Vegetation and Flora of the Sand Deposits of the Mississippi River Valley in Northwestern Illinois

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Illinois Natural History Survey Bulletin
Volume 37, Article 6

October 2006

Illinois Natural History Survey, David L. Thomas, Chief
A Division of the Illinois Department of Natural Resources

Illinois Natural History Survey
Distribution Office
I-Building
1816 South Oak Street
Champaign, IL 61820

Citation:

Ebinger, J.E., L.R. Phillippe, R.W. Nÿboer, W.E. McClain, D.T. Busemeyer, K.R. Robertson, and G.A. Levin. 2006. Vegetation and flora of the sand deposits of the Mississippi River valley in northwestern Illinois. Illinois Natural History Survey Bulletin 37(6):191–238.

Editor: Charles Warwick

US ISSN 0073-4918

Printed by authority of the State of Illinois
P0109796—.75M—09-06

Printed with soy ink on recycled and recyclable paper.

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ACKNOWLEDGMENTS

The authors thank the Illinois Department of Natural Resources for funding parts of this project through the Illinois Wildlife Preservation Fund as well as other funding sources, the Illinois Nature Preserves Commission for allowing access to the nature preserves, the United States Army for access to the Savanna Army Depot when it was under their control, and the United States Fish and Wildlife Service for access to the Lost Mound Unit of the Upper Mississippi River Wildlife and Fish Refuge in 2004 and 2005. We also thank Dr. Gordon Tucker, Eastern Illinois University, for his help in identification of the Cyperaceae. Special thanks go to Dr. John B. Taft, scientist at the Illinois Natural History Survey, for his help with the statistical analysis, particularly the Principal Components Analysis (PCA).

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ABSTRACT

This study was undertaken to determine vascular plant species composition, vegetation structure, and floristic quality of the major plant communities in the windblown sand deposits of northwestern Illinois during the growing seasons of 2002 through 2005. The major plant communities of the Ayers Sand Prairie Nature Preserve in Carroll County, Big River State Forest in Henderson County, Lost Mound Unit of the Upper Mississippi River Wildlife and Fish Refuge in Carroll and Jo Daviess counties, and the Thomson-Fulton Sand Prairie Nature Preserve located in Whiteside County were examined and the importance values determined for the plant species present. Located on broad terraces of the Mississippi River, these nature preserves and natural areas are remnants of a larger grassland/savanna/forest complex that contained extensive marsh; wet, mesic, and dry sand prairie; sand savanna; and sand forest communities. Most of the sand deposits are now cultivated and the original vegetation is found only in protected remnants, some of which are relatively large. The mature dry sand prairies were dominated by *Schizachyrium scoparium*; other important species were *Opuntia macrorhiza*, *Dichanthelium villosissimum*, *Ambrosia psilostachya,* and *Tephrosia virginiana*. Other assemblages of prairie and exotic species were encountered in successional sand prairie communities. Generally, the mature prairie communities in these preserves and natural areas had 35 or more species present in the study plots. Savanna and closed canopy forest communities were also examined. The dry sand savannas were dominated by *Quercus velutina* and *Q. marilandica*, dry sand forests were dominated by *Q. velutina*, and dry-mesic sand forests were dominated by *Q. alba* and *Q. velutina*.

INTRODUCTION

Glacial outwash, windblown sand deposits are common in the northern half of Illinois due to erosional events associated with Wisconsian glaciation (Willman and Frye 1970, Schwegman 1973, King 1981). The most extensive are the Kankakee sand deposits in northeastern Illinois and the Illinois River sands of Cass, Mason, and Tazewell counties in central Illinois. Numerous smaller sand deposits also occur, including the sands along the upper Mississippi River and its tributaries, the Green River Lowlands sand deposits of Lee and Henry counties in northwestern Illinois, and the Chicago Lake plain and beaches along Lake Michigan in northeastern Illinois.

These sand deposits, named the Parkland Sand or the Parkland Formation, consist of windblown sand in dunes and in sheetlike deposits between and bordering the dunes (Willman and Frye 1970). The dunes are usually found on terraces along the major river valleys in the northern half of Illinois, and consist of medium-grained sands that are sorted by wind from the underlying glacial outwash. These sands were reworked by wind forming the dune and swale topography characteristic of these deposits. Dunes 6 to 12 meters high are common and occasional dunes to 30 m tall are encountered (Gleason 1910).

Extensive glacial outwash, windblown sand deposits are scattered throughout the lowlands of the Mississippi River in northwestern Illinois (Fig. 1). Referred to as the Mississippi River Section of the Illinois River and Mississippi River Sand Areas Natural Division, these scattered deposits occur from Jo Daviess County south to Henderson County (Schwegman 1973). Some of these deposits were formed when glacial lakes (Lake Milan and Lake Cordova) in Carroll, Henry, Rock Island, and Whiteside counties drained (Fig. 1). Others were deposited during flood events during the retreat of the Wisconsin Glacier when moraines and ice dams were breached and glacial lakes to the north of Illinois drained (Willman and Frye 1970).

Dry habitats are characteristic of sand deposits, and the commonly associated species are those adapted to xeric conditions. However, plant communities of sand deposits are extremely diverse and include sand ponds (McClain et al. 1997), marshes and sedge meadows (Handel et al. 2003, Feist et al. 2006), prairies (Handel et al. 2003, McClain et al. 2003, 2004, Phillippe et al. 2004), savannas and woodlands (McDowell et al. 1983, Johnson and Ebinger 1992, 1995), closed forests (Jenkins et al. 1991, Coates et al. 1992, McClain et al. 2002), and flatwoods (McDowell et al. 1983).

Some of the most comprehensive early work completed on the vegetation of Illinois sand deposits was undertaken in the early 1900s by Dr. Henry Allen Gleason, an ecologist and plant geographer then at the Illinois Natural History Survey, and by Arthur G. Vestal, a botanist at the University of Illinois (Hart and Gleason 1907, Gleason 1910, Vestal 1913). These authors described the principal plant communities and discussed the animals associated with these sand deposits, particularly the insects.

Except for the early work by Gleason (1910), little has been published concerning the vegetation of sand deposits along the Upper Mississippi River valley in northwestern Illinois. Though most of these scattered sand deposits are now under cultivation, a fairly extensive preserve system has maintained some of this former diversity. The present study was undertaken to determine vascular plant species composition, vegetation structure of the different plant communities based on the life forms of the species present, and the floristic quality of the major plant communities of the nature preserves and other natural areas located in the windblown sand deposits of the Mississippi River Section of the Illinois River and Mississippi River Sand Areas Natural Division in northwestern Illinois.

STUDY SITES

All of the study sites are located within 150 km of each other, and are within a few km of the Mississippi River (Fig. 1). The climate associated with these sand deposits is continental with warm summers and cold winters. Based on weather data from Dixon, Illinois, 50 km east of the Mississippi River near the middle of the study area, mean annual precipitation is 94.7 cm, with June having the highest rainfall (12.4 cm). Mean annual temperature is 8.5°C with the hottest month being July (average of 22.3°C), and the coldest January (average of -7.9°C). The average number of frost-free days is 161 (Midwestern Regional Climate Center 2005).

Lost Mound Unit of the Upper Mississippi River Wildlife and Fish Refuge: Lost Mound is located in northwest Carroll and southwest Jo Daviess counties on the former Savanna Army Depot (42.2410°N, -90.3380°W [WGS84/NAD83]). Gleason (1910), in his classic monograph "Vegetation of the Inland Sand Deposits of Illinois," first described this extensive prairie, which was known as "The Prairie" by local residents. Little of the area was destroyed by cultivation, as grazing was the primary agricultural use of the area. In 1918 the U.S. army purchased most of "The Prairie" to use as an artillery test range. While ownership by the army prevented the large-scale conversion of this area to row crops, the landscape was damaged with the construction of warehouses and other structures that were used to store munitions, and the roads and railroads used to transport them.

The army's mission required preventing wildfires in the extensive remaining prairie. The army restricted the potential for fires by introducing grazing to the area beginning in the late 1940s. Whereas cattle were the primary means of reducing vegetation cover, sheep were used for a time in the early 1950s. Recent cattle grazing leases typically began in late March and extended until November, with 1,000 to 1,200 cattle reducing the vegetation to a lawnlike condition (Robertson et al. 1997). Areas where watering tanks were established had even greater disturbance to the surrounding vegetation, often with extensive areas of bare sand exposed. Where cattle had access to the Mississippi River, side slopes of the sand bluffs were rutted and eroded. Also, changes in the river's hydrology to maintain the navigational channel, have created higher water levels that caused additional bluff erosion and sloughing. Cattle helped maintain some of the blowout communities by increasing disturbance. Recent grazing leases also had provisions to improve the grasslands. *Juniperus virginiana* (red cedar) and other brush were removed, and some herbaceous vegetation was planted. As part of this "improvement" program, some areas were seeded with a no-till drill to Eurasian cool-season grasses and adventive legumes, particularly *Bromus inermis* (awnless brome grass) and *Trifolium arvense* (rabbit-foot clover).

Even with the disturbances, the Illinois Natural Areas Inventory recognized most of the Savanna Army Depot as a statewide significant natural area because of the size of the prairie remnant, the potential for recovery, and the many rare plants and animals present (White 1978). Bowles and Jones (1995) noted the locations of numerous state-listed plants and

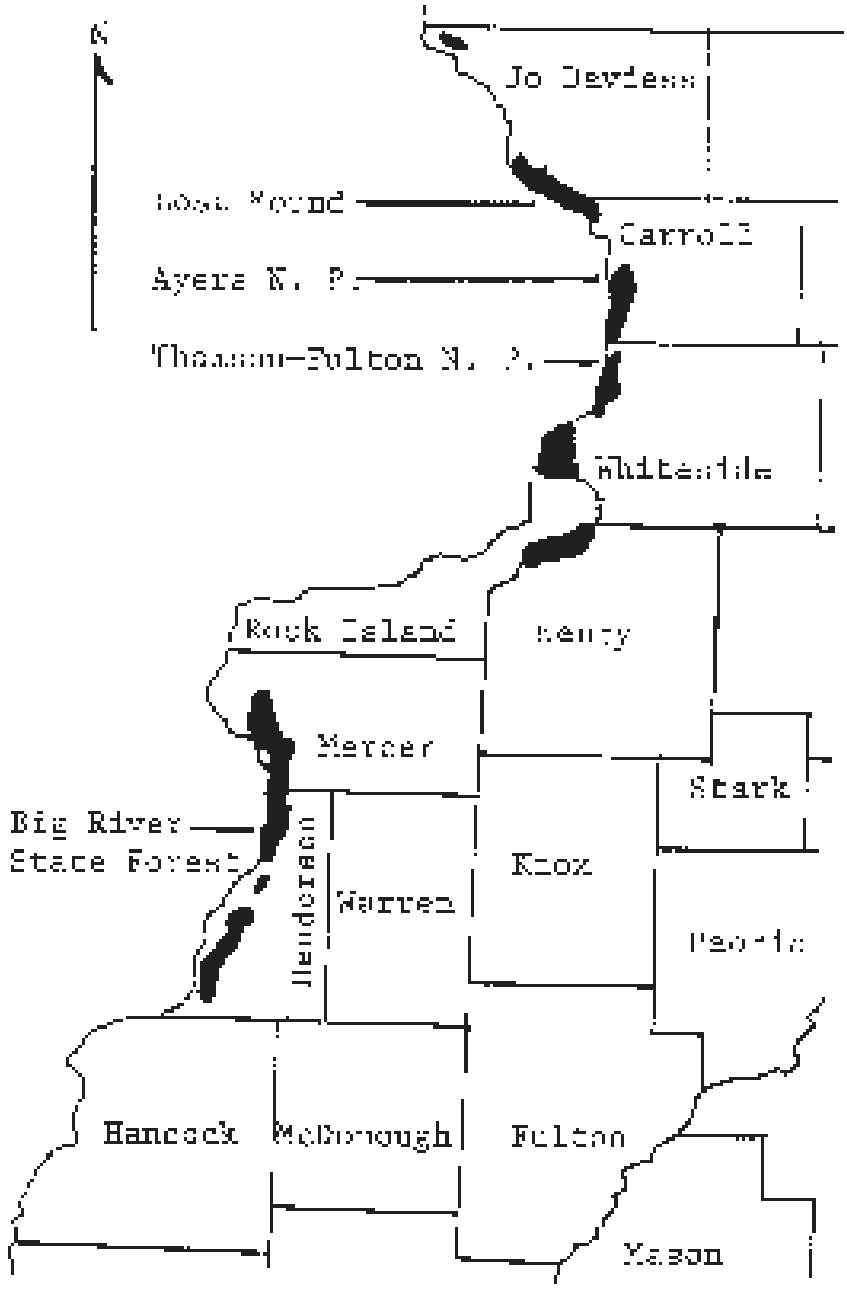

Figure 1. Distribution of sand deposits along the Mississippi River in northwestern Illinois from Jo Daviess County to Henderson County, Illinois. The general location of the four natural areas and nature preserves studies are also included.

prairies of high natural quality on the depot. As a result, staff of the Illinois Department of Natural Resources persuaded the army to fence some areas to exclude cattle, reduce the grazing period, and decrease the number of cattle on the depot. Grazing ceased in the late 1990s as the military mission was ended at the depot. The land first was transferred to the U.S. Fish and Wildlife Service in 2003. Some of the prairie parcels sampled have been transferred to the Illinois Department of Natural Resources and the Jo-Carroll Local Redevelopment Authority in later years.

The major soil type of Lost Mound is Sparta loamy sand that developed under prairie vegetation. This soil is found on flat to sloping areas, is excessively drained, and consists of deep, dark brown, friable, coarse sand that is underlain by fine loose yellow sand that is often exposed in blowouts (Tegeler 1996). The savanna soils are mostly on steep slopes and are classified as Chelsea loamy sands, which are excessively drained, dark grayish brown in color, and relatively thin; while the nearly level upland forest soils are classified as Bloomfield loamy fine sand and have a similar structure. The floodplain forest soils at Lost Mound are Birds silt loam, which are nearly level, poorly drained, and dark gray-brown in color.

Ayers Sand Prairie Nature Preserve: This preserve is located in northwestern Carroll County about 3 km south of Savanna (SE1/4 S24 T24N R3E; 42.0535°N, -90.1051°W [WGS84/NAD83]). This 46-ha area was dedicated as an Illinois Nature Preserve in 1974. Since dedication the preserve has been recovering from past grazing, off-road vehicle use, cultivation, and other disturbances. The southeastern and northwestern thirds of the preserve are recovering from heavy grazing and cultivation. Parts of the cultivated areas are rapidly reverting to sand prairie vegetation, while *Bromus inermis* and other cool-season introduced grasses dominate an extensive area in the southeastern part of the preserve. Some blowouts are present in the preserve, though most are now revegetated. The southwestern third of the preserve contains some high-quality dry sand prairie. This area is probably still recovering from past grazing, but was not cultivated. The Illinois Natural Area Inventory considered most of the preserve to be "Grade C" dry sand prairie due to extensive disturbances, though parts of the southwestern section were listed as "Grade B" with a few small areas of "Grade A" (White 1978). The soils of the preserve are Sparta loamy sands (Ray et al. 1975).

Thomson-Fulton Sand Prairie Nature Preserve: This preserve is located in extreme northwestern Whiteside County about 6 km northeast of Fulton, Illinois (SW1/4 S1 and SE1/4 S2 T22N R3E; 41.9253°N, -90.1113°W [WGS84/NAD83]), immediately south of the Carroll/Whiteside County line. It is a small part of the Thomson Sand Area that extends north into Carroll County. In Whiteside County this sand deposit covers nearly 85 km^2 (Smith et al. 1928). The preserve contains about 15 ha of sand prairie that are currently recovering from past grazing, off-road vehicle use, cultivation, and other disturbances. In portions of both the southern and northern parts of this prairie, several ha were plowed and planted to watermelons the year before being dedicated as a preserve by the Illinois Department of Conservation in 1970. This cultivated area is reverting to sand prairie vegetation. Disturbance by off-road vehicles increased the size and number of blowouts in the preserve. These areas are now recovering, many being revegetated, but some contain moving sand. Also, pines that were planted in parts of the prairie prior to acquisition, have been mostly removed. The Illinois Natural Area Inventory considered the area to be mostly "Grade C" dry sand prairie due to extensive disturbances (White 1978). The soils of the preserve are mostly Sparta loamy sand (Sabata 1995).

Big River State Forest: This state forest, which contains a few natural areas, is located in northwestern Henderson County, about 8 km north of Oquawka (S24, S25, S36 T12N R5W; 40.9920°N, -90.9205°W [WGS84/NAD83]). Two natural areas within the state forest were studied; a dry sand prairie (NW1/4 S36) and a degraded dry sand savanna (SW1/4 S25). Both sites have been subjected to past disturbances. The dry sand prairie was heavily grazed in the past and pines were planted along the east edge. The dry sand savanna was probably clear-cut soon after settlement and has been subjected to more recent cutting and fire suppression. The Illinois Natural Area Inventory considered most of the dry sand prairie to be of "Grade B" quality, while the dry sand savanna was listed as

"Grade C" due to the young trees of small size, fire suppression, and other disturbances (White 1978). The soils of the natural areas studied are light colored Plainfield sand and medium-dark colored Oquawka sand that are water-deposited sands of the Mississippi River terrace that have been reworked by wind (Veale and Wascher 1956).

MATERIALS AND METHODS

Vascular Plant Species and Community Types*:* The natural areas studied were visited a minimum of five times each year throughout the growing seasons of 2002 through 2005, except for the Lost Mound Unit, which was extensively studied on numerous earlier trips during the growing seasons of 1996 and 1997 by some of the authors (Robertson et al. 1997). Voucher specimens of each plant species were collected, identified, and deposited in the herbarium of the Illinois Natural History Survey, Champaign, Illinois (ILLS), and the Stover-Ebinger Herbarium of Eastern Illinois University, Charleston, Illinois (EIU). The species encountered are listed in Appendix I. This list of taxa includes the citation of voucher specimens of nearly all species that have been found in the natural areas studied, as well as a few taxa that were observed but not collected. The list also includes a few species reported by the Illinois Natural Area Inventory (INAI) for which vouchers could not be located. Criteria for designating adventive (non-native) species followed Mohlenbrock (2002), Gleason and Cronquist (1991), and Taft et al. (1997). Nomenclature follows Mohlenbrock (2002). We recorded the location of threatened and endangered plant species listed by Herkert and Ebinger (2002).

The plant communities encountered were described, for the most part, using the classification system of White and Madany (1978). All of the sand prairie communities examined during the present study would be described as various successional stages of a dry sand prairie, including the blowout and blowing sand communities discussed below. In some instances we added modifiers in parenthesis to indicate successional trends, and sometimes the dominant species when discussing a particular community. We consider a mature-to-late successional sand prairie to be equivalent to Grades A and B used by the Illinois Natural Area Inventory (INAI), while successional sand prairie to be equivalent to a low Grade B or C (White 1978). The INAI grading criteria are based on the perceived successional state of the vegetation with Grade A (essentially not degraded {high floriistic quality]) to Grade E (highly disturbed [i.e., cropland]).

Ground Layer Sampling*:* In the late summers of 2004 and 2005 transects were located randomly along cardinal compass directions within the sand prairie communities studied. These transects were located using aerial photographs and ground observation to ensure that they did not cross community boundaries. Within each community a 50-m-long transect was located. Along each transect, 1-m^2 quadrats were alternately located at 1-m intervals (n=50/transect). A random numbers table was used to determine the number of meters (0 to 9) a quadrat was located from the transect line. In some areas (Ayers Sand Prairie Nature Preserve, Thomson-Fulton Sand Prairie Nature Preserve, Big River State Forest) more than one 50-m transect was completed for each habitat type. Only the first transect completed in each habitat type was used in the calculations in this paper. Species cover was determined using the Daubenmire (1959) Cover Class System as modified by Bailey and Poulton (1968). The modified Daubenmire cover scale is as follows: Class 1 = 0 to 1%; Class 2 = >1 to 5%; Class 3 = >5 to 25%; Class 4 = >25 to 50%; Class 5 = >50 to 75%; Class 6 = >75 to 95%; Class 7 = >95 to 100%. Importance Value (IV) was determined by summing relative cover and relative frequency (total possible=200).

Overstory Sampling*:* Savanna and forest communities at Lost Mound and Big River were studied in the late summer of 2005. These areas were surveyed by dividing a portion of each savanna or forest community into contiguous quadrats 25 m on a side. These sample quadrats were located near the central part of each study area and more than 50 m from the nearest woodland edge. All living and dead-standing woody individuals ≥10.0 cm dbh were identified and their diameters recorded. From these data, living-stem density (stems/ha), basal area (m^2/ha), relative density, relative dominance, importance value (IV), and average diameter (cm) were calculated for each species. Determination of the IV follows the procedure used by McIntosh (1957), and is the sum of the relative density and relative

dominance (basal area) for a total sum of 200. Dead-standing density (stem/ha) and basal area (m^2/ha) were also determined. Woody understory composition and density (stems/ha) were determined using nested circular plots 0.0001, 0.001, and 0.01 ha in size located at 15-m intervals along randomly located east-west transects within each study area. Four additional 0.0001-ha circular plots were located 6 m from the center points of each plot center along cardinal compass directions. In the 0.0001-ha plots, woody seedlings (≤50 cm tall) were counted; in the 0.001-ha circular plots small saplings (>50 cm tall and <2.5 cm dbh) were recorded; and in the 0.01-ha circular plots large saplings (2.5-9.9 cm dbh) were tallied.

Data Analysis: The Floristic Quality Index (FQI) was determined for each nature preserve and natural area using the coefficient of conservatism (CC) assigned each species based on a species tolerance to disturbance and its fidelity to habitat integrity (Taft et al. 1997). The FQI, therefore, is a weighted index of species richness (N = number of species present on a site), and is the arithmetic product of the average coefficient of conservatism (C-Value = the average of all species CCs) multiplied by the square root of the native species richness (√N) of an inventory site: FQI = C-Value (√N). For relatively small areas that are intensively studied, the FQI gives a rapid means of comparison and an indication of the floristic integrity of the site. Using the FQI along with other floristic measures, such as quadrat-based sampling methods, provides a meaningful way of making comparisons among sites. Prairies with an FQI of 35 or higher are usually considered good-quality natural areas (Taft et al. 1997). Though area dependent, the FQI can still be useful in explaining the variation among sites of similar size and habitat (Taft et al. 2006). In our study, the FQI was determined for each of the four natural areas studied, as well as for each of the 15 sand prairie communities surveyed.

The Sorensen Index of Similarity (ISs) was used to determine the degree of vegetation similarity between the prairie areas surveyed throughout the Mississippi River sand deposits (Mueller-Dombois and Ellenberg 1974). In this index [ISs = 2C/A+B x 100], A equals the number of species in the first community, B equals the number of species in the second community, and C equals the number of species common between the two communities.

Cluster analysis was used to produce a hierarchical classification of sample transects from the sand prairie study sites (PC-ORD; McCune and Mefford 1999) and a variety of distance measures and linkage methods were explored. While there was some variation in the results among methods, cluster analysis using the Euclidean (Pythagorean) distance measure and Ward's linkage method produced a dendrogram similar to Sorensen Distance Measure and Farthest Neighbor Linkage method. This consensus of group clusters was integrated into ordination biplots using both Detrended Correspondence Analysis (DCA) and Principal Components Analysis (PCA). Since all samples (transects) were from a similar vegetation type (dry to dry-mesic sand prairie) and included many shared species, the dataset was amenable to analysis using the linear response model in PCA. Gradient lengths on the first DCA axis (2.5 standard deviations [SD]) were within the range where both linear and Gaussian methods can be effective ordination techniques (Ter Braak and Prentice 1988**,** Ter Braak 1995). Most plots (i.e., transects [12 of 15]) fall within 2 SD on the first DCA axis indicating most species are responding with little variation over the observed range of environmental conditions. Under these circumstances, a linear response model (e.g., PCA) is appropriate. The graphical depiction of the PCA biplot also was more readily interpretable compared to DCA; consequently, PCA was the preferred ordination technique with this dataset. A correlation matrix was used for the ordination with species scores divided by their standard deviation. The top-ranking 75 species based on importance values were used for the ordination; the remaining 45 species in the dataset all were scarce (present in only one or two transects) and occurred in low percentage cover.

Constrained ordination using community-level parameters as environmental variables (i.e., native species richness, adventive species richness, species density [average species number per quadrat], percent bare ground, mean coefficient of conservatism) with Redundancy Analysis explained 91% of the species-environment relations. However, percent bare ground was the only variable explaining a significant amount of the variation ($P = 0.01$).

RESULTS

Lost Mound

A total of 621 species in 353 genera and 108 families was documented (Appendix I). Ferns, fern-allies, and gymnosperms accounted for 21 species in 11 families and 15 genera, while 157 were monocots in 18 families and 75 genera, and 443 were dicots in 79 families and 263 genera. Adventive (exotic) species accounted for 136 taxa, about 22% of all species. Five state-threatened species (Herkert and Ebinger 2002) were recorded: *Besseya bullii* (kitten tails), *Cyperus grayoides* (sand prairie flat-sedge), *Elymus trachycaulus* (bearded wheat grass), *Equisteum pratense* (meadow horsetail), and *Salvia azurea* (blue sage); and seven state-endangered species were encountered: *Bouteloua gracilis* (blue grama), *Ceanothus herbaceus* (redroot), *Hudsonia tomentosa* (beach heather), *Mirabilis hirsuta* (hairy umbrella-wort), *Opuntia fragilis* (fragile prickly pear), *Orobanche fasciculata* (clustered broomrape), and *Polanisia jamesii* (James' clammyweed). The FQI was determined only for the dry sand prairie communities at Lost Mound because the FQI is meaningful for only small areas. The FQI for sand prairie communities at this site when adventive species were included was 59.70 with a mean C-value of 2.97, and with the adventive species excluded from the calculations the FQI was 80.00 with a mean C-value of 3.98.

Blowout Community (early successional dry sand prairie): Blowouts were numerous at Lost Mound. All had a sparse vegetation cover with relatively few species. In the community surveyed, seven species dominated, all with high mean covers and IVs. Five of these species, *Carex muhlenbergii* (Muhlenberg's sedge), *Dichanthelium villosissimum* (hairy panic grass), *Aristida tuberculosa* (needle grass), *Cyperus schweinitzii* (Schweinitiz' sedge), and *Panicum virgatum* (switch grass) were the native graminoid taxa; whereas *Croton glandulosus* (sand croton) and *Ambrosia psilostachya* (western ragweed) were the dominant forbs (Table 1). The 16 remaining species were mostly native dry sand prairie components that were common in surrounding plant communities. The only adventive species, *Mollugo verticillata* (carpetweed) was uncommon with an IV of 0.8. Bare ground and litter had a mean cover of 63%. This community is the Blowout Formation of Gleason (1910), who describes the four major associations of this formation (windward slope, basin, blowsand, and deposition), and discusses the stages of succession to the bunch-grass association.

Blowing Sand Community (early successional dry sand prairie): Areas of blowing sand, generally associated with dune ridges, were common at Lost Mound. These open areas were the result of past disturbances, particularly grazing (Table 1). On the dune ridge *Hudsonia tomentosa* formed extensive low mounds and dominated with a mean cover of 20.4% and an IV of 41.0. *Tephrosia virginiana* (goat's-rue), *Dichanthelium villosissimum*, *Ambrosia psilostachya*, and *Andropogon gerardii* (big bluestem) followed in IV. Most of the other species found in the plots were common sand prairie species. The adventive *Rumex acetosella* (sour dock) was common, ranking eighth in IV, and found in about 50% of the plots. The adventive cool-season *Poa pratensis* (Kentucky blue grass) was present but infrequent. Bare ground and litter had a mean cover of 41%. This community is the *Hudsonia* Association of Gleason (1910), which he commonly found in the Hanover region (Lost Mound).

Dry Sand Prairie Community (successional with cool season grasses common): Much of Lost Mound had been subjected to cattle grazing, which kept the vegetation cover sparse and low, and helped decrease the frequency and intensity of "wild" fires. Many of these areas were seeded in cool-season, Eurasian grasses, particularly *Poa pratensis* and *Bromus inermis*. Generally this was done with minimal or no ground preparation. The resulting pastures had a relatively high importance of the cool season grasses, along with a fairly well-developed sand prairie community with most of the prairie grasses and forbs still present (Table 2). In the three areas surveyed, *Poa pratensis* was second in importance on two sites and sixth in importance on the third. On this third site (Primms Prairie), *Bromus inermis* was fifth in importance and the adventive *Rumex acetosella* (sour dock) was second. On all three sites native prairie grasses and forbs were common, with *Poa pratensis, Bromus inermis*, and *Rumex acetosella* the chief adventive species encoun-

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Table 1. Frequency (%), mean cover (% of total area) and importance value (I.V.) of the ground layer species encountered in the fall 2005 surveys of a blowout community and a blowing sand community at Lost Mound, Jo Daviess County, Illinois. (* non-native species)

	Blowout Community Area 1 (n=50)			Blowing Sand Community Area 2 (n=50)		
Species	Freq.%	Mean Cover	I.V.	Freq.%	Mean Cover	I.V.
Carex muhlenbergii	58	5.96	25.7	48	0.59	6.9
Dichanthelium villosissimum	66	5.57	25.5	66	5.67	17.2
Aristida tuberculosa	94	3.89	24.4	72	1.49	11.3
Cyperus schweinitzii	94	3.51	23.3	54	0.72	8.2
Croton glandulosus	98	2.04	19.5	6	0.08	0.8
Ambrosia psilostachya	78	2.75	19.0	70	2.74	13.1
Panicum virgatum	54	3.63	18.3	22	0.94	4.2
Cyperus lupulinus	60	0.85	10.8	40	0.55	5.9
Tephrosia virginiana	12	2.70	9.7	36	10.92	21.9
Oenothera clelandii	30	0.35	5.1	4	0.02	0.5
Paspalum bushii	12	1.03	4.8	2	0.06	0.3
Polygonella articulata	16	0.42	3.4	32	0.60	4.9
Chamaesyce geyeri	16	0.28	3.0	2	0.01	0.2
Diodia teres	6	0.13	1.2	--	--	--
Leptoloma cognatum	2	0.30	1.2	--	--	--
Carex tonsa	6	0.08	1.0	54	2.08	10.3
Koeleria macrantha	4	0.12	1.0	34	1.35	6.4
**Mollugo verticillata*	4	0.07	0.8	--	--	--
Conyza canadensis	4	0.02	0.7	--	--	--
Triplasis purpurea	4	0.02	0.7	--	--	--
Asclepias viridiflora	2	0.01	0.3	--	--	--
Monarda punctata	2	0.01	0.3	--	--	--
Sporobolus cryptandrus	2	0.01	0.3	--	--	--
Hudsonia tomentosa	--	--	--	68	20.39	41.0
Andropogon gerardii	--	--	--	36	4.31	11.4
**Rumex acetosella*	--	--	--	50	1.62	8.8
Selaginella rupestris	--	--	--	18	2.09	5.5
Cyperus grayoides	--	--	--	24	0.61	4.0
Rhus aromatica	--	--	--	6	2.06	4.0
Schizachyrium scoparium	--	--	--	8	1.41	3.3
Euphorbia corollata	--	--	--	12	0.79	2.8
Lespedeza capitata	--	--	--	14	0.65	2.7
Solidago nemoralis	--	--	--	4	0.31	1.0
**Poa pratensis*	--	--	--	6	0.08	0.8
Opuntia macrorhiza	--	--	--	2	0.30	0.7
Plantago patagonica	--	--	--	4	0.02	0.5
Brickellia eupatorioides	--	--	--	2	0.06	0.3
Lithospermum croceum	--	--	--	2	0.06	0.3
Asclepias verticillata	--	--	--	2	0.01	0.2
Aster sericeus	--	--	--	2	0.01	0.2
Bouteloua hirsuta	--	--	--	2	0.01	0.2
Sporobolus clandestinus	--	--	--	2	0.01	0.2
Totals		33.75	200.0		62.62	200.0
Bare ground and litter		63.04			40.60	

tered (Table 2). On these three sites the mean cover of bare ground and litter ranged from 13 to 30%.

Dry Sand Prairies Community (mid-successional): On interdunal areas and lower dune slopes, mid-successional dry sand prairies dominated by *Sporobolus clandestinus* (dropseed) and *Selaginella rupestris* (rock spikemoss) were common. These two species combined accounted for over one-third of the importance value. *Sporobolus cryptandrus* (sand dropseed) and *S. compositus* were also present, but in lower numbers. Other common graminoids included *Koeleria macrantha* (June grass), *Leptoloma cognitum* (fall witch grass), *Cyperus lupulinus* (flatsedge), and *C. schweinitzii*; the common forbs were *Ambrosia psilostachya, Asclepias verticillata* (horsetail milkweed), and *Opuntia macrorhiza* (plains prickly pear) (Table 3).

On upper dune slopes and dune ridges, another mid-successional dry sand prairie community was sometimes found. *Heterotheca spartea* (porcupine grass), *Opuntia macrorhiza*, and *Selaginella rupestris* dominated the community, and along with the subdominants *Schizachyrium scoparium* (little bluestem) and *Ambrosia psilostachya,* accounted for nearly 60% of the total IV (Table 3). In both of these communities few adventive species other than *Poa pratensis* were encountered. Both communities were heavily grazed in the past and both had a mean cover of bare ground and litter of 22 to 23%.

Dry Sand Prairie Community (mature or late successional): Excessive grazing and the introduction of cool season grasses and other exotic species have degraded most of the dry sand prairie community at Lost Mound. Some areas, however, have been fenced and have not recently been subjected to heavy grazing. One area, located on a dune ridge and east-facing dune slope, was fenced in 1995 to exclude grazing. During the spring of 2005 a "wildfire" burned the east-facing slope. This burned area is presently dominated by two native species, *Ambrosia psilostachya* and *Schizachyrium scoparium,* and the adventive *Rumex acetosella* (Table 4). Other common species include the prairie forb *Aster ericoides* (heath aster); two native bunch-grasses, *Koeleria macrantha* and *Leptoloma cognatum;* and the native prairie shrub *Amorpha canescens* (leadplant). These seven species accounted for more than 50% of the IV. On the unburned dune ridge the dry sand prairie was dominated by *Schizachyrium scoparium* with an IV of 40.4. *Selaginella rupestris*, which was second in IV, formed extensive colonies on the surface of the sand between the other species, while *Ambrosia psilostachya* ranked third with an IV of 20.1. On this prairie the adventive *Rumex acetosella* and *Potentilla recta* (sulfur cinquefoil) ranked fourth and fifth in IV, while native graminoid taxa accounted for the next five species in IV (Table 4). Bare ground and litter had a mean cover of 27% on the unburned, and 38% on the burned part of this prairie. This community is the Mixed Consocies of the Bunch-Grass Association described by Gleason (1910).

Dry Sand Savanna Community: Fire suppression, grazing, and other disturbances degraded most of the dry sand savannas at Lost Mound. The savanna surveyed, which had a tree canopy cover of less than 40%, was located in and along the margin of a large stabilized blowout. In parts of this savanna the trees were widely scattered, other areas had nearly 80% closed canopy. *Quercus velutina* (black oak) was the only species present that exceeded 10 cm dbh. This species dominated the seedling and sapling layer and averaged 240 stems/ha (≤10 cm dbh.) and 14.323 m^2/ha of basal area (Table 5). Wind action had exposed the large basal caudex of many of the older black oaks showing that these trees probably originated as grubs. Black oak and species of *Rubus* (dewberries, blackberries, and raspberries), *Rhus* (sumac), and *Prunus* (cherries) were common components of the seedling layer. Saplings averaged fewer than 3,000 stems/ha, nearly all less than 2.5 cm dbh (Table 5).

Dry Sand Forest Community: In the southern third of Lost Mound, at the edge of the Mississippi River, is a large stabilized dune covered by dry sand forest. This forest was dominated by *Quercus velutina* with 332 stems/ha, 22.959 m^2/ha of basal area, and 95% of the IV (Table 6). The only other species reaching tree size (≤10 cm dbh) were a few small individuals of *Prunus serotina* (wild black cherry), *Quercus alba* (white oak), *Fraxinus lanceolata* (green ash), and *Juglans nigra* (black walnut). The seedling and small sapling layers were dense.

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Table 2. Frequency (%), mean cover (% of total area), and importance value (I.V.) of the ground layer species encountered in the fall of 2005 in dry sand prairie successional communities dominated by cool season grasses at Lost Mound, Jo Daviess County, Illinois. (*non-native species)

Species	*Schizachyrium/Poa* Community Area 3 (n=50)			*Tephrosia/Poa* Community Area 4 (n=50)			Primms Prairie Area 5 (n=50)		
	Freq. %	Mean Cover	I.V.	Freq. %	Mean Cover	I.V.	Freq. %	Mean Cover	I.V.
Schizachyrium scoparium	100	26.58	45.6	62	10.77	21.8	--	--	--
**Poa pratensis*	68	5.63	14.4	76	17.47	32.0	88	7.18	14.3
Ambrosia psilostachya	72	4.98	14.1	16	0.13	2.4	88	12.29	20.1
Selaginella rupestris	46	7.02	14.1	42	9.25	17.1	--	--	--
Opuntia macrorhiza	44	5.19	11.5	2	0.75	1.2	4	0.02	0.3
Koeleria macrantha	50	4.78	11.4	22	1.57	4.9	28	1.36	3.4
Cyperus lupulinus	80	1.15	9.8	20	0.20	2.9	56	0.43	4.4
Asclepias verticillata	60	1.92	8.7	28	0.73	4.8	38	0.24	2.9
Tephrosia virginiana	24	4.68	8.7	94	24.37	42.9	--	--	--
**Rumex acetosella*	44	0.96	5.9	--	--	--	94	10.22	18.1
Dichanthelium villosissimum	40	1.03	5.5	46	2.88	10.0	50	2.55	6.4
Helianthus pauciflorus	28	1.31	4.6	--	--	--	--	--	--
Leptoloma cognatum	28	1.07	4.3	10	0.49	2.0	52	2.07	5.9
Rhus aromatica	14	2.13	4.3	4	2.50	3.6	14	1.78	3.0
Carex tonsa	34	0.42	4.1	12	0.11	1.7	--	--	--
Aster sericeus	12	1.48	3.2	--	--	--	--	--	--
Cyperus schweinitzii	24	0.37	3.0	2	0.01	0.3	12	0.06	0.9
Physalis virginiana	22	0.51	3.0	54	2.03	10.0	30	0.55	2.7
Polygala polygama	20	0.25	2.4	--	--	--	8	0.04	0.6
Plantago patagonica	20	0.15	2.3	6	0.03	0.8	12	0.06	0.9
Panicum virgatum	10	0.73	2.0	14	0.12	2.0	86	8.03	15.1
Dichanthelium oligosanthes	14	0.32	1.9	--	--	--	42	1.54	4.7
Carex muhlenbergii	14	0.22	1.8	22	0.41	3.5	24	0.21	2.5
Andropogon gerardii	2	0.75	1.2	--	--	--	--	--	--
Conyza canadensis	10	0.15	1.2	--	--	--	50	1.28	5.0
Euphorbia corollata	8	0.33	1.2	--	--	--	--	--	--
Equisetum laevigatum	10	0.05	1.1	--	--	--	30	0.15	2.3
Lithospermum croceum	6	0.32	1.0	--	--	--	84	9.22	16.3
Pseudognaphalium obtusifolium	6	0.32	1.0	--	--	--	--	--	--
**Achillea millefolium*	8	0.04	0.9	--	--	--	44	0.81	3.9
Lespedeza capitata	8	0.09	0.9	--	--	--	44	2.41	5.7
Dichanthelium perlongum	6	0.18	0.8	4	0.12	0.7	--	--	--
Paspalum bushii	6	0.08	0.7	--	--	--	78	5.84	12.0
Brickellia eupatorioides	4	0.12	0.6	--	--	--	52	3.23	7.3
Erigeron strigosus	4	0.07	0.5	--	--	--	--	--	--
Oxalis stricta	4	0.07	0.5	--	--	--	20	0.10	1.5
**Kummerowia stipulacea*	4	0.02	0.4	--	--	--	--	--	--
Polygonum tenue	4	0.02	0.4	--	--	--	--	--	--
Callirhoe triangulata	2	0.06	0.3	--	--	--	--	--	--
Eragrostis spectabilis	2	0.06	0.3	2	0.06	0.4	2	0.06	0.2
Oenothera clelandii	2	0.01	0.2	--	--	--	4	0.07	0.4
Sporobolus cryptandrus	2	0.01	0.2	--	--	--	22	0.21	1.7
Opuntia fragilis	--	--	--	88	4.44	17.8	--	--	--
Solanum carolinense	--	--	--	28	1.75	6.1	16	0.28	1.6
Heterostipa spartea	--	--	--	14	0.27	2.2	8	0.09	0.7
Viola pedata	--	--	--	12	0.21	1.9	--	--	--
Bouteloua hirsuta	--	--	--	12	0.16	1.8	--	--	--
Croton glandulosus	--	--	--	6	0.37	1.4	38	0.24	2.9
Triplasis purpurea	--	--	--	4	0.12	1.2	--	--	--
Tradescantia ohiensis	--	--	--	6	0.08	0.9	--	--	--
Sporobolus clandestinus	--	--	--	4	0.02	0.6	4	0.31	0.7
Aristida tuberculosa	--	--	--	2	0.06	0.4	--	--	--
**Mollugo verticillata*	--	--	--	2	0.06	0.4	--	--	--

Table 2 cont	*Schizachyrium/Poa* Community Area 3 (n=50)			*Tephrosia/Poa* Community Area 4 (n=50)			Primms Prairie Area 5 (n=50)		
Species	Freq. %	Mean Cover	I.V.	Freq. %	Mean Cover	I.V.	Freq. %	Mean Cover	I.V.
Chamaescye geyeri	--	--	--	2	0.01	0.3	--	--	--
**Bromus inermis*	--	--	--	--	--	--	50	9.84	14.7
Verbena stricta	--	--	--	--	--	--	28	1.26	3.3
Sorghastrum nutans	--	--	--	--	--	--	14	1.83	3.1
Monarda punctata	--	--	--	--	--	--	26	0.43	2.3
Poinsettia dentata	--	--	--	--	--	--	18	0.14	1.4
**Potentilla recta*	--	--	--	--	--	--	14	0.27	1.3
Strophostyles helvula	--	--	--	--	--	--	10	0.15	0.9
Gleditsia triacanthos	--	--	--	--	--	--	8	0.14	0.8
Chamaecrista fasciculata	--	--	--	--	--	--	8	0.04	0.6
Crotalaria sagittalis	--	--	--	--	--	--	6	0.08	0.5
Rosa carolina	--	--	--	--	--	--	2	0.30	0.4
**Saponaria officinalis*	--	--	--	--	--	--	4	0.07	0.4
Senecio plattensis	--	--	--	--	--	--	4	0.12	0.4
Physalis heterophylla	--	--	--	--	--	--	4	0.02	0.3
Physalis subglabrata	--	--	--	--	--	- -	4	0.02	0.3
Asclepias syriaca	--	--	--	--	--	--	2	0.06	0.2
Juniperus virginiana	--	--	--	--	--	--	2	0.06	0.2
Prunus serotina	--	--	--	--	--	--	2	0.06	0.2
Cirsium discolor	--	--	--	--	--	--	2	0.01	0.1
Phyla lanceolata	--	--	--	--	--	--	2	0.01	0.1
**Potentilla argentea*	--	--	--	--	--	--	2	0.01	0.1
Totals		75.63	200.0		81.55	200.0		87.85	200.0
Bare ground and litter		30.36			16.82			13.08	

Woody seedlings averaged 34,066 stems/ha, small saplings averaged 10,533 stems/ha, but large saplings averaged only 468 stems/ha (Table 6). *Rubus allegheniensis* (common blackberry) dominated the seedling and small sapling layer with 17,188 and 2,813 stems/ha, respectively. Seedlings and small saplings of *Cornus racemosa* (gray dogwood) and *Prunus virginiana* (common chokecherry) were also common (Table 6).

Dry-Mesic Sand Forest Community: Along the northern edge of Lost Mound is a relatively extensive upland sand forest, most of which has been degraded by fire suppression, exotic species invasion, lumbering, and other human activities. Small mature second-growth forest inclusions of a few ha are occasional in this area. *Quercus alba* and *Q. velutina* were the dominant species, and together accounted for 69% of the IV, averaged 177 stems/ha, and had a combined basal area of 23.438 m^2/ha (Table 7). Twelve other species reached tree size ($\leq$10 cm dbh) with *Carya cordiformis* (bitternut hickory) and *Prunus serotina* the most important. Woody seedlings were abundant with 30,158 stems/ha. *Quercus alba* and *Prunus serotina* seedlings were the most common, but seedlings of many species of shrubs were also present. Small and large saplings were not abundant, resulting in an open understory (Table 7).

Wet-mesic Floodplain Forest Community: In the floodplain area immediately south of Lock and Dam 12, the hydrology influencing the floodplain forest and backwater sloughs has been altered since the dam was completed in 1939. Extensive wet-mesic floodplain forests grow on the exposed floodplains. *Acer saccharinum* (silver maple) dominated and accounted for 91% of the IV (182.9) with 217 stems/ha and a basal area of 34.175 m^2/ha. Small numbers of *Ulmus americana* (American elm), *Fraxinis lanceolata*, and *Celtis occidentalis* (hackberry), were encountered (Table 8). Woody seedlings were common, but few would enter the sapling layer as indicated by the small number of saplings present.

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Table 3. Frequency (%), mean cover (% of total area), and importance value (I.V.) of the ground layer species encountered in the fall of 2005 in dry sand prairie mid-successional communities at Lost Mound, Jo Daviess County, Illinois. (*non-native species)

Species	*Sporobolus/Selaginella* Community Area 6 (n=50)			*Heterostipa/Opuntia* Community Area 7 (n=50)		
	Freq.%	Mean Cover	I.V.	Freq.%	Mean Cover	I.V.
Sporobolus clandestinus	100	28.20	46.1	--	--	--
Selaginella rupestris	68	12.37	22.4	66	15.36	25.1
Koeleria macrantha	86	8.16	18.3	32	2.36	6.3
Ambrosia psilostachya	98	6.97	17.9	84	7.31	17.8
Asclepias verticillata	96	5.06	15.3	28	0.63	3.9
Cyperus lupulinus	92	0.66	9.1	76	1.66	10.5
Opuntia macrorhiza	52	3.08	8.8	80	16.53	28.0
Leptoloma cognatum	56	1.76	7.3	22	1.18	3.9
Cyperus schweinitzii	66	0.82	7.0	16	0.28	2.1
Sporobolus cryptandrus	54	1.10	6.3	8	0.04	1.0
Plantago patagonica	62	0.31	6.0	10	0.05	1.2
**Poa pratensis*	56	0.48	5.6	26	1.15	4.2
Physalis virginiana	36	0.87	4.3	12	0.40	1.8
Dichanthelium villosissimum	24	0.37	2.7	38	0.78	5.2
Monarda punctata	12	1.03	2.5	--	--	--
Dichanthelium oligosanthes	20	0.30	2.2	2	0.01	0.2
Lithospermum croceum	18	0.43	2.2	12	0.21	1.5
Oenothera clelandii	22	0.16	2.2	--	--	--
Rhus aromatica	2	1.25	1.9	--	--	--
**Achillea millefolium*	10	0.44	1.5	--	--	--
Panicum virgatum	12	0.16	1.3	20	0.30	2.6
Schizachyrium scoparium	4	0.60	1.2	82	8.68	19.2
Paspalum setaceum	10	0.10	1.0	--	--	--
Solidago nemoralis	6	0.37	1.0	--	--	--
Carex muhlenbergii	8	0.04	0.8	22	0.41	3.0
Lespedeza capitata	8	0.04	0.8	--	--	--
**Potentilla recta*	6	0.08	0.6	--	--	--
Sorghastrum nutans	6	0.08	0.6	--	--	--
Verbena stricta	4	0.12	0.6	--	--	--
Eragrostis spectabilis	4	0.07	0.5	--	--	--
Penstemon pallidus	4	0.02	0.4	--	--	--
Physalis heterophylla	2	0.06	0.3	--	--	--
Sporobolus compositus	2	0.06	0.3	--	--	--
Antennaria neglecta	2	0.01	0.2	--	--	--
Aristida basiramea	2	0.01	0.2	--	--	--
Bouteloua hirsuta	2	0.01	0.2	12	0.45	1.8
Oxalis stricta	2	0.01	0.2	--	--	--
Psuedognaphalium obtusifolium	2	0.01	0.2	--	--	--
Heterostipa spartea	--	--	--	98	16.72	30.3
Tephrosia virginiana	--	--	--	28	5.52	9.6
Carex tonsa	--	--	--	24	0.17	2.9
Equisetum laevigatum	--	--	--	24	0.12	2.8
Brickellia eupatorioides	--	--	--	12	0.98	2.4
Callirhoe triangulata	--	--	--	4	1.55	2.3
Andropogon gerardii	--	--	--	8	0.96	2.0
Ceanothus herbaceus	--	--	--	4	1.26	2.0
Croton glandulosus	--	--	--	10	0.79	2.0
Euphorbia corollata	--	--	--	10	0.39	1.5
Helianthus pauciflorus	--	--	--	6	0.18	0.9
Paspalum bushii	--	--	--	4	0.36	0.9
Chrysopsis camporum	--	--	--	6	0.03	0.7
**Chenopodium album*	--	--	--	2	0.01	0.2
Solanum carolinense	--	--	--	2	0.01	0.2
Totals		75.67	200.0		86.84	200.0
Bare ground and litter		22.36			22.99	

Table 4. Frequency (%), mean cover (% of total area), and importance value (I.V.) of the ground layer species encountered in the fall of 2005 in burned and unburned mature dry sand prairie communities at Lost Mound, Jo Daviess County, Illinois. (*non-native species)

	Unburned Dry Sand Prairie Community Area 8 (n=50)			Burned Dry Sand Prairie Community Area 9 (n=50)		
Species	Freq.%	Mean Cover	I.V.	Freq.%	Mean Cover	I.V.
Schizachyrium scoparium	96	21.30	40.4	90	5.42	16.2
Selaginella rupestris	78	10.94	23.2	24	0.56	2.9
Ambrosia psilostachya	86	8.43	20.1	88	9.56	22.7
**Rumex acetosella*	78	1.58	9.1	98	8.85	22.5
**Potentilla recta*	70	1.92	9.0	30	1.47	4.9
Andropogon gerardii	22	4.59	8.8	14	2.07	4.5
Cyperus lupulinus	80	1.15	8.6	60	0.55	5.8
Koeleria macrantha	64	1.60	7.9	66	2.83	10.0
Carex tonsa	62	0.86	6.7	42	0.31	4.0
Leptoloma cognatum	50	1.52	6.6	54	3.34	9.8
**Poa pratensis*	46	1.69	6.6	24	0.41	2.7
Opuntia macrorhiza	26	2.81	6.4	34	3.19	8.0
Sorghastrum nutans	22	1.63	4.4	14	0.27	1.5
Dichanthelium villosissimum	36	0.77	4.3	46	0.38	4.4
**Achillea millefolium*	36	0.38	3.7	46	0.68	4.9
Carex muhlenbergii	36	0.28	3.5	14	0.07	1.2
Asclepias verticillata	36	0.18	3.4	68	0.49	6.4
Bouteloua hirsuta	18	1.11	3.3	4	0.07	0.4
Physalis virginiana	28	0.54	3.2	24	0.27	2.4
Solidago nemoralis	16	0.81	2.6	18	0.97	3.0
Lithospermum croceum	20	0.40	2.3	14	1.38	3.3
Polygala polygama	22	0.11	2.1	28	0.24	2.7
Dichanthelium oligosanthes	20	0.20	2.0	8	0.04	0.8
Plantago patagonica	20	0.10	1.9	--	--	--
Monarda punctata	12	0.45	1.7	2	0.06	0.3
Oenothera clelandii	14	0.12	1.4	16	0.18	1.6
Aster ericoides	8	0.19	1.0	60	4.33	11.9
Sporobolus cryptandrus	10	0.05	1.0	--	--	--
Rhus aromatica	2	0.30	0.7	12	1.93	4.1
Conyza canadensis	6	0.03	0.5	--	--	--
Aristida basiramea	4	0.02	0.3	--	--	--
Aristida tuberculosa	4	0.02	0.3	--	--	--
Cyperus schweinitzii	4	0.02	0.3	18	0.09	1.5
Helianthemum canadense	2	0.06	0.3	--	--	--
Panicum virgatum	4	0.02	0.3	--	--	--
**Potentilla argentea*	2	0.06	0.3	--	--	--
Croton glandulosus	2	0.01	0.2	2	0.01	0.2
Dichanthelium perlongum	2	0.01	0.2	2	0.01	0.2
Draba reptans	2	0.01	0.2	--	--	--
Gleditsia triacanthos	2	0.01	0.2	--	--	--
Hieracium longipilum	2	0.01	0.2	--	--	--
Liatris aspera	2	0.01	0.2	--	--	--
Linum sulcatum	2	0.01	0.2	2	0.01	0.2
Oxalis stricta	2	0.01	0.2	30	0.35	3.1
**Poa compressa*	2	0.01	0.2	--	--	--
Amorpha canescens	--	--	--	46	2.96	8.6
Tephrosia virginiana	--	--	--	16	2.16	4.8
Ionactis linariifolius	--	--	--	18	1.90	4.5
Helianthus occidentalis	--	--	--	18	1.16	3.3
Coreopsis palmata	--	--	--	8	0.72	1.9
Aster sericeus	--	--	--	8	0.67	1.8
Anemone cylindrica	--	--	--	8	0.38	1.3
Callirhoe triangulata	--	--	--	6	0.42	1.2
Eragrostis spectabilis	--	--	--	10	0.20	1.1
Ceanothus americanus	--	--	--	2	0.30	0.7
Heterostipa spartea	--	--	--	6	0.13	0.7
Physalis subglabrata	--	--	--	4	0.12	0.5
Bouteloua curtipendula	--	--	--	2	0.06	0.3
Equisetum laevigatum	--	--	--	2	0.06	0.3
Froelichia gracilis	--	--	--	4	0.02	0.3
Asclepias viridiflora	--	--	--	2	0.01	0.2
Dalea purpurea	--	--	--	2	0.01	0.2
Solanum carolinense	--	--	--	2	0.01	0.2
Totals		66.33	200.0		61.68	200.0
Bare ground and litter		26.70			38.10	

Table 5. Size class density (#/ha), basal area (m^2/ha), relative values, importance value (I.V.), and average diameter (cm) of the woody species encountered in 2005 in a dry sand savanna associated with a blowout at Lost Mound, Jo Daviess County, Illinois. (*non-native species)

Species	Seed-lings	Small Sap-lings	Large Sap-lings	Trees (#/ ha)	Basal Area (m^2/ha)	Rel. Den.	Rel. Dom.	I. V.	Av. Diam. (cm)
Quercus velutina	4583	1167	167	240	14.323	100.0	100.0	200.0	24.2
Rubus flagellaris	3750	--	--	--	--	--	--	--	--
Rhus aromatica	2917	--	--	--	--	--	--	--	--
Prunus virginiana	1667	583	--	--	--	--	--	--	--
Prunus serotina	1250	375	17	--	--	--	--	--	--
Juniperus virginiana	833	167	50	--	--	--	--	--	--
Rubus occidentalis	417	--	--	--	--	--	--	--	--
Ribes missouriense	--	292	--	--	--	--	--	--	--
Rubus allegheniensis	--	42	--	--	--	--	--	--	--
**Rosa multiflora*	--	42	--	--	--	--	--	--	--
Carya ovata	--	--	17	--	--	--	--	--	--
Totals	15417	2668	251	240	14.323	100.0	100.0	200.0	

Ayers Sand Prairie Nature Preserve

A total of 175 species in 132 genera and 56 families was documented (Appendix I). Ferns, ferns-allies, and gymnosperms accounted for 4 species, while 42 were monocots in 4 families and 28 genera, and 129 were dicots in 48 families and 100 genera. Adventive species accounted for 36 taxa, about 20% of all species. The state-threatened (Herkert and Ebinger 2002) *Cyperus grayoides* was a common associate of blowouts. The FQI for this site when adventive species were included was 47.62 with a mean C-value of 3.60, and with the adventive species excluded from the calculations the FQI was 52.73 with a mean C-value of 4.41.

Blowing Sand Community (early successional): In areas of blowing sand, plants were widely scattered and bare ground and litter averaged 61% cover. Numerous species were established in these areas with *Aristida tuberculosa* (IV of 32.1), *Dichanthelium villosissimum* (IV of 27.3) and *Ambrosia psilostachya* (IV of 17.9) the most common. Most of the species associated with the mature and disturbed dry sand prairie were also found, but in low numbers (Table 9). A few species, such as *Carex tonsa* (shaved sedge), *Callirhoe triangulata* (poppy mallow), *Viola pedata* (bird's-foot violet), *Cyperus schweinitzii, Liatris aspera* (rough blazing-star), *Polygonella articulata* (jointweed), and *Chamaesyce geyeri* (Geyer's spurge) were more common in these areas of blowing sand than in the mature or disturbed sand prairies (Table 9).

Dry Sand Prairie Community (mid-successional): The disturbed dry sand prairie community had a high species diversity that included many taxa associated with dry sand prairies. Two bunch-grasses, *Dichanthelium villosissimum* and *Koeleria macrantha,* dominated this community with IVs of 37.0 and 30.1, respectively (Table 9). The disturbance species *Croton glandulosus* (IV of 15.5) and *Aristida tuberculosa* (IV of 13.2) were third and forth in IV, followed by *Ambrosia psilostachya* and *Hudsonia tomentosa*. Bare ground and litter averaged 46% cover.

Dry Sand Prairie Community (mature or late successional): In the mature dry sand prairie *Schizachyrium scoparium* dominated with an IV of 52.5 and a mean cover of 31.4 (Table 9). *Ambrosia psilostachya* was second with an IV of 26.4, followed by *Solidago nemoralis* (IV of 14.1), and *Koeleria macrantha* (IV of 13.0). The remaining 40 species encountered in the plots mostly had low frequencies and mean covers. The grasses formed extensive clumps while most other species grew in spaces between clumps, and were referred to as interstitial species by Gleason (1910). The exotic species *Achillea millefolium, Mollugo verticillata*, and *Poa pratensis* were rare. Bare ground and litter averaged 28% cover (Table 9).

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Table 6. Size class density (#/ha), basal area (m^2/ha), relative values, importance value (I.V.), and average diameter (cm) of the woody species encountered in 2005 in a mature second growth dry upland sand forest community associated with dune topography at Lost Mound, Jo Daviess County, Illinois. (*non-native species)

Species	Seed-lings	Small Sap-lings	Large Sap-lings	Trees (#/ ha)	Basal Area (m^2/ha)	Rel. Den.	Rel. Dom.	I. V.	Av. Diam. (cm)
Quercus velutina	3125	125	31	332	22.599	92.2	98.4	190.6	26.9
Prunus serotina	1094	750	356	24	0.310	6.6	1.4	8.0	12.7
Quercus alba	--	--	--	2	0.025	0.6	0.1	0.7	12.6
Fraxinus lanceolata	313	188	13	1	0.015	0.3	0.1	0.4	13.7
Juglans nigra	--	--	--	1	0.010	0.3	--	0.3	11.4
Rubus allegheniensis	17188	2813	--	--	--	--	--	--	--
Cornus racemosa	4688	1844	6	--	--	--	--	--	--
Prunus virginiana	1875	2688	6	--	--	--	--	--	--
Zanthoxylum americanum	1406	344	--	--	--	--	--	--	--
Rubus occidentalis	1250	812	--	--	--	--	--	--	--
Ribes missouriense	1094	406	--	--	--	--	--	--	--
Gleditsia triacanthos	938	125	6	--	--	--	--	--	--
Carya cordiformis	313	94	31	--	--	--	--	--	--
Celtis occidentalis	313	188	13	--	--	--	--	--	--
Rhus aromatica	313	--	--	--	--	--	--	--	--
**Rosa multiflora*	156	--	--	--	--	--	--	--	--
Juniperus virginiana	--	94	--	--	--	--	--	--	--
Malus ioensis	--	31	--	--	--	--	--	--	--
Ulmus americana	--	31	6	--	--	--	--	--	--
Totals	34066	10533	468	360	22.959	100.0	100.0	200.0	

Table 7. Size class density (#/ha), basal area (m^2/ha), relative values, importance value (I.V.), and average diameter (cm) of the woody species encountered in 2005 in a mature second growth dry-mesic upland sand forest at Lost Mound, Jo Daviess County, Illinois. (*non-native species)

Species	Seed-lings	Small Sap-lings	Large Sap-lings	Trees (#/ ha)	Basal Area (m^2/ ha)	Rel. Den.	Rel. Dom.	I. V.	Av. Diam. (cm)
Quercus alba	6563	47	188	99	14.086	28.3	52.6	80.9	40.0
Quercus velutina	1719	16	--	78	9.352	22.3	34.9	57.2	37.7
Carya cordiformis	1719	188	331	63	.964	18.0	3.6	21.6	13.4
Prunus serotina	4531	--	38	38	.689	10.9	2.6	13.5	14.5
Ulmus americana	1875	16	94	20	.448	5.7	1.7	7.4	16.0
Ulmus rubra	2500	--	63	15	.308	4.2	1.2	5.4	15.7
Celtis occidentalis	2344	109	63	11	.275	3.1	1.0	4.1	17.0
**Robinia pseudoacacia*	156	--	38	10	.107	2.8	0.4	3.2	11.7
Tilia americana	--	--	--	7	.150	2.0	0.6	2.6	16.3
Quercus rubra	--	--	--	3	.217	0.9	0.8	1.7	26.1
Betula nigra	--	--	--	3	.054	0.9	0.2	1.1	14.8
Carya ovata	--	--	--	1	.069	0.3	0.2	0.5	29.6
Juglans cinerea	--	--	--	1	.015	0.3	0.1	0.4	13.6
**Morus alba*	--	--	--	1	.025	0.3	0.1	0.4	18.0
Rubus allegheniensis	4063	359	--	--	--	--	--	--	--
Ribes missouriense	1719	47	--	--	--	--	--	--	--
Gleditsia triacanthos	781	--	--	--	--	--	--	--	--
Zanthoxylum americanum	625	47	--	--	--	--	--	--	--
Cornus racemosa	469	313	13	--	--	--	--	--	--
Rubus occidentalis	469	94	--	--	--	--	--	--	--
Juniperus virginiana	313	--	--	--	--	--	--	--	--
Celastrus scandens	156	--	--	--	--	-	--	--	--
**Lonicera tatarica*	156	--	--	--	--	--	--	--	--
Corylus americana	--	16	--	--	--	--	--	--	--
**Rosa multiflora*	--	47	--	--	--	--	--	--	--
Acer negundo	--	--	6	--	--	--	--	--	--
Totals	30158	1299	834	350	26.759	100.0	100.0		

Thompson-Fulton Sand Prairie Nature Preserve

A total of 182 species in 133 genera and 54 families was documented (Appendix I). Ferns, fern-allies, and gymnosperms accounted for 5 species, while 42 were monocots in 4 families and 28 genera, and 135 were dicots in 46 families and 101 genera. Adventive species accounted for 38 taxa, about 20% of all species. The state-endangered (Herkert and Ebinger 2002) *Penstemon grandiflorus* (large-flowered beardstongue) was relatively common in a small part of the preserve, while the state-threatened *Cyperus grayoides* was occasionally encountered. The FQI for this site when adventive species were included was 46.81 with a mean C-value of 3.47, and with the adventive species excluded from the calculations the FQI was 52.86 with a mean C-value of 4.42.

Dry Sand Prairie Community (early successional): The disturbance community contained many species commonly encountered in dry sand prairies. The most important forbs of this community were *Opuntia macrorhiza* (IV of 31.6) and *Ambrosia psilostachya* (IV of 24.8). The important grasses included the two bunch-grasses *Koeleria macrantha* (IV of 21.2) and *Dichanthelium villosissimum* (IV of 12.7) along with the common disturbance area grass *Aristida tuberculosa* (IV of 23.6)(Table 10). *Schizachyrium scoparium* was scarce; only a few scattered individuals were observed and none of these were found in plots. Three adventive species (*Rumex acetosella, Mollugo verticillata, Bromus tectorum*) were encountered in the plots, all with IV's of 1.7 or lower. Bare ground and litter mean cover was 7% (Table 10).

Dry Sand Prairie Community (mature or late successional): *Schizachyrium scoparium,* the leading dominant of the mature sand prairie, had an IV of 39.4 and a mean cover of 20.9% (Table 10). *Opuntia macrorhiza* was second with an IV of 31.7, followed by *Ambrosia psilostachya* (IV of 26.4), *Tephrosia virginiana* (IV of 21.9), and *Dichanthelium villosissimum* (IV of 21.8). Except for *Tephrosia virginiana*, which generally had a clumped distribution, these five species had frequencies of 84–91% with a mean cover higher than 8.0% (Table 10). *Schizachyrium scoparium and D. villosissimum* grew in clumps 10–40 cm across, forming the bunch-grass association described by Gleason (1910). Most other species grew in spaces between clumps. Of the remaining 24 species encountered in the plots, most had frequencies of less than 50% and IVs lower than 8.0. The exotic species *Rumex acetosella* was rare, while bare ground and litter mean cover was 22% (Table 10).

Big River State Forest

A total of 162 species in 127 genera and 54 families was documented (Appendix I). Gymnosperms accounted for 2 species, while 41 were monocots in 5 families and 27 genera, and 162 were dicots in 54 families and 127 genera. Adventive species accounted for 37 taxa, about 20% of all species. The state-endangered (Herkert and Ebinger 2002) *Penstemon grandiflorus* and *Stylisma pickeringii* (Patterson bindweed) were encountered in the dry sand prairie. The FQI for this site when adventive species were included was 38.18 with a mean C-value of 3.00, and with the adventive species excluded from the calculations the FQI was 43.47 with a mean C-value of 3.89.

Dry Sand Prairie Community (mature or late successional): The leading dominant of the mature sand prairie was *Schizachyrium scoparium* with an IV of 41.9 and a mean cover of 34% (Table 11). This species formed extensive clumps, many more than 40 cm across, while most other taxa were interstitial species. *Solidago nemoralis* (gray goldenrod) was second with an IV of 24.3, followed by *Opuntia macrorhiza* (IV of 19.0), and *Ambrosia psilostachya* (IV of 18.4). *Lespedeza capitata* (round-headed bush clover), *Stylisma pickeringii,* and *Monarda punctata* (horsemint) had IVs exceeding 10, while *Dichanthelium villosissimum*, *Cyperus lupulinus*, and *Commelina erecta* (day flower) had frequencies greater than 75% (Table 11). Most of the remaining species encountered had frequencies of less than 50% and IV's lower than 5.0. The only exotic species in the plots, *Poa pratensis* and *Chenopodium album*, were rare, having an IV of 0.2. Bare ground and litter had a mean cover of 10.7%, though in some areas the herbaceous vine, *Stylisma pickeringii* completely covered the plots (Table 11).

Table 8. Size class density (#/ha), basal area (m^2/ha), relative values, importance value (I.V.), and average diameter (cm) of the woody species encountered in 2005 in a wet-mesic floodplain forest at the edge of the Mississippi River, Lost Mound, Jo Daviess County, Illinois. (*non-native species)

Species	Seedlings	Small Saplings	Large Saplings	Trees (#/ha)	Basal Area (m^2/ha)	Rel. Den.	Rel. Dom.	I. V.	Av. Diam. (cm)
Acer saccharinum	80938	--	6	217	34.175	87.9	95.0	182.9	41.7
Ulmus americana	21563	344	--	25	1.151	10.1	3.2	13.3	23.5
Fraxinus lanceolata	7813	156	--	4	0.596	1.6	1.7	3.3	23.5
Celtis occidentalis	--	--	--	1	0.026	0.4	0.1	0.5	18.2
**Morus alba*	156	--	--	--	--	--	--	--	--
Totals	110470	500	6	247	35.948	100.0	100.0	200.0	

Dry Sand Savanna Community (degraded): Dry sand forest occurs just to the north of the dry sand prairie and continues for more than 1 km. Probably clear-cut soon after settlement, this forest has also been subjected to more recent cutting and fire suppression. *Quercus velutina* and *Q. marilandica* (blackjack oak) dominated this degraded sand savanna, which, due to fire suppression, is now a closed canopy forest. On the site trees averaged 588 stems/ha with an average basal area of 17.324 m^2/ha (Table 12). The oaks averaged 17.3 to 18.7 cm dbh, and except for a few *Juniperus virginiana* (red cedar) and *Prunus serotina,* were the only species that reached tree size (≥10 cm dbh). The seedling and sapling layers were dense; woody seedlings averaged 19,376 stems/ha, small saplings averaged 11,187 stems/ha, but large saplings averaged only 318 stems/ha (Table 12). Black oak dominated the seedling layer (7,500 stems/ha) and was second in small saplings (1,594 stems/ha) and large saplings (106 stems/ha). Blackjack oak was first in large saplings with 131 stems/ha. Species of *Rubus* (blackberries and raspberries) and *Cornus drummondii* (rough-leaved dogwood) were very common components of the seedling and small sapling layers.

DATA ANALYSIS AND SITE SIMILARITY

A summary of the floristic data and the Floristic Quality Index for each of the 15 prairie study sites (9 transects at Lost Mound, 3 at Ayers Nature Preserve, 2 at Thomson-Fulton Nature Preserve, and 1 at Big River State Forest) are included in Table 13. In this table the 15 study sites are grouped by the amount of past and present disturbances and the extent to which *Schizachyrium scoparium* dominated each community. Throughout the dry sand prairies of the Mississippi River valley in northwestern Illinois, *Schizachyrium scoparium* is usually one of the dominant species, although its importance decreased in successional and disturbance communities. Among all sites, native species richness ranged from 22 to 46 while adventive species richness was low, ranging from 1 to 7 species; the percent of native taxa exceeded 90% at all but two sites (Table 13). Little variation occurs in the Floristic Quality Index (FQI) of the sites (Table 13). The FQI for the sites ranged from 20.74 to 35.07, with only two exceeding 30.

Within the Mississippi River sand deposits, many of the sand prairie communities studied had a relatively high degree of similarity (Table 14). The Sorensen Indices of Similarity (ISs) for the 15 sand prairie areas examined ranged from 35.6% to 83.9% with most values above 50%. The lowest ISs was between the blowout community (Area 1) and the burned dry sand prairie (Area 9), both at Lost Mound. The highest ISs was between the blowing sand community at Ayers Nature Preserve (Area 12) and the successional dry sand prairie at Thomson/Fulton Nature Preserve (Area 14). All communities at Ayers Nature Preserve and Thomson-Fulton Nature Preserve were very similar as shown by the constantly high ISs, which ranged from 59.3 to 83.9 (Table 14). Overall, the vegetation of the mature dry sand prairie at Big River State Forest had a slightly lower similarity to

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Table 9. Frequency (%), mean cover (% of total cover), and importance value (I.V.) of the ground layer species encountered in 2004 in three plant communities at Ayers Nature Preserve, Carroll County, Illinois. (*non-native species)

	Dry Sand Prairie (late successional) Area 10 (n=50)			Dry Sand prairie (mid-successional) Area 11 (n=50)			Blowing Sand (early successional) Area 12 (n=50)		
Species	Freq. %	Mean Cover	I. V	Freq. %	Mean Cover	I. V.	Freq. %	Mean Cover.	I. V.
Schizachyrium scoparium	100	31.40	52.5	2	0.01	0.2	--	--	--
Ambrosia psilostachya	98	12.54	26.4	86	2.45	12.5	52	4.48	17.9
Solidago nemoralis	76	5.18	14.1	8	0.14	1.0	2	0.30	1.0
Koeleria macrantha	84	3.79	13.0	100	10.68	30.1	56	2.42	12.8
Dichanthelium villosissimum	72	2.08	9.6	100	14.16	37.0	84	6.60	27.3
Carex muhlenbergii	82	1.16	9.2	12	0.21	1.5	52	0.51	7.4
Asclepias verticillata	72	1.35	8.6	--	--	--	2	0.06	0.4
Carex tonsa	56	2.29	8.3	60	1.73	8.8	48	3.30	14.3
Cyperus lupulinus	68	0.94	7.6	4	0.02	0.4	8	0.04	1.0
Polygala polygama	64	0.62	6.8	34	0.52	4.0	2	0.01	0.2
Aster ericoides	26	2.60	6.0	--	--	--	--	--	--
Callirhoe triangulata	22	2.02	4.8	4	0.36	1.1	18	2.67	9.2
Viola pedata	22	0.99	3.4	--	--	--	36	0.92	6.5
Conyza canadensis	32	0.21	3.3	2	0.01	0.2	8	0.09	1.1
Lespedeza capitata	20	0.88	3.0	4	0.07	0.5	4	0.36	1.4
Chrysopsis camporum	16	0.81	2.6	6	0.13	0.8	--	--	--
Panicum virgatum	20	0.50	2.5	--	--	--	4	0.02	0.6
Oenothera clelandii	18	0.14	1.9	56	1.12	7.2	28	0.14	3.6
Lithospermum croceum	10	0.49	1.6	2	0.01	0.2	2	0.01	0.2
Cyperus schweinitzii	10	0.20	1.2	32	0.56	3.9	60	0.65	8.6
Hieracium longipilum	10	0.20	1.2	--	--	--	--	--	--
Pseudognaphalium obtusifolium	8	0.33	1.2	--	--	--	2	0.06	0.4
**Achillea millefolium*	10	0.15	1.1	--	--	--		--	--
Chenopodium dessicatum	10	0.05	1.0	--	--	--	4	0.02	0.6
Draba reptans	10	0.10	1.0	68	1.09	8.2	--	--	--
Selaginella rupestris	6	0.32	1.0	--	--	--	--	--	--
Leptoloma cognatum	8	0.14	0.9	8	0.38	1.5	4	0.07	0.7
Liatris aspera	8	0.14	0.9	--	--	--	44	3.33	13.9
Plantago patagonica	8	0.04	0.8	4	0.02	0.4	--	--	--
Chamaecrista fasciculata	6	0.03	0.6	--	--	--	--	--	--
Eragrostis spectabilis	2	0.30	0.6	--	--	--	2	0.06	0.4
Euphorbia corollata	2	0.30	0.6	26	1.83	6.0	20	0.59	3.9
Physalis virginiana	4	0.07	0.5	14	0.07	1.3	18	0.14	2.5
Aristida tuberculosa	4	0.02	0.4	100	2.20	13.2	100	7.77	32.1
Chamaesyce geyeri	4	0.02	0.4	12	0.16	1.4	30	0.25	4.1
Dichanthelium oligosanthes	4	0.02	0.4	--	--	--	--	--	--`
**Mollugo verticillata*	4	0.02	0.4	60	0.70	6.7	22	0.11	2.8
Froelichia gracilis	2	0.01	0.2	--	--	--	--	--	--
**Poa pratensis*	2	0.01	0.2	--	--	--	--	--	--
Polygonella articulata	2	0.01	0.2	50	0.40	5.2	42	0.61	6.4
Croton glandulosus	--	--	--	100	3.38	15.5	48	0.44	6.7
Cyperus grayoides	--	--	--	86	1.58	10.8	46	0.58	6.8
Hudsonia tomentosa	--	--	--	42	3.48	10.6	2	0.30	1.0
Paspalum bushii	--	--	--	20	2.23	6.3	12	0.50	2.7
Diodia teres	--	--	--	8	0.19	1.1	--	--	--
Monarda punctata	--	--	--	8	0.19	1.1	--	--	--
Froelichia floridana	--	--	--	6	0.03	0.6	6	0.08	0.9
Asclepias viridiflora	--	--	--	2	0.06	0.3	--	--	--
Cycloloma atriplicifolium	--	--	--	2	0.01	0.2	--	--	--
Tradescantia ohiensis	--	--	--	2	0.01	0.2	--	--	--
Rhus aromatica	--	--	--	--	--	--	2	0.06	0.4
Apocynum sibericum	--	--	--	--	--	--	2	0.01	0.2
Totals		72.47	200.0		50.19	200.0		37.56	200.0
Bare ground and litter		28.06			46.25			61.25	

Table 10. Frequency (%), mean cover (% of total cover), and importance value (I.V.) of the ground layer species encountered in 2004 in mature dry sand prairie and disturbed dry sand prairie communities at Thomson-Fulton Nature Preserve, Whiteside County, Illinois. (*non-native species)

Species	Dry Sand Prairie (late successional) Area 13 (n=50)			Dry Sand prairie (early successional) Area 14 (n=50)		
	Frequency (%)	Mean Cover	I.V.	Frequency (%)	Mean Cover	I.V.
Schizachyrium scoparium	100	20.92	39.4	--	--	--
Opuntia macrorhiza	98	15.06	31.7	82	22.71	31.6
Ambrosia psilostachya	96	11.08	26.4	100	14.49	24.8
Tephrosia virginiana	50	12.22	21.9	26	3.77	6.4
Dichanthelium villosissimum	84	8.65	21.8	66	6.00	12.7
Conyza canadensis	88	1.13	12.8	82	3.53	11.6
Callirhoe triangulata	28	3.64	8.2	--	--	--
Solidago nemoralis	22	1.95	5.3	10	0.73	1.8
Cyperus schweinitzii	36	0.33	5.1	18	0.14	1.8
Koeleria macrantha	24	0.56	3.8	94	11.55	21.2
Carex tonsa	22	0.75	3.7	34	0.91	4.3
Leptoloma cognatum	12	1.08	3.0	12	1.08	2.3
Cyperus lupulinus	22	0.11	2.9	34	0.22	3.5
Heterostipa spartea	20	0.20	2.9	--	--	--
Polygala polygama	18	0.09	2.4	48	0.73	5.3
Eragrostis spectabilis	8	0.72	1.9	36	0.33	3.8
Lespedeza capitata	8	0.14	1.2	40	3.40	7.5
Rhus aromatica	2	0.30	0.7	2	0.30	0.5
**Rumex acetosella*	6	0.03	0.7	10	0.39	1.4
Polygonella articulata	6	0.03	0.7	24	0.17	2.5
Dichanthelium depauperatum	4	0.12	0.7	--	--	--
Aristida tuberculosa	4	0.07	0.6	100	13.38	23.6
Lithospermum croceum	2	0.06	0.4	4	0.31	0.7
Croton linearis	2	0.01	0.3	14	0.07	1.5
Panicum virgatum	2	0.01	0.3	2	0.30	0.5
Pseudognaphalium obtusifolium	2	0.01	0.3	8	0.09	0.9
Croton glandulosus	2	0.01	0.3	56	0.33	5.8
Lactuca canadensis	2	0.01	0.3	10	0.10	1.1
Physalis virginiana	2	0.01	0.3	2	0.01	0.2
Paspalum bushii	--	--	--	84	9.06	17.6
Carex muhlenbergii	--	--	--	10	0.34	1.4
Chrysopsis camporum	--	--	--	6	0.66	1.3
Oenothera clelandii	--	--	--	12	0.06	1.3
Liatris aspera	--	--	--	2	0.30	0.5
Monarda punctata	--	--	--	4	0.02	0.4
Froelichia floridana	--	--	--	2	0.01	0.2
Totals		79.30	200.0		95.49	200.0
Bare ground and litter		22.12			6.88	

the other study areas with a ISs of 36.9% with the blowout community at Lost Mound to a high of 59.5 with the *Schizachyrium*/*Poa* community at Lost Mound (Table 14). This area is nearly 120 km south of the other study areas (Fig. 1).

A PCA biplot explained 44.5% of the variance in the first two axes, and with 66% of the variance explained in four axes. The ordination biplot indicated sample data are widely scattered in ordination space; however, three groups can be discerned (Fig. 2). Discriminating the sample data into three groupings was supported by results from cluster analysis. One grouping includes transects from all sites included in the study (LM 3, LM 7, LM 8, Ay10, TF13, and BR15) and is positively correlated with *Schizachyrium scoparium*, the dominant bunch grass in the sample transects and the species explaining the most variance on the first ordination axis. Associated species included *Ambrosia psilostachya, Eragrostis spectabilis, Lespedeza capitata, Monarda punctata, Opuntia macrorhiza, Polygala polygama,* and *Solidago nemoralis*. Another grouping comprised of transects from all sites except Big River (LM1, LM2, Ay11, Ay12, and TF14) is positively associated with species of blowouts and open sand habitats including *Hudsonia tomensosa, Panicum virgatum, Koeleria macrantha, Cyperus grayoides, Croton glandulosa, Polygonum articulata*, and *Aristida tuberculosa*. A third grouping is comprised solely of transects from Lost Mound (LM4, LM5, LM6, and LM9). Transects from this grouping are similar in that *S. scoparium* was missing or had

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Table 11. Frequency (%), mean cover (% of total cover), and importance value (I.V.) of ground layer species encountered in 2005 in a dry sand prairie community at Big River Natural Area, Henderson County, Illinois. (*non-native species)

Species	Dry Sand Prairie (mature) Area 15 (n=50)		
	Frequency (%)	Mean Cover	Importance Value
Schizachyrium scoparium	100	34.07	41.9
Solidago nemoralis	94	16.76	24.3
Opuntia macrorhiza	98	11.11	19.0
Ambrosia psilostachya	100	10.38	18.4
Lespedeza capitata	92	8.17	15.5
Stylisma pickeringii	46	7.24	10.9
Monarda punctata	94	2.38	10.0
Dichanthelium villosissimum	90	2.17	9.4
Cyperus lupulinus	94	0.47	8.1
Commelina erecta	76	0.83	6.9
Carex muhlenbergii	66	0.33	5.6
Physalis virginiana	40	1.33	4.5
Leptoloma cognatum	32	0.90	3.5
Conyza canadensis	30	0.15	2.6
Cyperus schweinitzii	28	0.14	2.4
Paspalum bushii	20	0.25	1.8
Koeleria macrantha	14	0.51	1.6
Eragrostis spectabilis	14	0.27	1.4
Rhus glabra	8	0.72	1.3
Talinum rugospermum	14	0.07	1.2
Erigeron strigosus	8	0.43	1.0
Aristida tuberculosa	10	0.05	0.8
Plantago patagonica	10	0.05	0.8
Lithospermum croceum	8	0.09	0.7
Oenothera clelandii	8	0.09	0.7
Rhus aromatica	4	0.36	0.7
Chamaecrista fasciculata	4	0.31	0.6
Eragrostis trichodes	6	0.13	0.6
Euphorbia corollata	4	0.31	0.6
Croton opsis linearis	6	0.03	0.5
Dichanthelium oligosanthes	6	0.03	0.5
Bouteloua hirsuta	4	0.12	0.4
Lactuca canadensis	2	0.06	0.3
Parthenocissus inserta	2	0.06	0.3
Pseudognaphalium obtusifolium	2	0.06	0.3
Quercus velutina	2	0.06	0.3
**Chenopodium album*	2	0.01	0.2
**Poa pratensis*	2	0.01	0.2
Solidago speciosa	2	0.01	0.2
Totals		100.52	200.0
Bare ground and litter		10.72	

an IV less than 10%. However, these transects grouped differently depending on choices of distance measure and linkage method in cluster analysis, indicating they were only nominally similar. Many adventive species were present in this third grouping including *Achillea millefolium, Bromus inermis, Poa pratensis, Potentilla recta,* and *Rumex acetosella*. Also, a few native grass species that are not bunch forming are associated with these transects including *Sporobolus clandestinus, S. cryptandrus, Heterotheca spartea*, and *Triplasis purpurea*.

The ecological meaning in the ordination axes is unclear. Neither of the species scores on the first two axes are correlated with the perceived conservatism of species (coefficients of conservatism) or wetness coefficients. A multiple regression of site characteristics (parameters of sand prairie community: species density, species richness, adventive species richness, mean coefficient of conservatism, and percent bare ground) onto the first two ordination axes explained 30.5% of the variance in the species data and 66.8% of the variance in the fitted species data. Results from forward selection of these site characteristics indicated that only one, percent bare ground, explained a significant amount of the variation ($P = 0.01$, F-statistic 2.15). A triplot of species, sites, and site characteristics (not shown) indicated that percent bare ground was inversely associated with transects from Group 1 and positively associated with transects from Group 2.

DISCUSSION

Historical Summary: Historical information on the sand deposits of northwestern Illinois comes from the work of Gleason in 1908 (Gleason 1910). This study was completed nine years before the establishment of the Savanna Army Deport in 1918. Most of the information in that study consisted of detailed species lists with only a small amount of qualitative descriptive information on a few of the more common associations. The annotated lists of the species encountered, as well as the species he found in each association, give some indication of the complexity of this extensive sand prairie. As Dr. Gleason was at Lost Mound for only three short visits during 1908 (31 May–3 June, 12–24 June, 15–18 August) he made no attempt to ensure that a complete collection or a complete list of this sand region was developed, and many unusual locations for species were omitted (Gleason 1910).

Gleason (1910) described many of the plant associations and the successional processes that occur in the sand deposits throughout Illinois. His description of the Blowout Formation, its associations, and its succession to the Bunch-Grass Association are an excellent analysis of the complex and varied successional process in the sand deposits. He also described in detail the Mixed Consocies of the Bunch-Grass Association, which corresponds to the dry sand prairie community of White and Madany (1978). As described by Gleason (1910), this association was dominated by up to nine native bunch (clump) grasses and sedges, all common taxa of the sand deposits. Since the bunch grasses virtually excluded other growth beneath them, the remaining species of this association were restricted to the small areas of bare sand between the bunches. Gleason (1910) divided these secondary species into four ecological groups based on their habits and structure: large perennials and shrubs (that could compete with the bunch grasses); mat-plants (*Selaginella rupestris, Opuntia macrorhiza*); interstitials (mostly annuals with slender, frequently unbranched stems that were restricted to sand between the bunch grasses); and parasites (*Orobanche fasciculata*).

Since the early work of Gleason (1910), a few additional studies have been completed on the floristic composition and structure of the sand deposits of northwestern Illinois. In 1976 the Illinois Natural Areas Inventory (INAI) examined some of the sand prairies of this region (White 1978). During these studies frequency data were collected from 20 to 30 circular 0.25-m^2 plots located along transects. None of these data were published but the results are available from Illinois Department of Natural Resources, Springfield, Illinois. Bowles et al. (2003) used many of these INAI sites in their study concerning the use of fire in the management of sand prairie vegetation.

Bunch-Grass Association of Gleason: Gleason (1910) reported that the Mixed Consocies of the Bunch-Grass Association dominated the sand deposits of Illinois, including the Hanover area of northwestern Illinois and the Oquawka area in Henderson County. Common bunch grasses were *Koeleria macrantha, Leptoloma cognatum*, and *Schizachyrium scoparium*

Table 12. Size class density (#/ha), basal area (m^2/ha), relative values, importance value (I.V.), and average diameter (cm) of the woody species encountered in 2005 in a degraded dry sand savanna community remnant at Big River Natural Area, Henderson County, Illinois. (* non-native species)

Species	Seed-lings	Small Sap-lings	Large Sap-lings	Trees (#/ha)	Basal Area (m^2/ha)	Rel. Den.	Rel. Dom.	I. V.	Av. Diam. (cm)
Quercus velutina	7500	1594	106	298	9.386	50.8	54.2	105.0	18.7
Quercus marilandica	1563	375	131	286	7.880	48.6	45.6	94.2	17.3
Juniperus virginiana	--	31	6	2	0.34	0.3	0.1	0.4	14.6
Prunus serotina	938	406	75	2	0.24	0.3	0.1	0.4	12.3
Rubus allegheniensis	3281	750	--	--	--	--	--	--	--
Rubus occidentalis	2031	1531	--	--	--	--	--	--	--
Cornus drummondii	1563	4250	--	-	--	--	--	--	--
Celtis occidentalis	1250	344	--	--	--	--	--	--	--
Ribes missouriense	781	438	--	--	--	--	--	--	--
Rhus aromatica	313	656	--	--	--	--	--	--	--
Rhus glabra	156	688	--	--	--	--	--	--	--
**Elaeagnus umbellata*	--	31	--	--	--	--	--	--	--
Gleditsia triacanthos	--	31	--	--	--	--	--	--	--
**Morus alba*	--	31	--	--	--	--	--	--	--
**Rosa multiflora*	--	31	--	--	--	--	--	--	--
Totals	19376	11187	318	588	17.324	100.0	100.0	200.0	

though all of the other graminoid taxa were also encountered, but rarely dominant. Overall, Gleason (1910) found that these three bunch grasses were "so regularly present and so frequently associated with each other that they may be regarded as the most typical grasses of the consocies." Except on rare occasions where one or two of the bunch-grass species dominated a small area, the remaining grasses never occupied large portions of the ground space. Essentially all of the other species reported by Gleason (1910) for northwestern Illinois were found during the present study.

Patterns of bunch grasses diversity and abundance involve many factors and are scale and habitat dependent. All of the common bunch grasses of northern Illinois occur throughout these sand deposits, their presence in any particular area related to disturbance, moisture, and many other biotic and abiotic factors. Within the sand deposits of northwestern Illinois, the high-quality areas surveyed were mostly associated with the bunch grass *Schizachyrium scoparium*. This species was generally the dominant or subdominant species of these high-quality sites (Fig. 2). Also, these high-quality areas were negatively associated with exotic, non-native species. In contrast, areas of disturbance where blowing sand was common were positively associated with non-native species. The bunch grasses *Dichanthelium villosissimum, Koeleria macrantha*, and *Panicum virgatum* were positively associated with these areas of blowing sand (Fig. 2). In mid-successional areas, where many native sand prairie species were common, the concentration of non-native species was highly variable, and many of the grasses present were not well-developed bunch grasses. Here *Dichanthelium oligosanthes, D. perlongum, Heterostipa spartea, Sporobolus clandestinus, S. cryptandrus, Triplasis purpurea*, and the non-native *Poa pratenisis* were common. The mid-summer bunch grass *Leptoloma congnatum* was positively associated with these mid-successional sites (Fig. 2).

Typical of the bunch-grass association, areas of bare ground and litter usually exist between the clumps. Generally the clumps of *Schizachyrium scoparium* were 15–40 cm across, nearly circular in outline, and formed dense masses. Some of the larger clumps of this species had dead centers forming rings in which no other species were observed. Most of the other common grasses of this bunch-grass association, particularly *Dichanthelium villosissimum* and *Koeleria macrantha,* had similar growth forms, but formed much smaller clumps. During the present study the mean cover of bare ground and litter in mature dry sand prairies was between 10% and 38%, in successional dry sand prairies between 6% and 30%, and in blowouts and blowing sand communities between 41% and 63%. Mature dry sand prairie communities in the Illinois River sand deposits of central Illinois also had extensive areas of open sand. At Long Branch Nature Preserve bare ground ranged from 38% to 44% in a mature dry sand prairie, while in a disturbed sand community bare ground averaged 59% (Phillippe et al. 2004). In another Mason County sand prairie complex at Henry

Allan Gleason Nature Preserve, bare ground and litter averaged 35% in a mature dry sand prairie, 47% to 52% in two successional communities, and 83% in a blowout community (McClain et al. 2004).

Between the clumps of grasses other graminoid species were common along with many prairie forbs. Though these sand prairies are part of the tallgrass prairie region, the species composition and relative abundance of the species in the interstitial areas between bunch grasses usually differ from those found in tallgrass prairies. Soil moisture retention of the sandy soil is low, and sand prairies generally support species that tolerate drier conditions. Also, productivity is generally low in sand prairies, due mostly to low soil organic matter content and low available nitrogen (Anderson et al. 1994). Very few native legumes were found in the communities studied. At Lost Mound, *Tephrosia virginiana* was the only native legume commonly encountered in the plots, other native legumes being rare. In contrast, at Ayers, Thomson/Fulton and Big River, both *Tephrosia virginiana* and *Lespedeza capitata* (round-headed bush clover) were relatively common, generally being among the top 10 species in IV.

Other Illinois Sand Deposits*:* Sand prairie remnants have also been studied in the Green River Lowland Section of the Grand Prairie Natural Division in northwestern Illinois. These remnants are between 50 and 75 km east of the Mississippi River, are adjacent to the Mississippi River sand deposits, and were deposited during warm periods near the end of Wisconsian Glaciation. One sand prairie remnant is on a shallow ridge surrounded by wet sand prairies and sedge meadows at the Richardson Wildlife Foundation (Handel et al. 2003). Here *Sorghastrum nutans* and *Schizachyrium scoparium* were dominant species, while the important forbs included *Euthamia graminifolia*, *Solidago nemoralis*, and *Liatris aspera*. The second sand prairie is associated with a dune ridge at Foley Sand Prairie Nature Preserve (McClain et al. 2003). Though *Schizachyrium scoparium* dominated this site, the remainder of the flora indicated more mesic conditions. On Foley sand prairie *Opuntia macrorhiza* was not encountered, *Dichanthelium villosissimum* was rare, and *Ambrosia psilostachya* was eighth in IV. Both prairie remnants were wetter than the sand prairies encountered in the Mississippi River sand deposits.

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Table 13. Summary of the variables for vegetation sample areas in the Mississippi River sand deposits of northwestern Illinois. (LM = Lost Mound; Ay = Ayers Sand Prairie Nature Preserve; TF = Thomson-Fulton Nature Preserve; BR = Big River State Forest)

	Dry Sand prairie with *Schizachyrium scoparium* usually a dominant species.						
	LM3	LM7	LM8	Ay10	TF13	BR15	mean
Floristic summary data							
Native species richness	38	32	39	38	28	37	35.33
Adventive species richness	4	2	6	2	1	2	2.83
Species density per plot	9.66	8.90	11.58	10.62	7.72	12.42	10.15
Total species richness	42	34	45	40	29	39	38.17
Percent native	90.48	94.12	86.67	95.00	96.55	94.87	92.95
Plant family number	18	15	21	19	12	19	17.33
Cover bare ground & litter	30.36	22.99	26.70	28.06	22.12	10.72	23.49
Floristic integrity index							
Floristic quality index (FQI)	27.47	27.10	28.03	26.72	26.55	26.26	27.02
FQI (native species)	28.85	27.93	30.10	27.42	27.02	26.96	28.05
Mean C-value	4.24	4.65	4.18	4.23	4.93	4.21	4.41
Native mean C-value	4.68	4.94	4.82	4.45	5.11	4.43	4.74

	Dry Sand Prairie with *Schizachyrium scoparium* absent or poorly represented.					Blowout, Blowing Sand, and Disturbance Communities, some cultivated in the past.					
	LM4	LM5	LM6	LM9	mean	LM1	LM2	Ay11	Ay12	TF14	mean
Floristic summary data											
Native species richness	30	46	35	45	39.00	22	32	34	34	31	3.06
Adventive species richness	2	7	3	5	4.25	1	2	1	1	1	1.20
Species density per plot	7.18	14.42	11.16	12.16	11.23	7.24	8.06	11.30	8.72	10.34	9.13
Total species richness	32	53	38	50	43.25	23	34	35	35	32	31.80
Percent native	93.75	86.79	92.11	90.00	90.66	95.65	94.12	96.88	97.14	96.88	96.13
Plant family number	14	22	17	23	19.00	11	14	21	19	14	15.80
Cover bare ground & litter	16.82	13.08	22.36	38.10	22.59	63.04	40.60	46.25	61.25	6.88	43.60
Floristic integrity index											
Floristic quality index (FQI)	28.11	20.74	23.85	35.07	26.94	24.19	31.04	29.07	28.23	26.87	27.88
FQI (native species)	29.03	22.25	24.85	36.97	28.28	24.73	32.98	29.50	28.64	27.30	28.63
Mean C-value	4.97	2.85	3.87	4.96	4.16	5.04	5.32	4.91	4.77	4.75	4.96
Native mean C-value	5.30	3.28	4.20	5.51	4.57	5.27	5.66	5.06	4.91	4.90	5.16

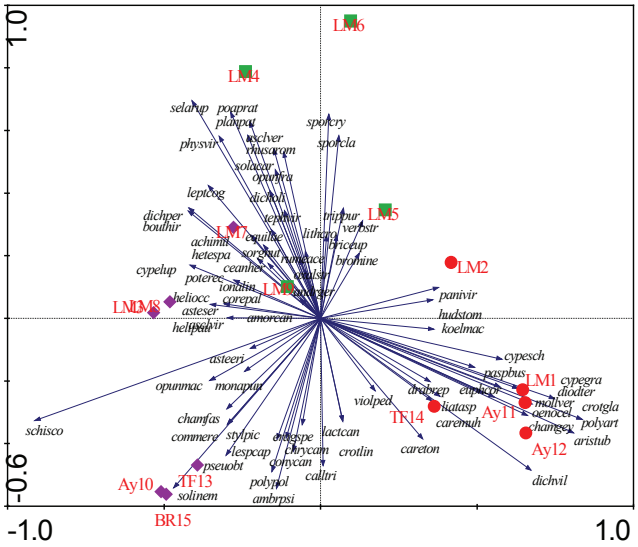

Figure 2. Biplot of species scores and plot loadings of the first two axes of a Principal Components Analysis (PCA) showing ground cover data, using importance values from 15 transects (n = 50 plots/transect) at Lost Mound (LM), Ayers Sand Prairie Nature Preserve (Ay), Thomson-Fulton Nature Preserve (TF), and Big River Natural Area (BR). Uncommon species were deleted.

achimil = *Achillea millefolium*
ambrpsi = *Ambrosia psilostachya*
amorcan = *Amorpha canescens*
andoger = *Andropogon gerardii*
aristub = *Aristida tuberculosa*
asclver = *Asclepias verticillata*
asclvir = *Asclepias viridiflora*
asteeri = *Aster ericoides*
asteser = *Aster sericeus*
bouthir = *Bouteloua hirsuta*
briceup = *Brickellia eupatorioides*
bromine = *Bromus inermis*
calltri = *Callirhoe triangulata*
caremuh = *Carex muhlenbergii*
careton = *Carex tonsa*
ceanher = *Ceanothus herbaceus*
chamgey = *Chamaesyce geyeri*
chamfas = *Chamaecrista fasciculata*
chrycam = *Chrysopsis camporum*
commere = *Commelina erecta*
conycan = *Conyza canadensis*
corepal = *Coreopsis palmata*
crotgla = *Croton glandulosus*
crotlin = *Crotonopsis linearis*
cypegra = *Cyperus grayoides*
cypelup = *Cyperus lupulinus*
cypesch = *Cyperus schweinitzii*
dicholi = *Dichanthelium oligosanthes*
dichper = *Dichanthelium perlongum*
dichvil = *Dichanthelium villosissimum*
diodter = *Diodia teres*
drarep = *Draba reptans*
equilae = *Equisetum laevigatum*
euphcor = *Euphorbia corollata*
eragspe = *Eragrostis spectabilis*
heliocc = *Helianthus occidentalis*
helipau = *Helianthus pauciflorus*
hetespa = *Heterostipa spartea*
hudstom = *Hudsonia tomentosa*
ionalin = *Ionactis linariifolius*
koelmac = *Koeleria macrantha*
lactcan = *Lactuca canadensis*
leptcog = *Leptoloma cognatum*
lespcap = *Lespedeza capitata*
liatasp = *Liatris aspera*
litocro = *Lithospermum croceum*
mollver = *Mollugo verticillata*
monapun = *Monarda punctata*
oenocel = *Oenothera clelandii*
opunfra = *Opuntia fragilis*
opunmac = *Opuntia macrorhiza*
oxalstr = *Oxalis stricta*
panivir = *Panicum virgatum*
paspbus = *Paspalum bushii*
physvir = *Physalis virginiana*
planpat = *Plantago patagonica*
poaprat = *Poa pratensis*
polyart = *Polygonella articulata*
polypol = *Polygala polygama*
poterec = *Potentilla recta*
pseuobt = *Pseudognaphalium obtusifolium*
rhusaro = *Rhus aromatica*
rumeace = *Rumex acetosella*
schisco = *Schizachyrium scoparium*
selarup = *Selaginella rupestris*
solacar = *Solanum carolinense*
solinem = *Solidago nemoralis*
sorgnut = *Sorghastrum nutans*
sporcla = *Sporobolus clandestinus*
sporcry = *Sporobolus cryptandrus*
stylpic = *Stylisma pickeringii*
tephvir = *Tephrosia virginiana*
trippur = *Triplasis purpurea*
verbstr = *Verbena stricta*
violped = *Viola pedata*

Table 14. Similarity index of the dry sand prairies studied in the Mississippi River sand deposits of northwestern Illinois.

AREAS	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8	Area 9	Area 10	Area 11	Area 12	Area 13	Area 14
Lost Mound – Area 1 blowout comm.														
Lost Mound – Area 2 blowing sand comm.	52.6													
Lost Mound – Area 3 *Schizachyrium/Poa* comm.	43.1	65.8												
Lost Mound – Area 4 *Tephrosia/Poa* comm.	50.9	63.6	54.1											
Lost Mound – Area 5 Primms Prairie	36.8	43.7	58.9	44.7										
Lost Mound – Area 6 *Sporobolus/Selaginella* comm.	36.0	55.5	62.5	54.3	59.3									
Lost Mound – Area 7 *Heterostipa/Opuntia* comm.	45.6	64.7	65.8	63.6	43.7	52.8								
Lost Mound – Area 8 unburned dry sand prairie	44.1	58.2	64.4	54.5	55.1	65.1	53.2							
Lost Mound – Area 9 burned dry sand prairie	35.6	52.4	63.0	51.2	54.4	56.8	50.0	67.4						
Ayers – Area 10 mature dry sand prairie	47.8	61.5	65.1	44.7	49.5	53.7	56.4	60.7	48.9					
Ayers – Area 11 disturbed dry sand prairie	58.6	60.9	49.9	41.8	38.6	41.1	46.4	50.0	42.4	68.4				
Ayers – Area 12 blowing sand comm.	55.2	63.8	54.5	41.8	43.2	46.6	46.3	50.0	42.4	75.9	74.3			
Thomson-Fulton – Area 13 mature dry sand prairie	60.3	56.8	56.1	50.0	47.3	43.6	51.4	51.8	48.9	59.5	61.3	69.3		
Thomson-Fulton – Area 14 disturbed dry sand prairie	66.7	59.2	55.7	43.5	48.9	45.3	45.1	53.7	46.0	59.3	66.7	83.9	80.5	
Big River – Area 15 mature dry sand prairie	36.9	52.6	59.5	43.2	44.2	57.5	47.4	52.9	45.7	48.8	51.9	51.9	53.7	55.7

The flora of the relatively mature dry sand prairie studied in the Mississippi River sand deposits is very similar to that of sand prairies associated with the Illinois River sand deposits in central Illinois. Dry sand prairies at Henry Allan Gleason Nature Preserve (McClain et al. 2004) and Long Branch Nature Preserve (Phillippe et al. 2004), both in Mason County, have nearly identical dominant species as those in northwestern Illinois. Both of these Mason County prairies were dominated by *Schizachyrium scoparium* while *Opuntia humifusa, Dichanthelium villosissimum*, and *Ambrosia psilostachya* were among the top six species in IV. Many subordinate species of these three dry sand prairies are also identical. In the mature dry sand prairies examined during the present study, many of the same species were high in IV. In many of the successional and disturbed communities examined during the present study, *Schizachyrium scoparium* was rarely encountered, though it was abundant throughout surrounding areas. The low incidence of this species may be related to its association with vesicular arbuscular mycorrhizal fungi that, for some reason, may not be present in the soil or may be due to the lack of certain soil nutrients (Dhillion et al. 1992, Anderson and Liberta 1992).

Management Implications: To study long-term changes in burned and unburned sand prairie remnants, many of the sites listed in the INAI were surveyed by Bowles et al. (2003) in 1996 and the results compared with the data obtained in the original INAI surveys. They studied seven sites: three that were managed with fire over the 20-year period and four that were not. Overall, native species richness per plot increased only on burned sites, whereas alien species richness per plot increased only on unburned sites. In the unburned sand prairies there was an increase in the alien grasses *Bromus inermis* and *Poa pratensis* that was accompanied by a decline in the native *Schizachyrium scoparium, Heterostipa spartea, Echinacea pallida, Helianthus pauciflorus,* and *Coreopsis palmata* (Bowles et al. 2003).

Similar results were observed during the present study, particularly at Lost Mound. Here fire suppression has been the rule since the army obtained the area in 1918 and adventive, cool-season grasses were planted into areas of the prairie. Fire suppression has undoubtedly resulted in adventive species becoming important components of this dry sand prairie, particularly in high disturbance areas and successional communities. Presently fire is occasionally used in many of the nature preserves in the Mississippi River sand deposits, and at Lost Mound a burning program is being initiated since the land was transferred to the U.S. Fish and Wildlife Service in 2003 (Nÿboer, personal observations). It is generally accepted that the establishment of prairie species is stimulated by fire and the removal of litter. Fires, as well as patch disturbances, generally increase species richness, particularly native prairie forbs that mostly occur as interstitial species in bunch-grass communities (Bowles et al. 2003). All available information indicates that fire, particularly early spring fires, are important in decreasing the extent of the cool-season, Eurasian grasses, decreasing the density and cover of adventive species, and increasing the density and cover of native sand prairie species.

Adventive Species: Presently adventive species are more abundant at Lost Mound than at the other natural areas examined. Adventive species are commonly associated with disturbances, particularly ground disturbances associated with human activity, such as roads, buildings, and agriculture, as well as overgrazing. At Lost Mound more than 100 adventive species were found associated with the prairie, mostly in areas of major disturbances. Within the plant communities studied at Lost Mound, adventive taxa were sometimes abundant. *Poa pratensis* was the most common adventive species in the study areas, being very abundant in the study plots in areas that had been heavily grazed in the past. Another commonly observed adventive grass was *Bromus inermis*, while *Rumex acetosella* and *Potentilla recta* were sometimes common in the study plots. At Ayers, Thomson/Fulton, and Big River, adventive species were less common. At these three sites *Poa pratensis* had an IV of 4.1 or lower within the plots. The only other adventive species encountered were *Achillea millefolium, Bromus tectorum*, *Chenopodium album*, *Mollugo verticillata*, and *Rumex acetosella.* Overall, in all of the natural areas examined, adventive species accounted for about 20% of the flora (Appendix I).

Few adventive legumes were recorded for the study plots. At Lost Mound, however, many were found in heavily disturbed areas, particularly along roadsides and in areas where cattle concentrations had been high (Appendix I). The most common adventive legume observed at Lost Mound was *Securigera varia* (crown vetch). Symstad (2004) found that the presence of crown vetch significantly increased soil nitrogen availability and significantly decreased native species richness and cover. High nitrogen levels caused a dramatic increase in *Poa pratensis* cover, which could hinder restoration efforts by competition with native species.

Forest and Savanna Communities: Gleason (1910) described the Lost Mound area as: "The sand deposits are chiefly prairie, but a belt of forest lies along the river, and tongues and irregular areas of forest project out into the prairie, in some places extending nearly across." Presently timber harvesting, grazing, oak wilt disease, and fire suppression have heavily modified the forest and savanna communities. A narrow belt of timber still exists along the river adjacent to Lost Mound. *Quercus velutina* dominates the dunes just back from the river, while a floodplain forest, dominated by *Acer saccharinum,* occurs on the frontal flats and the deposition area behind the navigation dam that crosses the Mississippi River near the north end of Lost Mound. On the sandy terrace behind the riverside dunes, prairie dominates. In this prairie scattered degraded savanna communities occur that are dominated by *Q. velutina*. In these sand forests and savannas, overstory species diversity is relatively low with *Q. velutina* the dominant species on dry sites and *Q. alba* becoming an important component of moister sites. At Big River State Forest, *Q. marilandica* becomes an important overstory component in the dry sand forest.

Throughout the sand deposits of Illinois, *Quercus velutina* generally dominates with none or only a few other *Quercus* species and sometimes with a few species of the genus *Carya* (hickories). In the Kankakee River sand deposits dry to dry-mesic sand savanna and forests communities are dominated by *Q. velutina*, which accounted for 75% to 97% of the IV. On more mesic sites *Q. alba* was the only other tree species commonly encountered (Johnson and Ebinger 1992). In the Illinois River sand deposits, in contrast, overstory species diversity is sometimes higher. Again *Q. velutina* is the dominant species, but *Q. marilandica* is usually well established along with occasional individuals of *Carya texana* (black hickory) and *C. tomentosa* (mockernut hickory) (McClain et al.2002). The forest communities in the Big River State Forest, though heavily degraded by fire suppression, are similar to the dry sand forests of the Illinois River sand deposits.

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APPENDIX I

Vascular plant species found in the Lost Mound Unit Savanna District of the Upper Mississippi River National Wildlife and Fish Refuge, Ayers Sand Prairie Nature Preserve, Thomson-Fulton Nature Preserve, and Big River State Forest, are listed alphabetically by family under major plant groups. An asterisk indicates non-native species. Collecting numbers preceded by G were collected by Henry A. Gleason and are deposited in the University of Illinois Herbarium, Urbana, Illinois (ILL). Collecting numbers proceeded by P or S were collected by Loy R. Phillippe or Amy Symstad and are deposited in the Illinois Natural History Survey Herbarium, Champaign, Illinois (ILLS). Collecting numbers preceded by E were collected by John E. Ebinger and are deposited in the Eastern Illinois University Herbarium, Charleston, Illinois (EIU). In addition, a few of the species were observed but not collected, and a few were reported by the Illinois Natural Areas Inventory (INAI) for which we could not find vouchers. The letter after each collecting number indicates the collecting site: s = Lost Mound; a = Ayers Sand Prairie Nature Preserve; t = Thomson-Fulton Nature Preserve; b = Big River State Forest.

FERNS AND FERN-ALLIES

Aspleniaceae
Asplenium platyneuron (L.) Oakes: P27959s

Dennstaedtiaceae
Pteridium aquilinum (L.) Kuhn: P28006s

Dryopteridaceae
Athyrium filix-femina (L.) Martens ssp. *angustum* (Willd.) R.T. Clausen: P27491s
Cystopteris protrusa (Weatherby) Blasdell: P27794s
Dryopteris carthusiana (Villars) H.P. Fuchs: P27487s
Woodsia obtusa (Spreng.) Torr.: P28578s

Equisetaceae
Equisetum arvense L.: P27198s
Equisetum x ferrissii Clute: P28587s
Equisetum hyemale L.: P27812s
Equisetum laevigatum A. Br.: P27529s; P36240a; E30652t
Equisetum pratense Ehrh.: P27195s

Onocleaceae
Onoclea sensibilis L.: P28270s

Ophioglossaceae
Botrychium dissectum Spreng.: P28441s
Botrychium virginianum (L.) Sw.: P27483s
Ophioglossum pusillum Raf.: P28440s

Osmundaceae
Osmunda claytoniana L.: P28449s

Pteridaceae
Adiantum pedatum L.: P27485s

Selaginellaceae
Selaginella rupestris (L.) Spring.: P27158s; E30611a; E31566t

GYMNOSPERMS

Cupressaceae
Juniperus virginiana L.: P27503s; E31263a; E30599t; E31667b

Pinaceae
**Pinus banksiana* Lamb.: P28581s; E30600t; E31952b
**Pinus resinosa* Ait.: P28446s
**Pinus sylvestris* L.: P37108a; E31231t

MONOCOTS

Agavaceae
**Yucca smalliana* Fern.: E31567t

Alismataceae
Alisma subcordatum Raf.: P27974s
Sagittaria latifolia Willd.: M3411; P28238s

Araceae
Arisaema dracontium (L.) Schott: P27488s
Arisaema triphyllum (L.) Schott: P27201s

Commelinaceae
Commelina erecta L.: P27849s; INAIa; E31378t; E31467b
Tradescantia ohiensis Raf.: P27424s; E30628a; E30653t; E31699b

Cyperaceae
Bolboschoenus fluviatilis (Torr.) Sojak: P28569s
Bulbostylis capillaris (L.) C.B. Clarke: P27832s; P37248b
Carex bicknellii Britt.: P27408s; E30630a
Carex blanda Dewey: P27280s
Carex brachyglossa Mack.: P27518s
Carex brevior (Dewey) Mack.: P27420s
Carex cephalophora Muhl. ex Willd.: E31867b
Carex conjuncta Boott: P27434s
Carex cristatella Britt.: P27810s
Carex duriuscula C.A. Meyer: P27326s
Carex festucacea Schk.: E31376a; P36717t
Carex frankii Kunth: P27963s
Carex gravida L.H. Bailey: P27498s
Carex grayi Carey: P27453s
Carex grisea Wahl: P27452s
Carex hirtifolia Mack.: P27472s
Carex hystericina Muhl.: P27494s
Carex laeviconica Dewey: P27796s
Carex lupulina Willd.: P27552s
Carex meadii Dewey: P27209s
Carex molesta Mack.: P27517s
Carex muhlenbergii Schk.: P27425s; E30629a; E30654t; E31468b
Carex pensylvanica Lam.: P27211s; E31321a; E31311t; E31664b
Carex rosea Schk.: P27437s
Carex scoparia Schk.: P27438s

Carex stipata Muhl.: P27471s
Carex stricta Lam.: P27430s
Carex tonsa (Fern.) Bickn.: P27159s; E31320a; E31379t
Carex tribuloides Vahl: P27551s
Carex typhina Michx.: P27792s
Carex vulpinioidea Michx.: P27756s
Cyperus erythrorhizos Muhl.: P28085s
Cyperus esculentus L.: P28084s
Cyperus grayoides Mohlenbr.: P27829s; P37104a; E31509t
Cyperus lupulinus (Spreng.) Marcks var. l*upulinus*: P27512s; P36211a; E31508t; E31865b
Cyperus lupulinus (Spreng,) Marcks var. *macilentus* (Fern.) Marcks: P27718s; E31864b
Cyperus x mesochorus Geise: E31866b
Cyperus odoratus L.: P28044s
Cyperus schweinitzii Torr.: P27717s; E31709a; E31380t; E31469b
Cyperus squarrosus L.: P28226s
Eleocharis acicularis (L.) Roem. & Schultes: P27543s
Eleocharis erythropoda Steud.: P28120s
Eleocharis ovata (Roth) Roem. & Schultes var. *obtusa* (Willd.) Kukenth: P27975s
Scirpus atrovirens Willd.: P27783s
Scirpus cyperinus (L.) Kunth: P27981s

Hydrocharitaceae
Elodea nuttallii (Planch.) St. John: P28242s
Vallisneria americana Michx.: P28245s

Iridaceae
Iris shrevei Small: P27800s
Sisyrinchium albidunm Raf.: E31322a; E31470b
Sisyrinchium campestre Bickn.: P27300s; E31665b
Sisyrinchium mucronatum Michx.: E31323a

Juncaceae
Juncus interior Wieg.: P27782s
Juncus tenuis Willd.: P27757s

Lemnaceae
Lemna minor L.: P28095s
Spirodela polyrhiza (L.) Schleiden: P28264.1s
Wolffia columbiana Karst: P28264.2s

Liliaceae
Allium canadense L.: P27788s
**Asparagus officinalis* L.: P27457s
**Hemerocallis fulva* (L.) L.: P27815s
Polygonatum commutatum (Schult.) A. Dietr.: P27716s
Polygonatum biflorum (Walt.) Ell.: E31700b
Smilacina stellata (L.) Desf.: P27166s

Najadaceae
Najas minor All.: P27814s

Orchidaceae
Galearis spectabilis (L.) Raf.: P27332s
Liparis liliifolia (L.) Rich.: P28439s
Spiranthes lacera (Raf.) Raf.: S364s

Poaceae
Agrostis gigantea Roth: P27761s
Agrostis hyemalis (Walt.) BSP.: P27509s; INAIa
Alopecurus carolinianus Walt.: P27440s
Andropogon gerardii Vitman: P28108s; E31264a; INAIt; E31954b
Aristida basiramea Engelm.: P328114s; P36235a
Aristida oligantha Michx.: P28112s
Aristida tuberculosa Nutt.: P28028s; E31265a; E31232t; P37242b
Bouteloua curtipendula (Michx.) Torr.: P27864s
Bouteloua gracilis (HBK.) Lag.: P28554s
Bouteloua hirsuta Lag.: P27940s; P36216a; INAIt; E31855b
**Bromus inermis* Leyss.: P27499s; E30631a; E30656t; E31701b
Bromus kalmii Gray: P28101s
**Bromus racemosus* L.: P27502s; E30655t
**Bromus tectorum* L.: P27311s; E30612a; E30601t; E31856b
Calamovilfa longifolia (Hook.) Scribn.: P28424s; E31266a; E31233t; E31471b
Cenchrus longispinus (Hack.) Fern.: P27968s; INAIa; INAIt; E31857b
**Chloris verticillata* Nutt.: P27732s
Cinna arundinacea L.: P28433s
**Dactylis glomerata* L.: P27470s
Dichanthelium acuminatum (Sw.) Gould & Clark var. *fasciculatum* (Torr.) Freckm.: P27713s
Dichanthelium acuminatum (Sw.) Gould & Clark var. *implicatum* (Scribn.) Gould & Clark: P28129s
Dichanthelium depauperatum (Muhl.) Gould: P27422s; P37099t
Dichanthelium linearifolium (Scribn.) Gould: P27527s
Dichanthelium oligosanthes (Schult.) Gould: P27423s; E30633a; E30659t; E31472b
Dichanthelium perlongum (Nash) Freckm.: E31936a
Dichanthelium villosissimum (Nash) Freckm.: P27414s; E30634a; E30658t; E31473b
Dichanthelium wilcoxianum (Vasey) Freckm.: S337s
Digitaria filiformis (L.) Koel.: P37243b
**Digitaria ischaemum* (Screb.) Schreb.: E31510t
**Digitaria sanguinalis* (L.) Scop.: P27917s; E31858b
**Echinochloa crus-galli* (L.) P. Beauv.: P27980s
Echinochloa muricata (Michx.) Fern.: P28053s
**Eleusine indica* (L.) Gaertn.: E31859b
Elymus canadensis L.: P27781s; E31511t
Elymus trachycaulus (Link) Gould: P27949s
Elymus virginicus L.: P27998s
**Elytrigia repens* (L.) Desv.: P27947s; E31710a; INAIt
**Elytrigia smithii* (Rydb.) Nevski: P27496s
**Eragrostis cilianensis* (All.) Vign.: P28213s
Eragrostis hypnoides (Lam.) BSP: P28044s
**Eragrostis minor* Host: P27778s
Eragrostis pectinacea (Michx.) Nees: P27836s
Eragrostis spectabilis (Pursh) Steud.: P27742s; P36231a; E31234t; E31955b
Eragrostis trichodes (Nutt.) Wood: P28284s; P37233b
**Festuca arundinacea* Schreb.: P27492s
**Festuca pratensis* Huds.: P27410s
Festuca subverticillata (Pers.) E.B. Alexeev: P27468s
**Festuca trachyphylla* (Hack.) Krajina: P27554s

Glyceria striata (Lam.) Hitchc.: P27482s
Heterostipa spartea (Trin.) Barkworth: P27412s; E30636a; E30660t; E31702b
Hordeum jubatum L.: P27548s
Koeleria macrantha (Ledeb.) Spreng.: P27421s; E30632a; E30602t; E31474b
Leersia oryzoides (L.) Swartz: P28043s
Leersia virginica Willd.: P28081s
Leptoloma cognatum (Schult.) Chase: P27916s; P36197a; E31512t; E31475b
**Lolium perenne* L.: P27513s
Muhlenbergia mexicana (L.) Trin.: P28435s
Muhlenbergia racemosa (Michx.) BSP: P28277s
Muhlenbergia schreberi J.F. Gmel.: P28434s
Panicum capillare L. var. *capillare*: P28054s; E31513t; E31860b
Panicum virgatum L.: P27986s; E31269a; E31235t
Paspalum bushii Nash: P27859s; P36215a; E31514t; E31476b
Paspalum setaceum Michx. var. *ciliatifolium* (Michx.) Vasey: P28066s; P36232a; INAIt; E31861b
**Phalaris arundinacea* L.: P27439s
**Poa bulbosa* L.: P27324s
**Poa compressa* L.: P27419s; E31711a; INAIt
Poa palustris L.: P27493s
**Poa pratensis* L.: P27307s; E30635a; E30661t; E31666b
Schizachyrium scoparium (Michx.) Nash: P28425s; E31267a; E31236t; P37237b
**Setaria faberi* R.A.W. Herrm.: P28069s; E31515t; E31863b
**Setaria glauca* (L.) P. Beauv.: P28051s; P36213a; E31862b
**Setaria viridis* (L.) P. Beauv.: P27725s
Sorghastrum nutans (L.) Nash: P28035s; P36206a; E31516t; P37246b
Spartina pectinata Link: P27997s; E31270a
Sphenopholis intermedia (Rydb.) Rydb.: P27486s
Sphenopholis obtusata (Michx.) Scribn.: P27514s
Sporobolus clandestinus (Biehler) Hitchc.: P28223s
Sporobolus compositus (Poir.) Merr.: P28418s; E31271a
Sporobolus cryptandrus (Torr.) Gray: P27511s; P36194a; P36160t; E31953b
Sporobolus heterolepis (Gray) Gray: INAIt
Sporobolus vaginiflorus (Torr.) A. Wood: P28212s; E31237t
Tridens flavus (L.) Hitchc.: P28090s; P37249b
Triplasis purpurea (Walt.) Chapm.: P28062s; P36230a; P366187t; P37250b
**Triticum aestivum* L.: P27764s
Vulpia octoflora (Walt.) Rydb.: P27303s; P36708a; E30662t

Pontederiaceae
Zosterella dubia (Jacq.) Small: P28259.1s

Potamogetonaceae
**Potamogeton crispus* L.: P28243s
Potamogeton nodosus Poir.: P27544s
Potamogeton pusillus L.: P28259.2s
Stuckenia pectinata (L.) Borner: P28258s

Smilacaceae
Smilax lasioneuron Hook.: P27813s
Smilax tamnoides L.: P27426s

Sparganiaceae
Sparganium eurycarpum Engelm.: P27984s

Typhaceae
Typha latifolia L.: P28442s

Zannichelliaceae
Zannichellia palustris L.: P28590s

DICOTS

Acanthaceae
Ruellia humilis Nutt.: P27838s; E31822b

Aceraceae
Acer negundo L.: P27277s; P36709a; E31381t
Acer saccharinum L.: P27208s
Acer saccharum Marsh.: P28588s

Amaranthaceae
Amaranthus rudis J. Sauer: P28235s
**Amaranthus spinosus* L.: P28430s
Amaranthus tuberculatus (Moq.) Sauer: P28432s
Froelichia floridana (Nutt.) Moq.: P27830s; P36210a; E31238t; E31823b
Froelichia gracilis (Hook.) Moq.: P27706s; E31937a; E31239t; E31446b

Anacardiaceae
Rhus aromatica Ait. var. *arenaria* (Greene) Fern.: P27320s; E31447b
Rhus aromatica Ait. var. *aromatica*: P27951s; E30613a; E30603t
Rhus glabra L.: P27334s; INAIa; P36190t; E31824b
Rhus hirta L.: P36223a; E31240t
Toxicodendron radicans (L.) Kuntze: P27719s; P36233a; E31241t; E31668b

Apiaceae
Cicuta maculata L.: P27993s
**Conium maculatum* L.: P27768s
Cryptotaenia canadensis (L.) DC.: P27786s
**Daucus carota* L.: P27726s; E31825b
Eryngium yuccifolium Michx.: INAIt
Heracleum maximum Bartr.: P27429s
Osmorhiza claytonii (Michx.) C.B. Clarke: P27436s
Osmorhiza longistylis (Torr.) DC.: P27435s
**Pastinaca sativa* L.: P27791s
Sanicula canadensis L.: P27711s
Sanicula odorata (Raf.) Pryer & Phillippe: P27469s
Spermolepis inermis (Nutt.) Math. & Constance: P27739s; E31377a

Apocynaceae
Apocynum sibiricum Jacq.: P28086s; P36222a

Araliaceae
Aralia nudicaulis L.: P27845s

Asclepiadaceae
Asclepias amplexicaulis Small: P27522s; E31359a; E31382t; E31826b
Asclepias hirtella (Pennell) Woodson: P36221a; P36166t
Asclepias incarnata L.: P27988s
Asclepias syriaca L. var. *syriaca*: P27704s; E31360a; E31383t; E31669b
Asclepias tuberosa L.: P27945s
Asclepias verticillata L.: P27946s; P36195a; E31384t; E31448b
Asclepias viridiflora Raf.: P27703s; E31361a; E31385t; E31449b

Asteraceae
**Achillea millefolium* L.: P27507s; E30637a; E30663t; E31670b
Ageratina altissima (L.) R.M. King & H. Rob.: P27966s
Ambrosia artemisiifolia L.: P28070s; P36209a; E31477t; E31827b
Ambrosia psilostachya DC.: Observed at s; E31275a; E31242t; E31828b
Ambrosia trifida L.: P28092s
Antennaria neglecta Greene: P27183s; E31312t
Antennaria plantaginifolia (L.) Hook.: P28118s; P36713a; E31647b
**Arctium lappa* L.: P27954s
**Arctium minus* Schk.: P28131s
Artemisia campestris L.: P28117s; E31478t
**Artemisia ludoviciana* Nutt.: P28286s
Aster cordifolius L.: P28596s
Aster ericoides L.: P28252s; E31274a; E31243t
Aster lanceolatus Willd.: P28232s
Aster lateriflorus (L.) Britt.: P28448s
Aster oblongifolius Nutt.: P28283s
Aster ontarionis Wieg.: P28234s
Aster oolentangiensis Riddell: P28423s
Aster pilosus Willd.: Observed at s; E31273a; E31245t; E31956b
Aster prenanthoides Muhl.; P28271s
Aster puniceus L.: P28444s
Aster sericeus Vent.: P28214s; INAIa; E31244t
Bidens bipinnata L.: E31829b
Bidens cernua L.: P28229s
Bidens comosa (Gray) Wieg.: P28228s
Bidens vulgata Greene: P28123s
Brickellia eupatorioides (L.) Shinners: P28218s; P36224a; E31246t; P37234b
**Carduus nutans* L.: P27541s; E31671b
**Centaurea biebersteinii* DC.: P27846s
Chrysopsis camporum Greene: P27533s; E30638a; E30665t
**Cirsium arvense* (L.) Scop.: P27777s
Cirsium discolor (Muhl.) Spreng.: P28050s; P36196a; E31479t
**Cirsium vulgare* (Savi) Tenore: P27943s
Conyza canadensis (L.) Cronq.: P28036s; E31276a; E31247t; P37231b
Coreopsis palmata Nutt.: P27715s; P36207a; E31386t; E31451b
**Crepis tectorum* L.: P27557s
Echinacea pallida (Nutt.) Nutt.: Observed at s; INAIt; E31453b
Eclipta prosrata (L.) L.: P28248s
Erechtites hieracifolia (L.) Raf.: P28225s
Erigeron annuus (L.) Pers.: P27497s; E31961a
Erigeron philadelphicus L.: P27432s
Erigeron strigosus Muhl.: P27520s; E31362a; E30664t; E31452b
Eupatoriadelphus purpureus (L.) R.M. King & H. Rob.: P27989s
Eupatorium perfoliatum L.: P27990s

Eupatorium serotinum Michx.: P27970s
Euthamia graminifolia (L.) Nutt.: E31480t
**Grindelia squarrosa* (Pursh) Dunal: P28059s
Helenium autumnale L.: P28072s
**Helianthus annuus* L.: P27720s
Helianthus hirsutus Raf.: P28603s
Helianthus mollis Lam.: P28061s
Helianthus occidentalis Riddell: P27924s; P36202a; E31481t; E31830b
Helianthus pauciflorus Nutt.: P28111s; E31250t; P37238b
**Helianthus petiolaris* Nutt.: P36220a; P36172t; E31831b
Helianthus strumosus L.: E31454b
Helianthus tuberosus L.: P28107s
Heliopsis helianthoides (L.) Sweet: P27952s
Hieracium longipilum Torr.: P27935s; P36203a; E31482t
Ionactis linariifolius (L.) Greene: P28568s; E31272a; INAIt
Krigia virginica (L.) Willd.: P27177s; E31324a; E30604t; E31648b
Lactuca canadensis L.: P28445s; P36198a; E31483t; P37236b
Lactuca floridana (L.) Gaertn.: P28103s
**Lactuca serriola* L.: P28064s; E31484t; E31832b
Liatris aspera Michx.: P28032s; E31278a; E31251t
**Matricaria discoidea* DC.: P27779s
Oligoneuron rigidum (L.) Small: P28217s
Pseudognaphalium obtusifolium (L.) Hilliard & Burtt: P28034s; E31277a; E31248t; E31951b
Ratibida pinnata (Vent.) Barnh.: P27987s
Rudbeckia hirta L.: P27730s; E31704a; E31672b
Rudbeckia laciniata L.: P28106s
Rudbeckia triloba L.: P28105s
Senecio plattensis Nutt.: P27164s; P36715a; E31649b
Silphium perfoliatum L.: P28099s
Solidago canadensis L.: P28077s; E31485t
Solidago juncea Ait.: INAIt
Solidago gigantea Ait.: P28080s
Solidago nemoralis Ait.: P27958s; E31279a; E31252t; P37235b
Solidago speciosa Nutt.: P28267s; INAIa; INAIt; E31455b
Solidago ulmifolia Muhl.: P28566s
**Taraxacum officinale* Weber: P27312s
**Tragapogon dubius* Scop.: P27411s; E30639a; E30666t; E31673b
Vernonia fasciculata Michx.: P28073s

Balsaminaceae
Impatiens capensis Meerb.: P28037s
Impatiens pallida Nutt.: P28005s

Berberidaceae
***Berberis thunbergii* DC.: P28001s
Podophyllum peltatum L.: P27283s

Betulaceae
Betula nigra L.: P27161s

Bignoniaceae
**Catalpa speciosa* Warder: P28121s; E31387t

Boraginaceae
**Cynoglossum officinale* L.: P27463s
**Echium vulgare* L.: P27500s
Hackelia virginiana (L.) I.M. Johnston: P27919s
**Lappula squarrosa* (Retz.) Dumort.: P27769s
Lithospermum croceum Fern.: P27163s; E30614a; E30605t; E31652b
Lithospermum incisum Lehm.: P27299s; INAIa; E31313t

Brassicaceae
**Alliaria petiolata* (Bieb.) Cavara & Grande: P27310s
**Alyssum alyssoides* (L.) L.: P27289s
Arabis canadensis L.: P27465s
Arabis divaricarpa A. Nelson: P27556s
Arabis glabra (L.) Bernh.: P27343s; E30640a; E31314t
Arabis lyrata L.: P27154s; E30615a; E30606t; E31650b
**Barbarea vulgaris* R. Br.: P27342s
**Berteroa incana* (L.) DC.: P27449s
**Brassica nigra* (L.) Koch: P27738s
**Capsella bursa-pastoris* (L.) Medic.: P27279s
Cardamine bulbosa (Muhl.) BSP: P27331s
**Cardamine hirsuta* L.: P27433s
Cardamine parviflora L.: P27309s
Cardamine pensylvanica Willd.: P28239s
Descurainia pinnata (Walt.) Britt.: P27165s; E30616a; E30667t; E31651b
**Draba nemorosa* L.: P27284s
Draba reptans (Lam.) Fern.: P27156s; E31325a; E30668t
**Eriophila verna* (L.) Chev.: P27191s; E31565t
**Erysimum cheiranthoides* L.: E30670t
**Erysimum inconspicuum* (S. Wats.) MacM.: P27416s
**Lepidium campestre* (L.) R. Br.: P27407s
**Lepidium densiflorum* Schrad.: P27409s; E31363a; E30669t; E31833b
Lepidium virginicum L.: P27302s; E30617a
Rorippa sessiliflora (Nutt.) A. Hitchc.: P27450s
**Rorippa sylvestris* (L.) Besser: P27535s
**Sisymbrium altissimum* L.: P27293s
**Thlaspi arvense* L.: P27204s

Cactaceae
Opuntia fragilis (Nutt.) Haw.: P28065s
Opuntia macrorhiza Engelm.: P27862s; E31253t; E31445b

Caesalpiniaceae
Chamaecrista fasciculata (Michx.) Greene: P27934s; P36192a; E31487t; E31834b
Gleditsia triacanthos L.: P27417s; E31365a; E31488t; E31674b
Gymnocladus dioicus (L.) K. Koch: P27805s

Campanulaceae
Campanulastrum americanum (L.) Small: P27809s
Lobelia cardinalis L.: P27999s
Lobelia inflata L.: P28126s
Lobelia siphilitica L.: P28091s
Triodanis perfoliata (L.) Nieuwl.: P27505s; E30641a; E30671t; E31675b

Cannabinaceae
**Cannabis sativa* L.: P27833s; E31935a
**Humulus japonicus* Sieb. & Zucc.: P28285s
Humulus lupulus L.: P28124s

Capparaceae
Polanisia dodecandra (L.) DC.: P27737s; E31456b
Polanisia jamesii (Torr. & Gray) Iltis: P27714s

Caprifoliaceae
**Lonicera morrowii* Gray: P27295s; E31327a; P36182t
**Lonicera tatarica* L.: P27281s; E31328a
**Lonicera xylosteum* L.: E31676b
Sambucus canadensis L.: P27766s
Viburnum lentago L.: P27323s
**Viburnum opulus* L.: P27428s

Caryophyllaceae
**Arenaria serpyllifolia* L.: P27305s; E30644a; E31653b
**Cerastium brachypodum* (Engelm.) B.L. Robins.: P27181s
**Cerastium fontanum* Baum.: P27315s
**Dianthus armeria* L.: P27775s
**Holosteum umbellatum* L.: P27184s; E30618a; E31630b
**Myosoton aquaticum* (L.) Moench.: P27442s
Paronychia canadensis (L.) Wood: P27831s
Paronychia fastigiata (Raf.) Fern.: P27921s
**Saponaria officinalis* L.: P27707s; E31677b
Silene antirrhina L.: P27418s; E30643a; E30643t; E31679b
**Silene cserei* Baumg.: P27418s; E30672t
**Silene dioica* (L.) Clairv.: E31678b
Silene nivea (Nutt.) Otth.: P27787s
**Silene pratensis* (Spreng.) Godron & Gren: P27526s; E30642a
**Stellaria media* (L.) Cyrillo: S227s

Celastraceae
Celastrus scandens L.: P27427s; E30645a; E31836b
Euonymus atropurpureus Jacq.: P28597s

Ceratophyllaceae
Ceratophyllum demersum L.: P28240s

Chenopodiaceae
**Chenopodium album* L.: P36204a; E31388t; E31457b
**Chenopodium ambrosioides* L.: P28048s
Chenopodium desiccatum A. Nels.: E31280a
Chenopodium pratericola Rydb.: P28049s
Chenopodium simplex (Torr.) Raf.: P27834s
Cycloloma atriplicifolium (Spreng.) Coult.: P27736s; E31939a; E31680b
**Salsola collina* Pallas: P28115s; E31486t

Cistaceae
Helianthemum bicknellii Fern.: P27851s; P36241a; P37241b
Helianthemum canadense (L.) Michx.: P27456s; E30646a; P36716t
Hudsonia tomentosa Nutt.: P27460s; E31326a
Lechea pulchella Raf.: P27867.2s
Lechea tenuifolia Michx.: P27868.1s; P37239b

Convolvulaceae
Calystegia sepium (L.) R. Br.: P27767s
**Convolvulus arvensis* L.: P27852s
Stylisma pickeringii (Torr.) Gray: E31458b

Cornaceae
Cornus drummondii C.A. Mey.: P27976s; E31364a; E31681b
Cornus racemosa Lam.: P27490s

Cucurbitaceae
Sicyos angulatus L.: P28088s

Cuscutaceae
Cuscuta campestris Yuncker: P37100t

Elaeagnaceae
**Elaeagnus umbellata* Thunb.: P27336s; P36714a; E31654b

Euphorbiaceae
Acalypha gracilens Gray: S142s
Acalypha rhomboidea Raf.: P27741s
Chamaesyce geyeri (Engelm.) Small: P27956s; P36211a; E31491t
Chamaesyce maculata (L.) Small: P28030s; P36174t; P37240b
Chamaesyce nutans (Lag.) Small: P28047s
**Chamaesyce prostrata* (Ait.) Small: E31490t
Croton capitatus Michx.: S354s
Croton glandulosus L.: P27723s; P36218a; E31492t; E31837b
Crotonopsis linearis Michs.: INAIa; E31493t; E31838b
Euphorbia corollata L.: P27960s; E31366a; E31389t; E31459b
**Euphorbia esula* L.: P27314s
Poinsettia dentata (Michx.) Kl. & Garcke: P28052s; P36193a; E31494t; E31839b

Fabaceae
Amorpha canescens Pursh: P27702s; E31367a; E31495t; E31460b
Amorpha fruticosa L.: P27817s; P36184t
Amphicarpaea bracteata (L.) Fern.: P28038s
Apios americana Medic.: P28102s
Baptisia alba (L.) Vent. E31390t
**Baptisia australis* (L.) R. Br.: P37106a
Crotalaria sagittalis L.: P27962s
Dalea candida (Michx.) Willd.: S322s
Dalea purpurea Vent.: P27824s; E31368a; INAIt
Desmodium canadense (L.) DC.: P28104s
Desmodium glutinosum (Muhl.) A. Wood: P27842s
Desmodium illinoense Gray: P27914s; E31840b
**Kummerowia stipulacea* (Maxim.) Makino: P28276s

Lespedeza capitata Michx.: P28122s; E31281a; E31254t; E37232b
Lespedeza intermedia (S. Wats.) Britt.: P28567s
**Medicago lupulina* L.: P27413s; E30647a; E31682b
**Melilotus albus* Medic.: P27501s; E31369a; E31391t; E31461b
**Melilotus officinalis* (L.) Pallas: P27406s; E31706a; E30674a; E31683b
**Robinia pseudoacacia* L.: P27444s
**Securigera varia* (L.) Lassen: P27524s
Strophostyles helvula (L.) Ell. var. *helvula*: P27933s; P36243a; E31841b
Strophostyles helvula (L.) Ell. var. *missouriensis* (S. Wats.) Britt.: P27765s
Strophostyles leiosperma (Torr. & Gray) Piper: P27925s
Tephrosia virginiana (L.) Pers.: P27728s; E31282a; E31255t; E31462b
**Trifolium arvense* L.: P27747s
**Trifolium campestre* Schreb.: P27733s
**Trifolium hybridum* L.: P28455s
**Trifolium pratense* L.: P27473s; E31842b
**Trifolium repens* L.: P27474s
**Vicia villosa* Roth: P27476s

Fagaceae
Quercus alba L.: P28443s
Quercus x bushii Sarg.: E31634b
Quercus macrocarpa Michx.: P27319s
Quercus marilandica Muench.: E31655b
Quercus muhlenbergii Englem.: P27475s
Quercus palustris Muench.: P28094s
Quercus rubra L.: P28042s
Quercus velutina Lam.: P27187s; E30619a; E31256t; E31633b

Fumariaceae
Corydalis micrantha (Engelm.) Gray: P27287s
Dicentra cucullaria (L.) Bernh.: P27203s

Gentianaceae
Gentiana puberulenta J. Pringle: INAIt

Geraniaceae
Geranium carolinianum L.: P27553s; E31684b
Geranium maculatum L.: P27329s

Grossulariaceae
Ribes missouriense Nutt.: P27189s; P36227a; P36181t; E31636b

Haloragidaceae
**Myriophyllum spicatum* L.: P28260s

Hydrophyllaceae
Ellisia nyctelea L.: P27278s
Hydrophyllum virginianum L.: P27338s

Hypericaceae
**Hypericum perforatum* L.: P27700s
Hypericum punctatum Lam.: P27996s
Hypericum sphaerocarpum Michx.: P27797s

Juglandaceae
Carya cordiformis (Wangenh.) K. Koch: P27466s
Carya ovata (Mill.) K. Koch: P28119s
Carya tomentosa (Poir.) Nutt.: P28130s
Juglans cinerea L.: P28584s
Juglans nigra L.: P27291s

Lamiaceae
Agastache nepetoides (L.) Ktze.: P27944s
Hedeoma hispida Pursh: P27415s
**Leonurus cardiaca* L.: P27708s; E31685b
Lycopus americanus Muhl.: P27955s
Lycopus uniflorus Michx.: P28079s
**Mentha arvensis* L.: P27992s
Monarda fistulosa L. var. *fistulosa*: P27841s; E31843b
Monarda fistulosa L. var. *mollis* (L.) Benth.: P27950s
Monarda punctata L.: P27931s; E31283a; E31257t; E31844b
**Nepeta cataria* L.: P27776s; P36164t; E31845b
Physostegia virginiana (L.) Benth.: P28078s
**Prunella vulgaris* L.: P27967s
Pycnanthemum virginianum (L.) Dur. & B.D. Jacks.: P28098s
Salvia azurea Michx. & Lam.: P28060s
Scutellaria lateriflora L.: P28075s
Scutellaria leonardii Epling: P27837s
Scutellaria ovata Hill: P27744s
Stachys hispida Pursh: P28247s
Stachys tenuifolia Willd.: P27799s
Teucrium canadense L.: P27801s
Trichostema dichotomum L.: P27941s

Linaceae
Linum sulcatum Riddell: P27823s

Lythraceae
Ammannia coccinea Rottb.: P28237s
**Lythrum salicaria* L.: P28249s
Rotala ramosior (L.) Koehne: P27866s

Malvaceae
Callirhoe triangulata (Leavenw.) Gray: P27762s; P36201a; E31496t; E31686b
Hibiscus laevis All.: P28075s
**Malva neglecta* Wallr.: P28251s

Menispermaceae
Menispermum canadense L.: P27484s

Molluginaceae
**Mollugo verticillata* L.: P27705s; P36219a; E31258t; E31687b

Moraceae
**Morus alba* L.: P27285s; P36225a; E31259t
**Morus tatarica* L.: E31688b

Nelumbonaceae
Nelumbo lutea (Willd.) Pers.: P28003s

Nyctaginaceae
Mirabilis hirsuta (Pursh) MacM.: P27793s
**Mirabilis nyctaginea* (Michx.) MacM.: P27521s; E31370a; E31497t; E31689b

Nymphaeaceae
Nymphaea tuberosa Paine: P28263s

Oleaceae
Fraxinus lanceolata Borkh.: P27489s
Fraxinus pennsylvanica Marsh.: P36238a; P36165t
**Syringa vulgaris* L.: P27321s

Onagraceae
Circaea lutetiana L.: P27709s
Epilobium ciliatum Raf.: P28438s
Gaura longiflora Spach: P28050s
Oenothera biennis L.: P28083s: P37102a
Oenothera clelandii W. Dietr., Raven, & W.L. Wagner: P27729s; P36205a; E31498t; E31463b
Oenothera laciniata Hill: P27926s

Orobanchaceae
Orobanche fasciculata Nutt.: G2634s

Oxalidaceae
Oxalis stricta L.: P27525s; E30648a
Oxalis violacea L.: E31637b

Papaveraceae
Sanguinaria canadensis L.: P27193s

Phrymaceae
Phryma leptostachya L.: P27844s

Phytolaccaceae
Phytolacca americana L.: S110s; E31846b

Plantaginaceae
Plantago aristata Michx.: P27758s
**Plantago lanceolata* L.: P27735s
Plantago patagonica Jacq.: P27508s; E30649a; E30675t; E31690b
Plantago rugelii Decne.: P27840s
Plantago virginica L.: P27448s

Polemoniaceae
Phlox divaricata L.: P27194s

Polygalaceae
Polygala polygama Walt.: P27516s; E31285a; E30676t; E31464b
Polygala sanguinea L.: Observed at a.
Polygala verticillata L.: P22291s

Polygonaceae
Antenoron virginianum (L.) Roberty & Vautier: P28039s
**Fallopia convolvulus* (L.) A. Love: P27835s; E31691b
Fallopia scandens (L.) Holub.: P28128s; E31499t
Persicaria amphibium (L.) S.F. Gray: P28230s
**Persicaria cespitosa* (Blume) Nakai: P28068s
**Persicaria hydropiper* (L.) Opiz: P28093s
Persicaria lapathifolia (L.) S.F. Gray: P28057s
Persicaria pensylvanica (L.) Small: P27978s
Persicaria punctata (Ell.) Small: P28056s
**Persicaria vulgaris* Webb & Moq.: P27979s
Polygonella articulata (L.) Meisn.: P28220s; E31284a; E31260t
**Polygonum aviculare* L.: E31392t
Polygonum ramosissimum Michx.: P28215s
Polygonum tenue Michx.: P27930s; P36234a; P36171t; P37244b
**Rumex acetosella* L.: P27313s; E30650a; E30607t; E31656b
Rumex altissimus Wood: P27540s
**Rumex crispus* L.: P27546s
Rumex verticillatus L.: P27816s

Portulacaceae
Claytonia virginica L.: P27199s
**Portulaca oleracea* L.: P27865s
Talinum rugospermum Holz.: P27740s; P36242a; P22637t; E31847b

Primulaceae
Androsace occidentalis Pursh: P27157s; E31329a; E31315t; E31657b
Lysimachia ciliata L.: P27798s

Ranunculaceae
Anemone canadensis L.: P27317s
Anemone caroliniana Walt.: P27155s; INAIa
Anemone cylindrica Gray: P27538s; INAIa
Anemone quinquefolia L.: P27202s
Anemone virginiana L.: P27790s
Aquilegia canadensis L.: P27286s
Caltha palustris L.: P27316s
Clematis virginiana L.: P28273s
Ranunculus abortivus L.: P27168s; E30677t
Ranunculus fascicularis Bigel.: P27301s
Ranunculus pensylvanicus L.f.: P27972s
Ranunculus septentrionalis Poir.: P27330s
Thalictrum dasycarpum Fisch. & Lall.: P27802s

Rhamnaceae
Ceanothus americanus L.: P27731s; P36199a; INAIt
Ceanothus herbaceus Raf.: P27458s
**Rhamnus cathartica* L.: P27328s

Rosaceae
Agrimonia gryposepala Wallr.: P27965s
Agrimonia pubescens Wallr.: P28002s
Crataegus calpodendron (Ehrh.) Medic.: P27985s

Fragaria virginiana Duchesne: P27294s
Geum canadense Jacq.: P27710s; E31500t
Geum triflorum Pursh: P27153s
Malus coronaria (L.) Mill.: P27174s
Malus ioensis (Wood) Britt.: P27276s
**Malus pumila* Mill.: P27205s
Physocarpus opulifolius (L.) Maxim.: P28004s
**Potentilla argentea* L.: P27297s
Potentilla arguta Pursh: INAIt
**Potentilla inclinata* Vill.: P27405s
Potentilla norvegica L.: P27754s
**Potentilla recta* L.: P27504s; E31371a; E30678t; E31692b
Potentilla simplex Michx.: P28602s; INAIt
Prunus americana Marsh.: P27162s
Prunus nigra Ait.: P27160s
Prunus serotina Ehrh.: P27341s; E30620a; E31318t; E31658b
Prunus susquehanae Willd.: INAIa; E31316t
Prunus virginiana L.: P28296s; P36229a; E31317t
Rosa carolina L.: P27506s; P37105a; E31393t
**Rosa multiflora* Thunb.: P27545s; P36712a
Rosa suffulta Greene: P28100s
Rubus allegheniensis Porter: P27536s
Rubus argutus Link: P27477s
Rubus baileyanus Britt.: E31394t
Rubus flagellaris Willd.: P27445s
Rubus occidentalis L.: P27461s; P36228a; P36163t; E31693b
Rubus pensilvanicus Poir.: E31848b

Rubiaceae
Cephalanthus occidentalis L.: P27807s
Diodia teres Walt.: P27937s; P36239a; E31261t; E31849b
Galium aparine L.: P27288s; E30679t; E31694b
Galium circaezans Michx.: P28579s
Galium concinnum Torr. & Gray: P27843s
Galium triflorum Michx.: P27743s

Rutaceae
Ptelea trifoliata L.: P27750s; INAIa; E30680t
Zanthoxylum americanum Mill.: P27173s; E31372a

Salicaceae
Populus deltoides Marsh.: P27340s; P36711a
Populus grandidentata Michx.: P27333s
Populus tremuloides Michx.: P27961s
Salix amygdaloides Anderss.: P27804s
Salix interior Rowlee: P27206s
Salix nigra Marsh.: P27318s

Santalaceae
Comandra umbellata (L.) Nutt.: P27335s; INAIt

Saxifragaceae
Penthorum sedoides L.: P27973s

Scrophulariaceae
Agalinis tenuifolia (Vahl) Raf.: P28451s
Aureolaria grandiflora (Benth.) Pennell: S216s
Bacopa rotundifolia (Michx.) Wettst.: P27971s
Besseya bullii (Eat.) Rydb.: P27539s; E31659b
**Chaenorrhinum minus* (L.) Lange: P 27854s
Gratiola neglecta Torr.: P27549s
**Linaria vulgaris* Mill.: P27795s
Lindernia dubia (L.) Pennell var. *dubia*: P29046s
Mimulus ringens L.: P28089s
Nuttallanthus canadensis (L.) D. Sutton: P27178s; E30621a; E30608t; E31660b
Penstemon grandiflorus Nutt.: P36188t; P37247b
Penstemon pallidus Small: P27325s; E30651a; E30609t; E31695b
Scrophularia lanceolata Pursh: P27446s
**Verbascum blattaria* L.: P27953s
**Verbascum thapsus* L.: P27995s; E31707a; E31501t; E31850b
**Veronica arvensis* L.: P27298s; E30622a; E30682t; E31661b
**Veronica dillenii* Crantz: P27180s
Veronica peregrina L.: P27282s
Veronicastrum virginicum (L.) Farw.: INAIt

Solanaceae
Physalis heterophylla Nees: P27515s; E31373a; E31502t; E31851b
Physalis subglabrata Mack. & Bush: P28236s; E31465b
Physalis virginiana Mill.: P27459s; E31374a; P36186t; E31696b
Solanum carolinense L.: P27724s; P37101t; E31697b
**Solanum dulcamara* L.: P36237a; E30681t
Solanum ptychanthum Dunal: P27745s; E31503t
**Solanum rostratum* Dunal: P28031s

Tiliaceae
Tilia americana L.: P27443s

Ulmaceae
Celtis occidentalis L.: P27172s; P37103a; E31505t
Ulmus americana L.: P27167s; P36200a
**Ulmus pumila* L.: P27152s; E31504t; E31698b
Ulmus rubra Muhl.: P27196s

Urticaceae
Boehmeria cylindrica (L.) Sw.: P28007s
Laportea canadensis (L.) Wedd.: P28082s
Parietaria pensylvanica Muhl.: P27455s; E31852b
Pilea pumila (L.) Gray: P28272s
Urtica gracilis Ait.: P27748s

Verbenaceae
Phyla lanceolata (Michx.) Greene: P27839s
Verbena bracteata Lag. & Rodr.: P27734s; E31375a
Verbena hastata L.: P28055s
Verbena stricta Vent.: P27869s; E31286a; E31262t; E31466b
Verbena urticifolia L.: P27808s

Violaceae
Viola pedata L.: P27186s; E30623a; E31319t; E31662b
Viola pratincola Greene: P27327s; P37097t
Viola pubescens Ait.: P27339s
**Viola rafinesquii* Greene: P27322s; E30610t; E31663b
Viola sororia Willd.: P27185s

Vitaceae
Parthenocissus inserta (Kern.) K. Fritsch: P27811s; E31853b
Parthenocissus quinquefolia (L.) Planch.: P27939s; P36226a; E31506t
Vitis riparia Michx.: P27447s; P36236a; E31395t; E31854b

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