

Vascular Plants of Sand Prairie Conservation Area in Scott County, Missouri

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ABSTRACT This study was undertaken to document the vascular plant species of Sand Prairie Conservation Area, an 80 hectare site located at roughly 37°05'N; 89°30'W in Scott County, Missouri, during the growing seasons of 2007 and 2008. A total of 220 vascular plant taxa were collected from the Conservation Area: 55 Monocots, 162 Dicots, one Pteridophyte, and two Gymnosperms. Forty-one non-native taxa were documented, representing about 19 percent of the species collected. Notable collections include 10 Species of Conservation Concern and one state record. During the 2008 growing season, the distributions of the 10 Species of Conservation Concern found on Sand Prairie Conservation Area were mapped using GPS and GIS technologies. The assembled species list, along with known distributions of Species of Conservation Concern, will serve as baseline data for future management and restoration efforts.

INTRODUCTION Slightly elevated, sandy formations deposited by the Mississippi and Ohio Rivers are common across the alluvial basin region of southeast Missouri. Most occur within the Mississippi and St. Francis River Alluvial Plain Subsections east of Crowley's Ridge. These formations exist primarily in the form of elongated ridges, such as Sikeston Ridge and Malden Ridge, but also occur as broad, flat-topped alluvial plains, such as the East Prairie Sand Plain and the Blodgett Dissected Sand Plain. A few smaller sand hills (eolian formations) occur within the Black River Alluvial Plain Subsection west of Crowley's Ridge. These sandy deposits are the result of a complex history of glaciofluvial processes associated with Wisconsin glaciation (Autin et al. 1991, Nigh and Schroeder 2002). During this geologic time, drastic fluctuations in sediment yield and changes in river courses occurred in response to waxing and waning of the Laurentide Ice Sheet in northern North America (Teller 1987, Schumm and Brakenridge 1987). In southeastern Clark County in

extreme northeast Missouri, similar glaciofluvial processes along the Des Moines River formed the Alexandria Alluvial Plain (Nigh and Schroeder 2002).

Sikeston and Malden Ridge are considered "aggradational surfaces" of historic river meanders (Autin et al. 1991), whereby relocation or diversion of a river channel creates a remnant elevated terrace. The two alluvial plains most likely formed during large-scale glacial outwash events associated with Lake Agassiz (a proglacial lake formed at the headwaters of the Mississippi River during glacial advance). One such flood approximately 10,900 years before present (ybp) formed Thebes Gap, a narrow constriction of the Mississippi River within the Benton Hills region. In effect, the East Prairie Sand Plain was deposited as the river reached the much broader alluvial basin below Thebes Gap. No information could be found for the origin of the Blodgett Dissected Sand Plain, but it is considered to be deposited earlier than the East Prairie Sand Plain around 12,500 ybp (Autin et al. 1991, Porter and Guccione 1994).

Sand prairies, a unique type of tall grass prairie classified as a terrestrial natural

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community of Missouri, were once a common component of this sandy landscape (Nigh and Schroeder 2002, Nelson 2005). Prior to European settlement, approximately 10,300 hectares of sand prairie existed within southeast Missouri, with particularly large tracts identified in Dunklin, northwestern Mississippi, and northern New Madrid counties (Schroeder 1983). While this is considered a conservative estimate, it is still much less than one percent of the total presettlement prairie inventoried in Missouri. At the time of European settlement, much of the southeast Missouri region was occupied by swamps, marshes, and other uninhabitable wetland communities, thus the slightly elevated sandy ridges and plains were some of the first to be developed for pasture and semisubsistence agriculture throughout the 1800s (Nigh and Schroeder 2002).

Early travelers into the southeast Missouri region, such as Brackenridge (1814), described large tracts of open sandy grassland, notably "Big Prairie," now known as Sikeston Ridge. However, a few small farmsteads with herds of cattle were also observed on the prairies in areas south of Cape Girardeau. Throughout the latter half of the 19th century, land development expanded as drainage canals were created and rivers channelized to allow for crop production in the wet bottomlands (Nigh and Schroeder 2002). Marbut (1896) explains that the region provided early settlers with an ease of living with fertile soils, abundant wildlife, and the Mississippi River as a means of transportation of goods to market. As a result of land conversion to cropland, highways, and urban development and the subsequent change in hydrology, nearly all of the sand prairie communities have been eliminated or severely altered, with only a few small disturbed tracts remaining (Nigh and Schroeder 2002, Nelson 2005). Currently, Missouri sand prairies are listed as a Critically Imperiled Community of Conservation Concern (Missouri Natural Heritage Program 2009).

Despite their rarity in Missouri, sand prairies are quite common throughout the Midwest, as sand deposits associated with Wisconsin glaciation are not unique to the state. Other sand prairies occur in portions of Lower Michigan (Kost et al. 2007), southern and central Wisconsin (Whitford 1972), eastern

Iowa (Crum 1972, Schulten 1985), west-central Indiana (Dubis et al. 1988), central Nebraska (Steinauer and Rolfsmeier 2003), and particularly northern Illinois (Corbett and Anderson 2006). Floristic composition studies of sand prairies in northern Illinois were first conducted by Hart and Gleason (1907), Gleason (1910), Vestal (1913), and Sampson (1921). Since that time, updated studies have been conducted on the numerous remnants within the region (Fell 1957; McClain et al. 2003, 2005; Phillippe et al. 2004, 2008; Ebinger et al. 2006).

In Missouri, Nelson (2005) briefly describes sand prairie communities, listing several of the dominant, characteristic, and restricted taxa. He explains that only about 16 hectares of natural, undisturbed sand prairies still remain. While his treatment offers insight into the primary vegetation of southeastern Missouri sand prairies and emphasizes the need for their protection, no comprehensive floristic surveys have been conducted. The present study was undertaken to assemble a thorough vascular plant species list for Sand Prairie Conservation Area (SPCA) in Scott County, Missouri, during the growing seasons of 2007 and 2008, and to document the distributions of all Species of Conservation Concern (SOCC) found on the site.

STUDY SITE SPCA (Figure 1) is located within the Blodgett Dissected Sand Plain Landtype Association (LTA) of the Mississippi River Alluvial Plain Subsection in east-central Scott County, approximately 5 kilometers east of Benton, Missouri (T28N; R14E; roughly 37°05'N; 89°30'W; elevation approximately 99–104 m). Structurally, the Blodgett Dissected Sand Plain LTA is a slightly elevated alluvial plain deposited around 12,500 ybp. Local relief for the LTA is 3–6 m. Several low ditches, cut by braided stream channels of the Mississippi River between 12,500 and 10,900 ybp are interspersed throughout (Porter and Guccione 1994, Nigh and Schroeder 2002).

Typical substrates within the LTA are poorly developed entisols, which consist of recently deposited alluvium that has not yet developed a soil profile (Nigh and Schroeder 2002). Soil composition ranges from very friable loamy fine sand to coarse sand, and blowouts or actively moving sand are com-

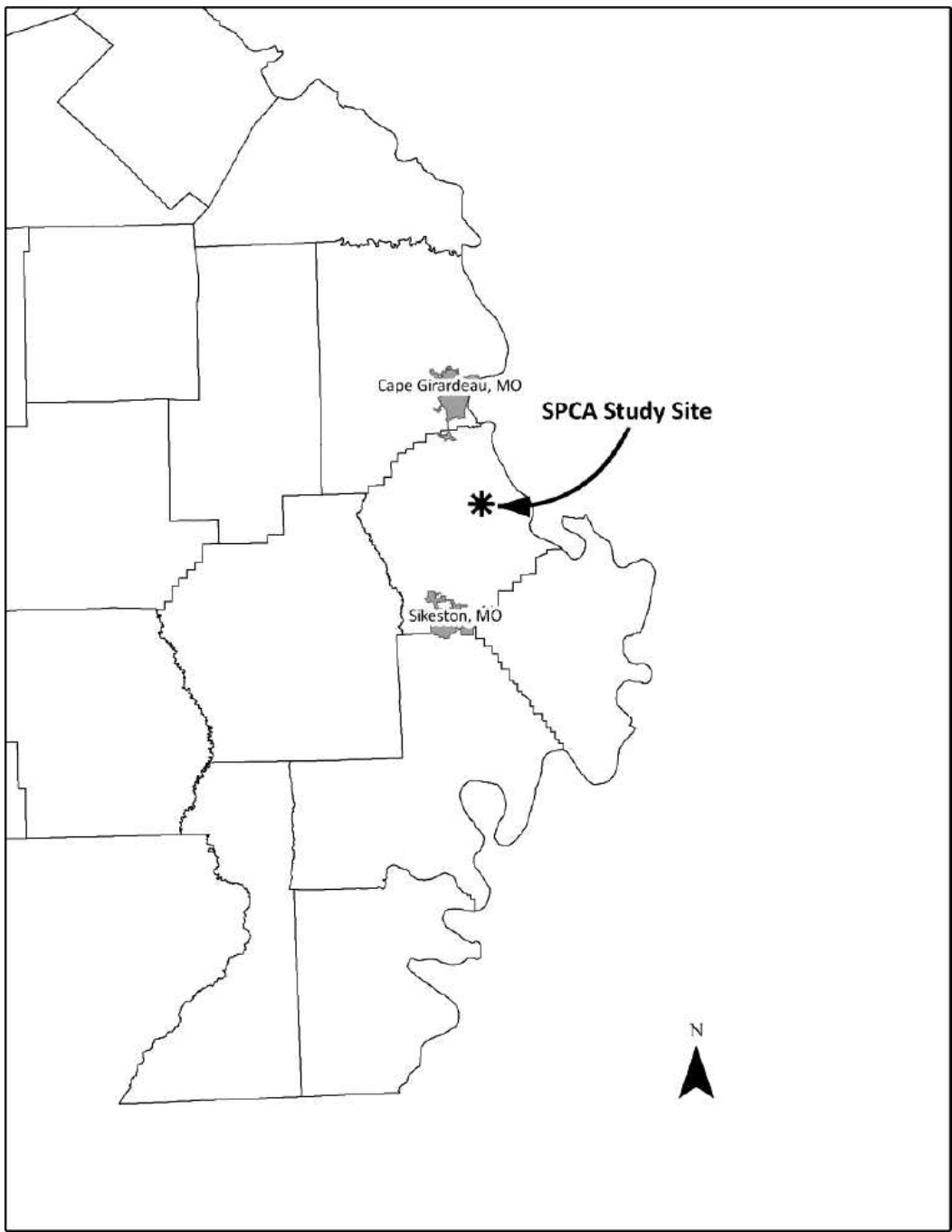


Figure 1. Location of Sand Prairie Conservation Area in Scott County, Missouri.

mon (Festervand 1981, Nelson 2005). Typical climate for the area is considered continental with warm summers and cold winters. Mean annual precipitation is about 122 cm, with all

months receiving relatively equal amounts of rain. Mean annual temperature is about 13.6°C, with a mean July maximum daily temperature of 32.8°C and a mean January

minimum daily temperature of -3.8°C . Frost free periods in the region range from 220–250 days per year (Nigh and Schroeder 2002).

The SPCA tract was acquired by the Missouri Department of Conservation (MDC) in 2005 and consists of 80 hectares of old field/sand prairie remnant. The Conservation Area (Figure 2) consists of a northern 32 hectare unit, a middle 32 hectare unit, and a southern 16 hectare unit all separated by tree lines (windbreaks during past cultivation). An active sandblow extends diagonally from the southwest to northeast through the middle and northern units, and a small sand dune occurs along the western edge of the southern unit. A small disturbed woodland and wetland area occurs in the northeast corner of the site. Soils on SPCA are predominantly of the Scotco soil series (Festervand 1981, Soil Survey Staff 2008). Soil samples collected from SPCA reveal low levels of potassium ($36\text{--}70\text{ kg/ha}^{-1}$), magnesium ($86\text{--}273\text{ kg/ha}^{-1}$), and organic matter ($0.2\text{--}0.5\%$) and high levels of phosphorus ($90\text{--}355\text{ kg/ha}^{-1}$). Soil pH ranged from 4.6 to 5.0. Similar results were obtained from the sandy soils of northern Illinois sand prairies (Anderson and Roberts 1993, Corbett and Anderson 2006). In an effort to control woody encroachment, the site is patch burned annually, with the intention of burning the entire site on a three year basis. SOCC plantings and herbicide treatments also occur occasionally.

METHODS

2007 Growing Season

During the 2007 growing season, a thorough collection of vascular plant species was conducted on SPCA by JAW, accomplished in a random fashion simply by traversing the area looking for material in flower and/or fruit. The site was visited once weekly from 29 March to 8 October. Specimens in reproductive condition (with the exception of a few tree species) were collected and processed (pressed, dried, identified, mounted, and labeled) in the Travis Brooks Herbarium at Southeast Missouri State University (SEMO). Duplicates of each specimen were made, with one set housed at SEMO and the other at MDC's Southeast Regional Office in Cape Girardeau, Missouri. Collected specimens

were identified by JAW, with occasional assistance and confirmation from AJB, using keys primarily by Gleason and Cronquist (1991), Yatskievych (1999, 2006), and Steyermark (1963). Nomenclature follows Yatskievych (1999) for pteridophytes, gymnosperms, and monocots, Yatskievych (2006) for dicots (A-Fabaceae, excluding Faboideae), and Yatskievych and Turner (1990) for the remaining dicot families.

2008 Growing Season

Collection of any additional species found on SPCA continued throughout the 2008 growing season from 15 April to 3 September following the same methods as above. Additionally, the distributions of any SOCC found on the site were mapped using GPS and GIS technologies. A total of 38 SOCC (Table 1) likely to occur on SPCA were targeted (George Yatskievych, pers. comm.). Boundaries of SOCC populations were estimated and waypoints were collected using a GPS 12 along the assumed boundary. For each SOCC, the range of waypoints collected was recorded. In some cases, when a SOCC appeared to have a wide distribution or several scattered populations, satellite photos were used to keep track of specific occurrences. Arcview 9.2 GIS software was used to create a map for each species at the site consisting of all waypoints collected. Digitized shapefiles were then created by estimating the population boundaries from the SOCC waypoints. While the process of determining SOCC distributions in the field was rather subjective, the site was visited rather extensively during the 2007 growing season and most of the population locations were well known.

RESULTS A total of 220 vascular plant taxa in 166 genera and 70 families were found on SPCA (Appendix I). Monocots were represented by 55 species in nine families and 36 genera, while dicots accounted for 162 species in 58 families and 127 genera. Gymnosperms accounted for two species in two families, and one pteridophyte species was found as well. The predominant families were the Poaceae with 34 species, the Asteraceae with 32 species, and the Cyperaceae with 12 species. There were 41 non-native species collected, about 19 percent of the total taxa encountered. A state record spe-

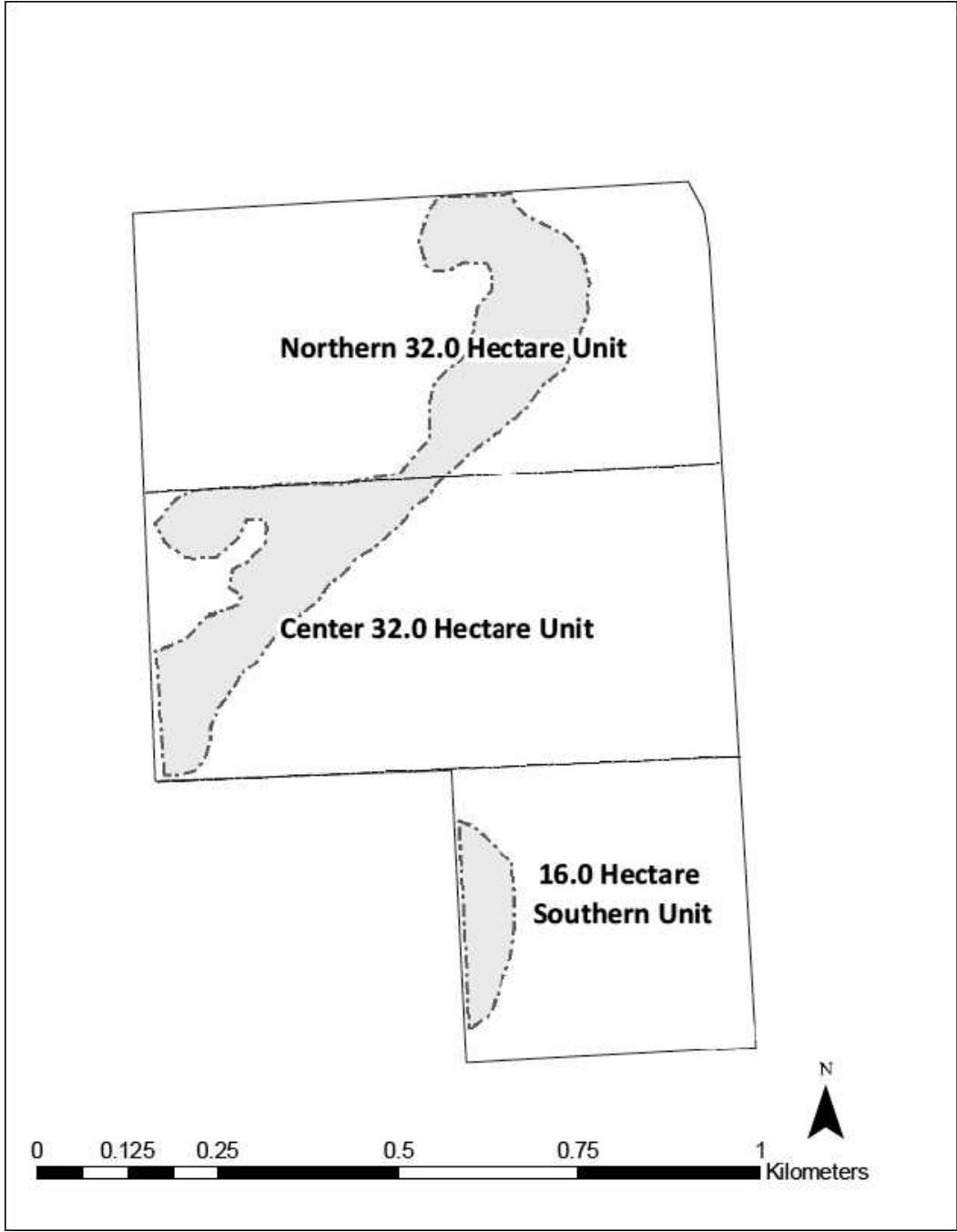


Figure 2. Major features and units of Sand Prairie Conservation Area (sandblow and dune are shaded).

cies, *Cenchrus spinifex* (sandbur), was also collected from the Conservation Area. A total of 10 SOCC were encountered at SPCA (Table 2, Figure 3). Of these, five are listed as critically imperiled (S1), three are listed as imperiled (S2), and two are listed as vulnerable (S3) in the state (Missouri Natural Heritage Program 2009).

Table 1. Targeted SOCC currently or historically known to occur in dry sand prairie or associated communities in southeast Missouri (George Yatskievych, pers. comm.). Taxa are arranged alphabetically by species. All names follow Yatskievych (1999) for monocots, Yatskievych (2006) for dicots (A—Fabaceae, excluding Faboideae), and Yatskievych and Turner (1990) for the remaining dicot families. For definitions of state and global ranks used see Missouri Natural Heritage Program (2009)

Taxon	Family	Common Name	State Status	Global Status
<i>Aristida desmantha</i> Trin. & Rupr.	Poaceae	Sand Three-awn	S1	G5
<i>Aristida lanosa</i> Muhl. ex Elliott	Poaceae	Wooly Three-awn	S1	G5
<i>Callirhoe triangulata</i> (Leavenw.) A. Gray	Malvaceae	Clustered Poppy Mallow	SH	G3
<i>Carex longii</i> Mack.	Cyperaceae	Greenish-white Sedge	S1	G5
<i>Carya pallida</i> (Ashe) Engler & Graebner	Juglandaceae	Sand Hickory	S2S3	G5
<i>Conyza canadensis</i> (L.) Cronquist var. <i>pusilla</i> (Nutt.) Cronquist	Asteraceae	Horseweed	S1S2	G5T5
<i>Corydalis micrantha</i> (Engelm.) A. Gray ssp. <i>australis</i> (Chapman) Ownbey	Fumariaceae	Small-flowered Corydalis	S2	G5T5?
<i>Croton michauxii</i> G. L. Webster	Euphorbiaceae	Slender Rushfoil	S1	S1G5
<i>Cyperus compressus</i> L.	Cyperaceae	Coco Grass	SU	G5
<i>Cyperus croceus</i> Vahl	Cyperaceae	Baldwin's Sedge	S1	G5
<i>Cyperus grayoides</i> Mohlenbr.	Cyperaceae	Umbrella Sedge	S3	G3
<i>Cyperus hystricinus</i> Fernald	Cyperaceae	Umbrella Sedge	S1	G4
<i>Cyperus plukenetii</i> Fernald	Cyperaceae	Plukenet's Umbrella Sedge	S1	G5
<i>Cyperus polystachyos</i> Rottb. var. <i>texensis</i> (Torr.) Fernald	Cyperaceae	Many-spiked Umbrella Sedge	S2S3	G5T5
<i>Cyperus retroflexus</i> Buckley	Cyperaceae	Umbrella Sedge	S1	G5
<i>Cyperus retrofractus</i> (L.) Torr.	Cyperaceae	Umbrella Sedge	S1S2	G5
<i>Desmodium ochroleucum</i> M. Curtis	Fabaceae	Tick Clover	SH	G1G2
<i>Desmodium viridiflorum</i> (L.) DC.	Fabaceae	Tick Trefoil	S1	G5?
<i>Euphorbia geyeri</i> Engelm. var. <i>geyeri</i>	Euphorbiaceae	Geyer's Spurge	S1	G5T5
<i>Gaillardia aestivalis</i> (Walter) H. Rock var. <i>flavovirens</i> (C. Mohr) Cronquist	Asteraceae	Prairie Blanketflower	SH	G5T3T5
<i>Helianthemum canadense</i> (L.) Michx.	Cistaceae	Rockrose	SU	G5
<i>Helianthus angustifolius</i> L.	Asteraceae	Narrow-leaved Sunflower	S2	G5
<i>Hypericum adpressum</i> Raf. ex W. P. C. Barton	Clusiaceae	Creeping St. John's Wort	S1	G3
<i>Lactuca hirsuta</i> Muhl. ex Nutt.	Asteraceae	Downy Lettuce	SU	G5?
<i>Monarda punctata</i> L. var. <i>occidentalis</i> (Epling) E. J. Palmer & Steyerf.	Lamiaceae	Dotted Beebalm	SA	G5T4T5
<i>Monarda punctata</i> L. var. <i>villicaulis</i> (Pennell) Shinn.	Lamiaceae	Dotted Beebalm	S3	G5T5?
<i>Panicum verrocosum</i> Muhl.	Poaceae	Warty Panicum	S1	G4
<i>Paspalum bifidum</i> (Bertol.) Nash	Poaceae	Pitchfork Paspalum	S1	G5
<i>Paspalum setaceum</i> Michx. var. <i>setaceum</i>	Poaceae	Bead Grass	S1	G5T5
<i>Polygonella americana</i> (Fischer & C. Meyer) Small	Polygonaceae	Jointweed	S2	G5
<i>Polypremum procumbens</i> L.	Loganiaceae	Juniper Leaf	S2	G5
<i>Rhynchosia difformis</i> (Elliot) DC.	Fabaceae	Rhynchosia	S1	G5?
<i>Schoenoplectus hallii</i> (A. Gray) S. G. Sm.	Cyperaceae	Hall's Bulrush	S2	G2G3
<i>Sida elliotii</i> Torrey & A. Gray	Malvaceae	Sida	S1	G4G5
<i>Sisyrinchium atlanticum</i> E. P. Bicknell	Iridaceae	Blue-eyed Grass	S2	G5
<i>Stylisma pickeringii</i> (Torr. ex M. A. Curtis) A. Gray var. <i>pattersonii</i> (Fernald & B. G. Schub.) Myint	Convolvulaceae	Stylisma	S1	G4T4
<i>Trichostema setaceum</i> Houltt.	Lamiaceae	Blue Curls	S1	G5
<i>Xyris jupicai</i> Rich.	Xyridaceae	Yellow-eyed Grass	S1	G5

DISCUSSION

Vegetation of Sand Prairie Conservation Area
The current flora of SPCA compares well with Nelson's (2005) treatment of Missouri's sand prairies. More than half (14) of the 26

dominant and characteristic species listed for southeast Missouri sand prairies were present on SPCA, along with numerous restricted taxa. Similarities also exist between SPCA and northern Illinois sand prairies (McClain

Table 2. SOCC mapped during the 2008 growing season. Taxa are arranged alphabetically by species. All names follow Yatskievych (1999) for monocots, Yatskievych (2006) for dicots (A—Fabaceae, excluding Faboideae), and Yatskievych and Turner (1990) for the remaining dicot families. For definitions of state and global ranks see Missouri Natural Heritage Program (2009)

Taxon	Family	Common Name	State Rank	Global Rank
<i>Aristida desmantha</i>	Poaceae	Sand Three-awn	S1	G5
<i>Corydalis micrantha</i> ssp. <i>australis</i>	Fumariaceae	Small-flowered Corydalis	S2	G5T5?
<i>Croton michauxii</i>	Euphorbiaceae	Slender Rushfoil	S1	G5
<i>Cyperus grayoides</i>	Cyperaceae	Umbrella Sedge	S3	G3
+ <i>Desmodium strictum</i>	Fabaceae	Tick Trefoil	S1	G4
<i>Desmodium viridiflorum</i>	Fabaceae	Tick Trefoil	S1	G5?
<i>Helianthus angustifolius</i>	Asteraceae	Narrow-leaved Sunflower	S2	G5
<i>Monarda punctata</i> var. <i>villicaulis</i>	Lamiaceae	Dotted Beebalm	S3	G5T5?
<i>Polygonella americana</i>	Polygonaceae	Jointweed	S2	G5
<i>Sida elliptii</i>	Malvaceae	Sida	S1	G4G5

+ Species encountered but not on targeted SOCC list

et al. 2003, 2005; Phillippe et al. 2004, 2008; Ebinger et al. 2006). Many of the common species encountered on these sites also occur on SPCA, including *Digitaria cognata* ssp. *cognata* (fall witch grass), *Cyperus grayoides* (umbrella sedge), *Cyperus lupulinus* (umbrella sedge), *Opuntia humifusa* (eastern prickly pear), *Heterotheca camporum* (golden aster), *Conyza canadensis* (horseweed), *Euphorbia corollata* (flowering spurge), *Carex muehlenbergii* (a sedge), and *Monarda punctata* (dotted beebalm). Conversely, several taxa that one might expect to find in sand prairies, including *Rhus aromatica* (fragrant sumac), *Oenothera clelandii* (evening primrose), and *Eragrostis trichodes* (sand love grass) were not evident (McClain et al. 2005; Phillippe et al. 2004, 2008). This is probably a reflection of the recently disturbed nature of this site, and these taxa simply haven't been able to become established (or to re-establish) as yet. Another possibility is that certain less conspicuous species (e.g., *Paronychia fastigiata*—forked chickweed) were simply overlooked because only taxa found in flower and/or fruit were collected. Continued monitoring of SPCA, along with appropriate management strategies (see comments below), could foster the overall diversity of this site to include these, and other, desired species.

Bunch grasses are often considered the dominant vegetation type of sand prairies. These grasses are characterized as developing dense clumps as much as 0.6 m in diameter, and form a patchy cover throughout the prairie (Hart and Gleason 1907, Gleason

1910). Several conspicuous bunch grass taxa were encountered on SPCA including *Andropogon ternarius* (splitbeard bluestem), *A. virginicus* var. *virginicus* (broomsedge), *A. gerardii* (big bluestem), *Digitaria cognata* ssp. *cognata*, *Panicum laxiflorum* (panic grass), and *P. oligosanthos* (panic grass). *Schizachyrium scoparium* (little bluestem) is commonly the dominant bunch grass species in mature sites in northern Illinois (McClain et al. 2003, 2005; Phillippe et al. 2004, 2008; Ebinger et al. 2006), but was not encountered at SPCA. While little bluestem is commonly associated with other tall-grass prairie communities of Missouri, including sand prairies in northeast Missouri, it is uncertain why it does not occur in southeast Missouri sand prairies. Some evidence suggests that the establishment and growth of *S. scoparium* and *A. gerardii* are dependent upon vesicular-arbuscular mycorrhizae (VAM) in the soil, which form a symbiotic relationship with the roots (Anderson and Roberts 1993, Anderson et al. 1994). No studies have been conducted on populations of splitbeard bluestem, but if the soils at SPCA differ significantly from those of other sand prairies to the north, successful establishment of little and big bluestem may be hindered by lack of an associated VAM fungal endophyte.

The state record collected from SPCA, *Cenchrus spinifex*, was confirmed from Gleason and Cronquist (1991). This species has probably been overlooked in the past as it closely resembles *C. longispinus*, but has fewer spines and glabrous fascicles. *Cenchrus spinifex* generally occurs in sandy, disturbed soils

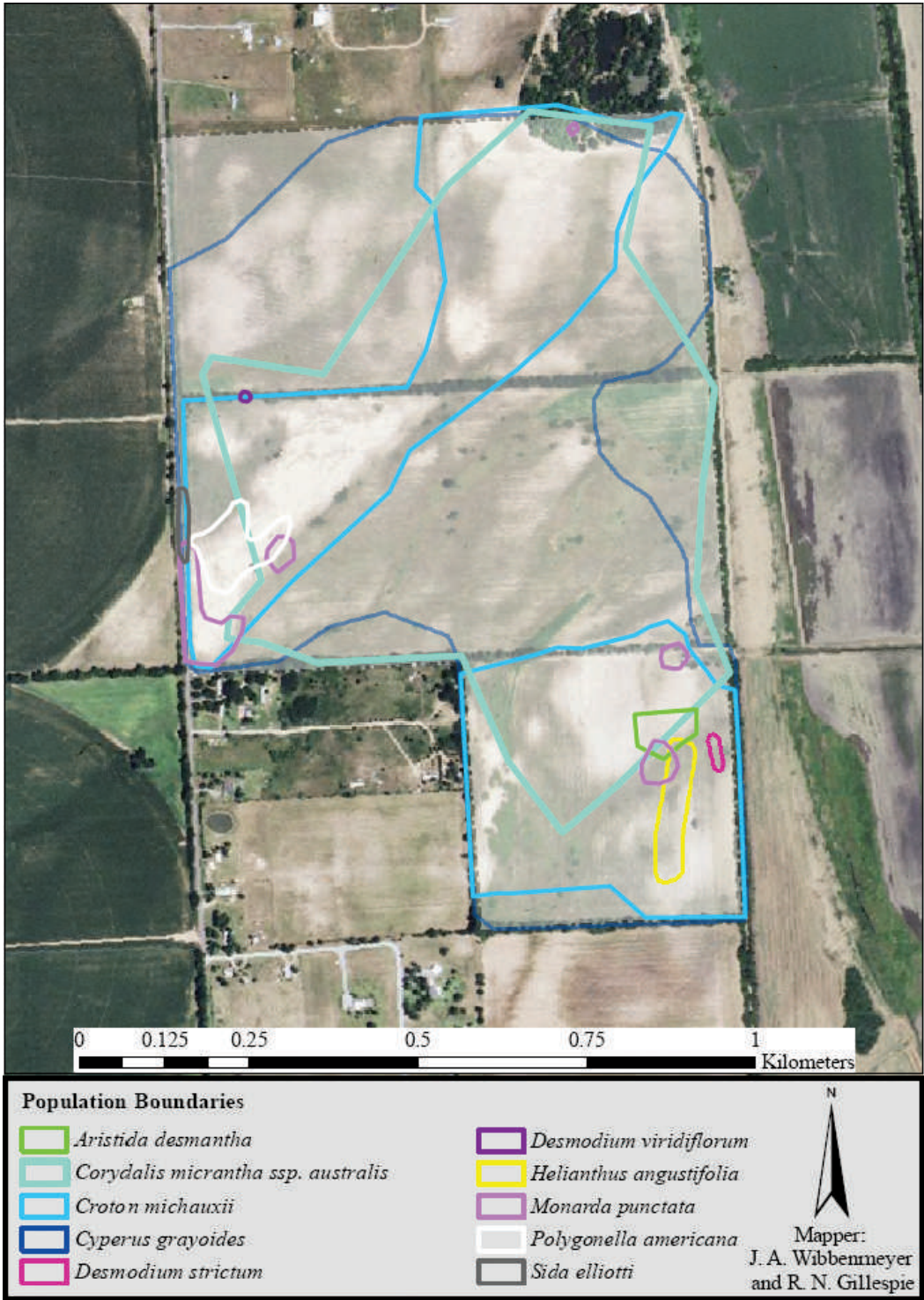


Figure 3. Distributions of the Species of Conservation Concern located on Sand Prairie Conservation Area.

throughout the southern U. S., and has previously been reported from several counties in northeast Arkansas (Barkworth et al. 2003). Therefore, its presence on SPCA is not surprising, and it should be searched for in similar sites throughout southeast Missouri.

Of the 41 non-native taxa encountered on the site, many appeared to be restricted to tree lines or the wetland complex area on the northeast corner of the site. However, a few, such as *Bromus tectorum* (downy chess), *Sorghum halepense* (Johnson grass), and *Lespedeza cuneata* (sericea lespedeza) were encountered within the open prairie. These three taxa are listed as Category A Exotic Pest Plants of Missouri, and are considered serious threats to natural communities as they commonly replace native vegetation (Missouri Exotic Pest Plants 2008). *Bromus tectorum*, for example, begins root elongation earlier in the spring than some native grasses, and therefore tends to have a competitive edge for important, but limited nutrients.

Species of Conservation Concern

The ten SOCC encountered at SPCA (Table 2) are all listed as Critically Imperiled (S1), or Imperiled (S2) in the state, with the exception of *Cyperus grayoides* and *Monarda punctata* var. *villicaulis*, which are listed as Vulnerable (S3) (Missouri Natural Heritage Program 2009). In general, these species are state listed as a result of habitat loss and fire suppression (see Nelson 2005). Most are not critically threatened on a global level, being listed as Apparently Secure (G4) or Secure (G5), with numerous populations across the United States. However, *Cyperus grayoides* (umbrella sedge) is listed as Vulnerable (G3) in the nation (Missouri Natural Heritage Program 2009).

Cyperus grayoides was found to be widespread throughout the tract. It appears to be a fairly resilient species, being found in open sand blow areas, within dense bunch grass stands, and even within shaded tree line areas. However, this species is only found in scattered locations throughout the south-central United States. Periodic disturbances, such as wind erosion and fire, are considered an important factor in maintaining populations of *C. grayoides*. Until recently, all Missouri populations of *C. grayoides* were thought to occur on private lands where

natural disturbance regimes had been interrupted (NatureServe 2008).

Management Implications

Current management of SPCA consists of periodic prescribed burns, SOCC plantings, and herbicide treatments of some non-native species. In comparison with other tall-grass prairie communities, relatively few studies exist for the effects of certain management practices on sand prairies. Bowles et al. (2003) reported that long-term management by fire of disturbed sand prairies in northern Illinois decreased species richness of non-native taxa, while non-natives increased in unburned plots. Niering and Dreyer (1989) found an increase in abundance, height, vigor, and floral productivity of little bluestem stands in a sandy old field in Connecticut after burning, while Dubis et al. (1988) reported a decrease in density of little bluestem in an Indiana sand prairie, but found that cover values remained stable.

The use of prescribed burns increases temperature and light at the soil surface, and releases nutrients from the previous year's biomass. This, in turn, allows earlier germination of native grasses. In general, early spring burns are often used to inhibit the growth of cool-season grasses (Ehrenreich and Aikman 1963, Niering and Dreyer 1989). However, numerous studies show that *Bromus tectorum*, an exotic, invasive, cool-season grass mostly found in the arid west, quickly invades recently burned sites (Melgoza and Nowak 1991). Harris (1967) and Harris and Wilson (1970) report that *B. tectorum* has the ability to germinate and begin root elongation at cooler temperatures than other native, warm-season grasses, thus exploiting soil moisture prior to germination of native grasses. Furthermore, Zedler and Loucks (1969) explain that dry communities often experience increased moisture stress following fire. Nonetheless, Dhillon and Anderson (1994), examining the effects of burning on sand prairies during drought and non-drought years, found that native grass production is still greater even during drought years.

Encroachment by woody vegetation has also been reported as a major problem in many disturbed sand prairies. Prescribed burns tend to promote the growth of woody

trees, shrubs, and vines, inhibiting native herbaceous taxa (Niering and Dreyer 1989). Such species as *Rhus aromatica* (fragrant sumac) and *Prunus angustifolia* (chickasaw plum) are more of an issue than non-native herbaceous species at the Henry Allan Gleason Nature Preserve in Mason County, Illinois (Tim Kelly, pers. comm.). Alternatively, *Quercus velutina* (black oak) easily establishes in sandy soils following fire suppression (Fell 1957). *Rhus copallinum* (dwarf sumac), *R. glabra* (smooth sumac), *Prunus angustifolia*, and *Campsis radicans* (trumpet creeper) appeared to be the most abundant woody shrubs and vines at SPCA, often forming dense stands within the open prairie.

The effects of plant invasions on any community type are numerous and can cause altered competitive relationships and physical structure, thereby leading to novel disturbance regimes and successional paths (Woods 1997). The sand prairie vegetation of southeast Missouri is adapted to fire regimes characteristic of native grasslands, therefore prescribed burning will be an important tool for future management and restoration efforts. Frequent burns are recommended for post-agricultural grasslands, with biennial burns tending to process more biomass (and therefore more nutrients) than annual burns with only a growing season worth of plant material (Niering and Dreyer 1989). However, continuous frequent burning may also reduce soil nutrient levels through leaching or by creating insufficient organic matter (Ehrenreich and Aikman 1963), especially on sparsely vegetated sand prairies.

While these preliminary data offer insight into the current flora of SPCA and the distribution of SOCC, continued research will be critical in maintaining this unique community type. Long-term monitoring programs that incorporate a quantitative approach will be important for evaluating the site to determine important ecological characteristics such as species abundance. In addition, these disturbed remnants offer an excellent opportunity to study the effects of management practices, such as burning and herbicide treatments, on sand prairies specifically.

At present, SPCA serves several important roles as defined by Saunders et al. (1987) as a remnant site, primarily as a representative of

a threatened ecosystem (example-oriented role) in Missouri, and as a repository of individual species that apparently do not exist elsewhere in the state (species-oriented role). Since this site is an official Conservation area and the only publicly accessible sand prairie in southeast Missouri, we also anticipate that it will serve an important role in public education and outreach to the local community (social value-oriented role). Therefore, management strategies can also be geared toward maintaining or improving SPCA with these goals in mind.

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APPENDIX I. Taxa encountered at Sand Prairie Conservation Area. Taxa are arranged alphabetically by family under major plant groups with corresponding authors given. All names follow Yatskievych (1999) for monocots, Yatskievych (2006) for dicots (A-Fabaceae, excluding Faboideae), and Yatskievych and Turner (1990) for the remaining dicot families. An asterisk indicates non-native taxa. One state record is denoted with a # symbol, and one species not collected due to limited population numbers is denoted with a ♦ symbol. Collection numbers, all of which belong to Josh Wibbenmeyer, are given for each species, with complete sets deposited in the Travis Brooks Herbarium at Southeast Missouri State University (SEMO) and at MDC’s Southeast Regional office, both in Cape Girardeau, Missouri

PTERIDOPHYTES	
ASPLENIACEAE	
<i>Asplenium platyneuron</i> (L.) Britton, Sterns & Poggenb.	314
GYMNOSPERMS	
CUPRESSACEAE	
<i>Juniperus virginiana</i> L.	281
PINACEAE	
<i>*Pinus taeda</i> L.	419
MONOCOTS	
AGAVACEAE	
<i>*Yucca smalliana</i> Fern.	275
ALISMACEAE	
<i>Sagittaria latifolia</i> Willd. var. <i>latifolia</i>	421
COMMELINACEAE	
<i>Commelina erecta</i> L.	268
<i>Tradescantia ohiensis</i> Raf.	233
CYPERACEAE	
<i>Bulbostylis capillaris</i> (L.) Kunth ex C. B. Clarke	313
<i>Carex annectens</i> (E. P. Bicknell) E. P. Bicknell var. <i>annectens</i>	253
<i>Carex lupuliformis</i> Sartwell ex Dewey	316
<i>Carex muehlenbergii</i> Schkuhr ex Willd.	231, 258, 528
<i>Cyperus echinatus</i> (L.) A. W. Wood	344
<i>Cyperus esculentus</i> L.	307
<i>Cyperus grayoides</i> Mohlenbr.	283, 409, 438, 588
<i>Cyperus lupulinus</i> (Spreng.) Marcks	291, 385
<i>Cyperus odoratus</i> L.	387, 393
<i>Eleocharis ovata</i> (Roth) Roem. & Schult.	308
<i>Fimbristylis autumnalis</i> (L.) Roem. & Schult.	408
<i>Scirpus pendulus</i> Muhl. ex Elliott	428
JUNCACEAE	
<i>Juncus acuminatus</i> Michx.	315
<i>Juncus biflorus</i> Elliott	317
LEMNACEAE	
<i>Lemna minor</i> L.	590

APPENDIX I. Continued

LILIACEAE	
<i>*Allium vineale</i> L.	274, 279
POACEAE	
<i>Agrostis hyemalis</i> (Walter) Britton, Sterns & Poggenb. var. <i>hyemalis</i>	260
<i>Agrostis perennans</i> (Walter) Tuck.	401
<i>Andropogon gerardii</i> Vitman	372, 422
<i>Andropogon ternarius</i> Michx. var. <i>ternarius</i>	370
<i>Andropogon virginicus</i> L. var. <i>virginicus</i>	347, 348
<i>Aristida desmantha</i> Trin. & Rupr.	425
<i>Aristida dichotoma</i> Michx.	435
<i>Aristida purpurascens</i> Poir. var. <i>purpurascens</i>	411, 439
<i>*Bromus commutatus</i> Schrad.	576
<i>*Bromus racemosus</i> L.	255
<i>*Bromus tectorum</i> L.	256
<i>Cenchrus longispinus</i> (Hack.) Fernald	325
<i>#Cenchrus spinifex</i> Cav.	284
<i>*Cynodon dactylon</i> (L.) Pers.	312
<i>Digitaria cognata</i> (Schult.) Pilg. ssp. <i>cognata</i>	297, 342
<i>Digitaria filiformis</i> (L.) Koeler	407, 431
<i>*Digitaria sanguinalis</i> (L.) Scop.	326, 358
<i>Elymus virginicus</i> L.	282
<i>Eragrostis spectabilis</i> (Pursh) Steud.	303
<i>*Eriochloa acuminata</i> (C. Presl) Kunth var. <i>acuminata</i>	405
<i>Leersia oryzoides</i> (L.) Sw.	433
<i>*Lolium perenne</i> L.	575
<i>Panicum dichotomum</i> L.	378
<i>Panicum laxiflorum</i> Lam.	239, 244
<i>Panicum oligoanthos</i> Schult.	252
<i>Paspalum setaceum</i> Michx. var. <i>stramineum</i> (Nash) D. J. Banks	299, 310, 324
<i>*Poa pratensis</i> L.	228
<i>*Secale cereale</i> L.	257
<i>*Setaria viridis</i> (L.) P. Beauv.	302, 332, 412
<i>*Sorghum halepense</i> (L.) Pers.	286
<i>Sporobolus neglectus</i> Nash	413
<i>Tridens flavus</i> (L.) Hitchc.	305, 371, 434
<i>Triplasis purpurea</i> (Walter) Chapm. var. <i>purpurea</i>	329
<i>Vulpia octoflora</i> (Walter) Rydb. var. <i>octoflora</i>	534
TYPHACEAE	
<i>Typha latifolia</i> L.	306
DICOTS	
ACANTHACEAE	
<i>Ruellia humilis</i> Nutt.	365
ACERACEAE	
<i>Acer rubrum</i> L.	356
AMARANTHACEAE	
<i>*Amaranthus palmeri</i> S. Watson	328
<i>Froelichia floridana</i> (Nutt.) Moq. var. <i>campestris</i> (Small) Fernald	309
ANACARDIACEAE	
<i>Rhus copallinum</i> L.	323
<i>Rhus glabra</i> L.	376
<i>Toxicodendron radicans</i> (L.) Kuntze	577
APIACEAE	
<i>Chaerophyllum tainturieri</i> Hook.	220, 265
<i>Eryngium prostratum</i> Nutt.	380
<i>Spermolepis echinata</i> (Nutt. ex DC.) A. Heller	259

APPENDIX I. Continued

Spermolepis inermis (Nutt. ex DC.) Mathias & Constance 240

**Torilis arvensis* (Huds.) Link 277, 345

APOCYNACEAE

Apocynum cannabinum L. 304

AQUIFOLIACEAE

Ilex decidua Walter 535

ASCLEPIADACEAE

Asclepias amplexicaulis Sm. 250

Asclepias viridiflora Raf. 295

Cynanchum laeve (Michx.) Pers. 361

ASTERACEAE

Achillea millefolium L. 264

Ambrosia artemisiifolia L. 383

Ambrosia trifida L. 420

Bidens bipinnata L. 423

Cirsium discolor (Muhl. ex Willd.) Spreng. 416

Conoclinium coelestinum (L.) DC. 430

Conyza canadensis (L.) Cronquist 366

Coreopsis grandiflora Hogg ex Sweet 270

Coreopsis lanceolata L. 237

Eclipta prostrata (L.) L. 404

Erechtites hieracifolius (L.) Raf. ex DC. var. *hieracifolius* 418

Erigeron strigosus Muhl. ex Willd. var. *strigosus* 272

Eupatorium perfoliatum L. var. *perfoliatum* 386

Eupatorium serotinum Michx. 381, 429

Gamochaeta purpurea (L.) Cabrera 262

Helianthus angustifolius L. 424

Helianthus divaricatus L. 360

Helianthus hirsutus Raf. 394

Heterotheca camporum (Greene) Shinnars 276

Heterotheca subaxillaris (Lam.) Britton & Rusby 296, 417

Krigia virginica (L.) Willd. 216, 234

Lactuca canadensis L. 350

**Lactuca serriola* L. 343

Mikania scandens (L.) Willd. 432

Packera glabella (Poir.) C. Jeffrey 529

Pseudognaphalium obtusifolium (L.) Hilliard & B. L. Burt 414

Pyrrohapappus carolinianus (Walter) DC. 346

Rudbeckia hirta L. var. *pulcherrima* Farw. 271

Solidago rugosa Mill. 437

Symphotrichum pilosum (Willd.) G. L. Nesom 440

**Taraxacum officinale* F. H. Wigg. 453

**Tragopogon dubius* Scop. 527

BALSAMINACEAE

Impatiens capensis Meerb. 335

BIGNONIACEAE

Campsis radicans (L.) Seem. 349

**Catalpa bignonioides* Walter 269

BORAGINACEAE

**Buglossoides arvensis* (L.) I. M. Johnst. 223

Lithospermum caroliniense (Walter ex J. F. Gmel.) MacMill. 215

Myosotis macrosperma Engelm. 533

BRASSICACEAE

**Arabidopsis thaliana* (L.) Heynh. 200, 201, 226

**Cardamine hirsuta* L. 451

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Descurainia pinnata (Walter) Britton 452, 532

Lepidium virginicum L. 235, 238

**Thlaspi arvense* L. 225

CACTACEAE

Opuntia humifusa (Raf.) Raf. 280

CAESALPINIACEAE

Chamaecrista fasciculata (Michx.) Greene 351

Chamaecrista nictitans (L.) Moench 388

CAMPANULACEAE

Triodanis perfoliata (L.) Nieuwl. 251

CAPPARACEAE

Polanisia dodecandra (L.) DC. 290

CAPRIFOLIACEAE

**Lonicera japonica* Thunb. ex Murray 249

Sambucus canadensis L. 334

Symphoricarpos orbiculatus Moench 340

CARYOPHYLLACEAE

**Agrostemma githago* L. 245

**Arenaria serpyllifolia* L. 219

Cerastium brachypodum (Engelm. ex A. Gray) B. L. Rob. 221

**Holosteum umbellatum* L. 204

Sagina decumbens (Elliott) Torr. & A. Gray ssp. *decumbens* 278

**Saponaria officinalis* L. 289

Silene antirrhina L. 530

**Silene latifolia* Poir. 247

CHENOPODIACEAE

**Chenopodium pratericola* Rydb. 389

Chenopodium sp. 436

CLUSIACEAE

Hypericum mutilum L. ssp. *mutilum* 390

CONVOLVULACEAE

Cuscuta pentagona Engelm. 363

**Ipomoea hederacea* Jacq. 352

Ipomoea lacunosa L. 354

EBENACEAE

Diospyros virginiana L. 367

ELAEAGNACEAE

**Elaeagnus umbellata* Thunb. 207

EUPHORBIACEAE

Croton glandulosus L. var. *septentrionalis* Müll. Arg. 287

Croton michauxii G. L. Webster 294

Euphorbia corollata L. 339

Euphorbia davidii Subils 426

Euphorbia maculata L. 410

FABACEAE

Astragalus distortus Torrey & A. Gray 222

Crotalaria sagittalis L. 400

Desmodium ciliare (Muhlenb. ex Willd.) DC. 627

Desmodium sessilifolium (Torrey) Torrey & A. Gray 338

◆*Desmodium strictum* (Pursh) DC.

Desmodium viridiflorum (L.) DC. 359

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Galactia volubilis (L.) Britton 353, 395
**Lespedeza cuneata* (Dum. - Cours.) Don 415
Lespedeza stuevei Nutt. 377, 399
Strophostyles helvula (L.) Elliott 382
**Vicia villosa* Roth 248, 298

FAGACEAE
Quercus falcata Michx. 330
Quercus marilandica Muenchh. 208
Quercus palustris Muenchh. 319
Quercus stellata Wangenh. 341
Quercus velutina Lam. 211, 212, 355

FUMARIACEAE
Corydalis micrantha (Engelm.) A. Gray ssp. *australis* (Chapman) Ownbey 202

GERANIACEAE
Geranium carolinianum L. 241, 266

HYDROPHYLLACEAE
Phacelia purshii Buckley 261

JUGLANDACEAE
Carya texana Buckley 320, 321, 322, 327

LAMIACEAE
**Lamium amplexicaule* L. 198
Monarda punctata L. var. *villicaulis* (Pennell) Shinn. 337
Teucrium canadense L. 333

LAURACEAE
Sassafras albidum (Nutt.) Nees 306

LYTHRACEAE
Rotala ramosior (L.) Koehne 403

MALVACEAE
Sida elliotii Torrey & A. Gray 606

MENISPERMACEAE
Cocculus carolinus (L.) DC. 331

MIMOSACEAE
**Albizia julibrissin* Durazz. 301, 427

MORACEAE
**Morus alba* L. 210

NYCTAGINACEAE
Mirabilis albida (Walter) Heimerl 362

ONAGRACEAE
Ludwigia alternifolia L. 336
Oenothera biennis L. 402
Oenothera laciniata Hill 243, 293

OXALIDACEAE
Oxalis stricta L. 217

PASSIFLORACEAE
Passiflora incarnata L. 589

PHYTOLACCACEAE
Phytolacca americana L. 300

PLANTAGINACEAE
Plantago aristata Michx. 311

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Plantago virginica L. 254

PLATANACEAE
Platanus occidentalis L. 384

POLYGONACEAE
Polygonella americana (Fischer & C. Meyer) Small 364
Polygonum hydropiperoides Michx. 318
Polygonum pensylvanicum L. 369, 379
Rumex altissimus Alph. Wood 531
Rumex hastatulus Baldwin ex Elliott 246, 273

PORTULACACEAE
Claytonia virginica L. 450

ROSACEAE
Crataegus crus-galli L. 229, 292
Prunus angustifolia Marshall 209
Prunus serotina Ehrh. 213
Rosa carolina L. 242
Rosa setigera Michx. 573
Rubus enslenii Tratt. 230
Rubus pensilvanicus Poiret 236

RUBIACEAE
Diodia teres Walter 288
Galium aparine L. 224, 263
Galium tinctorium L. 392

RUTACEAE
Zanthoxylum americanum Miller f. *americanum* 449

SALICACEAE
Salix nigra Marshall 232

SCROPHULARIACEAE
Collinsia violacea Nutt. 203
Nuttallanthus canadensis (L.) D. Sutton 199
**Verbascum thapsus* L. 357
**Veronica arvensis* L. 218

SOLANACEAE
Solanum carolinense L. 267

ULMACEAE
Celtis laevigata Willd. 368
Celtis occidentalis L. 374
Ulmus americana L. 373
**Ulmus pumila* L. 375

URTICACEAE
Boehmeria cylindrica (L.) Sw. 391

VALERIANACEAE
Valerianella radiata (L.) Dufr. 227

VERBENACEAE
Glandularia canadensis (L.) Nutt. 214
Phyla lanceolata (Michx.) E. Greene 406
Verbena stricta Vent. 285

VIOLACEAE
Viola rafinesquii E. Greene 205

VITACEAE
Vitis aestivalis Michx. 574