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FLORISTIC DIVERSITY IN TEN TALLGRASS PRAIRIE REMNANTS OF EASTERN NEBRASKA

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ABSTRACT

Ten eastern Nebraska tallgrass prairie remnants, varying in size from one to 18 ha, were studied or visited during the growing seasons from 1979 to 1993. A total of 217 prairie plant species were recorded. Big bluestem (*Andropogon gerardii*), little bluestem (*Andropogon scoparius*), smooth brome (*Bromus inermis* subsp. *inermis*), New Jersey tea (*Ceanothus herbaceus* var. *pubescens*), false sunflower (*Heliopsis helianthoides* var. *scabra*), Kentucky bluegrass (*Poa pratensis*), and porcupine-grass (*Stipa spartea*) were prevalent in all the prairies although the specific floristic composition has been reported to vary depending on past management, topography, season of evaluation, and prairie size. Of the total species recorded, 13.8% (30 of 217) were non-native with Kentucky bluegrass (average frequency = 99%), Japanese brome (*Bromus japonicus*) (32%), smooth brome (30%), and red clover (*Trifolium pratense*) (27%) the most frequent. This study provides baseline information against which future studies can be compared.

† † †

Prior to European settlement of eastern Nebraska in the mid-1800s, the region consisted primarily of true or tallgrass prairie (Weaver, 1965). Big and little bluestem (*Andropogon gerardii* Vitm. and *A. scoparius* Michx.) dominated the community, together constituting more than 75% of the vegetation (Weaver 1965). Lowlands were predominately big bluestem (80–90%) with smaller amounts of indiagrass (*Sorghastrum nutans* (L.) Nash), little bluestem, and switchgrass (*Panicum virgatum* L.). In the wettest lowlands, reed canary grass (*Phalaris arundinacea* L.) and prairie cordgrass (*Spartina pectinata* Link) were also important species. Upland, more xeric prairies, were dominated by little bluestem with varying amounts of junegrass (*Koeleria pyramidata* (Lam.) Beauv.), porcupine-grass (*Stipa spartea* Trin.), rough dropseed (*Sporobolus asper* (Michx.) Kunth), side-oats grama (*Bouteloua curtipendula* (Michx.) Torr.). On lower and

middle slopes, the bluestems intermingled in about equal amounts. Although believed to be non-native (Cronquist et al. 1977), Kentucky bluegrass (*Poa pratensis* L.) was frequent in upland and lowland prairies. The spread of this species is attributed to its introduction by European settlers and the suppression of naturally caused prairie fires which are destructive to it (Weaver, 1965). Notable is the absence of smooth brome (*Bromus inermis* Leyss. subsp. *inermis*) from Weaver's observations.

Since European settlement, however, much of the tallgrass prairie in eastern Nebraska has been reduced to scattered remnants, primarily as a consequence of extensive cultivation and development. The fragmentation and reduction in size of the tallgrass prairie ecosystem has resulted in a loss of critical habitat for many organisms as well as a loss of some portion of the native gene pool (Wagner, 1975). Weaver (1965), for example, recorded up to 250 species of prairie plants in lowlands and 200 in uplands. Boettcher and Bragg (1989), however, recorded only 153 species in upland prairie remnants in Douglas and Sarpy counties of eastern Nebraska, although their sites were not those evaluated by Weaver.

The objective of this paper is to indicate the species present in eastern Nebraska prairie remnants circa 1979–1993. This information will provide a baseline data set, for a relatively narrowly defined region, to which future evaluations can be compared. Among other purposes, such comparisons will allow us to assess the effectiveness of management of native prairie remnants, particularly those intended to be managed to maintain the natural diversity of the tallgrass prairie ecosystem.

METHODS

Study sites

The principal study on which this paper is based was conducted in 1979 (Boettcher, 1981). A survey of east-central Nebraska counties resulted in the selection of ten sites, nine in Douglas and one in Sarpy County (Table I). All prairies evaluated had a history of mowing, although the frequency of mowing varied from one to six or more times per growing season. Prairie size varied from one to 18 ha. Soils on all sites were deep, nearly level to steeply-sloping, silty loams or silty clay loams formed on loess (Boettcher, 1981; Bartlett, 1975).

Vegetation Records

Boettcher (1981) conducted both a floristic survey and a quantitative evaluation of species composition at each of the ten study sites. The floristic survey involved recording all species observed at each site. Procedures for the quantitative evaluation are detailed in Boettcher and Bragg (1989) but generally involved the

use of ten circular, 1-m² microplots systematically arranged along one 10-m transect, situated along each principal topographic location at each of ten prairie sites. A total of 21 such locations, referred to in this paper as "study areas," were evaluated by recording the canopy cover of each species (Daubenmire, 1959). Topographic locations included north-facing, south-facing, east-facing, and west-facing slopes as well as nearly level uplands or hilltops. Sampling was conducted three times during 1979; (1) May 30–June 6, (2) June 20–27, (3) July 30–August 13. Some sites were also evaluated a fourth time, September 22–30, depending on the time of mowing.

Other species were added to Boettcher's (1981) site listings based on (1) a survey of specimens from the University of Nebraska at Omaha herbarium, (2) subsequent research at the study sites, and (3) visits to the ten study sites made after 1979. Plant identifications were verified at the University of Nebraska at Omaha Herbarium (OMA). Common and scientific nomenclature follows the Great Plains Flora Association (1986).

Table I. Study site characteristics. N = north-facing slope, S = south-facing slope, E = east-facing slope, W = west-facing slope, H = hilltop, U = upland. Evaluations: 1 = May 30–June 6, 2 = June 20–27, 3 = July 30–August 13, 4 = September 22–30. Mowed frequently = 6 or more times per year.

Site No.	Prairie name ¹	Location	Size (ha)	Management	Topographic locations evaluated	Evaluation dates
1	Stolley	NW¼, Sec. 15, T15N, R11E, Douglas Co. Nebraska	8.5	Mowed in July	N, S, E	1, 2, 3
2	Bates-3	SE¼, SE¼, Sec. 20, T16N, R12E, Douglas Co.	1.2	Mowed in August	N	1, 2, 3
3	Bates-17	N½, NE¼, Sec. 20, T16N, R12E, Douglas Co.	6.9	Mowed in August	N, S, H	1, 2, 3
4	Hwy-36	NE¼, NE¼, SW¼, Sec. 14, T16N, R12E, Douglas Co.	2.0	Mowed in August	N, S, H	1, 2, 3
5	Radar	NE¼, NE¼, NW¼, Sec. 14, T16N, R 12E, Douglas Co.	2.0	Mowed frequently	N, S	1, 2, 3, 4
6	Jensen/King	SE¼, SW¼, Sec. 12, T16N, R12E, Douglas Co.	2.4	Mowed in June	S, H	1, 2, 3, 4
7	Long	NE¼, NW¼, Sec. 19, T16N, R13E, Douglas Co.	4.9	Mowed in July	S	1, 2, 3, 4
8	Millard	SW¼, SE¼, Sec.14, T15N, R11E, Douglas Co.	2.0	Mowed frequently	U	1, 2, 3, 4
9	Hover	NW¼, NE¼, Sec. 28, T14N, R13E, Sarpy Co.	4.9	Mowed in August	W	1, 2, 3
10	Bauermeister	NE¼, W½, Sec. 3, T14N, R11E, Douglas Co.	18.2	Mowed in late August	N, E, W, H	1, 2, 3, 4

¹For convenience, names were assigned based on ownership or location.

RESULTS AND DISCUSSION

For the ten study sites, a total of 153 species were recorded by Boettcher (1981) of which 96 were found within study plots and quantitatively evaluated (Tables II and III). An additional 64 species were subsequently added to Boettcher's species lists from Abbadi (1993), Bragg (1991), Hickey (1992), Hover (1979), Sambol (1981) as well as from reports and surveys by Tanya Bray and specimens contributed by Steven Lamphere and students from flora classes.

Boettcher and Bragg (1989), using canopy cover data from May–August evaluations, found eight species to be abundant in all study sites. Of these, big bluestem was the most prevalent. It occurred in all 21 study areas, with the highest canopy cover. It also averaged highest in canopy cover (47%) for combined data from all areas. Kentucky bluegrass, a common, non-native, cool-season grass, also occurred in all study areas although it dominated canopy cover in only two (average canopy cover = 29%). Porcupine-grass (average canopy cover = 16%), a native, cool-season grass, dominated canopy cover in five areas and was present at all sites except one in which smooth brome canopy cover was highest. Other species that were common to all sites included little bluestem (11% cover), false sunflower (*Heliopsis helianthoides* (L.) Sweet var. *scabra* (Dun.) Fern.) (5% cover), and New Jersey Tea (*Ceanothus herbaceus* Raf. var. *pubescens* (T. & G.) Shinn.) (9% cover), lead plant (*Amorpha canescens* Pursh) (10% cover) and white aster (*Aster ericoides* L.) (3%) although they were not dominants, as determined by either canopy cover or frequency.

Of the total number of species recorded, 13.8% (30 of 217) were non-native. Kentucky bluegrass (average frequency for all sites = 99%), Japanese brome (*Bromus japonicus* Thunb. ex Murr.) (32%), smooth brome (30%),

and red clover (*Trifolium pratense* L.) (27%) occurred most frequently in plots at all sites. Additional non-native species with a frequency of more than 50%, but only this frequent in a few study areas, were yellow sweet clover (*Melilotus officinalis* (L.) Pall.), common dandelion (*Taraxacum officinale* Weber), goat's beard (*Tragopogon dubius* Scop.), yellow foxtail, (*Setaria glauca* (L.) Beauv.). Smooth brome, an aggressive, introduced cool-season grass, was found in all prairies, even dominating a frequently-mowed site. The ubiquitous occurrence of this species, or even its presence, was not observed in prairies ca. 1930–1959 (Weaver and Fitzpatrick, 1934; Weaver, 1954, 1965, 1968). The frequent occurrence of smooth brome in extant prairies is of particular concern since it indicates the aggressive movement of this undesirable European grass into native prairies where its effects on native plants and animals are not yet known. Field observations, for example, suggest that smooth brome causes a decline in the number and vigor of many native prairie plants. Extensive planting of smooth brome, particularly along highways and in pastures, may account for its rapid expansion since the 1950s.

During the 60 years since Weaver's first reports (Weaver, 1954, 1965, 1968; Weaver and Fitzpatrick, 1934), there appears to have been both a general decline in the total number of native species and an increase in introduced species. Kentucky bluegrass, smooth brome, Japanese brome, and red clover are all more common than previously indicated (Weaver and Fitzpatrick, 1934). A direct comparison with Weaver's studies, however, is not feasible because of the broad area covered in his reports, which often combined information from as many as six states (Weaver, 1968). Differences between the present and past prairies, however, are not unexpected since different management is likely to affect plant species composition in native prairies (Boettcher and Bragg, 1989).

Table II. Numbers of taxa encountered in sampling plots (Boettcher, 1981) and total numbers of taxa known from the ten prairies studied. Locations of sites are given in Table I.

	Study sites										All sites
	1	2	3	4	5	6	7	8	9	10	
No. of taxa in plots	62	47	63	62	34	56	44	50	36	69	96
No. of taxa known	165	59	68	75	40	67	72	104	101	121	217
No. of non-native taxa	20	6	5	10	10	7	8	14	11	12	30
Percentage of non-native taxa	12.1	10.2	7.4	13.3	25.0	10.4	11.1	13.5	10.9	9.9	13.8

Table III. Occurrence of taxa at the 10 prairie locations included in this study. Site information is given in Table I. An 'x' in italics indicates that a specimen from this prairie is present in the herbarium of the University of Nebraska at Omaha (OMA). Underlining indicates that the taxon appeared in at least one of the sampling plots at that study site and was quantitatively evaluated by Boettcher (1981). An asterisk following the name indicates a non-native species. Nomenclature follows Great Plains Flora Association (1986).

Taxa	Study Sites									
	1	2	3	4	5	6	7	8	9	10
<i>Abutilon theophrasti</i> *								x		x
<i>Achillea millefolium</i>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	x	<u>x</u>	x	<u>x</u>	<u>x</u>	<u>x</u>
<i>Agropyron intermedium</i> *	<i>x</i>									
<i>Agropyron smithii</i>	x									
<i>Agrostis stolonifera</i> *							x		x	
<i>Amaranthus retroflexus</i>	x									
<i>Ambrosia artemisiifolia</i>	x							x	x	x
<i>Ambrosia trifida</i>	x									
<i>Amorpha canescens</i>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>
<i>Andropogon gerardii</i>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>
<i>Andropogon scoparius</i>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>
<i>Anemone canadensis</i>		x								
<i>Anemone cylindrica</i>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>		x	x	<u>x</u>
<i>Antennaria neglecta</i>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>		<u>x</u>
<i>Apocynum cannabinum</i>	<i>x</i>									<i>x</i>
<i>Artemisia ludoviciana</i>	<i>x</i>					<u>x</u>	x	x	x	<i>x</i>
<i>Asclepias amplexicaulis</i>	<u>x</u>	<u>x</u>			<u>x</u>		<u>x</u>	<u>x</u>	x	<i>x</i>
<i>Asclepias syriaca</i>	<i>x</i>		<u>x</u>	<u>x</u>			<u>x</u>	<u>x</u>	x	<i>x</i>
<i>Asclepias tuberosa</i>				x		x		x	x	x
<i>Asclepias verticillata</i>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>
<i>Asclepias viridiflora</i>	x									
<i>Aster drummondii</i>									<i>x</i>	
<i>Aster ericoides</i>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>
<i>Aster laevis</i>	<i>x</i>	<i>x</i>						x	x	
<i>Aster oblongifolius</i>	<i>x</i>	<i>x</i>				x			<i>x</i>	x
<i>Aster oolentangiensis</i>	x							x	<i>x</i>	
<i>Aster pilosus</i>									<i>x</i>	
<i>Aster sagittifolius</i>								x		
<i>Aster sericeus</i>	<u>x</u>		<u>x</u>	<u>x</u>		<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>
<i>Aster simplex</i>	<i>x</i>								x	
<i>Astragalus canadensis</i>	x									<u>x</u>
<i>Astragalus crassicaarpus</i>	<u>x</u>		<u>x</u>			x		x	x	<u>x</u>
<i>Baptisia lactea</i>	<u>x</u>									x
<i>Bouteloua curtipendula</i>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>
<i>Bouteloua hirsuta</i>	x									
<i>Bromus inermis</i> *	<u>x</u>	x	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>
<i>Bromus japonicus</i> *	<u>x</u>	x		<u>x</u>	<u>x</u>	x	<u>x</u>	x	<u>x</u>	x
<i>Bromus tectorum</i> *	<i>x</i>									
<i>Cacalia plantaginea</i>	<u>x</u>						x		x	<u>x</u>
<i>Callirhoe alcaeoides</i>								x		x
<i>Calystegia sepium</i> subsp. <i>angulata</i>	<i>x</i>									
<i>Campanula americana</i>									<i>x</i>	
<i>Cannabis sativa</i> *								x	<i>x</i>	
<i>Carduus nutans</i> *	x									
<i>Carex bicknellii</i>	<i>x</i>									
<i>Carex brevior</i>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>
<i>Carex gravida</i>	<i>x</i>									
<i>Carex heliophila</i>	<u>x</u>	<u>x</u>								<u>x</u>
<i>Carex lanuginosa</i>	<i>x</i>									
<i>Carex meadii</i>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	x	<u>x</u>
<i>Carex</i> sp.	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>	<u>x</u>
<i>Cassia chamaecrista</i>					x		<u>x</u>			<u>x</u>

[illegible]

[illegible]

Taxa	Study Sites									
	1	2	3	4	5	6	7	8	9	10
<i>Rubus occidentalis</i>										x
<i>Rudbeckia hirta</i>	x	x	x	x		x	x	x	x	x
<i>Rumex altissimus</i>	x									
<i>Rumex crispus*</i>	x									
<i>Rumex</i> sp.								x		
<i>Sambucus canadensis</i>	x								x	
<i>Sanicula canadensis</i>							x			
<i>Scrophularia lanceolata</i>	x									
<i>Scutellaria parvula</i>	x	x	x	x			x			x
<i>Senecio plattensis</i>	x		x	x				x		x
<i>Setaria faberi*</i>								x		x
<i>Setaria glauca*</i>				x	x			x	x	x
<i>Setaria viridis*</i>	x						x			
<i>Silphium integrifolium</i>	x	x	x	x		x	x	x	x	x
<i>Silphium laciniatum</i>	x			x			x	x		x
<i>Silphium perfoliatum</i>										x
<i>Sisymbrium loeselii*</i>	x			x					x	
<i>Sisyrinchium campestre</i>	x	x	x	x		x	x	x	x	x
<i>Solanum ptycanthum</i>	x									
<i>Solidago canadensis</i>	x		x	x		x	x	x	x	x
<i>Solidago gigantea</i>									x	
<i>Solidago missouriensis</i>	x							x	x	x
<i>Solidago rigida</i>	x									x
<i>Solidago speciosa</i>	x									
<i>Solidago</i> sp.	x	x	x	x		x	x	x	x	x
<i>Sorghastrum nutans</i>	x	x	x	x	x	x	x	x	x	x
<i>Spartina pectinata</i>	x									x
<i>Sphenopholis obtusata</i> var. <i>obtusata</i>	x									
<i>Spiranthes cernua</i>	x									
<i>Sporobolus asper</i>	x					x	x	x	x	x
<i>Sporobolus vaginiflorus</i>	x									
<i>Stipa spartea</i>	x	x	x	x		x	x	x	x	x
<i>Taraxacum officinale*</i>	x	x	x	x	x	x	x	x	x	x
<i>Teucrium canadense</i> var. <i>canadense</i>	x							x		x
<i>Thalictrum dasycarpum</i>	x		x	x			x			x
<i>Toxicodendron rydbergii</i>	x									
<i>Tradescantia bracteata</i>	x								x	
<i>Tragopogon dubius*</i>	x		x	x	x	x	x	x	x	x
<i>Tridens flavus</i>									x	
<i>Trifolium pratense*</i>	x	x			x	x		x		x
<i>Triodanis leptocarpa</i>									x	
<i>Ulmus</i> sp.	x			x		x				x
<i>Verbena stricta</i>	x					x			x	
<i>Verbena urticifolia</i>									x	x

Of the ten prairies reported in this study, two have been destroyed: Millard Prairie for construction of condominiums and Long Prairie, apparently to use the soil as fill. A total of 750 m² of sod from Millard Prairie was transplanted to Allwine Prairie Preserve, a reestablished tallgrass prairie research/teaching site approximately 10 km northeast of the original Millard Prairie location. A third site, Hover Prairie, is presently for sale although there are some efforts to preserve it and others to move sod from the site to another location. A fourth site, Bauermeister Prairie was acquired by the

U. S. Army Corps of Engineers ca. 1981 in the purchase of land for a flood-control dam site. Mowing was ceased around that time and prescribed burning was implemented, each half of the site being burned one in every three years since 1984. The dam site, including the prairie, is now cooperatively managed by the Corps and the City of Omaha, and the burn frequency established in 1984 has been continued. A fifth site, Stolley Prairie, is still in private ownership. The owner, Mr. William Stolley, is interested in its preservation and hopes to work with the City of Omaha to incorporate the site

in a future park. Starting in 1981, this prairie was leased jointly by the Omaha Audubon Society and the Papio Natural Resource District (via a wildlife habitat protection plan). Since 1991, the Audubon Society alone leased the site. It was mowed last in 1981 and, beginning in 1982, portions have been burned generally following a prescribed burn schedule similar to that used at Bauermeister Prairie. Prescribed burning of this site has been coordinated through the Biology Department, University of Nebraska at Omaha. Management of the remainder of the ten prairies of this study continues as indicated on Table I.

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