A SITE INVENTORY OF THE GREEN RIVER STATE CONSERVATION AREA, LEE COUNTY, ILLINOIS

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INTRODUCTION

The Green River, located in northwestern Illinois, is in a broad valley that was formed by glacial outwash at the end of Wisconsin glaciation. Prior to drainage in the late 1800's the Green River watershed contained the Great Winnebago Swamp, one of the most extensive wetlands in northern Illinois. At that time marsh and wet sand prairie communities were common, along with extensive sand flats and dunes dominated by sand prairie communities. Scrub-oak forests and savanna communities were common on the dry sandy ridges, while floodplain forests were common along the river channels (Robertson 1998). After European settlement, much of the Green River lowland was drained and most of the original vegetation lost to agricultural purposes.

Nearly all of the Green River watershed has been disturbed by grazing, drainage, and cultivation. The few remaining natural communities vary extensively in quality and size. Some of the best quality prairie remnants are at the Green River State Wildlife Area (GRSWA) in Lee County, 24 km south of the town of Dixon, Illinois and 10 km north of Ohio, Illinois. Located in the southwestern part of Lee County, the initial purchase of land for the present GRSWA started in 1938 under the Federal Aid in Wildlife Restoration Act to provide habitat for waterfowl and the dwindling populations of the greater prairie chicken. Subsequent land acquisitions have increased the size of the GRSWA to 1038 ha (2565 acres). This multiple-use area is managed for the protection of wildlife, for compatible recreation programs, and for natural heritage resources.

At the time of purchase little original natural character of the area remained. During the natural areas inventory in the mid 1970's no grade A or B quality natural areas were reported from the GRSWA. The present study was

undertaken to document the rate of woody encroachment that has occurred throughout the GRSWA since the original purchase, and to provide base-line vegetation data by establishing permanent plots within the sand prairie communities in prescribed burn units 6 and 9.

DESCRIPTION OF THE STUDY AREAS

The Green River Lowlands Section of the Grand Prairie Division is located in northwestern Illinois (Schwegman 1973). About 1280 km^2 in size, this section is located just to the northwest of the terminal moraine of Wisconsin glaciation (Killey 1998). The Bloomington Morainic System, and specifically the Sheffield Moraine, is located southeast of the GRSWA. This morainal system rises to a maximum of 60 m above the Green River Lowlands. The deposition of extensive sand and gravel deposits occurred in the Green River Lowlands during intermittent warm periods and retreats of the Wisconsin Episode. Some of these sands have been reworked by wind, and numerous sand dunes dot the areas (Zwicker 1985, Killey 1998).

Prior to European settlement, the Green River Lowlands that presently contain the GRSWA was described as a swamp, marsh, rolling prairie, and dry prairie (1833 to 1843 Land Survey Record). It was part of the nearly one-half million acres of prairie wetlands historically known as the Great Winnebago Swamp. Drainage of the Green River Lowlands was largely completed by the late 1800's when the Green River was channeled. Upon completion of these drainage projects, much of the region presently within the GRSWA was subjected to cropping and/or grazing. The dryer conditions resulted in these sandy soils being severely affected via wind erosion. Soil Conservation Agencies promoted the establishment of pine plantations and hedge rows to

alleviate that problem. These conservation plantings primarily used exotic plants.

The climate at the GRSWA is continental with warm summers and cold winters. Based on weather data from the city of Walnut, located 35 km southwest of the GRSWA, the average January maximum temperature is -2°C, the minimum -12°C, whereas the average July maximum and minimum temperatures are 29°C and 17°C, respectively (Angel and Armstrong 1998). The average number of frost free days is 161. Average precipitation is 93 cm, with more rainfall in the spring and summer.

MATERIALS AND METHODS

The GRSWA was visited at various times during the growing season of 1999 and 2000. During each trip voucher specimens of each species observed were collected, identified, and deposited in the herbarium of the Illinois Natural History Survey, Champaign, Illinois (ILLS). Criteria for designating native and non-native taxa followed Fernald (1950), Mohlenbrock (1986), and Gleason and Cronquist (1991). Plant community classification follows White and Madany (1978), while nomenclature follows, for the most part, Mohlenbrock (1986).

In each of the two burn units studied, 12 transects 250 m long were located in a general north-south orientation (Figure 1). The first transect in each burn unit was located near the units west edge, each additional trnasect situated approximately 50 m to the east until the entire unit was traversed with transects. Additional transects were added to include odd shaped parts of each burn unit until each unit contained the same linear extent of transects (2500 m). Permanent metal T-posts were positioned at both ends of each transect.

Started 10 m south of the north end of each transect and at each 25 m thereafter (10m, 35m, 60m, 85m, 110m, 135m, 160m, 185m, 210m, 235m) 10 points were established (Figure 1). The center point of the 10 permanent plots along the transect was located to the east and west of these original points. A random numbers table (0 to 9) was used to determine the number of meters the center point would be located from the transect line (Table 1). Center points located at even numbered intervals (10m, 60m, etc) were located to the east, center points located at odd numbered intervals (35m, 85m, etc) were located to the west side of the transect line.

At each center point (10 along each transect) the woody vegetation was analyzed using nested circular plots, while the ground layer was analyzed using 1/4 m^2 plots. At each center point a 0.04 ha circular plot was established and all living trees 10 cm dbh and above were identified to species and their diameters recorded (cm). Density (stems/ha), basal area (m^2/ha), relative frequency, relative density, relative dominance, importance value (IV), and average diameter were calculated for each species.

Woody understory composition, frequency, and density (stems/ha) were determined using 0.0001, 0.001, and 0.01 ha nested circular plots at each center point. Four additional 0.0001 ha and 0.001 ha plots were located 7 m from each center point on cardinal compass directions. In the 0.0001 ha plot, tree and shrub seedlings ($\leq$40 cm tall) were counted; in the 0.001 ha circular plots small saplings (>40 cm tall and $\leq$2.5 dbh) were recorded; and in the 0.01 ha circular plots large saplings (2.6 to 9.9 cm dbh) were recorded. The shrubby species of Rubus (blackberries and raspberries) were counted in the 0.0001 ha plots, while the prairie shrubs Rhus aromatica Ait. (fragrant sumac) and Rubus

flagellaris Willd. (dewberry) were surveyed with the ground layer taxa in the 1/4 m^2 plots.

At each center point the quadrats for determining the cover and frequency of ground layer vegetation were located at 1 m intervals to the east and west of the center points. At even numbered center points the quadrats were placed 2 and 4 m to the east of the center point, and at odd numbered center points the quadrats were placed 1, 3, and 5 m to the west of the center point (25 quadrats for each transect). Cover was determined using the Daubenmire cover class system (Daubenmire 1959) as modified following Bailey and Poulton (1968). Only plants rooted within the frame of the quadrat were recorded. The modified Daubenmire cover scale is as follows: class 1 = 0-1%; class 2 = >1-5%; class 3 = >5 -25%; class 4 = >25-50%; class 5 = >50-75%; class 6 = >75-95%; class 7 = >95-100%. Importance value (IV) for ground cover species was determined by summing relative cover and relative frequency.

RESULTS AND DISCUSSION

Vegetation of prescribed burn unit # 9:

This unit is very open with scattered clumps of trees, and a few forested areas along the edge. Because of the forested areas included in the surveyed part of the prescribed burn unit, the overall tree density was 78.3 stems/ha with a basal area of 4.222 m^2/ha (Table 2). The trees encountered, for the most part, were relatively small, the average diameter of all species <30 cm dbh. The forests communities were relatively young, probably <50 years in age. The dominant species encountered in the forested areas was Acer saccharinum L. (silver maple) which ranked second in IV. Prunus serotina Ehrh. (wild black

cherry), ranked first with an IV of 126.3, and was most common in the small clumps of trees in the prairie, but was also common in the forested areas. Quercus velutina Lam. (black oak) was common around the edge of the prairie areas and as scattered individuals on the prairie. The other tree species were present in very low number, with Acer negundo L. (box elder) and Fraxinus pennsylvanica Marsh. (green ash) associated with the forested areas, Populus tremuloides Michx. (quaking aspen) in a large disturbed clump of trees, and Robinia pseudoacacia L. (black locust) common at the edge of some of the forested areas.

Numerous woody understory seedlings, saplings, and shrubs were common in this burn unit (Table 3). The woody understory in the scattered clumps of trees on the prairie was very dense, seedlings and saplings of wild black cherry being the most common along with two shrubby species of Lonicera (honeysuckle). The forested areas, in contrast, had a relatively open understory with wild black cherry, shrubby honeysuckles, Rubus occidentalis L. (black raspberry), and Ulmus americana L. (American elm) commonly encountered. Some shrub species were very common, Rhus glabra L. (smooth sumac), Cornus racemosa Lam. (gray dogwood), and Rubus pensylvanicus Poir. (blackberry) forming large thickets, particularly near the small clumps of trees and at the forest edge. Smooth sumac and blackberries were also common on the prairie, sometimes forming large clumps >30 m across.

Because of the diversity of the ground layer within this burn unit, the ground layer data was divided into three parts: ground layer species associated with a grade B dry-mesic sand prairie (Table 4); ground layer species associated with a good quality grade C dry-mesic to mesic sand prairie (Table

5); and ground layer species of a disturbed prairie/open forest/sedge meadow complex (Table 6).

In the grade B dry-mesic sand prairie the dominant grass was Sorghastrum nutans Nash(Indian grass) with an IV of 61.0, while Panicum villosissimum Nash (panic grass) and Andropogon gerardii Vitman (big bluestem) were fairly common (Table 4). Dominant native fall forbs included Euthamia graminifolia (L.) Salisb. (grass-leaved goldenrod), Liatris aspera Michx. (rough blazing-star), and Euphorbia corollata L. (flowering spurge) with IV's between 14.8 and 11.3. Dewberry, a native prostrate or low arched shrub, was fourth with an IV of 11.4. A total of 59 taxa were encountered in the plots with the highest diversity in the prairie areas, a few occurring only in the plots in the forest. A few exotic taxa were encountered in the dry-mesic sand prairie with Rumex acetosella L. (sour dock) and Achillea millefolium L. (common yarrow) being the most important. Except for sour dock, which was found in 23% of the plots, the exotic taxa were not obvious, being relatively unimportant members of the plant community. Some small forest groves occur as islands in this dry-mesic sand prairie. Forested areas and forested fence rows border the north, west, and south sides of burn unit # 9.

In the good quality grade C dry-mesic to mesic sand prairie the dominant grass was Indian grass, being first with an IV of 41.7, followed by Schizachyrium scoparium Nash (little bluestem) with an IV of 19.3 (Table 5). Other common grasses included the exotic taxon Poa pratensis L. (Kentucky bluegrass), Panicum villosissimum Nash (hairy panic grass) and big bluestem, all among the top 12 species in IV. Common forbs included grass-leaved goldenrod, flowering spurge, and Solidago canadensis L. (tall goldenrod) while dewberry was fifth with an IV of 10.1 (Table 5). Few exotic forbs were

encountered with sour dock and common yarrow being the most important. A total of 54 taxa were encountered in the plots with eight being exotic species. The number of exotic species found, the extensive woody component, the occasional large monocultures of smooth sumac, and the lack of most conservative native species resulted in this being considered a grade C community.

To the southeast of the grade C dry-mesic to mesic sand prairie discussed above is a degraded prairie with an open forest community dominated by quaking aspen and a sedge meadow community. Three line transects traversed this area (Figure 1), the results given in Table 6. In the sedge meadow, which is of relatively good quality, Carex stricta Lam. dominated (IV of 22.8), while the common grasses were Calamagrostis canadensis (Michx.) Beauv. (bluejoint grass), Muhlenbergia mexicana (L.) Trin. (muhly), and Spartina pectinata Link (cord grass). The common fall forbs included Stachys palustris L. (woundwort), Helianthus grosseserratus Martens (sawtooth sunflower), Solidago gigantea Ait. (late goldenrod), Campanula aparinoides Pursh (marsh bellflower), Gentiana andrewsii Griesb. (closed gentian), and Boehmeria cylindrica (L.) Sw. (false nettle). The open quaking aspen forest lacked many herbaceous species, the dominants being dense stands of Rubus spp., including R. allegheniensis Porter (common blackberry), R. flagellaris Willd. (dewberry), R. occidentalis (black raspberry), and R. pensylvanicus Poir. (Pennsylvania blackberry). Degraded prairie remnants, disturbed open and closed groves of forest, and small relative good quality prairie remnants were scattered throughout the remainder of this area.

Vegetation of prescribed burn unit # 6:

This unit is very open with scattered groves of trees, and a few very open, disturbed forest communities at the edge. No extensive forest areas were included in the survey unit and the overall tree density was 46.2 stems/ha with a basal area of 1.749 m^2/ha (Table 7). The trees encountered were relatively small, the average diameter for most tree species was less than 33 cm dbh, the only exception being a few large Populus delotoides Marsh. (cottonwood). The dominant species encountered was wild black cherry which ranked first with an IV of 136.5, and was most common in small clumps of trees on the prairie. Pinus banksiana Lamb. (jack pine) was common in small clumps of a few dozen trees where it was originally planted and has become established. Crataegus mollis (Torr. & Gray) Scheele (red haw) was common along the north edge of the prescribed burn unit where many disturbance species were common. The remaining tree species were occasionally encountered as scattered individuals or in small groves of trees on the open sand prairie.

Woody seedlings and small saplings of most trees and shrubs were not common in this prescribed burn unit, and averaged only 1104 seedling stems/ha and 2125 small sapling stems/ha (Table 8). These low numbers were mostly due to the low density of most shrubby species that were common in the prescribed burn unit # 9. In particular, few blackberries were encountered in prescribed burn unit # 6, and only a few large clumps of smooth sumac were found. The relatively high number of large saplings was mostly due to wild black cherry and Lonicera x bella Zabel (honeysuckle) saplings found in the groves of trees on the sand prairie and in the disturbed open forest to the north edge of the burn unit. Also, a large colony of black locust was present along the southeast edge of the burn unit.

The area of the north edge of the study area in prescribed burn unit # 6 is open, disturbed forest, with many open grown red haw trees and a ground layer dominated by Kentucky bluegrass and Bromus inermis Leyss. (awnless brome grass) (Table 9). Most of the remaining part of the study area is grade C dry to dry-mesic sand prairie that was probably heavily grazed and possibly cultivated prior to the purchase of the area by the state of Illinois. In the grade C dry to dry-mesic sand prairie the fall forb Ambrosia psilostachya DC. (western ragweed) is the dominant taxon with an IV of 34.8, while fragrant sumac is second with an IV of 17.3 (Table 9). Common grasses on the sand prairie included hairy panic grass, little bluestem, Indian grass, Leptoloma cognatum (Schult.) Chase (fall witch grass), and awnless brome grass. A total of 79 taxa were encountered in the plots in this study area, 13 being exotic taxa. Common exotic species on the sand prairie included awnless brome grass, yarrow, and sour dock (Table 9).

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Table 1. Random numbers used to determine the center point of 10 permanent plots along each of 12 transectcs (01 to 12) in Burn Unit # 9 (001 to 120) and to determine the center point of 10 permanent plots along each of 12 transects (13 to 24) in Burn Unit # 6 (121 to 240) within the Green River State Wildlife Area, Lee County, Illinois.

TRANSECT #	PLOT #'S									
01	001	002	003	004	005	006	007	008	009	010
RANDOM #	9	1	8	2	6	0	8	9	2	8
02	011	012	013	014	015	016	017	018	019	020
RANDOM #	9	3	7	8	5	6	1	3	6	8
03	021	022	023	024	025	026	027	028	029	030
RANDOM #	2	3	4	7	8	3	4	1	1	3
04	031	032	033	034	035	036	037	038	039	040
RANDOM #	9	9	5	5	9	6	8	3	3	1
05	041	042	043	044	045	046	047	048	049	050
RANDOM #	4	2	6	2	6	8	6	8	1	9
06	051	052	053	054	055	056	057	058	059	060
RANDOM #	4	5	4	7	6	8	4	8	8	2
07	061	062	063	064	065	066	067	068	069	070
RANDOM #	6	5	1	0	9	9	6	5	9	7
08	071	072	073	074	075	076	077	078	079	080
RANDOM #	5	0	0	5	1	9	5	1	3	7
09	081	082	083	084	085	086	087	088	089	090
RANDOM #	3	1	3	1	0	8	9	6	0	2
10	091	092	093	094	095	096	097	098	099	100
RANDOM #	4	4	5	6	0	3	8	7	5	0
11	101	102	103	104	105	106	107	108	109	110
RANDOM #	2	0	1	9	0	5	6	5	3	5
12	111	112	113	114	115	116	117	118	119	120
RANDOM #	1	2	2	3	6	6	0	2	7	7

Table 1 -- continued

TRANSECT #	PLOT #'S									
13	121	122	123	124	125	126	127	128	129	130
RANDOM #	6	2	5	3	5	2	4	1	7	0
14	131	132	133	134	135	136	137	138	139	140
RANDOM #	6	9	6	5	4	8	1	1	7	6
15	141	142	143	144	145	146	147	148	149	150
RANDOM #	7	4	1	7	4	6	8	5	0	9
16	151	152	153	154	155	156	157	158	159	160
RANDOM #	5	0	5	8	0	4	7	7	6	9
17	161	162	163	164	165	166	167	168	169	170
RANDOM #	7	4	7	3	0	3	9	5	7	1
18	171	172	173	174	175	176	177	178	179	180
RANDOM #	8	6	4	0	2	1	8	1	6	5
19	181	182	183	184	185	186	187	188	189	190
RANDOM #	4	4	8	0	1	2	4	3	5	6
20	191	192	193	194	195	196	197	198	199	200
RANDOM #	3	5	1	7	7	2	7	0	8	0
21	201	202	203	204	205	206	207	208	209	210
RANDOM #	1	5	4	5	3	1	8	2	2	3
22	211	212	213	214	215	216	217	218	219	220
RANDOM #	7	4	2	1	1	1	5	7	8	2
23	221	222	223	224	225	226	227	228	229	230
RANDOM #	5	3	1	4	3	8	5	5	3	7
24	231	232	233	234	235	236	237	238	239	240
RANDOM #	6	3	7	4	3	5	0	9	9	8

Table 2. Densities (stems/ha), diameter classes, basal areas (m^2/ha), relative values, importance values, and average diameters of the woody species in prescribed burn unit # 9, Green River State Wildlife Area, Lee County, Illinois. (PLOTS 1-120)

Species	Diameter Classes (cm) 10 - 19	20 - 29	30 - 39	40+	Total stems/ha	Basal Area m^2/ha	Rel. Freq.	Rel. Den.	Rel. Dom.	I.V.	Av. Diam. (cm)
Prunus serotina	14.6	17.9	5.0	0.6	38.1	1.686	37.6	48.7	40.0	126.3	22.6
Acer saccharinum	6.3	7.1	5.8	3.1	22.3	1.832	21.1	28.4	43.4	92.9	28.7
Quercus velutina	4.7	0.8	0.8	0.6	6.9	0.325	16.5	8.8	7.7	33.0	21.6
Acer negundo	2.1	0.6	–	–	2.7	0.069	4.6	3.4	1.6	9.6	17.4
Fraxinus pennsylvanica	1.0	0.2	0.9	–	2.1	0.086	4.6	2.6	2.1	9.3	21.0
Populus tremuloides	1.5	0.2	0.2	–	1.9	0.046	3.7	2.4	1.1	7.2	16.0
Ulmus americana	0.6	–	–	0.2	0.8	0.068	3.7	1.1	1.6	6.4	26.2
Juniperus virginiana	0.4	0.4	–	–	0.8	0.021	3.7	1.1	0.5	5.3	17.0
Robinia pseudoacacia	0.6	1.1	–	–	1.7	0.064	0.9	2.1	1.5	4.5	21.8
Morus alba	0.6	–	–	–	0.6	0.006	1.8	0.8	0.1	2.7	11.2
Salix fragilis	–	0.2	–	–	0.2	0.014	0.9	0.3	0.3	1.5	29.1
Malus pumila	0.2	–	–	–	0.2	0.005	0.9	0.3	0.1	1.3	18.0
Totals	32.6	28.5	12.7	4.5	78.3	4.222	100.0	100.0	100.0	300.0	

Table 3. Frequency (%), and densities (stems/ha) of the woody seedlings (≤50 cm tall), small saplings (>50 cm tall <2.5 cm dbh), large saplings (2.5 to 9.9 cm dbh), and trees (≥10.0 cm dbh) in prescribed burn unit # 9, Green River State Wildlife Area, Lee County, Illinois. (PLOTS 1-120)

Species	Seedlings		Small Saplings		Large Saplings		Trees	
	Frequency %	Density #/ha	Frequency %	Density #/ha%	Frequency %	Density #/ha	Frequency %	Density #/ha
Prunus serotina	1.3	291.7	7.9	450.0	6.6	14.2	34.2	38.1
Acer saccharinum	–	–	–	–	1.7	10.0	19.2	22.3
Quercus velutina	0.8	187.5	4.2	208.3	5.0	5.8	15.0	6.9
Acer negundo	–	–	–	–	1.7	2.5	4.2	2.7
Fraxinus pennsylvanica	–	–	0.6	43.8	1.7	2.5	4.2	2.1
Populus tremuloides	0.2	145.8	1.5	168.8	0.8	3.3	3.3	1.9
Ulmus americana	0.4	41.7	–	–	0.8	0.8	3.3	0.8
Juniperus virginiana	–	–	–	–	–	–	3.3	0.8
Robinia pseudoacacia	0.6	62.5	4.0	508.3	1.7	7.5	0.8	1.7
Morus alba	0.2	20.8	–	–	0.8	0.8	1.7	0.6
Salix fragilis	–	–	–	–	–	–	0.8	0.2
Malus pumila	–	–	–	–	–	–	0.8	0.2
Catalpa speciosa	–	–	0.2	2.1	2.5	2.5	–	–
Malus ioensis	0.2	20.8	0.2	2.1	–	–	–	–
Ulmus rubra	–	–	–	–	0.8	0.8	–	–
Lonicera maackii	1.9	458.3	5.2	91.7	16.6	65.8	–	–
Lonicera x bella	0.2	83.3	0.6	12.5	0.8	7.5	–	–
Cornus racemosa	0.8	187.5	9.2	1654.2	0.8	5.8	–	–
Rhus glabra	4.4	687.5	18.5	2781.3	–	–	–	–
Prunus virginiana	0.2	83.3	1.5	54.2	–	–	–	–
Sambucus canadensis	–	–	1.3	39.6	–	–	–	–
Salix humilis	–	–	0.4	39.6	–	–	–	–
Rosa multiflora	0.2	20.8	1.5	20.8	–	–	–	–
Populus deltoides	–	–	0.4	12.5	–	–	–	–
Rhamnus cathartica	–	–	0.2	4.2	–	–	–	–
Ptelea trifoliata	–	–	0.2	2.1	–	–	–	–
Rubus occidentalis	33.5	9666.7	–	–	–	–	–	–
Rubus pensylvanicus	5.0	1000.0	–	–	–	–	–	–
Celtis occidentalis	0.2	41.7	–	–	–	–	–	–
Totals		12999.9		6096.1		129.8		78.3

Table 4. Frequency (%), relative frequency, relative cover, and importance values of the species encountered along line transects through a grade B dry-mesic sand prairie and some wooded areas just west of Pump Factory Road in prescribed burn unit # 9, Green River State Wildlife Area, Lee County, Illinois. (PLOTS 1 to 40)

Species	Frequency %	Relative Frequency	Relative Cover	Importance Value
Sorghastrum nutans	79.0	17.0	44.0	61.0
Euthamia graminifolia	43.0	9.3	5.5	14.8
Liatris aspera	26.0	5.6	6.4	12.0
Rubus flagellaris	24.0	5.2	6.2	11.4
Euphorbia corollata	32.0	6.8	4.5	11.3
Panicum villosissimum	34.0	7.3	3.0	10.3
Carex tonsa	20.0	4.3	1.6	5.9
Rumex acetosella	23.0	5.0	0.9	5.9
Lespedeza capitata	15.0	3.2	2.0	5.2
Parthenium integrifolium	8.0	1.7	2.7	4.4
Antennaria plantaginifolia	9.0	1.9	2.1	4.0
Solidago nemoralis	10.0	2.2	1.8	4.0
Phalaris arundinacea	3.0	0.7	3.2	3.9
Andropogon gerardii	6.0	1.3	2.2	3.5
Polygala polygama	15.0	3.2	0.3	3.5
Parthenocissus quinquefolia	6.0	1.3	2.0	3.3
Schyzachyrium scoparium	4.0	0.9	1.9	2.8
Solidago canadensis	6.0	1.3	1.2	2.5
Osmorhiza longistylis	6.0	1.3	0.4	1.7
Asclepias verticillata	7.0	1.5	0.1	1.6
Fragaria virginiana	3.0	0.7	0.8	1.5
Achillea millefolium	5.0	1.1	0.3	1.4
Rosa carolina	4.0	0.9	0.5	1.4
Sanicula canadensis	3.0	0.7	0.7	1.4
Carex muhlenbergii	4.0	0.9	0.3	1.2
Conyza canadensis	5.0	1.1	0.1	1.2
Helianthus grosseserratus	3.0	0.7	0.5	1.2
Oxalis dillenii	5.0	1.1	0.1	1.2
Agrostis alba	3.0	0.7	0.4	1.1
Hieracium longipilum	4.0	0.9	0.2	1.1
Viola sagittata	4.0	0.9	0.2	1.1
Botrychium dissectum	3.0	0.7	0.2	0.9
Eragrostis spectabilis	2.0	0.4	0.4	0.8
Leptoloma cognatum	3.0	0.7	0.1	0.8
Potentilla simplex	3.0	0.7	0.1	0.8
Setaria glauca	3.0	0.7	0.1	0.8
Viola sororia	2.0	0.4	0.4	0.8
Aristida intermedia	3.0	0.7	--	0.7
Antennaria neglecta	1.0	0.2	0.3	0.5
Bidens frondosa	1.0	0.2	0.3	0.5
Bromus inermis	1.0	0.2	0.3	0.5
Erigeron strigosus	2.0	0.4	0.1	0.5
Galium triflorum	1.0	0.2	0.3	0.5
Geum canadense	1.0	0.2	0.3	0.5

Table 4 -- continued

Helianthemum bicknellii	2.0	0.4	0.1	0.5
Polygonatum commutatum	1.0	0.2	0.3	0.5
Comandra umbellata	2.0	0.4	--	0.4
Cyperus filiculmis	2.0	0.4	--	0.4
Aster pilosus	1.0	0.2	0.1	0.3
Hackelia virginiana	1.0	0.2	0.1	0.3
Lechea tenuifolia	1.0	0.2	0.1	0.3
Monarda punctata	1.0	0.2	0.1	0.3
Prunella vulgaris	1.0	0.2	0.1	0.3
Rudbeckia hirta	1.0	0.2	0.1	0.3
Acalypha gracilens	1.0	0.2	--	0.2
Chenopodium standleyanum	1.0	0.2	--	0.2
Cyperus schweinitzii	1.0	0.2	--	0.2
Kummerowia striata	1.0	0.2	--	0.2
Polygala sanguinea	1.0	0.2	--	0.2
Totals		100.0	100.0	200.0

Table 5. Frequency (%), relative frequency, relative cover, and importance values of the species encountered along line transects through part of a good quality grade C dry-mesic to mesic sand prairie west of Pump Factory Road in prescribed burn unit # 9, Green River State Wildlife Area, Lee County, Illinois. (PLOTS 41 to 80 and 111 to 120)

Species	Frequency %	Relative Frequency	Relative Cover	Importance Value
Sorghastrum nutans	75.0	15.0	26.7	41.7
Schizachyrium scoparium	43.0	7.0	12.3	19.3
Euthamia graminifolia	40.0	8.1	6.0	14.1
Euphorbia corollata	34.0	6.8	6.8	13.6
Rubus flagellaris	22.0	4.4	5.7	10.1
Poa pratensis	34.0	7.0	2.5	9.5
Soldiago canadensis	21.0	4.2	5.0	9.2
Rosa carolina	22.0	4.4	3.6	8.0
Parthenium integrifolium	16.0	3.2	4.6	7.8
Desmodium canadense	18.0	3.7	3.9	7.6
Panicum villosissimum	24.0	4.9	1.6	6.5
Andropogon gerardii	10.0	1.9	1.9	3.8
Viola sagittata	11.0	2.3	1.5	3.8
Solidago nemoralis	9.0	1.8	1.9	3.7
Stachys palustris	8.0	1.6	2.1	3.7
Polygala polygama	14.0	2.9	0.6	3.5
Liatris aspera	8.0	1.6	1.5	3.1
Hieracium longipilum	8.0	1.6	1.2	2.8
Panicum virgatum	6.0	1.1	1.4	2.5
Asclepias verticillata	9.0	1.8	0.1	1.9
Lespedeza capitata	4.0	0.8	1.0	1.8
Carex tonsa	7.0	1.5	0.3	1.8
Aster lanceolatus	4.0	0.8	0.8	1.6
Liatris pycnostachya	3.0	0.6	1.0	1.6
Lycopus americanus	4.0	0.8	0.7	1.5
Rumex acetosella	6.0	1.1	0.2	1.3
Toxicodendron radicans	2.0	0.3	1.0	1.3
Achillea millefolium	5.0	1.0	0.2	1.2
Antennaria neglecta	3.0	0.6	0.5	1.1
Helianthus grosseserratus	2.0	0.5	0.6	1.1
Ambrosia artemisiifolia	2.0	0.5	0.4	0.9
Antennaria plantaginifolia	2.0	0.5	0.4	0.9
Eleocharis verrucosa	3.0	0.6	0.3	0.9
Agrostis alba	2.0	0.3	0.4	0.7
Carex stricta	2.0	0.3	0.2	0.5
Oxalis dillenii	2.0	0.5	--	0.5
Acalypha rhomboidea	1.0	0.2	0.2	0.4
Apocynum sibiricum	1.0	0.2	0.2	0.4
Helianthemum bicknellii	2.0	0.3	0.1	0.4
Heterotheca camporum	1.0	0.2	0.2	0.4
Leptoloma cognatum	2.0	0.3	0.1	0.4
Solanum ptycanthum	1.0	0.2	0.2	0.4
Solidago gigantea	2.0	0.3	0.1	0.4
Cyperus filiculmis	2.0	0.3	--	0.3

Table 5 -- continued

Acalypha gracilens	1.0	0.2	--	0.2
Botrychium dissectum	1.0	0.2	--	0.2
Calystegia sepium	1.0	0.2	--	0.2
Daucus carota	1.0	0.2	--	0.2
Kummerowia striata	1.0	0.2	--	0.2
Lactuca canadensis	1.0	0.2	--	0.2
Parthenocissus quinquefolia	1.0	0.2	--	0.2
Taraxacum officinalis	1.0	0.2	--	0.2
Cyperus schweinitzii	1.0	0.2	--	0.2
Paspalum bushii	1.0	0.2	--	0.2
Totals		100.0	100.0	200.0

Table 6. Frequency (%), relative frequency, relative cover, and importance values of the species encountered along line transects through disturbed prairie, sedge meadow, and disturbed forest just west of Pump Factory Road in prescribed burn unit # 9, Green River State Wildlife Area, Lee County, Illinois. (PLOTS 81 to 110)

Species	Frequency %	Relative Frequency	Relative Cover	Importance Value
Carex stricta	41.0	8.9	13.9	22.8
Solidago canadensis	33.0	7.1	10.8	17.9
Eupatorium rugosum	23.0	4.9	4.5	9.4
Calamagrostis canadensis	16.0	3.4	5.9	9.3
Stachys palustris	21.0	4.8	3.6	8.4
Helianthus grosseserratus	9.0	2.0	6.4	8.4
Muhlenbergia mexicana	8.0	1.7	4.3	6.0
Poa compressa	15.0	3.1	2.6	5.7
Sorghastrum nutans	12.0	2.6	3.1	5.7
Andropogon gerardii	12.0	2.6	2.9	5.5
Solidago gigantea	13.0	2.9	2.6	5.5
Viola pranticola	13.0	2.9	2.6	5.5
Geum canadense	13.0	2.9	2.3	5.2
Euthamia graminifolia	15.0	3.1	1.9	5.0
Spartina pectinata	8.0	1.7	3.0	4.7
Potentilla simplex	9.0	2.6	1.8	4.4
Acalypha rhomboidea	13.0	2.9	1.4	4.3
Rosa carolina	11.0	2.2	2.0	4.2
Rubus flagellaris	8.0	1.7	2.3	4.0
Pilea pumila	7.0	1.4	1.8	3.2
Agrimonia parviflora	7.0	1.5	1.4	2.9
Lycopus americanus	9.0	2.0	0.8	2.8
Campanula aparinoides	11.0	2.2	0.3	2.5
Hackelia virginiana	5.0	1.1	1.1	2.2
Phalaris arundinacea	4.0	0.9	1.3	2.2
Acalypha gracilens	8.0	1.7	0.2	1.9
Agrostis alba	7.0	1.4	0.4	1.8
Galium triflorum	7.0	1.4	0.4	1.8
Lycopus uniflorus	5.0	1.1	0.7	1.8
Cirsium discolor	4.0	0.8	0.9	1.7
Parthenium integrifolium	4.0	0.9	0.8	1.7
Solidago nemoralis	4.0	0.9	0.8	1.7
Toxicodendron radicans	4.0	0.9	0.6	1.5
Circaea lutetiana	4.0	0.9	0.4	1.3
Panicum villosissimum	4.0	0.9	0.4	1.3
Solanum ptycanthum	4.0	0.9	0.4	1.3
Verbena hastata	4.0	0.9	0.4	1.3
Ambrosia artemisiifolia	4.0	0.9	0.3	1.2
Aster lanceolatus	3.0	0.5	0.6	1.1
Gentiana andrewsii	3.0	0.5	0.6	1.1
Ribes missouriense	3.0	0.5	0.6	1.1
Cryptotaenia canadensis	1.0	0.3	0.7	1.0
Thelypteris palustris	1.0	0.3	0.7	1.0
Oxalis dillenii	4.0	0.9	--	0.9

Table 6 -- continued

Boehmeria cylindrica	3.0	0.5	0.3	0.8
Carex cristatella	3.0	0.5	0.3	0.8
Plantago rugelii	3.0	0.5	0.3	0.8
Veronicastrum virginicum	3.0	0.5	0.3	0.8
Asclepias syriaca	1.0	0.3	0.3	0.6
Erigeron annuus	1.0	0.3	0.3	0.6
Erechtites hieracifolia	1.0	0.3	0.3	0.6
Euphorbia corollata	1.0	0.3	0.3	0.6
Lactuca canadensis	1.0	0.3	0.3	0.6
Parthenocissus quinquefolia	1.0	0.3	0.3	0.6
Pastinaca sativa	1.0	0.3	0.3	0.6
Phytolacca americana	1.0	0.3	0.3	0.6
Polygonum amphibium	1.0	0.3	0.3	0.6
Polygonum punctatum	1.0	0.3	0.3	0.6
Rumex acetosella	3.0	0.5	0.1	0.6
Schizachyrium scoparium	3.0	0.5	0.1	0.6
Spiraea alba	3.0	0.5	0.1	0.6
Taraxacum officinalis	3.0	0.5	0.1	0.6
Achillea millefolium	1.0	0.3	0.1	0.4
Barbarea vulgaris	1.0	0.3	0.1	0.4
Botrychium dissectum	1.0	0.3	0.1	0.4
Bidens aristosa	1.0	0.3	0.1	0.4
Eleocharis verrucosa	1.0	0.3	0.1	0.4
Lythrum alatum	1.0	0.3	0.1	0.4
Panicum virgatum	1.0	0.3	0.1	0.4
Penthorum sedoides	1.0	0.3	0.1	0.4
Pycnanthemum virginianum	1.0	0.3	0.1	0.4
Conyza canadensis	1.0	0.3	--	0.3
Juncus interior	1.0	0.3	--	0.3
Totals		100.0	100.0	200.0

Table 7. Densities (stems/ha), diameter classes, basal areas (m^2/ha), relative values, importance values, and average diameters of the woody species in prescribed burn unit # 6, Green River State Wildlife Area, Lee County, Illinois. (PLOTS 121-240)

Species	Diameter Classes (cm) 10 - 19	20 - 29	30 - 39	40+	Total stems/ha	Basal Area m^2/ha	Rel. Freq.	Rel. Den.	Rel. Dom.	I.V.	Av. Diam. (cm)
Prunus serotina	12.3	5.2	2.1	0.6	20.2	0.749	50.0	43.7	42.8	136.5	19.9
Pinus banksiana	7.7	3.6	0.8	0.2	12.3	0.401	15.9	26.6	23.0	65.5	19.1
Crataegus mollis	7.7	0.2	–	–	7.9	0.120	8.0	17.1	6.9	32.0	13.9
Quercus velutina	0.4	0.2	0.7	0.2	1.5	0.164	6.8	3.2	9.4	19.4	32.5
Acer saccharinum	0.9	0.4	–	0.4	1.7	0.107	5.7	3.6	6.1	15.4	25.3
Juniperus virginiana	1.0	–	–	–	1.0	0.016	5.7	2.3	0.9	8.9	13.9
Populus deltoides	–	–	0.2	0.2	0.4	0.101	1.1	0.9	5.8	7.8	52.9
Morus alba	0.2	–	–	0.2	0.4	0.049	2.3	0.9	2.8	6.0	32.2
Ulmus americana	–	0.4	–	–	0.4	0.024	2.3	0.9	1.4	4.6	27.0
Ulmus pumila	–	–	0.2	–	0.2	0.015	1.1	0.4	0.8	2.3	30.0
Celtis occidentalis	0.2	–	–	–	0.2	0.003	1.1	0.4	0.1	1.6	13.8
Totals	30.4	10.0	4.0	1.8	46.2	1.749	100.0	100.0	100.0	300.0	

Table 8. Frequency (%), and densities (stems/ha) of the woody seedlings (≤50 cm tall), small saplings (>50 cm tall <2.5 cm dbh), large saplings (2.5 to 9.9 cm dbh), and trees (≥10.0 cm dbh) in prescribed burn unit # 6, Green River State Wildlife Area, Lee County, Illinois. (PLOTS 121-240)

Species	Seedlings		Small Saplings		Large Saplings		Trees	
	Frequency %	Density #/ha	Frequency %	Density #/ha%	Frequency %	Density #/ha	Frequency %	Density #/ha
Prunus serotina	0.2	20.8	9.6	306.3	34.2	113.3	36.7	20.2
Pinus banksiana	0.4	62.5	0.2	2.1	0.8	2.5	11.7	12.3
Crataegus mollis	–	–	0.8	12.5	3.3	10.0	5.8	7.9
Quercus velutina	0.8	125.0	1.9	27.1	0.8	1.7	5.0	1.5
Acer saccharinum	–	–	–	–	–	–	4.2	1.7
Juniperus virginiana	–	–	–	–	0.8	0.8	4.2	1.0
Populus deltoides	–	–	–	–	–	–	0.8	0.4
Morus alba	–	–	0.2	2.1	1.7	3.3	1.7	0.4
Ulmus americana	0.2	20.8	–	–	–	–	1.7	0.4
Ulmus pumila	0.2	20.8	1.0	33.3	0.8	3.3	0.8	0.2
Celtis occidentalis	–	–	–	–	–	–	0.8	0.2
Robinia pseudoacacia	–	–	1.9	106.3	1.7	25.0	–	–
Malus ioensis	0.2	20.8	0.6	41.7	–	–	–	–
Ulmus rubra	–	–	0.2	2.1	–	–	–	–
Lonicera x bella	–	–	5.6	150.0	12.5	52.5	–	–
Lonicera maackii	–	–	0.4	6.3	0.8	6.7	–	–
Elaeagnus umbellata	–	–	1.0	25.0	1.7	4.2	–	–
Rosa multiflora	–	–	0.2	2.1	0.8	0.8	–	–
Rhus glabra	1.5	187.5	9.4	1227.1	–	–	–	–
Prunus virginiana	0.4	125.0	1.5	95.8	–	–	–	–
Salix exigua	–	–	0.4	43.8	–	–	–	–
Cornus racemosa	0.2	41.7	0.2	29.2	–	–	–	–
Sambucus canadensis	–	–	0.4	12.5	–	–	–	–
Rubus occidentalis	1.5	437.5	–	–	–	–	–	–
Rubus pensylvanicus	0.4	41.7	–	–	–	–	–	–
Totals		1104.1		2125.3		224.1		46.2

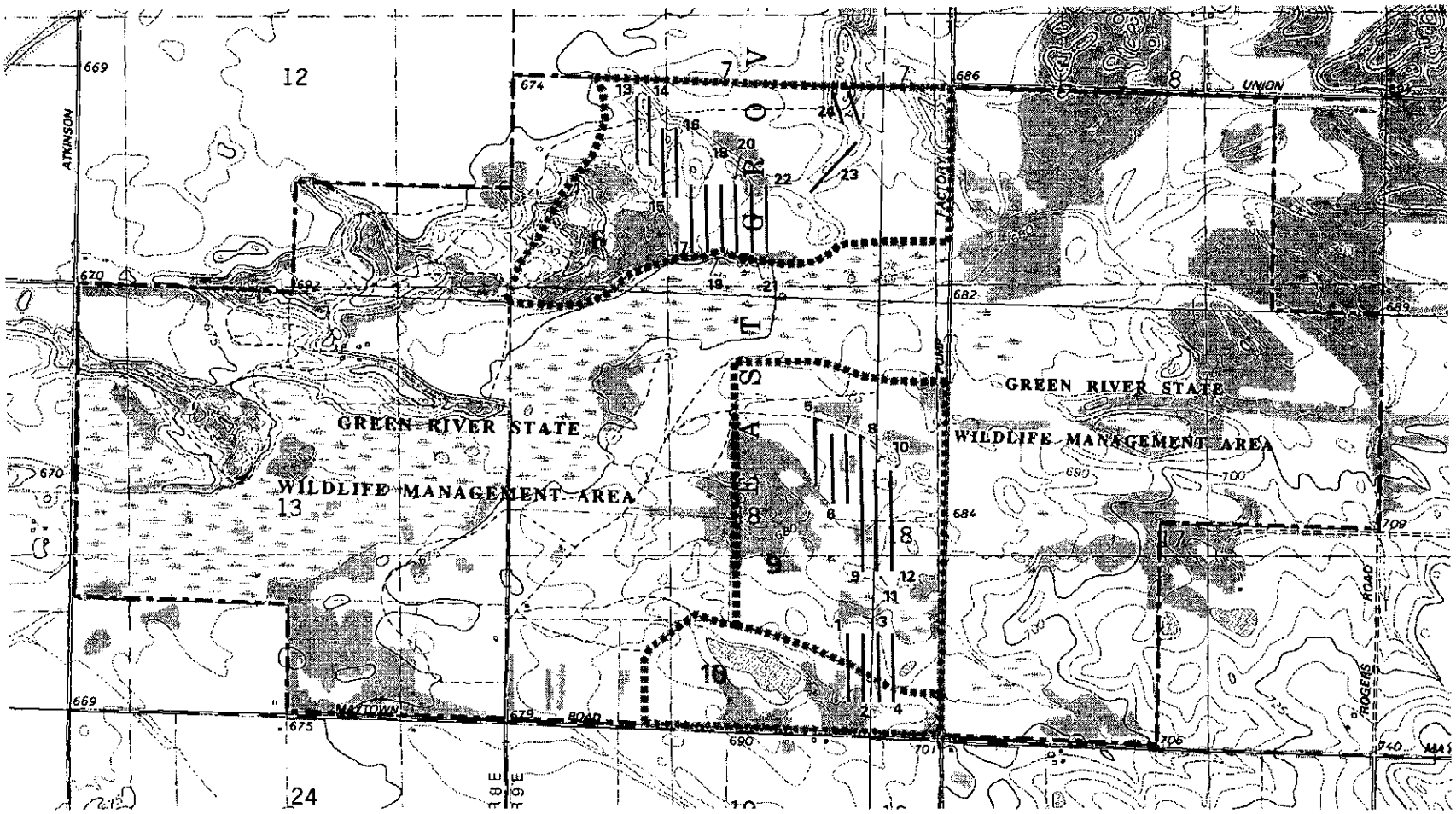
Table 9. Frequency (%), relative frequency, relative cover, and importance values of the species encountered along line transects in poor quality dry to dry-mesic sand prairie in prescribed burn unit # 6, Green River State Wildlife Area, Lee County, Illinois. (PLOTS 121 to 240)

Species	Frequency %	Relative Frequency	Relative Cover	Importance Value
Ambrosia psilostachya	78.0	14.7	20.1	34.8
Rhus aromatica	30.0	5.7	11.6	17.3
Poa pratensis	25.0	4.8	12.0	16.8
Panicum villosissimum	49.0	9.4	6.7	16.1
Bromus inermis	29.0	5.5	6.0	11.5
Schizachyrium scoparium	13.0	2.5	8.1	10.6
Euphorbia corollata	29.0	5.4	4.8	10.2
Sorghastrum nutans	10.0	2.0	5.9	7.9
Carex tonsa	20.0	3.7	3.8	7.5
Leptoloma cognatum	19.0	3.7	3.2	6.9
Achillea millefolium	22.0	4.1	2.0	6.1
Heterotheca camporum	14.0	2.6	3.1	5.7
Equisetum laevigatum	17.0	3.3	0.3	3.6
Rumex acetosella	18.0	3.4	0.2	3.6
Conyza canadensis	13.0	2.4	0.3	2.7
Tephrosia virginiana	3.0	0.5	2.1	2.6
Asclepias verticillata	13.0	2.4	0.1	2.5
Cyperus schweinitzii	10.0	2.0	0.5	2.5
Rosa carolina	11.0	2.2	0.3	2.5
Amorpha canescens	4.0	0.8	1.6	2.4
Euthamia graminifolia	7.0	1.3	1.0	2.3
Paspalum bushii	9.0	1.7	0.6	2.3
Sporobolus cryptandrus	11.0	2.0	0.2	2.2
Brickelia eupatorioides	8.0	1.5	0.1	1.6
Aster pilosus	3.0	0.5	0.7	1.2
Eragrostis spectabilis	2.0	0.3	0.8	1.1
Carex muhlenbergii	5.0	0.9	0.1	1.0
Carex pensylvanica	1.0	0.1	0.9	1.0
Lespedeza capitata	5.0	0.9	0.1	1.0
Chenopodium standleyanum	4.0	0.8	0.1	0.9
Solidago nemoralis	4.0	0.8	--	0.8
Toxicodendron radicans	1.0	0.3	0.4	0.7
Coreopsis lanceolata	1.0	0.3	0.3	0.6
Senecio plattensis	2.0	0.4	0.2	0.6
Oenothera rhombipetala	3.0	0.5	--	0.5
Cyperus filiculmis	2.0	0.4	--	0.4
Parthenocissus quinquefolia	1.0	0.1	0.3	0.4
Penstemon sp.	2.0	0.3	0.1	0.4
Polygonum tenue	2.0	0.3	0.1	0.4
Antennaria plantaginifolia	1.0	0.1	0.2	0.3
Lactuca canadensis	1.0	0.3	--	0.3
Liatris aspera	1.0	0.2	0.1	0.3
Lithospermum caroliniense	1.0	0.2	0.1	0.3
Melilotus alba	2.0	0.3	--	0.3
Rudbeckia hirta	2.0	0.3	--	0.3

Table 9 -- continued

Solidago gigantea	1.0	0.2	0.1	0.3
Spartina pectinata	1.0	0.2	0.1	0.3
Taraxacum officinale	1.0	0.3	--	0.3
Vitis riparia	1.0	0.2	0.1	0.3
Agrostis hyemalis	1.0	0.1	0.1	0.2
Aristida basiramea	1.0	0.2	--	0.2
Helianthemum bicknellii	1.0	0.1	0.1	0.2
Nepeta cataria	1.0	0.2	--	0.2
Phytolacca americana	1.0	0.1	0.1	0.2
Sanicula canadensis	1.0	0.1	0.1	0.2
Solanum carolinense	1.0	0.1	0.1	0.2
Stipa spartea	1.0	0.1	0.1	0.2
Andropogon gerardii	1.0	0.1	--	0.1
Asclepias amplexicaulis	1.0	0.1	--	0.1
Bidens bipinnata	1.0	0.1	--	0.1
Botrychium dissectum	1.0	0.1	--	0.1
Erigeron strigosus	1.0	0.1	--	0.1
Fragaria virginiana	1.0	0.1	--	0.1
Geum canadense	1.0	0.1	--	0.1
Gnaphalium obtusifolium	1.0	0.1	--	0.1
Hieracium longipilum	1.0	0.1	--	0.1
Lithospermum incisum	1.0	0.1	--	0.1
Oxalis dillenii	1.0	0.1	--	0.1
Parthenocissus inserta	1.0	0.1	--	0.1
Physalis virginiana	1.0	0.1	--	0.1
Plantago rugelii	1.0	0.1	--	0.1
Poa compressa	1.0	0.1	--	0.1
Potentilla argentea	1.0	0.1	--	0.1
Potentilla simplex	1.0	0.1	--	0.1
Solanum dulcamara	1.0	0.1	--	0.1
Tragopogon dubius	1.0	0.1	--	0.1
Verbascum thapsus	1.0	0.1	--	0.1
Vicia villosa	1.0	0.1	--	0.1
Viola pratincola	1.0	0.1	--	0.1
Totals		100.0	100.0	200.0

Figure 1. Appromimate location of transect lines in burn units #9/10 (lines 01–12) and burn unit #6 (lines 13-24), Green River State Wildlife Area, Lee County, Illinois.



APPENDIX I. TREE AND LARGE SHRUB ENCROACHMENT AT THE GREEN RIVER STATE WILDLIFE AREA, LEE COUNTY, ILLINOIS

Aerial photographs from 1939, 1951, 1970, and 1988 were digitized to demonstrate woody encroachment (tree & large shrub) at the Green River State Wildlife Area (GRSWA), Lee County, Illinois. These aerial photographs were borrowed from the University of Illinois Map Library and scanned with a Microtek ScanMaker. Twenty-one stratified random 5 hectare sites, approximately 10.1156% of the GRSWA (Figure 1), were interpreted and then digitized using ARC/INFO.

Data interpretation was difficult depending on the quality and resolution of the original photos, problems with registering the photos, and problems with the interpretation of the data, specifically differentiating between trees and other features which show up as black or dark gray such as shadows and wet areas. The 1939, 1951, and 1970 aerial photographs were all flown in August while the 1988 aerial was flown in April.

In 1939, one year after the initial purchase of the land for the GRSWA, approximately 47.5 ha or 4.6% of the present area was covered by trees and large shrubs (Table 1). These species have increased dramatically, in 1951 there was approximately 72.2 ha or 7% cover, in 1970 approximately 184.9 ha or 17.8%, and in 1988 approximately 294.6 ha or 28.4%. This is a dramatic increase of 247.1 ha in 49 years.

Trees and large shrubs, from 1939 (4.6% cover) to 1988 (28.4% cover), have significantly increased at the GRSWA. This woody encroachment is most obvious where hedge rows and pine plantations have been introduced.

Table 1. Cover (ha) of trees and large shrubs within 21, 5 hectare, stratified random sites digitized from aerial photography during four years (1939, 1951, 1970, & 1988) within the Green River State Wildlife Area, Lee County, Illinois.

5 hectare sites	1939 (ha)	1951 (ha)	1970 (ha)	1988 (ha)
1	0.0	0.2	0.9	2.2
2	0.0	0.0	1.0	1.2
3	2.8	2.2	3.8	3.4
4	0.2	0.1	0.8	1.0
5	0.0	0.3	0.9	1.7
6	0.0	0.0	0.3	0.4
7	0.1	0.5	0.3	1.9
8	0.0	0.1	0.5	1.6
9	0.0	0.1	0.8	0.9
10	0.4	0.5	0.2	1.6
11	0.0	0.1	0.1	0.8
12	0.0	0.3	0.1	0.4
13	0.1	0.1	2.9	3.9
14	0.4	0.2	0.3	1.3
15	0.3	0.2	0.6	0.8
16	0.1	0.2	1.0	1.7
17	0.0	0.8	1.3	1.6
18	0.0	0.3	1.6	1.6
19	0.4	1.1	0.9	1.1
20	0.0	0.0	0.4	0.7
21	0.0	0.0	0.0	0.0
Totals	4.8	7.3	18.7	29.8

Figure 1. Location of the 21 5-hectare, stratified random sites used for tree/tall shrub vegetation analysis from aerial photography, Green River State Wildlife Area, Lee County, Illinois.