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WOODY INVASION OF GLACIAL DRIFT HILL PRAIRIES IN EAST-CENTRAL ILLINOIS

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ABSTRACT

All encroaching woody species were counted and identified on the Waterworks Ravine Hill Prairie, and on an adjacent degraded remnant that was dominated by prairie vegetation 70 years ago. Woody invading species totaled 9,537 stems/ha on the prairie, while on the degraded remnant there were 47,900 stems/ha. *Euonymus alatus* dominates both sites, while *Viburnum prunifolium* and *Cornus florida* are also common.

INTRODUCTION

Glacial drift hill prairies are grassland openings in forested areas that are usually less than a hectare in size (Hansen, 1922), are on steep, usually south-or southwest-facing slopes and are on unstable glacial till (Costello, 1931). Both glacial drift and loess hill prairies in western Illinois were studied by Evers (1955), while in east-central Illinois Vestal (1918) mapped a series of nine small glacial drift hill prairies just east of Charleston. More recently, Reeves, *et al.* (1978) studied the soil and climate of east-central Illinois glacial drift hill prairies, while Ebinger (1981) surveyed the vegetation of these prairies.

Present observations indicate that glacial drift hill prairies are relatively transient plant communities in east-central Illinois. While small degraded remnants occasionally are found, the few that remain are being rapidly eliminated by encroaching woody vegetation. The present study was undertaken to determine this encroachment on the Waterworks Ravine Hill Prairie, one of the largest still in existence, and compare the results with an adjacent degraded hill prairie remnant that in 1918 Vestal had described as the largest hill prairie in the area.

METHODS

The study area was the region where Vestal (1918) had mapped the extent of nine small glacial drift hill prairies 70 years ago. This area, locally referred to as the Waterworks Ravine, is located about 1 mile east of Charleston, in Coles County, Illinois (Sect. 24, T12N, R9E). The Waterworks Ravine Hill Prairie occurs in this ravine on a steep south- to southwest-facing slope above an intermittent stream that enters Lake Charleston one half mile to the east.

In early Spring of 1988, the size of the remaining prairies in the Waterworks Ravine was determined. Areas with prairie grasses were considered prairie or prairie remnants. Two areas in the ravine were chosen for future study, one being the Waterworks Ravine Hill Prairie (Area A), and one a degraded prairie remnant (Area B) described by Vestal (1918) as the largest hill prairie in the area.

The entire Waterworks Ravine Hill Prairie (Area A) was divided into 2 × 2 m plots (136 plots). In the degraded remnant (Area B) a quadrat 10 m on a side was placed in the area where some prairie species were still found, and divided into 2 × 2 m plots (25 plots). All woody plants that usually are not associated with prairies were counted, identified (Mohlenbrock, 1975), and their frequencies and densities (stems/ha) calculated for both areas.

RESULTS AND DISCUSSION

Of the nine glacial drift hill prairies mapped by Vestal (1918) one remains a hill prairie with typical prairie vegetation, three other small remnants degraded by woody species encroachment could be located, while no trace exists of the other five. Of these nine areas, the one described by Vestal (1918) as "mostly bare clay with scattered bunches of *Andropogon scoparius*", is now the best quality hill prairie being 544m^2 in size (Area A). The prairie area described as the largest is now a small remnant degraded by woody species encroachment, and was used as a comparison plot (Area B). It is about 30 m west of Area A.

Area A is presently dominated by a fairly dense stand of *Sorghastrum nutans* (L.) Nash., while *Euphorbia corollata* L., *Melilotus alba* Desr., *Silphium terebinthinaceum* Jacq., *Solidago nemoralis* Ait. and *Physostegia virginiana* (L.) Benth. are the common forbs. Prairie shrubs include *Ceanothus americanus* L. and *Rosa carolina* L. (Ebinger, 1981; Reeves *et al.*, 1978). Within the plots of Area A, 23 invading woody species were found, averaging 9,537 stems/ha (Table 1). *Euonymus alatus* is the dominant invading species of this area with 2,518 stems/ha, and a frequency of 32%. *Cornus florida*, *Viburnum prunifolium*, *Ostrya virginiana*, and *Quercus velutina* also are common, averaging between 1,710 and 735 stems/ha, and having frequencies of 15% or higher.

In the degraded glacial drift hill prairie, Area B, 17 encroaching woody species were found in the plots, averaging 47,900 stems/ha (Table 1). Again, *Euonymus alatus* is the most commonly encountered species, averaging 13,100 stems/ha, and being found in all of the plots examined. Other common species include *Viburnum prunifolium*, *Toxicodendron radicans*, *Cornus florida*, and *Diospyros virginiana*, averaging between 7,900 and 4,900 stems/ha, and having frequencies of 68% or higher. In both areas most of the woody individuals are less t han 2.5 cm dbh, while none were encountered with a dbh greater than 12.5 cm.

Of the invading woody species, *Euonymus alatus* dominates on both areas. Other common invaders in both areas are *Viburnum prunifolium* and *Cornus florida*, while *Quercus velutina* is common in Area A, but is relatively unimportant in Area B. Also, Area A has a higher diversity of invading species with *Hydrangea arborescens*, *Quercus muhlenbergii*, *Tilia americana* L., *Carya ovata* (Mill.) K. Koch., *Liriodendron tulipifera* L., *Viburnum recognitum* Fern., *Rhamnus cathartica* L., *Crataegus mollis* (T. & G.) Scheele, and *Rhus glabra* L. being found here but not in Area B. In contrast, *Toxicodendron radicans* and *Diospyros virginiana* are common invading species in Area B, but not in Area A; while *Diospyros virginiana*, *Acer saccharum*, and *Xanthoxylum americanum* Mill. are absent from Area A.

Euonymus alatus (burning-bush) was reported as naturalized in Illinois by Ebinger and Phillippe (1973). This species, which is native to eastern Asia, is a commonly planted ornamental that is becoming a problem in some natural areas (Ebinger, 1983). In the woods the Waterworks Ravine, burning-bush has an abundance about 10 times greater than that recorded for all other woody species combined. Ebinger (1983) found that *E. alatus* seedlings exceeded 150,000 stems/ha, saplings averaged 1,700 stems/ha, with some individuals more than 5 cm dbh and exceeding 30 years in age. The present data suggest that this species will be a major invader of glacial drift hill prairies when a seed source occurs in the immediate area.

In general, the total number of woody invading species encountered in plots at the edge of Area A are much higher than the number found in the inner plots, where many plots lack woody invading species. In the plots at the edge of study Area A, woody plants average 17,666 stems/ha, while in the inner plots woody plants average 3,125 stems/ha. This indicates that encroachment is taking place at the edge of the prairie. It appears that shading by surrounding woody vegetation may be creating a microclimate favoring the woody invading species at the expense of the natural prairie vegetation. If this trend continues on the Waterworks Ravine Hill Prairie, woody species encroachment will eliminate this prairie within the next 70 years.

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Table 1. Frequency (%) and density (stems/ha), of all woody stems encountered on the Waterworks Ravine Hill Prairie (Area A), and on an adjacent degraded glacial drift hill prairie (Area B).

	AREA A		AREA B	
	Freq. %	Density (stems/ha)	Freq. %	Density (stems/ha)
Euonymus alatus Thunb.	32	2518	100	13100
Cornus florida L.	26	1710	72	5600
Viburnum prunifolium L.	18	1176	68	7900
Ostrya virginiana (Mill.) K. Koch	18	1066	32	1700
Quercus velutina Lam.	15	735	4	200
Hydrangea arborescens L.	2	478	—	—
Malus ioensis (Wood) Britt.	9	422	20	800
Lonicera maackii Maxim.	7	220	44	1600
Fraxinus americana L.	6	202	40	1600
Toxicodendron radicans (L.) Kuntze	4	202	72	6700
Ligustrum vulgare L.	6	165	36	1300
Quercus muhlenbergii Engelm.	4	110	—	—
Liriodendron tulipifera L.	3	110	—	—
Cercis canadensis L.	2	74	36	1300
Diospyron virginiana L.	—	—	68	4900
Acer saccharum Marsh.	—	—	8	500
Elaeagnus umbellata Thunb.	1	74	8	200
Others	—	275	—	500
TOTALS	—	9537	—	47900