

A Natural Areas Inventory of Douglas, Johnson, Leavenworth, Miami, and Wyandotte Counties in Northeast Kansas



Open-File Report No. 124
September 1, 2005

Kelly Kindscher, William H. Busby,
Jennifer M. Delisle, Jennifer A. Dropkin, and Craig C. Freeman

Kansas Natural Heritage Inventory
Kansas Biological Survey
2101 Constant Avenue
Lawrence, KS 66047

A NATURAL AREAS INVENTORY OF DOUGLAS, JOHNSON, LEAVENWORTH, MIAMI, AND WYANDOTTE COUNTIES IN NORTHEAST KANSAS

Cover Photo: Native Prairie in Leavenworth County, 1995. Photo by Kelly Kindscher. By 2005, this site was part of a new residential development.

Report submitted September 1, 2005.

Citation:

Kindscher, K, W. H. Busby, J. M. Delisle, J. A. Dropkin, and C. C. Freeman.
A Natural Areas Inventory of Douglas, Johnson, Leavenworth, Miami, and
Wyandotte Counties in Northeast Kansas. Open-File Report No. 124. Kansas
Biological Survey. Lawrence, KS. iii+74 pp.

Abstract

In 2004, the Kansas Biological Survey initiated a two-year inventory to identify and survey the remaining high-quality natural areas in Douglas, Johnson, Leavenworth, Miami, and Wyandotte Counties and to identify habitat that might harbor rare species.

The primary natural areas in these counties are prairie and forest plant communities. Of 251 prairie sites we visited in the area, we found 126 high-quality prairies larger than five acres each. We found 24 high-quality forest sites, most of which were larger than 10 acres each. These findings, added to previous documentation, results in a total of 166 high-quality prairie sites and 38 high-quality forests that are documented in the Kansas Natural Heritage Inventory database for the five-county area.

High-quality prairie communities include Unglaciated Tallgrass Prairie, Glaciated Tallgrass Prairie, and Low (Wet) Prairie. High-quality forest communities include Oak-Hickory Forest, Ash-Elm-Hackberry Forest, Cottonwood-Sycamore Floodplain Forest, Cross Timbers-Post Oak Woodland, and Maple-Basswood Forest.

Each high-quality plant community found is capable of sustaining known or possible rare species of interest. Specifically, we found Regal fritillary butterflies at 76 sites in the inventory, as well as Red-shouldered hawks, Broad-winged hawks, Red-eyed vireos, and Prairie mole crickets.

In addition, we found 29 previously unknown populations of Mead's milkweed, a federally protected species that is listed as threatened, and we confirmed the continued presence of 6 previously known populations as well. These findings, added to previous documentation, result in a total of 87 populations of Mead's milkweed that are documented in the Kansas Natural Heritage Inventory database for the five-county area.

We also confirmed the continued presence of one previously known population of the Western prairie fringed orchid, a federally protected species that is listed as threatened, and confirmed the destruction of another population in the area.

We calculated the percentages of remaining high-quality native prairie in each county and compared them to the estimates of native prairie present in the 1850s. We found that by 2005, native prairie was 0.5% of Douglas County (94% in the 1850s), 0.3% of Miami County (90% in the 1850s), 0.006% of Johnson County (84% in the 1850s), 0.17% of Leavenworth County (90% in the 1850s), and none remaining in Wyandotte County (75% in the 1850s).

We have provided county maps showing the locations of remaining high-quality prairies and forests in the five-county area. We suggest several management recommendations for landowners and opportunities for both landowners and planning commissions to conserve some of their biologically rich tracts of land.

Table of Contents

Abstract	i
List of Figures and Tables	iii
Chapter 1: Introduction	1
1.1. Project Purpose	1
1.2. Objectives	1
Chapter 2: General Description of the Five-County Area	2
2.1. Survey Area and Landscape Features	2
2.2. Land-Use History and Trends	2
2.3. Potential Natural Communities and Species in the Five-County Area	4
Chapter 3: Inventory Methods	9
3.1. Data Sources	9
3.2. Site Selection	9
3.3. Ranking Criteria	10
3.4. Site Description Format	14
Chapter 4: Survey Results and Discussion	15
4.1. Natural Areas Found during the County Inventory and Their Significance	15
4.2. Significant Plant Species	20
4.3. Wildlife Species	30
4.4. Direct Benefits of High-Quality Natural Areas to People and County Inventory Results	39
4.5. Management Recommendations	39
Literature Cited and Data Sources	41
Appendices: Maps of Prairie and Forest Sites by County	
A: Douglas County	43
B: Miami County	44
C: Leavenworth County	45
D: Johnson County	46
E: Wyandotte County	47
Appendices: Plant Species Found during the County Inventory	
F: Prairie Plant Species	48
G: Floristic Quality Indices for Prairie Sites	61
H: Forest Plant Species	65
Acknowledgments	74

List of Figures and Tables

Figures

Figure 2.1.	The Study Area in Northeast Kansas	3
Figure 2.2.	Unglaciated Tallgrass Prairie in Douglas County, 2005	5
Figure 2.3.	Oak-Hickory Forest in Miami County, 2004	6
Figure 4.1.	Mead's Milkweed	21
Figure 4.2.	Western Prairie Fringed Orchid	24
Figure 4.3.	Regal Fritillary on milkweed	30
Figure 4.4.	Regal Fritillary Density at Survey Sites.....	32
Figure 4.5.	Transect Estimate of Regal Fritillary Numbers	33
Figure 4.6.	Regal Fritillary Abundance at Burned and Unburned Prairie Sites	34
Figure 4.7.	Average Regal Fritillary Abundance in the County Inventory Area, 2005	35

Tables

Table 2.1.	Native High-Quality Prairie in the County Inventory, 1850s–2005	4
Table 2.2.	Presettlement Community Types in the County Inventory Area	7
Table 2.3.	Protected Animal and Plant Species in the County Inventory Area	7
Table 4.1.	Prairie Sites Visited, by Community Type, 2004–2005	15
Table 4.2.	Prairie Sites Visited, by County, 2004–2005	15
Table 4.3.	Prairie Sites by Quality, Number, and Size, 2005	16
Table 4.4.	Native Prairie Lost in Douglas County, 1988–2005	17
Table 4.5.	Forest Sites, by Community Type, 1988–2005	18
Table 4.6.	Forest Sites, by Quality and Size, 2005	19
Table 4.7.	Mead's Milkweed Populations, by Prairie Quality, 2004–2005	22
Table 4.8.	New Mead's Milkweed Populations Found, 2004–2005	22
Table 4.9.	Extant Mead's Milkweed Populations, 1988–2005	23
Table 4.10.	The Most Conservative Prairie Plants Found, 2004–2005	26
Table 4.11.	The Most Conservative Forest Plants Found, 2004–2005	27
Table 4.12.	State-Ranked Imperiled and Critically Imperiled Plant Species Found, 2004–2005	28
Table 4.13.	The Most Invasive Prairie and Forest Plants Species Found, 2004–2005	29
Table 4.14.	Regal Fritillaries Sighted at Prairie Sites, 2004–2005	32
Table 4.15.	Target Animal Species Encountered at Prairie Sites	36
Table 4.16.	Target Animal Species Affiliations, by Community Type	38

Chapter 1: Introduction

1.1. Project Purpose

In 2004, the Kansas Biological Survey was funded by a State Wildlife Grant from the Kansas Department of Wildlife & Parks to begin a project to identify the remaining, high-quality prairies, forests, and other natural areas in Douglas, Johnson, Leavenworth, Miami, and Wyandotte Counties in northeast Kansas. The primary objective of this study was to provide information so policy makers can balance the need for development of natural resources with the need to preserve remaining natural areas in the rapidly developing Kansas City Region and Kansas River Corridor. Although some natural areas in the five-county area had been documented and mapped (see Lauer 1989), no systematic effort had been made previously to find what natural areas remain in these counties.

High-quality natural areas are those places on the landscape that support plant communities that closely approximate the native vegetation (e.g., native tallgrass prairie or oak-hickory forest) that existed prior to Euro-American settlement. Healthy natural areas benefit native biological diversity. They also provide many beneficial services to humans by buffering the effects of pollution, protecting water quality, preventing soil erosion, improving land values, and providing opportunities for outdoor recreation. They are reservoirs of biological diversity and sanctuaries for sensitive and declining species.

Our goal was to locate, classify, and evaluate the natural communities remaining in the study area and to identify the plants and animals that rely on them. We were especially concerned with identifying natural areas that provide critical habitat for rare and threatened species.

1.2. Objectives

The objectives of this study were

- a) to find, identify, and assess through field surveys the remaining high-quality natural areas in the five-county area;
- b) to document the locations of protected and rare animal and plant species in these areas and to record them in the Kansas Natural Heritage Inventory database;
- c) to document the number of new and previously known sites supporting high-quality prairies, forests, and rare species;
- d) to provide management recommendations to landowners interested in preserving and restoring natural areas on their property; and
- e) to identify sensitive environments, potential parklands, and scenic recreational areas. This information will be valuable for planning purposes and will provide an opportunity for Douglas, Johnson, Leavenworth, Miami, and Wyandotte Counties to lead in the integration of conservation planning with development planning.

Chapter 2: General Description of the Five-County Area

2.1. Survey Area and Landscape Features

The survey area includes Douglas, Johnson, Leavenworth, Miami, and Wyandotte Counties in northeast Kansas (see Figure 2.1). This area is bounded on the northeast side by the Missouri River and is traversed by the Kansas River and several tributaries, including the Wakarusa River in Douglas County, Stranger Creek in Leavenworth County, and Mill Creek, Cedar Creek, and Turkey Creek in Johnson and Wyandotte Counties (McCauley 1998). The five-county area lies within two physiographic provinces, the Glaciated Region (which includes Leavenworth, Wyandotte, and the northern portion of Douglas and Johnson Counties) and the Osage Cuestas (which includes southern Douglas and Johnson and northern Miami Counties). Both provinces are underlain by limestone, shale, and sandstone formations. The Glaciated Region was formed by glacial drift deposited during the last two Ice Ages (Lauver 1989; McCauley 1998).

2.2. Land-Use History and Trends

2.2.a. Past Land-Use Patterns

Prior to Euro-American settlement, the five-county area was inhabited by the Kansa and other Native American tribes. Most of the land was then prairie, which was maintained by fire set by Indians or started by lightning. When Euro-American settlement began in the 1850s, federal land surveyors estimated prairie to cover 94% of Douglas County, 90% of Leavenworth and Miami Counties, 84% of Johnson County, and 75% of Wyandotte County (see Table 2.1). The rest of the land was primarily covered with forest. Europeans at first settled near rivers for access to timber, transportation, and commerce but then expanded to upland prairies, which they tilled for crops and used for pasture. Over time, livestock grazing and suppression of fire led to woody growth replacing grassland; in some areas, conversion of grassland to farmland further reduced prairie acreage. In addition, most wetlands were drained (Lauver 1989; Kindscher 1992). Riparian forests were cut down for timber use, farmland development, and river channel control (Lauver 1989).

2.2.b. Current Land Use Trends

At present, land in the United States is being converted to cropland, housing, offices, shopping centers, and industrial uses at an accelerating rate. Some estimates indicate that the amount of land being claimed for urban and suburban uses has increased by nearly 300% since 1955, while the U.S. population has increased by 75%. Conversion of natural areas to human uses reduces habitat for wildlife and limits ecosystem benefits and has become one of the most serious threats to native plant and animal species (Ewing et al. 2005). Development in northeast Kansas is part of this land-use trend.

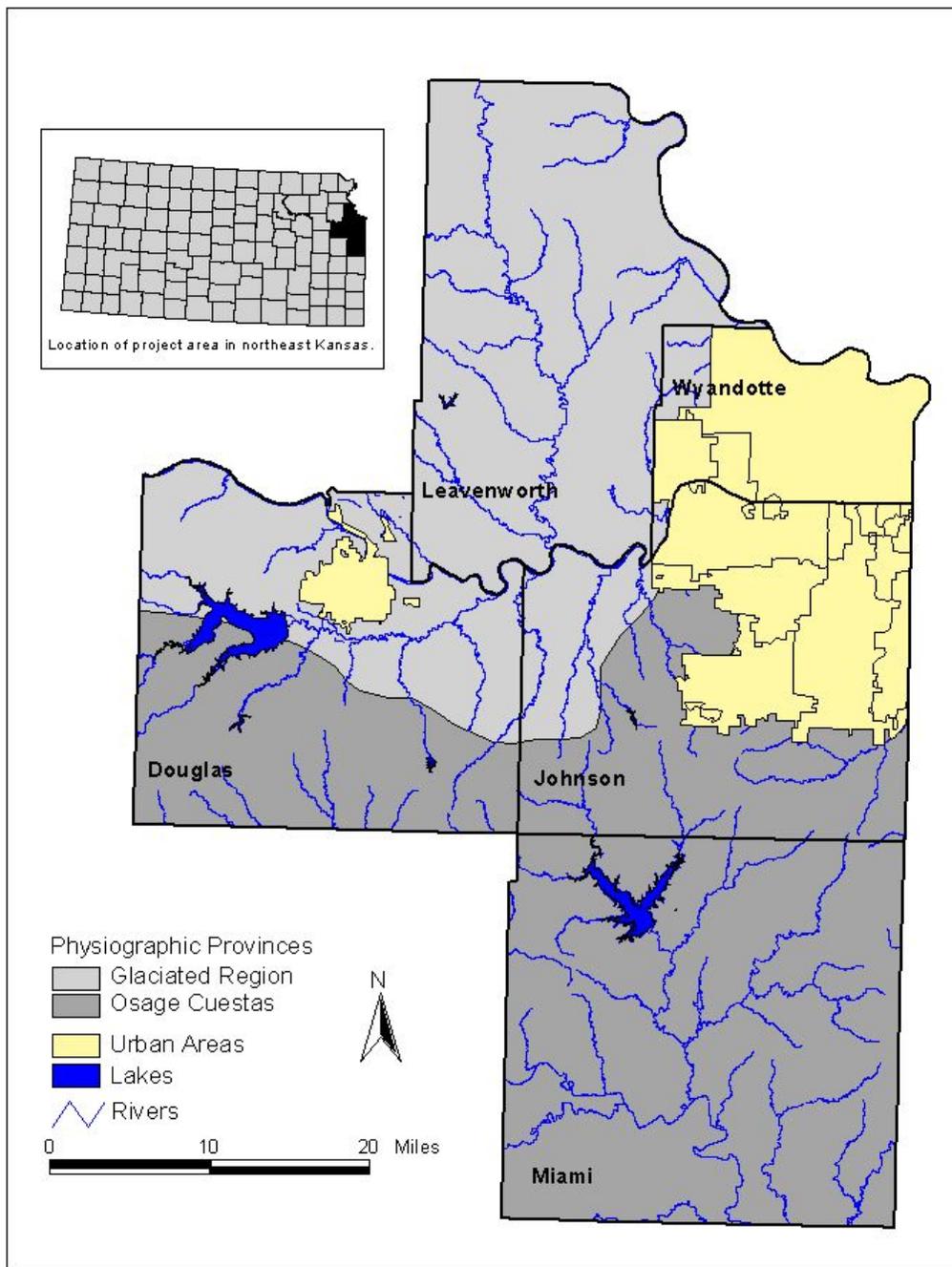


Figure 2.1.—The study area in northeast Kansas, showing Douglas, Johnson, Leavenworth, Miami, and Wyandotte Counties, rivers and streams, the Glaciated Region, and the Osage Cuestas.

Table 2.1. Acreage and Percentage of Land in Native High-Quality Prairie in Douglas, Johnson, Leavenworth, Miami, and Wyandotte Counties, 1850s–2005

County	1850s Prairie Acreage	1850s Estimated Percent of High-Quality Prairie	2005 Prairie Acreage	2005 Percent of High-Quality Prairie Remaining
Douglas	285,158	94%	1,395	0.5%
Miami	332,214	90%	941	0.3%
Johnson	256,318	84%	16	0.006%
Leavenworth	271,872	90%	475	0.17%
Wyandotte	76,320	75%	None	None

Note.—Data for the 1850s are from the Kansas State Board of Agriculture (1877). The data for 2005 are for parcels greater than five acres that the Kansas Natural Heritage Inventory has identified or confirmed remain (see Section 4 below).

2.3. Potential Natural Communities and Species in the Five-County Area

Several prairie and forest community types were present in Kansas before Euro-American settlement (Table 2.2). The most common prairie community types included Glaciated Tallgrass Prairie, found only in the Glaciated Region of northeast Kansas, and Unglaciated Tallgrass Prairie, found in the Osage Cuestas Region of east-central and southeast Kansas (see Figure 2.2). Low (Wet) Prairie was found along creeks and streams.

Numerous forest community types were found in the five-county area before European settlement, each characterized by proximity to rivers or moist habitats and the kind of trees dominant in the forest makeup. The most common community type was Oak-Hickory Forest (see Figure 2.3). Other community types included Ash-Elm-Hackberry Floodplain Forest, Cottonwood-Sycamore Floodplain Forest, Pecan-Hackberry Floodplain Forest, Cross Timbers Woodland–Post Oak Woodland (characterized by Post Oak, Blackjack Oak, and Eastern Red Cedar), and Maple-Basswood Forest.



Figure 2.2.—Flowers in Unglaciaded Tallgrass Prairie in Douglas County, 2005



Figure 2.3.—Oak-Hickory Forest in Miami County, 2004

Table 2.2. Major terrestrial and wetland plant communities in Douglas, Johnson, Leavenworth, Miami, and Wyandotte Counties before Euro-American settlement (adapted from Lauver et al. 1999).

Ash-Elm-Hackberry Floodplain Forest	Mixed Oak Floodplain Forest
Bur Oak Floodplain Woodland	Mixed Oak Ravine Woodland
Buttonbush Swamp	Neutral Seep
Cottonwood–Black Willow Floodplain Forest	Oak-Hickory Forest
Cottonwood-Sycamore Floodplain Forest	Ozark Limestone Glade
Eastern Cattail Marsh	Pecan-Hackberry Floodplain Forest
Freshwater Marsh	Pondweed Aquatic Wetland
Glaciated Tallgrass Prairie	Sandstone Prairie
Loess Hills Tallgrass Prairie	Unglaciated Tallgrass Prairie
Maple-Basswood Forest	Wet Prairie

Table 2.3. Animal and Plant Species Protected by Federal and/or State Laws with Historic or Current Occurrences in Douglas, Johnson, Leavenworth, Miami, and Wyandotte Counties, Kansas

Common Name	Scientific Name	Status
Mammals		
Eastern spotted skunk	<i>Spilogale putorius</i>	T
Franklin’s ground squirrel	<i>Spermophilus franklini</i>	S
Southern bog lemming	<i>Synaptomys cooperi</i>	S
Southern flying squirrel	<i>Glaucomys volans</i>	S
Birds		
Bald eagle	<i>Haliaeetus leucocephalus</i>	LT, T
Black tern	<i>Chlidonias niger</i>	S
Cerulean warbler	<i>Dendroica cerulea</i>	S
Henslow’s sparrow	<i>Ammodramus henslowii</i>	S
Least tern	<i>Sterna antillarum</i>	LE, E
Peregrine falcon	<i>Falco peregrinus</i>	E
Piping plover	<i>Charadrius melodus</i>	LT, T
Whip-poor-will	<i>Caprimulgus vociferus</i>	S
Yellow-throated warbler	<i>Dendroica dominica</i>	S
Reptiles		
Broadhead skink	<i>Eumeces laticeps</i>	T
Redbelly snake	<i>Storeria occipitomaculata</i>	T
Smooth earth snake	<i>Virginia valeriae</i>	T
Timber rattlesnake	<i>Crotalus horridus</i>	S
Amphibians		
Central newt	<i>Notophthalmus viridescens</i>	T
Crawfish frog	<i>Rana areolata</i>	S
Spring peeper	<i>Pseudacris crucifer</i>	T

Fishes		
Blue sucker	<i>Cycleptus elongatus</i>	S
Chestnut lamprey	<i>Ichthyomyzon castaneus</i>	T
Flathead chub	<i>Platygobio gracilis</i>	T
Hornyhead chub	<i>Nocomis biguttatus</i>	T
Pallid sturgeon	<i>Scaphirhynchus albus</i>	LE, E
Sicklefin chub	<i>Macrhybopsis meeki</i>	E
Silverband shiner	<i>Notropis shumardi</i>	T
Sturgeon chub	<i>Macrhybopsis gelida</i>	T
Western silvery minnow	<i>Hybognathus argyritis</i>	T
Invertebrates		
American burying beetle	<i>Nicrophorus americanus</i>	LE, E
Flat floater mussel	<i>Anodonta suborbiculata</i>	E
Fluted shell mussel	<i>Lasmigona costata</i>	T
Mucket mussel	<i>Actinonais ligimentina</i>	E
Rock pocketbook mussel	<i>Arcidens confragosus</i>	T
Washboard mussel	<i>Megalonaias nervosa</i>	S
Plants		
Mead's milkweed	<i>Asclepias meadii</i>	LT
Running buffalo-clover	<i>Trifolium stoloniferum</i>	LE
Western prairie fringed orchid	<i>Platanthera praeclara</i>	LT

Note.—Status abbreviations (federal abbreviations are listed first, then state) are as follows: LE = listed as endangered by the U.S. Fish & Wildlife Service; LT = listed as threatened the U.S. Fish & Wildlife Service; S = listed as species in need of conservation by Kansas Department of Wildlife & Parks; E = listed as endangered by Kansas Department of Wildlife & Parks; and T = listed as threatened by Kansas Department of Wildlife & Parks.

Chapter 3: Inventory Methods

3.1. Data Sources

Data sources that we used to develop the inventory included previously mapped sites in the Heritage database, digital images, examination of topographic maps, aerial photographs, and field surveys.

3.2. Site Selection

Work began on January 1, 2004, and ended August 31, 2005, and concentrated on the April–July field season each year. Our initial efforts focused on identification of potential natural areas using digital imagery, recent and historical aerial photography (U.S. Department of Agriculture 2003), and previously mapped sites recorded in the Heritage database. Locations were mapped onto topographic maps from the U.S. Geological Survey, and field crews checked these sites.

Forested areas could be readily observed in aerial photographs, and potential high-quality sites were digitized using GIS software. These polygons were printed onto aerial photographs and topographic maps, which we used in the field to find sites.

Using digital images to locate potential prairies was not as successful as using aerial photographs and topographic maps. We had anticipated using remote sensing data and aerial photography to differentiate between prairie and human-influenced grasslands like fescue pastures and crops. We discovered early in the first season of the project that, although aerial photographs were helpful, up to a point, satellite data from Landsat imagery lacked the resolution needed to allow identification of prairies. This is because we used remote-sensing techniques in a highly fragmented portion of the state. Our sites are small, and so hundreds of sites were identified. It became clear that it would be easier to drive all roads looking for sites than to investigate all sites identified as possible natural areas by remote sensing, and we changed our study procedure. To make sure we found appropriate potential natural area sites in the five-county area, field crews drove along all county roads in Douglas, Johnson, Leavenworth, Miami, and Wyandotte Counties. Sites identified in this manner were compared to historical maps (Public Land Surveys of Kansas 1850s) and previously mapped sites in the Heritage database.

Potential prairie sites of five acres or more, forest sites of 10 acres or more, and sites that were smaller but potentially had rare species or were buffered by important plant communities were mapped onto field maps that were used in field surveys during April–July 2004 and March–July 2005. Natural communities that met the quality criteria used by the Kansas Natural Heritage Inventory were identified and assessed by three crews, each of at least two field biologists, botanists, or ecologists, who mapped community boundaries, assessed their condition following standard Heritage methodology, and identified species of plants present. Considering the importance of property rights and our respect for them, we obtained landowner permission before we accessed any potential sites. We contacted landowners by asking who owned the tract of land at the nearest

house, by using county land ownership maps, and by obtaining information through the county courthouses. In exchange for permission to inventory their land, we offered to send property owners the plant species lists we compiled while surveying their property.

3.3. Ranking Criteria

The objective of a natural areas inventory is to locate tracts of relatively undisturbed natural land that contain one or more natural communities existing in undisturbed or minimally disturbed conditions. Based on what we know about presettlement vegetation and communities (Table 2.2), and the rarity of certain plants and animals in the area (Table 2.3), we can employ ranking criteria to determine the overall quality of our potential natural areas.

3.3.a. Natural Heritage Procedures

We used standard Natural Heritage procedures (NatureServe 2005c) to determine potential natural area rankings: a grade was assigned to each community and species occurrence to summarize its quality and condition. Four grades ranging from A to D were used, while X was used to indicate a site that had been extirpated (e.g., developed for housing or converted to cropland or other uses). For plant communities, an A-grade indicated a pristine or relatively undisturbed occurrence, while a D-grade site was severely degraded.

Typically, the Heritage program gathers detailed information only for A- and B-grade community occurrences, limited information for most C-grade occurrences, and only the information needed to assign a grade for D-grade sites. We followed that procedure here. Information about lower-quality sites, however, may be useful (e.g., for determining whether those sites can be buffers for high-quality core areas, links between high-quality sites, restoration projects, or parklands and recreational areas), and where appropriate, we gathered that information, too. These areas can be identified and characterized if the information is deemed potentially useful, but normally they are not added to the Natural Heritage databases.

Sites are ranked by using three key factors: landscape context, size, and condition. Landscape context is the extent to which an area is embedded in a landscape of intact natural communities. Normally, landscape context and size are weighted more heavily than condition. The rationale is that landscape context and size cannot increase, or can do so only slightly with time, whereas condition is a more variable attribute and can be increased fairly quickly with appropriate management inputs. Also, the assessed condition of a prairie remnant may vary with season, observer, management, or environmental conditions.

Landscape Context.—Landscape context refers to the general condition of the landscape in which a site occurs, considering such issues as disturbance regimes, fragmentation, topography, and biological diversity. Landscape context is ranked A–D. Generally speaking, A-grade landscapes have not been converted to human land uses (like cropland or housing) and are dominated by natural communities. Natural processes, species

interactions, and species migrations can occur across all natural communities and experience no complete barriers. Surrounding vegetation is greater than 80% natural. B-grade landscapes have experienced some land conversion, but natural communities remain well-connected. Natural processes and species interactions and migrations can occur across many natural communities and experience few barriers. Surrounding vegetation is 50–80% natural. C-grade landscapes are fragmented by cultural land, including cropland or developed areas. Barriers severely affect many natural processes, species interactions, and migrations, and many species are unable to maintain viable populations. Surrounding vegetation is 20–50% natural. D-grade landscapes are surrounded almost entirely by cultural land. Natural processes and species migrations are severely compromised and cannot occur at natural scales. Only a subset of the historic biological diversity is viable within natural communities.

Size.—Determining the size of a natural community may appear straight-forward, but several issues complicate this process: patch size and minimum distance separating two occurrences.

Patch size denotes the size and landscape position of a natural community (Lauver et al. 1999). Four patch types usually are recognized: matrix, large-patch, small-patch, and linear. Matrix communities occur on the dominant landforms in an ecoregion and form extensive and often contiguous cover, usually greater than 1,000 acres. Large-patch communities generally occur on subdominant landform features and form large but interrupted cover, usually 20–1,000 acres. Small-patch communities occur on specialized landforms and microhabitats, and generally are less than 20 acres. Linear communities are long, narrow communities usually associated with riverine features.

Size standards have been established for many natural communities to distinguish viable from nonviable occurrences and, for viable occurrences, to rank them (A–D, with A being the best and D being the worst). Each community occurrence must meet the minimum size set for its type to be considered viable. For example, for Glaciated Tallgrass Prairie, a matrix community type, occurrences less than 10,000 acres usually are not considered viable (able to support ecosystem functions necessary to maintain high levels of native biodiversity for more than 100 years).

A second factor complicating the size issue is how far apart two occurrences of the same community type can be before they are considered distinct occurrences. Several evaluation guidelines are available to assist in determining the minimum distance of separation for terrestrial natural communities. Basically, two tracts are treated as distinct if they are separated by:

- 1) a substantial barrier to natural processes and/or to native species, such as a busy highway, developed area, or large body of water;
- 2) cultural vegetation that limits connection of patches;
- 3) a different community type coverage greater than 0.5 mile wide if the communities frequently do not occur in a mosaic, or 1–2 miles wide if frequently in a mosaic;

- 4) a tract subjected to management that is significantly different from that employed on the separated tracts; or
- 5) a major break or change in ecological land unit.

Condition.—Condition refers to impact that human disturbance has had on a site. Condition can be estimated by any of several available methods. Most Natural Heritage programs use subjective field assessments, which are based on estimates of native species richness, abundance of exotic species, and ecological processes. As with landscape context, condition may be ranked from A–D, with A being the best (least affected by human disturbance) and D being the worst (severely affected by human disturbance).

The determination of condition at a site was a primary purpose of our fieldwork. For each site we visited, we took note of the ecological and physical characteristics present, working in teams of two or more to put together an accurate plant species list for each site. Plant species that could not be identified in the field were brought back to the Kansas Biological Survey and the R. L. McGregor Herbarium for more exact identification.

3.3.b. Floristic Quality Assessment

Floristic Quality Assessment (FQA) is a standardized tool used to estimate the floristic quality of a natural area based on the vascular plants growing there (Taft et al. 1997; Freeman and Morse 2002). By extension, it can be used to assess the overall ecological quality of a site. Ecologists, botanists, environmental professionals, and land managers use FQA to establish baseline assessments, to conduct long-term monitoring, and to assess restoration progress in a variety of ecological settings (Herman et al. 1997; Taft et al. 1997). Developed in the 1970s (Wilhelm 1977; Swink and Wilhelm 1979), the method has been refined from its original form (Wilhelm and Ladd 1988; Taft et al. 1997; Rooney and Rogers 2002) and now is in use or development in numerous states and provinces in the United States and Canada (Taft et al. 1997).

The method was developed to avoid subjective measures of natural community quality, such as “high” or “low.” Some elements of FQA still are subjective, but the method has clear advantages over other evaluation tools, including repeatability and ease of application. Ideally, FQA should be used with other content-based and context-based measures (*sensu* Rooney and Rogers 2002) to estimate the integrity of native plant communities (Taft et al. 1997).

The FQA method is based on calculating an average coefficient of conservatism (C) and a floristic quality index (FQI) for a site. It may be used to compare several sites supporting the same community type (e.g., several Glaciated Tallgrass Prairies) but should not be used to compare different community types (Rooney and Rogers 2002). A coefficient of conservatism is an integer from zero to 10 that is assigned to each native plant species in a given geographic region—often a state or province. Naturally occurring hybrids and infraspecific taxa usually are not assigned coefficients.

Coefficients of conservatism express two basic ecological tenets: plants differ in their tolerance of the type, frequency, and amplitude of anthropogenic disturbance, and plants vary in their fidelity to remnant natural plant communities (Taft et al. 1997). As employed in FQA, these two principles exhibit an inverse relationship: the lower a species' tolerance of human-mediated disturbance, the higher its likelihood of occurring only in a natural plant community. Low coefficient values (0–3) denote taxa often found in highly disturbed habitats and without a strong affinity for natural communities. High coefficient values (7–10) denote species that tolerate only limited disturbance and usually are found in natural communities. With these principles as a guide, the C value applied to each species represents a relative rank based on observed behavior and patterns of occurrence in Kansas natural communities. Non-native species are not assigned coefficients because they were not part of the presettlement landscape. They do have an effect on FQA, however, and they may be incorporated in the assessment process.

The FQA process begins with a thorough inventory of vascular plants at a site of interest. The checklist then is used to calculate a floristic quality index (FQI) for the site. A mean C value (mean C) is calculated. The mean C value for a site is the arithmetic mean of the coefficients of all native vascular plants occurring on the entire site ($\text{mean C} = \Sigma C/N$), without regard to dominance or frequency. Non-native taxa are excluded from the calculation of mean C. The FQI is the mean C multiplied by the square root of the total number of taxa (\sqrt{N}) inventoried on the site ($\text{FQI} = \text{mean C} \times \sqrt{N}$). Separate calculations may be made using $N =$ all taxa (native and non-native) and $N =$ native taxa only (see analysis and discussion in Taft et al. 1997). The basic formula for FQI combines the conservatism of the taxa with a measure of the taxon richness of the site. By multiplying by \sqrt{N} instead of N , the formula reduces the effect of the size of the site (larger sites tend to have a larger total number of species). If the sampling method involves transects or quadrats, a mean C and FQI can be calculated for each sample (Wilhelm 1977; Taft et al. 1997).

3.3.c. Rare Species

Natural Heritage programs across the United States determine state ranks for rare species (NatureServe 2005b). For state-ranked plant and animal species, the following factors are considered in assessing conservation status: total number and condition of populations; population size; range extent and area of occupancy; short- and long-term trends in the above factors; scope, severity, and immediacy of threats to the species; number of protected and managed populations; intrinsic vulnerability, and environmental restrictions.

State conservation status ranks of species are based on a 1–5 scale, ranging from critically imperiled (S1) to demonstrably secure (S5). The two state rankings of interest in the County Inventory are the S1 (critically imperiled) and S2 (imperiled) species. We noted the presence of each S1 and S2 plant and animal species found in our survey.

3.4. Site Description Format

Once permission to survey a site was received from the landowner, each site was visited by a two- or three-person crew who filled out data sheets with the following information:

- 1) latitude and longitude by GPS and a general description of the area;
- 2) landscape description of the site and the surrounding area;
- 3) description of the vegetative community and ranking (according to standard Heritage methodology; NatureServe 2005c);
- 4) the names of all plant species found on the site (the taxonomy used was from the Great Plains Flora Association 1991);
- 5) any occurrences of rare, threatened, or endangered species; and
- 6) the outline of the site on an aerial photograph of the area.

Data were entered into the Kansas Natural Heritage Inventory database and into plant species databases. Polygons representing natural area occurrences were digitized using ArcView 3.3 software using current aerial photographs as base maps. Tabular data were exported from the Heritage database and attached to each polygon as attributes.

The focus of this study was on the identification of remaining high-quality natural terrestrial communities, which are considered important habitats for many rare species. Resources did not permit systematic assessments of target animals at the identified sites with the exception of one easily surveyed species, the Regal fritillary butterfly (see Section 4.3.a below). Inventory methods for individual target animals were limited to asking field survey personnel to record evidence of any target animals encountered in the course of other field work. A rare species report form listing potentially occurring target animal species was developed and used to record such species.

Chapter 4: Survey Results and Discussion

4.1. Natural Areas Found during the County Inventory and Their Significance

4.1.a. Plant Communities and Their Distribution

Plant Communities.—During the 2004–2005 project season, we visited a total of 249 prairie sites in the five-county area. The prairies fell into three community types: Unglaciated Tallgrass Prairie (189 sites), Glaciated Tallgrass Prairie (57 sites), and Low (Wet) Prairie (three sites) (see Table 4.1).

Table 4.1. Prairie Sites Visited, by Community Type, 2004–2005

Community	All Five Counties	Douglas	Miami	Leavenworth	Johnson	Wyandotte
Glaciated Tallgrass Prairie	57	15	0	42	0	0
Unglaciated Tallgrass Prairie	189	111	77	0	1	0
Low (Wet) Prairie	3	2	0	1	0	0
All Communities	249	128	77	43	1	0

For this inventory work, we concentrated our efforts on finding sites that were previously unknown and undocumented (new sites) in the Kansas Natural Heritage Inventory database. During the second season we continued to look for new sites, but we also quickly looked at sites that had been previously documented in the Heritage database (revisits) to verify whether those sites still exist as native habitat and to reevaluate their overall rank (= grade). Many of these previously documented sites had not been revisited for over 15 years, and several were known to have been converted to other land uses—primarily agriculture or development.

Of the 249 sites we visited and ranked during 2004–2005, 62 are new sites and 187 are sites previously tracked in the Heritage database (see Table 4.2).

Table 4.2. Prairie Sites Visited, by County, 2004–2005

	All Five Counties	Douglas	Miami	Leavenworth	Johnson	Wyandotte
New	62	16	36	10	0	0
Revisits	187	112	41	33	1	0
All Sites	249	128	77	43	1	0

To be considered A-grade according to Heritage methods, a prairie would be surrounded by a large-acreage, high-quality prairie landscape. Such landscape no longer exists in the County Inventory area, so no prairie we visited during 2004–2005 had an overall rank of A.

Of the 249 sites visited, 136 sites were C-grade or better. Ninety-five prairie sites were D-grade (severely degraded), and 19 were X-grade (extirpated) (see Tables 4.3 and 4.4). The severely degraded and extirpated sites are considered to be areas of high-quality tallgrass prairie that have been lost during the last 15 years.

Table 4.3. Number of Remaining Prairie Sites and Acreages in the 2005 Kansas Natural Heritage Inventory Database, by Rank (No. of Sites = 231).

County	A Sites	B Sites	C Sites	D Sites¹	X Sites²
Douglas:					
No. of Sites	0	40	49	24	11
Acres	0	798.77	595.95	265.05	167.12
Miami:					
No. of Sites	0	20	32	9	7
Acres	0	331.66	609.58	120.33	57.8
Leavenworth:					
No. of Sites	0	7	17	11	2
Acres	0	124.91	350.29	153.17	9.08
Johnson:					
No. of Sites	0	1	0	0	1
Acres	0	15.64	0	0	8.93
All Five Counties:					
No. of Sites	0	68	98	44	21
Acres	0	1,270.98	1,555.82	538.55	242.9

Note.— All sites meet the five-acre minimum requirement. Of the D-ranked sites, 44 are revisits that were previously recorded in the Natural Heritage Inventory Database. No prairie sites have been documented in Wyandotte County. X = extirpated sites (previously tracked sites that have been converted to housing or cropland).

¹ Sites previously ranked as A, B, or C that were determined to have been significantly degraded.

² Only sites previously ranked as A, B, or C that are no longer prairie.

Table 4.4. Native High-Quality Prairie Lost in Douglas County, 1988–2005

	No. of Sites	Acres
1988	110	1,963
2005	89	1,395

Note.—“Lost” means that previously documented sites that were ranked A, B, or C were ranked D or X when revisited during 2004–2005 (meaning that sites listed as “lost” had been converted to housing, cropland, or other uses). This table reflects the change in amount of documented native prairie (ranked A, B, or C) in Douglas County from 1988 to 2005.

Loss of Native Tallgrass Prairie.—Douglas County provides a case study of loss of native prairie in the five-county survey. Starting in 1988, the Kansas Natural Heritage Inventory program initiated extensive survey work in the county to find native tallgrass prairie. The program found 110 sites in 1988, but by 2005, 19% of these sites had been lost to development, conversion to commodity crop production, or other uses. Even greater loss is evident by the fact that the remaining acreage of native tallgrass prairie has been reduced in Douglas County by 29% during the last 17 years, so that only 1,395 acres remain, an area less than one-fifth the area of the City of Lawrence. If the current average rate of loss of 33.4 acres per year (calculated from numbers in Table 4.4) continues, there will be no high-quality prairie left in Douglas County by 2047.

Mapping of Plant Communities.—The distribution of all prairie sites can be seen in the county maps in Appendices A–E. We are confident that we have successfully inventoried almost all of the remaining high-quality tallgrass prairie remnants in these counties. Since we drove the roads, we may have missed a small number of sites that are not visible from county roads.

The mapping of these sites is very useful for planning purposes and to see where our native prairie remnants remain. Overall, more native prairie remains in 2005 in Douglas County (Appendix A) than the other four counties in the study area. This may be due to Douglas County being relatively distant from Kansas City and having numerous rock outcrops. Remaining prairie remnants in Douglas County are somewhat concentrated in the northwest and across the southern half of the county. Land use related to the growth of the City of Lawrence is evident by the lack of prairie in the area surrounding the city and the known loss of two sites in this area. For Miami County the sites are more prevalent across the southern portion of the county, which is further removed from the Kansas City metropolitan area. Surprisingly, Leavenworth County has only a few remaining native prairie sites, and these are generally small in size. Closeness to the Kansas City area is one factor, but other factors are that past glaciation and the presence of loess soils related to the proximity of the Missouri River have made most of Leavenworth County suitable for farming, even on fairly steep hillsides. Both Johnson and Wyandotte Counties have very little remaining native habitat because of urbanization.

Forest Communities.—We visited 24 forest sites in the five-county area (see Appendices A–E), all new to the Heritage database. They included five different community types, including two Ash-Elm-Hackberry forests, two Cottonwood-Sycamore Floodplain Forests, two Cross Timbers–Post Oak Woodlands, three Maple-Basswood Forests, and 15 Oak-Hickory Forests. The addition of these sites brings the total number of forest sites in the five-county area that are documented in the Heritage database to 38 (see Table 4.5). The floodplain forests were most common along the Kansas River, while the other forest community types were found most typically on north-facing slopes along bluffs and steep hills associated with streams.

Table 4.5. Forest Sites in the Kansas Natural Heritage Inventory Database, by Community Type, 1988–2005.

Community	All Five Counties	Douglas	Miami	Leavenworth	Johnson	Wyandotte
Ash-Elm-Hackberry Floodplain Forest	3	1	1	0	1	0
Cottonwood-Sycamore Floodplain Forest	6	3	0	2	1	0
Cross Timbers–Post Oak-Blackjack Oak Woodland	4	3	0	1	0	0
Maple-Basswood Forest	2	0	1	1	0	0
Oak-Hickory Forest	22	10	3	3	3	3
Pecan-Hackberry Floodplain Forest	1	0	0	1	0	0
All Forest Community Sites	38	17	5	8	5	3

While there were no A-grade forest sites found during the County Inventory, owing to their small size and occurrence in fragmented landscapes, there were four B-grade and 18 C-grade sites, mostly in Douglas County (see Table 4.6).

Overall, there is significantly more native forest acreage left in the five counties than prairie acreage even though over 80% of the area was originally covered with native prairie. Almost half of the forest acres ranked in the County Inventory were in Douglas County, but each county had some forest sites of B- or C-grade. Additional forest sites remain to be inventoried in Leavenworth, Miami, and Douglas Counties. Approximately half of the remaining sites remain undocumented. Forest sites were considerably more difficult to inventory because of their large size, often linear shape along bluffs and rivers, and because they usually had multiple ownership. In addition, we wanted to find as many spring ephemeral woodland species—which are often indicators of forest quality—as possible when we inventoried, and those could be readily observed only in April and May, which limited our survey time.

There are also many sites in all counties that have become forested areas over the last several decades, as landscape fires have been eliminated and brush and trees have spread

where landscape management, suburban growth, availability of seeds, and other factors have inadvertently encouraged them. These areas provide significant habitat for wildlife species, but they are not high-quality plant communities, so they have not been inventoried or mapped in the survey work. Typically, these areas do not serve as habitat for many of our rare species.

Table 4.6. Acreage of Forest Sites in the Kansas Natural Heritage Inventory Database, 2005, by Rank.

County	B	C	Total
Douglas:			
No. of Sites	3	14	17
Acres	209.07	999.56	1,208.63
Miami:			
No. of Sites	1	4	5
Acres	266.62	250.38	517.00
Leavenworth:			
No. of Sites	5	3	8
Acres	1,736.61	81.29	1,817.90
Johnson:			
No. of Sites	1	4	5
Acres	17.01	1,066.48	1,083.49
Wyandotte			
No. of Sites	0	3	3
Acres	0	389.52	389.52
All Five Counties:			
No. of Sites	10	28	38
Acres	2,229.31	2,787.23	5,016.54

Note.—Two sites smaller than 10 acres were kept in the study owing to the quality of surrounding buffer communities. No overall A-grade sites have been identified in the five-county study area.

4.1.b. Floristic Quality Assessment Results

The Floristic Quality Index provides additional support that the communities that we identified during the 2004–2005 inventory are high-quality tracts (see Appendix G). Specifically, those areas with the highest-ranked condition grades (independent of overall rank) were more likely to have high Floristic Quality Index scores than other sites. Index scores ranked between 56.23 for an A-grade site and 13.79 for a C-grade site, both in Douglas County.

4.2. Significant Plant Species

4.2.a. Mead's Milkweed (*Asclepias meadii*)

Description and Location.—Mead's milkweed, which is federally protected and listed as threatened, occurs in the Midwest and eastern Great Plains (U.S. Fish & Wildlife Service 2003). It is a smooth, rhizomatous, perennial herb with a distinctive single nodding head of greenish-cream-colored, fragrant flowers produced at the end of each flowering stem (see Figure 4.1). Flowers are produced from mid-May to early June. Slender, hairy, erect pods mature from mid-June late September. Slender, vegetative plants often arise from the rhizomes in the vicinity of flowering or fruiting stems.

A majority of the remaining concentrations of the species occurs in Kansas, where more than 100 populations have been documented in the eastern two tiers of counties in the Osage Cuestas and in the southern Glaciated Region (Freeman and Hall 1991). Large populations may include several thousand stems, but most populations in Kansas have fewer than 50. Most populations occur on dry-mesic to mesic tallgrass prairies that are hayed annually, but a few sites are known to be grazed lightly during the winter. Plants grow most frequently on the middle and upper slopes of ridges and hills that have shallow, well-drained, limestone or (infrequently) sandstone soils.

Mead's milkweed has declined due to habitat destruction and alteration by humans. Because of its rhizomes, plants can survive annual mowing, a common practice on native prairie in eastern Kansas. Unfortunately, haying removes fruits before they can mature and release seeds, which prevents new plants from growing in most populations. Consequently, populations on most prairies with a long history of haying show less genetic variability than do populations on sites managed by fire (Freeman and Hall 1991).

County Inventory Results.—We found 45 sites in the County Inventory that had Mead's milkweed on them. Most of those sites are in Douglas and Miami Counties, and most of those sites are B- and C-grade sites. Five D-grade sites, however, still support Mead's milkweed populations (see Table 4.7).



Figure 4.1. Mead's Milkweed (*Asclepias meadii*)

Table 4.7. Sites with Documented Populations of Mead’s Milkweed (*Asclepias meadii*) Found, 2004–2005, by Site Grade.

County	Total	A	B	C	D
Douglas	17	0	11	4	2
Miami	26	0	8	15	3
Leavenworth	2	0	1	1	0
Johnson	0	0	0	0	0
Wyandotte	0	0	0	0	0
All Five Counties	45	0	20	20	5

While 6 of the 45 sites with Mead’s milkweed populations on them were already documented in the Heritage database, we found new populations of Mead’s milkweed at 39 sites (see Table 4.8).

Table 4.8. New Populations of Mead’s Milkweed (*Asclepias meadii*) Found at Sites New to the Kansas Natural Heritage Inventory Database and at Sites Previously Tracked by the Heritage Database.

	Total Number of New Populations of Mead’s Milkweed	New Populations Found at Revisited Sites	New Populations Found at New Sites
Douglas	13	12	1
Miami	24	12	12
Leavenworth	2	2	0
Johnson	0	0	0
Wyandotte	0	0	0
All Five Counties	39	26	13

Of all the sites we visited during the County Inventory, 57 had Mead’s milkweed populations documented on them before the start of this study. During our inventory, we found Mead’s populations at only 45 of those sites (see Table 4.9). This means that we visited 12 sites during the County Inventory that have been known to have supported Mead’s milkweed populations in the past, but we did not see those populations during the inventory. Of those 12 sites, 2 are B-grade, 3 are C-grade, five are D-grade, and 2 are extirpated sites. We are relatively confident the Mead’s populations that have been previously documented at the B- and C-grade sites still exist, even if we did not see them. It is possible that the D-grade sites might still support Mead’s as well. Some of those sites are ranked as D because of their small size, not because of the condition of the prairie.

Table 4.9. Known Mead’s Milkweed (*Asclepias meadii*) Populations remaining in the County Inventory Area in 2005.

County	New Sites Found Containing Mead’s Milkweed Populations, 2004–2005	2005 Total of New and Previously Identified Mead Milkweed Sites
Douglas	17	34
Miami	26	40
Leavenworth	2	9
Johnson	0	4
Wyandotte	0	0
All Five Counties	45	87

Note.—This table shows the total number of sites with documented populations of Mead’s milkweed, including the number of sites visited during the 2004–2005 County Inventory and known sites tracked by the Kansas Natural Heritage Inventory Database.

Most of the populations we found comprised only a few stems (far fewer than 50). The stems we found could belong to a few plants or even one individual plant that had spread by rhizomes, indicating an extremely limited genetic diversity and viability.

We documented a few D-ranked sites that still support Mead’s milkweed populations. Again, these are small populations with questionable viability and diversity. Since the Kansas Natural Heritage Inventory began keeping records of Mead’s milkweed occurrences in 1988, five sites known to have had Mead’s milkweed have been extirpated.

4.2.b. Western Prairie Fringed Orchid (*Platanthera praeclara*)

Description and Location.—The Western prairie fringed orchid is federally protected and is listed as threatened. It occurs on tallgrass prairies, in prairie swales, and in fens in the eastern Great Plains and western Midwest (U.S. Fish & Wildlife Service 1995). It is a perennial herb with open, spikelike clusters of showy white flowers that are produced from mid-June to late June. Individual plants may produce flowers once every 2–4 years, or even less often. Each flower has a distinctive three-lobed, fringed lip (see Figure 4.2).



Figure 4.2. Western Prairie Fringed Orchid (*Platanthera praeclara*)

In Kansas, north of the Kansas River, the orchid inhabits moderate to steep slopes and swales of tallgrass prairie on glacial drift. South of the Kansas River, the species occurs primarily on level to hilly, unglaciated upland prairies covered with a thin, discontinuous mantle of loess. On the slopes of prairies, Western prairie fringed orchid often grows in damp or seepy areas. Historically, it also occurred in wet-mesic prairies in the floodplains of rivers. Scattered populations have been documented at 22 sites in 16 counties in eastern Kansas (Freeman and Hall 1991). In Kansas, three populations of Western prairie fringed orchid grow on native tallgrass prairies with Mead's milkweed. All known populations in Kansas have fewer than 40 individuals; populations in the northern Great Plains include thousands of individuals.

The Western prairie fringed orchid is threatened by conversion of habitat. Other factors that may contribute to the species' decline are drainage of prairie wetlands and encroachment of prairies by woody plants. Seasonal fires, in combination with high rainfall, may promote flowering in this species; lack of these conditions may have contributed to its rarity.

County Inventory Results.—We found no new populations of the Western prairie fringed orchid during the County Inventory. We did, however, document the continued existence of a Western prairie fringed orchid population at a previously known site in the five-county area, and we confirmed the loss of another site, Elkins Prairie.

4.2.c. Indicator Species and Conservative Species

To determine if sites are high-quality native prairies or high-quality native forests, we look for species that are indicators of quality (see Tables 4.10 and 4.11). These are typically referred to as *conservative species*, which are species that have high fidelity to certain community types, which is reflected by a high coefficient of conservatism. Many of these species—for example, the high-quality prairie indicators inland New Jersey tea (*Ceanothus herbaceous*) and azure aster (*Aster oolentangiensis*)—occur almost exclusively on our highest-quality sites. Finding one of these species often means that other important species might be present, and they often indicate that some of our rarest species might also be present, such as Mead's milkweed (*Asclepias meadii*).

Most of our efforts to find new prairies were based on looking for indicator species while driving the roads. When we had personal leads about locating additional native prairie sites from landowners and other knowledgeable people, and when we identified sites through aerial photography, we quickly determined whether we would be interested in inventorying those sites by looking for these indicator species, which are typically showy or large conservative species.

Table 4.10. The Most Conservative Prairie Plants Found during the County Inventory for 126 Prairie Sites.

Species Name	Common Name	No. of Sites Where Found
COEFFICIENT OF CONSERVATISM = 10:		
<i>Asclepias meadii</i> *	Mead's milkweed	40
<i>Dichanthelium leibergii</i>	Leiberg's dichanthelium	3
<i>Melanthium virginicum</i>	Virginia bunchflower	8
<i>Trifolium reflexum</i>	Buffalo clover	2
COEFFICIENT OF CONSERVATISM = 9:		
<i>Buchnera americana</i>	Blue hearts	9
<i>Ceanothus americanus</i>	New Jersey tea	55
<i>Platanthera praeclara</i> *	Western prairie fringed orchid	1
COEFFICIENT OF CONSERVATISM = 8:		
<i>Agalinis gattereri</i>	Gattereri's agalinis	1
<i>Agalinis skinneriana</i>	Skinner's agalinis	1
<i>Aster oolentangiensis</i>	Azure aster	82
<i>Aster sericeus</i>	Silky aster	2
<i>Camassia scilloides</i>	Wild hyacinth	22
<i>Carex bicknellii</i>	Bicknell's sedge	14
<i>Carex inops</i> subsp. <i>heliophila</i>	Sun sedge	4
<i>Ceanothus herbaceous</i>	Inland New Jersey tea	75
<i>Dodecatheon meadia</i>	Shooting star	4
<i>Echinacea atrorubens</i>	Smooth coneflower	12
<i>Eleocharis tenuis</i>	Slender spikerush	8
<i>Fimbristylis puberula</i>	Hairy fimbristylis	17
<i>Gentiana puberulenta</i>	Downy gentian	84
<i>Lilium canadense</i>	Michigan lily	4
<i>Parthenium hispidum</i>	Whole-leaf feverfew	1
<i>Polygala incarnata</i>	Slender milkwort	13
<i>Polygala sanguinea</i>	Blood milkwort	13
<i>Prenanthes aspera</i>	Rough rattlesnakeroot	13
<i>Psoralea argophylla</i>	Silverleaf scurfpea	5
<i>Scleria triglomerata</i>	Whip razorsedge	56
<i>Spiranthes vernalis</i>	Spring ladies'-tresses	2
<i>Sporobolus heterolepis</i>	Prairie dropseed	35
<i>Stipa spartea</i>	Porcupinegrass	70
<i>Veronicastrum virginicum</i>	Culver's root	20

Note.—Species in bold are indicator species of native tallgrass prairie; these species are large and showy and can be readily identified. Coefficients of conservatism range from 1 to 10. The higher the coefficient, the more conservative the plant species is considered, and its presence is indicative of a high-quality community. See Section 3.3.b above for discussion of conservative species.

*Listed as federally threatened.

Table 4.11. The Most Conservative Forest Plants Found during the 2004–2005 County Inventory for 24 Forest Sites.

Species Name	Common Name	No. of Sites Where Found
COEFFICIENT OF CONSERVATISM = 10:		
<i>Carex hitchcockiana</i>	Hitchcock's sedge	2
COEFFICIENT OF CONSERVATISM = 9:		
<i>Asarum canadense</i>	Canadian wildginger	2
<i>Ceanothus americanus</i>	New Jersey tea	1
<i>Cypripedium parviflorum</i>	Yellow lady's slipper	8
<i>Uvularia grandiflora</i>	Large-flower bellwort	2
COEFFICIENT OF CONSERVATISM = 8:		
<i>Adiantum pedatum</i>	Northern maiden-hair fern	2
<i>Hybanthus concolor</i>	Green violet	2
<i>Lilium canadense</i>	Michigan lily	12

Note.—Species in bold are indicator species of native forest; these species are large and showy and can be readily identified in the spring. Coefficients of conservatism range from 1 to 10. The higher the coefficient, the more conservative the plant species is considered, and its presence is indicative of a high-quality community. See Section 3.3.b above for discussion of conservative species.

4.2.d. Protected and Rare Species Occurrences

The rare plant species found during our survey work (Kansas state-ranked critically imperiled and imperiled species) are listed in Table 4.12. These 28 species are not known from many locations throughout the state. These data will help determine their status and rank. Finding them at numerous sites indicates that the sites surveyed, especially the prairie sites, contain many species of statewide importance.

4.2.e. Non-Native and Invasive Plant Species

Invasive species are non-native (exotic) species that rapidly establish themselves in new habitats, especially habitats that have experienced localized or generalized disturbance. The species listed in Table 4.13 are those that have most often invaded our prairies and forests. One species, not on this list, is sericea lespedeza (*Lespedeza cuneata*), which was found at five sites that we inventoried. The low incidence of this highly invasive species may indicate that it is not currently a major threat to these high-quality sites.

Table 4.12. Kansas State-Ranked S1 (Critically Imperiled) and S2 (Imperiled) Plant Species Found While Surveying 150 Prairie and Forest Sites, 2004–2005.

Species Name	Common Name	No. of Sites Where Found
STATE RANK = S1:		
<i>Agalinis skinneriana</i>	Skinner's agalinis	1
<i>Carex hitchcockiana</i>	Hitchcock's sedge	2
<i>Carex missouriensis</i>	Missouri sedge	1
<i>Carex normalis</i>	Large straw sedge	2
<i>Platanthera praeclara</i>	Western prairie fringed orchid	1
<i>Rubus alumnus</i>	Nursling highbush blackberry	3
<i>Rubus argutus</i>	Serrate-leaf highbush blackberry	1
<i>Rubus enslenii</i>	Enslens blackberry	2
STATE RANK = S2:		
<i>Asclepias meadii</i>	Mead's milkweed	40
<i>Carex hisutella</i>	Hairy-leaf hirsute sedge	2
<i>Carex radiata</i>	Radiate sedge	4
<i>Carex retroflexa</i>	Reflexed sedge	1
<i>Carya lacinosa</i>	Kingnut hickory	6
<i>Dichanthelium latifolium</i>	Wideleaf dichanthelium	7
<i>Dichanthelium linearifolium</i>	Slimleaf dichanthelium	16
<i>Dichanthelium leibergii</i>	Leiberg's dichanthelium	3
<i>Dichanthelium ovale</i>	Stiff-leaf dichanthelium	1
<i>Eleocharis verrucosa</i>	Slender spikerush	8
<i>Elymus hystrix</i>	Bottlebrush grass	1
<i>Galearis spectabilis</i>	Showy orchis	1
<i>Geranium maculatum</i>	Spotted cranesbill	1
<i>Hybanthus concolor</i>	Green violet	2
<i>Hydrophyllum appendiculatum</i>	Notch-bract waterleaf	2
<i>Melanthium virginicum</i>	Virginia bunchflower	8
<i>Rhynchospora harveyi</i>	Harvey's beakrush	1
<i>Rubus laudatus</i>	Praiseworthy blackberry	4
<i>Taenida integerrima</i>	Yellow pimpernel	3
<i>Tomanthera auriculata</i>	Earleaf foxglove	2

Note.—Ranks are determined by the Kansas Natural Heritage Inventory.

Table 4.13. The Most Common Non-Native and Invasive Prairie and Forest Plant Species Found during the County Inventory at 150 Surveyed Sites.

Species Name	Common Name	No. of Sites Where Found
<i>Tragopogon dubius</i>	Goat's beard	110
<i>Dianthus armeria</i>	Deptford pink	90
<i>Bromus japonicus</i>	Japanese brome	82
<i>Potentilla recta</i>	Sulphur cinquefoil	81
<i>Bromus inermis</i>	Smooth brome	75
<i>Chrysanthemum leucanthemum</i>	Ox-eye daisy	74
<i>Festuca arundinacea</i>	Tall fescue	60
<i>Poa pratensis</i>	Kentucky bluegrass	58
<i>Melilotus officinalis</i>	Yellow sweet clover	57
<i>Trifolium pratense</i>	Red clover	55
<i>Phleum pratense</i>	Common timothy	42
<i>Hypericum perforatum</i>	Common St. John's-wort	37
<i>Medicago lupulina</i>	Black medick	37
<i>Carduus nutans*</i>	Musk thistle	36
<i>Allium vineale</i>	field bindweed	33
<i>Melilotus albus</i>	White sweet clover	30
<i>Rumex crispus</i>	Curly dock	30
<i>Barbarea vulgaris</i>	Winter cress	29
<i>Daucus carota</i>	Wild carrot	27
<i>Lactuca serriola</i>	Prickly lettuce	27
<i>Trifolium campestre</i>	Low hop clover	27
<i>Trifolium repens</i>	White clover	26
<i>Agrostis stolonifera</i>	Redtop	22
<i>Thlaspi arvense</i>	Pennycress	20
<i>Dactylis glomerata</i>	Orchardgrass	19
<i>Prunella vulgaris</i>	Self-heal	19
<i>Alliaria petiolata</i>	Garlic mustard	18
<i>Rosa multiflora*</i>	Multiflora rose	17
<i>Torilis arvensis</i>	Hedge parsley	15
<i>Verbascum thapsus</i>	Woolly mullein	12
<i>Lespedeza cuneata</i>	Sericea lespedeza	11
<i>Maclura pomifera</i>	Osage orange	10
<i>Convolvulus arvensis</i>	Field bindweed	9
<i>Taraxacum officinale</i>	Common dandelion	9

* indicates designation as a state noxious weed as determined by the Kansas State Board of Agriculture.

4.3. Wildlife Species

4.3.a. Regal Fritillary (*Speyeria idalia*)

The Regal fritillary is a large orangish butterfly that was once found from the tall and mixed-grass prairies of the northern and central Great Plains east to the meadows and wetlands of the East Coast. Now it is almost entirely gone from the eastern half of its range, very rare east of the Mississippi River, and generally uncommon east of the Missouri River (NatureServe 2005a). Part of this decline can be attributed to loss of habitat from agricultural development and forest succession. However, declines since the 1980s have been considerable, and it is likely that multiple factors (including fire and spraying for Gypsy moths) are involved (NatureServe 2005a). In northeast Kansas, fire seems to be the most common and significant threat to metapopulations.

In its remaining range, the Regal fritillary is essentially a native tall- and mixed-grass prairie obligate. Host plants are violets (*Viola* spp., probably usually *V. pedatifida* in northeast Kansas). Eggs are laid in August and September and hatch before winter. The species survives winter in litter as tiny caterpillars that feed, grow, and pupate in early spring. The first adults appear in northeast Kansas in very late May, and peak abundances are seen mid-June through early July, when mating occurs. Males are most conspicuous as they spend time slowly flying over or through the vegetation in search of females, which are usually sedentary and crawl through vegetation (see Figure 4.3).

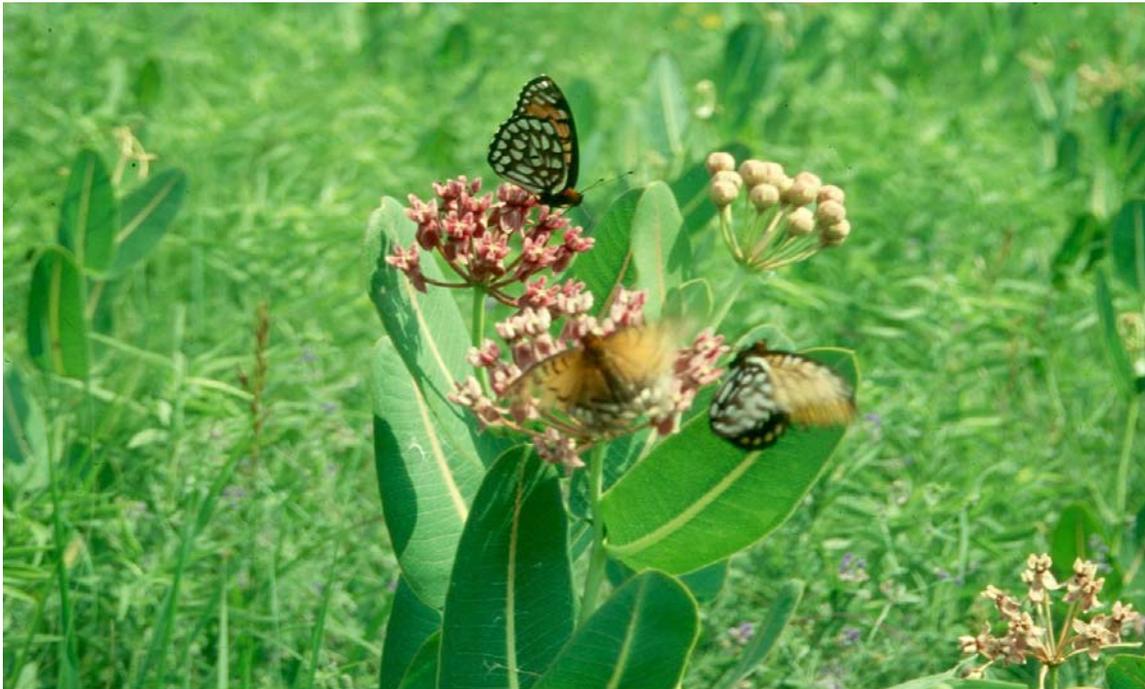


Figure 4.3.—Regal fritillary (*Speyeria idalia*) on milkweed

Survey Methods.—Regal fritillary populations were surveyed by two different methods. First, the presence of the species was recorded incidental to community surveys (incidental surveys). Because the Regal fritillary is a conspicuous butterfly with a diurnal activity period in June, it was readily noticed by field personnel in prairies. Field personnel were asked to record numbers of butterflies observed, but because there was no standardized protocol, this was essentially a presence/absence survey.

The second method consisted of systematic surveys. To get a better idea of the abundance of the butterflies, we conducted transect studies. We measured Regal fritillary abundance at 87 native tallgrass prairie remnants in Douglas, Leavenworth, and Miami Counties (52, 8, and 27 sites, respectively) in northeast Kansas. We conducted surveys using strip-transects (length range 130–1,300 m, mean = 475 m), counting all individuals seen ≤ 30 m to each side of the transect centerline while walking (about 4 km/h). Transect centerlines generally ran the length of each (usually rectangular) site from one edge to the other, and were located parallel to, and >30 m from, the edges of the site to each side of the line. Most sites were wide enough to accommodate two transects; their centerlines were >60 m apart when positioned parallel to one another. Transects were not physically marked; a visual landmark and/or compass was used to mark a bearing to walk, thereby defining a transect centerline, and a GPS unit was used to measure transect lengths and distances between transects. A laser rangefinder was used to measure distances to butterflies and edges of remnants to the sides of transect centerlines. If no individuals were detected at a site on transects, binoculars were used to scan the site for several minutes to check for their presence.

All surveys were conducted in mid-June 2005 (June 14, 15, 20, 21 for Douglas County; June 22 for Leavenworth County; and June 23, 24 for Miami County) by the same observer (Alexis Powell), between 8:30 and 17:00 CST, under dry (no dew or recent precipitation), sunny, and warm (25–34°C) conditions, with winds <20 km/h.

We selected sites based on ease of access (landowner permission, proximity to roads) in order to maximize the number that could be visited each day, but each site was representative of prairie remnants in the region with regard to size, quality, and management. When signs of recent fire (absence of litter, recently killed cedars, charred delicate woody stems) were evident at a site, we classified it as burned (21 sites total; 17 in Douglas, 4 in Miami County). Otherwise, we classified sites as unburned (66 sites total; 35 in Douglas, 8 in Leavenworth, and 23 in Miami County) and noted when additional aspects of management, such as haying or grazing, were obvious. One large prairie remnant (in Douglas County) had both burned and unburned portions, which we treated as separate sites in the analysis.

The raw data from each transect were converted to individuals/100 m transect, by multiplying total counts of individuals detected ≤ 30 m from the transect line (range 0–78 individuals) by 100 m/transect length.

Incidental Survey Results.—We noted the presence of Regal fritillaries at 76 out of 249 (31%) sites inventoried in the five-county area during 2004–2005 (see Table 4.14).

Table 4.14. Regal Fritillaries (*Speyeria idalia*) Sighted at Prairie Sites Visited during the County Inventory, 2004–2005 (No. of Sites = 249).

	Total Sites	A	B	C	D
Douglas	40	0	12	18	10
Miami	20	0	5	14	1
Leavenworth	16	0	1	10	5
Johnson	0	0	0	0	0
Wyandotte	0	0	0	0	0
All Five Counties	76	0	18	42	16

Systematic Survey Results.—Regal fritillary butterflies were detected on the majority (70 of 87 = 80%) of sites surveyed in Leavenworth, Douglas, and Miami Counties. Relative abundance varied greatly among sites (Figure 4.4). Of sites with Regal fritillaries, most had relatively low densities of the butterflies (63% of sites had 1–3 individuals per 100 m), while a few sites had extremely high densities (6% of sites had 10+ butterflies per 100 m). Average density over all 87 sites was 4.41 individuals/ha (10.90 individuals/acre). The maximum density at a site was 28.27 individuals/ha (69.86 individuals/acre).

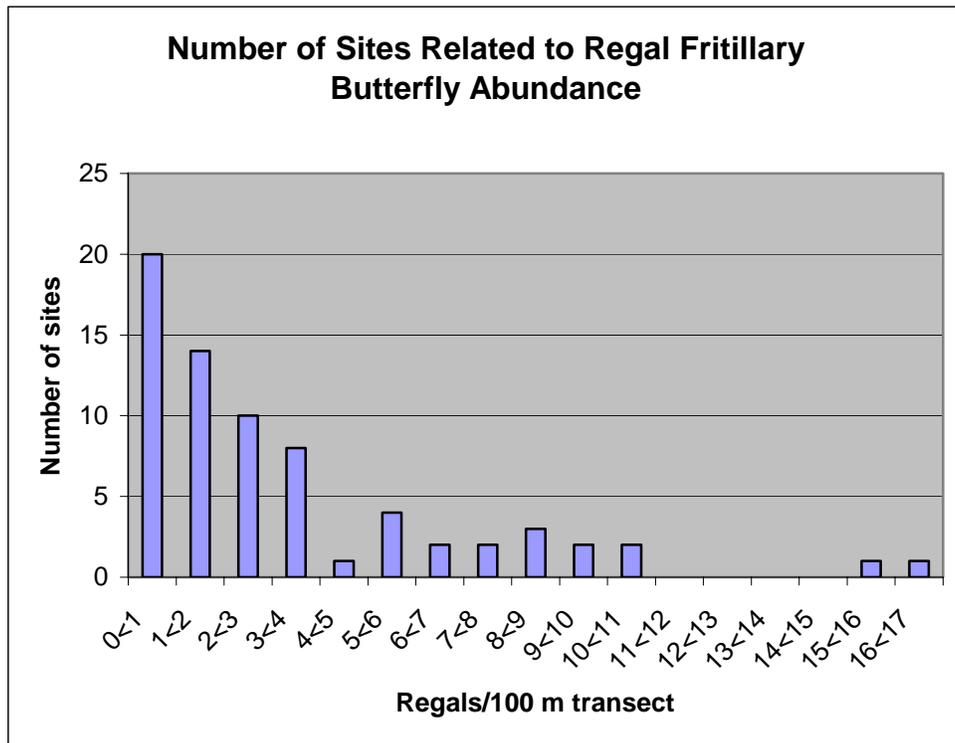


Figure 4.4. Regal fritillary butterfly density at survey sites.

The counts reported here are conservative estimates of the true density. As seen in Figure 4.5, many butterflies are missed at distances beyond five meters from the transect

centerline. This was particularly the case at sites with high abundances where, because of the large numbers of individuals to count, more distant individuals were more likely to be missed. In addition, while we did not determine the sex of individual butterflies, the vast majority were probably males searching for mates, as opposed to females that spend more time in vegetation. So again, these counts are underestimates of true densities.

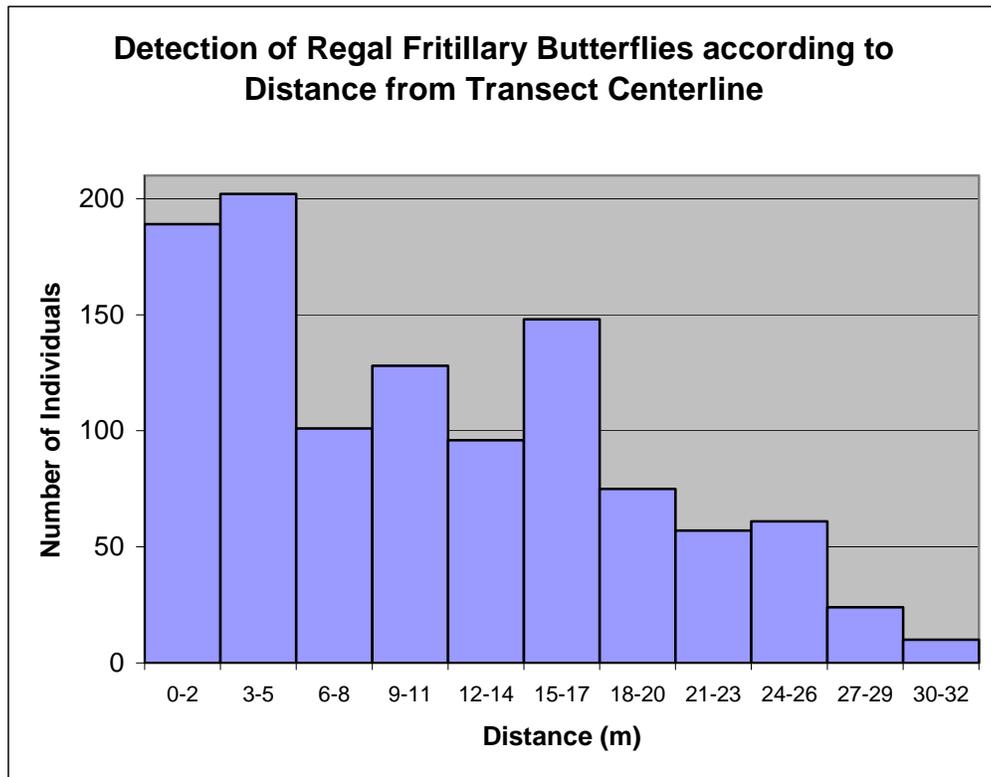


Figure 4.5. Total numbers of Regal fritillary butterflies detected by distance from the centerline of the transect.

Sites where butterflies were not detected were mostly prairies that had been recently burned (Figure 4.6). Furthermore, Regal fritillary densities at recently burned prairies were, on average, lower than on prairie without evidence of recent burning. At burned sites and unburned sites, the abundance was 0.872 and 3.221 individuals/100 m transect, respectively. These differences were statistically significant ($p < 0.01$).

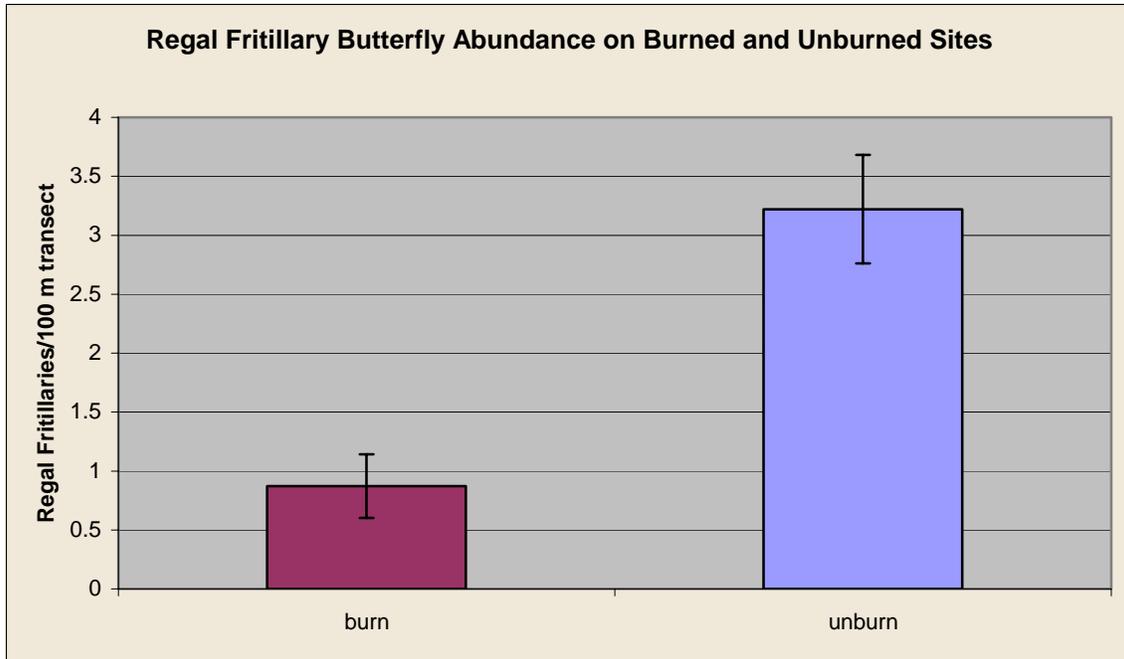


Figure 4.6. Regal fritillary abundance (and standard errors) on burned and unburned prairie sites.

Finally, densities exhibited a strong geographic effect with significant ($p < 0.0001$) differences among the three counties (Figure 4.7). In Douglas, Leavenworth, and Miami Counties, the average abundance was 2.915, 7.050, and 0.847 individuals/100 m transect, respectively.

Discussion of Surveys.—Incidental surveys documented the presence of Regal fritillary on about 30% of the prairie sites visited during this study. However, many field surveys were conducted at times unsuitable for butterfly activity, such as outside of their June–August adult activity season, or during cool, wet, or cloudy conditions. Thus, this survey provides a highly conservative estimate of Regal fritillary presence on prairie sites in the study area. The remainder of the discussion is based on results from the systematic survey.

In the systematic survey, Regal fritillary butterflies were present on most prairies in the surveyed area, but their abundance is significantly different among counties and varies considerably among sites. Some of this variation can be attributed to the effect of burning prairies as a management tool. We found that the Regal fritillary is generally absent or at very low abundance on sites that were recently burned (preceding spring or fall), whereas it can reach spectacular levels of up to 17 individuals/100 m on unburned sites. The only burned site on which abundance surpassed 2.5 individuals/100 m was one where patch burning was employed—there, abundance was 5.3 individuals/100 m. Past burning events may explain the low abundance of Regal fritillaries at many “unburned” sites. Studies suggest it takes Regal Fritillary populations 4–5 years to recover following a burn (Swengel 1996, 1998). The reason for the low abundance on burned sites is

believed to be the elimination of larvae during spring burns (NatureServe 2005a). However, adults are strong dispersers and readily colonize new sites. Consequently, even if they are eliminated by fire at one site, Regal fritillaries generally reappear if other prairies that support populations are nearby.

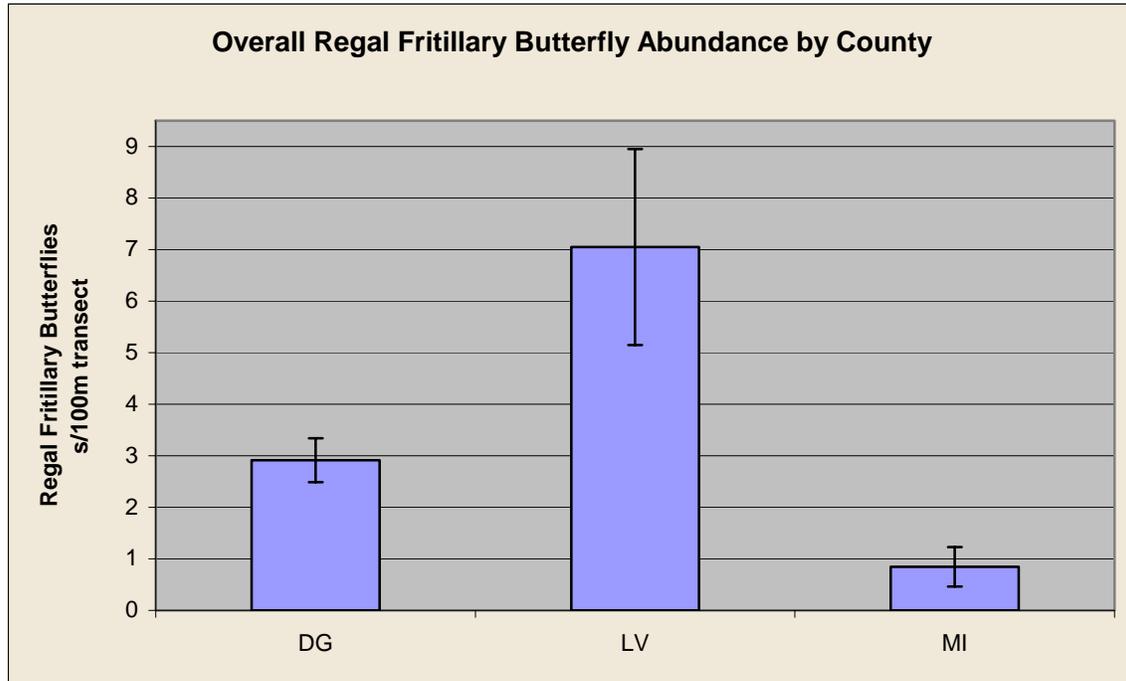


Figure 4.7. Average Regal fritillary abundance (and standard errors) in the County Inventory Area, 2005. DG = Douglas County; LV = Leavenworth County; MI = Miami County.

It is unclear why densities varied so strikingly among Leavenworth, Douglas, and Miami Counties. Populations are known to exhibit strong annual variation (NatureServe 2005a). Given that this was a 1-year study, it remains to be seen if the among-county differences persist over a longer time period.

Conservation Implications.—The remaining high-quality prairies in the study area support healthy Regal fritillary populations. Given the declining status of this species over large parts of its range, the conservation value of remaining prairies in the study area for this species is significant. However, the continued viability of populations in this region is not secure, given the lack of protection afforded remaining prairies and the current trend of steady prairie loss and degradation caused by development and other factors. Conservation of the Regal fritillary will require the maintenance of a network of properly managed prairies. It is unrealistic to expect the remaining small prairies to support populations in isolation. Because of periodic burns and other stochastic factors, populations at any one site are at high risk of extirpation. It is therefore wise to maintain multiple sites in reasonable proximity to provide sources of recolonization.

4.3.b. Other Animal Species: Survey Methods and Results

Information on rare animal species encountered during natural community field work is summarized in Table 4.15. The observations of Red-shouldered hawk, Broad-winged hawk and White-eyed vireo were made in forested (hawks) or scrub (vireo) habitats during June and probably represent breeding birds. More information is needed on the breeding status and distribution of these species in the five-county area. The Prairie mole cricket and Regal fritillary butterflies were recorded in prairie remnants. Surveys for Prairie mole crickets were conducted under appropriate conditions at 17 prairies in Douglas and Miami Counties in May 2005. The fact that crickets were found at only one site indicates that this species is rare in this area. However, only a small subset of the prairies were inventoried for this species, so more information is needed about the Prairie mole cricket in the study area. In contrast, the Regal fritillary butterfly was encountered at 30% of prairies checked in Leavenworth, Douglas, and Miami Counties (76 out of 249 prairie sites). Observations reported in Table 4.15 were recorded during the County Inventory, not during targeted surveys, and thus may not have been conducted at appropriate times or weather conditions for butterfly activity. Other Regal fritillary data were derived from systematic surveys in 2005 (see Section 4.3.a above) and provide a more accurate and comprehensive assessment of the status of the Regal fritillary on prairie remnants in the study area.

Table 4.15. Target Animal Species Encountered at Prairie Sites during the County Inventory (No. of Sites = 249).

Scientific Name	Common name	State Status	State Rank	Number of sites	Counties
<i>Buteo lineatus</i>	Red-shouldered hawk	--	S2	2	Douglas, Miami
<i>Buteo platypterus</i>	Broad-winged hawk	--	S1B	2	Douglas, Leavenworth
<i>Vireo griseus</i>	White-eyed vireo	--	S2B	1	Douglas
<i>Gryllotalpa major</i>	Prairie mole cricket	SINC	S3	1	Miami
<i>Speyeria idalia</i>	Regal fritillary butterfly	--	S4	76	Douglas, Leavenworth, Miami

Note.—SINC = species in need of conservation; B indicates a breeding population; S1 = critically imperiled; S2 = imperiled; S3 = vulnerable to extirpation or extinction; S4 = apparently secure. Although Regal fritillaries are ranked S4, they are of concern; see Section 4.3.a above.

4.3.c. Discussion of Natural Areas and Target Animals

The affiliations of target animal with particular natural communities documented in the County Inventory are presented in Table 4.16. All community types for which high-quality examples were identified in this study are believed to provide habitat for at least several species of target animals. Some target species, such as Prairie mole cricket and

Regal fritillary butterfly, have specialized habitat requirements and may be restricted to habitat within a single natural community type in the five-county area. If remaining sites containing appropriate habitats continue to be lost or degraded, extirpation of these species in the Douglas, Leavenworth, Miami, Johnson, and Wyandotte Counties is likely. Other species, such as the Timber rattlesnake and Spotted skunk, have more generalized habitat associations and may utilize a range of community types. The conservation status of such generalized habitat species may hinge less on the presence and condition of specific natural community types and more on other environmental factors. In general, the link between natural community habitats and the occurrence of target animals is strong, and the persistence of many target species within the five-county area may well depend on sites identified in this study.

Table 4.16. Likely or Known (L) and Possible (P) Affiliations of Target Animal Species with Natural Communities Documented in the County Inventory.

	Ash-Elm-Hackberry Floodplain Forest	Cottonwood-Sycamore Floodplain Forest	Cross Timbers Forest	Maple-Basswood Forest	Oak-Hickory Forest	Glaciated Tallgrass Prairie	Unglaciated Tallgrass Prairie	Low (Wet) Prairie
Mammals								
Spotted skunk			P	P	P	P	P	P
Eastern chipmunk	P	P	L	L	L			
Franklin’s ground-squirrel					P	P	P	
Southern bog lemming						L	L	L
Southern flying squirrel	L	L	P	L	L			
Birds								
Cerulean warbler	L	L						
Henslow’s sparrow							L	
Red-shouldered hawk	L	L	L	L	L			
Broad-winged hawk	P	P	L	L	L			
Whip-poor-will			L	L	L			
Yellow-throated warbler		L						
Reptiles								
Broadhead skink	P	P	L	P	L			
Red-bellied snake	P	P	L	P	L			
Smooth earth snake	P	P	P	L	L			
Timber rattlesnake	P	P	L	P	L	P	P	
Amphibians								
Central newt	P	P						
Crawfish frog							L	L
Spring peeper	P	P						
Insects								
Prairie mole cricket							L	
Regal fritillary						L	L	P

Note.—See Table 2.3 for scientific names and status.

4.4. Direct Benefits of High-Quality Natural Areas to People and County Inventory Results

The remaining native prairies and forest provide many benefits to the public. They include habitats for rare species (as documented in our study), flood control, water- or air-quality control, recreational opportunities, or aesthetic enjoyment of the outdoors. The remaining natural areas also provide habitat for some of the state's sensitive and declining species and help to maintain biological diversity. In addition, many of the residents in the region appreciate the pastoral, native landscapes of Kansas and want to see them remain as part of the identifiable Kansas landscape.

4.5. Management Recommendations

The County Inventory revealed that high-quality prairies and forests still exist in northeast Kansas, but as Table 2.1 shows, less than 0.5% of historic native prairie still exists, and our data indicate that during the last 10 years a significant number of these remaining remnants have decreased and are still decreasing in both size and number. Although we know that a smaller amount of high-quality native forest still exists, we do not have enough survey information to calculate its acreage or quality. Other high-quality plant communities do exist in this area, but their acreage is so small that we did not find them in our detailed study. The majority of remaining areas of high-quality native prairie and forest are owned by private landowners, and it is thanks to them that these native communities still exist.

4.5.a. Landowners and Managers

With the majority of remaining high-quality prairies and forests being held as private property, encouragement of continued good management is essential. In addition, various means need to be found to encourage good management for biological diversity, including funding through U.S. Department of Agriculture programs, state programs, and local monies, for both direct management and conservation of these high-quality native tracts.

A substantial number (perhaps 10%) of tracts of native prairie and forest are owned by public and nonprofit entities, including the U.S. Army Corps of Engineers, Kansas Department of Wildlife & Parks, the University of Kansas, Baker University, county and city governmental entities, and nonprofit organizations. These public and nonprofit landowners also need to be encouraged to manage these tracts appropriately because they may have other management interests, may not have significant staff or funding, or may not fully recognize the ecological values of the lands they manage.

4.5.b. Conservation Easements

One way to maintain the natural areas that remain in the five-county area is for property owners to preserve the high-quality property that they have. Conservation easements are a tool that provides landowners with tax benefits when they agree to limit the kind of development that can occur on their property. Planning commissions and nonprofit

organizations can educate landowners about conservation easements and encourage their use. Conservation easements held by the Kansas Land Trust, The Nature Conservancy, and the Kansas Department of Wildlife & Parks have already been put into place to protect the ecological values of forests and prairies in the five-county area. Funds for programs to purchase conservation easements on additional high-quality parcels of forest and prairie would significantly help conserve these tracts. Open space programs being discussed in Johnson and Douglas Counties could significantly aid in this process.

4.5.c. Restoration and Other Uses of Low-Quality Sites

Programs can be developed by state and local government to provide funding to landowners to restore lower-quality areas adjacent to higher-quality property. When high-quality areas are surrounded with buffers of restored land, corridors can be created that give native plants and animals the opportunity to expand and find appropriate habitat to live in. Where clusters of prairies and forests occur, lands that connect them could be appropriate places to encourage and fund restoration in voluntary programs.

4.5.d. Other Management Recommendations

The information obtained by this survey work can be helpful to landowners as we have provided plant species lists to all landowners who gave us permission to visit their land. This study can also be useful to several organizations in northeast Kansas that are involved with planning and land-use management. We will encourage them to create new programs to encourage the conservation of these lands by working with private property owners. We will be sharing this information with the following entities:

- Kansas Department of Wildlife & Parks;
- U.S. Fish & Wildlife Service;
- planning commissions in Douglas, Miami, Johnson, Leavenworth, and Miami Counties;
- ECO2, a land-use task force based in Douglas County;
- the Kansas Land Trust; and
- The Nature Conservancy.

We intend to update this information and provide additional information on our County Inventory web page. We encourage others to look at it, or to obtain an additional copy of this report at:

http://www.kbs.ku.edu/people/staff_www/kindscher/County_Inventory/html/Co_Inv_Website_No_Frames_051705.htm.

Alternatively, this report can be found by typing the title into a search engine.

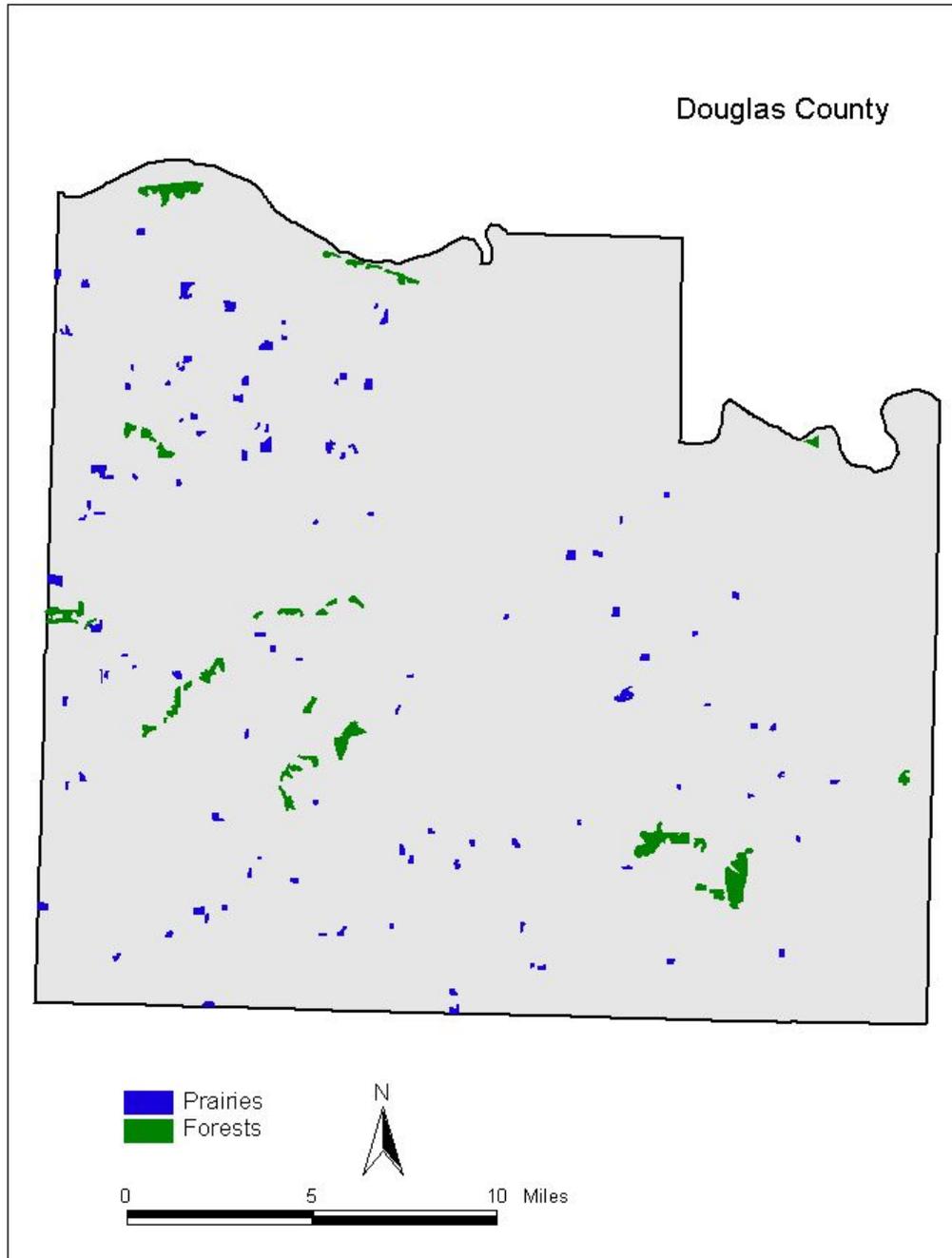
Literature Cited and Data Sources

- Ewing, R., J. Kostyack, D. Chen, B. Stein, and M. Ernst. 2005. Endangered by sprawl: how runaway development threatens America's wildlife. National Wildlife Federation, Smart Growth America, and NatureServe. Washington, D.C., January.
- Freeman, C. C., and S. M. Hall. 1991. Status survey for western prairie fringed orchid (*Platanthera praeclara* Sheviak & Bowles) on the Fort Riley Military Reservation.
- Freeman, C. C., and C. A. Morse. 2002. Kansas floristic quality assessment: coefficients of conservatism. Unpublished report of the R. L. McGregor Herbarium and Kansas Biological Survey, University of Kansas. Lawrence.
- Great Plains Flora Association. 1991. The flora of the Great Plains. 2nd ed. University Press of Kansas, Lawrence.
- Herman, K. D., L. A. Masters, M. R. Penskar, A. A. Reznicek, G. S. Wilhelm, and W. W. Brodowicz. 1997. Floristic quality assessment: development and application in the state of Michigan (USA). *Natural Areas Journal* 17:265–279.
- Kansas Natural Heritage Inventory database. 1988–2005. Lawrence: Kansas Biological Survey.
- Kansas State Board of Agriculture. 1877. Fifth annual report of the State Board of Agriculture to the legislature of the State of Kansas. Geo. W. Martin, Kansas Publishing House, Topeka.
- Kindscher, K. 1992. Environmental features report for Horizon 2020. Manuscript. Kansas Biological Survey, Lawrence.
- Lauver, C. L., K. Kindscher, D. Faber-Langendoen, and R. Schneider. 1999. A classification of the natural vegetation of Kansas. *Southwestern Naturalist* 44:421–443.
- Lauver, C. L. 1989. Final report on the natural areas inventory of Douglas County, Kansas, with a progress report on the inventory of other Kansas counties. Report no. 38. Kansas Biological Survey, Lawrence.
- McCauley, J. R. 1998. Development and general geology of the Kansas River corridor. Chapter 1 of *The Kansas River corridor—Its geologic setting, land use, economic geology, and hydrology*, by L. L. Brady, compiler, D. A. Grisafe, J. R. McCauley, G. C. Ohlmacher, H. A. M. Quinodoz, and K. A. Nelson. Open-file report no. 98-2. Kansas Geological Survey, Lawrence. Electronic version posted January 13, 1998, at http://www.kgs.ku.edu/Publications/KR/kr_geol.html; accessed August 24, 2005.
- NatureServe. 2005a. Comprehensive report: *Speyeria idalia* (Regal fritillary). NatureServe explorer: an online encyclopedia of life. Version 4.5. NatureServe, Arlington, VA. Available at <http://www.natureserve.org/explorer>, accessed August 23, 2005.
- NatureServe. 2005b. NatureServe conservation status. NatureServe explorer: an online encyclopedia of life. Version 4.5. NatureServe, Arlington, VA. Available at <http://www.natureserve.org/explorer/ranking.htm>, accessed August 23, 2005.
- NatureServe. 2005c. Natural Heritage methodology: supporting interoperability within the NatureServe network. NatureServe, Arlington, VA. Available online at

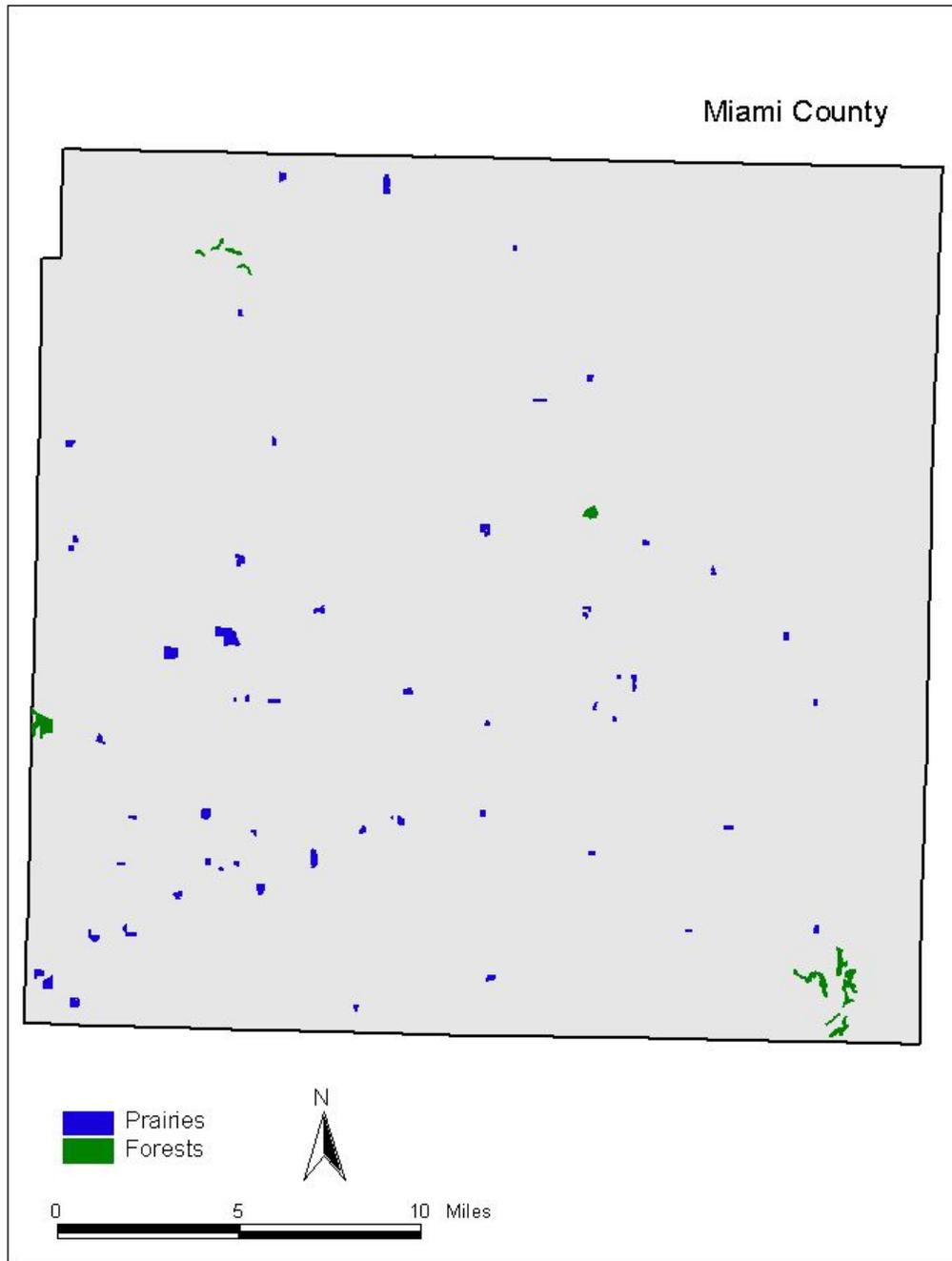
- <http://www.natureserve.org/prodServices/heritagemethodology.jsp>, accessed September 1, 2005.
- Public Land Surveys of Kansas. 1850s. Published on CD by the Kansas Society of Land Surveyors and Kansas Historical Society. Cameron Howell, Project Manager. National Archives, Record Group 49: Land Entry Files of the U.S. General Land Office, Bureau of Land Management. General Land Office Township Surveys, Kansas. Leavenworth, KS: Duke West Interactive Graphics, Inc.
- Rooney, T. P., and D. A. Rogers. 2002. The modified floristic quality index. *Natural Areas Journal* 22:340–344.
- Swengel, A. B., 1996. Effects of fire and hay management on abundance of prairie butterflies. *Biological Conservation* 76:73–85.
- Swengel, A. B. 1998. Effects of management on butterfly abundance in tallgrass prairie and pine barrens. *Biological Conservation* 83:77–89.
- Swink, F., and G. S. Wilhelm. 1979. *Plants of the Chicago region*. 3rd ed. Morton Arboretum, Lisle, IL.
- Taft, J. B., G. S. Wilhelm, D. M. Ladd, and L. A. Masters. 1997. Floristic quality assessment for vegetation in Illinois: a method for assessing vegetation integrity. *Erigenia* 15:3–23.
- U.S. Department of Agriculture. 2003. Natural color compressed county mosaics of Douglas, Johnson, Leavenworth, Miami, and Wyandotte Counties. National Agricultural Imagery Program NAIP-03. Photo Imaging Branch, Aerial Photography Field Office, Farm Service Agency. Salt Lake City.
- U.S. Fish & Wildlife Service. 1995. *Platanthera praeclara* (Western prairie fringed orchid) recovery plan. U.S. Fish & Wildlife Service, Ft. Snelling, MN.
- U.S. Fish & Wildlife Service. 2003. Mead's milkweed (*Asclepias meadii*) recovery plan. U.S. Fish & Wildlife Service, Fort Snelling, MN.
- U.S. Geological Survey. N.d. Topographic Maps of Douglas, Johnson, Leavenworth, Miami, and Wyandotte Counties. Wilhelm, G. S. 1977. Ecological assessment of open land areas in Kane County, Illinois. Kane County Urban Development Division. Geneva, IL.
- Wilhelm, G. S. 1977. Ecological assessment of open land areas in Kane County, Illinois. Kane County Urban Development Division. Geneva, Illinois.
- Wilhelm, G. S., and D. Ladd. 1988. Natural area assessment in the Chicago region. In *Transactions of the 53rd North American Wildlife and Natural Resources Conference*, pp. 371–375.

Appendix A

Douglas County Prairie and Forest Sites, 2005

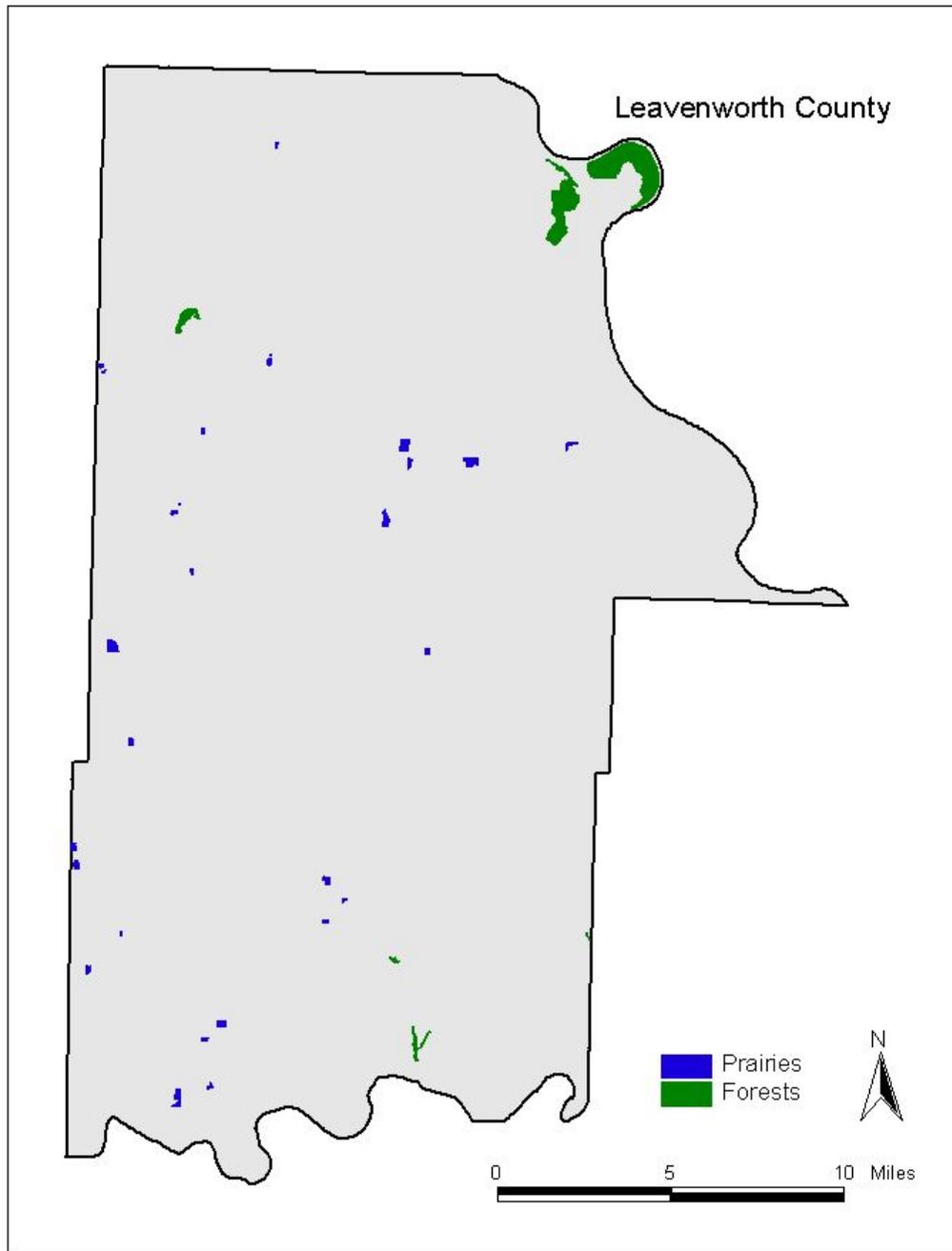


Appendix B Miami County Prairie and Forest Sites, 2005



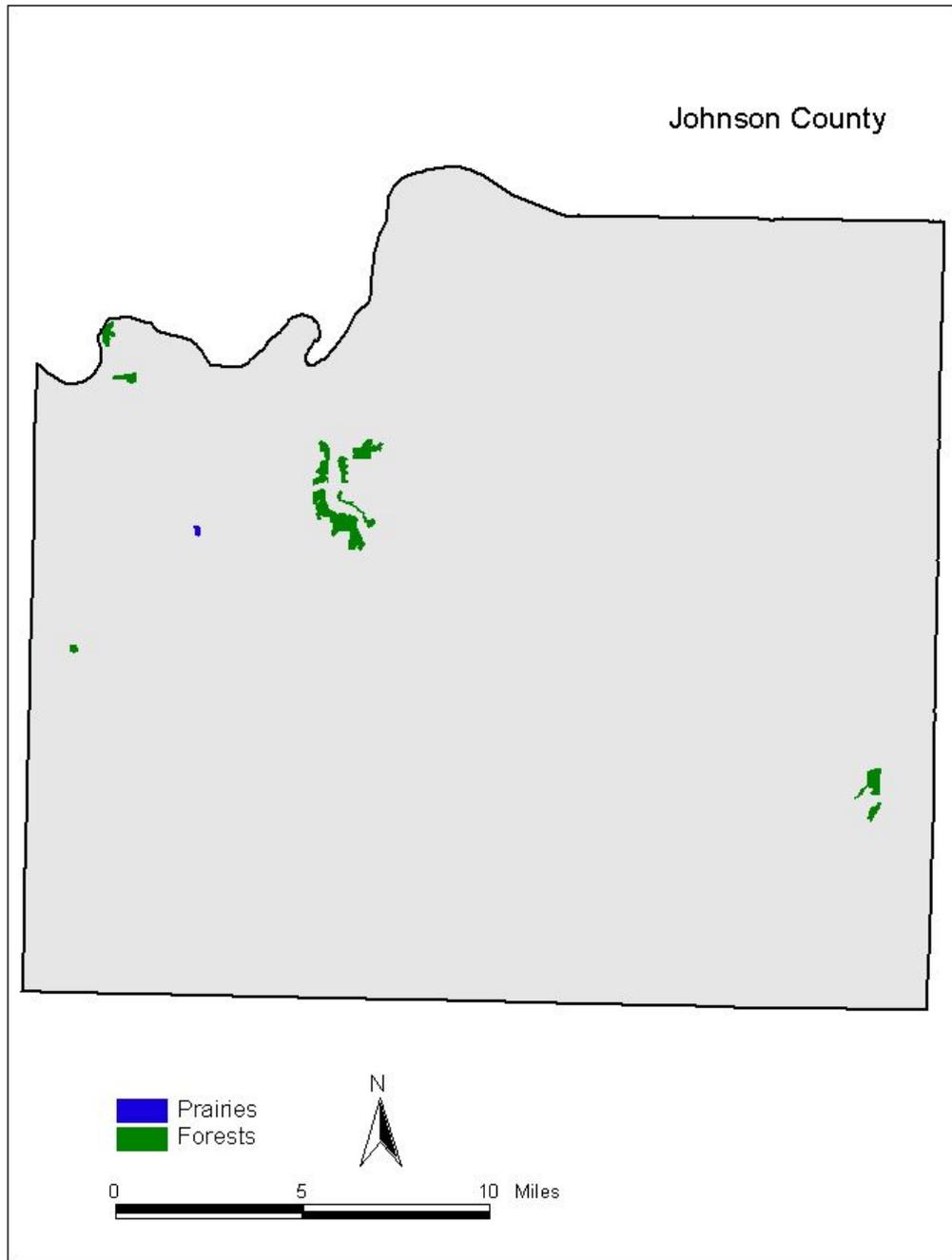
Appendix C

Leavenworth County Prairie and Forest Sites, 2005

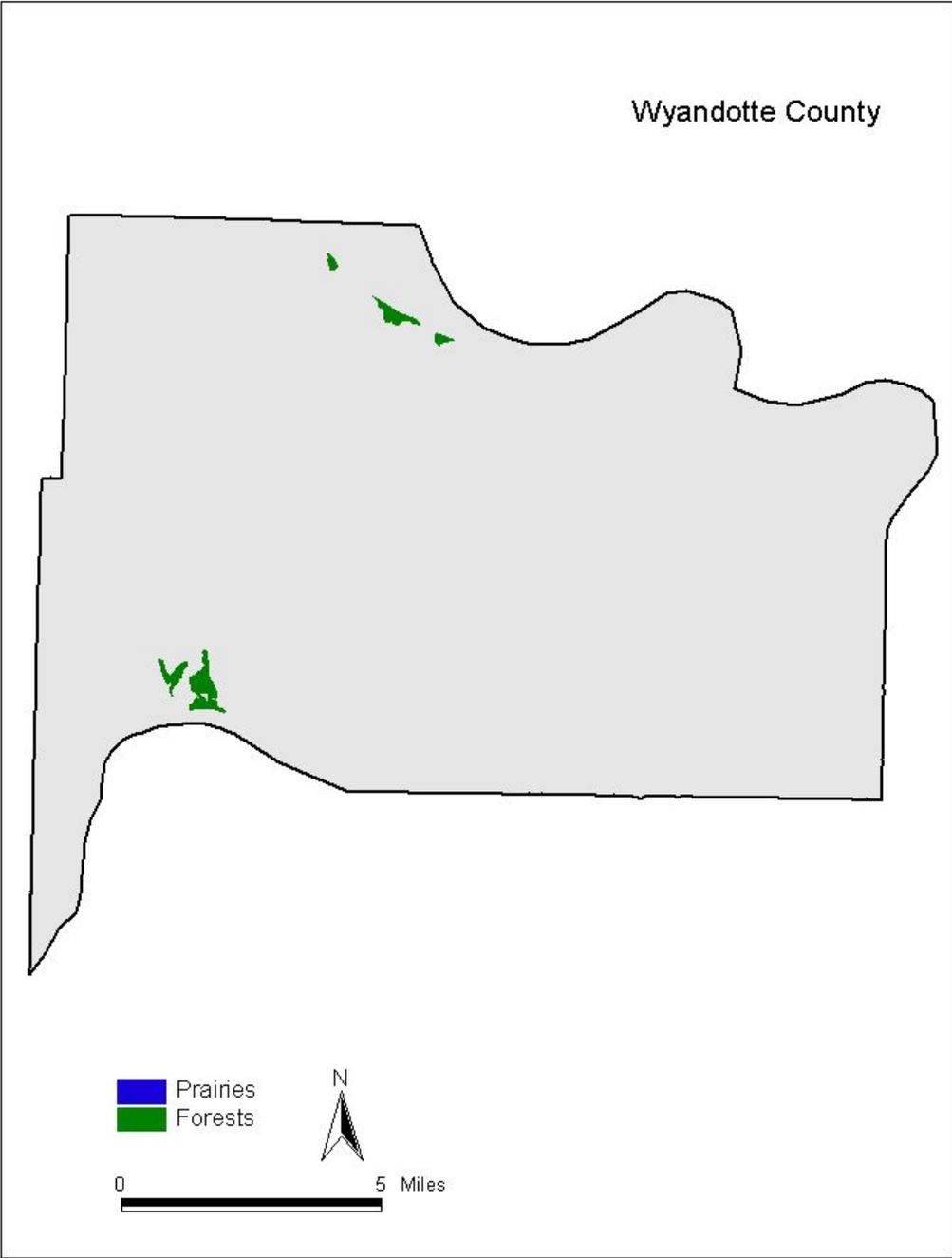


Appendix D

Johnson County Prairie and Forest Sites, 2005



Appendix E
Wyandotte County Prairie and Forest Sites, 2005



Appendix F
Prairie Plant Species Found during the County Inventory
(No. of Prairie Sites = 126)

Species Name	Common name	No. of Sites Where Found
<i>Abutilon theophrasti</i>	Velvet-leaf	1
<i>Acalypha rhomboidea</i>	Rhombic copperleaf	1
<i>Acalypha virginica</i>	Virginia copperleaf	21
<i>Acer negundo</i>	Common boxelder	2
<i>Achillea millefolium</i>	Yarrow	105
<i>Agalinis gattingeri</i>	Gattinger's agalinis	1
<i>Agalinis skinneriana</i>	Skinner's agalinis	1
<i>Agalinis tenuifolia</i>	Narrow leaf agalinis	1
<i>Agrimonia parviflora</i>	Small-flower agrimony	2
<i>Agrostis hyemalis</i>	Winter bentgrass	45
<i>Agrostis stolonifera</i>	Redtop	21
<i>Alisma subcordatum</i>	Smallflower water plantain	1
<i>Alliaria petiolata</i>	Garlic mustard	1
<i>Allium canadense</i>	Canada wild onion	36
<i>Allium drummondii</i>	Drummond's onion	2
<i>Allium stellatum</i>	Summer pink onion	1
<i>Allium vineale</i>	Field garlic	27
<i>Ambrosia artemisiifolia</i>	Common ragweed	42
<i>Ambrosia psilostachya</i>	Western ragweed	15
<i>Ambrosia trifida</i>	Giant ragweed	12
<i>Amorpha canescens</i>	Lead plant	115
<i>Amorpha fruticosa</i>	False indigo	12
<i>Ampelopsis cordata</i>	Heart leaf raccoon grape	1
<i>Andropogon gerardii</i>	Big bluestem	108
<i>Andropogon scoparium</i>	Little bluestem	98
<i>Andropogon virginicus</i>	Broomsedge bluestem	9
<i>Androsace occidentalis</i>	Western rock-jasmine	1
<i>Anemone virginiana</i>	Tall anemone	5
<i>Antennaria neglecta</i>	Field pussytoes	72
<i>Antennaria parlinii</i>	Plantainleaf pussytoes	1
<i>Apios americana</i>	American potato bean	5
<i>Apocynum cannabinum</i>	Hemp dogbane	100
<i>Arabis canadensis</i>	Canadian rockcress	1
<i>Arabis glabra</i>	Tower rockcress	1
<i>Arctium minus</i>	Common burdock	1

<i>Arenaria serpyllifolia</i>	Thyme-leaved sandwort	5
<i>Aristida oligantha</i>	Prairie threeawn	2
<i>Aristida purpurascens</i>	Arrow-feather threeawn	1
<i>Artemisia ludoviciana</i>	Mexican sagewort	16
<i>Asclepias amplexicaulis</i>	Bluntleaf milkweed	29
<i>Asclepias hirtella</i>	Prairie milkweed	30
<i>Asclepias meadii</i>	Mead's milkweed	40
<i>Asclepias purpurascens</i>	Purple milkweed	3
<i>Asclepias stenophylla</i>	Narrowleaf milkweed	25
<i>Asclepias sullivantii</i>	Sullivant's milkweed	45
<i>Asclepias syriaca</i>	Common milkweed	52
<i>Asclepias tuberosa</i>	Butterfly milkweed	97
<i>Asclepias verticillata</i>	Whorled milkweed	68
<i>Asclepias viridiflora</i>	Green-flowered milkweed	74
<i>Asclepias viridis</i>	Green Antelopehorn milkweed	104
<i>Asimina triloba</i>	Pawpaw	1
<i>Asparagus officinalis</i>	Asparagus	7
<i>Aster drummondii</i>	Drummond's aster	4
<i>Aster ericoides</i>	Heath aster	90
<i>Aster laevis</i>	Smooth blue aster	10
<i>Aster oblongifolius</i>	Aromatic aster	10
<i>Aster oolentangiensis</i>	Azure aster	82
<i>Aster pilosus</i>	Hairy aster	80
<i>Aster praealtus</i>	Common willow-leaved aster	75
<i>Aster sericeus</i>	Silky aster	2
<i>Astragalus canadensis</i>	Canadian milk-vetch	1
<i>Astragalus crassicaarpus</i>	Common ground plum	27
<i>Astragalus distortus</i>	Ozark milkveatch	1
<i>Astragalus missouriensis</i>	Missouri milkvetch	1
<i>Baptisia alba</i>	White wild indigo	4
<i>Baptisia australis</i>	Blue false indigo	14
<i>Baptisia bracteata</i>	Plains wild indigo	104
<i>Baptisia lactea</i>	White wild indigo	37
<i>Barbarea vulgaris</i>	Winter cress	29
<i>Bidens aristosa</i>	Tickseed beggartick	3
<i>Bidens bipinnata</i>	Spanish needles	1
<i>Bidens polylepis</i>	Coreopsis beggar-tick	2
<i>Bouteloua curtipendula</i>	Side-oats grama	39
<i>Bouteloua hirsuta</i>	Hairy grama	1
<i>Bromus inermis</i>	Smooth brome	73
<i>Bromus japonicus</i>	Japanese brome	81
<i>Bromus tectorum</i>	Downy brome	1
<i>Buchnera americana</i>	Blue hearts	9

<i>Cacalia atriplicifolia</i>	Pale Indian plantain	3
<i>Cacalia plantaginea</i>	Indian plantain	74
<i>Callirhoe alcaeoides</i>	Pale poppy mallow	10
<i>Calylophus serrulatus</i>	Plains yellow evening primrose	9
<i>Calystegia sepium</i>	Hedge bindweed	15
<i>Camassia scilloides</i>	Wild hyacinth	22
<i>Campanula americana</i>	American bellflower	1
<i>Campsis radicans</i>	Trumpet creeper	2
<i>Cardamine parviflora</i>	Small-flower bittercress	1
<i>Carduus nutans</i>	Musk thistle	43
<i>Carex annectens</i>	Yellowfruit sedge	17
<i>Carex australis</i>	Southern sedge	6
<i>Carex bicknellii</i>	Bicknell's sedge	14
<i>Carex blanda</i>	Woodland sedge	3
<i>Carex brevior</i>	Straw sedge	36
<i>Carex bushii</i>	Bush's sedge	42
<i>Carex caroliniana</i>	Carolina sedge	2
<i>Carex cephalophora</i>	Woodbank sedge	2
<i>Carex frankii</i>	Frank's sedge	9
<i>Carex gravida</i>	Heavy sedge	29
<i>Carex hisutella</i>	Hairy-leaf hirsute sedge	1
<i>Carex inops subsp. heliophila</i>	Sun sedge	4
<i>Carex lanuginosa</i>	Woolly sedge	1
<i>Carex meadii</i>	Mead's sedge	32
<i>Carex mesochorea</i>	Savannah sedge	6
<i>Carex missouriensis</i>	Missouri sedge	1
<i>Carex molesta</i>	Sedge	3
<i>Carex scoparia</i>	Broom sedge	1
<i>Carex sp.</i>	Sedge	8
<i>Carex umbellata</i>	Low sedge	2
<i>Carex vulpinoidea</i>	Fox sedge	4
<i>Carya ovata</i>	Shagbark hickory	1
<i>Cassia chamaecrista</i>	Showy partridge pea	15
<i>Cassia marilandica</i>	Maryland senna	14
<i>Ceanothus americanus</i>	New Jersey tea	55
<i>Ceanothus herbaceus</i>	Inland New Jersey tea	75
<i>Ceanothus sp.</i>	New Jersey tea	1
<i>Celastrus scandens</i>	American bittersweet	6
<i>Celtis occidentalis</i>	Common hackberry	1
<i>Cerastium brachypetalum</i>	Grey mouse ear	2
<i>Cerastium brachypodum</i>	Shortstalk cerastium	3
<i>Cerastium fontanum</i>	Mouse-ear chickweed	7
<i>Cercis canadensis</i>	Redbud	4

<i>Chaerophyllum tainturieri</i>	Erect chervil	19
<i>Chenopodium berlandieri</i>	Pitseed goosefoot	2
<i>Chrysanthemum leucanthemum</i>	Ox-eye daisy	74
<i>Cicuta maculata</i>	Common water hemlock	3
<i>Circaea lutetiana</i>	Northern enchanter's nightshade	1
<i>Cirsium altissimum</i>	Tall thistle	47
<i>Cirsium undulatum</i>	Wavyleaf thistle	16
<i>Cirsium vulgare</i>	Bull thistle	2
<i>Claytonia virginica</i>	Virginia springbeauty	2
<i>Clematis pitcheri</i>	Pitcher's clematis	1
<i>Comandra umbellata</i>	Bastard toadflax	86
<i>Commelina communis</i>	Common dayflower	1
<i>Conium maculatum</i>	Poison-hemlock	1
<i>Convolvulus arvensis</i>	Field bindweed	9
<i>Conyza canadensis</i>	Canada horseweed	27
<i>Conyza ramosissima</i>	Lawn horseweed	1
<i>Coreopsis palmata</i>	Finger coreopsis	59
<i>Cornus drummondii</i>	Roughleaf dogwood	44
<i>Coronilla varia</i>	Crown vetch	2
<i>Corydalis micrantha</i>	Slender fumewort	2
<i>Corylus americana</i>	American hazelnut	1
<i>Crataegus mollis</i>	Summer hawthorn	12
<i>Crataegus sp.</i>	Hawthorn	1
<i>Crotalaria sagittalis</i>	Rattlebox	2
<i>Croton capitatus</i>	Woolly croton	9
<i>Croton monanthogynus</i>	One-seeded croton	5
<i>Cuscuta glomerata</i>	Cluster dodder	1
<i>Cynanchum laeve</i>	Smooth swallow-wort	1
<i>Cyperus aristatus</i>	Awed flat-sedge	1
<i>Cyperus echinatus</i>	Globe flatsedge	1
<i>Cyperus lupulinus</i>	Great Plains flatsedge	4
<i>Cyperus strigosus</i>	False nutsedge	3
<i>Dactylis glomerata</i>	Orchardgrass	18
<i>Dalea candida</i>	White prairie clover	106
<i>Dalea multiflora</i>	Roundhead prairie clover	29
<i>Dalea purpurea</i>	Purple prairie clover	102
<i>Datura stramonium</i>	Jimsonweed	1
<i>Daucus carota</i>	Wild carrot	26
<i>Delphinium virescens</i>	Plains larkspur	57
<i>Delphinium carolinianum</i>	Carolina larkspur	10
<i>Descurainia pinnata</i>	Pinate tansy-mustard	3
<i>Desmanthus illinoensis</i>	Illinois bundleflower	70
<i>Desmodium canadense</i>	Canada tickclover	4

<i>Desmodium canescens</i>	Hoary tickclover	1
<i>Desmodium cuspidatum</i>	Long-leaf tickclover	1
<i>Desmodium glutinosum</i>	Large-flowered tickclover	1
<i>Desmodium illinoense</i>	Illinois tickclover	93
<i>Desmodium paniculatum</i>	Panicled tickclover	6
<i>Desmodium sessilifolium</i>	Sessile-leaf tickclover	71
<i>Dianthus armeria</i>	Deptford pink	89
<i>Diarrhena obovata</i>	Beakgrain	1
<i>Dichanthelium acuminatum</i>	Pointed dichanthelium	64
<i>Dichanthelium latifolium</i>	Wideleaf dichanthelium	1
<i>Dichanthelium leibergii</i>	Leiberg's dichanthelium	3
<i>Dichanthelium linearifolium</i>	Slimleaf dichanthelium	15
<i>Dichanthelium oligosanthes</i>	Scribner's panicum	103
<i>Dichanthelium sphaerocarpon</i>	Roundseed dichanthelium	11
<i>Diodia teres</i>	Rough buttonweed	2
<i>Diospyrus virginiana</i>	Persimmon	1
<i>Dipsacus fullonum</i>	Fuller's teasel	1
<i>Dodecatheon meadia</i>	Shooting star	4
<i>Draba cuneifolia</i>	Wedge leaf-draba	3
<i>Echinacea atrorubens</i>	Smooth coneflower	12
<i>Echinacea pallida</i>	Pale purple coneflower	87
<i>Echinochloa muricata</i>	Prickly barnyardgrass	2
<i>Elaeagnus umbellata</i>	Autumn olve	1
<i>Eleocharis compressa</i>	Flatstem spikesedge	14
<i>Eleocharis erythropoda</i>	Bald spikerush	1
<i>Eleocharis macrostachya</i>	Large-spike spike-rush	1
<i>Eleocharis palustris</i>	Marsh spike-rush	3
<i>Eleocharis sp.</i>	Spikerush	10
<i>Eleocharis verrucosa</i>	Slender spikerush	8
<i>Ellisia nyctelea</i>	Water-pod	1
<i>Elymus canadensis</i>	Canada wildrye	49
<i>Elymus virginicus</i>	Virginia wildrye	36
<i>Equisetum sp.</i>	Scouring-rush	1
<i>Eragrostis spectabilis</i>	Purple love grass	5
<i>Erigeron annuus</i>	Annual fleabane	62
<i>Erigeron philadelphicus</i>	Philadelphia fleabane	7
<i>Erigeron strigosus</i>	Daisy fleabane	96
<i>Eryngium leavenworthii</i>	Leavenworth's eryngo	1
<i>Eryngium yuccifolium</i>	Button snakeroot	85
<i>Erythronium mesochoreum</i>	Prairie dogtooth violet	9
<i>Euonymus atropurpureus</i>	Eastern wahoo	1
<i>Eupatorium altissimum</i>	Tall joe-pye-weed	33
<i>Eupatorium perfoliatum</i>	Clasping-leaf joe-pye-weed	1

<i>Eupatorium rugosum</i>	White snakeroot	12
<i>Euphorbia corollata</i>	Flowering spurge	106
<i>Euphorbia dentata</i>	Toothed spurge	2
<i>Euphorbia marginata</i>	Snow-on-the-mountain	2
<i>Euphorbia missurica</i>	Missouri spurge	1
<i>Euphorbia nutans</i>	Eyebane	2
<i>Euphorbia spathulata</i>	Spurge	4
<i>Euthamia graminifolia</i>	Grassleaf euthamia	1
<i>Euthamia gymnospermoides</i>	Viscid euthamia	43
<i>Festuca arundinacea</i>	Tall fescue	58
<i>Festuca octoflora</i>	Sixweeks fescue	4
<i>Festuca paradoxa</i>	Cluster fescue	1
<i>Festuca pratensis</i>	Meadow mountain-fescue	1
<i>Festuca sp.</i>	Fescue	1
<i>Fimbristylis puberula</i>	Hairy fimbristylis	17
<i>Fragaria virginiana</i>	Wild strawberry	85
<i>Fraxinus pennsylvanica</i>	Green ash	1
<i>Galium aparine</i>	Cleavers	14
<i>Galium circaezans</i>	Woods bedstraw	4
<i>Galium obtusum</i>	Bluntleaf bedstraw	16
<i>Galium pedemontanum</i>	Foothill bedstraw	4
<i>Galium sp.</i>	Bedstraw	1
<i>Galium virgatum</i>	Southwestern bedstraw	6
<i>Gaura coccinea</i>	Scarlet gaura	1
<i>Gaura longiflora</i>	Biennial gaura	25
<i>Gaura parviflora</i>	Velvety gaura	7
<i>Gaura sp.</i>	Gaura	2
<i>Gentiana puberulenta</i>	Downy gentian	84
<i>Geranium carolinianum</i>	Carolina cranesbill	22
<i>Geum canadense</i>	White avens	7
<i>Gleditsia triacanthos</i>	Honey locust	10
<i>Glyceria striata</i>	Fowl manna grass	2
<i>Glycyrrhiza lepidota</i>	American licorice	1
<i>Gnaphalium obtusifolium</i>	Fragrant cudweed	1
<i>Gutierrezia dracunculoides</i>	Annual broomweed	2
<i>Hedeoma hispidum</i>	Rough false pennyroyal	10
<i>Hedyotis crassifolia</i>	Small bluet	3
<i>Hedyotis nigricans</i>	Narrowleaf bluet	3
<i>Helenium autumnale</i>	Common sneezeweed	1
<i>Helianthus annuus</i>	Common sunflower	13
<i>Helianthus grosseserratus</i>	Sawtooth sunflower	79
<i>Helianthus hirsutus</i>	Hairy sunflower	1
<i>Helianthus maximilianii</i>	Maximilian's sunflower	4

<i>Helianthus mollis</i>	Ashy sunflower	52
<i>Helianthus rigidus</i>	Stiff sunflower	83
<i>Helianthus salicifolius</i>	Willowleaf sunflower	24
<i>Helianthus tuberosus</i>	Jerusalem artichoke	5
<i>Heliopsis helianthoides</i>	Rough ox-eye	12
<i>Hemerocallis fulva</i>	Daylily	1
<i>Heuchera richardsonii</i>	Alumroot	5
<i>Hibiscus trionum</i>	Flower-of-an-hour	1
<i>Hieracium longipilum</i>	Longbeard hawkweed	96
<i>Hordeum jubatum</i>	Foxtail barley	2
<i>Hordeum pusillum</i>	Little barley	2
<i>Humulus japonicus</i>	Japanese hop	1
<i>Hydrophyllum virginianum</i>	Virginia waterleaf	1
<i>Hypericum perforatum</i>	Common St. John's-wort	36
<i>Hypericum punctatum</i>	Spotted St. John's-wort	23
<i>Hypericum sp.</i>	St. John's-wort	1
<i>Hypoxis hirsuta</i>	Yellow star grass	19
<i>Ipomoea hederacea</i>	Ivy-leaf morning glory	1
<i>Ipomoea lacunosa</i>	White morning-glory	1
<i>Isopyrum biternatum</i>	Fale rue-anemone	1
<i>Iva annua</i>	Annual sumpweed	1
<i>Juglans nigra</i>	Black walnut	2
<i>Juncus brachycarpus</i>	White-root rush	1
<i>Juncus diffusissimus</i>	Slim-pod rush	1
<i>Juncus dudleyi</i>	Dudley's rush	4
<i>Juncus interior</i>	Inland rush	15
<i>Juncus marginatus</i>	Shore rush	2
<i>Juncus tenuis</i>	Path rush	13
<i>Juncus torreyi</i>	Torrey's rush	9
<i>Juniperus virginiana</i>	Easter red cedar	44
<i>Koeleria pyramidata</i>	Junegrass	84
<i>Kuhnia eupatorioides</i>	False boneset	69
<i>Lactuca canadensis</i>	Canada lettuce	13
<i>Lactuca ludoviciana</i>	Louisiana lettuce	32
<i>Lactuca serriola</i>	Prickly lettuce	25
<i>Lactuca sp.</i>	Lettuce	2
<i>Lamium amplexicaule</i>	Hen-bit dead nettle	1
<i>Lamium purpureum</i>	Purple dead nettle	1
<i>Leersia virginica</i>	White grass	1
<i>Lepidium campestre</i>	Field peppergrass	4
<i>Lepidium densiflorum</i>	Peppergrass	17
<i>Lepidium virginicum</i>	Virginia peppergrass	3
<i>Leptoloma cognatum</i>	Fall witchgrass	3

<i>Lespedeza capitata</i>	Round-head lespedeza	88
<i>Lespedeza cuneata</i>	Sericea lespedeza	10
<i>Lespedeza stipulacea</i>	Korean lespedeza	2
<i>Lespedeza violacea</i>	Prairie lespedeza	67
<i>Lespedeza virginica</i>	Slender bush lespedeza	3
<i>Liatris aspera</i>	Rough gayfeather	59
<i>Liatris mucronata</i>	Eastern dotted gayfeather	2
<i>Liatris punctata</i>	Dotted gayfeather	11
<i>Liatris pycnostachya</i>	Thickspike gayfeather	93
<i>Liatris squarrosa</i>	Hairy gayfeather	8
<i>Lilium canadense</i>	Michigan lily	4
<i>Linaria canadensis</i>	Oldfield toadflax	1
<i>Lindernia dubia</i>	Yellow false pimpernel	1
<i>Linum sulcatum</i>	Grooved flax	50
<i>Lithospermum canescens</i>	Hoary gromwell	64
<i>Lithospermum caroliniense</i>	Carolina gromwell	11
<i>Lithospermum incisum</i>	Narrowleaf gromwell	30
<i>Lobelia spicata</i>	Palespike lobelia	93
<i>Lomatium foeniculaceum</i>	Wild pasley	13
<i>Lonicera maackii</i>	Amur honeysuckle	1
<i>Lotus corniculatus</i>	Bird's-foot trefoil	1
<i>Ludwigia alternifolia</i>	Bush seedbox	6
<i>Ludwigia polycarpa</i>	Many-fruit seedbox	1
<i>Luzula bulbosa</i>	Bulbous woodrush	1
<i>Lycopus americanus</i>	American bugleweed	2
<i>Lysimachia ciliata</i>	Fringed loosestrife	11
<i>Lythrum alatum</i>	Winged loosestrife	16
<i>Maclura pomifera</i>	Osage orange	2
<i>Medicago lupulina</i>	Black medick	35
<i>Medicago sativa</i>	Alfalfa	7
<i>Melanthium virginicum</i>	Virginia bunchflower	8
<i>Melilotus albus</i>	White sweet clover	28
<i>Melilotus officinalis</i>	Yellow sweet clover	56
<i>Melilotus sp.</i>	Sweet clover	1
<i>Melissa officinalis</i>	Lemon balm	2
<i>Microseris cuspidata</i>	Wavy-leaf false-dandelion	1
<i>Mirabilis albida</i>	White four-o'clock	7
<i>Mirabilis nyctaginea</i>	Wild four-o'clock	4
<i>Monarda fistulosa</i>	Wild bergamot	23
<i>Morus alba</i>	White mulberry	2
<i>Muhlenbergia cuspidata</i>	Plains muhly	4
<i>Muhlenbergia sp.</i>	Muhly	1
<i>Myosotis verna</i>	Virginia forget-me-not	15

<i>Nepeta cataria</i>	Common catnip	1
<i>Nothoscordum bivalve</i>	Yellow false-garlic	2
<i>Oenothera biennis</i>	Common evening primrose	3
<i>Oenothera macrocarpa</i>	Missouri evening primrose	8
<i>Oenothera speciosa</i>	White evening primrose	48
<i>Oenothera villosa</i>	Common evening primrose	9
<i>Onosmodium molle</i>	Western marblemseed	1
<i>Ophioglossum engelmannii</i>	Limestone adder's-tongue	3
<i>Opuntia macrorhiza</i>	Bigroot prickly pear	1
<i>Opuntia sp.</i>	Prickly pear	1
<i>Oxalis dillenii</i>	Green wood sorrel	49
<i>Oxalis stricta</i>	Yellow wood sorrel	1
<i>Oxalis violacea</i>	Violet wood sorrel	22
<i>Panicum virgatum</i>	Switchgrass	73
<i>Panicum capillare</i>	Common witchgrass	2
<i>Paronychia fastigiata</i>	Forked nailwork	1
<i>Parthenium hispidum</i>	Whole-leaf feverfew	1
<i>Parthenocissus quinquefolia</i>	Virginia creeper	5
<i>Paspalum setaceum</i>	Sand paspalum	2
<i>Pedicularis canadensis</i>	Wood betony	48
<i>Penstemon cobaea</i>	Cobaea beardtongue	19
<i>Penstemon digitalis</i>	Smooth beardtongue	20
<i>Penstemon pallidus</i>	Pale beardtongue	1
<i>Penstemon tubaefflorus</i>	Tube beardtongue	52
<i>Penthorum sedoides</i>	Ditch stonecrop	2
<i>Phalaris arundinacea</i>	Reed canarygrass	1
<i>Phleum pratense</i>	Common timothy	43
<i>Phlox divaricata</i>	Sweetwilliam phlox	1
<i>Phlox pilosa</i>	Prairie phlox	72
<i>Physalis heterophylla</i>	Clammy groundcherry	18
<i>Physalis longifolia</i>	Common groundcherry	12
<i>Physalis pumila</i>	Clammy ground cherry	78
<i>Physalis sp.</i>	Groundcherry	1
<i>Physalis virginiana</i>	Virginia groundcherry	9
<i>Phytolacca americana</i>	Pokeweed	4
<i>Plantago aristata</i>	Bottlebrush plantain	8
<i>Plantago lanceolata</i>	English plantain	6
<i>Plantago major</i>	Ripple-seed plantain	1
<i>Plantago patagonica</i>	Woolly plantain	6
<i>Plantago rugelii</i>	Rugel's plantain	1
<i>Plantago sp.</i>	Plantain	2
<i>Plantago virginica</i>	Pale-seeded plantain	54
<i>Platanthera praeclara</i>	Western prairie fringed orchid	1

<i>Poa compressa</i>	Canada bluegrass	4
<i>Poa pratensis</i>	Kentucky bluegrass	56
<i>Podophyllum peltatum</i>	May-apple	3
<i>Polygala incarnata</i>	Slender milkwort	13
<i>Polygala sanguinea</i>	Blood milkwort	13
<i>Polygala verticillata</i>	Whorled milkwort	7
<i>Polygonatum biflorum</i>	Solomon's seal	5
<i>Polygonum amphibium</i>	Smartweed	2
<i>Polygonum arenastrum</i>	Prostrate knotweed	1
<i>Polygonum pensylvanicum</i>	Pennsylvania smartweed	2
<i>Polytaenia nuttallii</i>	Prairie parsley	77
<i>Populus deltoides</i>	Plains cottonwood	2
<i>Potentilla arguta</i>	Tall cinquefoil	11
<i>Potentilla recta</i>	Sulphur cinquefoil	89
<i>Potentilla simplex</i>	Old-field cinquefoil	50
<i>Prenanthes aspera</i>	Rough rattlesnakeroot	13
<i>Prunella vulgaris</i>	Self-heal	17
<i>Prunus americana</i>	Wild plum	15
<i>Prunus mexicana</i>	Big-tree plum	1
<i>Prunus serotina</i>	Black cherry	6
<i>Psoralea argophylla</i>	Silverleaf scurfpea	5
<i>Psoralea esculenta</i>	Prairie turnip	59
<i>Psoralea tenuiflora</i>	Many-flowered scurfpea	83
<i>Ptilimnium nuttallii</i>	Nuttall's mock bishop-weed	13
<i>Pycnanthemum tenuifolium</i>	Slender mountain mint	95
<i>Pyrrhopappus carolinianus</i>	Carolina desert-chicory	1
<i>Quercus alba</i>	White oak	1
<i>Quercus borealis</i>	Northern red oak	1
<i>Quercus macrocarpa</i>	Bur oak	1
<i>Quercus marilandica</i>	Blackjack oak	2
<i>Quercus muehlenbergii</i>	Chinquapin oak	6
<i>Quercus prinoides</i>	Dwarf chinquapin oak	1
<i>Quercus sp.</i>	Oak	1
<i>Quercus stellata</i>	Post oak	1
<i>Quercus velutina</i>	Black oak	3
<i>Ranunculus sceleratus</i>	Cursed crowfoot	1
<i>Ratibida columnifera</i>	Yellow prairie coneflower	16
<i>Ratibida pinnata</i>	Grayhead prairie coneflower	83
<i>Rhamnus lanceolata</i>	Lance-leaf buckthorn	1
<i>Rhus aromatica</i>	Aromatic sumac	2
<i>Rhus copallina</i>	Dwarf sumac	11
<i>Rhus glabra</i>	Smooth sumac	49
<i>Rhynchospora harveyi</i>	Harvey's beakrush	1

<i>Ribes odoratum</i>	Buffalo currant	1
<i>Robinia pseudoacacia</i>	Black locust	3
<i>Rosa arkansana</i>	Prairie wild rose	98
<i>Rosa carolina</i>	Pasture rose	1
<i>Rosa multiflora</i>	Multiflora rose	9
<i>Rosa setigera</i>	Climbing rose	11
<i>Rubus ostryifolius</i>	Highbrush blackberry	1
<i>Rubus enslenii</i>	Enslens' blackberry	1
<i>Rubus flagellaris</i>	Northern dewberry	38
<i>Rubus laudatus</i>	Praiseworthy blackberry	4
<i>Rubus occidentalis</i>	Black raspberry	1
<i>Rubus pensilvanicus</i>	Highbush blackberry	3
<i>Rudbeckia hirta</i>	Black-eyed Susan	111
<i>Rudbeckia subtomentosa</i>	Sweet coneflower	11
<i>Rudbeckia triloba</i>	Brown-eyed Susan	4
<i>Ruellia humilis</i>	Fringeleaf ruellia	101
<i>Ruellia strepens</i>	Limestone ruellia	1
<i>Rumex altissimus</i>	Pale dock	4
<i>Rumex crispus</i>	Curly dock	29
<i>Sagittaria latifolia</i>	Broad-leaf arrowhead	1
<i>Salix humilis</i>	Dwarf prairie willow	8
<i>Salix nigra</i>	Black willow	2
<i>Salvia azurea</i>	Blue sage	106
<i>Salvia reflexa</i>	Lance-leaf sage	2
<i>Sambucus canadensis</i>	Elderberry	6
<i>Sanicula canadensis</i>	Canada sanicle	1
<i>Schrankia nuttallii</i>	Sensitive briar	70
<i>Scirpus atrovirens</i>	Green bulrush	6
<i>Scirpus fluviatilis</i>	River tuberous-bulrush	1
<i>Scirpus georgianus</i>	Georgia bulrush	3
<i>Scirpus pendulus</i>	Rusty bulrush	44
<i>Scirpus validus</i>	Soft-stem twine-bulrush	2
<i>Scleria triglomerata</i>	Whip razorsedge	56
<i>Scutellaria parvula</i>	Small skullcap	25
<i>Scutellaria resinosa</i>	Resinous skullcap	1
<i>Senecio plattensis</i>	Plains groundsel	8
<i>Senecio pseud aureus</i>	Groundsel	3
<i>Senecio sp.</i>	Groundsel	2
<i>Setaria glauca</i>	Yellow bristlegrass	2
<i>Setaria parviflora</i>	Knotroot bristlegrass	14
<i>Silene antirrhina</i>	Sleepy catchfly	17
<i>Silene stellata</i>	Starry campion	8
<i>Silphium integrifolium</i>	Rosinweed	54

<i>Silphium laciniatum</i>	Compass plant	100
<i>Silphium perfoliatum</i>	Cup plant	2
<i>Sisymbrium altissimum</i>	Tumble mustard	1
<i>Sisyrinchium campestre</i>	Prairie blue-eyed grass	53
<i>Smilax herbacea</i>	Carrionflower greenbrier	3
<i>Smilax hispida</i>	Bristly greenbrier	6
<i>Solanum carolinense</i>	Carolina horse nettle	78
<i>Solanum ptychanthum</i>	Black nightshade	1
<i>Solidago canadensis</i>	Canada goldenrod	104
<i>Solidago gigantea</i>	Giant goldenrod	7
<i>Solidago missouriensis</i>	Missouri goldenrod	88
<i>Solidago mollis</i>	Ashy goldenrod	1
<i>Solidago nemoralis</i>	Gray goldenrod	22
<i>Solidago petiolaris</i>	Downy goldenrod	1
<i>Solidago rigida</i>	Stiff goldenrod	97
<i>Solidago speciosa</i>	Noble goldenrod	22
<i>Solidago ulmifolia</i>	Elmleaf goldenrod	2
<i>Sorghastrum nutans</i>	Indiangrass	67
<i>Spartina pectinata</i>	Prairie cordgrass	74
<i>Spermolepis inermis</i>	Spreading scaleseed	7
<i>Sphenopholis obtusata</i>	Prairie wedgescale	10
<i>Spiranthes cernua</i>	Nodding ladies'-tresses	1
<i>Spiranthes lacera</i> var. <i>gracilis</i>	Southern slender ladies'-tresses	3
<i>Spiranthes</i> sp.	Dropseed	1
<i>Spiranthes vernalis</i>	Spring ladies'-tresses	2
<i>Sporobolus asper</i>	Rough dropseed	77
<i>Sporobolus heterolepis</i>	Prairie dropseed	35
<i>Sporobolus</i> sp.	Dropseed	1
<i>Stellaria</i> sp.	Chickweed	2
<i>Stipa spartea</i>	Porcupinegrass	70
<i>Strophostyles leiosperma</i>	Slick-seed bean	7
<i>Symphoricarpos occidentalis</i>	Wolfberry	1
<i>Symphoricarpos orbiculatus</i>	Buckbrush	42
<i>Talinum parviflorum</i>	Prairie fameflower	1
<i>Taraxacum officinale</i>	Common dandelion	7
<i>Tephrosia virginiana</i>	Goat's rue	11
<i>Teucrium canadense</i>	American germander	16
<i>Thalictrum dasycarpum</i>	Purple meadow rue	2
<i>Thlaspi arvense</i>	Pennycress	19
<i>Thlaspi perfoliatum</i>	Thorowort pennycress	5
<i>Tomanthera auriculata</i>	Earleaf foxglove	2
<i>Torilis arvensis</i>	Hedge parsley	12
<i>Toxicodendron radicans</i>	Common poison ivy	32

<i>Tradescantia bracteata</i>	Bracted spiderwort	26
<i>Tradescantia ohiensis</i>	Ohio spiderwort	91
<i>Tragia betonicifolia</i>	Nettleleaf noseburn	16
<i>Tragopogon dubius</i>	Goat's beard	90
<i>Tridens flavus</i>	Purpletop	13
<i>Trifolium campestre</i>	Low hop clover	27
<i>Trifolium pratense</i>	Red clover	53
<i>Trifolium reflexum</i>	Buffalo clover	2
<i>Trifolium repens</i>	White clover	25
<i>Triodanis leptocarpa</i>	Slimpod Venus' looking glass	18
<i>Triodanis perfoliata</i>	Venus' looking glass	36
<i>Triosteum perfoliatum</i>	Common horsegentian	4
<i>Tripsacum dactyloides</i>	Eastern gammagrass	112
<i>Triticum aestivum</i>	Wheat	1
<i>Ulmus americana</i>	American elm	11
<i>Ulmus glabra</i>	Wych elm	1
<i>Ulmus pumila</i>	Siberian elm	3
<i>Ulmus rubra</i>	Red elm	31
<i>Valerianella radiata</i>	Corn salad	24
<i>Verbascum thapsus</i>	Woolly mullein	10
<i>Verbena canadensis</i>	Rose verbena	37
<i>Verbena hastata</i>	Blue verbena	4
<i>Verbena simplex</i>	Narrowleaf verbena	11
<i>Verbena stricta</i>	Woolly verbena	12
<i>Verbena urticifolia</i>	White verbena	4
<i>Vernonia baldwinii</i>	Common ironweed	95
<i>Vernonia fasciculata</i>	Western ironweed	3
<i>Veronica arvensis</i>	Corn speedwell	4
<i>Veronica peregrina</i>	Purslane speedwell	7
<i>Veronicastrum virginicum</i>	Culver's root	20
<i>Viola pedata</i>	Bird-foot violet	1
<i>Viola pedatifida</i>	Prairie violet	93
<i>Viola pratensis</i>	Meadow violet	20
<i>Viola rafinesquii</i>	Johnny-jump-up	6
<i>Viola sororia</i>	Downy blue violet	5
<i>Vitis aestivalis</i>	Pigeon grape	1
<i>Vitis cinerea</i>	Graybark grape	1
<i>Vitis riparia</i>	Riverbank grape	6
<i>Vitis sp.</i>	Grape	1
<i>Xanthium strumarium</i>	Common cocklebur	1
<i>Yucca glauca</i>	Small soapweed	2
<i>Yucca smalliana</i>	Adam's needle	1
<i>Zizia aurea</i>	Golden zizia	61

Appendix G
Floristic Quality Indices for Prairie Sites
(No. of Sites = 115)

This table includes all prairie sites with species lists that were seen and ranked during the 2004–2005 inventory season with size greater than or equal to five acres and overall rank of C or better.

Site Number	FQI	County	Site Grade	Overall Grade	No. of Acres	No. of Species Found
No. 1	56.23	Douglas	A	B	34.87	65
No. 2	55.20	Douglas	A	B	15.37	159
No. 3	53.07	Douglas	A	B	6.97	168
No. 4	52.03	Douglas	A	B	5.75	110
No. 5	50.99	Leavenworth	B	C	20.66	75
No. 6	49.09	Douglas	A	B	18.58	72
No. 7	47.92	Miami	B	C	15.82	140
No. 8	47.72	Miami	A	B	40.30	104
No. 9	46.48	Leavenworth	A	B	8.10	142
No. 10	46.15	Leavenworth	B	C	10.43	152
No. 11	46.13	Miami	B	C	11.07	78
No. 12	46.11	Leavenworth	B	C	20.69	69
No. 13	46.10	Douglas	A	B	52.17	90
No. 14	46.04	Leavenworth	B	C	48.92	44
No. 15	45.34	Miami	B	C	16.62	80
No. 16	44.71	Miami	A	B	8.15	99
No. 17	44.70	Miami	A	B	63.45	119
No. 18	44.64	Miami	B	C	20.17	129
No. 19	44.54	Leavenworth	B	C	49.86	209
No. 20	44.17	Leavenworth	A	B	66.30	103
No. 21	44.08	Douglas	A	B	6.57	82
No. 22	43.82	Miami	B	C	30.15	98
No. 23	43.64	Miami	B	C	10.35	91
No. 24	43.55	Douglas	AC	C	26.48	132
No. 25	43.31	Miami	B	C	19.06	98
No. 26	43.31	Leavenworth	B	C	11.52	97
No. 27	43.14	Miami	A	B	14.14	72
No. 28	42.75	Douglas	A	B	17.33	93
No. 29	42.25	Miami	B	C	25.30	111

No. 30	42.25	Leavenworth	B	C	35.48	94
No. 31	42.04	Douglas	A	B	7.29	92
No. 32	41.95	Leavenworth	B	C	16.61	160
No. 33	41.78	Miami	B	C	14.97	90
No. 34	41.44	Miami	B	C	27.83	40
No. 35	41.22	Miami	B	C	8.58	85
No. 36	41.19	Leavenworth	A	B	10.65	89
No. 37	41.00	Miami	A	B	5.91	96
No. 38	40.99	Leavenworth	B	C	10.31	130
No. 39	40.94	Douglas	B	C	9.05	90
No. 40	40.88	Leavenworth	B	C	8.41	134
No. 41	40.81	Douglas	AB	B	10.45	104
No. 42	40.70	Douglas	B	C	10.46	85
No. 43	40.58	Douglas	A	B	63.00	158
No. 44	40.53	Miami	B	C	15.16	101
No. 45	40.48	Leavenworth	B	C	14.09	169
No. 46	40.46	Leavenworth	B	C	25.91	94
No. 47	40.42	Douglas	A	B	8.77	100
No. 48	40.31	Miami	B	C	34.41	88
No. 49	40.11	Leavenworth	B	C	45.40	81
No. 50	40.11	Miami	A	B	10.07	85
No. 51	40.06	Miami	B	C	9.05	68
No. 52	39.94	Douglas	B	C	14.87	64
No. 53	39.90	Douglas	A	B	15.12	107
No. 54	39.73	Miami	B	C	30.29	106
No. 55	39.46	Miami	B	C	13.04	89
No. 56	39.37	Douglas	B	C	6.45	96
No. 57	39.10	Miami	A	B	8.25	105
No. 58	38.73	Douglas	A	B	7.39	93
No. 59	38.68	Douglas	A	B	13.67	117
No. 60	38.63	Miami	B	C	12.57	85
No. 61	38.53	Miami	B	C	6.25	107
No. 62	38.30	Leavenworth	A	B	8.33	85
No. 63	38.25	Douglas	B	B	7.14	82
No. 64	38.13	Douglas	B	C	5.56	78
No. 65	38.01	Miami	B	C	130.95	93
No. 66	37.86	Leavenworth	B	C	12.55	87
No. 67	37.57	Douglas	B	C	15.87	89
No. 68	37.38	Miami	B	C	27.01	75

No. 69	37.32	Miami	B	C	10.09	122
No. 70	37.32	Douglas	B	C	5.34	92
No. 71	37.29	Miami	A	B	23.20	68
No. 72	37.23	Leavenworth	B	C	9.13	77
No. 73	37.11	Douglas	A	B	12.58	92
No. 74	37.05	Douglas	A	B	50.51	125
No. 75	37.00	Douglas	A	B	11.97	67
No. 76	36.79	Douglas	A	B	5.48	84
No. 77	36.74	Douglas	B	C	15.43	87
No. 78	36.65	Douglas	B	C	8.03	110
No. 79	36.65	Miami	B	C	6.80	77
No. 80	36.62	Leavenworth	B	C	7.08	78
No. 81	36.58	Miami	A	B	8.73	103
No. 82	36.01	Douglas	B	C	11.59	41
No. 83	35.89	Douglas	B	C	5.40	90
No. 84	35.63	Miami	B	C	6.85	26
No. 85	35.62	Miami	B	C	7.72	81
No. 86	35.54	Miami	B	C	21.70	103
No. 87	35.50	Douglas	A	B	24.04	83
No. 88	35.13	Douglas	B	C	5.39	89
No. 89	34.78	Douglas	A	B	15.64	55
No. 90	34.67	Douglas	A	B	6.73	77
No. 91	34.18	Douglas	B	C	6.47	80
No. 92	33.38	Douglas	B	C	9.29	68
No. 93	33.38	Douglas	B	C	5.12	198
No. 94	32.96	Miami	B	C	12.95	66
No. 95	32.81	Douglas	B	C	11.20	69
No. 96	32.66	Douglas	B	C	5.03	67
No. 97	32.55	Miami	B	C	8.30	61
No. 98	32.50	Douglas	B	C	16.73	104
No. 99	32.13	Douglas	B	C	5.38	76
No. 100	31.19	Douglas	C	C	14.40	79
No. 101	31.11	Douglas	B	C	13.42	67
No. 102	30.73	Douglas	B	C	9.70	65
No. 103	30.02	Douglas	B	C	10.36	82
No. 104	29.79	Douglas	B	C	18.04	68
No. 105	29.69	Douglas	C	C	15.85	104
No. 106	29.55	Douglas	B	C	6.62	69
No. 107	28.13	Douglas	B	C	25.86	72

No. 108	27.50	Douglas	B	C	9.17	99
No. 109	27.20	Douglas	B	C	10.72	62
No. 110	27.20	Douglas	A	B	41.56	45
No. 111	23.88	Douglas	A	B	63.18	41
No. 112	23.76	Douglas	C	C	17.32	66
No. 113	21.43	Douglas	B	C	9.79	100
No. 114	21.20	Douglas	B	C	18.29	25
No. 115	18.97	Douglas	B	C	5.66	25

Appendix H
Forest Plant Species Found during the County Inventory
(No. of Forest Sites = 24)

Species Name	Common name	No. of Sites Where Found
<i>Acalypha rhomboidea</i>	Rhombic copperleaf	1
<i>Acalypha virginica</i>	Virginia copperleaf	1
<i>Acer negundo</i>	Common boxelder	9
<i>Acer saccharinum</i>	Silver maple	3
<i>Acer saccharum</i>	Sugar maple	1
<i>Achillea millefolium</i>	Yarrow	2
<i>Adiantum pedatum</i>	Northern maiden-hair fern	2
<i>Aegilops cylindrica</i>	Jointed goatgrass	1
<i>Aesculus glabra</i>	Ohio buckeye	15
<i>Agastache nepetoides</i>	Hyssop	7
<i>Agrimonia parviflora</i>	Small-flower agrimony	2
<i>Agrimonia pubescens</i>	Downy agrimony	14
<i>Agrostis stolonifera</i>	Redtop	1
<i>Alliaria petiolata</i>	Garlic mustard	17
<i>Allium canadense</i>	Canada wild onion	2
<i>Allium sp.</i>	Onion	1
<i>Allium vineale</i>	Field garlic	5
<i>Ambrosia artemisiifolia</i>	Common ragweed	1
<i>Ambrosia trifida</i>	Giant ragweed	2
<i>Amelanchier arborea</i>	Downy service-berry	1
<i>Amorpha canescens</i>	Lead plant	1
<i>Amorpha fruticosa</i>	False indigo	1
<i>Ampelopsis cordata</i>	Heart leaf raccoon grape	1
<i>Amphicarpaea bracteata</i>	Hog peanut	10
<i>Andropogon gerardii</i>	Big bluestem	1
<i>Andropogon scoparium</i>	Little bluestem	1
<i>Anemone canadensis</i>	Canadian anemone	2
<i>Anemone virginiana</i>	Tall anemone	2
<i>Antennaria neglecta</i>	Field pussytoes	1
<i>Antennaria parlinii</i>	Plantainleaf pussytoes	3
<i>Apocynum cannabinum</i>	Hemp dogbane	7
<i>Aquilegia canadensis</i>	Canada columbine	3
<i>Arabis canadensis</i>	Canadian rockcress	1
<i>Arabis shortii</i>	Short's rockcress	1
<i>Arctium minus</i>	Common burdock	1
<i>Arenaria serpyllifolia</i>	Thyme-leaved sandwort	1
<i>Arisaema dracontium</i>	Green dragon	9

<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	15
<i>Asarum canadense</i>	Canadian wildginger	2
<i>Asclepias purpurascens</i>	Purple milkweed	3
<i>Asimina triloba</i>	Pawpaw	15
<i>Asplenium platyneuron</i>	Ebony spleenwort	4
<i>Aster drummondii</i>	Drummond's aster	15
<i>Aster laevis</i>	Smooth blue aster	1
<i>Aster lanceolatus</i>	Lance-leaf aster	3
<i>Aster praealtus</i>	Common willow-leaved aster	2
<i>Berberis thunbergii</i>	Japanese barberry	2
<i>Botrychium virginianum</i>	Rattlesnake fern	16
<i>Bromus inermis</i>	Smooth brome	2
<i>Bromus pubescens</i>	Canadian brome	3
<i>Cacalia atriplicifolia</i>	Pale Indian plantain	14
<i>Cacalia plantaginea</i>	Indian plantain	3
<i>Campanula americana</i>	American bellflower	4
<i>Campsis radicans</i>	Trumpet creeper	2
<i>Capsella bursa-pastoris</i>	Shepherd's purse	1
<i>Cardamine concatenata</i>	Cut-leaf toothwort	14
<i>Cardamine parviflora</i>	Small-flower bittercress	1
<i>Carduus nutans</i>	Musk thistle	2
<i>Carex aggregata</i>	Cluster sedge	1
<i>Carex albicans</i>	White tinge sedge	3
<i>Carex austrina</i>	Southern sedge	3
<i>Carex bicknellii</i>	Bicknell's sedge	1
<i>Carex blanda</i>	Woodland sedge	11
<i>Carex bushii</i>	Bush's sedge	1
<i>Carex cephalophora</i>	Woodbank sedge	4
<i>Carex conjuncta</i>	Soft fox sedge	2
<i>Carex davisii</i>	Davis' sedge	3
<i>Carex granularis</i>	Meadow sedge	2
<i>Carex gravida</i>	Heavy sedge	2
<i>Carex grisea</i>	Narrowleaf sedge	2
<i>Carex hisutella</i>	Hairy-leaf hirsute sedge	1
<i>Carex hitchcockiana</i>	Hitchcock's sedge	2
<i>Carex jamesii</i>	James' sedge	4
<i>Carex leavenworthii</i>	Leavenworth's sedge	4
<i>Carex meadii</i>	Mead's sedge	1
<i>Carex molesta</i>	Sedge	1
<i>Carex normalis</i>	Large straw sedge	2
<i>Carex oligocarpa</i>	Sedge	4
<i>Carex retroflexa</i>	Reflexed sedge	1
<i>Carex shortiana</i>	Short's sedge	2

<i>Carex sp.</i>	Sedge	7
<i>Carex sparganioides</i>	Bur-reed sedge	2
<i>Carex umbellata</i>	Low sedge	2
<i>Carex radiata</i>	Radiate sedge	4
<i>Carya cordiformis</i>	Bitternut hickory	17
<i>Carya laciniosa</i>	Kingnut hickory	6
<i>Carya ovata</i>	Shagbark hickory	19
<i>Carya tomentosa</i>	Mockernut hickory	1
<i>Cassia marilandica</i>	Maryland senna	1
<i>Catalpa speciosa</i>	Catalpa	1
<i>Ceanothus americanus</i>	New Jersey tea	1
<i>Celastrus scandens</i>	American bittersweet	2
<i>Celtis occidentalis</i>	Common hackberry	18
<i>Cerastium fontanum</i>	Mouse-ear chickweed	1
<i>Cercis canadensis</i>	Redbud	16
<i>Chaerophyllum tainturieri</i>	Erect chervil	9
<i>Chamaecrista nictitans</i>	Sensitive partridgepea	1
<i>Chasmanthium latifolium</i>	Sea oats	4
<i>Circaea lutetiana</i>	Northern enchanter's nightshade	2
<i>Cirsium altissimum</i>	Tall thistle	2
<i>Cirsium vulgare</i>	Bull thistle	1
<i>Claytonia virginica</i>	Virginia springbeauty	5
<i>Clematis pitcheri</i>	Pitcher's clematis	1
<i>Comandra umbellata</i>	Bastard toadflax	2
<i>Commelina communis</i>	Common dayflower	1
<i>Commelina erecta</i>	Erect dayflower	1
<i>Conyza canadensis</i>	Canada horseweed	2
<i>Corallorhiza wisteriana</i>	Wister's coralroot	2
<i>Cornus drummondii</i>	Roughleaf dogwood	14
<i>Coronilla varia</i>	Crown vetch	1
<i>Corydalis flavula</i>	Yellow harlequin	2
<i>Corydalis micrantha</i>	Slender fumewort	1
<i>Corylus americana</i>	American hazelnut	2
<i>Crataegus mollis</i>	Summer hawthorn	3
<i>Croton glandulosus</i>	Tropic croton	1
<i>Cryptotaenia canadensis</i>	Honewort	3
<i>Cyperus echinatus</i>	Globe flatsedge	1
<i>Cypripedium parviflorum</i>	Yellow lady's slipper	8
<i>Cystopteris fragilis</i>	Fragile fern	1
<i>Cystopteris protrusa</i>	Lowland bladder fern	14
<i>Dasistoma macrophylla</i>	Mullein foxglove	6
<i>Daucus carota</i>	Wild carrot	1

<i>Delphinium tricorne</i>	Dwarf larkspur	11
<i>Delphinium virescens</i>	Plains larkspur	1
<i>Delphinium carolinianum</i>	Carolina larkspur	1
<i>Descurainia pinnata</i>	Pinate tansy-mustard	1
<i>Desmodium glutinosum</i>	Large-flowered tickclover	12
<i>Desmodium paniculatum</i>	Panicled tickclover	2
<i>Diarrhena obovata</i>	Beakgrain	8
<i>Dicentra cucullaria</i>	Dutchman's breeches	14
<i>Dichanthelium acuminatum</i>	Pointed dichanthelium	5
<i>Dichanthelium clandestinum</i>	Deer-tongue dichanthelium	3
<i>Dichanthelium latifolium</i>	Wideleaf dichanthelium	7
<i>Dichanthelium linearifolium</i>	Slimleaf dichanthelium	1
<i>Dichanthelium oligosanthes</i>	Scribner's panicum	1
<i>Diospyros virginiana</i>	Persimmon	2
<i>Draba cuneifolia</i>	Wedge leaf-draba	1
<i>Echinacea pallida</i>	Pale purple coneflower	1
<i>Ellisia nyctelea</i>	Water-pod	8
<i>Elymus canadensis</i>	Canada wildrye	2
<i>Elymus hystrix</i>	Bottle-brush wildrye	2
<i>Elymus villosus</i>	Hairy wildrye	4
<i>Elymus virginicus</i>	Virginia wildrye	10
<i>Equisetum sp.</i>	Scouring-rush	1
<i>Erigeron annuus</i>	Annual fleabane	4
<i>Erigeron philadelphicus</i>	Philadelphia fleabane	1
<i>Erigeron strigosus</i>	Daisy fleabane	2
<i>Erythronium albidum</i>	White fawn-lily	14
<i>Erythronium mesochoreum</i>	Prairie dogtooth violet	3
<i>Euonymus atropurpureus</i>	Eastern wahoo	3
<i>Eupatorium altissimum</i>	Tall joe-pye-weed	2
<i>Eupatorium purpureum</i>	Bluestem joe-pye-weed	9
<i>Eupatorium rugosum</i>	White snakeroot	5
<i>Euphorbia dentata</i>	Toothed spurge	1
<i>Festuca arundinacea</i>	Tall fescue	1
<i>Festuca obtusa</i>	Nodding fescue	6
<i>Festuca octoflora</i>	Sixweeks fescue	1
<i>Fragaria virginiana</i>	Wild strawberry	4
<i>Fraxinus americana</i>	White ash	8
<i>Fraxinus pennsylvanica</i>	Green ash	9
<i>Fraxinus sp.</i>	Ash	1
<i>Galearis spectabilis</i>	Showy orchis	1
<i>Galium aparine</i>	Cleavers	15
<i>Galium circaezans</i>	Woods bedstraw	18
<i>Galium concinnum</i>	Shining bedstraw	10

<i>Galium obtusum</i>	Bluntleaf bedstraw	3
<i>Galium pedemontanum</i>	Foothill bedstraw	1
<i>Gaura coccinea</i>	Scarlet gaura	1
<i>Geranium maculatum</i>	Spotted cranesbill	1
<i>Geum canadense</i>	White avens	14
<i>Geum verum</i>	Heart-leaf avens	2
<i>Glechoma hederacea</i>	Gill-over-the-ground	1
<i>Gleditsia triacanthos</i>	Honey locust	12
<i>Glyceria striata</i>	Fowl manna grass	1
<i>Gymnocladus dioica</i>	Kentucky coffee-tree	13
<i>Hackelia virginiana</i>	Virginia stickseed	9
<i>Hedeoma hispidum</i>	Rough false pennyroyal	1
<i>Hedeoma pulegioides</i>	American false pennyroyal	1
<i>Helenium autumnale</i>	Common sneezeweed	1
<i>Helianthus hirsutus</i>	Hairy sunflower	16
<i>Helianthus tuberosus</i>	Jerusalem artichoke	1
<i>Hesperis matronalis</i>	Dame's rocket	1
<i>Heuchera richardsonii</i>	Alumroot	1
<i>Hieracium gronovii</i>	Gronovius' hawkweed	1
<i>Hieracium longipilum</i>	Longbeard hawkweed	1
<i>Humulus lupulus</i>	Common hops	2
<i>Hybanthus concolor</i>	Green violet	2
<i>Hydrophyllum appendiculatum</i>	Notch-bract waterleaf	2
<i>Hydrophyllum virginianum</i>	Virginia waterleaf	18
<i>Hypericum perforatum</i>	Common St. John's-wort	1
<i>Hypericum punctatum</i>	Spotted St. John's-wort	2
<i>Hypericum sphaerocarpaceum</i>	Round-fruit St. John's-wort	4
<i>Hypoxis hirsuta</i>	Yellow star grass	2
<i>Impatiens capensis</i>	Spotted touch-me-not	13
<i>Impatiens pallida</i>	Pale touch-me-not	1
<i>Iodanthus pinnatifidus</i>	Eastern purple-rocket	1
<i>Iris germanica</i>	German iris	2
<i>Isopyrum biternatum</i>	Fale rue-anemone	11
<i>Juglans nigra</i>	Black walnut	19
<i>Juncus interior</i>	Inland rush	1
<i>Juncus marginatus</i>	Shore rush	1
<i>Juncus tenuis</i>	Path rush	2
<i>Juniperus virginiana</i>	Easter red cedar	15
<i>Lactuca floridana</i>	Florida lettuce	10
<i>Lactuca serriola</i>	Prickly lettuce	2
<i>Lactuca sp.</i>	Lettuce	1
<i>Lamium amplexicaule</i>	Hen-bit dead nettle	1
<i>Lamium purpureum</i>	Purple dead nettle	5

<i>Laportea canadensis</i>	Wood nettle	9
<i>Leachea tenuiflora</i>	Narrow-leaf pinweed	1
<i>Leersia virginica</i>	White grass	1
<i>Lespedeza violacea</i>	Prairie lespedeza	4
<i>Lespedeza virginica</i>	Slender bush lespedeza	2
<i>Liatris aspera</i>	Rough gayfeather	1
<i>Liatris squarrosa</i>	Hairy gayfeather	1
<i>Lilium canadense</i>	Michigan lily	12
<i>Lithospermum arvense</i>	Corn gromwell	1
<i>Lithospermum canescens</i>	Hoary gromwell	1
<i>Lomatium foeniculaceum</i>	Wild parsley	1
<i>Lonicera maackii</i>	Amur honeysuckle	1
<i>Lysimachia nummularia</i>	Moneywort	1
<i>Maclura pomifera</i>	Osage orange	8
<i>Medicago lupulina</i>	Black medick	1
<i>Medicago minima</i>	Prickly medick	1
<i>Melilotus albus</i>	White sweet clover	2
<i>Menispermum canadense</i>	Moonseed	17
<i>Mertensia virginica</i>	Virginia bluebells	1
<i>Monarda fistulosa</i>	Wild bergamot	1
<i>Morus alba</i>	White mulberry	3
<i>Morus rubra</i>	Red mulberry	6
<i>Muhlenbergia sp.</i>	Muhly	3
<i>Nothoscordum bivalve</i>	Yellow false-garlic	6
<i>Osmorhiza longistylis</i>	Long-style sweet-cicely	8
<i>Ostrya virginiana</i>	Hop-hornbeam	11
<i>Oxalis dillenii</i>	Green wood sorrel	4
<i>Oxalis stricta</i>	Yellow wood sorrel	2
<i>Oxalis violacea</i>	Violet wood sorrel	3
<i>Parietaria pensylvanica</i>	Pennsylvania pellitory	3
<i>Paronychia canadensis</i>	Canada nailwort	3
<i>Parthenocissus quinquefolia</i>	Virginia creeper	17
<i>Pedicularis canadensis</i>	Wood betony	2
<i>Pellaea atropurpurea</i>	Purple-stem cliffbreak	2
<i>Penstemon digitalis</i>	Smooth beardtongue	5
<i>Penstemon tubaefflorus</i>	Tube beardtongue	1
<i>Phalaris arundinacea</i>	Reed canarygrass	1
<i>Phlox divaricata</i>	Sweetwilliam phlox	16
<i>Phryma leptostachya</i>	Lopseed	2
<i>Physalis pumila</i>	Clammy ground cherry	1
<i>Physostegia virginiana</i>	Virginia lion-heart	1
<i>Phytolacca americana</i>	Pokeweed	6
<i>Pilea pumila</i>	Clearweed	2

<i>Plantago rugelii</i>	Rugel's plantain	1
<i>Plantago virginica</i>	Pale-seeded plantain	1
<i>Platanus occidentalis</i>	Sycamore	14
<i>Poa annua</i>	Annual bluegrass	1
<i>Poa pratensis</i>	Kentucky bluegrass	2
<i>Poa sylvestris</i>	Woodland bluegrass	4
<i>Podophyllum peltatum</i>	May-apple	19
<i>Polygonatum biflorum</i>	Solomon's seal	17
<i>Polygonum amphibium</i>	Smartweed	2
<i>Polygonum caespitosum</i>	Oriental lady's thumb	1
<i>Polygonum punctatum</i>	Dotted smartweed	2
<i>Polygonum virginianum</i>	Virginia knotweed	15
<i>Populus deltoides</i>	Plains cottonwood	4
<i>Potentilla simplex</i>	Old-field cinquefoil	1
<i>Potentilla sp.</i>	Cinquefoil	1
<i>Prunella vulgaris</i>	Self-heal	2
<i>Prunus mahaleb</i>	Mahleb cherry	1
<i>Prunus serotina</i>	Black cherry	10
<i>Prunus virginiana</i>	Choke cherry	6
<i>Pycnanthemum tenuifolium</i>	Slender mountain mint	3
<i>Pycnanthemum verticillatum</i>	Hairy mountain mint	1
<i>Pycnanthemum virginianum</i>	Virginia mountain mint	1
<i>Quercus alba</i>	White oak	1
<i>Quercus borealis</i>	Northern red oak	18
<i>Quercus macrocarpa</i>	Bur oak	19
<i>Quercus marilandica</i>	Blackjack oak	3
<i>Quercus muehlenbergii</i>	Chinquapin oak	16
<i>Quercus palustris</i>	Pin oak	1
<i>Quercus stellata</i>	Post oak	8
<i>Quercus velutina</i>	Black oak	10
<i>Ranunculus abortivus</i>	Earlywood buttercup	9
<i>Ratibida pinnata</i>	Grayhead prairie coneflower	2
<i>Rhamnus lanceolata</i>	Lance-leaf buckthorn	1
<i>Rhus aromatica</i>	Aromatic sumac	3
<i>Rhus copallina</i>	Dwarf sumac	1
<i>Rhus glabra</i>	Smooth sumac	2
<i>Ribes missouriense</i>	Missouri gooseberry	18
<i>Rosa multiflora</i>	Multiflora rose	7
<i>Rosa setigera</i>	Climbing rose	5
<i>Rubus enslenii</i>	Enslen's blackberry	1
<i>Rubus flagellaris</i>	Northern dewberry	4
<i>Rubus occidentalis</i>	Black raspberry	5
<i>Rubus pensilvanicus</i>	Highbush blackberry	8

<i>Rubus sp.</i>	Blackberry	3
<i>Rudbeckia hirta</i>	Black-eyed Susan	2
<i>Rudbeckia laciniata</i>	Goldenglow	3
<i>Rudbeckia triloba</i>	Brown-eyed Susan	1
<i>Ruellia strepens</i>	Limestone ruellia	5
<i>Rumex patientia</i>	Patient dock	1
<i>Salvia azurea</i>	Blue sage	1
<i>Sambucus canadensis</i>	Elderberry	14
<i>Sanguinaria canadensis</i>	Bloodroot	4
<i>Sanicula canadensis</i>	Canada sanicle	11
<i>Sanicula gregaria</i>	Fragrant sanicle	11
<i>Schedonorus pratensis</i>	Meadow mountain-fescue	1
<i>Scirpus atrovirens</i>	Green bulrush	1
<i>Scrophularia marilandica</i>	Late figwort	1
<i>Scutellaria parvula</i>	Small skullcap	2
<i>Senecio obovatus</i>	Round-leaf ragwort	2
<i>Silene stellata</i>	Starry campion	11
<i>Silphium integrifolium</i>	Rosinweed	1
<i>Silphium perfoliatum</i>	Cup plant	1
<i>Sisyrinchium angustifolium</i>	Narrow-leaf blue-eyed-grass	3
<i>Sisyrinchium campestre</i>	Prairie blue-eyed grass	1
<i>Smilacina racemosa</i>	Feathery false lily of the valley	6
<i>Smilax herbacea</i>	Carrionflower greenbrier	8
<i>Smilax hispida</i>	Bristly greenbrier	18
<i>Solanum carolinense</i>	Carolina horse nettle	1
<i>Solanum ptychanthum</i>	Black nightshade	1
<i>Solidago canadensis</i>	Canada goldenrod	2
<i>Solidago gigantea</i>	Giant goldenrod	3
<i>Solidago missouriensis</i>	Missouri goldenrod	1
<i>Solidago nemoralis</i>	Gray goldenrod	1
<i>Solidago sp.</i>	Goldenrod	1
<i>Solidago ulmifolia</i>	Elmleaf goldenrod	12
<i>Sphenopholis obtusata</i>	Prairie wedgescale	2
<i>Stachys tenuifolia</i>	Slender-leaf hedge nettle	2
<i>Staphylea trifolia</i>	American bladdernut	15
<i>Stellaria media</i>	Common chickweed	2
<i>Stellaria pallida</i>	Pale chickweed	2
<i>Strophostyles helvolus</i>	Trailing wildbean	1
<i>Strophostyles leiosperma</i>	Slick-seed bean	1
<i>Symphoricarpos orbiculatus</i>	Buckbrush	19
<i>Taenidia integerrima</i>	Yellow pimpernel	3
<i>Taraxacum officinale</i>	Common dandelion	1

<i>Thalictrum dasycarpum</i>	Purple meadow rue	12
<i>Thalictrum dioicum</i>	Early meadow rue	1
<i>Thaspium barbinode</i>	Bearded meadow-parsnip	1
<i>Thlaspi arvense</i>	Pennycress	1
<i>Tilia americana</i>	American basswood	15
<i>Torilis arvensis</i>	Hedge parsley	3
<i>Toxicodendron radicans</i>	Common poison ivy	17
<i>Tradescantia ohiensis</i>	Ohio spiderwort	1
<i>Tridens flavus</i>	Purpletop	1
<i>Trifolium pratense</i>	Red clover	1
<i>Trillium sessile</i>	Toadshae trillium	1
<i>Triodanis perfoliata</i>	Venus' looking glass	6
<i>Triosteum perfoliatum</i>	Common horsegentian	9
<i>Ulmus americana</i>	American elm	13
<i>Ulmus rubra</i>	Red elm	13
<i>Urtica dioica</i>	Stinging nettle	7
<i>Uvularia grandiflora</i>	Large-flower bellwort	2
<i>Valerianella radiata</i>	Corn salad	1
<i>Verbascum thapsus</i>	Woolly mullein	1
<i>Verbena canadensis</i>	Rose verbena	2
<i>Verbena urticifolia</i>	White verbena	4
<i>Verbesina alternifolia</i>	Wingstem crownbeard	10
<i>Vernonia baldwinii</i>	Common ironweed	5
<i>Veronica arvensis</i>	Corn speedwell	1
<i>Veronica peregrina</i>	Purslane speedwell	2
<i>Viburnum prunifolium</i>	Black-haw viburnum	2
<i>Viburnum rufidulum</i>	Rust black-haw viburnum	1
<i>Viola pedata</i>	Bird-foot violet	1
<i>Viola pedatifida</i>	Prairie violet	2
<i>Viola pratincola</i>	Meadow violet	17
<i>Viola pubescens</i>	Downy yellow violet	14
<i>Viola rafinesquii</i>	Johnny-jump-up	1
<i>Viola sororia</i>	Downy blue violet	5
<i>Vitis cinerea</i>	Graybark grape	1
<i>Vitis riparia</i>	Riverbank grape	15
<i>Woodsia obtusa</i>	Blunt-lobe cliff fern	2
<i>Zanthoxylum americanum</i>	Common prickly ash	3
<i>Zizia aurea</i>	Golden zizia	9

Acknowledgments

The work for this project, “A Natural Areas Inventory of Douglas, Johnson, Leavenworth, Miami, and Wyandotte Counties in Northeast Kansas,” was carried out under a subgrant of the State Wildlife Grants program, a federal program through the U.S. Fish & Wildlife Service. It was administered by the Kansas Department of Wildlife & Parks. Special thanks to Kansas Department of Wildlife & Parks employees Carl Magnuson and Ed Miller.

We are grateful to property owners who gave us permission to visit their properties, and without whom this inventory would not have been possible.

Many individuals worked on the County Inventory, from field workers to office support personnel. They include Mandi Atkinson, Kristopher Fisk, Stephanie Fritts, Bernadette Kuhn, Quinn Long, Jennifer Moody-Weis, Michelle Moran, Dawn Morningstar, Caleb Morse, Sun-Yurp Park, Alexis Powell, and Vaughn Salisbury.