

Loss of Hulsebus Loess Hill Prairie, Henderson County, Illinois to Woody Plant Invasion

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ABSTRACT

Hulsebus Hill Prairie, Henderson County, Illinois, was recognized by the Illinois Natural Areas Inventory in 1976 as a good quality loess hill prairie. The dominant herbaceous plants were *Bouteloua curtipendula* (sideoats grama), *Schizachyrium scoparium* (little bluestem), *Asclepias verticillata* (whorled milkweed), and *Dalea candida* (white prairie clover). Twenty-one herbaceous prairie species were present in the 0.2 ha prairie. The prairie was overgrown with woody vegetation by 1997 and *Ageratina altissima* (white snakeroot) had become the dominant herbaceous taxon on the hillside. A 2008 study showed an increase in herbaceous vegetation associated with forest communities. A dense cover of *Cornus drummondii* (rough-leaved dogwood) covered the site and no hill prairie vegetation remained.

INTRODUCTION

Loess hill prairies are prominent features of the Illinois, Mississippi, and Sangamon river bluffs. Due to their presence on steep terrain, they were not converted to row crop agriculture like loam soil prairies. Some hill prairies are currently regarded among the highest quality prairie remnants in Illinois. Despite these features, few studies were completed on hill prairies in Illinois during the early 1900s. The classic publication "Hill Prairies of Illinois" by R. A. Evers (1955) brought widespread recognition to these hillside grasslands.

Dr. Robert Evers observed the effects of woody invasion on some hill prairies following his initial study and began accumulating data for a second publication, but was unable to complete the work. Other authors described woody invasion in several parts of Illinois

(Kilburn and Warren 1963, Reeves et al 1978, Ebinger 1981, Behnke and Ebinger 1989). McClain (1983) documented the loss of sixty-two percent of the area of five hill prairies at Pere Marquette State Park, Jersey County, Illinois. Other studies described widespread fragmentation of hill prairies and made predictions that small unmanaged hill prairies would disappear within 20 years (McClain and Anderson 1990, Robertson et al. 1995, Schwartz et al. 1997).

One of the primary woody invaders of hill prairies in Illinois is *Cornus drummondii* C. A. Mey. (rough-leaved dogwood). This shrub is known for the formation of dense thickets that encircle and advance upon hill prairie communities. These dense shrub zones create shade and competition detrimental to prairie species, thus initiating the conversion from prairie to forest (McClain and Anderson 1990).

The Illinois Natural Areas Inventory (INAI) conducted a statewide survey in the 1970s to identify high quality remnants of natural vegetation (White 1978). Six hill prairies were recognized in Henderson County, including a small loess hill prairie, known as Hulsebus Hill Prairie, located on the Mississippi River bluffs near Olena. The dominant herbaceous plants present on this site were *Bouteloua curtipendula* (sideoats grama) *Schizachyrium scoparium* (little bluestem), *Asclepias verticillata* (whorled milkweed), and *Dalea candida* (white prairie clover). Twenty-one herbaceous prairie species were observed on the prairie (Table 1).

In 1993, while conducting surveillance of natural areas, Illinois Nature Preserves Commission (INPC) and the Illinois Department of Natural Resources (IDNR) personnel described Hulsebus Hill prairie as “barely hanging on” due to woody plant invasion. An INPC representative was unable to find any trace of the hill prairie in 1996. Field studies in 1997 and 2008 confirmed the location and documented the disappearance of the hill prairie. The purpose of this study was to document the transformation of Hulsebus Hill Prairie to forest and to describe factors causing its disappearance.

DESCRIPTION OF THE STUDY AREA

Hulsebus Hill Prairie is located in Stronghurst Township (T 9N, R5W, SW ¼ SE ¼ SE ¼ of S5), Henderson County in northwestern Illinois approximately four km northwest of the Village of Olena and ten km northwest of the Village of Stronghurst. Ellison Creek, a permanent stream, is less than a km from the site, and the Mississippi River lies approximately five km to the west.

Hickory silt loam is the common soil of the bluffs and slopes of Henderson County. Hickory soils are very deep, well drained, and highly dissected. The parent material of this soil is glacial till capped with up to 20 inches of wind-blown loess. The upper horizons contain rock fragments, up to 20 percent sand, and are strongly acidic (Heisner and Elmer 2006).

The climate of west-central Illinois is continental, characterized by hot, humid summers and cold winters. The highest recorded temperature at Aledo in nearby Mercer County is 39 C in September of 1953, while the lowest temperature of -27 C was recorded on January 17, 1977. The average annual precipitation of 88.5 cm falls mostly as rain during

April to September. The average annual snowfall is 82.3 cm. During an average year, 49 days will have 2.5 cm or more of snow on the ground (Heisner and Elmer 2006).

METHODS

Field data were obtained from the 1976 INAI survey of Hulsebus Loess Hill Prairie. The INAI ecologists utilized 30 1/4m circular plots to determine frequency of hill prairie vegetation. The 1997 survey utilized 1/4 m square plots to study herbaceous plants and woody seedlings less than 1m tall along two randomly located north/south transects, each 25 m in length (50 quadrants). The 2008 study utilized one m² quadrants placed along two 25 m transects oriented east to west across the hillside in the area formerly occupied by prairie vegetation (50 quadrants). Quadrants were placed at one m intervals along the transects with even-numbered plots being placed to the right and odd-numbered plots to the left. Cover for each species was determined using the procedure described by Daubenmire (1959) as modified by Bailey and Poulton (1969). From this data relative frequency, relative cover, and Importance Value were determined.

Woody vegetation was studied along two line transects, each 2 m x 25 m, that were placed east/ west across the hillside. All small saplings (over 1 m in height but less than 1 cm dbh) and large saplings (over 1 m in height and greater than 1 cm dbh) were counted. These data were used to estimate stems/ha for each species. Nomenclature follows Mohlenbrock (2002).

RESULTS

The INAI field ecologists documented the presence of a high quality loess hill prairie community, 0.16 ha in size, at this site on August 16, 1976. The hill prairie community was described as having a good grass cover, but low wildflower diversity. Herbaceous prairie species had disappeared when McClain and Moorehouse surveyed the site on October 7, 1997. Species associated with woodlands, including *Ageratina altissima* (white snakeroot) and the woody vine *Toxicodendron radicans* (poison ivy) were dominant. The only prairie species located were two plants of side oats grama and five plants of little bluestem (Table 1).

White snake root was the dominant plant in the herbaceous understory with an IV of 29.4 when the site was visited on September 21, 2008. Other prominent understory plants were *Euonymus atropurpureus* (wahoo), *Toxicodendron radicans* (poison ivy), *Viola sororia* (downy blue violet), and *Parthenocissus quinquefolia* (Virginia creeper). Several herbaceous plants and woody vines, commonly regarded as forest herbs, were more prominent in 2008, including *Aquilegia canadensis* (columbine), *Solidago ulmifolia* (elm-leaved goldenrod), *Sanicula odorata* (common black snakeroot), *Smilax tamnoides* (greenbriar) and *Menispermum canadense* (moonseed) (Table 1).

The woody vegetation is currently dominated by *Cornus drummondii* (rough-leaved dogwood), *Ulmus americana* (American elm), and *Celtis occidentalis* (hackberry). The density of dogwood, including small and large saplings, exceeded 12,000 individuals per ha. The invasive exotic shrub, *Lonicera maackii* (Amur honeysuckle), was common (Table 2).

DISCUSSION

All hill prairies, regardless of size or landscape position, are susceptible to invasion and conversion to forest by woody plants. Small hill prairies located within densely forested lands are especially vulnerable, as evidenced by Hulsebus Hill Prairie. The amount of time required for the conversion from hill prairie to forest has been estimated to be a maximum of 15 to 20 years (McClain and Anderson 1990). Hulsebus Hill Prairie was overwhelmed with woody vegetation 17 years after its discovery.

One of the primary invaders of hill prairies is rough-leaved dogwood, a species known for its high seed production and prolific sprouting abilities. This taxon produces dense, nearly pure stands that frequently encircle and advance upon hill prairie communities. The extensive root systems of rough-leaved dogwood are difficult to control, and prescribed fires often fail to impact the dense growth of shrubs due to a reduced biomass of prairie grasses. Stopping woody invasion is not an easy task. Even intensively managed hill prairies do not show a reversal of woody invasion or an expansion of hill prairie vegetation (Robertson et al. 1995). Managers trying to duplicate landscape fires on small parcels of land will find the task of maintaining prairie communities increasingly difficult or impossible due to urbanization and other restrictions.

Invasive exotic woody species, primarily Amur honeysuckle, also contribute to the loss of hill prairie. Individuals of this species were present at Hulsebus (Table 2) and at Pere Marquette in Jersey County (McClain and Anderson 1990). Glacial drift hill prairies near Charleston in Coles County contain high densities of *Euonymus alatus* (burning bush) (Behnke and Ebinger 1989), and field ecologists have observed high densities of *Albizia julibrissin* (mimosa) in loess hill prairies of Randolph County in southwestern Illinois (Debbie Neumann, personal observation).

Hill prairie reconstruction has also been greatly neglected. Except for Kilburn and Warren (1963), no efforts have been made to recreate these communities on former hill prairie sites. This contrasts with the extensive reconstruction of mesic black-soil prairies over the last 50 years (McClain 2003, Kurtz 2001, Schramm 1976, 1990). Quantitative studies of the flora and fauna of hill prairies will be critical templates in reconstruction efforts in the future.

The profound changes taking place in hill prairies are considered permanent. Many studies have documented the replacement of hill prairie vegetation by shrubs and small trees (Behnke and Ebinger 1989, McClain 1983, Robertson et al. 1995, Schwartz et al. 1997). Woody invasion of hill prairies will be a continuing problem for decades and many hill prairies will be converted to forest. The disappearance of two other Henderson County Hill Prairies, Bailey Hill Prairie and Delabar-Pruitt Hill Prairie, was recently confirmed by INPC representative Angella Moorehouse, leaving only three of the original six INAI hill prairies intact.

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Table 1. Frequency (F), relative frequency (RF), relative cover (RC), and importance values (IV) for ground layer vegetation in 1976, 1997, and 2008 at Hulsebus Hill Prairie, Henderson County, Illinois.

Species	1976		1997				2008			
	F	RF	F	RF	RC	IV	F	RF	RC	IV
<i>Bouteloua curtipendula</i>	97.0	23.2	2	0.5	0.6	1.1	--	--	--	--
<i>Schizachyrium scoparium</i>	90.0	21.6	4	1.0	0.2	1.2	--	--	--	--
<i>Asclepias verticillata</i>	40.0	9.6	--	--	--	--	--	--	--	--
<i>Dalea candida</i>	40.0	9.6	--	--	--	--	--	--	--	--
<i>Dichanthelium</i> sp.	30.0	7.2	16	3.9	0.6	4.5	--	--	--	--
<i>Melilotus albus</i>	27.0	6.4	18	4.4	6.1	10.5	--	--	--	--
<i>Lithospermum incisum</i>	23.3	5.6	--	--	--	--	--	--	--	--
<i>Ruellia humilis</i>	20.0	4.8	8	2.0	1.5	3.5	--	--	--	--
<i>Aster</i> sp.	10.0	2.4	4	1.0	1.0	2.0	--	--	--	--
<i>Poa pratensis</i>	6.7	1.6	12	3.0	1.0	4.0	--	--	--	--
<i>Amorpha canescens</i>	6.7	1.6	--	--	--	--	--	--	--	--
<i>Cornus drummondii</i>	6.7	1.6	14	3.4	5.1	8.5	18	3.3	4.4	7.7
<i>Chamaecrista fasciculata</i>	3.3	0.8	--	--	--	--	--	--	--	--
<i>Pycnanthemum tenuifolium</i>	3.3	0.8	--	--	--	--	--	--	--	--
<i>Bouteloua hirsuta</i>	3.3	0.8	--	--	--	--	--	--	--	--
<i>Solidago nemoralis</i>	3.3	0.8	--	--	--	--	--	--	--	--
<i>Prunus serotina</i>	3.3	0.8	--	--	--	--	6	1.0	0.4	1.4
<i>Toxicodendron radicans</i>	--	--	48	11.8	23.4	35.2	32	5.9	8.5	14.4
<i>Ageratina altissima</i>	--	--	52	12.8	16.0	28.8	72	13.3	16.1	29.4
<i>Carex pensylvanica</i>	--	--	36	8.9	6.6	15.5	64	11.9	6.2	18.1
<i>Carex</i> sp.	--	--	34	8.4	2.1	10.5	--	--	--	--
<i>Parthenocissus quinquefolia</i>	--	--	18	4.4	6.0	10.4	28	5.2	6.6	11.8
<i>Solidago ulmifolia</i>	--	--	12	3.0	6.1	9.1	20	3.6	6.1	9.7
<i>Smilax tamnoides</i>	--	--	18	4.4	4.0	8.4	24	4.5	5.0	9.5
<i>Quercus rubra</i>	--	--	12	3.0	5.2	8.2	16	3.0	3.2	6.2
<i>Muhlenbergia sobolifera</i>	--	--	10	2.5	3.0	5.5	2	0.4	0.1	0.5
<i>Celtis occidentalis</i>	--	--	10	2.5	1.4	3.9	26	4.8	5.0	9.8
<i>Viola sororia</i>	--	--	10	2.5	1.3	3.8	46	8.5	2.0	10.5
<i>Celastrus scandens</i>	--	--	8	2.0	1.4	3.4	12	2.0	3.0	5.0
<i>Galium circaezans</i>	--	--	4	1.0	1.1	2.1	4	0.7	0.2	0.9
<i>Lactuca canadensis</i>	--	--	4	1.0	1.1	2.1	--	--	--	--
<i>Euonymus atropurpureus</i>	--	--	4	1.0	1.1	2.1	38	7.0	8.3	15.3
<i>Aquilegia canadensis</i>	--	--	4	1.0	1.0	2.0	34	6.3	1.5	7.8
<i>Fraxinus americana</i>	--	--	6	1.5	0.2	1.7	--	--	--	--
<i>Xanthoxylum americanum</i>	--	--	4	1.0	0.6	1.6	--	--	--	--
<i>Vitis vulpina</i>	--	--	--	--	--	--	10	1.9	3.3	5.2
<i>Veronicastrum virginicum</i>	--	--	--	--	--	--	8	1.5	3.7	5.2
<i>Elymus virginicus</i>	--	--	--	--	--	--	14	2.6	2.0	4.6
<i>Menispermum canadense</i>	--	--	--	--	--	--	8	1.5	2.6	4.1
<i>Sanicula odorata</i>	--	--	--	--	--	--	10	1.9	2.1	4.0
<i>Campanulastrum americanum</i>	--	--	--	--	--	--	10	1.9	1.6	3.5
<i>Desmodium glutinosum</i>	--	--	--	--	--	--	4	0.7	1.3	2.0
<i>Helianthus divaricatus</i>	--	--	--	--	--	--	4	0.7	1.3	2.0
<i>Juniperus virginiana</i>	--	--	--	--	--	--	4	0.7	1.0	1.7
<i>Lonicera maackii</i>	--	--	--	--	--	--	4	0.7	1.0	1.7
<i>Symphoricarpos orbiculatus</i>	--	--	--	--	--	--	4	0.7	1.0	1.7
<i>Ulmus americana</i>	--	--	--	--	--	--	4	0.7	1.0	1.7
<i>Carya ovata</i>	--	--	--	--	--	--	4	0.7	0.3	1.0
Others	--	--	--	8.1	2.3	10.4	--	2.4	1.2	3.6
Totals	--	99.2	--	100.0	100.0	200.0	--	100.0	100.0	200.0

Table 2. Density (stems/ha) of the small (>50 cm tall, ≤ 2.5 cm dbh) and large saplings (2.6-5.0 cm dbh) encountered at Hulsebus Loess Hill Prairie, Henderson County, Illinois.

Species	Small Saplings	Large Saplings
<i>Cornus drummondii</i> (rough-leaved dogwood)	10400	2200
<i>Toxicodendron radicans</i> (poison ivy)	900	--
<i>Ulmus americana</i> (American elm)	500	300
<i>Celtis occidentalis</i> (hackberry)	500	100
<i>Ostrya virginiana</i> (hop hornbeam)	100	100
* <i>Lonicera maackii</i> (Amur honeysuckle)	100	--
<i>Quercus rubra</i> (red oak)	100	--
<i>Juniperus virginiana</i> (red cedar)	--	100
Totals	12600	2800

* = Non-native species

