

Old Field Succession and *Schizachyrium scoparium* at Sand Prairie-Scrub Oak Nature Preserve, Mason County, Illinois

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ABSTRACT

Schizachyrium scoparium, a dominant species of mature dry sand prairies in Illinois, is not found in the early stages of old field succession. A 30-year-old abandoned field at Sand Prairie-Scrub Oak Nature Preserve, Mason County, Illinois, when surveyed in 2000, was dominated by *Eragrostis trichodes* [importance value (I.V.) of 97.4], with *Strophostyles helvula* (I.V. 43.7) and *Monarda punctata* (I.V. 16.9) ranking second and third in I.V. (possible 200), while *Schizachyrium scoparium* was absent. When the authors revisited this field in the summer of 2008 *Schizachyrium scoparium* had become the dominant grass (I.V. 66.8), *Eragrostis trichodes* had dropped to fifth in importance (I.V. 11.1), while *Strophostyles helvula* maintained second (I.V. 33.3). *Schizachyrium scoparium* entered, and established dominance in the old field sometime after the 2000 survey. The reasons for these changes are not known, but may be related to the soil mycorrhizal community.

INTRODUCTION

In pre-settlement times dry sand prairies were common on the upper slopes and ridges of dunes and other dry areas throughout the Illinois River sand deposits. Soils of dry sand prairie communities lacked a dark A horizon, and the grasses, most of which were bunch-grasses, rarely exceeded 1 m in height. In the absence of recurring fires dry sand prairies developed into dry sand savannas (White and Madany 1978). Gleason (1910) was the first to quantify the species composition of the Mixed Consociates of the Bunch-Grass Association, a classification that corresponds to the dry sand prairie community of White and Madany (1978). Gleason (1910) described this association as being dominated by native bunch-grasses and sedges with most other species restricted to the areas of bare sand between bunch-grasses.

A few dry sand prairie communities have been studied in the Illinois River sand deposits. These studies involved mature dry sand prairie communities that had been subjected to some present day minor disturbances and probably past grazing, but were never culti-

vated. In these dry sand prairies *Schizachyrium scoparium* (little bluestem) was the dominant bunch-grass species, commonly accounting for a third to half of the importance value (Phillippe et al. 2004, McClain et al. 2005, 2008). One study, however, also involved successional communities of known age that were once cultivated (McClain et al. 2008). That study involved a 30-year-old field that was cultivated until the land now known as Sand Prairie-Scrub Oak Nature Preserve was purchased in 1969 (McFall and Karnes 1995). When surveyed in 2000 (McClain et al. 2008) this field was dominated by *Eragrostis trichodes* (thread love grass) which had an importance value (I.V.) of 97.4, with *Strophostyles helvula* (wild bean) and *Monarda punctata* (horsemint) ranking second and third in I.V. (possible 200), while *S. scoparium* was absent. When the authors visited this field in the summer of 2008 numerous changes had occurred, the most important being the dominance of *Schizachyrium scoparium* (Table 1). The purpose of the present study was to document these changes in this 39-year-old field, and suggest a probable reason for these changes.

DESCRIPTION OF THE STUDY AREA

Sand Prairie-Scrub Oak Nature Preserve is a 590 ha preserve, located between the villages of Bath and Kilbourne (Sections 13, 14, 23, 26 T20N R9W), Mason County, in the Illinois River Section of the Illinois River and the Mississippi River Sand Areas Natural Division (Schwegman 1973). Sand deposits account for nearly 5% of the land surface of the state, and are common in the northern half of Illinois due to events associated with Wisconsinian glaciation (Willman and Frye 1970, Schwegman 1973, King 1981). These sand deposits were formed when glacial lakes drained about 14,500 years ago after glacial moraines were breached. The resulting Kankakee Torrent carried huge amounts of sand and gravel that were deposited when the waters of the Kankakee Torrent slowed upon entering the broad lowlands of the Illinois River below present day Hennepin (Willman 1973). These sands were reworked by wind creating the characteristic dune and swale topography characteristic of these deposits.

Soils of the study site are excessively drained Plainfield sands which contain about 95% sand, are low in organic material, and have a pH of 5.1 to 5.3 (Calsyn 1995). The climate is continental with warm summers and cold winters. Mean annual precipitation is 96.0 cm, with May having the highest rainfall (11.3 cm). Mean annual temperature is 10.8°C with the hottest month being July (24.6°C), and the coldest January (-5.0°C). Frost free days range from 140 to 206 with an average of 173 days (Midwestern Regional Climate Center for Havana, Illinois 2009).

METHODS

Ground-layer species in the 39-year-old field were analyzed in September 2008 using m² plots located at 1 m intervals along two 25 m transects oriented east/west in the study area and were located within 5 m of the original transects surveyed in September 2000 (n=25/transect) (McClain et al. 2008). Odd-numbered plots were placed to the right, even-numbered to the left. A random numbers table was used to determine the number of meters (0 to 9) the plot was located from the transect line. Percent cover for each species and bare ground and litter, were determined by using the Daubenmire (1959) cover class system as modified by Bailey and Poulton (1968). The midpoint of each cover class was

used to calculate mean cover, relative cover, frequency (%), relative frequency, and importance value for each species. As used here, IV is the sum of the relative frequency and relative cover. Nomenclature follows Mohlenbrock (2002).

RESULTS

In the 39-year-old field, 27 herbaceous species were present in the 50 plots sampled. Of these taxa *Schizachyrium scoparium* was most important with a frequency of 100%, a mean cover of 50.0%, and an I.V. of 66.8 (Table 1). *Strophostyles helvula* was second with a frequency of 98%, a mean cover of 17.0% and an I.V. of 33.3, while *Physalis heterophylla* (ground cherry), *Leptoloma cognatum* (fall witch grass), *Eragrostis trichodes*, and *Tridens flavus* (purple-top) followed in I.V. In addition to *S. scoparium*, some species that typically dominate mature dry sand prairies were also present, but had low I.V.'s. The remaining species were all commonly associated with sand prairies, and were mostly present in low numbers, being restricted to the small openings between the bunchgrasses. The only exotic species encountered in the plots was *Mollugo verticillata* (carpetweed) that occurred in very low numbers (Table 1).

DISCUSSION

Mature dry sand prairies in Illinois are dominated by *Schizachyrium scoparium*. This bunch grass commonly formed dense clumps that were 20-60 cm across, and nearly circular in outline. Some of the larger clumps had dead centers in which no other species were found growing. Common associated species of these dry sand prairies were *Ambrosia psilostachya* (western ragweed), *Dichanthelium villosissimum* (hairy panic grass), *Opuntia humifusa* (common prickly pear), and *Tephrosia virginiana* (goat's-rue). In three recent studies of dry sand prairies in Mason County, Illinois these taxa were always present and among the six dominant species of the site (Phillippe et al. 2004, McClain et al. 2005, 2008,).

Although *Schizachyrium scoparium* is a dominant species of mature dry sand prairies in Illinois, it is not found in the early stages of old field succession. At Sand Prairie-Scrub Oak Nature Preserve, McClain and Ebinger (2008) examined the herbaceous vegetation at one-, three-, and twelve-year intervals in a fallow field following clearing of a pine plantation. By the twelfth year the dominant species were *Diodia teres* (I.V. 42), *Eragrostis trichodes* (I.V. 30), *Opuntia humifusa* (I.V. 25), *Aristida desmantha* (I.V. 21), and *Dichanthelium villosissimum* (I.V. 16) while *S. scoparium* was not present.

More recently at Sand Prairie-Scrub Oak Nature Preserve a 60-year-old field abandoned in the early 1940's was surveyed in 2000 (McClain et al. 2008). *Eragrostis trichodes* dominated this field, but it also contained many taxa commonly associated with mature sand prairies with *S. scoparium*, *Ambrosia psilostachya*, *D. villosissimum*, and *Opuntia humifusa* being among the top five species found.

In another study at Henry Allan Gleason Nature Preserve similar results were obtained (McClain et al. 2005). This sand prairie was located on the south flank of "Devil's Tower" a large sand dune that dominates Henry Allan Gleason Nature Preserve. Gleason (1910) indicated that Devil's Tower was originally covered with prairie but most had

been destroyed by cultivation and pasturing. The slopes of this dune were planted in pines that were removed in 1978. These slopes presently contain a disturbed dry sand prairie having high species diversity, including some taxa commonly associated with mature dry sand prairies: *Ambrosia psilostachya*, *Dichanthelium villosissimum*, *Opuntia humifusa*, and *Schizachyrium scoparium*. *Eragrostis trichoides* was the dominant species with an IV of 47.8 and a mean cover of 16.15.

Some of the dominant species of mature dry sand prairies, such as *Dichanthelium villosissimum* and *Opuntia humifusa*, are present the first year following abandonment (McClain and Ebinger 2008). *Schizachyrium scoparium*, in contrast, does not become an important component until 30 to 40 years after an agricultural field is abandoned. This slow colonization is not due to the lack of a seed source as native prairie adjoins this field to the west and north where *S. scoparium* is the dominant species. It is likely that the formerly cultivated fields lack the mycorrhizal community associated with the roots of *S. scoparium* (Anderson and Liberta 1987, Anderson et al. 1994). The increase in organic material, that is very low in these disturbed soils, may prevent the establishment of the fungus. Slight increases in organic content in these soils over time may allow the establishment of the mycorrhizal community and the corresponding presence of *S. scoparium*.

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Table 1. Frequency (%), mean cover (% of total area), relative frequency, relative cover, and importance value (I.V.) of the ground layer species encountered in the Fall of 2008 in a 39-year-old abandoned field at Sand Prairie-Scrub Oak Nature Preserve, Mason County, Illinois and the I.V. of the species encountered at the same site in a survey conducted in 2000.

Species	2008				2000	
	Freq. %	Mean Cover	Rel. Freq.	Rel. Cover	I. V.	I.V.
<i>Schizachyrium scoparium</i>	100	50.00	16.5	50.3	66.8	--
<i>Strophostyles helvula</i>	98	17.00	16.2	17.1	33.3	43.7
<i>Physalis heterophylla</i>	50	6.30	8.3	6.3	14.6	4.8
<i>Leptoloma cognatum</i>	50	4.33	8.3	4.4	12.7	--
<i>Eragrostis trichodes</i>	44	3.76	7.3	3.8	11.1	97.4
<i>Tridens flavus</i>	40	4.22	6.6	4.2	10.8	2.5
<i>Dichanthelium villosissimum</i>	32	3.02	5.3	3.0	8.3	1.2
<i>Ambrosia artemisiifolia</i>	28	2.03	4.6	2.0	6.6	--
<i>Chenopodium simplex</i>	30	0.45	4.9	0.4	5.3	1.1
<i>Eragrostis spectabilis</i>	20	1.81	3.3	1.8	5.1	10.6
<i>Coryza canadensis</i>	24	0.56	4.0	0.6	4.6	1.8
<i>Chamaecrista fasciculata</i>	10	0.62	1.7	0.6	2.3	0.5
<i>Oenothera clelandii</i>	12	0.16	2.0	0.2	2.2	1.1
<i>Asclepias syriaca</i>	8	0.67	1.3	0.7	2.0	2.4
<i>Chrysopsis camporum</i>	6	0.90	1.0	0.9	1.9	0.8
<i>Opuntia humifusa</i>	6	0.90	1.0	0.9	1.9	0.6
<i>Rosa carolina</i>	6	0.66	1.0	0.7	1.7	--
<i>Paspalum bushii</i>	8	0.19	1.3	0.2	1.5	9.8
<i>Solanum carolinense</i>	4	0.60	0.7	0.6	1.3	--
<i>Solidago canadensis</i>	4	0.60	0.7	0.6	1.3	--
<i>Asclepias verticillata</i>	6	0.08	1.0	0.1	1.1	--
<i>Lactuca canadensis</i>	4	0.12	0.7	0.1	0.8	--
<i>Pseudognaphalium obtusifolium</i>	4	0.07	0.7	0.1	0.8	0.6
<i>Croton glandulosus</i>	4	0.02	0.7	--	0.7	--
<i>Solidago nemoralis</i>	2	0.30	0.3	0.3	0.6	--
<i>Teucrium canadense</i>	2	0.06	0.3	0.1	0.4	0.6
<i>Cyperus schweinitzii</i>	2	0.01	0.3	--	0.3	--
<i>Monarda punctata</i>	--	--	--	--	--	16.9
<i>Ampelamus albidus</i>	--	--	--	--	--	1.1
<i>Brickellia eupatorioides</i>	--	--	--	--	--	0.9
<i>Dichanthelium oligosanthes</i>	--	--	--	--	--	0.6
<i>Ipomoea lacunosa</i>	--	--	--	--	--	0.5
<i>Mollugo verticillata</i>	--	--	--	--	--	0.5
Totals		99.44	100.0	100.0	200.0	200.0
Bare ground and litter		16.50				