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Vascular Flora of Capel Glacial Drift Hill Prairie Natural Area, Shelby County, Illinois

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ABSTRACT

The vascular flora of Capel Glacial Drift Hill Prairie Natural Area, Shelby County, Illinois was studied during the 2009 and 2010 growing seasons. The 1.10 ha glacial drift hill prairie is located on a southwest-facing slope associated with Lake Shelbyville, Wolf Creek State Park 4 km east of Findley, Illinois. Plant community structure was determined using m^2 square quadrats located at one-meter intervals along two randomly located transect lines. Frequency, mean cover, relative frequency, relative cover, and importance value (I. V. total = 200) were determined from the data collected. A total of 106 vascular plant taxa were observed on the site, with 39 encountered in the plots. *Andropogon gerardii* (big bluestem) had the highest importance value followed by *Schizachyrium scoparium* (little bluestem), *Echinacea pallida* (pale coneflower), and *Dalea purpurea* (purple prairie clover). Exotic species were represented by six taxa.

Key Words: *Andropogon gerardii,* glacial hill prairie formation, soil slumping.

INTRODUCTION

Small prairie openings in the forested landscapes of east-central Illinois were first described and named "hill prairies" by Vestal (1918). These small prairies (mostly < 1 ha), now refer to as glacial drift hill prairies, developed near the crest of slopes or spurs on mostly Wisconsin age glacial till. In east-central Illinois these prairie openings have been studied in Coles County (Ebinger 1981, Reeves et al. 1978, Owens and Cole 2003, Behnke and Ebinger 1989), Vermilion County (Owens and Ebinger 2008) and on Illinoian glacial till in Jasper County (Edgin et al. 2010). Glacial drift hill prairies have also been studied in central Illinois in Moultrie County (Owens et al. 2006), Macoupin County (McClain et al. 2002), and are not uncommon in the Illinois River valley from Peoria and Tazewell counties north through Marshall, Woodford, and Putnam counties (McFall and Karnes 1995).

Glacial drift hill prairies have many edaphic, physical, and floristic similarities. They occur on steep south- to southwest-facing slopes with well-drained soils that are low in organic content and nutrients (Ebinger 1981, McClain et al. 2002, Owens et al. 2006,

Owens and Ebinger 2008). The predominant vegetation is native warm season clump grasses complemented by prairie forbs with a sparse vegetation ground cover. Drying winds, unstable soil, fire, cutting, and grazing were thought to play significant roles in the development and maintenance of these sites (Vestal 1918, Reeves et al. 1978). The present study was undertaken to describe the composition and structure of the vegetation of Capel Glacial Drift Hill Prairie Natural Area. This prairie was added to the Illinois Natural Areas Inventory in 1999 and is considered to be of high natural quality.

DESCRIPTION OF THE STUDY SITE

Capel Glacial Drift Hill Prairie Natural Area is located on a southwest-facing slope overlooking Lake Shelbyville in Wolf Creek State Park, 4 km east of Findley, Shelby County, Illinois (SW1/4, NE1/4, Section 7, T12N, R5E). This 1.10 ha prairie is located at an elevation of about 190 m on the Shelbyville terminal moraine of Wisconsin glaciation in the Grand Prairie Section of the Grand Prairie Natural Division (Schwegman 1973). Tallgrass "black soil" prairie dominated the extensive flat to gently rolling uplands of this natural division, the forests being mostly restricted to floodplains and dissected topography of river valleys and other hilly areas (Anderson 1991, Ebinger and McClain 1991). Lake Shelbyville was formed when the Kaskaskia River was dammed just east of the town of Shelbyville in 1970 by the Army Corps of Engineers. Small prairie opening are occasionally encountered in the rough topography surrounding the lake where edaphic and microclimatic conditions combined to produce excessively droughty sites (Reeves et al. 1978, Edgin et al. 2010). The forest communities found at Wolf Creek State Park were discussed by Newell et al. (1991).

The soil of the glacial drift hill prairie is Miami loam, a highly eroded soil with little of the original A horizon present, the original loess deposits having eroded away (Gotsch 1996). This soil, which is on 18 to 30 % slopes, is well drained, low in organic content, slightly acid, and commonly low in available phosphorus and potassium. Many gravel size pebbles are imbedded in the soil. In this part of Illinois annual precipitation averages 97.5 cm, with April having the highest rainfall (9.4 cm). Mean annual temperature is 11.8 $^{\circ}$C with July being the hottest month (average of 24.6 $^{\circ}$C), the coldest being January (-3 $^{\circ}$C). The average number of frost-free days is 171 (Midwestern Regional Climate Center 2011).

First examined in 1998 by personnel from the Illinois Department of Natural resources (Smith1998), Capel Glacial Drift Hill Prairie was first burned in the spring of 1999. Subsequent management efforts have focused on control of *Melilotus albus* (white sweet clover) and *Securigera varia* (crown vetch). Prescribed burning was conducted in April of 2005 and 2010, and a wild fire burned the site in the spring of 2011.

MATERIALS AND METHODS

Collections of the vascular flora of the prairie and adjacent open woodland margin were made periodically during the 2009 and 2010 growing seasons. Voucher specimens were collected for most taxa and deposited in the Stover-Ebinger Herbarium of Eastern Illinois University, Charleston (EIU). Nomenclature follows Mohlenbrock (2002), and the

assignment of exotic species status was determined using Taft et al. (1997) and Mohlenbrock (2002).

Quantitative sampling was conducted in late summer of 2010 using m^2 quadrats located at one-meter intervals along two randomly placed 25 m transects oriented perpendicular to the slope (n = 25 per transect). Even-number quadrats were placed to the right, odd-numbered to the left of each transect. Percent cover of each species was determined using Duabenmire cover class system (Daubenmire 1959) as modified by Bailey and Poulton (1968): 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%. From these data, frequency (%), mean cover (%), relative frequency, relative cover, and Importance Value [relative frequency + relative cover) were determined.

The Floristic Quality Index (FQI) was determined using the coefficient of conservatism (CC) assigned to each species by Taft et al. (1997). As used here, the FQI is a weighted index of species richness (N) and is the arithmetic product of the mean coefficient of conservatism (C-value), multiplied by the square root of species richness ($\sqrt{N}$) of the site [FQI = C-value ($\sqrt{N}$)].

RESULTS

Floristic Composition

At total of 106 vascular plant species were collected or observed in and at the edge of the prairie (Appendix I). Of the species present 26 were monocots in five families while 80 were dicots in 31 families. Seven non-native (exotic) taxa were found with only *Melilotus albus* occurring in the plots. Predominant plant families were Asteraceae (24 species), Poaceae (19), and Fabaceae (10). No state endangered or threatened species were observed (Illinois Endangered Species Protection Board 2005). The C-value and FQI for all species were 4.54 and 46.7 respectively with 21 species having a CC of seven or more.

Ground Layer

Of the 106 species encountered on the prairie 39 were found in the plots (Table 1). Prairie grasses were the most important species. *Andropogon gerardii* (big bluestem) dominated with the highest importance value (I.V. of 38.5) and mean cover (24.57%), followed by *Schizachyrium scoparium* (little bluestem) (I.V. of 25.3 and a mean cover of 13.99%). Other species with importance values ±10.0 included *Echinacea pallida* (pale coneflower), *Dalea purpurea* (purple prairie clover), *Aster oolentangensis* (sky-blue aster), and *Asclepias viridiflora* (green milkweed). Five woody species were recorded in the plots, *Rosa carolina* (Carolina rose) with an I.V. of 6.1, *Cornus drummondii* (rough-leaved dogwood) with an I.V. of 1.3, and seedlings of three tree species (*Carya ovata, Quercus stellata*, and *Sassafras albidum*).

Table 1. Frequency (%), mean cover (% of total area), relative frequency, relative cover, and importance value (I.V.) for the ground layer species at Capel Glacial Drift Hill Prairie Natural Area, Wolf Creek State Park, Shelby County, Illinois. (*exotics)

Species	Freq. %	Mean Cover	Rel. Freq.	Rel. Cover	I. V.
Andropogon gerardii	90	24.57	8.6	29.9	38.5
Schizachyrium scoparium	88	13.99	8.4	16.9	25.3
Echinacea pallida	98	11.92	9.3	14.4	23.7
Dalea purpurea	82	4.91	7.8	5.9	13.7
Aster oolentangensis	70	5.35	6.7	6.5	13.2
Asclepias viridiflora	84	2.78	8.0	3.4	11.4
Euphorbia corollata	68	1.81	6.5	2.2	8.7
Brickellia eupatorioides	56	1.56	5.3	1.9	7.2
Aster patens	38	2.76	3.6	3.3	6.9
Rosa carolina	34	2.36	3.2	2.9	6.1
Lithospermum canescens	48	0.59	4.6	0.7	5.3
Lespedeza virginica	36	1.40	3.4	1.7	5.1
Coreopsis palmata	30	1.22	2.9	1.5	4.4
**Melilotus albus*	34	0.56	3.2	0.7	3.9
Hypericum sphaerocarpum	34	0.47	3.2	0.6	3.8
Aureolaria grandiflora	14	1.33	1.3	1.6	2.9
Sporobolus cryptandrus	26	0.28	2.5	0.3	2.8
Solidago nemoralis	16	1.00	1.5	1.2	2.7
Silphium integrifolium	10	1.02	1.0	1.2	2.2
Carex pensylvanica	12	0.69	1.1	0.8	1.9
Cornus drummondii	6	0.61	0.6	0.7	1.3
Ruellia humilis	12	0.06	1.1	0.1	1.2
Comandra umbellata	10	0.10	1.0	0.1	1.1
Ipomoea pandurata	6	0.42	0.6	0.5	1.1
Physostegia virginiana	8	0.14	0.8	0.2	1.0
Pycnanthemum pilosum	6	0.37	0.6	0.4	1.0
Tree seedlings (3 species)	8	0.09	0.8	0.1	0.9
Elymus virginicus	4	0.02	0.4	--	0.4
Taenidia integerrima	4	0.02	0.4	--	0.4
Eupatorium serotinum	2	0.06	0.2	0.1	0.3
Helianthus divaricatus	2	0.06	0.2	0.1	0.3
Helianthus mollis	2	0.06	0.2	0.1	0.3
Antennaria plantaginifolia	2	0.01	0.2	--	0.2
Aster turbinellus	2	0.01	0.2	--	0.2
Galium circaezans	2	0.01	0.2	--	0.2
Polygala senega	2	0.01	0.2	--	0.2
Scutellaria leonardii	2	0.01	0.2	--	0.2
Totals		82.63	100.0	100.0	200.0
Bare ground and litter		26.24			

DISCUSSION

The glacial drift hill prairies of east-central Illinois are characterized by similar soils (type, structure, stability, slope, exposure), flora (common prairie grasses and forbs as well as few conservative prairie species), and bare ground (25 to 50% of the total cover), but commonly differ in size, species richness, and distribution and abundance of the dominant grass species. These differences are likely related to edaphic characteristics of the sites. Some of the glacial drift hill prairies, particularly those in Macoupin County (McClain et al 2002) and Jasper County (Edgin et al. 2010) are on more shallow slopes, are larger, and have higher species richness. In these hill prairies *Andropogon gerardii* commonly dominates and the soils are stable, soil slumping being uncommon. The glacial drift hill prairies of the Middle Fork of the Vermilion and the upper Embarras Rivers (Coles and Vermilion Counties), in contrast, are usually on steeper slopes, tend to be somewhat smaller, and have lower species richness. Also, *Schizachyrium scoparium* and *Sorghastrum nutans* are the most abundant grasses while *Andropogon gerardii* is apparently a minor component (Edgin et al. 2010). In these hill prairies soil slumping is common.

Slumping, the down-hill movement of large masses of soil, is a characteristic of many glacial drift hill prairies in central Illinois. The sparse prairie vegetation can not hold the tremendous weight of the saturated clay soil on the steep slopes. In wet years, soil breaks away and slide down hill, taking prairie vegetation, shrubs, and sometimes large trees with it. On Capel Hill Prairie excessive soil slumping, due to shoreline erosion of Lake Shelbyville, has limited the size of the prairie. The slumping has helped maintain the hill prairie by eliminating surrounding trees and by creating bare ground which rapidly succeeds to a community containing mostly prairie grasses and forbs (Owens et al. 2006). Slumping facilitates an early succession stage that seems to be favorable to *Schizachyrium scoparium* (Vestal 1918). This sun-loving, early to mid-successional species is usually associated with drier sites with poorer soils and tends to decrease with succession.

Capel Hill Prairie is located 11 km southwest of Coneflower Glacial Drift Hill Prairie in Moultrie County (Owens et al. 2006). This prairie, which is located on the Cerro Gordo recessional moraine of Wisconsin glaciation, occurs on a moderate slope with eroded, well-drained Miami silt loam soil that is slightly acidic and has low organic content. On both Coneflower and Capel hill prairies *Andropogon gerardii* was the dominant grass while *Schizachyrium scoparium* ranked second among the grasses. Though similar, Capel Hill Prairie has low species diversity (106 taxa) and has excessive soil slumping due to its position on the Lake Shelbyville shoreline, Coneflower Hill Prairie, in contrast, has high species diversity (164 taxa), and minimal soil slumping. Excessive disturbances are probably responsible for some of this lack of diversity. It is very possible that previous to the formation of Lake Shelbyville, Capel Hill Prairie had minimal slumping. The undercutting of the shoreline by wave action is undoubtedly responsive for the present excess slumping, and may be responsible for the low species diversity. Five species originally reported as occurring on this hill prairie (Smith 1998) (*Calystegia spithamaea*, *Helenium autumnale*, *Liatris aspera*, *Polygala verticillata, Pycnanthemum tenuifolium*) were not observed during the two years of our study.

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Appendix I. Vascular plant species encountered Capel Glacial Drift Hill Prairie Natural Area, Wolf Creek State Park, Shelby County, Illinois are listed alphabetical by family under the major plant groups. Collecting numbers (JEE) are listed after each species. Specimens are deposited in the Ebinger/Stover Herbarium (EIU), Eastern Illinois University, Charleston. Species followed by INAI (Illinois Natural Areas Inventory) were observed on the site during the original survey by the INAI. During the present study most of these species were observed. (*exotics)

DICOTS

Acanthaceae
Ruellia humilis Nutt.:33032

Apiaceae
Taenidia integerrima (L.) Drude:33074

Asclepiadaceae
Asclepias purpurascens L.:32912
Asclepias tuberosa L.:32407
Asclepias viridiflora Raf.:32911

Asteraceae
Achillea millefolium L.:32913
Ambrosia artemisiifolia L.:32689
Antennaria plantaginifolia (L.) Hook.:32760
Arnoglossum atriplicifolium (L.) H. Robins.:32409
Aster oolentangiensis Riddell:32690
Aster patens Ait.:32384
Aster turbinellus Lindl.:32385
Brickellia eupatorioides (L.) Shinners:32410
Coreopsis palmata Nutt.:32411
Echinacea pallida (Nutt.) Nutt.:32412
Erigeron strigosus Muhl.:32914
Eupatorium altissimum L.:32691
Eupatorium serotinum Michx.:32692
Helenium autumnale L.:INAI
Helianthus divaricatus L.:32413
Helianthus mollis Lam.:INAI (observed)
Liatris aspera Michx.:INAI
Parthenium integrifolium L.:32414
Ratibida pinnata (Vent.) Barnh.:33075
Silphium integrifolium Michx.:32415
Solidago nemoralis Ait.:32386
Solidago speciosa Nutt.:32693
Solidago ulmifolia Muhl.:32437
Verbesina helianthoides Michx.:32416

Boraginaceae
Lithospermum canescens (Michx.) Lehm.:32756

Caprifoliaceae
Viburnum prunifolium L.:32694
Viburnum rafinesquianum Schultes:33031

Cistaceae
Lechea tenuifolia Michx.:32417

Convolvulaceae
Calystegia spithamaea (L.) Pursh:INAI
Ipomoea pandurata (L.) G.F.W. Mey.:32418

Cornaceae
Cornus drummondii C.A. Mey.:32439
Cornus florida L.:32766

Ebenaceae
Diospyros virginiana L.:32440

Elaeagnaceae
**Elaeagnus umbellata* Thunb.:32696

Euphorbiaceae
Euphorbia corollata L.:32419

Fabaceae
Dalea candida (Michx.) Willd.:32441
Dalea purpurea Vent.:32420
Desmodium sessilifolium (Torr.) Torr. & Gray.:32442
Lespedeza capitata Michx.:32698
**Lespedeza cuneata* (Dum.-Cours.) G. Don:32699
Lespedeza violacea (L.) Pers.:32700
Lespedeza virginica (L.) Britt.:32421
**Melilotus albus* Medic.:32422
**Melilotus officinalis* (L.) Pallas:32915
**Securigera varia* (L.) Lassen:32697

Fagaceae
Quercus muhlenbergii Engelm.:32701
Quercus stellata Wangh.:32916

Gentianaceae
Frasera caroliniense Walt.:32755

Hypericaceae
Hypericum sphaerocarpum Nutt.:32423

Juglandaceae
Carya tomentosa (Poir.) Nutt.:33076

Lamiaceae
Hedeoma pulgioides (L.) Pers.:32702
Monarda bradburiana Beck.:32703
Physostegia virginiana (L.) Benth.:32704
Pycnanthemum pilosum Nutt.:32424
Pycnanthemum tenuifolium Schrad.:INAI
Scutellaria leonardii Epling:32443

Lauraceae
Sassafras albidum (Nutt.) Nees:INAI (observed)

Oxalidaceae
Oxalis violacea L.:32759

Polyalaceae
Polygala senega L.:32444
Polygala verticillata L.:INAI

Portulacaceae
Claytonia virginica L.:32761

Primulaceae
Lysimachia lanceolata Walt.:32917

Ranunculaceae
Ranunculus fascicularis Bigel:32758

Rhamnaceae
Ceanothus americanus L.:32425

Rosaceae
Amelanchier arborea (Michx. F.) Fern.:32763
Rosa carolina L.:32445

Rubiaceae
Galium circaezans Michx.:32426
Houstonia lanceolata (Poir.) Britt.:32446

Santalaceae
Comandra umbellata (L.) Nutt.:INAI (observed)

Scrophulariaceae
Agalinus tenuifolia (Vahl.) Raf.:32388
Aureolaria grandiflora (Benth.) Pennell:32427
Penstemon pallidus Small:32428

Violaceae
Viola pedata L.:32764
Viola pratincola Greene:32757

Vitaceae
Parthenocissus quinquefolia (L.) Planch.:INAI (observed)

MONOCOTS
Cyperaceae
Carex brachyglossa Mack.:33030
Carex hirsutella Mack.:32905a
Carex muhlenbergii Schk.:32429
Carex pensylvanica Lam.:32762

Iridaceae
Sisyrinchium albidum Raf.:32765

Liliaceae
Allium canadense L.:32905

Orchidaceae
Spiranthes magnicamporum Sheviak:32389

Poaceae
Agrostis gigantea Roth:32380
Agrostis hyemalis (Walt.) BSP.:32906
Bromus pubescens Muhl.:32907
Andropogon gerardii Vitman:32430
Danthonia spicata (L.) Roem. & Schultes:32705
Dichanthelium acuminatum (Sw.) Gould & Clark:32706
Dichanthelium depauperatum Muhl.:32908
Elymus x ebingeri G.C. Tucker:32382
Elymus canadensis L.:32432
Elymus histrix L.:32707
Elymus virginicus L.:32381
Festuca subverticillata (Pers.) E.B. Alexeev:32909
**Poa compressa* L.:32433
**Poa pratensis* L.:INAI (observed)
Schizachyrium scoparium (Michx.) Nash:32434
Sphenopholis obtusata (Michx.) Scribn.:33910
Sporobolus cryptandrus (Torr.) Gray:32448
Sporobolus heterolepis (Gray) Gray:32708
Tridens flavus (L.) Hitchc.:32709