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The Vascular Flora of Doolittle Prairie State Preserve—
A Prairie Pothole Wetland Complex

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Doolittle Prairie State Preserve is a 10 ha prairie pothole wetland complex located in Story County, central Iowa. A vascular flora of Doolittle Prairie is compiled and the prominent vegetation communities and zones described based on field observations by the authors and several additional investigators from 1982 to 1997. The preserve contains 14 shallow wetlands comprised of low prairie, wet meadow, and shallow emergent plant communities, as well as a disturbed prairie community and fence rows. These communities support a diverse vascular flora of 223 native species, plus 42 non-natives, representing 59 families and 178 genera. The Asteraceae (40), Poaceae (24), and Cyperaceae (22) families contained the greatest number of native plant species. The low prairie community has the highest number of species (104) and the greatest species overlap with the disturbed prairie and wet meadow communities. The fence row/parking area community contains the second highest number of species (101) and the greatest number of non-natives (33), with 78% of the species restricted to that community. Species number decreased in communities with increasing soil moisture. The wet meadow (46 species) and shallow emergent (14 species) communities contained the lowest number of species. A quantitative comparison of floristic composition was made between Doolittle Prairie and three other Iowa state preserves of similar size and vegetation community types. Floristic similarity between Doolittle Prairie and the other preserves ranged from 35-39%.

INDEX DESCRIPTORS: Doolittle Prairie State Preserve, Iowa flora, prairie pothole, plant communities, Story County.

The recently glaciated area of central Iowa known as the Des Moines Lobe is relatively flat, contains extremely rich soils, and is one of the most intensively cultivated areas in the world. Much of this area originally consisted of shallow prairie wetlands or "potholes" that were subsequently drained or ditched for agricultural purposes. Doolittle Prairie State Preserve is one of the few remaining prairie pothole wetland complexes in the Des Moines Lobe, and it retains a diverse assemblage of wet prairie and wetland plants.

Knowledge of native plant diversity and community structure is critical, particularly with increased interest and attempts to restore prairie and wetland habitats. Many of Iowa's state preserves containing prairie vegetation communities lack even a description of the vascular flora. Of the 28 state preserves that contain significant prairie areas (Fleckenstein 1992), only eight (29%) have published floras. Larger, contiguous preserves are expected to contain greater plant diversity, and yet, of the 13 prairie state preserves containing 36 ha or greater, only five (38%) have published floras.

In this paper, we present a species list of vascular plants and describe the vegetative communities/vegetation zones of Doolittle Prairie. Data from floristic surveys and plant collections of the authors and previous workers since 1982 were compiled and combined with a comprehensive vegetation survey conducted during the 1997 growing season. Portions of Doolittle Prairie have not been plowed, and thus, the species list and community descriptions provide useful baseline information for pre-European settlement prairie wetland vegetation.

STUDY AREA

Doolittle Prairie State Preserve is a 10 ha prairie pothole complex located in Story County, approximately 11 km north of Ames and 2 km south of Story City (NE 1/4 of section 25 in T85N R24W, La Fayette Township) (Fig. 1). The preserve occupies the northern half of the Doolittle Prairie conservation area (Fig. 2). The area of the preserve north of the fence row contains plant communities with the greatest diversity and the least number of non-native species. The area of the preserve south of the fence row is disturbed and aerial photographs indicate that about half of the land west of the wetlands was plowed after 1958 and before 1965. Plowing was not evident on successive aerial photographs. The public land south of the preserve is highly disturbed; this area was cultivated for a longer time period and the hydrology of one of the wetlands was modified with a low berm. A narrow strip of land adjacent to the access road is reconstructed prairie (Fig. 2). The preserve and reconstructed prairie area adjacent to the access road are the areas surveyed for this study.

The prairie wetlands at Doolittle Preserve were formed during the Wisconsin glacial episode 14,000 years ago. An intricate array of cavities and tunnels formed in the glacier as it melted. Eventual collapse of these cavities led to the development of shallow upland swales and depressions (prairie wetlands) separated by low, saddle-like ridges formed from glacial debris (Prior 1991). Doolittle Prairie is on the southern edge of the prairie pothole region in North America and soil maps suggest that at the time of settlement wetlands covered 20-60% of central and northern Iowa, depending on topography and natural drainage patterns (Galatowitsch and van der Valk 1994). Doolittle Prairie contains 14 saucer-like wetlands, interconnected with shallow vegetated drainage channels (Fig. 2). The flat topography and simple, undeveloped natural drainage system of the surrounding area suggest that wetlands covered a large portion of the presettlement landscape surrounding Doolittle Prairie State Preserve. This observation is confirmed by aerial photographs taken in 1939 (Reviewed at Farm Service Agency, Story County).
FLORA OF DOOLITTLE PRAIRIE

Fig. 1. Location of Doolittle Prairie Preserve (©) and three similar preserves (1=Stinson Prairie, 2=Cedar Hills Sand Prairie, 3=Williams Prairie) used for floristic comparison. The boundary of the Des Moines Lobe designates the extent of glacial advances and the prairie pothole region in Iowa.

Soils at Doolittle Prairie are classified as a Kossuth-Otto-Ras association, mineral soils composed of silty clay loam (DeWitt 1984). The swales and depressions contain very poorly drained Okoboji soils (pH 6.6–7.8), surrounded by calcareous Harps soils (pH 7.9–8.4). The wetlands are imbedded in level, poorly drained, upland flats composed of Kossuth soils. Poorly drained Otto-Ras soils are found on the slight topographic rises (DeWitt 1984).

The climate for central Iowa is midcontinental with hot humid summers and cold dry winters. Winter (December through February) average temperature is −6°C with an average daily minimum of −11°C. Summer (June through August) average temperature is 22°C and average daily maximum is 29°C. The frost-free growing season averages 151 days and the mean annual precipitation is 797 mm, of which 60% falls as rain from May to September (Bair 1992). The prevailing wind is from the northwest. Summer weather is characterized by thunderstorms often associated with high winds and occasional hailstorms and tornados (DeWitt 1984).

Settlement History
William Rochester and Fidelia Electa Doolittle came to Story County in 1855, as some of the area's earliest settlers. They built a farmstead northeast of the preserve area, and eventually the preserve area was part of their 405 ha land holding at the time of William R. Doolittle’s death in 1893 (S. Lekwa, personal communication). The site was not plowed, presumably because of its wetness. Merlin and Wesley Doolittle, grandchildren of William R. Doolittle, farmed the land adjacent to the current preserve, but the sentimental value of their grandfather’s original homestead prevented them from draining and plowing the area of the preserve. However, hay was harvested from the “wild meadow” until the late 1960s. When the market for “wild hay” declined, the land was sold to the state and became a preserve in 1980. Currently, the Story County Conservation Board manages the preserve and alternately burns half of the prairie every 2–3 years (S. Lekwa, personal communication).

METHODS
Collections of the vascular plants of Doolittle Prairie Preserve are based on field studies conducted by the authors and several additional investigators from 1982 to present. Greg R. Woodley catalogued the vascular flora (excluding the parking area and fence rows) during the 1982 and 1983 growing seasons (Woodley 1983). Lynn Clark collected many of the graminoids found in the preserve during the late 1980s. Further collections were made by the authors on an intermittent basis from 1991 through 1996. During 1997, the authors conducted biweekly surveys of the preserve and land adjacent to the access road from late April to early October. The plant species recorded during the 1997 survey were combined with the previous collections and compiled into an annotated catalogue (Appendix I). The nomenclature of all plant species follows Eilers and Roosa (1994). The plant species were also classified into five communities/vegetation zones: fence rows/parking area, disturbed prairie, low prairie, wet meadow, and shallow emergent wetland community. The
number of species exclusive to each community and species overlap among communities were calculated.

To place the flora of Doolittle Prairie State Preserve into context with other wet prairie remnants in Iowa, the percent floristic similarity was calculated between Doolittle Prairie and three other preserves of similar size containing wet prairie. These were Stinson Prairie (Kossuth County; Glenn-Lewin 1976), Cedar Hills Sand Prairie (Black Hawk County; Crum 1972), and Williams Prairie (Johnson County; Sorenson, 1962) (Fig. 1). Wetlands and swales cover at least 50% of the area of each of these preserves. For meaningful comparisons, preserves of similar area were chosen to avoid potential confounding effects of the species-area relationship (number of species increases with increasing area) (Hayek and Buza 1997). Floristic similarities were calculated using Sorensen's Index of Similarity:

\[ \text{Index of Similarity} \% = \frac{C}{(N_1 + N_2 - C)} \times 100 \]

where \( C \) = number of native species in common, \( N_1 \) = number of native species in the first flora, and \( N_2 \) = number of native species in the second flora (Greig-Smith 1964).

**RESULTS AND DISCUSSION**

An annotated checklist of vascular plants collected from the Doolittle Prairie State Preserve is presented in Appendix I. There are 223 native (218 native species if the reconstructed prairie adjacent to access road is excluded) and 42 non-native species, representing 59 families documented at Doolittle Prairie (Table 1). Doolittle Prairie contains 13% of the species present in the total flora of the State of Iowa (Eilers and Rosa 1994). By major groups, 60 native and 13 non-native species are monocotyledons and 158 native and 29 non-native species are dicotyledons. Families with the greatest number of native species are: Asteraeae (40), Poaceae (24), Cyperaeae (22), and Rosaceae (13) (Table 1). Forty-one genera are represented by two or more species, with Carex (19), Asclepias (5), and Aster (5) having the greatest number of native species (Table 1). No federal or state threatened or endangered species were found in Doolittle Prairie.

The plant species list in Appendix I is a compilation of several collection efforts, and the collector history for each species is designated. Woodley surveyed only the northern half of the preserve and the other collectors made sporadic species surveys. Since the effort and aerial coverage of each survey was different, a direct comparison of the efficiency of the surveys is not possible. However, it is possible to determine the presence of plant populations through time.

Vegetation Communities

Five vegetation zones or communities occur in Doolittle Prairie: fence row/parking area, disturbed prairie, low prairie, wet meadow (sedge meadow), and shallow emergent. The community classification of each species is given in Appendix I. Fence rows are found on the perimeter and through the middle of the preserve (the fence row through the middle of the preserve was removed in 1998). The fence rows and parking area are primarily upland. Fence row vegetation is dominated by Cornus drummondii. Early successional species occur around the edges of the preserve and in the parking area of the preserve. In the early 1980s, a strip of prairie vegetation was planted adjacent to the preserve access road on formerly cultivated land (C. Kurtz, personal communication) (Fig. 2). Native plants found only in this area are designated in Appendix I with a ‘+’.

The southern half of the preserve is a disturbed prairie community (Fig. 2). Approximately half of the southern half of the preserve was plowed around 1965 and contains large populations of Bromus inermis and Phalaris canariensis. The southern portion of the preserve was flooded around 1993, but generally is dry during the summer

<table>
<thead>
<tr>
<th>Table 1: Floristic composition of Doolittle Prairie State Preserve.</th>
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</thead>
<tbody>
<tr>
<td><strong>MAJOR GROUPS</strong></td>
</tr>
<tr>
<td><strong>NATIVE</strong></td>
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<tr>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>Pteridophytes</td>
</tr>
<tr>
<td>Gymnosperms</td>
</tr>
<tr>
<td>Monocotyledons</td>
</tr>
<tr>
<td>Dicotyledons</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Families with five or more species</strong></td>
</tr>
<tr>
<td><strong>FAMILY</strong></td>
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<tr>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>Asteraceae</td>
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<tr>
<td>Poaceae</td>
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<tr>
<td>Cyperaceae</td>
</tr>
<tr>
<td>Fabaceae</td>
</tr>
<tr>
<td>Rosaceae</td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td><strong>C. Genera with four or more species</strong></td>
</tr>
<tr>
<td><strong>GENERA</strong></td>
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<tr>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>Carex</td>
</tr>
<tr>
<td>Polygonum</td>
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<tr>
<td>Asclepias</td>
</tr>
<tr>
<td>Aster</td>
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<tr>
<td>Cirsiurn</td>
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<tr>
<td>Galium</td>
</tr>
<tr>
<td>Solidago</td>
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<tr>
<td>Viola</td>
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<td>----------------------------------------------------------</td>
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</tbody>
</table>

Wetlands in the preserve contain two or three vegetation zones, which we loosely designate as communities. The low prairie community is dominated by the grasses Andropogon gerardii, Panicum virgatum, Poa pratensis, Sporobolus heterolepis, Sorghastrum nutans, and Spartina patens. Other common plants include Solidago canadensis, Silphium lacinatum, and Zizia aurea. The soil of this vegetation zone is often inundated in the spring with 1–3 cm of standing water, but usually dries completely by mid-summer. During drought periods, the low prairie community remains dry all year, occasionally for several years. Upland plant species may invade at this time, until the water table rises and the wet prairie plants again dominate.

The wet meadow vegetation community is dominated by sedges such as Carex haydenii, C. lanuginosa, and C. tenuifolia, and also includes Carex canadensis, Juncus palustris, and Juncus effusus. Sedge meadows generally have a temporary water regime, with 5–30 cm of standing water that recedes by mid-summer. During the wet summer of 1993, these zones remained flooded with a water
The fence row/parking area community contains the second highest number of species (101) and the greatest number of non-natives (33) (Fig. 3). Seventy-eight percent of the species in the fence rows and parking area community are restricted to that community, and species overlap is moderate with the disturbed prairie community, small with the low prairie and wet meadow, and non-existent with the shallow emergent community (Fig. 3). The fence rows and parking area tend to be drier than the other communities, resulting in a higher number of species found exclusively in this community.

Species number decreases in communities with increased soil moisture. The wet meadow (46 species) and shallow emergent (14 species) communities contained the lowest number of species. The wet meadow community is clearly a transition community between low prairie and shallow emergent, containing only five exclusive species and having a large overlap with the low prairie (Fig. 3). When present, species overlap between the shallow emergent community and all other communities is minimal.

Hydrology is the major factor that determines the plant species distribution and vegetation zonation in the wetlands of the preserve. In response to annual and multiple year water fluctuations, plants species form concentric vegetation zones or communities along the hydrologic gradient (Stewart and Kantrud 1971, van der Valk and Welling 1988). During high water periods, flooding drowns the emergent vegetation, creating gaps in the vegetation. Periods of low water expose the gaps as mud flats, providing an opportunity for seeds in the seed bank to germinate, thus assuring long-term survival of these emergent species (van der Valk and Davis 1980).

Invasion by non-native (Bromus inermis) and aggressive native species (Typha latifolia and Phalaris arundinacea) are the greatest management challenge at Doolittle Prairie Preserve. Control of weedy species is difficult because intensive agriculture surrounding the preserve and disturbed prairie and fence row/parking area vegetation communities provide high levels of nutrients and seed sources into the preserve. Direct herbicide application on Typha and Phalaris populations and planting native species in the disturbed prairie area combined with a frequent burn schedule are recommended to control these species populations. The removal of fence rows would eliminate woody vegetation seed sources, although it should be noted that fence rows provide important habitat for a variety of uncommon bird species that are summer residents at Doolittle, including Bell’s Vireo (Vireo bellii) and Willow Flycatcher (Empidonax traillii) (W. Norris, personal observation).

Expanding the preserve 10–12 ha would also improve the vegetation communities. Currently, four prairie potholes straddle the preserve boundaries while three cultivated wetlands immediately to the east of the preserve flood nearly every year. Increasing the boundaries

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**Table 2. Size, location, and species composition of four wet prairies used in the floristic analysis.**

<table>
<thead>
<tr>
<th>NAME</th>
<th>SIZE (ha)</th>
<th>LOCATION (county)</th>
<th>TOTAL NATIVE SPECIES</th>
<th>NO. OF NATIVE SPECIES IN COMMON (Floristic Similarity, %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doolittle Prairie</td>
<td>10</td>
<td>Story</td>
<td>223</td>
<td>—</td>
</tr>
<tr>
<td>Stinson Prairiea</td>
<td>12.5</td>
<td>Kossuth</td>
<td>153</td>
<td>103 (39)</td>
</tr>
<tr>
<td>Cedar Hills Sand Prairieb</td>
<td>14.6</td>
<td>Black Hawk</td>
<td>257</td>
<td>128 (33)</td>
</tr>
<tr>
<td>Williams Prairiec</td>
<td>12</td>
<td>Johnson</td>
<td>213</td>
<td>106 (37)</td>
</tr>
</tbody>
</table>

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aGlenn-Lewin 1976
bCrum 1972
cSorensen 1962

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**Legend**

- Common Species

<table>
<thead>
<tr>
<th>NAME</th>
<th>SIZE (ha)</th>
<th>LOCATION (county)</th>
<th>TOTAL NATIVE SPECIES</th>
<th>NO. OF NATIVE SPECIES IN COMMON (Floristic Similarity, %)</th>
</tr>
</thead>
</table>
of the preserve and restoring native vegetation would save the existing wetlands and reduce the invasion of weedy species into the high quality prairie.

Floristic Analysis

The floristic composition of Doolittle Prairie was compared to the published surveys of three other wet prairie preserves: Stinson Prairie (Glenn-Lewin 1976), Cedar Hills Sand Prairie (Crum 1972), and Williams Prairie (Sorenson 1962) (Table 2). Stinson Prairie is located in northern central Iowa on the Des Moines Lobe (Fig. 1). In addition to swales and potholes, the preserve contains dry and mesic prairie vegetation types. Both Cedar Hills Sand Prairie and Williams Prairie are located in the east central portion of the state, outside of the Des Moines Lobe on the Iowa Surface (Fig. 1). In addition to potholes and swales, Cedar Hills Sand Prairie contains a ridge of excessively drainedolian sand that supports dry and mesic prairie vegetation. Williams Prairie is a wet meadow dominated by sedges located on the Iowa River floodplain.

The floristic similarity of Doolittle Prairie to the other three prairies was similar, ranging from 35–39% reflecting a low level of floristic commonness among any of these prairie preserves (Table 2). Such a low level of common native plants suggests that these prairie preserves together contain a tremendous amount of plant diversity, despite their small size. The floristic analysis indicates that single preserves do not possess the entire realm of prairie species diversity and that multiple preserves or conservation areas are needed to encompass the complete prairie flora. Iowa's state preserves and conservation areas form the foundation of native plant diversity preservation in a state that is almost completely privately owned and dominated by agricultural land use. For this reason, the state preserves are a valuable resource and deserve continued protection, maintenance, and study.

ACKNOWLEDGEMENTS

The authors thank Lynn Clark, Lloyd Crum, Carl Kurtz, Steve Lekwa, Deborah Q. Lewis, and John Pearson for their help in preparing this paper. We also appreciate the help of Donald Pratt and James Krum with plant identification. Finally, we thank Donald R. Farrar, Deborah Q. Lewis, and an anonymous reviewer for their helpful comments on the manuscript.

LITERATURE CITED


APPENDIX 1. ANNOTATED CATALOGUE

Common names are given in parentheses after the binomial. Voucher specimens of each species are deposited in the Ada Hayden Herbarium (ISC) at Iowa State University, Ames, unless otherwise noted.

Key
1 Introduced species
+ Native species found only in planted area along access road
* Not vouchered
C = current study (1991-1997)
W = Woodley (1982-1983)
O = other recent collectors (1987-1997)

Plant Community Codes
1 = Fence row/parking area
2 = Disturbed prairie
3 = Low prairie
4 = Wet meadow
5 = Shallow emergent

PTERIDOPHYTES

EQUISETACEAE (Horsetail Family)
Equisetum arvense L. (common horsetail) O *
Equisetum X ferrissii Clute (hybrid-scouring rush) C, W [3]
Equisetum laevigatum A. Br. (smooth-scouring rush) C, W [2, 3]

OPHIOGLOSSACEAE (Adder’s Tongue Family)
Botrychium virginianum (L.) Sw. (rattlesnake fern) C * [1]

GYMNOSPERMS

CUPRESSACEAE (Cypress Family)
Juniperus virginiana L. (red cedar) C, W * [1]

ANGIOSPERMS

(DICOTYLEDONS)

ACERACEAE (Maple Family)
Acer negundo L. (box elder) C * [1]
Acer saccharinum L. (silver maple) C, W * [1]

AMARANTHACEAE (Amaranth Family)
Amaranthus rudis Sauër (amaranth) C [1]
ANACARDIACEAE (Cashew Family)
Toxicodendron radicans (L.) Kuntze (poison ivy) C [1, 2]

APIACEAE ( Parsley Family)
Cichorium intybus L. (water hemlock) C , W [3, 4]
Eryngium yuccifolium Michx. (rattlesnake master) C , W * [3]
Omorhiza longistyris (Torrey) DC. (anise root) C * [1]
Pastinaca sativa L. (wild parsnip) C , W [2, 3]
Sanicula canadensis L. (black snakeroot) C [1]
Sanicula gregaria Bickn. (common snakeroot) C [1] 
Stachys uvae Walter (water parsnip) C , W * [4]
Zizia aurea (L.) Koch (golden Alexander) C , W [2, 3]

APOCYNACEAE (Dogbane Family)
Apocynum cannabinum L. (Indian hemp) C , W [2, 3, 4, 5]
Apocynum androsaemifolium Jacq. C [2, 3]

ASCLEPIADACEAE (Milkweed Family)
Asclepias incarnata L. (milkweed) C , W [2, 3, 4]
Asclepias sullivantii Engel. ex Gray (Sullivant's milkweed) C , W [2]
Asclepias syriaca L. (common milkweed) C , W [2, 3]
Asclepias tuberosa L. ssp. variegata Woodson (butterfly milkweed) C , W [3]

ASTERACEAE (Aster Family)
Achillea millefolium L. ssp. lanulosa (Nutt.) Piper (yarrow) C , W [2, 3]
Ambrosia artemisiifolia L. (common ragweed) C , W * [1, 2]
Ambrosia trifida L. (giant ragweed) C , W * [1, 2]
Antennaria neglecta Greene (pussy toes) C [3]
Artemisia ludoviciana Nutt. (prairie sage) C , W [3]
Aster ericoides L. (heath aster) C , W [2, 3]
Aster laevis L. (smooth aster) C , W [3]
Aster lamarckianus Willd. var. simplex (Willd.) A.G. Jones (panicled aster) C , W [3, 4]
+ Aster novae-angliae L. (New England aster) C , W
Aster pilosus Willd. (frost aster) C [2, 3]
Bidens pilosa Greene (tall beggar ticks) C [2]
Buckwheat aureus (L.) Shinn (false besnet) C
Calendula officinalis (L.) Pers. (daisy fleabane) C [1]
Cirsium arvense (L.) Scop. (Canada thistle) C * [2]
Cirsium discolor (Muhl. ex Willd.) Sprengel (field thistle) C , W * [2]
Cirsium hillii (Canby) Fern. (Hill's thistle) W
Cirsium vulgare (Savi) Tenore (bull thistle) C , O * [2, 3]
Echinacea pallida Nutt. (pale purple coneflowe) C , W [3]
Erechtites hieracifolia (L.) Raf. ex DC. (fireweed) C [1]
Erigeron annuus (L.) Pers. (daisy fleabane) C [1]
Erigeron speciosus Muhl. ex Willd. (rough fleabane) C , W [1, 2, 3]
+ Eupatorium altissimum (L.) var. rostratum C , W [3, 4]
Helianthus annuus L. (sunflower) C , W [3, 4]
Helianthus tuberosus (L.) Desf. (sunflower) C , W [3, 4]
Heliopsis helianthoides (L.) Sweet (ox-eye) C , W [O, 3]
Lactuca canadensis L. (wild lettuce) C [2]
Lactuca uva-castanea (Nutt.) Riddell (prairie lettuce) W *
+ Lactuca serriola L. (prickly lettuce) W *
+ Liatris aspera Michx. (rough blazing-star) C , W
Liatris pycnostachya Michx. (prairie blazing star) C , W [3, 4]
Ratibida pinnata (Vent.) Barnh. (grey-headed coneflower) C , W [2, 3]
Rudbeckia hirta L. (black-eyed Susan) C , W [2, 3]
Senecio platenis Nutt. (prairie ragwort) C , W [3]
Solidago canadensis L. (Canada goldenrod) C , W [2, 3]
Solidago gigantea Aron (tall goldenrod) C , W [2, 3]
Solidago riddelli Riddell (Riddell's goldenrod) C * [3, 4, 5]
Solidago rigida L. (stiff goldenrod) C , W [3]
+ Taraxacum officinale Weber (dandelion) C , W [1]
+ Tragopogon dubius Scop. (goat's beard) C , W [1]
Vernonia fasciculata Michx. (western ironweed) C , W [3, 4]

BORAGINACEAE (Borage Family)
Hackelia virginiana (L.) I.M. Johnston (stickseed) C [1]
Lithospermum canescens (Michx.) Lehm. (hoary pacucoon) C , W [3]

BRASSICACEAE (Mustard Family)
Arabis hirsuta (L.) Scop. (rock cress) C , W [1, 3]
+Capsella bursa-pastoris (L.) Medicus (shepherd's purse) C [1]
Cardamine bulbosa (Schreber) BSP. (spring cress) C , W * [1]
+ Lepidium densiflorum Schraeder (pepper grass) C [1]
Rorippa palustris (L.) Besser (marsh cress) C [4]

CAMPANULACEAE (Bluebell Family)
Lobelia spicata Lam. (pale spike lobelia) C , W [3]

CAPRIFOLIACEAE (Honeysuckle Family)
+ Lonicera maackii Maxim. C [1]
Sambucus canadensis L. (elderberry) C , O * [1]

CARYOPHYLLACEAE (Pink Family)
+ Silene pratenis (Raf.) Gren. & Godron (white campion) O [1]

CELASTRACEAE (Wahoo Family)
Euryonymus atropurpureus Jacq. (wahoo) C [1]

CHENOPODIACEAE (Goosefoot Family)
+ Chenopodium album L. (lamb's quarters) C [1]

CONVOLVULACEAE (Morning Glory Family)
Calystegia sepium (L.) R. Br. (bindweed) C , W [1]`

CORNACEAE (Dogwood Family)
Cornus drummondii C.A. Meyer (rough-leaved dogwood) C , O [1, 2]

EUPHORBIIACEAE (Saxa Family)
Anchusa virginica L. C [1]
Euphorbia nautica Lag. (nodding spurge) C [1]

FABACEAE (Bean Family)
Amorpha canescens Pursh (lead plant) C , W [3]
Baptisia australis Muhl. ex Ell. var. glabrescens (Arisey) Isetly (islem (wred indigo) W [3]
+Baptisia lactea (Raf.) Thieret (white wild indigo) C
Dalea purpurea Vent. (purple prairie clove) C * [3]
Desmodium canadense (L.) DC. (showy tick- trefoil) C , W [3]
Gleditsia triacanthos (L.) H.考证er (yellow locust) C * [1]
Glycyrrhiza lepidota Pursh (wild licorice) O *
Lathyrus palustris L. (marsh vetchling) C , W [3]
Lespedeza capitata Michx. (round-headed bush clover) C , W [3]
+ Medicago lupulina (L. black medic) C [1]

1 Discovered just prior to publication and not included in floristic similarity analysis.
GENTIANACEAE (Gentian Family)
Gentiana andrewsi C, W [3, 4]
Gentiana puberulenta C, W [3]

LAMIACEAE (Mint Family)
Lavandula angustifolia L. (English lavender) C [1]
Nepeta cataria L. (catnip) C [1]
Plectranthus amboinicus (Lour.) Nees (pectledranthus) C [1, 3]

LENTIBULARIACEAE (Bladderwort Family)
Utricularia vulgaris L. (common bladderwort) C * [5]

LYTHRACEAE (Loosestrife Family)
Anagallis arvensis L. (corn speedwell) C, W [1, 2]
Lythrum salicaria L. (purple loosestrife) C, W [1]

MALVACEAE (Mallow Family)
Abutilon theophrasti Medicus (velvet leaf) C [1]

MORACEAE (Mulberry Family)
Canna sativa L. (bottle gentian) C, W [1]
Eupatorium perfoliatum L. (water hemlock) C [1]

ONAGRACEAE (Evening Primrose Family)
Euphorbia amygdaloides L. (pale evening primrose) C [1, 2]

OXALIDACEAE (Wood-sorrel Family)
Oxalis stricta L. (yellow wood sorrel) C, W [1]
Oxalis violacea L. (violet wood sorrel) C [3]

PHRYMACEAE (Lopseed Family)
Phryma leptostachya L. (loosestrife) C [1]

PLANTAGINACEAE (Plantain Family)
Plantago ovata Hb. (common plantain) C [1, 2]

POLEMONIACEAE (Phlox Family)
Phlox pilosa L. (prairie phlox) C [1]

POLYGONACEAE (Smartweed Family)
Polygonum olivaceum Blake C [1]
Polygonum amphibium L. (water plantain) C [1]

RUBIACEAE (Madder Family)
Galium aparine L. (cleavers) C [1]

SALICACEAE (Willow Family)
Salix alba L. (white willow) C [1]

SAXIFRAGACEAE (Buttercup Family)
Ranunculus abortivus L. (buttercup) C [1]
Ranunculus flabellaris A. Gray (yellow buttercup) C [1]

SANTALACEAE (Sandalwood Family)
Vicia americana L. (red vetch) C, W [1]

SAXIFRAGACEAE (Buttercup Family)
Anemone canadensis L. (Canada anemone) C, W [1, 2]
Anemone pulsatilla L. (pulsatilla) C, W [1, 2]

SOLANACEAE (Solomon’s Seal Family)
Lycopus europaeus L. (European plectranthus) C [1, 2]
Lycopus europaeus subsp. europaeus L. (European plectranthus) C [1]
Lycopus europaeus subsp. wilderi Gmelin (wild plectranthus) C [1]
Lycopus europaeus subsp. vulvaria L. (European plectranthus) C [1]
Lycopus europaeus subsp. viridis L. (European plectranthus) C [1]

SOLANACEAE (Nightshade Family)
Physalis heterophylla Nees (clammy ground cherry) C [3]
Physalis virginiana L. (ground cherry) C [1]
IRIDACEAE (Iris Family)
Iris shrevei Small (blue flag) C, W [4, 5]
Sisyrinchium campestre Bickn. (blue-eyed grass) C, W [3]
JUNCACEAE (Rush Family)
Juncus dudleyi Wieg. C, O [1, 3]
LEMNACEAE (Duckweed Family)
Lemma minor L. (duckweed) C * [5]
LILIACEAE (Lily Family)
Allium canadense L. (wild onion) C, W, O [3]
Consualla majalis L. (lily-of-the-valley) C [1]
Hypoxis hirsuta (L.) Cov. (yellow stargrass) C * [2, 3]
Polygonatum biflorum (Walter) Ell. (Solomon’s seal) C * [1]
Smilax hispida Munl. (green brier) C [1]
ORCHIDACEAE (Orchid Family)
POACEAE (Grass Family)
!Agrostis gigantea Roth (redtop) C [1, 2]
!Andropogon gerardii Vitman (big bluestem) C, W [3]
!Bouteloua curtipendula (Michx.) Torrey (side-oats grama) C, W [3]
!Bromus inermis Leysser (smooth brome) C, W [1, 2]
!Bromus japonicus Thunb. ex Murray (Japanese brome) C [1]
!Bromus tectorum L. (downy chess) C * [1]
Calamagrostis canadensis (Michx.) Beav. (bluejoint) C, W [4]
!Dactylis glomerata L. (orchard grass) C [1, 2]
Dichanthelium acuminatum (Sw.) Gould & Clark var. implicatum (Scribner) Gould & Clark C [3]
Dichanthelium acuminatum (Sw.) Gould & Clark var. villosum (Gray) Gould & Clark C [3]
Dichanthelium leibergii (Vasey) Freckm. (Leiberg’s panic grass) C [3]
Dichanthelium oligosanthes (Shultes) Gould var. scriberianum (Nash) Gould C, W [3]
!Digitaria ischaemum (Schreber ex Schweig.) Schreber ex Muhl. (smooth crabgrass) C [1]
!Echinochloa crus-galli (L.) Beauv. (barnyard grass) C [1]
Elymus canadensis L. (Canada rye) C, W [3]
Elymus virginicus L. (Virginia rye) C * [1]
Erigeron pulcherrimus (Michx.) Nees (yellow fleabane) C, O [1]
Glyceria striata Lam. (smooth brome) C, O [1]
Hordum jubatum L. (squirrel-tail barley) C * [1]
Koeleria macrantha (Leh. ex Willd.) (smooth brome) C, W [3]
Leersia oryzoides (L.) Sw. (rice cut-grass) C, W [4]
Muhlenbergia frondosa (Poiret) Fern. (wirestem muhly) C [2]
Panicum dichotomiflorum Michx. (knee grass) C [1]
Panicum virgatum L. (swinch grass) C, W [3, 4]
Phalaris arundinacea L. (reed canary grass) C, W [2, 3, 4]
!Poa compressa L. (Canada bluegrass) C, W [2, 3]
!Poa pratensis L. (Kentucky bluegras) C, W [1, 2, 3, 4]
Sicchus sarachyrum scoparium (Michx.) Nash (little bluestem) C, W [3]
!Setaria faberi Herrm. (foxtail) C, W [1]
!Setaria glauca (L.) Beauv. (yellow foxtail) C [1]
Sorghastrum nutans (Michx.) Nash (sorghastrum) C, W [1, 2]
Stipa spartea Trin. (porcupine grass) C, W [3]
TYPHACEAE (Cattail Family)
Typha latifolia L. (common cattail) C * [4, 5]