

Vegetation of Prairie Restorations at the Prairie Ridge State Natural Area, Jasper County, Illinois

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ABSTRACT

Four prairie restoration sites were studied at the Prairie Ridge State Natural Area in Jasper County, Illinois. The first restoration was planted in 1967, the last in 1997. All sites were dominated by native grasses, *Sorghastrum nutans* Nash (Indian grass) and *Andropogon gerardii* Vitman (big bluestem) being the most important with *Schizachyrium scoparium* (Michx.) Nash (little bluestem) occurring on two sites. *Solidago canadensis* L. (tall goldenrod), *S. nemoralis* Ait. (field goldenrod) and *Euthamia graminifolia* (L.) Salisb. (grass-leaved goldenrod) were the common perennial forbs. Plant species diversity was not particularly high, ranging from 53 to 92 taxa, of which 10% to 18% were adventive species. The floristic quality index varied from 18.8 to 26.1, with no conservative prairie taxa being encountered on the sites.

INTRODUCTION

Tallgrass prairie was once common throughout the central United States and adjacent Canada. Almost no original prairie remains in Illinois where more than 61% of the land was once covered by prairie vegetation (Iverson et al. 1991). Now numerous attempts have been made to recreate or restore prairie communities in Illinois (McClain 1986, 1997; Packard and Mutel 1997).

As agricultural practices became more intense during the first half of the twentieth century, the greater prairie chicken (*Tympanuchus cupido*) population underwent a precipitous decline (Simpson 1998). The Prairie Ridge State Natural Area (PRSNA) had its origin with the establishment of the Prairie Chicken Foundation in 1959, with the goal of saving the declining Illinois' population of the greater prairie chicken. Land purchases for the PRSNA began in 1962 when the Prairie Chicken Foundation, The Nature Conservancy, and the Illinois Department of Natural Resources purchased property to protect a small population of the greater prairie chicken (Sanderson et al. 1973, McFall and Karnes 1995).

The PRSNA is presently 1,100 ha in size and is managed by the Illinois Department of Natural Resources. The PRSNA now consists of many diverse habitats, including wet-

lands, native grasslands, and introduced grasslands (Simpson 1998). Currently 17 state endangered and eight state threatened taxa are known from the PRSNA (Herkert 1992, Simpson and Esker 1997, Simpson 1998).

Since the original purchase, many tracts of land have been purchased and incorporated into the PRSNA. All of the purchases were of cultivated lands which were left fallow, or planted into grasslands to create habitat for the greater prairie chicken. Some sites were planted to cool-season, non-native grasses, others to various mixtures of native prairie species with a dominance of grass taxa. The present study was undertaken to quantify the differences in plant species composition and abundance at four different aged prairie restoration sites at the PRSNA.

METHODS

The PRSNA was visited weekly during the growing season of 1998 and occasionally in 1999 and 2000 to record the presence and abundance of the vascular plant species found at each of four restoration sites (Kessler 2000). Voucher specimens of all species observed were collected and deposited in the Stover- Ebinger herbarium of Eastern Illinois University, Charleston, Illinois (EIU). Nomenclature follows Mohlenbrock (1986). The species encountered are listed in Appendix I.

During mid-summer of 1998 a 50 m line transect was established near the center line of the long axis of each study site. Along each transect, 1/4 m² quadrats were randomly located at one meter intervals, odd numbered quadrats to the right, even numbered quadrats to the left. A random numbers table was used to determine the number of meters the quadrats were located from the transect line (0-9). Percent cover was determined using the Daubenmire (1959) cover class system as modified by Bailey and Poulton (1968) (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%). The importance value (IV) for each taxon was determined for each study site by summing relative cover and relative frequency.

The Floristic Quality Index (FQI) was determined for each site using the coefficient of conservatism (CC) assigned to each species by Taft et al. (1997). The FQI is a weighted index of species richness (N), and is the arithmetic product of the average coefficient of conservatism (CC), multiplied by the square root of the species richness (\sqrt{N}) of an inventory site [FQI = mean CC (\sqrt{N})]. The Sorensen Index of Similarity (ISs) (Mueller-Dombois and Ellenberg 1974) was used to determine the degree of similarity between the study sites [ISs = $2C/(A+B) \times 100$].

DESCRIPTION OF THE PRSNA AND THE STUDY SITES

The PRSNA is located in Jasper County, Illinois, near the middle of the Effingham Section of the Southern Till Plain Natural Division (Schwegman 1973). Prior to settlement by European man, tallgrass prairie dominated 64% of Jasper County; currently 84% of the land is devoted to agriculture and 5% is woodland, the original prairie restricted primarily to railroad rights-of-way (Barmstedt 1992).

The study sites include four separate restored prairies scattered throughout the PRSNA in Jasper County. All sites were cultivated, and after purchase were planted to native prairie grasses. Sites have been maintained by occasional burns, mowing, and grazing. The soils in the study area are composed of Illinois glacial till overlain with loess deposits (Willman et al. 1975). Two soil types occur on the study sites, the Hoyleton silt loam and the Cisne silt loam (Barmstedt 1992). These grayish brown soils have a high clay content, poor drainage, moderately low organic content, and occur on level to near level ground. The surface layer is friable and about 20 cm thick, the subsoil is a silty clay loam, mottled, firm, and 100-150 cm thick.

Lew's Prairie

Approximately 2 ha, this site was planted to prairie grasses in 1967, but no information is available on the type of seed used. The site was burned in 1984, 1991, 1995, and 1999, mowed in 1983, 1986, 1987, 1992, and 1993, and hayed in 1985.

McGraw Sanctuary (southwest corner)

Approximately 1.6 ha, this site was planted in May 1989. Seed source was from a surrounding site that probably contained Ramsey Indian Grass and Kaw Big Bluestem. No forbs were added. The site was cut for seed in 1989, burned in 1990, 1992, and 1995, and hayed in 1996.

Galbreath Sanctuary - Field B

Approximately 2.4 ha, this field was planted in May 1991. The seed was a little bluestem mix from Walnut, Lee County, Illinois to which two pounds of mixed forb seed was added. This portion of Galbreath Sanctuary was burned in 1993, 1994, 1997, and 2000, mowed in 1991 and 1995, and cut for seed in 1997, 1998, and 1999.

Frohning Farm

Approximately 4 ha, this site was planted on 19 May 1997. The seed mix was a Missouri ecotype of big bluestem plus forbs.

RESULTS

The prairie restorations vary from 1.6 to 4 ha in size and with 53 to 92 plant taxa, of which adventive species accounted for between 10.2 and 18.8% of the species found (Table 1). There was very little correlation between site age and species diversity, the 1991 restoration have higher species diversity than sites established in 1967 and 1989. This is reflected in the higher number of perennial grasses and forbs at this site, as well as the higher FQI (28.6) and mean CC (3.26). The FQI of the four restorations using only native taxa, ranged from 20.6 to 28.6 with a mean CC of 2.94 to 3.26.

All sites were dominated by native grasses, *Sorghastrum nutans* Nash (Indian grass) and *Andropogon gerardii* Vitman (big bluestem) being the most important with *Schizachyrium scoparium* (Michx.) Nash (little bluestem) occurring on two sites (Table 2). *Solidago canadensis* L. (tall goldenrod), *S. nemoralis* Ait. (field goldenrod), *Euthamia graminifolia* (L.) Salisb. (grass-leaved goldenrod), and *Vernonia missurica* Raf. (Missouri ironweed) were the common perennial forbs, while *Rubus flagellaris* Willd. (dew-berry) was the most important woody species. The few exotic species encountered

mostly occurring in low numbers. The adventive *Setaria faberi* Herrm. (giant foxtail) was third in importance in the 1997 restoration, while *Achillea millefolium* L. (common yarrow) was occasionally encountered on the other sites.

DISCUSSION

Native perennial grasses were the most obvious taxa of the restoration sites. This high grass component would be expected, as all planting used a grass mixture containing Indian grass, big bluestem, and little bluestem. The only restoration site with a low IV of native grasses was Lew's Prairie. This site is somewhat degraded. Salt run-off from adjacent oil wells and tanks could have had some effect on the grasses, resulting in an increase in tall goldenrod, field goldenrod, and grass-leaved goldenrod (Table 2).

All of the restoration sites have many species in common as indicated by a similarity index ranging from 45.7 to 67.4 (Table 3). The site with the lowest similarity index is Frohning Farm. Planted in 1997, this site does not have many of the perennial forbs common to the other sites.

Many species with high IV's were found on three or more of the sites. The top three of these species, Indian grass, big bluestem and tall goldenrod, were recorded for all four sites, while field goldenrod, grass-leaved goldenrod, dewberry, Missouri ironweed, and *Eleocharis verrucosa* were found on three of the four sites, not occurring in the plots on Frohning Farm.

There was very little correlation between age of the restored site and quality. Many variables existed between sites, such as seed source, number of burns, and other maintenance practices. Lew's Prairie, the oldest site ranked second in similarity to Galbreath Sanctuary, the third oldest of the sites. Lew's Prairie had an FQI of 25.4 compared to an FQI of 28.6 for Galbreath Sanctuary. This is probably because Galbreath Sanctuary had a more diverse seed source, more burns, and less chances for invasion by problem exotics. Galbreath Sanctuary is also situated between other natural areas, while the other restorations are surrounded by agricultural land. The availability of native seed from surrounding areas probably helped to increase the diversity. McGraw Sanctuary, the second oldest site, placed fourth with an FQI of 20.6, and the lowest species diversity (Table 1). This site was planted in grasses; no forb seed was added; and there was no close seed source for native perennials, resulting in a low diversity and therefore a lower FQI. As expected, Frohning Farm had a low FQI (21.4), being planted in 1997. This site will require several years of management to increase species diversity.

Most of the species encountered on the restoration sites were recorded by Edgin and Ebinger (2000) for a successional prairie community at the PRSNA. This prairie was a fallow field at the time of purchase in 1973. Other than prescribed burns, no management was undertaken, and no seeds or root stock introduced. Seed originating from a nearby cemetery prairie and a roadside were probably responsible for the present diversity where 134 native taxa were found. At this site the FQI was 39.4; the mean CC was 3.40, with 10 adventive taxa, and a few conservative prairie species present.

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Appendix 1. Summary of vascular flora at PRSNA

A consolidated list of the vascular flora observed on the restored prairie sites at Prairie Ridge State Natural Area, Jasper County, Illinois in 1998, 1999, and 2000. Families, genera, and species are arranged alphabetically. Nomenclature generally follows Mohlenbrock (1986). Taxa that are introduced are preceded by an asterisk. Collection numbers for voucher specimens are in brackets. Collections made by Bob Edgin are preceded by E; collections made by Tucker are preceded by T; collections without a prefix are those of Kessler. All specimens are deposited at EIU; some duplicates are at ILLS.

MONOCOTYLEDONEAE (LILIOPSIDA)

COMMELINACEAE: *Tradescantia virginiana* L. [371]

CYPERACEAE: *Carex blanda* Dewey [242], *C. bushii* Mack. [249], *C. cephalophora* Willd. [245], *C. cristatella* Britton & Brown [296], *C. hirsutella* Mack. [216], *C. scoparia* Willd. [275], *C. vulpinoidea* Michx. [285]; *Cyperus acuminatus* Torr. & Hook. [430], *C. esculentus* L. [312], *C. echinatus* (L.) A. Wood [338], *C. strigosus* L. [355]; *Eleocharis verrucosa* (Svens.) Harms [215]; *Scirpus georgianus* Harper [238]

JUNCACEAE: *Juncus acuminatus* Michx. [250], *J. biflorus* Ell. [359], *J. brachycarpus* Engelm. [374], *J. interior* Wieg. [353], *J. torreyi* Coville [323]; *Luzula multiflora* (Retz.) Lejeune var. *echinata* (Small) F.J. Herm. [observed]

LILIACEAE: *Camassia scilloides* (Raf.) Cory [218]; **Yucca flaccida* Haw [T12377]

POACEAE: *Agrostis alba* L. [326]; *A. hyemalis* (Walt.) BSP. [259], *Alopecurus carolinianus* Walt. [212]; **A. pratensis* L. [201]; *Andropogon gerardii* Vitman [E473]; **Bromus commutatus* Schrad. [266]; **Echinochloa crus-galli* (L.) Beauv. [409]; *Elymus canadensis* L. [T12329], *E. virginicus* L. [T12351]; **Festuca arundinacea* Schreb. [241], **F. pratensis* Hudson [258]; *Muhlenbergia glabriflora* Scribn. [T12378]; *Panicum capillare* L. [396], *P. lanuginosum* Ell. [434], *P. virgatum* L. [397]; *Paspalum ciliatifolium* Michx. [429], *P. laeve* Michx. [425]; **Phleum pratense* L. [335]; **Poa compressa* L. [239]; *Schizachyrium scoparium* (Michx.) Nash. [440]; **Setaria faberi* Herrm. [426]; *Sorghastrum nutans* (L.) Nash [408]

DICOTYLEDONEAE (MAGNOLIOPSIDA)

ACANTHACEAE: *Ruellia humilis* Nutt. [348]

ANACARDIACEAE: *Rhus glabra* L. [358]; *Toxicodendron radicans* (L.) Kuntze [T12349]

APIACEAE: *Cicuta maculata* L. [observed]; *Eryngium yuccifolium* Michx. [365]

APOCYNACEAE: *Apocynum cannabinum* L. [T12326]

ASCLEPIADACEAE: *Asclepias hirtella* (Pennell) Woodson [363], *A. incarnata* L. [393], *A. syriaca* L. [331], *A. verticillata* L. [400]

ASTERACEAE: **Achillea millefolium* L. [222]; *Ambrosia bidentata* Michx. [418], *A. artemisifolia* L. [T12341]; *Aster pilosus* Willd. [observed]; *Bidens aristosa* (Michx.) Britt. [423]; *Boltonia asteroides* (L.) L'Hér. [T12343]; *Cirsium discolor* (Muhl.) Spreng. [E475]; *Conyza canadensis* (L.) Cronq. [T12350]; *Coreopsis palmata* Nutt. [301]; *Erechtites hieracifolia* (L.) Raf. ex DC. [T12337]; *Erigeron annuus* (L.) Pers. [T12338], *E. strigosus* Muhl. [290]; *Eupatorium perfoliatum* L. [412], *E. serotinum* Michx. [T12334]; *Euthamia graminifolia* (L.) Salisb. [T12366]; *Gnaphalium obtusifolium* L. [431]; *Helianthus grosseserratus* Martens [T12345], *H. mollis* Lam. [404]; *Lactuca canadensis* L. [T12348]; **L. serriola* L. [T12333]; **Leucanthemum vulgare* Lam. [309]; *Liatris pycnostachya* Michx. [381]; *Rudbeckia hirta* L. [289]; *Senecio glabellus* Poir. [209]; *Silphium terebinthinaceum* Jacq. [E448]; *Solidago canadensis* L. [E1065]; *Solidago juncea* Ait. [416], *S. nemoralis* Ait. [419], *S. rigida* L. [T12330]; **Sonchus asper* (L.) Hill [345]; *Vernonia missurica* Raf. [401]

BORAGINACEAE: *Myosotis verna* Nutt. [205]

BRASSICACEAE: **Barbarea vulgaris* R.Br. [204]; *Cardamine parviflora* L. [206]

CAESALPINACEAE: *Cassia fasciculata* Michx. [387]

CAMPANULACEAE: *Triodanis perfoliata* (L.) Nieuwl. [298]

CAPRIFOLIACEAE: **Lonicera japonica* Thunb. [254]; *Symphoricarpos orbiculata* (L.) Moench [T12379]

CARYOPHYLLACEAE: **Dianthus armeria* L. [235]

EUPHORBIACEAE: *Acalypha virginica* L. [369, 427]; *Euphorbia corollata* L. [437]

FABACEAE: *Baptisia lactea* (Raf.) Thieret [366]; *Desmodium paniculatum* (L.) DC. [414]; *Lespedeza capitata* Michx. [E463]; **Melilotus alba* Medic. [300]; *Strophostyles leiosperma* (Torr. & Gray) Piper [436]; **Trifolium hybridum* L. [376], **T. pratense* L. [311]

HYPERICACEAE: *Hypericum drummondii* (Grev. & Hook.) Torr. & Gray [343], *H. mutilum* L. [292, T12324], **Hypericum perforatum* L. [302], *Hypericum punctatum* Lam. [382]

LAMIACEAE: *Monarda fistulosa* L. [380]; **Prunella vulgaris* L. [389]; *Pycnanthemum tenuifolium* Schrad. [318]; *Teucrium canadense* L. [367]

LINACEAE: *Linum medium* (Planch.) Britton [403, T12344]

MIMOSACEAE: *Desmanthus illinoensis* (Michx.) MacM. [347]

MOLLUGINACEAE: **Mollugo verticillata* L. [T12335]

ONAGRACEAE: *Epilobium coloratum* Biehler [T12336]; *Gaura biennis* L. [406]; *Ludwigia alternifolia* L. [368]; *Oenothera biennis* L. [386]

OXALIDACEAE: *Oxalis dillenii* Jacq. [210], *O. violacea* L. [220]

PLANTAGINACEAE: **Plantago lanceolata* L. [316], *P. virginica* L. [261]

POLYGALACEAE: *Polygala sanguinea* L. [325], *P. verticillata* L. [314]

POLYGONACEAE: *Polygonum pensylvanicum* L. [407], *P. punctatum* Ell. [T12333], *P. tenue* Michx. [T12353]; **Rumex acetosella* L. [E358], **R. crispus* L. [247]

PORTULACACEAE: *Claytonia virginica* L. [207]

ROSACEAE: *Fragaria virginiana* L. [221]; *Malus ioensis* (Wood) Britt. [T12347]; *Potentilla simplex* Michx. [219], **P. recta* L. [291]; *Rosa carolina* L. [357]; *Rubus flagellaris* Willd. [214]

RUBIACEAE: *Galium aparine* L. [211], *G. obtusum* Bigel. [225]

SCROPHULARIACEAE: *Agalinis purpurea* (L.) Pennell [T12340]; *Gratiola neglecta* Torr. [255]; *Lindernia dubia* (L.) Pennell var. *anagallidea* (Michx.) Cooperrider [T12325]; *Mimulus ringens* L. [391]; *Penstemon digitalis* Nutt. [229]; *P. pallidus* Small [236]

SOLANACEAE: *Solanum carolinense* L. [362]

VERBENACEAE: *Verbena hastata* L. [332]

VIOLACEAE: *Viola praticola* Greene [438]

Table 1. The year planted, size (ha), number of taxa present, Floristic Quality Index (FQI), and mean Coefficient of Conservatism (CC) on the four prairie restoration sites studied at the Prairie Ridge State Natural Area, Jasper County, Illinois.

Parameters	Lew's	McGraw	Galbreath	Frohning
Year Planted	1967	1989	1991	1997
Size (ha)	2.0	1.6	2.4	4.0
Total Species	80	53	92	59
Native Species	65	44	77	53
% Adventive Species	18.8	17.0	16.3	10.2
Perennial Forbs	36	17	42	25
Perennial Grasses	8	6	12	6
FQI (native taxa)	25.4	20.6	28.6	21.4
Mean CC (native taxa)	3.15	3.11	3.26	2.94
FQI (all taxa)	22.9	18.8	26.1	20.3
Mean CC (all taxa)	2.56	2.58	2.72	2.64

Table 2. Importance values of the species encountered in the four prairie restoration sites studied at the Prairie Ridge State Natural Area, Jasper County, Illinois.

Species	Lew's	McGraw	Galbreath	Frohning
<i>Sorghastrum nutans</i>	20.50	38.71	22.68	94.89
<i>Andropogon gerardii</i>	11.04	48.66	31.27	80.45
<i>Solidago canadensis</i>	43.20	12.74	0.82	7.83
<i>Solidago nemoralis</i>	14.30	16.67	33.42	--
<i>Euthamia graminifolia</i>	22.00	4.76	17.85	--
<i>Rubus flagellaris</i>	23.60	3.16	5.38	--
<i>Vernonia missurica</i>	15.15	0.80	7.42	--
<i>Carex</i> spp.	--	11.14	11.86	--
<i>Eleocharis verrucosa</i>	1.59	9.58	10.18	--
<i>Schizachyrium scoparium</i>	--	16.49	2.38	--
<i>Pycnanthemum tenuifolium</i>	17.29	--	0.42	--
<i>Cassia fasciculata</i>	10.66	3.19	--	--
<i>Panicum virgatum</i>	--	1.11	2.52	--
<i>Setaria faberi</i>	--	--	0.43	11.03
<i>Cyperus strigosus</i>	--	9.46	1.67	--
<i>Achillea millefolium</i>	5.30	--	4.26	--
<i>Euphorbia corollata</i>	0.53	--	7.07	--
<i>Hypericum perforatum</i>	--	0.80	5.90	--
<i>Panicum lanuginosum</i>	0.53	--	5.90	--
<i>Potentilla simplex</i>	1.59	--	4.26	--
<i>Asclepias syriaca</i>	--	--	--	5.79
<i>Verbena hastata</i>	--	4.76	--	--
<i>Malus ioensis</i>	--	--	4.23	--
<i>Scirpus georgianus</i>	--	3.99	--	--
<i>Desmodium paniculatum</i>	3.80	--	--	--
<i>Acalypha virginica</i>	--	0.80	2.95	--
<i>Lonicera japonica</i>	0.53	--	2.52	--
<i>Oxalis dillenii</i>	--	--	2.98	--
<i>Rosa carolina</i>	--	--	2.89	--
<i>Lespedeza capitata</i>	2.15	--	0.43	--
<i>Cyperus echinatus</i>	--	--	2.55	--
<i>Baptisia lactea</i>	--	--	2.38	--
<i>Prunella vulgaris</i>	2.15	--	--	--
<i>Eryngium yuccifolium</i>	--	1.60	--	--
<i>Liatris pycnostachya</i>	1.09	--	--	--
<i>Cirsium discolor</i>	1.09	--	--	--
<i>Ambrosia bidentata</i>	1.06	--	--	--
<i>Viola pratincola</i>	--	--	0.85	--
<i>Oenothera biennis</i>	--	--	0.82	--
<i>Barbarea vulgaris</i>	--	0.80	--	--
<i>Hypericum mutilum</i>	--	0.80	--	--
<i>Paspalum laeve</i>	--	--	0.43	--
<i>Rumex acetocella</i>	--	--	0.43	--
<i>Sassafras albidum</i>	--	--	0.43	--
<i>Linum medium</i>	--	--	0.42	--
Totals	200.00	200.00	200.00	200.00

Table 3. Similarity index of the four prairie restoration sites studied at the Prairie Ridge State Natural Area, Jasper County, Illinois.

	Lew's	McGraw	Galbreath
McGraw	63.2		
Galbreath	67.4	56.6	
Frohning	45.7	47.8	48.7
