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25 Years of Vegetational Changes in a Glacial Drift Hill Prairie Community in East-Central Illinois

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ABSTRACT

Waterworks Glacial Drift Hill Prairie in east-central Illinois was surveyed and the frequency, cover, relative values, and importance value of the ground layer vascular plants determined. The results were compared to a previous study conducted 25 years ago. The site was dominated by *Sorghastrum nutans* (L.) Nash (Indian grass), while the common forbs included *Liatris aspera* Michx. (Rough blazing star), *Solidago nemoralis* Ait. (Gray goldenrod), *Antennaria neglecta* Greene (Field pussytoes), *Helianthus divaricatus* L. (Woodland sunflower), *Eupatorium altissimum* L. (Tall thoroughwort), and *Asclepias verticillata* L. (Whorled milkweed). After 25 years without disturbance or management, the prairie was greatly reduced in size, probably a result of the increased shading due to the principle woody invaders *Cornus drummundii* C.A. Mey (Roughleaf dogwood), and *Prunus serotina* Ehrh (Black cherry). The edge of the prairie was dominated by *Cornus florida* L. (Flowering dogwood) and the non-native *Elaeagnus umbellata* Thunb. (Autumn olive). Cutting, combined with prescribed burning, is recommended to increase the size of the hill prairie.

INTRODUCTION

Glacial drift hill prairies are relatively short-lived plant communities occurring on glacial till that does not have a mantle of loess (Robertson et al., 1996). These small inclusions of prairie forbs and grasses are mostly less than 1ha in size and located on steep south to southwest facing slopes.

Glacial drift hill prairies are a relatively rare community type in east-central Illinois due to woody encroachment. A re-survey of a study by Vestal (1918) of glacial drift hill prairie openings along the Embarras River in Coles County, Reeves et al. (1978) found that the total number of prairie openings had been reduced from 10 in 1918 to only three in 1978. This study documents a trend associated with encroachment of woody species onto

the waterworks hill prairie remnant, and the ultimate impact this encroachment had on prairie species integrity and composition.

DESCRIPTION OF STUDY AREA

Waterworks Hill Prairie is located on the eastern city limits of Charleston, Coles County, Illinois (Sect. 24 T12N R9E) on a steep, southwest facing hillside above an intermittent stream that enters Lake Charleston about one half mile to the east (Ebinger 1981). Presently, the prairie measures about 20 m long and 14 m wide, and is surrounded by immature second growth forest composed of mainly *Quercus alba* L. (White oak), *Q. velutina* Lam. (Black oak), *Cornus florida* L., and *Cercis canadensis* L.(Redbud) (Ebinger 1981). A few individuals of *Prunus serotina* Ehrh., *Juniperus virginiana* L. (Eastern red cedar), and *Corylus americana* Walt. (American hazelnut) are scattered throughout the prairie.

The soils of the Waterworks Hill Prairie are Miami Loam associated with thirty to sixty percent slopes (Hamilton 1993). This very steep, well-drained soil is on unevenly sided slopes in uplands adjacent to floodplains. Erosion of Miami type soils is relatively high when not controlled by woodland vegetation.

MATERIALS AND METHODS

Ground layer species were analyzed in early September using ¼ m^2 quadrats located at each meter along a randomly located 25m long transect that was oriented perpendicular to the slope, even-numbered quadrats to the right, odd-numbered quadrats to the left. Species cover was determined using Daubenmire (1959) cover classes as modified by Bailey and Poulton (1968). Bare ground cover was also determined. The modified Daubenmire cover scale is as follows: 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%. Frequency (%), relative frequency, cover, relative cover, and importance value (IV) of each species was determined. As used here the IV is the sum of the relative frequency and relative cover. Nomenclature follows Mohlenbrock (1986).

RESULTS

Within the plots 35 vascular plant species were recorded. The dominant grass was *Sorghastrum nutans* (L.) Nash with an IV of 37.67 (Table 1). This species was the only native grass species found in the plots. The common forbs were *Solidago nemoralis* Ait. (IV of 19.78), *Liatris aspera* Michx. (IV of 18.18), *Antennaria neglecta* Greene (IV of 9.57), and *Helianthus divaricatus* L. (IV of 8.8). Nearly all of the 21 species of forbs encountered in the plots were native prairie perennials, only a few exotic species were found.

Presently, the hill prairie opening is about 20 m long by 14 m wide (280m^2). In an earlier study Ebinger (1981) reported the prairie was 28 m long by 21 m wide (588 m^2), a reduction of near 50%. Woody encroachment onto the prairie is evident. Not only had the prairie decreased in size since the last survey, but numerous woody seedlings were also present. Seedlings and small plants of five native tree species were found in the plots, with *Prunus serotina* Ehrh. (IV of 18.74) being the most important. Native prairie shrubs were

also common with *Cornus drummundii* C.A. Mey., *Rosa carolina* L. (Carolina rose) and *Ceanothus americanus* L. (New jersey tea) being present (Table 1).

DISCUSSION

The Waterworks Glacial Drift Hill Prairie has decreased in size by nearly 50% since 1978, when studied by Ebinger (1981). This reduction, due to woody species encroachment, is similar to results found by McClain and Anderson (1990) for loess hill prairies in western Illinois. McClain and Anderson found that the conversion from prairie to young forest or shrub community is complete within 15 to 20 years from the onset of woody plant invasion.

Of the woody species encountered within the hill prairie most were trees from the surrounding forest. In the area just adjacent to the remaining prairie, two of the principal invaders were *Cornus florida* L. and the non-native *Elaeagnus umbellata* Thunb. Both species that are bird dispersed. While not common on the prairie, these species were principal components of the prairie edge.

In a 1989 survey of this site, *Euonymus alatus* Jacq. (Winged burning bush) was found to be a dominant species averaging 13,100 stems/ha, and found in all plots examined (Behnke and Ebinger 1989). Of the invading woody species in this survey, *E. alatus* was not found in any plots, or visually seen on the hill prairie remnant. However, individuals of *E. alatus* were seen in low frequency in the woodland bordering the Waterworks Hill Prairie, and in very concentrated and high frequency in the ravine below the site. This dramatic change in frequency could be attributed to the hydric nature of the species and the present xeric conditions of the site, thus allowing the present prairie area to fend off invasion.

The data collected from our study showed, just as found by Ebinger (1981), there has been, and still is, a dramatic trend toward encroachment by forest taxa on the hill prairie. In the current study two woodland species *Prunus serotina* Ehrh. and *Cornus drummondii* Meyer were found to exhibit relatively high importance values. Furthermore, several *Desmodium* Desv. species and *Lonicera prolifera* (Kirchn.) Rhed. (Grape honeysuckle), both woodland species represented in the current study were not found by Ebinger (1981). These species are undoubtedly appearing due to encroachment and shading of the former prairie area. The present species composition of this hill prairie is very similar to that found by Ebinger (1981).

A more weedy and problematic species found in the survey is *Melilotus alba* Medic. (White sweetclover). This exotic was found in only one quadrat, and visually seen to be in very low frequency and not a major component of the site as a whole. In contrast, Ebinger (1981) found that this species averaged 8 stems per m^2. This could be due to a variety of factors, but probably can be attributed to the biennial nature of the species.

Future management of the Waterworks Glacial Drift Hill Prairie should be directed toward enlarging the site at least to the size measured in Ebinger (1981). Efforts should be made to remove all exotics from the site, could use a cut stump herbicide treatment method. After initial clearing of the site, it is recommended to introduce prescribed fire in

order to stimulate the seedbank and recolonize former areas of hill prairie that have been invaded by forest taxa.

LITERATURE CITED

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

Behnke, G. and J.E. Ebinger. 1989. Woody invasion of glacial drift hill prairies in east-central Illinois. Transactions of the Illinois Academy of Science 82, 1 and 2: 1-4.

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

Ebinger, J.E. 1981. Vegetation of glacial drift hill prairies in east-central Illinois. Castanea 46: 115-121.

Hamilton, G. 1993. Soil Survey of Coles County, Illinois. United States Department of Agriculture, Soil Conservation Service and Illinois Agricultural Experimental Station, Washington, D.C.

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.

Mohlenbrock, R.H. 1986. Guide to the vascular flora of Illinois, revised and enlarged edition. Southern Illinois University Press, Carbondale and Edwardsville.

Reeves, J.T., U.D. Zimmerman, and J.E. Ebinger. 1978. Microclimatic and soil differences between hill prairies and adjacent forests in east-central Illinois. Transactions of the Illinois Academy of Science 71: 156-164.

Robertson, K.R., M.W. Schwartz, J.W. Olson, B.K. Dunphy, and H.D. Clarke. 1996. 50 years of change in Illinois hill prairies. Erigenia 14: 41-52.

Vestal, A.G. 1918. Local inclusions of prairie within forest. Transactions of the Illinois State Academy of Science 11: 122-126 +3pls.

Table 1. Mean cover, frequency (%), relative values and importance value (IV) for the species commonly found on Waterworks Glacial Drift Hill Prairie, Coles County, Illinois. * = non-native taxon

SPECIES	Mean Cover	Relative Cover	Frequency	Relative Frequency	IV
Sorghastrum nutans	8.58	28.18	52	9.49	37.67
Solidago nemoralis	4.02	13.21	36	6.57	19.78
Prunus serotina	3.26	10.71	44	8.03	18.74
Liatris aspera	2.58	6.5	64	11.68	18.18
Cornus drummondii	1.60	5.26	28	5.1	10.36
Antennaria neglecta	1.58	5.19	24	4.38	9.57
Helianthus divaricatus	0.68	2.23	36	6.57	8.8
Eupatorium altissimum	0.72	4.34	12	2.19	6.53
Rosa carolina	0.88	2.87	20	3.65	6.52
Asclepias verticillata	1.52	4.99	8	1.46	6.45
Euphorbia corollata	0.42	1.38	24	4.38	5.76
Lithospermum canecens	0.86	2.83	16	2.92	5.75
Silphium terebinthinaceum	0.32	1.05	24	4.38	5.43
Ceanothus americanus	0.84	2.76	12	2.19	4.95
Quercus rubra	0.62	2.04	8	1.46	3.5
Galium circaezans	0.62	2.04	8	1.46	3.5
Porteranthus stipulatus	0.08	0.26	16	2.92	3.18
Polygala senega	0.16	0.53	12	2.19	2.72
Desmodium rotundifolium	0.26	0.46	12	2.19	2.65
Vitis aestivalis	0.06	0.2	12	2.19	2.39
Physostegia virginiana	0.06	0.2	12	2.19	2.39
*Poa compressa**	0.14	0.46	8	1.46	1.92
Quercus alba	0.04	0.13	8	1.46	1.59
Desmodium glutinosum	0.04	0.13	8	1.46	1.59
Baptisia leucantha	0.12	0.39	4	0.73	1.12
Lespedeza virginica	0.12	0.39	4	0.73	1.12
Lonicera prolifera	0.12	0.39	4	0.73	1.12
Solidago ulmifolia	0.12	0.39	4	0.73	1.12
Others[1]	0.14	0.49	28	5.11	5.6
Totals	30.46	100	-	100	200
Average Bare Ground	69.54				

[1] *Aster pilosus*, *Cercis canadensis*, *Elaeagnus umbellata**, *Juniperus virginiana*, *Melilotus alba**, *Solidago canadensis*, *Toxicodendron radicans*.