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A Potential Understory Flora for Oak Savanna in Iowa

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Oak savanna occurred in Iowa until the time of settlement and then was degraded rapidly. There were no scientific studies of savanna prior to, or after, settlement, and now no high-quality examples exist within the state. To identify those vascular plants adapted to live in the understory of savanna we examined regional and local flora for species that occurred in both prairie and broken woodland, and for species that occurred in both openings and forest. We then compiled a detailed description of the ecological range of habitats for each of these species. We identified 252 species (39 graminoids, 183 forbs, 5 vines, 25 shrubs and small trees) as potential inhabitants of the understory of clay-loam savanna; 150 of these species were found commonly or frequently across the state. We also identified 35 additional species as potential inhabitants of the understory of sand savannas. Of the 52 families represented, Asteraceae included 22% of all species; Poaceae, 13%; Fabaceae, 9%; Rosaceae 7%; and Scrophulariaceae, 5%. Common to frequent forb species were widely distributed in the upper Midwest: 83% occurred in savannas in at least one other state, 44% occurred in two states, and 16% occurred in three states. Although the range of habitats of only 8% of the species included both prairie and closed-canopy woodland, most of these species occurred in a broad range of plant communities, soil moisture levels and soil types.

INDEX DESCRIPTORS: Savanna, Iowa vascular flora, bur oak, oak ecosystems, woodland, understory vegetation, restoration.

Oak ecosystems in the Midwest range from closed-canopy forests to scattered trees in prairies. A broad part of this continuum, generally called savanna, has a two-tiered structure, an incomplete canopy, and a predominantly herbaceous understory of graminoids and forbs (Bray 1955, 1960; Curtis 1959; White and Madany 1978; Nuzzo 1986; Packard 1993). The composition of the understory is closely related to both prairie and dry oak forest communities (Curtis 1959), but includes a higher proportion of forbs than a prairie and a lower proportion of forbs, vines and shrubs than an oak forest (Bray 1960).

Bur oak (*Quercus macrocarpa*) was the dominant tree of oak savannas in the prairie-forest transition zone in Iowa, Minnesota, Wisconsin, and Illinois (Burns and Honkala 1990), and bur oak savannas probably occurred intermittently throughout the entire ecological range of bur oak, from dry uplands and droughty sandy plains to black prairie loams, fertile sandstone or limestone soils, and moist bottomlands (Curtis 1959; Moran 1980; Burns and Honkala 1990). *Quercus alba* also formed savannas on dry slopes, *Q. velutina* and *Q. ellipsoides* (NE. Iowa only) on dry slopes and sandy alluvial flats, and *Q. bicolor* (primarily SE. Iowa) on alluvial plains (Curtis 1959; Eilers and Roosa 1994).

Several factors combined to hinder our understanding of the location, composition, and dynamics of savanna vegetation in Iowa. There were no scientific studies of Midwest oak savanna, prior to or near the time of settlement, from Iowa or the surrounding states, and the early accounts by travelers or General Land Office surveyors may have been biased or misleading (Nuzzo 1986). Moreover, reports of Midwest presettlement vegetation were of limited use because most described the community type but not the understory vegetation (e.g., Ellarson 1949; Anderson and Anderson 1975; Stroessner and Habeck 1966; Tans 1976). Later floras consisted of species lists that briefly indicated the habitat of the few specimens recorded (e.g., Fitzpatrick and Fitzpatrick 1889; Lindly 1904; Burk 1931; Gilly and McDonald 1947, 1948), or stated only the predominant habitats in which each species was found (Eilers and Roosa 1994). In Iowa, only three possible remnants were located, according to Nuzzo (1986), and few high quality stands now exist elsewhere in the Midwest to provide baseline data. Most of these are dry or dry-mesic savannas on sandy, rocky, or sterile soils (Nuzzo 1986), rather than mesic savannas on deep clay-loam soils characteristic of much of the savanna region of Iowa (Prior 1976).

Classification of Savannas

Unfortunately the term *savanna* has been applied to a wide range of habitats with varying degrees of canopy closure, and there is no single accepted classification. Curtis (1959) defined savanna as having between one tree per acre and a canopy coverage of 50%, whereas Madany (1981) used the definition of the Illinois Natural History Areas Inventory of 10-80% canopy coverage (White and Madany 1978). Other classifications have been proposed, some of which classify communities with between 30 and 70% canopy coverage as closed canopy savanna or woodland (Botts, et al. 1994; Faber-Langendoen 1994, 1995). Whether a site is classified as a savanna, or as a mosaic of prairie and closed canopy savanna, will often be determined by the scale utilized (Faber-Langendoen 1994, 1995).

Henderson (1994) classified oak-dominated communities in the prairie-forest continuum by utilizing fire and floristics of the understory as well as physiognomy and the coverage of the canopy. By his classification, intermediate between forests and prairies are the communities with a two-tiered structure of trees taller than 5m which form an incomplete canopy; the understory is predominantly herbaceous. Summer- and fall-blooming groundlayer plants are prevalent and productive; fires are frequent. Within this continuum, savannas have a canopy coverage of 5-30% and grasses predominate in the groundlayer; fires can be frequent and intense. Closed savannas and woodlands are characterized by a higher percentage of canopy coverage: 30-70% for closed savannas and 70-100% for woodlands. In addition, in both closed savannas and woodlands, forbs are increasingly co-dominant with grasses and there is frequent, less intense, fire. Finally, forests are multi-layered, with well-developed woody understories. Spring ephemerals and fire-sensitive herbs are increasingly prominent, and summer- and fall-blooming groundlayer plants are less prominent or absent. Fires are infrequent.

Our study is of savanna in the broad sense, as it has been used in studies over the last 50 years. It includes understory vegetation expected in Henderson's (1994) categories of savanna and closed savanna.

History of Savannas in the Midwest

At the time of settlement, Midwestern oak savanna occurred in most of Missouri and Illinois, in the southern one-half of Wisconsin, in the prairie-forest transition zone of Minnesota, and more locally,

in Michigan, Indiana and Ohio (Nuzzo 1986). In Iowa, oak savannas formed 3000-4000 years ago over most of the state except in the largely treeless northwest Iowa plains region (Eilers and Roosa 1994). By the time of settlement, savanna or a mosaic of open oak woodland and prairie occupied parts of the southern and eastern three-fourths of Iowa and the drainage system of the Little Sioux River in northwestern Iowa (Clark 1926; Shimek 1948; Dick-Peddie 1953; Anderson 1983; Nuzzo 1986). The presence of prairie, savanna, woodland or forest, however, was determined both regionally and locally by different factors, including fire, climate, topography, and the depth, texture and nutrient content of soil (Curtis 1959; Anderson 1983; Glenn-Lewin, et al. 1984; Bowles, et al. 1994; Eilers and Roosa 1994; Will-Wolf and Montague 1994).

After settlement, savannas throughout the Midwest became closed forest within 20 to 40 years (Curtis 1959), were converted to crops or pastureland (Curtis 1959), or were degraded by grazing (Bray 1955). Savannas are now some of the rarest plant communities in the United States.

With the disappearance of oak savanna, many of the understory species formerly occupying that habitat were found only in the woodland or prairie sections of their respective habitats, and the rarity of some species ensured that they would not be encountered along their full continuum of potential habitats. Only one early study provided a clue to what species might have inhabited some grasslands in the partial shade of oaks in Iowa (Shimek 1910). Currently, we do not know what the expected abundance of each species would be along the gradients from prairie to forest, from dry to moist conditions, or from deep loam to sandy soils.

To increase our understanding of savanna ecosystems in Iowa, we sought 1) to identify species native to Iowa that have the potential to exist in partial shade (either under widely spaced oaks or between closely spaced oaks when the canopy coverage approaches closure), 2) to compile descriptions of habitat for each species, including moisture regimes and soil types, and 3) to compare this information with that from major studies in surrounding states.

METHODS

To identify those native species with the potential to occupy the understory of oak savanna in Iowa, we consulted regional floras for Iowa (Fay 1953; Van Bruggen 1958; Davidson 1959; Monson 1959; Cooperrider 1962; Eilers 1971), studies of grasses and sedges (Gilly 1946; Pohl 1966), and the state flora (Eilers and Roosa 1994). Our initial list included those species recorded in both prairie and the partial shade of broken woodland, as well as species recorded from edges of open woodland to the deeper shade of forests. We excluded species restricted to two regions markedly different from most of Iowa in both landform and vegetation, the Loess Hills along the Missouri River (Novacek, et al. 1985; Nuzzo 1986; Eilers and Roosa 1994) and the driftless area of northeastern Iowa (Eilers and Roosa 1994). We included, as a separate category, species found primarily in sandy soil, especially along river valleys and in the Lake Calvin Basin (Prior 1976; Nuzzo 1986; Eilers and Roosa 1994).

To further document the breadth of habitats occupied by species, and to reevaluate our list, we examined local floras (Pammel 1898, 1899; Fitzpatrick and Fitzpatrick 1897; Barnes, Reppert, and Miller 1900; Mueller 1903; Wilder 1906; Shimek 1910; Pammel 1920; Augustine 1940; Gilly and McDonald 1947, 1948; Easterly 1951; Fay 1951; Thorne 1955; Hartley 1966; Wolden 1971). We then compiled a description of the habitat for each species, which included the documented range of community types, moisture regimes, and soils. Soil moisture regimes were divided into five categories: wet, wet-mesic, mesic, dry-mesic and dry (Curtis 1959).

To compare the species and habitat descriptions collected from the literature of Iowa with data collected from existing savannas, we

examined one study in Iowa (Shimek 1910) and studies of savannas in three adjacent states (Bray 1955, 1958, 1960; Curtis 1959; Drew 1973; Madany 1981; Packard 1988; Betz and Lamp 1992). Data on presence in other states were summarized from these cross-reference studies (Table 2) and percent occurrence was calculated separately for species expected to occur in dry to mesic clay-loam savannas and for species expected to occur primarily in sandy or dry savannas. Twenty-five species occurring primarily in wet-mesic savanna were excluded because studies in other states did not include this habitat. Common to frequent species on our list provided the best comparison with other states because of the use of only prevalent species by Madany (1981) and by Curtis (1959), the use of only those species that occurred in more than 10% of the locations by Bray (1958, 1960), and the use of relatively few locations by Mead (Packard 1988) and by Drew (1973).

RESULTS

Characterization of understory savanna species

From the cited studies we compiled a list of 252 species (39 graminoids, 183 forbs, 5 vines, 25 shrubs and small trees) as potential inhabitants of the understory of clay-loam savannas (Table 1 A.), and 35 additional species that would be more restricted to sandy savannas (Table 1 B.).

Of 52 families, the best represented were Asteraceae, 22% of the total species; Poaceae, 13%; Fabaceae, 9%; Rosaceae, 7%; Scrophulariaceae, 5%; Ranunculaceae, 4%; Lamiaceae, 4%; Liliaceae, 4%; Cyperaceae, 4%. If only the 151 common species found in clay-loam savannas were utilized, these percentages were Asteraceae, 28%; Rosaceae, 12%; Poaceae, 10%; Fabaceae, 8%; Liliaceae, 4%; Ranunculaceae, 3%; Lamiaceae, 3%; Cyperaceae, 2%; Scrophulariaceae, 1%. These percentages and rankings are close to those given in Curtis (1959) for the groundlayer of oak savanna in Wisconsin, except that he did not list the Rosaceae in the five most abundant families. In contrast to our treatment of the species in this family, Curtis (1959) lumped all species of *Rosa* into a single taxon, and he listed species for the groundlayer only, and therefore did not include rosaceous small trees and shrubs.

Most species on our list did not inhabit both prairie and forest (Table 1). Of the 188 species of graminoids and forbs we listed as common to infrequent for clay-loam savanna, only 8% inhabited both prairie and forest; 61% occurred primarily in prairie and woodland openings, and 31% occurred in openings and forest. Thus the species composition of our list is more similar to prairie vegetation than to that of the forest. These figures are close to those for the Wisconsin savannas studied by Bray (1960), in which only 7% of the species were well represented from prairie to forest; of the other species, 56% ranged primarily from prairie to savanna with a presence of less than 5% in closed canopy forest, and 37% were found primarily in savanna, closed savanna, and woodland, and had a presence of less than 5% in prairie. Similarly, Betz and Lamp (1992) found 61% of Illinois prairie species in the savanna understory. Comparisons such as these, however, will be more meaningful when we know the canopy coverage, moisture regime, soil type, and the frequency and intensity of fire, for each habitat.

Most of the species we list inhabited a broad range of soil moisture levels, and soil types. Of the five moisture categories, 26% of the species occurred in two categories, 52% in three categories, and 13% in four categories. Of the species we list for clay-loam soil, 52% also occurred in sandy soils, and 63% also occurred in sandy, rocky, or gravelly soils.

Comparisons with other studies

Shimek (1910), recorded 137 species in small prairie openings (usually < 0.01 ha) mostly in oak forests on loess, drift, sandy, or allu-

Table 1. Understory species potentially occupying oak savanna in Iowa. Binomial nomenclature is according to Gleason and Cronquist (1991); synonyms in parentheses are used by Eilers and Roosa (1994). Cross references to seven other studies are presented in columns 1-7. Overall abundance in the savanna region of Iowa (primarily eastern and southern Iowa) is given first in the next column; if the species is not found commonly or frequently throughout the savanna region, distribution notes indicate regional abundance. Notes on distribution and abundance are from Eilers and Roosa (1994): C (common), F (frequent), INF (infrequent) and R (rare). Habitat descriptions indicate the range of community types in which a species is known to occur in Iowa; habitats are ranked from most to least frequent as mentioned in the literature. Moisture regimes are given if they diverge from mesic conditions (wet, w-m, mesic, d-m, dry), and soil types are listed if they diverge from clay-loam soils. Underlining indicates conditions or habitats in which a species was found predominantly; parentheses indicate habitats in which a species was seldom found. Specific regions referred to are: Des Moines lobe (DML), Iowan Surface (IaS), and Paleozoic Plateau (Pal. Plt.).

1. Iowa. Shimek: hill prairies in oak woodland, primarily in Johnson Co.; x indicates presence.
2. Illinois. Packard: tallgrass savanna in Hancock Co. recorded originally by Mead in 1846; x indicates presence.
3. Illinois. Betz and Lamp: savanna cemeteries; silt-loam soil (sl), sand-gravel (sg), sandy soil (ss).
4. Illinois. Madany: prevalent species in oak savanna; dry-mesic (dm), dry-mesic sand (dms), and dry sand (ds).
5. Wisconsin. Curtis: prevalent species in mesic oak savanna; x indicates presence.
6. Wisconsin. Bray: savanna; p, s or w indicate presence $\geq 10\%$ in prairie, savanna or woodland.
7. Minnesota. Drew: prairie-forest transition zone; present in prairie (p), bur oak savanna (s), bur oak woodland (w).

Taxon	Florals of occurrence							Overall Savanna	Habitats, moisture, and soil types
	1	2	3	4	5	6	7	Regional abundance	
A. Species expected to be found in clay-loam savanna, except those species most abundant in or restricted to dry or sand savannas									
Graminoids									
<i>Agrostis hyemalis</i> Hairgrass	x	x	sl	—	—	—	—	INF F: n 1/2 R: se	Prairie, open woods and openings, thickets, wooded bluffs; to dry; to <i>sandy</i> and rocky soils.
<i>Agrostis perennans</i> Autumn bent-grass	—	—	—	—	—	—	—	F F: s Inf-R: n	Open upland and lowland woods, bluffs, prairie swales, margins of streams or ponds; w-m to d-m; to acidic, sandy, alluvial, sandstone, and limestone soils.
<i>Andropogon gerardii</i> Big bluestem	x	x	sl sg ss	dm dms	x	p s	p s	C	Prairie, borders of woods, open rocky woods, thickets; w-m to dry; to sandy soils.
<i>Bouteloua curtipendula</i> Side-oats grama	x	—	ss	—	—	p s	p s	C	Prairie, and prairie openings, open upland woods; to <i>dry</i> ; to sandy, gravelly and rocky soils.
<i>Bromus altissimus</i> (<i>Bromus latiglumis</i>)	—	—	—	—	—	—	—	INF F-Inf: e R: sw	Low prairie, alluvial woods, open wooded slopes; to w-m.
<i>Bromus kalmii</i> Prairie brome	—	—	—	—	—	s	—	R F: Pal. Plt. R: elsewh in e	Upland prairie, sparsely wooded slopes, rocky hillsides; w-m to d-m.
<i>Bromus pubescens</i> Canada brome	—	—	—	—	—	—	—	C	Oak woodland, prairies, loamy sandstone bluffs; to rocky soils.
<i>Carex backii</i> (<i>Carex saximontana</i>)	—	—	—	—	—	—	—	R R: nw & ne	Dry woods, prairie; to dry.
<i>Carex bicknellii</i>	—	—	sl sg	—	—	—	—	INF F: w 3/4 R: e	Prairie, open woods; w-m to dry; to limestone.
<i>Carex brevior</i> (<i>Carex molesta</i>) Repulsive sedge	x	—	sl	—	—	—	w	INF F: n, sc & sw Inf-R: elsewh	Prairie, loess bluffs, dry woods, openings in woods; w-m to <i>dry</i> ; to sandy soil.
<i>Carex cephalophora</i>	—	—	ss	—	—	—	—	C-F C-F: s 1/2	Dry to mesic woods and woodland openings, w-m prairie; w-m to dry.

<i>Carex davisii</i> Davis's sedge	-	-	-	-	-	-	-	F F: s 1/2 R: n 1/2	Alluvial woods, upland woods, prairie swales; <i>w-m</i> to dry; to alluvium and sand.
<i>Carex leavenworthii</i> Leavenworth's sedge	-	-	-	-	-	-	-	INF F-Inf: se R: ne	Prairie, woodlands, wooded bluffs; to sand; to d-m.
<i>Carex normalis</i>	-	-	-	-	-	-	-	INF F: ne Inf: elsewh	Open mesic woods, prairie, prairie sloughs; to w-m.
<i>Carex pennsylvanica</i> Pennsylvania sedge	x	-	sl	dms	x	s	w	C	Upland woods, upland prairie; to dry; to sandy soil.
<i>Carex sprengeii</i>	-	-	-	-	-	-	-	INF C: Pal. Plt. R: se; F-Inf: elsewh	Upland woods, thickets, prairie; w-m to d-m; to sandy soil.
<i>Carex tetanica</i>	x	-	-	-	-	-	-	R	Wet prairie, marshes, prairie- woodland borders; <i>w-m</i> to dry.
<i>Elymus canadensis</i> Canada wild rye	x	-	sl	dm	-	p	p	C	Prairie, open woods, sparsely wooded ridges, slopes, and bluffs; <i>w-m</i> to dry; to sand, limestone, sandstone or alluvium.
<i>Elymus hystrix</i> (<i>Hystrix patula</i>) Bottlebrush-grass	-	x	-	-	-	-	w	C	Prairie openings in upland woods, open woodland, wooded slopes, thickets; to d-m; to rich or rocky soils.
<i>Elymus trachycaulus</i> (<i>Agropyron trachycaulum</i>) Slender wheatgrass	-	-	-	-	-	-	p	INF F-C: n Inf-R: se & sc	Prairie, broken woodland; w-m to d-m.
<i>Elymus villosus</i> Downy wild rye	-	-	-	-	-	-	-	C	Mesic open woods, borders of woodland, prairie, thickets; to d-m; to rich, rocky, sandy or alluvial soils.
<i>Elymus virginicus</i> Virginia wild rye	-	-	-	-	-	-	-	C	Open alluvial woods, thickets, prairie; to w-m; to <i>alluvial</i> or rocky (limestone) soils.
<i>Festuca paradoxa</i>	-	x	-	-	-	-	-	R R: se 1/2	Prairie, low or dry open woods.
<i>Juncus tenuis</i> Path rush	x	-	-	-	-	-	-	C	Open woods, prairie-forest edges, fields; <i>w-m</i> to dry; packed soil.
<i>Koeleria pyramidata</i> (<i>Koeleria macrantha</i>) Junegrass	-	-	sl	dms	-	p	p	INF Inf:e F: elsewh	Prairie, open woods; d-m to dry; to sandy, sterile, or rocky (limestone or sandstone) soils.
<i>Melica nitens</i> Three-flowered melic	-	-	sg	-	-	-	-	R R: c & e	Open rocky woods, wooded bluffs bordering prairie, prairie, along streams; to dry; rich to sandy or limestone soil.
<i>Muhlenbergia racemosa</i> Marsh muhly	-	-	-	-	-	-	-	C	Prairie, open upland woods, slopes and bluffs, bottomlands; wet to <i>dry</i> ; to sandy, rocky (sandstone or limestone) soils.
<i>Muhlenbergia schreberi</i> Nimblewill	-	-	-	-	-	-	-	C	Open woodlands, bluffs, stream bottomlands, thickets, prairie; to dry; to sandy, rocky (gravel, sandstone and limestone) and <i>alluvial</i> soils.
<i>Panicum clandestinum</i> (<i>Dichanthelium clandestinum</i>) Deertongue grass	-	-	-	-	-	-	-	INF Inf-R: se	Upland woods, thickets, prairie swales; to w-m; to <i>sandy</i> soil.
<i>Panicum lanuginosum</i> (<i>Dichanthelium acuminatum</i>)	-	x	sl	-	-	-	-	C-F R: w	Prairie, fields, openings in woods, open woods, bluffs; to dry; to sandy and sandstone soils.

<i>Panicum leibergii</i> (<i>Dichanthelium leibergii</i>)	-	-	sl	-	x	p	p	INF C: nc R: nw & se Inf: elsewh	Prairie, dry open woods; to <i>dry</i> ; to rocky soil and alluvium.
<i>Panicum virgatum</i> Switchgrass	x	-	ss	dm	-	-	s	C	Prairie, edges of upland woods, along streams; w-m to <i>dry</i> ; to sandy soil.
<i>Schizachyrium scoparium</i> Little bluestem	x	-	sl	dm	x	p	p	C	Upland prairie, borders of woods, open woods; to <i>dry</i> ; to sandy or rocky soils.
<i>Sorghastrum nutans</i> Indian grass	x	x	sl	dm	-	p	p	C	Prairie, rocky open woods; to <i>dry</i> ; to sandy soil.
<i>Sphenopholis obtusata</i> Wedge-grass	x	-	-	-	-	-	-	INF C-F: se R: w 1/4 F: elsewh	Rich woods, openings and bluffs in upland woods, open woodland, prairie; to wet; to sandy and rocky soil.
<i>Sporobolus asper</i> Tall dropseed	-	-	-	-	-	-	-	C	Dry prairie, open wooded slopes; d-m to <i>dry</i> ; to sand, gravel, sterile and <i>disturbed</i> soils.
<i>Sporobolus heterolepis</i> Northern dropseed	-	-	sl	-	-	p	-	INF C: nc & sw Inf: elsewh	Prairie, rocky woodland openings, loess bluffs; w-m to <i>dry</i> ; to rocky and sandy soil.
<i>Stipa spartea</i> Porcupine-grass	-	-	sl	ds	x	p	p	INF C: nc & sw Inf: elsewh	Prairie, open woods; d-m to <i>dry</i> ; to sandy soil.
<i>Tridens flavus</i> Purpletop	-	-	-	-	-	-	-	INF C: se Inf-R: extr s	Prairie and prairie openings in woods, <i>disturbed</i> prairie, thickets; to alluvial and sandy soils.

Forbs

<i>Achillea millefolium</i> Common yarrow	x	-	-	dm	-	p	p	C	Prairie, woodland; to <i>dry</i> ; <i>disturbed</i> soil to sand.
<i>Agalinis auriculata</i> (<i>Tomanthera auriculata</i>)	-	-	-	-	-	-	-	R R: e & sc	Prairie, open upland woods; w-m to <i>dry</i> .
<i>Agalinis tenuifolia</i> Common agalinis	-	-	-	-	-	-	-	C Inf: ne & se R: nw C: elsewh	Mesic prairie, dry wooded slopes, open woods, borders of streams; w-m to <i>dry</i> ; to sand.
<i>Agastache nepetoides</i> Yellow giant-hyssop	-	-	-	-	-	-	-	INF F: sc Inf-R: elsewh	Open upland woods and woodland edges; w-m to d-m; alluvial to sandy soils.
<i>Agastache scropulariifolia</i> Purple giant-hyssop	x	-	-	-	-	-	-	INF C: nc Inf-R: elsewh	Open woods, woodland-prairie borders, (prairie remnants); to w-m.
<i>Agrimonia gryposepala</i> Common agrimony	-	-	-	-	-	-	-	INF Inf: s 1/2 & nc C-F: elsewh	Woodland borders, woodland, mesic prairie, thickets; to <i>dry</i> ; sandy to rich and rocky soil.
<i>Allium canadense</i> Wild garlic	x	-	-	-	-	p	-	C-F	Prairie, upland forest, forest edges; w-m to d-m; to limestone, rocky, or alluvial soils.
<i>Ambrosia artemisiifolia</i> Common ragweed	x	-	-	dms	-	p	-	C	Prairie, prairie openings, sparsely-wooded bluffs, edges of woods; to <i>dry</i> ; <i>disturbed</i> ground to sandstone.
<i>Amphicarpa bracteata</i> Hog-peanut	-	-	sl	-	x	-	s	C-F	Woods and woodland edges, thickets, stream banks, openings, (prairie); to <i>dry</i> ; to rich, rocky and sandy soils.

<i>Anemone canadensis</i> Canada anemone	-	-	-	-	-	-	p	w	C	Wet-mesic prairie, low open woods, thickets; to <i>w-m</i> ; to sandy, calcareous and alluvial soils.
<i>Anemone cylindrica</i> Thimbleweed	x	-	sl	-	x	p	s	s	C C: nw 1/2 Inf-R: elsewh	Prairie, open woods, hilly woodlands; to <i>dry</i> ; to <i>sandy</i> , loess and calcareous soils.
<i>Anemone patens</i> (<i>Pulsatilla patens</i>) Pasque-flower	-	-	-	-	-	p	s	w	R C: nw Inf: IaS R: Pal. Plt.	Prairie, sparsely-wooded slopes; to <i>dry</i> ; to <i>sandy</i> , or <i>gravelly</i> , <i>calcareous</i> soil.
<i>Anemone virginiana</i> Tall anemone	-	-	-	-	-	-	-	-	C F: sc	Open woods to woodland borders, prairie; to <i>dry</i> ; to rocky soil.
<i>Antennaria neglecta</i> Cat's paw, Pussytoes	x	-	sl	dms	x	p	s	w	C-F Inf: sw	Prairie, open woodland to <i>dry</i> ; to rocky or sandy soils.
<i>Antennaria plantaginifolia</i> Pussy toes, Ladies'-tobacco	x	-	sl	dm	-	p	s	w	C	Prairie, open upland woods, ridges; to <i>dry</i> ; to clay, rocky or sandy soils.
<i>Apios americana</i> Common ground-nut	-	x	sl	-	-	-	-	-	C-F R: IaS C-F: elsewh	Alluvial woods, upland and <i>w-m</i> prairie, bogs, thickets; to wet; to sandy soil.
<i>Apocynum androsaemifolium</i> Spreading dogbane	-	-	sl	-	x	p	p	w	INF C: ne Inf: elsewh	Woodland edges and openings, upland prairie; to <i>dry</i> ; to sandy or rocky soils.
<i>Apocynum cannabinum</i> Indian hemp	-	-	-	-	-	-	-	-	C-F	Woodland openings, thickets, (prairie); to <i>dry</i> ; <i>disturbed</i> , rich, rocky or sandy soils.
<i>Aquilegia canadensis</i> Columbine	-	-	-	-	x	s	s	w	C-F F: sc & sw	Open or rich woods, wooded slopes and woodland openings; to d-m; to sandy, sandstone, or limestone soils.
<i>Arabis drummondii</i> Rock cress	-	-	-	-	-	-	-	-	INF Inf: e; R: sc	Prairie, openings in woods.
<i>Artemisia ludoviciana</i> White sage	x	-	-	-	-	-	s	w	C-F	Prairie, open woodland, openings, knolls; to <i>dry</i> ; to rocky, gravelly, and <i>sandy</i> soil.
<i>Asclepias exaltata</i> Tall or poke milkweed	-	-	-	-	x	-	-	-	R F: Pal. Plt. R: elsewh	Woodland borders and upland woods.
<i>Asclepias purpurascens</i> Purple milkweed	x	-	-	dms	-	-	-	-	INF Inf-R: thr	Open woodland, bluffs, thickets, prairie; to <i>dry</i> ; to sandy and rocky soil.
<i>Asclepias speciosa</i> Showy milkweed	-	-	-	-	-	-	-	-	R Inf-R: w 1/2	Prairie, woodland openings.
<i>Asclepias syriaca</i> Common milkweed	x	-	-	-	x	-	-	-	C	Open woodland, prairie, thickets; to <i>dry</i> ; <i>disturbed</i> open ground.
<i>Asclepias tuberosa</i> Butterfly-weed	x	-	sl	dm	-	-	-	-	F F-Inf: thr	Prairie, dry open woods, broken woodland; to <i>dry</i> ; to rocky or sandy soil.
<i>Asclepias verticillata</i> Whorled milkweed	x	-	sl	dm	-	-	-	-	INF C-F: w 1/2 Inf-R: e 1/2	Prairie, open woods, marshes; to <i>dry</i> ; to sand or rocky soil.
<i>Aster ericoides</i> Heath aster	x	-	sl	dms	-	p	s	s	C-F	Prairie, woodland, openings, thickets; to <i>dry</i> ; to sand.
<i>Aster laevis</i> Smooth blue aster	x	-	sl	-	-	p	-	s	C-F	Prairie, openings and edges of upland woods, bluffs; to d-m; to calcareous and sterile soils.
<i>Aster lanceolatus</i> Eastern lined aster	-	-	-	-	-	-	-	-	INF Inf-R: thr	Low prairie, open woods, marshes, near streams; to <i>w-m</i> ; to alluvium.

<i>Aster lateriflorus</i> Goblet aster	-	-	sl	-	-	-	-	C-F C: se; F: ne Inf: sw	Woods, openings in dry upland woods, prairie; to d-m.
<i>Aster novae-angliae</i> New England aster	x	-	sl ss	-	-	-	-	C	Prairie swales, borders of woods, open woodland, thickets; <i>wet</i> .
<i>Aster oolentangiensis</i> (<i>Aster azureus</i>) Sky-blue aster	x	-	sl ss	dm dms ds	-	p s	-	C-F C-F: se 2/3	Open woods, prairie, bluffs, thickets; to <i>dry</i> ; to limestone and sand.
<i>Aster pilosus</i> Frostweed	-	-	-	dm	-	-	-	C C: s 1/2 R: n 1/2	Prairie, upland open woods, borders of thickets, exposed sandstone bluffs; to <i>dry</i> .
<i>Aster sagittifolius</i> Arrow-leaved aster	-	-	sl	-	-	s w	-	C C: s 1/2 F: ne; R: nc	Open bur oak woods, openings, borders, bluffs; to <i>dry</i> ; to sandy soil.
<i>Aster sericeus</i> Silky aster	x	-	-	-	-	p s	-	F C: w F-Inf: e	Prairie, openings in woods; to <i>dry</i> ; to rocky (limestone) and sand.
<i>Aster turbinellus</i> Prairie aster	-	x	-	-	-	-	-	R R: se	Prairie, dry upland woods and woodland edges.
<i>Astragalus canadensis</i> Canadian milk-verbena	-	-	-	-	-	-	-	C-F C: w 1/2 F-Inf: e 1/2	Prairie, edges of woods, dry upland and open woods, bluffs, thickets; to <i>dry</i> ; to alluvial and rocky soils.
<i>Baptisia bracteata</i> Cream wild indigo	-	-	sl	dms ds	-	-	-	INF R: nw & extr e	Upland prairie, open woods; to <i>dry</i> ; to sandy, acidic, or rocky (limestone) soils.
<i>Baptisia lactea</i> Wild white indigo	-	x	sl ss	dm dms	-	-	-	F R: nw & extr e	Prairie, broken woodland, along streams; w-m to d-m; to sandy, rich, loamy, rocky or alluvial soil.
<i>Blephilia ciliata</i> Downy wood mint	-	-	-	-	-	-	-	R R: se & sc	Open woods, fields, thickets; to <i>dry</i> ; to limestone.
<i>Cacalia atriplicifolia</i> Pale Indian plantain	x	-	sl sg	-	-	-	-	INF F-Inf: s 1/2	Woodland edges, open woodlands, prairie, thickets; w-m to d-m; rich to <i>sandy</i> soil.
<i>Calystegia sepium</i> Hedge-bindweed	x	-	-	-	-	-	-	C	Woodland borders and openings in woods, thickets, sloughs, prairie; to w-m; to rich soil and alluvium.
<i>Camassia scilloides</i> Wild hyacinth	-	-	sl	-	-	-	-	INF Inf-R: s 1/2	Prairie to woodland edges and open woods; to <i>w-m</i> ; to rich, sandy and rocky soils.
<i>Campanula americana</i> Tall bellflower	-	x	-	-	-	-	-	C	Open woods, woodland edges, thickets; to <i>w-m</i> ; to <i>alluvium</i> .
<i>Castilleja coccinea</i> Painted cup	x	-	-	dms	-	-	p	R Inf-R: nc & nw	Prairie, swampy meadows, thickets, open woods; w-m to <i>dry</i> ; to sterile, sandy, rocky (limestone, sandstone), and alluvial soil.
<i>Chamaecrista fasciculata</i> Partridge pea	x	-	sl ss	dms ds	-	-	-	C	Prairie, open thickets, openings in woods; to <i>dry</i> ; to <i>disturbed</i> and sandy soils.
<i>Cirsium altissimum</i> Tall thistle	-	-	-	-	-	-	-	C Inf: nw; R: ne C: elsewh	Open woods, edges of woods, prairie; w-m to d-m.
<i>Cirsium discolor</i> Field Thistle	-	-	sl	-	-	-	-	C-F	Open upland woods, w-m prairie; w-m to d-m; <i>disturbed</i> ground.
<i>Clematis pitcheri</i> Leather flower	-	-	-	-	-	-	-	INF C: se; F: sc Inf -R: elsewh	Openings in woods, (prairie); to <i>sandy alluvial</i> soils.
<i>Clematis virginiana</i> Virgin's bower	x	-	-	-	-	-	-	INF C-F: n 1/2 only	Woodland-prairie margins, <i>disturbed</i> open alluvial woods, thickets; to <i>w-m</i> .

<i>Comandra umbellata</i> Bastard-toadflax	x	—	sl sg ss	dm dms	x	p s	—	C	Prairie, openings in upland woods; to dry; to gravelly or sandy soil.
<i>Coreopsis palmata</i> Prairie coreopsis	x	x	sl ss	dms ds	x	p s	—	C-F Inf: se only	Prairie, open woods, borders of upland woods; to d-m; to sandy soil.
<i>Coreopsis tripteris</i> Tall tickseed	x	x	sl ss	dm dms	—	—	—	INF Inf: s 1/2	Prairie, woodland borders, open woods, thickets; to d-m.
<i>Cuphea viscosissima</i> Waxweed	—	—	—	—	—	—	—	R R: se	Edges of upland woods, open woods, thickets, (prairie); to dry; to gravel.
<i>Dalea candida</i> White prairie clover	x	x	sl ss	—	—	p s	p	C-F	Prairie, open woodland; to dry; to sandy or rocky soils.
<i>Dalea purpurea</i> Purple prairie clover	x	—	sl ss	dm	x	p s	s p	C	Prairie, openings, open woods; to dry; to sandy, rocky or rich soils.
<i>Desmodium canadense</i> Showy tick-trefoil	—	—	sl ss	dm	—	—	—	C	Prairie, open woods, woodland borders, upland woods; w-m to d-m; to sand and alluvium.
<i>Desmodium canescens</i> Hoary tick-trefoil	—	x	—	—	—	—	—	INF Inf-R: thr	Open woods and edges, along streams, (prairie); wet to dry; to rich, clay or sandy soil.
<i>Desmodium illinoense</i> Prairie tick-trefoil	—	—	sl ss	—	—	—	—	C	Prairie, open woods; to dry; to sandy and rocky soil.
<i>Desmodium paniculatum</i>	—	x	—	—	—	—	—	INF C: se only Inf-R: elsewh	Upland open woods, bluffs, sandy alluvial woods, prairie; to dry; to sandy, rocky, limestone and sandstone soils.
<i>Desmodium sessilifolium</i> Sessile-leaved tick-trefoil	—	x	sl ss	—	—	—	—	R R: c, ne & se	Open upland woods, (prairie); to dry; to rocky, sandy and sandy alluvial soils.
<i>Dodecatheon meadia</i> Eastern shooting star	x	x	sl	dms	—	p s	—	INF C: IaS only Inf: se R: DML & Pal. Plt.	Prairie, open upland wooded bluffs; w-m to d-m; to sand.
<i>Echinacea purpurea</i> Purple coneflower	—	—	—	—	—	—	—	R R: se & sc	Borders of woods, open woods, prairie; w-m to d-m.
<i>Ellisia nyctelea</i> Water-pod	x	—	—	—	—	—	—	C	Woods, edges of woods, <i>disturbed</i> woods, open fields, (prairie); to sandy soil.
<i>Erigeron strigosus</i> Daisy fleabane	x	—	sl sg ss	—	—	—	—	C	Prairie, open upland woods; to dry; to sandy, rocky and <i>disturbed</i> soils.
<i>Eryngium yuccifolium</i> Rattlesnake master	—	—	sl	—	—	—	—	F F-Inf: thr	Prairie, open woods; w-m to d-m; to rocky soils.
<i>Eupatorium altissimum</i> Tall boneset	x	x	—	dm	—	—	—	F F: s Inf-R: n	Prairie, dry open woodlands and borders, bluffs; to d-m; to limestone.
<i>Eupatorium serotinum</i> Late boneset	—	—	ss	—	—	—	—	INF F: se R: sw	Open woods, sparsely wooded slopes, woodland edges, (prairie), bottomlands; to w-m.
<i>Euphorbia corollata</i> Flowering spurge	x	—	sl sg ss	dm dms ds	x	p w s	—	C	Prairie, openings in upland woods; to dry; to sandy soil and sandstone.
<i>Fragaria virginiana</i> Wild strawberry	x	—	sl sg ss	dm	x	p w s	s w p	C	Prairie, thickets, marshes, woodland openings and open woods; w-m to dry; to sandy soil.
<i>Galium boreale</i> Northern bedstraw	—	—	—	—	x	s w	s w	INF C-F: ne 1/4 F: extr e	Prairie, prairie-woodland edges, limestone ledges, fens; wet to d-m.
<i>Galium concinnum</i> Shining bedstraw	—	—	—	—	x	w s	w	C	Upland woods and slopes, mesic prairie; wet to d-m.
<i>Galium obtusum</i> Wild madder	—	—	sl	—	—	—	—	F F-Inf: thr	<i>Wet-mesic</i> prairie, open alluvial woods.

<i>Gentiana andrewsii</i> Bottle gentian	-	-	sl	-	-	-	-	INF F: IaS & c Inf-R: e & sc	Prairie, swales, bogs, marshes, low open woods; <i>w-m</i> to d-m; to sandy.
<i>Gentiana flavida</i> (<i>Gentiana alba</i>) Cream gentian	-	x	-	-	-	-	-	INF Inf-R: thr	Open upland woods, prairie; to <i>w-m</i> ; to rocky (limestone) and rich soil.
<i>Gentiana puberulenta</i> Prairie gentian	x	-	sl	-	-	-	p	INF F: nc Inf-R: elsewh	Open upland woods, prairie, open bluffs and slopes; to dry; to sandy or thin rocky limestone or cherty soil.
<i>Gentianaella quinquefolia</i> Stiff gentian	-	x	-	-	-	-	-	INF Inf-R: ne 1/2	Prairie openings, thickets, algific slopes, wooded slopes; to d-m; to calcareous rocky soil.
<i>Geranium maculatum</i> Wild geranium	-	-	sl ss	-	x	-	-	C	Open woods, sandy prairie, thickets; to d-m; to rich, rocky or sandy soils.
<i>Geum canadense</i> White avens	-	-	sl	-	-	-	-	C	Upland and alluvial woods, prairie and thickets; to <i>w-m</i> .
<i>Gnaphalium obtusifolium</i> Cudweed, everlasting	x	-	sl ss	-	-	-	-	C C: e 1/2 & sc R: nc	<i>Disturbed</i> prairie, open bur oak woods, knolls; to dry; to <i>sandy</i> and rocky (sandstone) soil.
<i>Hedeoma pulegioides</i> American pennyroyal	x	-	-	-	-	-	-	INF C: se only Inf-R: elsewh	Open upland woods, thickets, wooded bluffs, prairie; to dry; to sandstone and limestone.
<i>Helianthus grosseserratus</i> Sawtooth sunflower	-	-	sl ss	-	-	-	-	C-F	Prairie, open alluvial woods, <i>disturbed</i> areas; <i>w-m</i> to d-m; to alluvial and sandy soil.
<i>Helianthus birsuitus</i> Bristly sunflower	-	-	-	-	-	-	-	R R: nc, se & sw	Open woods, edges, and prairie.
<i>Helianthus laetiflorus</i> (<i>Helianthus rigidus</i>) Prairie sunflower	-	-	sl ss	-	x	p	- s	INF C: w 1/2 Inf: e 1/2	Prairie, thickets; to <i>dry</i> ; to <i>sandy</i> soil.
<i>Helianthus strumosus</i> Pale-leaved sunflower	-	-	sl	-	x	s	- w	F R: nw only	Prairie, borders of woods, open woods, thickets, <i>disturbed</i> areas; to d-m.
<i>Heliopsis helianthoides</i> Ox-eye	x	-	sl sg	dm	x	p	p s w	C-F	Open woods, borders of thickets and woodland, prairie; <i>w-m</i> to d-m; to sand and alluvium.
<i>Heuchera richardsonii</i> Prairie alum-root	-	-	sl	dms	x	p	s p	INF C: ne 1/4 & sw F-Inf: elsewh	Prairie, open oak woodland, borders and bluffs; <i>w-m</i> to dry; to clay, sandy or rocky (limestone) soil.
<i>Hieracium scabrum</i> Sticky hawkweed	-	-	-	-	-	-	-	F F: s and Pal. Plt. R-Inf: elsewh	Upland prairie, open woods, broken woodland, bluffs; to dry; to sandy soil.
<i>Hypericum punctatum</i> Spotted St. John'swort	-	x	-	-	-	-	-	C R: nc & Pal. Plt. only	Prairie, open woods, thickets, sparsely-wooded sandstone bluffs, stream banks, low woods; <i>w-m</i> to d-m; to sand and alluvium.
<i>Hypericum pyramidatum</i> Great St. John'swort	-	-	-	-	-	-	-	INF F-Inf: n 1/2 Inf-R: s 1/2	Woodland borders, open woods, low thickets, prairie remnants, marshes; to <i>w-m</i> ; to rich soil.
<i>Hypericum spiraecarpum</i>	-	x	sl sg	-	-	-	-	C C: e 1/2 only R: nw & sw	Prairie, swampy meadows, dry open woods; wet (<i>w-m</i>) to dry; to sterile, rocky, <i>sandy</i> or alluvial soils.
<i>Hypoxis hirsuta</i> Yellow star-grass	x	-	sl	-	-	-	p	C-F Inf: ne	<i>Prairie</i> , sparsely-wooded exposed bluffs, openings in woods; <i>w-m</i> to d-m; to sandstone and calcareous soil.
<i>Ipomoea pandurata</i> Wild potato	-	x	-	-	-	-	-	INF F: se R: nw, ne, ec & sc	Broken woodland, woods; <i>w-m</i> to dry; to alluvium.

<i>Krigia biflora</i> Cynthia, False dandelion	x	—	sl	dms	—	s	—	INF F: e R: n	Prairie, open woods, openings in woods; to dry; to sand.
<i>Kubnia eupatorioides</i> (<i>Brickellia eupatorioides</i>) False-boneset	x	—	ss	dms	—	p	— s	C-F	Prairie, wooded bluffs, open woods; to dry; to rocky and sandy soil.
<i>Lactuca canadensis</i> Wild lettuce	—	—	sl sg ss	dm	—	—	—	C Inf: nw only	Openings, borders of woods, thickets, (prairie remnants); to dry; to sandy soil.
<i>Lactuca ludoviciana</i> Prairie lettuce	—	—	—	—	—	—	—	INF F-Inf: w 1/2 R: e 1/2	Prairie, open wooded bluffs; to dry.
<i>Lathyrus venosus</i> Forest-pea	—	—	—	dm	—	s	s w p	INF C-F: nw & nc Inf-abs: elsewh	Dry upland prairie, open oak woods; w-m to dry; to sandy and acidic soils.
<i>Lepidium densiflorum</i> Peppergrass	x	—	—	—	—	—	s	C C: n 1/2 F: e & sc R: se & sw	Open alluvial woods, (prairie); w-m to d-m; disturbed soil.
<i>Lespedeza capitata</i> Round-headed bush clover	x	x	sl sg ss	dm dms	x	p	— s	C	Prairie, thickets, openings in woods; to dry; to sandy soil.
<i>Lespedeza violacea</i> Violet lespedeza	—	—	sl	—	—	—	—	INF C: se Inf: c & sc R: ne & sw	Open upland woods, rocky bluffs, prairie, thickets; to dry, gravelly, rocky (limestone) soil.
<i>Liatris aspera</i> Burton blazing-star	—	—	sl ss	dm dms	x	p	s s p	C C: e 2/3 Inf: elsewh	Prairie, hill prairie, openings in upland woods; to dry; to sandy soil.
<i>Liatris pycnostachya</i> Prairie blazing-star	x	—	—	—	—	—	—	C-F	Wet-mesic prairie, open woods; to w-m; rich to sandy soil.
<i>Liatris squarrosa</i> Plains blazing-star	—	—	—	—	—	—	—	INF Inf: w 1/2 R: se	Prairie, woodland openings; to d-m.
<i>Lilium michiganense</i> Michigan lily	—	—	ss	—	—	—	—	F F-Inf: thr	Wet-mesic prairie, mesic broken woodland, open upland woods; to wet.
<i>Lilium philadelphicum</i> Wood lily	—	—	—	—	—	—	s p	INF Inf-R: thr	Prairie, open woods; w-m to d-m; to sandy soil, often acidic.
<i>Linum sulcatum</i> Wild flax	x	—	—	—	—	p	p s	C R: se F-Inf: elsewh	Prairie, open upland woods; d-m to dry; to sandy soil.
<i>Lithospermum canescens</i> Hoary puccoon	x	x	sl ss	dm dms	x	p	p s s	C	Prairie, open upland woods, glades; to dry; to sandy or rocky soil.
<i>Lobelia cardinalis</i> Cardinal flower	—	—	—	—	—	—	—	INF F: ne & se Inf: sc R: nc	Wet-mesic alluvial woods, prairie sloughs; to wet.
<i>Lobelia inflata</i> Indian tobacco	—	—	—	—	—	—	—	C C-F: se 2/3	Dry upland woods, open woods, thickets, fields, disturbed areas; w-m to d-m.
<i>Lobelia spicata</i> Spiked lobelia	x	—	sl	—	x	—	p	C C: n & e F-Inf: elsewh	Mesic prairie, openings in woods, thickets; w-m to d-m; to sandy soil.
<i>Lysimachia ciliata</i> Fringed loosestrife	—	x	—	—	—	—	s	INF C-Inf: thr	Lowland woods, low prairie, thickets, borders, bogs; w-m to wet; to alluvium.
<i>Menispermum canadense</i> Moonseed	—	—	—	—	—	—	s	C	Woods, woodland borders; to w-m.
<i>Monarda fistulosa</i> Wild bergamont	—	x	sl sg ss	dm	x	p	p w s	C	Prairie, open woods, woodland openings; w-m to dry; to clayey, sandy, alluvial, rocky or rich soil.

<i>Oenothera biennis</i> (<i>Oenothera villosa</i>) Gray evening primrose	x	-	-	-	x	p	s	C	<i>Disturbed</i> prairie, dry ridges, open alluvial woods; w-m to dry; to sandy and gravelly soil.
<i>Orobanchе uniflora</i> Cancer-root	-	-	-	-	x	-	-	R R: se 1/3 & wc	Open <i>wet-mesic</i> woods.
<i>Oxalis stricta</i> Yellow wood-sorrel	x	x	-	-	-	-	-	C C: ne F: s 1/2	Openings in woods, open woods, thickets, (prairie); to dry; to alluvial, sandy, sterile, rocky and <i>disturbed</i> soils.
<i>Oxalis violacea</i> Violet wood-sorrel	x	-	sl	-	-	-	p	C Inf: sw 1/4	Prairie, woodland borders, open woods; to <i>dry</i> ; to acidic, rocky or sandy soil.
<i>Parthenium integrifolium</i> Feverfew, wild quinine	-	-	sl ss	-	-	-	-	R Inf-R: e 1/2	Prairie, open woodland; w-m to d-m; to sandy and rocky soil.
<i>Pedicularis canadensis</i> Wood betony, Lousewort	x	-	sl	-	-	-	s p	C Inf-R: w	Prairie, open woods, borders of creeks, thickets; to dry; to leached, sandy, acidic or sterile soils.
<i>Penstemon digitalis</i> Tall white beard-tongue	x	-	-	-	-	-	-	R F: se R: elsewh	Prairie, borders of woods, open woodland; w-m to dry; rich to <i>sandy</i> , gravelly soils.
<i>Penstamen tubaeiflorus</i>	-	-	-	-	-	-	-	R R: c, ec, se & sc	Prairie and dry woods; to d-m; to limestone.
<i>Phlox pilosa</i> Prairie phlox	x	-	sl	-	x	-	p	C Inf: se	Prairie, open woods, thickets; w-m to dry; to sandy, rocky and alluvial soils.
<i>Physalis heterophylla</i> Ground-cherry	-	-	sl sg ss	-	-	-	-	C-F	Prairie, upland woods; to dry; <i>disturbed</i> soil to sand.
<i>Physalis virginiana</i> Virginia ground-cherry	-	-	sl ss	ds	x	p	s s p	C-F	Prairie, dry woodlands; to dry; <i>disturbed</i> soil to sandy soil.
<i>Physostegia virginiana</i> False dragonhead	-	-	-	-	-	-	-	INF R: nw Inf: elsewh	Open woods, prairie; to w-m.
<i>Polemonium reptans</i> Jacob's ladder	-	-	-	-	-	-	-	C C: e 1/2 Inf-R: w 1/2	Open woods, woodland edges, wet-mesic prairie; w-m to d-m.
<i>Polygala sanguinea</i> Blood milkwort	-	x	-	-	-	-	-	C F-Inf: e 2/3	Prairie, open woods; <i>mesic</i> to dry; to <i>sandy</i> , sterile and acidic soil.
<i>Polygala senega</i> Seneca milkwort	x	x	sl	-	-	-	p	R F: IaS Inf: Pal. Plt. R: c & se	Sparsely wooded slopes, open woods, sandstone bluffs, prairie and thickets; to <i>dry</i> ; to calcareous or sandy soils.
<i>Polygala verticillata</i> Whorled milkwort	x	x	-	-	-	-	-	INF F: sw R: nc Inf: elsewh	Prairie, open woods; to <i>dry</i> ; to acidic, sterile, rocky (sandstone, limestone) and sandy soil.
<i>Polygonatum biflorum</i> Solomon's seal	-	-	sl sg ss	dms	x	s	s w w	C	Woodland borders, upland woods, prairie; to d-m; to sandy and rocky soil.
<i>Polytaenia nuttallii</i> Prairie parsely	-	x	sl	-	-	-	-	INF Inf: ne & sc R: elsewh	Prairie, open woods, broken woods; w-m to dry.
<i>Potentilla arguta</i> Prairie cinquefoil	x	-	sl ss	dms	-	p	- s	C-F R: ne F-Inf: elsewh	Prairie, open woods; to <i>dry</i> ; to alluvial, <i>sandy</i> or rocky soils.
<i>Potentilla norvegica</i> Rough cinquefoil	x	-	-	-	-	-	-	C	Open woodland, (w-m prairie); <i>disturbed</i> soil to sand or alluvium.
<i>Potentilla simplex</i> Common cinquefoil	x	-	sl ss	dm dms	-	s	- w	C C: e 1/2 Inf-R: w 1/2	Woodland openings, open woods, prairie near woods; to dry; to <i>sandy</i> and rocky soil.

<i>Prenanthes alba</i> Rattlesnake-root	-	x	-	-	x	s	w	C-F	Upland woods, mesic woods, bluffs, prairie remnants; to d-m; to rich, sandy, sandstone or calcareous soils.
<i>Psoralidium tenuiflorum</i> (<i>P. batesii</i>) Scurfy pea	-	-	sl	-	-	-	-	R R-Inf: s 1/2 & nc	Dry prairie, openings in woods.
<i>Pycnanthemum tenuifolium</i> Slender mountain mint	-	-	sl	dm	-	-	-	C F: s 1/2 Inf-R: n 1/2	Mesic prairie, dry open woods, thickets; w-m to dry; to alluvium, sand and gravel.
<i>Pycnanthemum verticillatum</i> (<i>P. pilosum</i>) Hairy mountain mint	x	-	-	-	-	-	-	INF F: se R: nw	Prairie, open woods, borders, thickets; to d-m; to sand.
<i>Pycnanthemum virginianum</i> Virginia mountain mint	-	-	sl ss	-	-	p s	-	C C: e 2/3 Inf-R: w	Mesic prairie, open woodland and edges; to wet; to calcareous soil.
<i>Pyrhopappus carolinianus</i> False dandelion	-	-	-	-	-	-	-	R R: ec, se & sw	Dry woods, prairie.
<i>Ranunculus fascicularis</i> Thick-root buttercup	x	-	sl	-	x	-	-	INF C-F: ec & ne R: c & se	Prairie, prairie openings, open upland woods; to dry; to sandy, acidic and rocky soil.
<i>Ratibida pinnata</i> Yellow coneflower	-	-	sl sg	dm	-	p s	-	C-F	Prairie, borders of dry woods; to d-m.
<i>Rudbeckia hirta</i> Black-eyed susan	x	-	sl sg ss	dm dms ds	x	p s p	s	C	Prairie, woodland openings, upland woods; w-m to dry; to sand.
<i>Rumex altissimus</i> Pale dock	-	-	-	-	-	-	-	C-F C-F: except Pal. Plt.	Prairie, open alluvial woods; to wet.
<i>Sabatia campestris</i> Common marsh-pink	-	x	-	-	-	-	-	R R: ec & se	Mesic upland woods, sandy prairie, thickets; to sandy and acidic soil.
<i>Scrophularia lanceolata</i> American figwort	x	-	sg ss	-	-	-	-	INF F-C: n & extr e Inf-R: elsewh	Prairie, borders, open upland woods; to dry; to sand.
<i>Senecio pauperculus</i> Prairie ragwort	-	-	-	-	-	-	-	INF F: nc & se R: ne	Wet-mesic prairie, openings, upland woods, sparsely wooded slopes, open woods; w-m to dry; to sand.
<i>Senecio plattensis</i> Prairie ragwort	x	-	sl ss	-	-	-	-	C-F	Prairie, woodland openings, bluffs and upland woods; to dry; to calcareous soil.
<i>Silene antirrhina</i> Sleepy catchfly	x	-	-	-	-	-	-	C C-F: s F-Inf: n	Open woods, edges of rich woods, fields, prairie-woodland borders, disturbed soil; to d-m; to sandy soil.
<i>Silene stellata</i> Starry campion	x	-	sg ss	-	-	-	-	F C: nw & nc F: s; R:ne	Upland woods and mesic prairie openings, thickets; to d-m; to sandy soil.
<i>Silphium integrifolium</i> Rosinweed	-	x	sl ss	dm	-	-	-	C-F Inf-R: ne 1/4	Prairie, woodland edges; to d-m; to sandy soil.
<i>Silphium perfoliatum</i> Cup plant	-	-	-	-	-	-	-	C-F	Prairie, shorelines, open wooded hillsides, alluvial woods; to w-m; to rich soil and alluvium.
<i>Silphium terbinthinaceum</i> Prairie dock	-	x	sl	dm	-	-	-	R R: ne & ec	Prairie, woodland openings; to d-m; to limestone.
<i>Sisyrinchium angustifolium</i> Blue-eyed grass	-	-	-	-	-	-	-	R R: s 1/2	Mesic woods and prairie, openings in damp woods; to w-m.
<i>Sisyrinchium campestre</i> Blue-eyed grass	x	-	-	dm	-	p s	-	C	Prairie, openings in woods; to dry; to sandy soils.
<i>Smilacina racemosa</i> False Solomon's seal	-	-	sl	dms	x	s w	w	C	Rich woods, upland woods and edges, thickets; to dry; to rich, rocky and sandy soils.

<i>Smilacina stellata</i> Starry false Solomon's seal	x	—	sl	dm	x	p	s	C	Woods, upland woods, mesic prairie openings; w-m to dry; to sandy soils.
			ss	dms		w	w		
				ds		s	p		
<i>Smilax herbacea</i> Carrion flower	—	—	sg	dm	x	s	s	C-F	Borders of open woods, rich woods; to w-m; to rich, rocky, or alluvial soils.
						w	w		
<i>Solidago canadensis</i> Canada goldenrod	—	x	sl	dm	—	—	p	C-F	<i>Disturbed</i> prairie, open woods, borders of woods; to w-m; to sandy soil.
			ss						
<i>Solidago missouriensis</i> Missouri goldenrod	x	—	—	—	—	—	s	C	Prairie, edges of upland woods, open woods; to dry; to sandy soil.
								C: w 2/3	
								Inf-R: e	
<i>Solidago nemoralis</i> Gray goldenrod	x	—	sl	dm	—	p	s	C-F	Prairie, openings, open woods, hillsides; to dry; to sandy, calcareous and rocky soils.
			ss	dms		s	w		
				ds			p		
<i>Solidago rigida</i> Stiff goldenrod	—	—	sl	dm	—	p	p	C-F	Prairie, open woods; to dry.
			ss			s		Inf: se	
<i>Solidago speciosa</i> Showy goldenrod	—	—	sl	dm	—	—	—	INF	Prairie, open woods and woodland borders; to dry; to sand.
			ss	dms				C: nc; R: se	
								F-Inf: elsewh	
<i>Taenidia integerrima</i> Yellow pimpernel	—	x	sl	dms	—	—	—	INF	Wooded slopes, bluffs, upland prairie, open thickets; to <i>dry</i> ; to calcareous and rocky soil.
			ss					Inf-R: thr	
<i>Teucrium canadense</i> Germander	x	—	—	—	—	—	—	C	<i>Wet mesic</i> prairie, low open woodland, upland woodland borders, thickets; w-m to d-m; to sandy, alluvial or rich soil.
<i>Thalictrum dasycarpum</i> Purple meadow rue	x	—	ss	—	x	p	p	C	<i>Wet-mesic</i> prairie, open alluvial woods, bogs; to wet; to sandy and alluvial soils.
						s	w		
<i>Thalictrum revolutum</i> Skunk meadow rue	—	—	sl	—	—	—	—	R	Prairie, woodland openings, open woods, thickets; to d-m; to sand.
			ss					R: ec & se	
<i>Thaspium barbinode</i> Smooth meadow parsnip	—	—	—	—	—	—	—	F	<i>Wet-mesic</i> prairie, open woods, wooded slopes and bluffs.
								F: e 1/2 only	
<i>Tradescantia obiensis</i> Ohio spiderwort	x	x	sl	dm	—	p	—	C	Prairie, open woods; w-m to dry; to <i>sandy</i> soil.
			ss	dms		s		F-C: se 2/3	
				ds					
<i>Triodanis perfoliata</i> Venus' looking-glass	—	—	—	—	—	—	—	INF	Open upland woods, wooded bluffs, prairie remnants; to <i>dry</i> ; to sandy soil.
								C: se	
								Inf-R: nw 1/2	
<i>Verbena hastata</i> Common vervain	x	—	ss	—	—	—	—	C	<i>Wet-mesic</i> prairie, open woods, bottomlands; to w-m.
<i>Vernonia baldwinii</i> Western ironweed	—	—	—	—	—	—	—	C-F	Prairie, woodland openings, open woods; to d-m; to sand.
								C-F: s 1/2	
								R: nc	
<i>Vernonia fasciculata</i> Ironweed	—	ss	—	—	—	—	—	C-F	Prairie, woodland edges; to w-m; to clay.
								Inf: sc & nw	
<i>Vernonia missurica</i> Missouri ironweed	—	—	—	dm	—	—	—	INF	Prairie, open woods; w-m to d-m.
								F: se only	
<i>Veronicastrum virginicum</i> Culver's root	—	—	sl	dm	—	s	p	C	Prairie, thickets, open woods and woodland borders, stream margins; <i>wet</i> to d-m; to sandy or rich soils.
			sg			w		Inf: nw	
			ss						
<i>Vicia americana</i> American vetch	x	—	—	—	—	—	s	INF	Prairie, open woods, openings, thickets; to w-m; to sandy and rich soils.
							w	C-F: n 1/2	
							p	Inf-R: s 1/2	
<i>Viola palmata</i> (<i>Viola pedatifida</i>) Prairie violet	—	x	sl	—	—	—	—	F	Prairie, open upland woods, bluffs, thickets; to d-m; to rocky and sandy soil.
			ss					C: nw & nc	
								F-Inf: elsewh	
<i>Viola pedata</i> Bird's-foot violet	—	—	sl	dms	x	p	—	INF	Prairie, borders, grassy openings, ridges, open woods; to d-m; to sandy soil.
			ss	ds		s		C: Pal. Plt.	
								F: sw	
								Inf: elsewh	

<i>Zigadenus elegans</i> Death-camas	-	-	-	-	x	-	-	INF Inf: n	Prairie, rich open woods; to dry; to calcareous soil.
<i>Zizia aurea</i> Golden Alexanders	x	-	ss	dm	x	-	w p	C-F	Prairie, borders, sedge meadows, thickets, open woods; to w-m.
Lianas									
<i>Celastrus scandens</i> Bittersweet	-	-	-	-	-	w	w s	C	Woodland openings and edges, thickets; to dry; to rocky, sandy or alluvial soils.
<i>Parthenocissus quinquefolia</i> Virginia-creeper	-	x	-	-	-	-	s w p	C	Open upland or alluvial woods, thickets, grassy fields; w-m to dry; alluvial, rocky to sandy soil.
<i>Parthenocissus vitacea</i> Grape woodbine	-	-	-	-	x	w	- s	C-F	Dry woods, woodland edges; to d-m; to sandy soil.
<i>Vitis riparia</i> Riverbank grape	-	-	-	dm	x	w	s s w p	C	Woodland edges, along streams, thickets, open weedy places; to dry; to alluvium.
<i>Vitis vulpina</i> Frost grape	x	-	-	-	x	-	-	R R: c, se & sc	Woodland-prairie borders, wooded bluffs, open woods, thickets, banks of streams; to dry; to alluvium.
Shrubs and small trees									
<i>Amorpha canescens</i> Lead-plant	x	-	sl sg ss	dm dms ds	x	p	s w p	C	Prairie, prairie openings, (open woods); to dry; to sandy, rocky or sterile soils.
<i>Amorpha fruticosa</i> False indigo	-	-	-	-	-	-	-	C-F	Alluvial open woods, prairie swales, thickets, wet margins, marshes; w-m to d-m; to alluvium.
<i>Amorpha nana</i> Smooth lead-plant	-	-	-	-	-	-	-	R R: c, n, & sc	Mesic prairie and upland woods.
<i>Ceanothus americanus</i> New Jersey Tea	x	-	sl sg ss	dm dms	x	-	-	C Inf: sc	Prairie, dry upland and open woods and edges; to dry; to sandy or rocky soil.
<i>Cornus racemosa</i> (<i>Cornus foemina</i>) Gray dogwood	-	-	-	-	x	w	w s	C	Upland woods, woodland edges, thickets; w-m to d-m.
<i>Corylus americana</i> Hazel-nut	-	x	-	dm dms	x	w	s s w p	C	Woodland, openings and edges of woods; to dry; to sandy and rocky soils.
<i>Crataegus calpodendron</i> Pear-hawthorne	-	-	-	-	-	-	-	INF Inf-R: thr	Prairie openings and edges of upland woods.
<i>Crataegus crus-galli</i> Cockspur-thorn	-	-	-	-	-	-	-	C-F Inf: sw & extr e; F: s 1/2	Open upland woods, pastures; to dry; to rocky, calcareous, and sandy soil.
<i>Crataegus mollis</i> Downy hawthorne	-	-	-	-	-	-	w	C-F Inf: Pal. Plt.	Open upland woods, prairie openings, thickets; to sandy, calcareous and alluvial soils.
<i>Crataegus punctata</i> Dotted hawthorne	-	-	-	-	-	-	w	INF R: nw & se	Open woods, grassy openings; to calcareous soils.
<i>Prunus americana</i> Wild plum	-	x	-	-	-	-	w s	C	Open woods and edges, (prairie); to sandy soil.
<i>Prunus virginiana</i> Chokecherry	-	-	-	-	-	-	s w p	C	Open woods, woodland openings, edges, (prairie); to d-m; to rich, rocky, and sandy soils.

<i>Pyrus ioensis</i> (<i>Malus ioensis</i>) Prairie crab-apple	-	x	-	-	x	-	-	C-F	Open upland woods and woodland edges, prairie openings, thickets; to dry.
<i>Rhus glabra</i> Smooth sumac	x	x	-	dm	x	p	w	C	Woodland openings and edges, open woods, (prairie), thickets; to dry.
<i>Ribes missouriense</i> Missouri gooseberry	-	x	-	-	-	-	-	C	Open woods and woodland edges, rich upland woods; to dry.
<i>Rosa blanda</i> Meadow rose	-	-	-	-	x	-	s	F F-Inf: thr	Prairie, thickets, open woods; to dry; to sandy and rocky soils.
<i>Rosa carolina</i> Pasture rose	x	-	sl	dm	x	-	-	C C: e 1/2 F: nc Inf: elsewh	Prairie, thickets, open upland woodland; to dry; to <i>sandy</i> and calcareous soils.
<i>Rosa setigera</i> Climbing prairie rose	-	x	-	-	-	-	-	R R: sw & se	Open woods, prairie, thickets, bluffs; to d-m; to rocky soil.
<i>Rubus allegheniensis</i> Blackberry	-	-	-	dm	x	s	-	C	Open woodland, thickets, prairie remnants; to dry.
<i>Rubus occidentalis</i> Blackraspberry	x	-	-	dm	-	-	-	C	Open upland woods, prairie openings, thickets, bluffs; to dry; to sandy, and rocky soils.
<i>Salix humilis</i> Prairie willow	x	-	sl	dm	-	p	s	C-F	Prairie, open woods; to d-m; to sand, clay, and rocky soil.
<i>Symphoricarpus occidentalis</i> Wolfberry	-	x	-	-	-	-	p	INF C: nw, nc & sw only	Prairie, thickets, open woods; to <i>dry</i> ; to rocky, and sandy soils.
<i>Symphoricarpus orbiculatus</i> Coralberry	-	-	-	-	-	-	-	C C: s only	Prairie, openings, borders, thickets, bluffs, second-growth woodland, <i>disturbed areas</i> ; to dry; to limestone, sand, and alluvium.
<i>Toxicodendron radicans</i> Poison ivy	x	-	-	-	x	s	s	C	Woods, woodland borders, thickets, ledges and bluffs, <i>disturbed</i> ground, prairie; w-m to dry; alluvial, sandy, rocky (limestone) to neutral soils.
<i>Zanthoxylum americanum</i> Prickly ash	-	x	-	-	-	-	w	C	Upland woods, openings and edges, thickets; to sandy and rocky (calcareous) soils.

B. Species restricted to, or most abundant in, dry or sandy savannas

Graminoids

<i>Aristida dichotoma</i> Churchmouse three-awn	-	-	-	-	-	-	-	INF Inf: se R: sw & nw	Prairie, open woods, slopes; <i>dry</i> ; to <i>sandy</i> and hard, white clay soils.
<i>Aristida oligantha</i> Prairie three-awn	-	-	-	-	-	-	-	C C: s 1/2 R: n 1/2	Prairie, wooded hillsides and open woods, <i>disturbed areas</i> ; <i>dry</i> ; to <i>sandy</i> and hard white clay soils.
<i>Aristida tuberculosa</i>	-	-	-	-	-	-	s	R Inf-R: e 1/4	Primarily sand dunes and <i>sandy</i> soil.
<i>Carex mühlenbergii</i> Muhlenberg's sedge	-	-	-	-	-	-	-	INF F: se R-Inf: elsewh	Open upland woods, openings and bluffs in woods, prairie; <i>dry</i> ; to <i>sand</i> .
<i>Danthonia spicata</i> Wild oat grass	-	-	-	-	-	-	-	INF Inf-R: thr	Upland woods, prairie openings in woods, prairie; to <i>dry</i> ; to sterile, <i>sandy</i> to rocky (sandstone) soil and acidic soil.
<i>Eragrostis spectabilis</i> Purple lovegrass	-	-	ss	-	-	-	s	INF R: nw Inf: elsewh	Open woods, prairie; <i>dry</i> ; <i>sandy</i> soil.

<i>Panicum depauperatum</i> (<i>Dichanthelium depauperatum</i>)	-	-	ss	-	-	-	-	R R: c, nc & extr e	Upland woods, prairie; <i>dry</i> ; sandstone ledges and <i>sandy</i> soil.
<i>Panicum oligosanthes</i> (<i>Dichanthelium oligosanthes</i>)	-	-	ss	-	-	-	-	R R: thr	Prairie, open woods; to <i>dry</i> ; to <i>disturbed</i> or <i>sandy</i> soil.
<i>Sporobolus vaginiflorus</i> Poverty-grass	-	x	-	-	-	-	-	INF F-Inf: thr	Woodland openings, knolls, open bluffs, prairie; to <i>dry</i> ; to <i>sand</i> , sandstone and sterile soils.

Forbs

<i>Ambrosia psilostachya</i> Western ragweed	x	-	ss	-	-	-	s	INF C: sw & loess hills Inf-R: elsewh	Prairie, woodland edges; <i>dry</i> ; to <i>sandy</i> soil.
<i>Artemisia campestris</i> Western sagewort	x	-	ss	-	-	p	s	INF Inf-R: w & s C-F: elsewh	Prairie, woodland edges, <i>disturbed</i> soil; mesic; primarily <i>sandy</i> soil.
<i>Aster oblongifolius</i> Aromatic aster	x	-	-	-	-	p	-	C-F C: sw F-Inf: elsewh	Prairie, openings in woods, rocky bluffs; d-m to <i>dry</i> ; to <i>sandy</i> soil, and gravel (limestone).
<i>Aster parviceps</i> Small-headed aster	-	-	-	-	-	-	-	INF F-Inf: sw R: ne	Prairie, open woods; <i>dry</i> ; <i>sandy</i> soil.
<i>Aureolaria grandiflora</i> Western false foxglove	-	x	sl	-	-	-	-	R F: extr e R: se & sc	Open woods, thinly wooded spurs, crests of bluffs; to <i>dry</i> ; to <i>sandy</i> and <i>rocky</i> (limestone) soil.
<i>Besseyia bullii</i> Kitten-tails	-	x	-	-	x	-	-	R R: n & e	Prairie, upland oak woods, open woods; to <i>dry</i> ; to <i>sand</i> , and <i>rocky</i> soils.
<i>Crotalaria sagittalis</i> Rattle-box	x	-	-	-	-	-	-	INF F-Inf: n 1/2 R: s 1/2	Prairie, woodland openings, open wooded slopes; d-m to <i>dry</i> ; to alluvial, <i>sandy</i> , and <i>rocky</i> soils.
<i>Hedeoma hispidum</i> Rough pennyroyal	x	-	ss	-	-	-	-	C-F	Prairie, rocky woods, open woods; <i>dry</i> ; to limestone and <i>sandy</i> soil.
<i>Helianthemum bicknellii</i> Frostweed	-	-	ss	ds	-	-	-	C C-F: s 1/2 & ne Inf: nc	Prairie remnants, open woods and woodland openings; to <i>dry</i> ; to acidic, <i>sandy</i> , or <i>rocky</i> (sandstone and talus) soils.
<i>Helianthemum canadense</i>	x	-	sl	-	-	s	-	INF C: ne; F: sw R: se only	Prairie, open upland woods; to <i>dry</i> ; to sandstone, <i>sandy</i> and talus soil.
<i>Lechea intermedia</i>	-	-	-	-	-	-	p w s	R R: wc, ec & ne	Prairie, upland woods; primarily in <i>dry sandy</i> soil.
<i>Lechea stricta</i> Pinweed	-	-	-	-	-	-	s	R F-Inf: ne only R: elsewh	Upland woods, ledges, prairie; <i>dry</i> ; <i>sandy</i> , rocky (sandstone, talus, limestone) soils.
<i>Lechea tenuifolia</i> Slender-leaved pinweed	-	-	ss	-	-	-	-	INF Inf-R: sc, se, nc, ne	Upland open woods, bluffs; <i>dry</i> ; sandstone and <i>sandy</i> soils.
<i>Lechea villosa</i> Hairy pinweed	-	-	-	-	-	-	-	R R: e	Prairie openings; upland, <i>dry sandy</i> woods.
<i>Lespedeza virginica</i> Virginia lespedeza	-	x	ss	-	-	-	-	INF F: se only R: sc & sw	Woodland edges, open upland woods, prairie, thickets; to <i>dry</i> ; to sandy, alluvial and rocky soils.
<i>Lithospermum carolinense</i> Hairy puccoon	-	-	-	-	-	-	s	INF R-Inf: s 1/2 F: ne only	Open upland woods, upland prairie; <i>dry</i> ; <i>sandy</i> soil.
<i>Lithospermum incisum</i> Fringed puccoon	-	-	ss	ds	-	-	s	INF C: n 1/2 & sw R: elsewh	Prairie, open woods; <i>dry</i> ; to <i>sandy</i> soils and sandy alluvium.

<i>Mirabilis nyctaginea</i> Wild four-o'clock	-	-	-	-	-	-	w	C	Prairie, sparsely-wooded ridges; to <i>dry</i> ; to <i>sandy</i> soil or gravel.
<i>Penstemon pallidus</i> Eastern white beard-tongue	-	-	ss	-	-	-	-	R F: se R: extr e & sc	Prairie, open woods, openings; d-m to <i>dry</i> ; to <i>sandy</i> , rocky, and acidic soil.
<i>Polygala incarnata</i> Pink Milkwort	-	x	-	-	-	-	-	R R: e & sw	Prairie, upland woods; to <i>dry</i> ; to <i>sandy</i> soil.
<i>Ruellia humilis</i> Wild petunia	x	-	sl ss	-	-	-	-	C-F C-F: s 1/2 Inf-R: n 1/2	Prairie and upland woods, bluffs; to <i>dry</i> ; to rocky or <i>sandy</i> soil.
<i>Scutellaria parvula</i> Skullcap	x	x	-	-	-	p	-	C-F Inf: nw only	Prairie, wooded slopes, openings on wooded ridges; to <i>dry</i> ; to <i>sandy</i> and rocky soils.
<i>Strophostyles helvula</i> Wooly bean	x	x	ss	-	-	-	-	INF C: se & sw F-Inf: elsewh	Prairie, river banks, thickets, oak woods; to <i>dry</i> ; to <i>sand</i> , alluvium and rich or rocky soil.
<i>Strophostyles leiosperma</i> Small-flowered wooly bean	-	x	ss	-	-	-	-	C C-F: s 1/2 Inf-R: n 1/2	Prairie, thickets, open upland woods; to <i>dry</i> ; to <i>sand</i> .
<i>Tephrosia virginiana</i> Goat's rue	-	x	ss	dms ds	-	s	-	INF Inf: e R: nw & ne	Prairie, open woods, loess bluffs; to <i>dry</i> ; to <i>sand</i> .

Shrubs

<i>Rhus aromatica</i> Fragrant sumac	-	x	-	-	-	-	-	INF C: se R: ne	Open woods, thickets, open places; to <i>dry</i> ; to acidic, rocky or sandy soils.
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vial soils in eastern Iowa. We listed 103 of these species (Table 1); most of the remainder were restricted to full sun in prairies.

Packard (1988) modernized a list of Illinois barrens plants in Hancock County, originally compiled by Mead in 1846. Packard classed this habitat as "tallgrass savanna". Trees included *Quercus bicolor*, *Q. imbricata*, *Q. marilandica*, *Q. velutina*, *Carya cordiformis*, and two species of *Salix*. Of the 95 species that were not trees, 88 were native to Iowa. This list of species was not restricted to understory vegetation, and only 59 of these species are found in Table 1.

Betz and Lamp (1992) recorded 238 understory species in 14 small (0.4 - 0.08 ha) cemeteries in northern Illinois and one in northwestern Indiana that represented savanna habitat; 233 species were native to Iowa. Eight of these cemeteries were on silt-loam soil, one was on sand-gravel soil, and 6 were on sandy soil. Characteristic trees included *Quercus velutina*, *Q. macrocarpa*, and *Carya ovata*. For species found by Betz and Lamp (1992) in more than one cemetery, we listed for clay-loam soils 90% of the species they found in clay-loam soil and 68% of the species they found in sandy soil (Table 1 A.). Betz and Lamp (1992) also recorded for clay-loam soils, 68% of the species they found in cemeteries on sandy soils.

Madany (1981) presented three lists of prevalent species from a state-wide survey of Illinois savannas (10-80% canopy cover) classified as 1) both dry and mesic savannas on loess or glacial till, 2) dry-mesic sand savanna, and 3) dry sand savanna. We included all three of these savanna types because they provided valuable data on breadth of habitat. *Quercus alba* and *Q. macrocarpa*, were among the dominants in dry-mesic savanna, *Q. velutina*, and *Q. alba* in dry-mesic sand savanna, and *Q. velutina* in dry sand savanna. This survey was not restricted to understory vegetation. Of the 96 native grass, forb, shrub, and vine species listed, 91 were native to Iowa. An addi-

tional list of 32 more localized species included 31 native to Iowa. We listed for clay-loam soils 94% of the species found by Madany (1981) in clay-loam savannas, and 64% of the species found by Madany (1981) in sand savannas (Table 1 A.). In contrast to Betz and Lamp (1992), Madany (1981) found only 34% of his sand savanna species in the few remaining, often degraded, clay-loam remnants.

The only studies other than Betz and Lamp (1992) that specifically listed understory species are those by Curtis (1959) and by Bray (1958, 1960). Curtis (1959) summarized studies of mesic oak savanna in southern Wisconsin. *Q. macrocarpa* dominated stands on level ground, and *Q. macrocarpa*, *Q. alba*, and *Q. velutina* were present on hills and drier ground. These savannas were once the major communities in southern Wisconsin, but now, with ground-cover intact, they are the rarest plant communities in the state (Nuzzo 1986). Curtis's list of prevalent ground-layer species included 45 native angiosperm species and 5 additional species that were modal but not prevalent. Of these 50 species, 47 were native to Iowa. We listed 43 of these species as common in Iowa (Table 1).

Bray (1958) studied 17 stands along the Mississippi River in southern Wisconsin and Minnesota, and Bray (1960) studied 60 stands in southern Wisconsin in which there had been no cutting and which, if previously grazed, had recovered. Canopy cover approached 60% in some stands. Although the sites included savannas in low meadows and prairie, thin soils on gravelly slopes, hill-sides and bluffs (including oak-juniper glades), and sand areas, oaks predominated in three-fourths of the sites. His studies were more restricted geographically than that by Curtis (1959), but included a broader selection of savanna types. Of 300 understory species identified, Bray analyzed only those species that occurred in more than 10% of the 49 geographic locations. All but one of the 13

graminoid, 79 forb, 3 vine, and 7 shrub species found in the two lists were native in Iowa. We listed 80% of these (Table 1). Most of the remaining species were restricted to forest in Iowa. We classified species in common with Bray's lists as occurring in prairie, savanna, or woods if he calculated their presence as more than 10% in the respective category.

Drew (1973) studied the prairie-forest transition zone in Minnesota. Twenty-two graminoid, 55 forb, 3 vine, and 20 shrub species were listed for sandy bur oak savanna or for both bur oak woods and prairie (13 locations with rocky, sandy, clay, or loam soil); all species were native to Iowa. We listed 50% of those forbs, vines, and shrubs and 53% of those grasses as common or infrequent (Table 1). These lower percentages were expected since Drew's list included all species recorded in the stands surveyed, not just prevalent or understory species. Most of these species not included on our list were found in Iowa only in dry sandy prairie, in rich woods, or on the Paleozoic Plateau.

Table 2. The occurrence, in selected studies of savannas in Illinois, Wisconsin and Minnesota, of species potentially occurring in the understory of Iowa oak savannas. A. The number of graminoids, forbs, and woody species (vines, shrubs and small trees), excluding those found primarily in wet-mesic habitats. B. Species occupying primarily dry or sand savannas.

	No. species	% Occurrence in 0-3 other states			
		0	1	2	3
A. Dry to mesic species					
Common-Frequent					
Graminoids	17	41	18	12	29
Forbs	97	15	39	28	16
Woody species	24	17	25	38	20
All C-F species	138	19	34	28	19
Infrequent					
Graminoids	15	53	20	13	13
Forbs	45	26	51	13	9
Woody species	3	67	0	33	0
All Inf species	63	36	44	11	9
Rare					
Graminoids	4	25	75	0	0
Forbs	19	58	42	0	0
Woody species	3	33	67	0	0
All R species	26	50	50	0	0
All C to R species					
Graminoids	36	43	29	9	20
Forbs	161	23	44	19	12
Woody species	30	20	27	37	17
All dry to mesic species	227	27	39	20	14
B. Dry and sand species					
Graminoids	9	33	56	11	0
Forbs	25	16	56	28	0
Woody species	1	0	100	0	0
All dry and sand species	35	20	57	23	0

Seventy-four percent of the species on our list were reported in the cited studies of savannas in Illinois, Wisconsin, or Minnesota (Table 2). Among forbs that were common to frequent, 83% were listed in savannas in other states, 44% were listed in two or more states, and 16% were listed in three other states. Common to frequent woody

species had similar representation, but only 59% of the graminoids were listed in those studies in other states. Among forbs that were infrequent, 73% were listed in other states, and among forbs that occurred primarily in dry and sandy habitats, 84% were listed in savannas in other states.

DISCUSSION

Several caveats should be noted before our list of potential savanna species is utilized for any region or habitat within Iowa. The ecological range of habitats for some species would be expected to vary as climate, moisture, and soils vary across the state. The absence of undisturbed savanna in Iowa and the paucity of precise descriptions of habitat in the Iowa literature did not allow us to examine Bray's (1958) hypothesis on the interaction of light and moisture on plant distribution. Bray (1958) concluded that species found in a mesic or wet-mesic prairie were often found in more shade when habitats were drier. Similarly, Pruka (1994) found that species inhabiting mesic savanna also occurred in closed-canopy forests under more xeric conditions. We suggest that both of these conclusions can be utilized to interpret not only a species' abundance in habitats locally, but also to interpret changes in habitat along climatic gradients. Species recorded primarily in forests in south-central Iowa, e.g., *Aralia nudicaulis*, *Claytonia virginica*, *Desmodium glutinosum* and *Solidago ulmifolia*, (Van Bruggen 1958), occurred more commonly in savannas to the north and east, especially in Wisconsin (Curtis 1959; Bray 1960).

Further, shade tolerance, our primary indicator for savanna understory species, is not the only determinant of a species' presence and abundance in a habitat. Every community is a mosaic of varying topography, aspect, soil type, and drainage. We would expect each of these components to affect the composition of the understory directly and to determine the intensity of fire and of mutualistic and competitive relationships which would alter the size, abundance, and perhaps the presence, of species in the understory (White 1983; Stritch 1990; Bowles, et al. 1994; Kline and McClintock 1994).

The descriptions of habitat indicate that many species occupy a wide range of plant communities and soil types, and that they tolerate broad variations in light and moisture, which fluctuate more in savanna than in the more stable and uniform habitats of open prairie or forest. Such information on habitat should challenge our ideas on where species existed before settlement. Many species declined in abundance and distribution with loss of habitat after settlement (Pammel 1901). But species have reappeared in substantial numbers and reproduced vigorously after reintroduction of fire and opening of the canopy (Bray 1960; Bronny 1989; Stritch 1990; Packard 1993; Hubner and Leach 1995). Further, findings by Madany (1981) and Betz (1992) that many species of dry or mesic sand savannas also occurred in dry and mesic savannas on loamy soil, along with our results which indicated that a majority of species occurring in clay-loam soils also occurred in sandy soils, point to an important possibility. It is that some species which tolerate shade, which are now found primarily in sand or on dry ridges, bluffs, or hilltops, might have occurred in fire-influenced presettlement clay-loam savannas. Moreover, these species might have been even more characteristic of fire-influenced presettlement clay-loam savannas than are those species now found in the few remaining degraded remnants of these savannas.

To verify which species can establish, grow, and reproduce in the understories of oak savannas and woodlands in Iowa, we encourage experimental introduction of the species we identified into savanna restorations. Only then can the effects of fire, fire-altered habitat and interspecific competitive interactions on plants be determined. Finally, we encourage studies on plant and animal associates, soil type, and the moisture and shade tolerance of potential savanna species. Ecologically sound restoration and reconstruction of these lost communities should then be achievable.

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