitation Objectives for the Fort Scott Prairie

The process to rehabilitate the FOSC prairie began in 1979, although little documentation regarding management objectives were found for this early period. The Fort Scott National Historic Site General Management Plan, May 1993 supports the prairie rehabilitation with the following management objectives:

- Restore and cultivate the native vegetation which provides the historic setting for the primary restoration and interpretive period of 1842 to 1853.
- Provide security for the cultural resources of the Historic Site through the protection against fire, theft and vandalism.
- Protect the integrity of the historic scene. Mitigate, to the fullest extent possible, modern intrusions on the historic scene.

Shetlar-Griffith-Shetlar, an engineering and landscape architecture firm, prescribed the initial seed mix for the prairie rehabilitation. In the parlance of cultural landscape management, this project constituted a “rehabilitation” and not a “reconstruction” as the prairie was considered a compatible use rather than an exact replica of site conditions (Birnbaum 1994). From a prairie restoration stand-point, however, the project was a “reconstruction” because the prairie was planted on a site on which it had been obliterated. The differences in usage between architectural and ecological perspectives can be confusing; for this document, we will use the NPS terminology for cultural landscape management – *rehabilitation*.

From 1984-2008, seeding, sod transplants, and plantings were undertaken to better approximate the species composition of the historic vegetation with the Little Osage Prairie serving as a model site. The Little Osage Prairie is a native tallgrass prairie remnant near Nevada, Missouri. We do not know when it was first suggested that the Little Osage Prairie serve as the model for the FOSC rehabilitation. The first reference to this goal is found in Jackson and Knoblauch (1985). While it is sensible to look at the species composition of nearby native prairie remnants as one source of information, it does not appear that a deliberate decision making process was used to establish the Little Osage Prairie as the model. Furthermore, Jackson and Knoblauch (1985) argued that....”

“It is doubtful that Fort Scott Prairie will ever be restored to a tallgrass prairie because of its original seeding scheme, its isolation, and its unique shallow and southern soil exposure. Fort Scott prairie should be maintained as a mixed-grass prairie through burning, mowing, and the removal of woody species. “

Despite this suggestion, the notion that rehabilitation of the FOSC prairie aspired to simulate the Little Osage Prairie persisted. This is evidenced by efforts after 1986 to augment the original planting, and several repeat studies comparing the composition of the FOSC prairie to the Little Osage Prairie. While it is commendable to strive for a complete facsimile of a native prairie, it may not be feasible or necessary to achieve the goals for the FOSC prairie as identified in the FOSC Cultural Landscape Report (2010). The CLR, in fact, noted the historical inaccuracy of tall grasses in such close proximity to Fort structures, but stated that the prairie.....

“serves an education purpose, contributes to viewer experience, creates a physical and visual buffer and provides shelter for birds and wildlife habitat. As the restored prairie serves these purposes, it should be managed as a resource.”

We will return to, and attempt to resolve, the question of what is an appropriate model to guide prairie rehabilitation at FOSC in the management recommendations section.

Cultural Landscape Maintenance History for the Fort Scott Prairie

Appendix 1 provides a timeline of management actions undertaken in the FOSC prairie. The initial seed mix consisted of five grass and eight forb species (Shetlar-Griffith-Shetlar 1978) (Table 1), and was planted with a seed drill. Following the initial planting in 1979, the prairie was mowed annually in the spring and fall for the first three years. Beginning in 1984, additional seeding was performed by hand broadcast and seed drill for three consecutive years.

Table 1. Species planted during initial prairie planting at Fort Scott NHS, 1979.

Species	Common Name	Type
<i>Amorpha canescens</i>	lead plant	Forb
<i>Andropogon gerardii</i>	big bluestem	Grass
<i>Bouteloua curtipendula</i>	sideoats grama	Grass
<i>Dalea purpurea</i>	purple prairie clover	Forb
<i>Helianthus maximiliani</i>	Maximilian sunflower	Forb
<i>Liatris aspera</i>	tall blazing star	Forb
<i>Panicum virgatum</i>	switchgrass	Grass
<i>Ratibida pinnata</i>	pinnate prairie coneflower	Forb
<i>Rudbeckia hirta</i>	blackeyed Susan	Forb
<i>Salvia azurea</i>	azure blue sage	Forb
<i>Schizachyrium scoparium</i>	little bluestem	Grass
<i>Silphium laciniatum</i>	compassplant	Forb
<i>Sorghastrum nutans</i>	Indian grass	Grass

Jackson and Knoblauch (1985) conducted a quantitative evaluation of the FOSC prairie and a formal comparison of the FOSC prairie to the species composition of the Little Osage Prairie. In the final report, the authors concluded:

“The vegetation analysis of the Fort Scott Prairie showed it to be as an example of mixed-grass prairie, typical of western Kansas. The Coefficient of Similarity with the Little Osage Prairie site was a low 37.3%. The Fort Scott Prairie does not represent a native tallgrass prairie. The Fort Scott Prairie has very high populations of Downy brome grass and Smooth brome grass which are management problems. Bromes tend to proliferate and choke out most other prairie species and are indicators of disturbance. Species diversity and richness for the Fort Scott Prairie are also low.”

Minimal management of the FOSC prairie was carried out between 1987 and 1992, with only a single mowing event documented.

K.A. Gifford, a biological technician at FOSC, conducted a second quantitative evaluation of the FOSC prairie in August 1993. She calculated a Coefficient of Similarity of 33% between the 1993 FOSC prairie data and the 1985 data collected for the Little Osage Prairie by Jackson and Knoblauch (1985). She concluded, therefore, that...

“the prairie units have changed somewhat since 1986 with an increase in number of species identified, from 66 to 72, and a change in species composition, 48 new species.....This change has not become closer [sic] to the “model” of Little Osage because the similarity index has remained the same.” (Gifford 1993)

Aggressive management of the FOSC prairie occurred between 1993 and 2001. Invasive, exotic species and overabundant woody species were removed. Overseeding with native prairie plants

was conducted, and sod was transplanted from a nearby native prairie. Two consecutive prescribed fires were conducted in the spring of 1998 and 1999. Much of this work is documented in a series of reports by D.E. Compton (1995, 1996, and 1998). Despite the intensified efforts, the prairie was described as follows in the 2004 fire management plan.

“Exotic invasive plant species have, in places, invaded to such an extent as to dominate the vegetative community. Woody plant encroachment is also a persistent concern at the NHS. Blackberry and black locust are two species particularly troublesome species [sic] due to their propensity to spread via the root system. Black walnut, wild plum, poison ivy, and tree of heaven among others have also become established in the restored prairie. The presence of exotic plant species, especially the brush and forb species, has resulted in a decidedly non-period appearance.” (National Park Service, 2004. Fort Scott NHS, Fire Management Plan)

For the period of 2002 to 2011, prescribed fires were conducted in the spring of 2002 and every third year thereafter. Other activities recorded for this period are removal of invasive, exotic species and overabundant woody species, and additional seeding and planting in 2008.

Current Conditions of the Fort Scott Prairie

In 2011, The Heartland Inventory and Monitoring Program (HTLN) in cooperation with Craig Corpstein conducted a complete floristic inventory of the prairie at FOSC. HTLN provided taxonomic assistance to Corpstein, a graduate student at Pittsburg State University. Chris Kopek and Karola Mlekush assisted sampling on five occasions throughout the growing season for a total of 11 days of sampling for the group. The floristic inventory serves as the basis of our analysis of current conditions, although Corpstein was consulted to identify the ten most abundant species in the prairie in 2011.

A total of 186 plant species were recorded in 2011 (Appendix 2). Species richness of the FOSC prairie has increased over time with the number of native species tripling between the 1986 and 2011 surveys (Table 2). While the total number of both native and introduced plant species has increased, introduced plant species, as a percentage of the total, have decreased by almost half. Important caveats of this finding include sample timing and effort. The 1985 study was done in May, and the 1993 study in August. In 2011, sampling was conducted throughout the growing season. Furthermore, total sampling effort in 2011 was double that of previous studies based on the number of field days (4, 5, and 11 in chronological order). It is possible, therefore, that some species were present, but overlooked during previous studies. That said, a total of 111 species were identified for the first time in 2011. This represents a large increase in species richness, many of which are native, even if some species were previously overlooked.



Table 2. Summary of species richness as categorized by plant guild and nativity during three vegetation surveys (1986, 1993, 2011) at Fort Scott NHS.

Summary characteristic	1986	1993	2011
Total number species	62	109	186
Native species richness (%)	35 (56.5)	73 (67.0)	141 (75.8)
Introduced species richness (%)	27 (43.5)	36 (33.0)	45 (24.2)
Native forb richness (%)	27 (43.5)	44 (40.4)	96 (51.6)
Introduced forb richness (%)	23 (37.0)	19 (17.4)	30 (16.1)
Native grass richness (%)	8 (12.9)	8 (11.0)	21 (11.3)
Introduced grass richness (%)	3 (4.8)	13 (11.9)	10 (5.4)
Native shrub richness (%)	0 (0.0)	4 (3.7)	4 (2.2)
Introduced shrub richness (%)	0 (0.0)	0 (0.0)	0 (0.0)
Native tree richness (%)	0 (0.0)	10 (9.1)	12 (6.5)
Introduced tree richness (%)	0 (0.0)	3 (2.8)	3 (1.6)
Native vine richness (%)	0 (0.0)	3 (2.8)	8 (4.3)
Introduced vine richness (%)	1 (1.6)	1 (0.9)	2 (1.1)

Species conservatism expresses the degree to which a particular plant species indicates relatively *natural* conditions. Each species' coefficient of conservatism represents its degree of tolerance to disturbance and fidelity to a particular natural, often defined as pre-settlement, plant community (Freeman and Morse 2002, Swink and Wilhelm 1994). Individual species values range from 0 to 10. Zero indicates a ubiquitous species that has little fidelity to any remnant natural community, while 10 indicates a species that is almost always restricted to a pre-settlement remnant. Coefficients of conservatism may be used to calculate a floristic quality index score (Swink and Wilhelm 1994). The score can be thought of as an overall measurement of the plant community's "naturalness".

Although the FOSC prairie is composed of a large number of species, most of the species have low coefficients of conservatism, suggesting that they are generalists rather than prairie specialists. The majority of species have coefficients of conservatism of 3 or less (Figure 3). No species assigned a conservatism value of 9 or 10 were observed in the FOSC prairie (Figure 3). Of those species with the highest coefficients of conservatism (CoC) found at FOSC, the majority were included in the original (1978) or subsequent plantings (Table 3).

Table 3. Eleven species with the highest coefficient of conservatism (CoC) values in the Fort Scott prairie. Species in **bold** were planted.

Species	Common Name	CoC
<i>Amorpha canescens</i>	leadplant	7
<i>Carex bicknellii</i>	Bicknell's sedge	8
<i>Carex meadii</i>	Mead's sedge	7
<i>Dalea candida</i>	white prairie clover	7
<i>Dalea purpurea</i>	Purple prairie clover	7
<i>Echinacea pallida</i>	pale purple coneflower	7
<i>Eryngium yuccifolium</i>	button eryngo	7
<i>Galium pilosum</i>	hairy bedstraw	7
<i>Helianthus mollis</i>	ashy sunflower	7
<i>Sporobolus heterolepis</i>	prairie dropseed	8
<i>Tradescantia ohiensis</i>	bluejacket	7

The rank ordering of species according to their abundance has shifted over time. While invasive species were among the most abundant species in the early years of the rehabilitation, invasives have decreased in abundance through time (Table 4). Five of the most abundant species were non-native in 1985, but that number decreased to 3 in 1986 and to only 1 in 2011 (Table 4). The rank ordering of native warm season grasses (i.e., prairie grasses) has shifted over time. In 1986, the 10 most abundant species included three warm season grasses (i.e., prairie grasses), and they were ranked 4th, 7th, and 8th in abundance. In 1993, four warm season grass species were among the 10 most abundant and ranked 1st, 2nd, 4th, and 8th in abundance. In 2011, however, only 2 warm season grasses were among the 10 most abundant species and ranked 1st and 3rd (Table 4).

Overall, prairie rehabilitation efforts have improved the condition of the prairie. The mean CoC calculated only from grass and forb species has increased from 2.2 in 1986, to 2.3 in 1993, and to 2.9 in 2011. An increase in the total species observed and the percentage of species with an assigned CoC value contribute to the increasing index score, as does the addition of prairie species with higher CoC values. The abundance of prairie grasses increased dramatically between 1986 and 1993, and prairie grasses remained dominant in 2011. The increase in species richness appears to be the result of both natural colonization and management activities. Planting appears to have been very successful with 34 of the 35 (97%) planted species still reported from the prairie in 2011 (Tables 1 & 5, Appendix 2). Furthermore, about 25% of the 112 species first seen in 2011 were documented as being planted or brought in with the sod transplants (Compton 1995, 1996, 1998; Table 5).

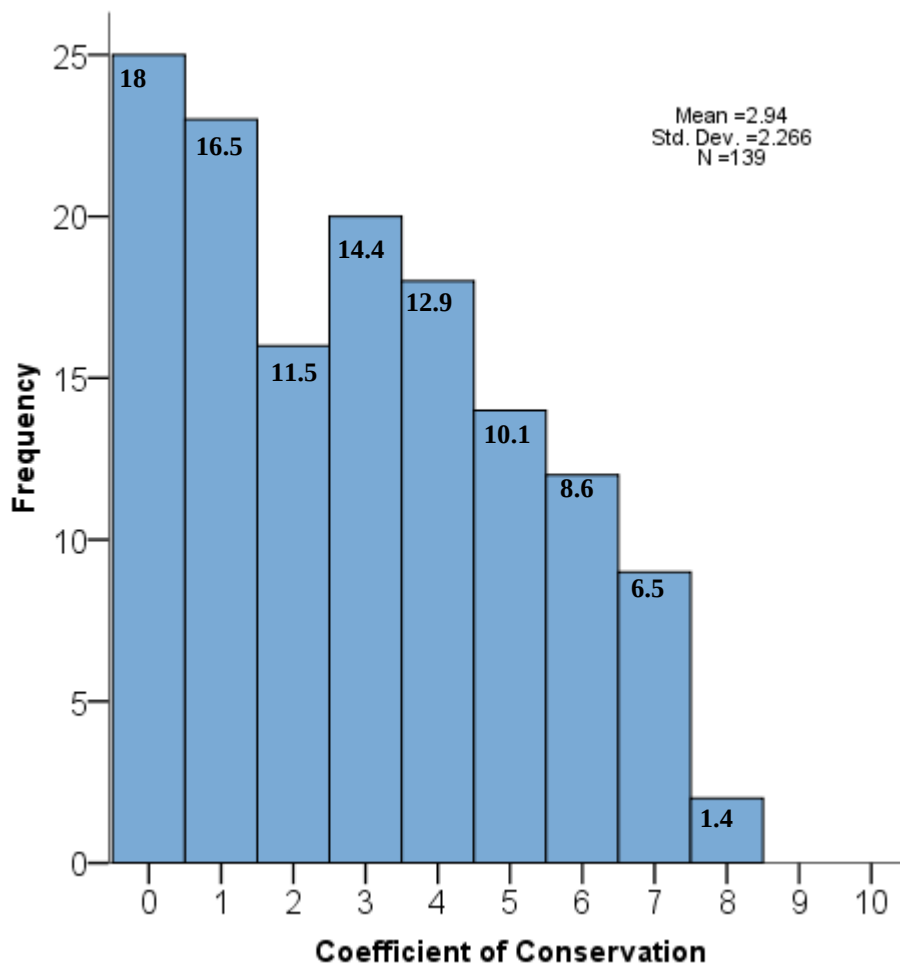


Figure 3. Histogram depicting frequency distribution of coefficient of conservation (CoC) values for plant species found in 2011 at Fort Scott NHS. Higher coefficients indicate greater conservatism. Bold values within bars indicate the percentage of plant species with that corresponding CoC. Non-native species are not assigned a CoC value.

Table 4. Coefficient of conservatism values for the ten most abundant species listed greatest to least abundant for three prairie studies at Fort Scott NHS - 1986 (Jackson and Knoblauch), 1993 (Grifford), and 2011 (Corpstein 2012).

Species	Common Name	Coefficient of Conservatism*
1986		
<i>Aegilops cylindrica</i>	jointed goat grass	*
<i>Bromus tectorum</i>	downy brome	*
<i>Hordeum pusillum</i>	little barley	0
<i>Panicum virgatum</i>	switch grass	4
<i>Cerastium fontanum</i>	common mouse's-ear-chickweed	*
<i>Trifolium dubium</i>	small hop clover	*
<i>Bouteloua curtipendula</i>	side-oats grama	5
<i>Andropogon gerardii</i>	big bluestem	4
<i>Chaerophyllum procumbens</i>	spreading chervil	0
<i>Bromus inermis</i>	smooth brome	*
1993		
<i>Panicum virgatum</i>	switch grass	4
<i>Bouteloua curtipendula</i>	side-oats grama	5
<i>Bromus secalinus</i>	rye brome	*
<i>Andropogon gerardii</i>	big bluestem	4
<i>Helianthus maximiliani</i>	Maximilian's sunflower	3
<i>Chenopodium album</i>	lamb's-quarters goosefoot	0
<i>Dalea purpurea</i>	purple prairie-clover	7
<i>Schizachyrium scoparium</i>	little bluestem	5
<i>Digitaria sanguinalis</i>	hairy crab grass	*
<i>Lactuca saligna</i>	willow-leaf lettuce	*
2011		
<i>Andropogon gerardii</i>	big bluestem	4
<i>Ambrosia trifida</i>	giant ragweed	0
<i>Panicum virgatum</i>	switch grass	4
<i>Helianthus maximiliani</i>	Maximilian's sunflower	3
<i>Eupatorium altissimum</i>	tall joe-pye-weed	2
<i>Solidago altissima</i>	Canadian goldenrod	1
<i>Ambrosia artemisiifolia</i>	common ragweed	0
<i>Bromus inermis</i>	smooth brome	*
<i>Acalypha virginica</i>	Virginia copperleaf	0
<i>Ratibida pinnata</i>	gray-head prairie-coneflower	3

* indicates non-native species

bold indicates common prairie grasses

Table 5. List of plant species planted after 1993 in a reconstructed prairie at Fort Scott NHS and identified in 2011 after not being identified during two previous surveys (1986 and 1993).

Species	Common Name	Type
<i>Amorpha canescens</i>	leadplant	Shrub
<i>Asclepias tuberosa</i>	butterfly milkweed	Forb
<i>Asclepias viridis</i>	green antelopehorn	Forb
<i>Callirhoe alcaeoides</i>	light poppymallow	Forb
<i>Dalea candida</i>	white prairie clover	Forb
<i>Echinacea pallida</i>	pale purple coneflower	Forb
<i>Elymus canadensis</i>	Canada wildrye	Grass
<i>Eryngium yuccifolium</i>	button eryngo	Forb
<i>Helianthus mollis</i>	ashy sunflower	Forb
<i>Hypoxis hirsuta</i>	common goldstar	Forb
<i>Liatris aspera</i>	tall blazing star	Forb
<i>Monarda fistulosa</i>	wild bergamot	Forb
<i>Oxalis violacea</i>	violet woodsorrel	Forb
<i>Penstemon digitalis</i>	talus slope penstemon	Forb
<i>Ratibida columnifera</i>	upright prairie coneflower	Forb
<i>Rudbeckia hirta</i>	blackeyed Susan	Forb
<i>Salvia azurea</i>	azure blue sage	Forb
<i>Silphium integrifolium</i>	wholeleaf rosinweed	Forb
<i>Silphium laciniatum</i>	compassplant	Forb
<i>Solidago missouriensis</i>	Missouri goldenrod	Forb
<i>Solidago rigida</i>	Stiff goldenrod	Forb
<i>Spartina pectinata</i>	prairie cordgrass	Grass
<i>Sporobolus heterolepis</i>	prairie dropseed	Grass
<i>Symphyotrichum ericoides</i>	heath aster	Forb
<i>Symphyotrichum pilosum</i>	hairy white oldfield aster	Forb
<i>Tradescantia ohiensis</i>	bluejacket	Forb
<i>Tripsacum dactyloides</i>	eastern gamagrass	Grass

Management Recommendations

We conclude that the current species composition, particularly the abundance of warm season grass species and the number of native flowering forbs, is adequate to provide the historic scene and meet the educational purposes of the FOSC prairie. Any future plans to augment the species composition (e.g., plantings, sod transplants) should be scrutinized for necessity and cost benefit. We see no harm in additional plantings. In fact, we encourage engaging local prairie enthusiasts

to volunteer as prairie gardeners, or other creative, low-cost options. Efforts to develop partnerships to assist with prairie maintenance are also recommended in the FOSC Cultural Landscape Report (p. 113). It is our opinion, however, that the limited resources available for prairie management be directed at the greatest threats. The spread of invasive and exotic species and the overabundance of woody species could undermine the expressed purposes of the FOSC prairie. Our recommendations, therefore, focus on those threats. In general, we propose a period of intensive management (3-5 years) that would include annual prescribed fire and manual control of invasive, exotic, and woody species. The FOSC Fire Management Plan (National Park Service 2004) similarly called for a period of annual prescribed fire, but the recommendation was not implemented. Following the period of intensive management, maintenance will consist of biennial prescribed fire and periodic treatment of exotics and woody species. Work plans and implementation guides are included below.

Prescribed Fire Management

We recommend an annual, late spring burn cycle for 3 to 5 years in order to suppress the invasive woody plants and cool season grasses and stimulate native plants. The targeted woody plants include the native smooth (*Rhus glabra*) and winged (*Rhus copallina*) sumacs. Cool season grasses of concern include annual bluegrass (*Poa annua*), annual bromes (*Bromus secalinus*, *Bromus sterilis*), cheatgrass (*Bromus tectorum*), Kentucky bluegrass (*Poa pratensis*), orchardgrass (*Dactylis glomerata*), tall fescue (*Schedonorus arundinaceus*), timothy (*Phleum pratense*), and smooth brome (*Bromus inermis*).



Burns in late spring most effectively suppress exotic cool season grasses as compared to fire during other seasons (Walsh 1995, Howard 1996). The recommended interval of annual burning stands in contrast to the three-year return interval applied to the FOSC prairie in the recent past (Kelley Collins, personal communication 2011). After this initial 5-year period, we recommend a 2-year burn interval which was the projected fire regime in the 1880s (Earls 2006) and as data from Konza prairie show the least woody plant cover is in annually burned prairie as opposed to prairie burned at intervals of three or more years (Briggs et al. 2002). At that point, rotating the burn cycle between seasons may best maintain plant diversity as this more closely approximates the natural fire regime in Eastern Kansas where lightning-ignited fires occurred most frequently during the dry summer months (July and August) (Bragg 1995) and Native Americans burned most extensively in the late fall, particularly October (McClain and Elzinga 1994).

In addition to the objectives of controlling undesirable species given above, the use of fire at FOSC is also important for fuels management. Prescribed fire may protect buildings, which are only a few meters from the prairie at FOSC. Periodic burning of the prairie reduces the risk of damage to adjacent structures from accidental fires, such as occurred in 1995. Reducing the fuel load periodically should reduce the amount of heat that might be put onto the buildings in an unplanned fire situation (Chandler et al. 1983).

Although treating non-native and invasive species with fire is a priority, native species also benefit. Even a small prairie, like the one at Fort Scott, can benefit from periodic burning. Native grasslands require periodic fire to maintain plant species diversity (Bragg 1995, Anderson 2006). Burning creates bare ground allowing light to penetrate the soil surface. As the soil warms, certain species are more likely to germinate than in a shaded, unburned condition (Glenn-Lewin et al. 1990). Smoke has also been shown to improve germination in some species (Jefferson et al. 2008, Schwilk and Zavala 2012). Stimulation of nutrient cycling is also an important result of burning. Although prairie soil is typically low in nitrogen, prairie plants are adapted to that condition and the occasional boost of nitrogen freed up as a result of burning benefits some species (Blair 1997, Anderson et al. 2006) including stimulation of flowering (Glenn-Lewin et al. 1990).

Prescribed fire also helps to control native woody plants which have gained abundance in recent years. It has been suggested that increased CO² in the atmosphere favors woody plants. Carbon and nitrogen enrichment from the air and precipitation may present favorable conditions for undesirable species allowing them to expand (Harmens et al. 2004, Springsteen et al. 2010).

Prior to implementing prescribed fire, NPS recommends developing well-defined objectives for use in a burn plan (USDI National Park Service 2003). We suggest the following management objectives, which have been reviewed by NPS Midwest Region Fuels Specialist (Scott Beacham, National Park Service, Midwest Regional Office) and Assistant Fire Management Officer for (Deon Steinle, U.S. Fish and Wildlife Service, Marais des Cygnes National Wildlife Refuge) who conducts burns at FOSC.

Resource management objectives:

1. Burn the vegetation with moderate to high fire severity over $\geq 60\%$ of the prairie. Reduce one hour fuel loading by $\geq 50\%$ of pre-burn fuel loads.
2. Topkill $\geq 40\%$ of woody species during each burn. Within 3-5 burns, reduce woody plant cover to $\leq 5\%$ of the 2011 amount.

Operational objectives

1. Provide for safety of fire fighter, park staff, and the public.
2. Protect historic structures.
3. Keep fire inside boundaries of the proposed prescribed fire units.

Mowing as a Surrogate for Prescribed Fire

During the first five years, if a prescribed fire has not been carried out by May 15 of the specified year, then mowing should be timed to coincide with flowering of shrub species – typically

between May 15 and June 15. Mower height should be set to 6-12 inches. Although we recommend fire as the primary management technique for managing the Fort Scott prairie, we recognize that weather, budgets, and availability of qualified personnel may limit its use. Mowing is commonly used as an alternative to fire in grasslands. Studies on mowing indicate that it can decrease woody plant abundance when applied annually (Gibson et al. 1993, Ratajczak et al. 2011). Mowing, however, does not functionally replace fire in that flowering is not stimulated in the same way, and mowing tends to favor grasses over forbs (Ehrenreich and Aikman 1963, Gibson et al 1993). Mowing alone can increase cool season grasses (Ehrenreich and Aikman 1963, Gibson et al 1993) and reduce grassland productivity (Ehrenreich and Aikman 1963). Raking or removing the mowed material may help to increase light to the soil leading to an increase in flowering forbs over mowing alone (Tix and Charvat 2005).

Invasive Plant Management

While the 2011 survey documented 42 non-native species, we only recommend control for a limited number of woody plant species at this time. These include the non-native Siberian elm (*Ulmus pumila*), tree-of-heaven (*Ailanthus altissima*), and white mulberry (*Morus alba*) as well as the native honey locust (*Robinia pseudoacacia*) and sumacs when found in the prairie. We also recommend chemical control of a single grass and forb species due to their potential for spread – Johnsongrass (*Sorghum halepense*) and crownvetch (*Securigera varia*). Johnsongrass is a designated noxious weed in Kansas and control is mandated by law. Daffodils (*Narcissus* spp.) should also be chemically treated as a pest plant within burn units as the smoke generated is noxious. Given the difficulties in chemically controlling cool season grasses, we support first attempting control with fire (see *Prescribed Fire Management*). We believe that fire may also control many of the remaining non-native plants, including sweetclover (*Melilotus officinalis*). However, the park should continue efforts to hand-pull sweetclover in order to maintain progress that has been made in controlling this species,

The treatment of non-native and pest woody plants in the prairie at Fort Scott National Historical site can be easily accomplished using relatively simple techniques. Workers may cut woody stems greater than 0.5 inches in diameter and then apply a ready-to-use formulation of triclopyr (e.g., Pathfinder II) to the cut surface using a hand or backpack sprayer. For woody stems less than 0.5 inches in diameter in the prairie, workers may apply foliar treatments of fluroxoppyr/triclopyr (e.g., Pasturegard) with backpack sprayers as the plants re-sprout following fire. Alternatively, these small diameter stems may be cut using loppers or a brush-cutter and then treated with ready-to-use formulation of triclopyr or use the same formulation to directly wet the lower 12-15 inches of the stem (i.e., basal bark treatment). Applications may be made any time that rain is not expected within 2 hours (unless otherwise noted on the label) and that temperatures are above freezing and the ground is free of snow and ice. Note: the shrubs bordering the prairie on the southeast corner of site serve as a visual barrier and should not be treated.

Crownvetch and Johnsongrass can also be treated with foliar applications of herbicide from backpack sprayers. In order to reduce the number of chemicals on hand, FOSC staff may also use fluroxoppyr/triclopyr to treat crownvetch during June-September. An application of 2% glyphosate (e.g., Round-up) in June or July prior to seed set should be applied to control Johnsongrass.

Table 6. Summary of treatment recommendations for plant management at Fort Scott NHS.

Species Targeted	Treatment Date	Recommended Treatment
Crownvetch	June-September	Foliar - fluroxopyr/triclopyr
Johnsongrass	June or July	Foliar - 2% glyphostae
Smooth sumac	Temperature above freezing. Ground free of ice and snow.	Basal bark – triclopyr+basal oil
Siberian elm		Cut stump – triclopyr+basal oil
White mulberry		Foliar - fluroxopyr/triclopyr
Winged sumac		
Locust		
Sweetclover	May-June (prior to seed set)	Hand pull Spot mow Foliar - aminopyralid

Information on crownvetch, Johnsongrass, tree-of-heaven, and Siberian elm may be found here: http://www.na.fs.fed.us/fhp/invasive_plants/weeds/.

Summary

Past efforts to rehabilitate the Fort Scott prairie through seeding and planting have been largely successful. A large number of plant species currently comprise the Fort Scott prairie. Warm season grasses, by and large, dominate the prairie and account for the bulk of above ground biomass. A large number of flowering forbs, many of which were planted, occur sporadically throughout the prairie.

Although species rich, many of the species in the Fort Scott prairie have low coefficient of conservatism (CoC) values. Low CoC values indicate species that grow under a wide range of environments and have moderate to low fidelity to prairie. The Floristic Quality Index of the Fort Scott prairie increased over time, however, the low index scores indicate that the Fort Scott prairie only partially represents a native prairie remnant.

Nevertheless, the current species composition, particularly the abundance of warm season grass species and the number of native flowering forbs, is adequate to provide the historic scene and meet the educational purposes of the Fort Scott prairie. It is not necessary for the Fort Scott prairie to replicate a tall grass prairie ecosystem to achieve those goals. We suggest, therefore, that future management target the overabundant woody, and invasive, exotic species.

An annual work plan that incorporates our management recommendations for the next 3-5 years is provided in Figure 4. Our recommendations are purposefully simple and designed to achieve the historical setting and education purposes of the prairie by promoting a reasonable facsimile of native tall grass prairie.

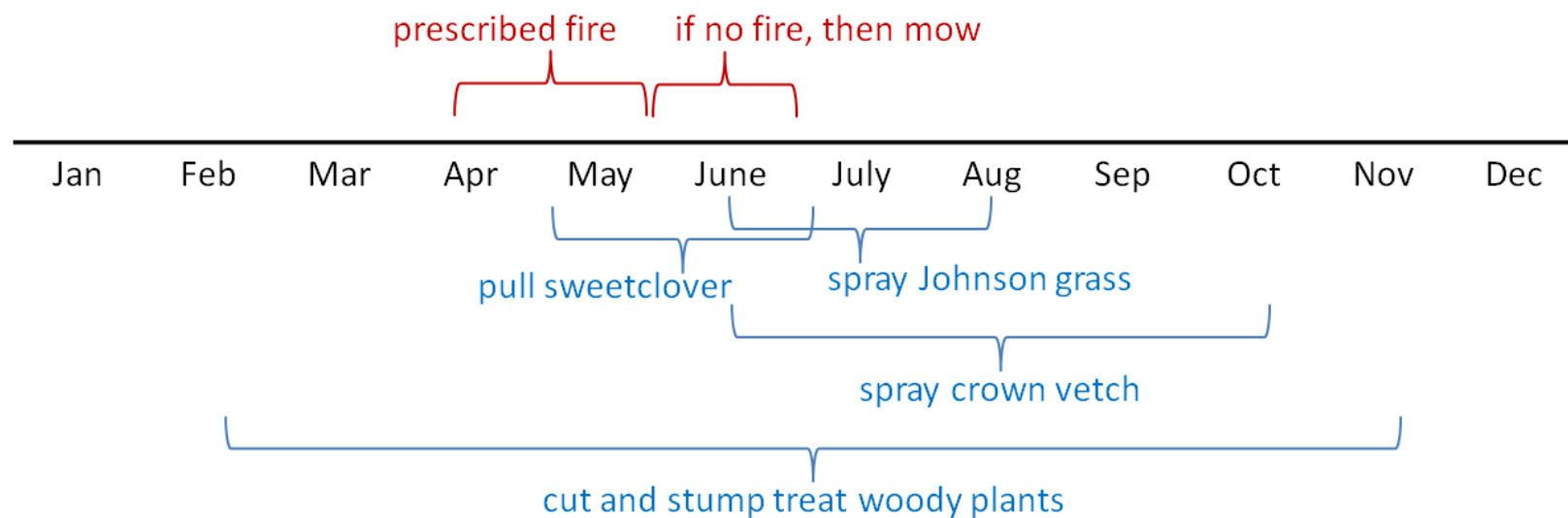


Figure 4. Proposed annual work plan for prairie management at Fort Scott NHS.

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Appendix 1. Fort Scott Prairie Rehabilitation and Maintenance History, 1979 – 2011.

Year	Management Activity	Vegetation Survey or Monitoring	Citation
1979	Initial seeding of Units A and B. Seeding performed by hand and seed drill.		Stubbendieck & Wilson 1986.
1980	Spring and fall mowing.		Resource Management Plan 1987.
1981	Spring and fall mowing.		Resource Management Plan 1987.
1982	Spring and fall mowing.		Resource Management Plan 1987.
1983		December 1, Jackson & Vinyard conduct walk-through of prairie.	Knoblauch & Jackson 1986.
1984	April, additional seeding of Units A and B. Unit C established at this time. Seeding performed by hand broadcast and seed drill.		Knoblauch & Jackson 1986.
1985	May, additional seeding of Units A and B. Seeding performed by hand and seed drill. Uncertain if Unit C was also seeded.		Knoblauch & Jackson 1986.
1986	May, additional seeding of Units A and B. Seeding performed by hand and seed drill. Uncertain if Unit C was also seeded.		Knoblauch & Jackson 1986.
1987			
1988		October 20, District Conservationist, Ronald Briggs evaluates prairie.	Briggs 1988.
1989	Spring mowing		Collins & Gifford 1993.

Year	Management Activity	Vegetation Survey or Monitoring	Citation
1990			
1991			
1992		June, Regional Restoration Ecologist, Lisa Thomas examines prairie.	Collins & Gifford 1993;
1993	Summer, manual removal of Johnson grass and yellow sweet clover.	Aug. 9-12, Kathy Gifford surveys prairie.	Collins & Gifford 1993; Gifford 1993.
1994	Manual and mechanical removal of exotic and woody vegetation.		Compton 1994.
1995	April, accidental partial burn of Unit A, near walking trail. Manual and mechanical removal of exotic and woody vegetation. Sod transplant into burned area of Unit A.		Compton 1995.
1996	Manual and mechanical removal of exotic and woody vegetation. Fall seeding of sections of Units A and B1. Seed collected from remnants located within 50 miles.	Monitoring of Unit A sod transplant areas.	Compton 1996.
1997	Manual and mechanical removal of exotic and woody vegetation. Nov., seeding performed in all units. Seeds purchased, not collected locally.	Late summer/early fall survey of Units A and B. Unit C not surveyed. Vouchers not collected.	Compton 1997.
1998	May, prescribed burn. Fall seeding Manual and mechanical removal of exotic and woody vegetation.		Compton Oct. 1998-Sept. 1999. Kelley Collins
1999	March, prescribed burn. Manual and mechanical removal of exotic and woody vegetation.	Monitoring of Unit A sod transplant areas.	Compton Oct. 1998-Sept. 1999.

Year	Management Activity	Vegetation Survey or Monitoring	Citation
2000	Seeding. Manual and mechanical removal of exotic and woody vegetation		Kelley Collins
2001	Seeding		Kelley Collins
2002	Mid April, prescribed burn.		Park files.
2003			
2004			
2005	April 8, prescribed burn. Manual, mechanical, and herbicide removal of exotic and woody vegetation.		Photographs & press release. Galen Ewing's work log.
2006	Manual, mechanical, and herbicide removal of exotic and woody vegetation.		Galen Ewing's work log.
2007	Manual, mechanical, and herbicide removal of exotic and woody vegetation.		Galen Ewing's work log.
2008	April 2, prescribed burn. Manual, mechanical, and herbicide removal of exotic and woody vegetation. Seeding of sections of Unit A, seed purchased. Planting grass/forb plugs in Units B1 and C, plugs purchased.		Photographs & press release.
2009	Manual, mechanical, and herbicide removal of exotic and woody vegetation.		Kelley Collins, Corpstein's personal observations.
2010	Manual, mechanical, and herbicide removal of exotic and woody vegetation		Kelley Collins, Corpstein's personal observations.
2011	March 24, prescribed burn. Manual, mechanical, and herbicide removal of exotic and woody vegetation.	Craig Corpstein surveys prairie.	Kelley Collins. Galen Ewing's work log.

Appendix 2. Compiled species list from three quantitative evaluations of the Fort Scott Prairie: Jackson and Knoblauch(1986), Griffith (1993), Kopek, Mlekush, and Corpstein (2011).

Species	Common Name	Type	Nativity	1986	1993	2011	Found in all yrs
<i>Abutilon theophrasti</i>	velvetleaf	Forb	I		x		
<i>Acalypha virginica</i>	Virginia threeseed mercury	Forb	N	x		x	
<i>Acalypha ostryifolia</i>	pineland threeseed mercury	Forb	N			x	
<i>Acer negundo</i>	boxelder	Tree	N			x	
<i>Achillea millefolium</i>	common yarrow	Forb	NI	x	x	x	x
<i>Aegilops cylindrica</i>	jointed goatgrass	Graminoid	I	x	x	x	x
<i>Ageratina altissima</i>	white snakeroot	Forb	N			x	
<i>Ailanthus altissima</i>	Tree of heaven	Tree	I			x	
<i>Allium canadense</i>	meadow garlic	Forb	N	x	x	x	x
<i>Ambrosia spp.</i>	ragweed	Forb	N	x			
<i>Ambrosia artemisiifolia</i>	annual ragweed	Forb	N		x	x	
<i>Ambrosia trifida</i>	great ragweed	Forb	N		x	x	
<i>Amorpha canescens</i>	leadplant	Shrub	N			x	
<i>Ampelopsis cordata</i>	heartleaf peppervine	Vine	N			x	
<i>Andropogon gerardii</i>	big bluestem	Graminoid	N	x	x	x	x
<i>Andropogon virginicus</i>	broomsedge bluestem	Graminoid	N		x		
<i>Apocynum cannabinum</i>	Indianhemp	Forb	N			x	
<i>Asclepias syriaca</i>	common milkweed	Forb	N			x	
<i>Asclepias tuberosa</i>	butterfly milkweed	Forb	N			x	
<i>Asclepias viridis</i>	green antelopehorn	Forb	N			x	
<i>Baptisia alba</i>	white wild indigo	Forb	N			x	
<i>Baptisia australis</i>	blue wild indigo	Forb	N			x	
<i>Barbarea vulgaris</i>	garden yellowrocket	Forb	I			x	
<i>Bidens bipinnata</i>	Spanish needles	Forb	N			x	
<i>Bouteloua curtipendula</i>	sideoats grama	Graminoid	N	x	x	x	x
<i>Bouteloua dactyloides</i>	buffalograss	Graminoid	N	x	x		
<i>Bouteloua hirsuta</i>	hairy grama	Graminoid	N			x	
<i>Bromus inermis</i>	smooth brome	Graminoid	NI	x	x	x	x
<i>Bromus secalinus</i>	rye brome	Graminoid	I		x		
<i>Bromus sterilis</i>	poverty brome	Graminoid	I		x		
<i>Bromus tectorum</i>	cheatgrass	Graminoid	I	x	x	x	x
<i>Bumelia lanuginosa</i>	gum bully	Tree	N		x		
<i>Callirhoe alcaeoides</i>	light poppymallow	Forb	N			x	
<i>Callirhoe involucrata</i>	purple poppymallow	Forb	N			x	
<i>Calystegia sepium</i>	hedge false bindweed	Forb	NI		x		
<i>Capsella bursa-pastoris</i>	shepherd's purse	Forb	I		x	x	

Species	Common Name	Type	Nativity	1986	1993	2011	Found in all yrs
<i>Campsis radicans</i>	trumpet creeper	Vine	N		x	x	
<i>Carex spp.</i>	sedge	Graminoid	N	x			
<i>Carex bicknellii</i>	Bickness's sedge	Graminoid	N			x	
<i>Carex blanda</i>	eastern woodland sedge	Graminoid	N			x	
<i>Carex meadii</i>	Mead's sedge	Graminoid	N			x	
<i>Carex vulpinoidea</i>	fox sedge	Graminoid	N			x	
<i>Carya illinoensis</i>	pecan	Tree	N			x	
<i>Celtis occidentalis</i>	common hackberry	Tree	N		x	x	
<i>Cerastium vulgatum</i>	big chickweed	Forb	I	x		x	
<i>Cercis canadensis</i>	eastern redbud	Tree	N			x	
<i>Chaerophyllum procumbens</i>	spreading chervil	Forb	N	x	x	x	
<i>Chamaecrista fasciculata</i>	partridge pea	Forb	N	x	x		
<i>Chamaesyce spp.</i>	sandmat	Forb	N			x	
<i>Chamaesyce maculata</i>	Spotted sandmat	Forb	N		x		
<i>Chenopodium album</i>	Lambs quarters	Forb	NI		x	x	
<i>Chrysopsis pilosa</i>	soft golden aster	Forb	N		x		
<i>Cirsium spp.</i>	thistle	Forb	N		x		
<i>Cirsium altissimum</i>	tall thistle	Forb	N			x	
<i>Claytonia virginica</i>	Virginia springbeauty	Forb	N	x		x	
<i>Clitoria mariana</i>	Atlantic pegeonwings	Forb	N		x		
<i>Cocculus carolinus</i>	Carolina coralbead	Vine	N			x	
<i>Commelina communis</i>	Asiatic dayflower	Forb	I			x	
<i>Commelina erecta</i>	whitemouth dayflower	Forb	N		x		
<i>Convolvulus arvensis</i>	field bindweed	Vine	I	x	x	x	x
<i>Conyza canadensis</i>	Canadian horseweed	Forb	N	x	x	x	x
<i>Conyza ramosissima</i>	dwarf horseweed	Forb	N		x		
<i>Croton spp</i>	croton	Forb	N	x			
<i>Croton capitatus</i>	hogwort	Forb	N		x	x	
<i>Croton glandulosus</i>	vente conmigo	Forb	N		x		
<i>Croton monanthogynus</i>	prairie tea	Forb	N			x	
<i>Croton texensis</i>	Texas croton	Forb	N		x	x	
<i>Cuphea viscosissima</i>	blue waxweed	Forb	N			x	
<i>Cynanchum laeve</i>	honeysuckle	Vine	N			x	
<i>Cynodon dactylon</i>	Bermudagrass	Graminoid	I			x	
<i>Dactylis glomerata</i>	orchardgrass	Graminoid	I			x	
<i>Dalea candida</i>	white prairie clover	Forb	N			x	
<i>Dalea purpurea</i>	purple prairie clover	Forb	N		x	x	
<i>Daucus carota</i>	Queen Anne's lace	Forb	I	x	x		

Species	Common Name	Type	Nativity	1986	1993	2011	Found in all yrs
<i>Delphinium carolinianum</i>	Carolina larkspur	Forb	N			x	
<i>Descurainia pinnata</i>	western tansy mustard	Forb	N			x	
<i>Desmanthus illinoensis</i>	Illinois bundleflower	Forb	N		x	x	
<i>Desmodium illinoense</i>	Illinois ticktrefoil	Forb	N		x	x	
<i>Digitaria ischaemum</i>	smooth crabgrass	Graminoid	I		x	x	
<i>Digitaria sanguinalis</i>	hairy crabgrass	Graminoid	N		x		
<i>Diospyros virginiana</i>	common persimmon	Tree	N			x	
<i>Echinacea angustifolia</i>	blacksamson echinacea	Forb	N			x	
<i>Echinacea pallida</i>	pale purple coneflower	Forb	N			x	
<i>Echinocystis lobata</i>	wild cucumber	Vine	N			x	
<i>Elymus virginicus</i>	Virginia wildrye	Graminoid	N		x	x	
<i>Elymus canadensis</i>	Canada wildrye	Graminoid	N			x	
<i>Erigeron annuus</i>	eastern daisy fleabane	Forb	N	x			
<i>Erigeron strigosus</i>	prairie fleabane	Forb	N		x	x	
<i>Eryngium yuccifolium</i>	button eryngo	Forb	N			x	
<i>Erysimum capitatum</i>	sanddune wallflower	Forb	N	x			
<i>Eupatorium altissimum</i>	tall thoroughwort	Forb	N			x	
<i>Euphorbia dentata</i>	toothed spurge	Forb	NI			x	
<i>Gaillardia pulchella</i>	Indian blanket	Forb	N			x	
<i>Galinsoga quadriradiata</i>	shaggy soldier	Forb	I			x	
<i>Galium aparine</i>	stickywilly	Forb	N	x		x	
<i>Galium pilosum</i>	hairy bedstraw	Forb	N			x	
<i>Gaura longiflora</i>	longflower beeblossom	Forb	N			x	
<i>Geranium carolinianum</i>	Carolina geranium	Forb	N	x	x	x	x
<i>Geum canadense</i>	white avens	Forb	N			x	
<i>Glandularia canadensis</i>	rose mock vervain	Forb	N		x	x	
<i>Helianthus annuus</i>	common sunflower	Forb	N			x	
<i>Helianthus grosseserratus</i>	sawtooth sunflower	Forb	N	x	x	x	x
<i>Helianthus hirsutus</i>	hairy sunflower	Forb	N			x	
<i>Helianthus maximiliani</i>	Maximilian sunflower	Forb	N	x	x	x	x
<i>Helianthus mollis</i>	ashy sunflower	Forb	N			x	
<i>Helianthus salicifolius</i>	willowleaf sunflower	Forb	N			x	
<i>Hemerocallis fulva</i>	orange daylily	Forb	I			x	
<i>Hesperis matronalis</i>	dames rocket	Forb	I			x	
<i>Hordeum pusillum</i>	little barley	Graminoid	N	x	x	x	x
<i>Houstonia spp.</i>	bluet	Forb	N	x			
<i>Hypoxis hirsuta</i>	common goldstar	Forb	N			x	

Species	Common Name	Type	Nativity	1986	1993	2011	Found in all yrs
<i>Ipomoea hederacea</i>	ivyleaf morning-glory	Vine	N		x		
<i>Ipomoea lacunosa</i>	whitestar	Vine	N			x	
<i>Iris spp.</i>	iris	Forb	I	x			
<i>Iris germanica</i>	German iris	Forb	I			x	
<i>Juglans nigra</i>	black walnut	Tree	N		x		
<i>Juniperus virginiana</i>	eastern redcedar	Tree	N			x	
<i>Kummerowia stipulacea</i>	Korean clover	Forb	I	x		x	
<i>Lactuca canadensis</i>	Canada lettuce	Forb	N	x	x	x	x
<i>Lactuca floridana</i>	woodland lettuce	Forb	N		x		
<i>Lactuca saligna</i>	willowleaf lettuce	Forb	I		x		
<i>Lactuca serriola</i>	prickly lettuce	Forb	I	x	x	x	x
<i>Lamium amplexicaule</i>	henbit deadnettle	Forb	I	x		x	
<i>Lamium purpureum</i>	purple deadnettle	Forb	I	x		x	
<i>Lathyrus latifolius</i>	perennial pea	Forb	I	x	x	x	x
<i>Lepidium virginicum</i>	Virginia pepperweed	Forb	N	x			
<i>Lepidium campestre</i>	field pepperweed	Forb	I			x	
<i>Liatris aspera</i>	tall blazing star	Forb	N			x	
<i>Linaria vulgaris</i>	butter and eggs	Forb	I	x	x	x	x
<i>Lithospermum arvense</i>	corn gromwell	Forb	I			x	
<i>Lonicera japonica</i>	Japanese honeysuckle	Vine	I			x	
<i>Maclura pomifera</i>	osage orange	Tree	I		x		
<i>Malus ioensis</i>	prairie crab apple	Tree	N		x		
<i>Medicago lupulina</i>	black medick	Forb	I		x	x	
<i>Melilotus officinalis</i>	yellow sweetclover	Forb	I	x	x	x	x
<i>Mimosa nuttallii</i>	Cat claw sensitive briar	Forb	N		x	x	
<i>Mirabilis nyctaginea</i>	heartleaf four o'clock	Forb	N	x		x	
<i>Monarda fistulosa</i>	wild bergamot	Forb	N			x	
<i>Morus alba</i>	white mulberry	Tree	I		x	x	
<i>Muhlenbergia frondosa</i>	wirestem muhly	Graminoid	N			x	
<i>Muscari botryoides</i>	common grape hyacinth	Forb	I			x	
<i>Narcissus pseudonarcissus</i>	daffodil	Forb	I			x	
<i>Nothoscordum bivalve</i>	crowpoison	Forb	N	x		x	
<i>Oenothera biennis</i>	common evening primrose	Forb	N			x	
<i>Ornithogalum umbellatum</i>	sleepydick	Forb	I	x		x	
<i>Oxalis stricta</i>	common yellow oxalis	Forb	N	x	x	x	x
<i>Oxalis violacea</i>	violet woodsorrel	Forb	N			x	
<i>Panicum capillare</i>	witchgrass	Graminoid	N			x	

Species	Common Name	Type	Nativity	1986	1993	2011	Found in all yrs
<i>Panicum virgatum</i>	switchgrass	Graminoid	N	x	x	x	x
<i>Parthenocissus quinquefolia</i>	Virginia creeper	Vine	N			x	
<i>Pascopyrum smithii</i>	western wheatgrass	Graminoid	N			x	
<i>Paspalum pubiflorum</i>	hairyseed paspalum	Graminoid	N		x	x	
<i>Paspalum setaceum</i>	thin paspalum	Graminoid	N		x		
<i>Penstemon digitalis</i>	talus slope penstemon	Forb	N			x	
<i>Phleum pratense</i>	timothy	Graminoid	I		x		
<i>Physalis longifolia</i>	longleaf groundcherry	Forb	N		x	x	
<i>Physalis pumila</i>	dwarf groundcherry	Forb	N		x		
<i>Phytolacca americana</i>	American pokeweed	Forb	N	x	x	x	x
<i>Pinus nigra</i>	Austrian pine	Tree	I		x		
<i>Plantago aristata</i>	largebracted plantain	Forb	N	x			
<i>Plantago major</i>	common plantain	Forb	I		x		
<i>Plantago patagonica</i>	woolly plantain	Forb	N		x		
<i>Plantago rugelii</i>	blackseed plantain	Forb	N			x	
<i>Poa annua</i>	annual bluegrass	Graminoid	I		x		
<i>Poa pratensis</i>	Kentucky bluegrass	Graminoid	NI			x	
<i>Populus deltoides</i>	cottonwood	Tree	N		x		
<i>Potentilla recta</i>	sulphur cinquefoil	Forb	I	x	x	x	x
<i>Prunus americana</i>	American plum	Shrub	N		x		
<i>Prunus hortulana</i>	hortulan plum	Tree	N		x	x	
<i>Psoraleidium tenuiflorum</i>	slimflower scurfpea	Forb	N			x	
<i>Pyrrhopappus carolinianus</i>	Carolina desert-chicory	Forb	N		x		
<i>Quercus alba</i>	white oak	Tree	N		x		
<i>Quercus macrocarpa</i>	bur oak	Tree	N			x	
<i>Ranunculus abortivus</i>	littleleaf buttercup	Forb	N			x	
<i>Ranunculus hispidus</i>	bristly buttercup	Forb	I	x			
<i>Ratibida columnifera</i>	upright prairie coneflower	Forb	N			x	
<i>Ratibida pinnata</i>	pinnate prairie coneflower	Forb	N	x	x	x	x
<i>Rhus copallina</i>	winged sumac	Tree	N			x	
<i>Rhus glabra</i>	smooth sumac	Shrub	N		x		
<i>Rosa carolina</i>	Carolina rose	Forb	N		x		
<i>Robinia pseudoacacia</i>	black locust	Tree	N		x	x	
<i>Rubus spp.</i>	blackberry	Shrub	N			x	
<i>Rubus flagellaris</i>	dewberry	Shrub	N		x		
<i>Rubus pensilvanicus</i>	Pennsylvania blackberry	Shrub	N		x		
<i>Rudbeckia triloba</i>	browneyed Susan	Forb	N		x	x	
<i>Rudbeckia hirta</i>	blackeyed Susan	Forb	N			x	

Species	Common Name	Type	Nativity	1986	1993	2011	Found in all yrs
<i>Ruellia strepens</i>	limestone wild petunia	Forb	N			x	
<i>Rumex altissimus</i>	pale dock	Forb	N		x	x	
<i>Rumex crispus</i>	curly dock	Forb	I	x	x	x	x
<i>Salvia azurea</i>	azure blue sage	Forb	N			x	
<i>Sambucus canadensis</i>	American black elderberry	Tree	N		x		
<i>Schedonorus arundinaceus</i>	tall fescue	Graminoid	I		x	x	
<i>Schizachyrium scoparium</i>	little bluestem	Graminoid	N	x	x	x	x
<i>Securigera varia</i>	crownvetch	Forb	I			x	
<i>Senna marilandica</i>	Maryland senna	Forb	N		x	x	
<i>Setaria faberi</i>	Japanese bristlegrass	Graminoid	I		x	x	
<i>Setaria pumila</i>	yellow foxtail	Graminoid	I		x		
<i>Setaria viridis</i>	green bristlegrass	Graminoid	I		x	x	
<i>Silphium integrifolium</i>	wholeleaf rosinweed	Forb	N			x	
<i>Silphium laciniatum</i>	compassplant	Forb	N			x	
<i>Smilax bona-nox</i>	saw greenbrier	Shrub	N			x	
<i>Solanum carolinense</i>	Carolina horsenettle	Forb	N		x	x	
<i>Solanum ptychanthum</i>	West Indian nightshade	Forb	N			x	
<i>Solidago spp.</i>	goldenrod	Forb	N	x	x		
<i>Solidago altissima</i>	Canada goldenrod	Forb	N			x	
<i>Solidago missouriensis</i>	Missouri goldenrod	Forb	N			x	
<i>Solidago rigida</i>	Stiff goldenrod	Forb	N			x	
<i>Sorghastrum nutans</i>	Indiangrass	Graminoid	N	x	x	x	x
<i>Sorghum halepense</i>	Johnsongrass	Graminoid	I		x	x	
<i>Spartina pectinata</i>	prairie cordgrass	Graminoid	N			x	
<i>Sporobolus compositus</i>	tall dropseed	Graminoid	N			x	
<i>Sporobolus heterolepis</i>	prairie dropseed	Graminoid	N			x	
<i>Stellaria media</i>	common chickweed	Forb	I			x	
<i>Strophostyles helvola</i>	amberique-bean	Forb	N			x	
<i>Strophostyles leiosperma</i>	slickseed fuzzybean	Forb	N			x	
<i>Symphoricarpos orbiculatus</i>	coralberry	Shrub	N			x	
<i>Symphyotrichum ericoides</i>	heath aster	Forb	N			x	
<i>Symphyotrichum pilosum</i>	hairy white oldfield aster	Forb	N			x	
<i>Taraxacum officinale</i>	common dandelion	Forb	NI	x	x	x	x
<i>Teucrium canadense</i>	Canada germander	Forb	N		x	x	
<i>Toxicodendron radicans</i>	eastern poison ivy	Forb	N		x	x	
<i>Tradescantia spp.</i>	spiderwort	Forb	N	x			

Species	Common Name	Type	Nativity	1986	1993	2011	Found in all yrs
<i>Tradescantia ohiensis</i>	bluejacket	Forb	N			x	
<i>Tradescantia tharpaii</i>	Tharp's spiderwort	Forb	N			x	
<i>Tragia betonicifolia</i>	betonyleaf noseburn	Forb	N		x	x	
<i>Tragopogon dubius</i>	yellow salsify	Forb	I	x	x	x	x
<i>Trifolium campestre</i>	field clover	Forb	I	x			
<i>Trifolium pratense</i>	red clover	Forb	I	x	x		
<i>Trifolium dubium</i>	suckling clover	Forb	I	x			
<i>Trifolium repens</i>	white clover	Forb	I	x	x		
<i>Tridens flavus</i>	purpletop tridens	Graminoid	N			x	
<i>Triodanis perfoliata</i>	clasping Venus' looking-glass	Forb	N	x			
<i>Tripsacum dactyloides</i>	eastern gamagrass	Graminoid	N			x	
<i>Ulmus americana</i>	American elm	Tree	N		x	x	
<i>Ulmus pumila</i>	Siberian elm	Tree	I			x	
<i>Ulmus rubra</i>	slippery elm	Tree	N			x	
<i>Valerianella radiata</i>	beaked cornsalad	Forb	N			x	
<i>Verbascum thapsus</i>	common mullein	Forb	I	x	x	x	x
<i>Verbena urticifolia</i>	white vervain	Forb	N			x	
<i>Veronica arvensis</i>	corn speedwell	Forb	I	x		x	
<i>Vernonia spp.</i>	ironweed	Forb	N		x		
<i>Vernonia baldwinii</i>	Baldwin's ironweed	Forb	N			x	
<i>Vernonia arkansana</i>	Arkansas ironweed	Forb	N			x	
<i>Viola bicolor</i>	field pansy	Forb	N	x		x	
<i>Viola sororia</i>	common blue violet	Forb	N			x	
<i>Vitis aestivalis</i>	summer grape	Vine	N		x	x	
Richness	velvetleaf			62	109	186	29
Year				1986	1993	2011	Found in all years

