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Flora of Twin Shelters and Twin Mounds Hill Prairies, Pere Marquette State Park, Jersey County, Illinois, Changes Since 1963

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ABSTRACT

The vascular flora of Twin Mounds and Twin Shelters hill prairies within Pere Marquette State Park, Jersey County, Illinois was studied during the 2009 and 2010 growing seasons. These two prairies are located on southwest-facing slopes approximately 10 km from Grafton, Illinois. Community composition was analyzed using m^2 quadrats placed at one-meter intervals along two randomly located transect lines within each prairie. Frequency, mean cover, and importance value (I. V. total = 200) were determined from the data collected. A total of 59 vascular plant taxa was collected in the prairies with 32 encountered in plots. *Schizachyrium scoparium* (Michx.) Nash (little bluestem) had the highest importance value followed by *Aster oolentangiensis* (sky blue aster), *Sorghastrum nutans* (L.) Nash (Indian grass), and *Solidago nemoralis* Ait. (gray goldenrod). Changes in the vegetation within the last 47 years include the extirpation of two vascular plant species, *Lespedeza violacea* (L.) Pers. (violet lespedeza) and *Asclepias hirtella* (Pennell) Woodson (tall green milkweed) and the moss *Wiessia controversa* Hedwig. The lichen *Dermatocarpon hepaticum* (Ach.) Th. Fr. and the vascular plant *Senecio plattensis* Nutt. (prairie ragwort) experienced significant population declines while the combined biomass of *Andropogon gerardii* Vitman (big bluestem) and *Sorghastrum nutans* (L.) Nash (Indian grass) increased.

INTRODUCTION

Pere Marquette State Park lies within the Driftless Section of the Middle Mississippi Border Natural Division (T6N, R13W, Sec. 9). This division is characterized by steep topography and numerous outcrops of limestone, dolomite, and shale, especially within Pere Marquette State Park (Schwegman 1973). The most widespread geologic feature is Pleistocene loess which forms a thick mantle over the underlying bedrock (Rubey 1952). This loess is the parent material for Hamburg silt, the grass-covered, calcareous soil characteristic of hill prairie communities in the western portion of Illinois. Though most of Pere Marquette State Park is forested, hill prairie communities are conspicuous features of south- to southwest-facing bluffs bordering the Illinois River floodplain (McFall & Karnes 1995). These hill prairies have been the focus of several studies, including Kil-

burn and Ford (1963) who studied the flora of Twin Mounds hill prairie, McClain (1983) who documented the loss of hill prairie at five locations in Pere Marquette State Park, and McClain and Anderson (1990) who studied woody invasion on Twin Mounds hill prairie. In addition, Evers (1955) examined numerous hill prairies in the Mississippi and Illinois river systems. More than 50 hill prairies throughout Illinois were examined in his extensive study and dominant plant species, disturbances, and general characteristics were recorded.

These previous studies, like most hill prairie surveys, were not designed to detect long term trends in the vegetation. The purpose of the present study was to document the flora of Twin Mounds and Twin Shelters hill prairies, and to determine changes in the vegetation of Twin Mounds hill prairie since the study of Kilburn and Ford (1963).

DESCRIPTION OF THE STUDY SITE

Land purchases for the establishment of Pere Marquette State Park began in 1932. Building and trail construction, including the shelter at the crest of Twin Shelters Hill Prairie, were completed by the Civilian Conservation Corps (CCC) under the direction of the National Park Service during the period April 1, 1933 to June 30, 1939. The work of the CCC also included 96 days for fighting "weed fires", the construction of four miles of firebreaks, 11 miles of fire hazard reduction, and 286 days of fire suppression training (McClain and Anderson 1990).

Fire suppression was practiced at Pere Marquette State Park and none of the hill prairies are known to have burned during the forty year period from 1932 until 1972. Woody vegetation made considerable advances onto the hill prairies during this time. Twin Mounds and Twin Shelters hill prairies are currently about 100 m apart, but were part of one large prairie in the1930s based on 1936 aerial photographs (McClain 1983). Woody invasion reduced the size of this large prairie from 8.7 ha in 1936 to 1.5 ha in 1983 (McClain and Anderson 1990). A "thin thread" of prairie still connected these two sites in 1979, but this narrow remnant has since been obscured by woody vegetation (McClain, personal observations). Recent studies indicate a reduction of 50% to 65% in the size of many hill prairies during the 50 year period from 1936 to 1986 (McClain and Anderson 1990, Robertson et. al. 1996, Schwartz et. al. 1997).

Prescribed fire was introduced to Pere Marquette in 1973 when a burn was conducted on Twin Mounds hill prairie by the Illinois Department of Conservation (now the Department of Natural Resources). Subsequent prescribed burns were conducted on the Twin Mounds hill prairie in 1975, 1977, 1982, 1985, 1987, 1996, 1999, 2002, 2007, 2009, and 2011. Prescribed burns were conducted on Twin Shelters hill prairie in 1974, 1987, 1996, 2007, and 2009.

METHODS

Twin Mounds and Twin Shelters hill prairies were visited during the growing seasons of 2009 and 2010 to collect vascular plant specimens and study the composition and structure of the prairie vegetation. Voucher specimens were deposited in the Stover-Ebinger Herbarium of Eastern Illinois University in Charleston (EIU). Exotic species were identi-

fied using Gleason and Cronquist (1991) and Mohlenbrock (2002) while nomenclature follows Mohlenbrock (2002).

The ground layer vegetation was surveyed along two 25 m long transects (n = 50 at each site) located on the mid-slope of Twin Mounds and Twin Shelters hill prairies. The transect location at Twin Mounds hill prairie is within the area studied by Kilburn and Ford (1963). One m^2 quadrats were located along each transect at 1 m intervals (n = 25). Odd-numbered quadrats were placed to the right and even-numbered quadrats were placed to the left. A random numbers table was used to determine the number of meters (0-9) a quadrat was placed from transects. Cover was determined using the Daubenmire cover class system (Daubenmire 1959) as modified by Bailey and Poulton (1968). From these data, frequency (%), relative frequency, mean cover (% of total cover), relative cover, and Importance Values (relative frequency + relative cover) were determined for each species found in the plots.

RESULTS

A total of 59 vascular plant species representing 25 families and 49 genera were documented on the prairies, including 11 monocot species representing 3 families and 48 dicot species representing 22 families (Appendix 1). The most common families were the Asteraceae with 13 species, Poaceae (9), and Fabaceae (9). No threatened or endangered species was discovered during the survey, while five exotic species were encountered.

Schizachyrium scoparium (Michx.) Nash. (little bluestem) dominated both prairies, accounting for 38.5 percent of the importance value at Twin Mounds hill prairie and 44.6 percent at Twin Shelters hill prairie (Table 1). *Sorgastrum nutans* (L.) Nash (Indian grass) was third in importance at Twin Mounds hill prairie and second at Twin Shelters hill prairie. Other common native grasses included *Bouteloua curtipendula* (Michx.) Torr. (side-oats grama) and *Andropogon gerardii* Vitman (big bluestem), both species with importance values of 8 or more. *Aster oolantangiensis* Riddell (sky-blue aster) was the most important forb encountered, being second in importance value (36.6) at Twin Mounds hill prairie and third in importance value (28.3) at Twin Shelters hill prairie. *Solidago nemoralis* Ait. (gray goldenrod), *Desmodium sessilifolium* (Torr.) Torr. & Gray (sessile-leaved tick trefoil), and *Dalea purpurea* Vent. (purple prairie clover) were other common forbs. Only 26 species, with a mean total cover of 60.4%, were recorded for the plots on Twin Mounds hill prairie, while 25 species, with a mean total cover of 54.9%, were reported on Twin Shelters hill prairie. Bare ground and litter cover values were nearly identical at both sites, varying from 41% to 43 % (Table 1). Small numbers of an unidentifiable species of the lichen *Dermatocarpon*, possibly *D. hepaticum* (Ach.) Th. Fr., and clumps of the moss *Barbula convuluta* Hedwig were present near the base of Twin Mounds hill prairie. No moss or lichen species were encountered in study plots on either site.

DISCUSSION

The vegetation of the study sites is not diverse. Only 59 vascular plant species were found during this study (9 trips over a two year period) compared to 65 recorded by Kilburn and Ford (1963). Four vascular plant species listed in 1963, *Desmodium panicula-*

tum (Nutt.) DC (panicled tick trefoil), *Spiranthes gracilis* (Bigel) Beck (slender ladies tresses) *Lespedeza violacea* (L.) Pers. (violet bush clover) and *Asclepias hirtella* (Pennell) Woodson (tall green milkweed), could not be located in 2010 and appear to be extirpated. Sessile-leaved tick trefoil, a species present on both hill prairies in 2010, may have been confused with panicled tick trefoil. *Spiranthes magnicamporum* Sheviak (prairie ladies' tresses), a species found in the present study, was not recognized until 1973 (Sheviak 1973). It is a fall blooming species characterized by two to three spiraling rows of flowers compared to just one row for slender ladies' tresses (Mohlenbrock 2002).

The two hill prairies have nearly identical vascular plant species compositions. All but one of the 59 species, including five exotic taxa, recorded for Twin Shelters hill prairie were also present on Twin Mounds hill prairie (Appendix 1). Gray goldenrod, sessile-leaved tick trefoil, and purple prairie clover were more common on Twin Mounds hill prairie while *Aster oblongifolius* Nutt. (aromatic aster), *Hedyotis nigricans,* and big bluestem were more abundant on Twin Shelters hill prairie. Twin Mounds hill prairie occupies the highest, most exposed part of the bluff and has experienced more management (twelve prescribed burns compared to five), factors that could contribute to the higher wildflower densities at this site (Table 1).

Kilburn and Ford (1963) did not report any *Aster* species. However, *Asters* were abundant in 2010 and they were reported from the early 1950s (Evers 1955). Four *Aster* species were collected in 2010, including three in study plots. *Aster oolantangiensis* Riddell (sky blue aster) was most common, having importance values of 36.6% at Twin Mounds hill prairie and 28.3% at Twin Shelters hill prairie (Table 1). The reasons for their absence in the 1963 study are not known, but *Aster* species may have been overlooked if sampling was conducted when plants were not flowering.

The increase in biomass of the tall prairie grasses, big bluestem and Indian grass, since 1963 may be affecting the abundance of small-statured plants (rosettes of vascular plants, mosses and lichens) that inhabit open, sunny spaces between clumps of prairie grasses. Big bluestem and Indian grass had combined cover values on Twin Mounds hill prairie of only 3.4% in 1963 compared to 14.3 % in 2010 (Table 1). Prairie ragwort, listed as *S. pauperacalus* Michx. (balsam ragwort) by Kilburn and Ford (1963), was common in quadrats on Twin Mounds hill prairie in 1963 with a frequency of 87 %. Its frequency dropped to 27 % by 1990 (McClain & Anderson 1990), and no plants were present in study plots on either prairie in 2010 (Table 1). Only nine plants were found growing in small patches of open soil near the base of Twin Mounds hill prairie

Nonvascular plants have also been affected by changes in the prairie community. The moss *Weisia controversa* Hedwig and the lichen *Dermatocarpon hepaticum* were prominent in 1963, having frequencies of 87.8 % and 68.9 %. However, neither species was present in plots in 2010 (Kilburn & Ford 1963, Table 1). *Weisia controversa* Hedwig appears to be extirpated, but a small population of *Dermatocarpon,* possibly *D. hepaticum*, was found at the base of Twin Shelters hill prairie in the same eroded area as prairie ragwort.

Prescribed fire programs have been implemented on hill prairies to mitigate the loss of wildland fire. However, most prescribed burns are conducted during the dormant season,

a practice that favors grasses such as big bluestem and Indian grass over wildlflowers. The hill prairies at Pere Marquette State Park were among the first sites burned when the Illinois Department of Conservation (Now the Department of Natural Resources) began its prescribed burning program in 1973. The cumulative effects of dormant season burning over a period of nearly forty years may be contributing to the prominent increase in biomass of tall prairie grasses (Anderson 2006).

The abundance of whitetail deer may also be affecting herbaceous wildflower density in these two hill prairies. These animals have become abundant in Illinois in the last 50 years and evidence of whitetail deer was observed in both hill prairies during this study. Deer selectively graze wildflowers such as *Amorpha canescens* Pursh. (lead plant), but rarely graze grasses or other graminoids. Deer browsing, which has the potential to shift herbaceous prairie plant populations in favor of grasses, may be contributing to the prominence of tall prairie grasses (Anderson et. al. 2001).

The hill prairies of Illinois are sites of rapid change. Woody invasion, fragmentation, size reduction, and the complete disappearance of these grasslands have taken place in the last 60 years (Robertson et. al. 1996, Schwartz et. al. 1997, McClain et. al. 2009). This study of hill prairies at Pere Marquette State Park suggests that other vegetation changes are occurring along with fragmentation and woody invasion, including changes in the density of grasses and wildflowers and species loss (McClain et. al. 2004).

LITERATURE CITED

Anderson, R. C., E. A. Corbett, M. R. Anderson, G.A. Corbett, and T. M. Kelley. 2001. High white-tailed deer density has negative impact on prairie forbs. Journal of the Torrey Botanical Club 128(4): 381-392.

Anderson, R. C. 2006. Evolution and origin of the grassland of Central North America: climate, fire, and mammalian grazers. Journal of the Torrey Botanical Society 133(4): 626-647.

Bailey, A. W. and C. E. Poulton. 1968. Plant communities and environmental relationships in a portion of Tillamook burn, northwestern Oregon. Ecology 49: 1-13.

Daubenmire, R. 1959. A canopy coverage method of vegetation analysis. Northwest Science 33: 43-64.

Evers, R. A. 1955. Hill Prairies of Illinois. Illinois Natural History Survey Bulletin 26: 367-446.

Gleason, H. A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. Second Edition, The New York Botanical Garden, Bronx, New York.

Kilburn, P. D. and C. D. Ford, Jr. 1963. Frequency distribution of hill prairie plants. Transactions of the Illinois Academy of Science 56:94-97.

McClain, W. E. 1983. Photodocumentation of the loss of hill prairie within Pere Marquette State Park, Jersey County, Illinois. Transactions of the Illinois State Academy of Science 76:343-346.

McClain, W. E. and E. A. Anderson. 1990. Loss of hill prairie through woody plant invasion at Pere Marquette State Park, Jersey County, Illinois. Natural Areas Journal 10:69-75.

McClain, W. E., Moorehouse, A., Ebinger, J. E. 2009. Loss of Hulsebus Hill Prairie, Henderson County, Illinois, to woody plant invasion. Transactions of the Illinois State Academy of Science 102 (3& 4): 141- 147.

McClain, W. E., Phillippe, L. R., Ebinger, J. E. 2004. Vascular Flora of Manito Prairie Nature Preserve, Tazewell County, Illinois. Transactions of the Illinois State Academy of Science 97(2): 83-94.

McFall, D. and J. Karnes. 1995. (Editors). A directory of Illinois Nature Preserves. Volume 2. Northwestern, Central and Southern Illinois. Illinois Department of Natural Resources, Division of Natural Heritage, Springfield, Illinois.

Mohlenbrock, R. H. 2002. Vascular flora of Illinois. Southern Illinois University Press, Carbondale, Illinois.

Robertson, K. R., M. W. Schwartz, J. W. Olson, B. K. Dunphy, and H. D. Clarke. 1996. Fifty years of change in Illinois Hill Prairies. Erigenia 14:41-52.

Rubey, W. W. 1952. Geology and mineral resources of the Hardin and Brussels Quadrangles. U. S. Government Printing Office. Washington, D. C.

Schwartz, M. W., K. R. Robertson, B. K. Dunphy, J. W. Olson, and A. M. Trame. 1997. The biogeography of and habitat loss on hill prairies. Pages 267-283. in M. M. Schwartz, ed., Conservation of Highly Fragmented Landscapes. Chapman & Hall. New York.

Schwegman, J. E. 1973. Comprehensive plan for the Illinois Nature Preserves System, Part 2. The Natural Divisions of Illinois. Illinois Nature Preserves Commission, Rockford. 32 pp + map.

Sheviak, C.J. 1973. A new *Spiranthes* from the grasslands of Central America. Botanical Museum Leaflet 23: 285-297.

Table 1. Frequency (%), mean cover (% of total area), and importance value (IV) for the species encountered at Twin Mounds and at Twin Shelters Loess Hill Prairies, Pere Marquette State Park, Jersey County, Illinois (*exotic species)

	Twin Mounds Prairie			Twin Shelters Prairie		
Species	Freq. %	Mean Cover	I. V.	Freq %	Mean Cover	I.V.
Schizachyrium scoparium	100	16.11	38.5	94	17.43	44.6
Aster oolentangiensis	100	15.00	36.6	84	9.24	28.3
Sorghastrum nutans	92	11.83	30.5	84	10.91	31.4
Solidago nemoralis	80	6.43	20.2	40	2.78	10.6
Desmodium sessilifolium	74	3.11	13.8	42	0.71	7.0
Dalea purpurea	92	1.64	13.6	44	0.62	7.1
Bouteloua curtipendula	96	1.03	13.1	78	0.74	11.9
Andropogon gerardii	34	2.46	8.1	52	5.40	16.9
Aster ericoides	42	1.53	7.5	12	0.06	1.7
Brickellia eupatorioides	24	0.22	3.2	24	0.27	3.8
Desmanthus illinoensis	16	0.18	2.2	12	0.11	1.8
Ruellia humilis	16	0.13	2.1	14	0.17	2.2
Hedyotis nigricans	14	0.07	1.8	52	2.07	10.9
Desmodium ciliare	12	0.16	1.7	8	0.09	1.3
Agalinus aspera	10	0.05	1.3	4	0.02	0.5
Asclepias viridiflora	6	0.08	0.8	--	--	--
Dalea candida	6	0.08	0.8	2	0.01	0.3
Dichanthelium oligosanthes	6	0.03	0.8	--	--	--
Spiranthes magnicamporum	6	0.03	0.8	--	--	--
Asclepias verticillata	4	0.07	0.6	4	0.02	0.5
Linum sulcatum	4	0.02	0.5	4	0.02	0.5
Lithospermum incisum	4	0.02	0.5	--	--	--
Cornus drummondii	2	0.06	0.3	6	1.11	2.8
Eupatorium altissimum	2	0.06	0.3	--	--	--
Amorpha canescens	2	0.01	0.2	--	--	--
Antennaria plantaginifolia	2	0.01	0.2	--	--	--
Aster oblongifolius	--	--	--	34	2.02	8.3
Lespedeza virginica	--	--	--	10	0.49	2.3
Rhus aromatic	--	--	--	8	0.43	1.9
Carex pensylvanica	--	--	--	10	0.10	1.6
Pycnanthemum pilosum	--	--	--	8	0.09	1.3
Lithospermum canescens	--	--	--	4	0.02	0.5
Totals		60.42	200.0		54.93	200.0
Bare ground and litter		41.24			43.11	

APPENDIX I

Vascular plant species encountered on two loess hill prairies at the Pere Marquette State Park, Jersey County, Illinois are listed alphabetically by family under the major plant groups. Collecting numbers are preceded by the initial of the collector (E = John E. Ebinger; M = William E. McClain). Specimens are deposited in the Stover/Ebinger Herbarium (EIU), Eastern Illinois University, Charleston, Illinois. (*exotic species)

DICOTS
Acanthaceae
Ruellia humilis Nutt.: E32349; E32356
Anacardiaceae
Rhus aromatica Ait. E32348; E32359
Asclepiadaceae
Asclepias verticillata L.: E32329; E32372
Asclepias viridiflora Raf. E32333; E32368
Asteraceae
Antennaria plantaginifolia (L.) Hook. E32679
Aster ericoides L.: E32675
Aster oblongifolius L.: E32684
Aster oolentangiensis Riddell: E32683
Aster pilosus Willd.: E32676
Brickellia eupatorioides (L.) Shinners: E32345; E32355
Erigeron strigosus Muhl.: E32228; E32222
Eupatorium altissimum L.: E32680
Eupatorium serotinum Michx.: E32353
Helianthus divaricatus L.:E32331
Senecio plattensis Nutt. M2829
Solidago nemoralis Ait.: E32330; E32367
Vernonia missourica Raf.: E32350
Boraginaceae
Lithospermum canescens (Michx.) Lehm.: E32685
Lithospermum incisum Lehm.: E32678
Caeslpiniaceae
Chamaecrista nictitans (L.) Moench.:E32335
Campanulaceae
Lobelia spicata Lam.: E32334: E32376; M2763
Cornaceae
Cornus drummondii C.A. Mey.: E32342 ; E32375
Euphorbiaceae
Chamaesyce nutans (Lag.) Small: E32363
Croton monanthogynus Michx.: E32361
Fabaceae
Amorpha canescens Pursh: E32336; E32371
Dalea candida (Michx.) Willd.: E32346
Dalea purpurea Vent.: E32338; E32358
Desmodium ciliare (Muhl.) DC.: E32340; E32362
Desmodium sessilifolium (Torr.) Torr. & Gray: E32339; E32360
Lespedeza capitata Michx.: E32677
Lespedeza virginica (L.) Britt.: E32682
**Melilotus albus* Medic.: E32343; E32370
Psoralidium tenuiflorum (Pursh) Rydb.: E32229; E32223
Hypericaceae
**Hypericum perforatum* L.: M2762
Lamiaceae
Monarda fistulosa L.: E32351
Pycnanthemum pilosum Nutt.: E32337
Linaceae
Linum sulcatum Riddell.: E32347: E32373
Mimosaceae
Desmanthus illinoensis (Michx.) MacM.: E32369
Onagraceae
Oenothera biennis L.: E32366
Oxalidaceae
Oxalis stricta L.: E32224
Ranunculaceae
Anemone virginiana L.: E32230
Rubiaceae
Hedyotis nigricans (Lam.) Fosb.: E32354; E32357
Scrophulariaceae
Agalinus aspera (Doug.) Britt.: E32687
Penstemon pallidus Small: E32231; E32225
Simaroubaceae
**Ailanthus altissima* (Mill.) Swingle: E32344
Solanaceae
Physalis heterophylla Dunal.: E32341; E32364
Physalis virginiana Mill.: E32232
Verbenaceae
Verbena stricta Vent.: M2761

MONOCOTS
Cyperaceae
Carex pensylvanica Lam.: E32686
Orchidaceae
Spiranthes magnicamporum (L.) Rich.: E32688
Poaceae
Andropogon gerardii Vitman: E32712
Bouteloua curtipendula (Michx.) Torr.: E32332; E32374
Dicanthelium oligosanthes (Schult.) Gould: E32226; E32219
Elmus canadensis L.: E32365
Elymus virginicus L.: E32352
**Poa pratensis* L.: E32227; E32220
Schizachyrium scoparium (Michx.) Nash: E32711
**Setaria faberi* F.Herrm.: E32377
Sorghastrum nutans (L.) Nash: E32710