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The Role of an Urban Tallgrass Prairie Remnant in Conservation: A Case Study in Central Iowa (USA)

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Although more than 85% of Iowa (USA) was covered by tallgrass prairie at the time of settlement by Europeans in the early 19th century, less than 0.1% remains. The Richard W. Pohl State Preserve at Ames (IA) High School, surrounded on three sides by structures, roads, and other development, protects 4 ha of tallgrass prairie. The preserve, commonly referred to as Ames High Prairie (AHP), was grazed but never plowed under private ownership until its acquisition by the Ames School District in 1959. Although considered for development as a parking lot or football field in the 1960s, the residents of Ames voted in 1970 to award The Nature Conservancy (TNC) a 49-year lease to the property (until 2019). This preserve, almost completely open in the 1930s, has been subject to numerous threats, including encroachment by woody plants, entry of non-native and invasive plant species associated with human activity, and erosion associated with storm water runoff, sewer line repair, foot and bike traffic, and major flood events.

Recent management activities at AHP, conducted by volunteer land stewards, high school and college students, TNC summer interns, and private contractors, has consisted of controlled burns, cutting and herbicide treatment of encroaching woody plants, manual removal and herbicide treatment of invasive herbaceous plants, and sowing of seeds (collected on site) into reopened areas.

Three vascular plant inventories of the 8.9 ha preserve (1966, 1995, current study) have documented the occurrence of 465 taxa (329 native) at AHP, including 5 Iowa special concern species. This flora includes 147 native prairie plant taxa, which ranks 8th in comparison with the 26 other (and mostly larger) prairies protected as state preserves in Iowa. As a vegetation remnant, AHP protects tallgrass prairie taxa and their gene pools, maintains an example of historically abundant (but now scarce) tallgrass prairie vegetation, and provides citizens an opportunity to experience prairie.

INDEX DESCRIPTORS: Iowa, prairie flora, prairie management, tallgrass prairie, urban prairie, volunteer land stewards.

The natural and cultural histories of Iowa are intertwined through tallgrass prairie. Native Americans made their home here when the last glaciers retreated, and we find compelling evidence that they used fire to remove dead thatch and promote growth of fresh grass, preventing invasion by forest plants and probably extending and maintaining the eastern edge of tallgrass prairie in North America (Pyne 1982; Anderson 1990). The history of exploration and settlement of Iowa prairies by Europeans encompasses the Louisiana Purchase, the Lewis and Clark expedition, the Black Hawk War, the eradication of bison and elk from the landscape, and technological improvements in farm machinery that facilitated conversion of vast acres of prairie to cropland (Smith 2001). Knowledge of this historic prairie vegetation in Iowa during the 19th century is available from Government Land Office surveys conducted in Iowa between 1832 and 1859 (Anderson 1996), written accounts of early explorers and settlers (especially those associated with military expeditions), and photographs and illustrations (Rosburg 2001).

Although grasslands historically comprised at least 85% of this state’s land area, less than 0.1% of Iowa’s original prairie currently remains (Smith 1998). Much of this remainder is owned and managed by public agencies or private conservation organizations. Of the 98 such Iowa prairie remnants summarized by Rosburg (Table 2 in Rosburg 2001), only 17 (19%) contain at least 40 ha (100 ac), and 33 (34%) contain no more than 4 ha (10 ac) of prairie. Smith (2001) describes these prairie remnants as “damaged” in ways not explicitly described but easy to imagine.

The Richard W. Pohl State Preserve at Ames High School, commonly referred to as Ames High Prairie (AHP), protects one such small (4 ha, 10 ac) prairie remnant. The history of this prairie mirrors that of most other Iowa prairie remnants, with dramatic reduction in land area, cessation of fire, encroachment by native woody species, substantial invasion by exotic plant species, sporadic knowledge of past vegetation, uneven awareness of existence among private citizens, and conflicts among those with differing visions for the conservation and management of this property. AHP faces additional unique challenges due to its occurrence within an urban matrix, especially storm water runoff from surrounding residential neighborhoods, occasional maintenance by city workers on a sewer line that passes through the preserve, frequent foot and bike traffic by local citizens across the prairie, and proximity of cultivated plants that have dispersed to the site. The persistence of AHP, if not most Iowa prairie remnants, is due to the efforts of individuals, conservation organizations, and county or state government agencies willing to purchase, legally protect, and restore these fragments of prairie vegetation.

In this paper, we describe the natural and cultural histories of AHP based on historic photographs and documents, as well as the history of prairie management in the preserve since the 1960s as documented from interviews with 12 individuals who have contributed to various aspects of this effort. Next, we present a checklist of the vascular
plant flora of AHP documented from three plant inventories (Freckmann 1966; Norris 1995; current study), which we compare to the floras of 26 other Iowa prairie remnants protected as state preserves. We then describe the current vegetation present in different regions of the preserve. Finally, we discuss the role of this urban prairie remnant in conservation.

STUDY SITE

Natural History

The 8.9 ha (22 ac) preserve, which contains 4 ha (10 ac) of remnant tallgrass prairie, is located in the N\(\frac{1}{2}\) of the SW\(\frac{1}{4}\) of Sec 34, T84N R24W (Franklin Twp) in the north part of Ames, Story County, IA – coordinates: 42.040° N 93.636° W (approximately 42.041° N – 42.038° N, 93.636° W – 93.640° W) (Fig. 1). It lies on the southern portion of the Des Moines Lobe of the Wisconsin glaciation (Herzberg and Pearson 2001; Prior 1991), and is located within ca. 40 km (25 mi) of the eastern extent of the Des Moines Lobe and ca. 64 km (40 mi) from its southern terminus. The preserve varies in topography, from relatively flat floodplain to moderately hilly, with dry ridges and hilltops and moist slopes (Fig. 2, prepared from United States Geological Survey, The National Map Viewer. 1975). A drainage way

![Fig. 1. Location of AHP in Story Co., Iowa. The preserve occurs within the Des Moines Lobe landform region, which is delineated on the map.](image1)

![Fig. 2. Topographic map of AHP and surrounding land.](image2)
follows the north edge of the east segment of the preserve and then bisects the preserve, flowing southwest to Squaw Creek beyond the preserve boundary.

We present a soil map of AHP in Fig. 3 (prepared from Web Soil Survey). The well-drained upland portions are associated with Storden, Clarion, Spillville, and Lester soils, which are all loams. The first three of these soils developed in association with tallgrass prairie vegetation, while Lester soil developed beneath a mixture of prairie and woodland, i.e., savanna. Coland soil occurs beneath the above mentioned drainage area, which also formed under tallgrass prairie (C.L. Burrs, pers. comm., December 29, 2014).

Central Iowa has been classified as mesothermal moist subhumid (Thornwaite 1948). Climatic data available for Ames, IA, for 1981-2010 (National Centers for Environmental Information) shows average yearly precipitation is about 880.62 mm (34.67 in). The average driest (18.8 mm (0.74 in)) and coldest (~6.78°C (19.8° F)) month is January, the average warmest (C.7.76 mm (5.03 in)) month is June, and the warmest (23.0° C (73.4° F)) month is July. The average frost-free growing season is from March 30 to November 4 (210 days).

Rosburg (2001) identified mesic tallgrass prairie and dry mesic prairie as the primary and secondary prairie communities, respectively, occurring at AHP. According to Government Land Office (GLO) surveys conducted in Iowa during the mid-19th century, all of the land now designated as AHP was occupied by prairie vegetation (Fig. 4a) at the time of these surveys, except for a wooded area in the southwest corner that borders Squaw Creek (Anderson 1996). Figs. 4 b-f (prepared from Iowa Geographic Map Server) show how the extent of prairie vegetation at AHP has changed from the 1930s to the present. Joens (1978) and Norris (1995) presented vegetation maps of AHP, based on their separate vegetation surveys, that identified floodplain forest vegetation as occupying regions of the preserve that were formerly prairie. Later in this paper, we discuss probable circumstances behind this wide variation in the extent of prairie vegetation at AHP, coupled with encroachment by woody vegetation, over the past 80 years.

Cultural History

Ownership and Past Land Use. The preserve property was first owned by John I. Blair, who had large land holdings on the north side of Ames. In 1867, Blair sold the 64.7 ha (160 ac) parcel that includes the prairie to E. B. Campbell. In 1891, Roan McClure bought the property from Mary Campbell. The property, which was annexed into the City of Ames in 1947, remained in the McClure family (later Allen family, when his daughter married Harry Allen) until the family sold it to the Ames Community School District in 1959 (unpublished records, Story County Recorder's Office, Nevada, IA).

The land within the boundaries of the current preserve was used for grazing, and the highest knoll in the current preserve was referred to as “pasture” on a mid-1950s topographic map of the region (Abrams Aerial Survey Corporation 1956). AHP was formerly referred to as the “Pippen Prairie,” as documented on plant specimen labels deposited at the Ada Hayden Herbarium at ISU (ISC) (e.g., “Disturbed area along the “Pig Pen” prairie remnant area, west of Ames new high school,” Potentilla simplex Michx. – ISC 249339, M.G. Lelong M47, 14 June 1961). However, we have encountered no evidence that the prairie was ever plowed for row crops. Once the land was sold to the Ames School District and construction of a new high school was underway just to the east, construction equipment was parked on the northeast part of the prairie (Anonymous 2003) and possibly some topsoil was removed from the prairie (Freckmann 1966). The school was occupied either prior to or during 1961 (Ellett et al. 1970). A storm-sewer drainage system was installed in the drainage way before 1970, while the school property to the east and a senior living center to the northeast of the prairie were constructed. Through the years, work on this drainage system has impacted this part of the preserve.

Currently located in an urban area, AHP is largely surrounded by developed properties. Housing developments are adjacent to the preserve on its west (Iowa State University (ISU) student housing) and north (general residential housing) boundaries, and Ames High School is situated on its east boundary. The forest vegetation that currently occupies the south part of the preserve extends southwest to Squaw Creek.

TNC Lease Agreement with the City of Ames. The high quality of the prairie in the current preserve has been recognized for many years. An unsuccessful effort was made in the late 1940s to obtain AHP for use as an outdoor classroom (Gucciardo 1987), and the site has been used for class field trips by ISU faculty at least since the 1960s (Freckmann 1966; R.Q. Landers, Jr., pers. comm., June 10, 2015). Nonetheless, after the Ames Community School District purchased the property and completed the high school buildings in the early 1960s, a proposal was made to build either a parking lot or an athletic field on the eastern end of the prairie (Anonymous, undated and unpublished notes, Ada Hayden Herbarium archives, ISU). The Ames Conservation Council responded by working to increase awareness of the prairie’s significance among Ames community members and high school personnel and advocating for its protection (Joens 1978). Participation on this committee by faculty members of Ames High School (Richard “Dick” Trump) and ISU (Duane Isely, Harold S. “Sande” McNabb, Richard “Dick” W. Pohl) was instrumental in this effort (D.R. Farrar, pers. comm., May 21, 2015; R.Q. Landers, Jr., pers. comm., June 10, 2015).

Ultimately, the Ames Conservation Council contacted The Nature Conservancy (TNC) about the possibility of negotiating a TNC lease of the prairie. This proposal came to a vote of the residents of the City of Ames in 1970, and the measure was approved. Terms of TNC’s lease were that for a payment of $1 per year, the lease would run for 49 years, beginning on October 1, 1970 (unpublished TNC lease document 1970, downloadable at Ames High School Prairie 2011). Per terms of the lease, which is set to expire in 2019, TNC oversees the management of AHP.

Designation as Iowa State Preserve. In late August 1995, city workers drove heavy equipment across the east portion of the prairie to access a broken sewer line located in the drainage way within the adjacent floodplain forest, scraping the soil off the lower part of the prairie in the process (personal observations of the authors; Reiners 1997; Norris and Farrar 1999). This damage sparked a series of meetings that involved the city, the school board, TNC and other environmental groups, and Ames citizens. A proposal was made that the AHP should become a state preserve. A more detailed management plan was drawn up (Reiners 1997) and presented to the State Preserves Advisory Board and the Iowa Department of Natural Resources (IDNR). At the same time, it was learned that Marjorie Pohl was willing to make a substantial contribution to the TNC for ongoing management if the preserve could be named in memory of her late husband, Richard W. Pohl, an ISU botanist. Richard Pohl had chaired the Ames Conservation Council, conducted research on the prairie, supervised prairie management projects, and led numerous field trips and prairie walks there for ISU students and the public. Ultimately, the prairie was officially dedicated as the Richard W. Pohl Memorial at Ames High Prairie State Preserve on August 18, 1997 (Fig. 5).
Fig. 3. Soil map of AHP (Web Soil Survey).
Fig. 4. AHP land cover in a) mid-19th century; b) 1939; c) 1953; d) 1972; e) 1994; f) 2015.
Friends of Ames High Prairie and Volunteers. At about the time that TNC obtained the 49-year lease for AHP, a smooth-wire fence was erected around the property (R.Q. Landers, Jr., pers. comm., June 10, 2015; L.G. Crim, pers. comm., June 15, 2015). Although the majority of the land now designated as AHP was open prairie through the first half of the 20th century (Fig. 4b-c), by the 1970s woody plants had encroached on well over half of the property (Fig. 4d; Fig. 9 in Joens 1978). For two decades after the above-mentioned lease was obtained (1970), volunteers organized as the “Friends of Ames High Prairie” or working independently removed invasive woody plants and non-native forbs from the main prairie and conducted prescribed burns at AHP (D.R. Farrar, pers. comm., May 21, 2015; C.L. Johnson, pers. comm., Apr. 28, 2015; J.F. Shearer, pers. comm., July 4, 2015).

In the early 1990s, a volunteer who had taken responsibility for management of the prairie at AHP, D.M. Brenner, prepared a management plan for the prairie remnants there (Fig. 6) and established regular schedules for prairie management activities (e.g.,

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**Fig. 5.** AHP Preserve sign, posted at east entrance.

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**Fig. 6.** AHP map identifying management priorities in 1991.
wood cutting, weed pulling) (D.M. Brenner, pers. comm., Apr. 28, May 25, June 11, and June 13, 2015). Despite the above work conducted by volunteers, which proceeded with little to no supervision (J.F. Shearer, pers. comm., July 4, 2015; D.M. Brenner, pers. comm., Apr. 28, 2015), by at least the mid-1980s, former tallgrass prairie vegetation was reduced to three separate parcels (Fig. 4e).

**TNC Management Plans (1997, 2003).** Just prior to designation of AHP as a state preserve, TNC prepared a management plan for the site which summarized previous ownership history and natural history of AHP, and stated two primary goals for the preserve: preservation of native prairie, and provision of biological educational experiences for local high school and university students (Reiners 1997). This document states that “burning and mechanical elimination of woody plants will be the primary tools” to maintain “open grassland conditions, the dominance of the vegetation by a diverse variety of native grasses and forbs, and the control of woody plants and non-native forbs.” Seed collection would be permitted for State Preserve Advisory Board projects, especially reconstruction/restoration projects of areas at AHP, that require local ecotype seeds not available commercially or locally from private sources. Finally, the plan mandates that a stewardship endowment fund of at least $50,000 should be established and administered by TNC to be used for maintenance of AHP.

After designation of AHP as a state preserve, this plan was revised (Klaas and 1997 ISU Restoration Ecology Class 2003) to incorporate the work of an ISU Restoration Ecology class, taught by ISU professor E.E. Klaas, which had adopted development of a management strategy for AHP as a class project. This revised plan added management goals to those identified in Reiners (1997) to include expansion of prairie remnants into one contiguous prairie, and restoration of a major drainage-way to a more natural state. This document then outlined management strategies (e.g., tree removal, control of invasive species, prescribed fire, reintroduction of native plant species using seed collected on site, filling and re-leveling of eroded areas, placement of erosion control structures to slow water flow) to achieve these goals. Finally, this revised management plan recommended that “a corps of volunteer stewards...be trained to conduct management practices, supervise other volunteers, keep records, and serve as ambassadors to the community.”

**Recent Management at AHP.** Since the late 1990s, management of AHP has been conducted by numerous entities including volunteers working independently or collectively (“Friends of Ames High Prairie”) (J. Murdock, pers. comm., April 29, 2015), Ames High School students (Fig. 7a-d) (M. Todd, pers. comm., July 8, 2015), ISU students (E.E. Klaas, pers. comm., April 27, 2015), summer TNC and Conservation Corps interns (S. Moats, pers. comm., July 2, 2015), and private contractors (S. Moats, pers. comm., July 2, 2015). This work has included tree and shrub removal, herbicide treatment of invasive plant species, collection of native prairie seed on site and reintroduction of the seed into recently cleared sites within preserve boundaries, and prescribed fires.

A series of work plans for AHP has been prepared by TNC staff (with frequent input from Friends of Ames High Prairie) to guide volunteer stewards during the years 2010-2013 (Filiapiak and Friends of Ames High Prairie 2010); 2013-2015 (Tucker 2013), and 2016-2019 (Maxson 2015). The current work plan identifies four threats to the prairie, in order of urgency: 1) woody encroachment; 2) herbaceous invasive species; 3) small size/fragmentation; and 4) lack of awareness/understanding of the prairie. It then states that realistic management goals for 2016-2019 are to: 1) maintain and enhance the native diversity of the existing prairie; 2) expand the existing prairie opening with the long-term goal of reconnecting management zones 2 and 3 with management zone 1; and 3) provide for early detection of new threats.

This work plan identifies specific objectives for reaching these goals as: 1) continued overstory tree removal from management zones 5 and 6; 2) collection of native seed from AHP and nearby remnant prairies for seeding into recently cleared areas; 3) aggressive management of invasive species; and 4) continued monitoring of the prairie remnants at AHP for new introductions of other invasive species. Finally, Maxson (2015) presents detailed protocols for meeting these objectives. These include the timing of Woody plant removal (objective 1), recommended herbicide types (objectives 1 and 3), procedures for collection, storage, and dispersal of seed onto prairie remnants (objective 2), establishment of permanent photo points (objective 4), and annual documentation of prairie remnant boundaries using a GPS unit (objective 4).

**METHODS**

**Field Work**

Thompson conducted extensive plant inventories in AHP during the 2011 field season (128 d, 640 h), as well as during several additional days of field work in subsequent years (2012-2015) to search for overlooked plant species. During this inventory, he repeatedly visited all the preserve’s habitats, including forests, native prairies, stream banks, mud and sandbars, and sites impacted by human disturbance. These latter areas included the preserve’s roadway and soil disturbed during repair work on the storm sewer in 2011 that extends through the preserve. Thompson collected 714 voucher specimens to document the preserve flora during this field work.

**Data Analysis**

**Compilation of the Vascular Plant Checklist.** We compiled a checklist of all vascular plant taxa encountered during the current inventory of AHP, as well as taxa reported by Freckmann (1966) and Norris (1995) during prior plant inventories of the preserve. Scientific nomenclature for plant taxa follows Flora of North America Committee (1993-1) from volumes available at the time of this study, the United States Department of Agriculture Plants Database (PLANTS 2011-2015), and Widrlechner (1998) for the genus Rubus. Common names follow (in order of priority) Eilers and Roosa (1994) and the United States Department of Agriculture Plants Database (PLANTS 2011-2015). Family circumscriptions and organizations of plants into larger groups follow Judd et al. 2008. Gleason and Cronquist (1991) was the primary reference used for plant identification. All taxa encountered by Thompson during the current study are documented by a specimen deposited in the Ada Hayden Herbarium (ISC) at ISU. For each vascular plant taxon encountered at AHP by Thompson during the current study, we include in the checklist the collection number of a voucher specimen documenting its occurrence in the preserve.

We provide the following additional information for each taxon in the checklist: source of each taxon report (i.e., Freckmann 1966; Norris 1995; current study), phytogeographic origin (following Eilers and Roosa 1994 and the United States Department of Agriculture Plants Database (PLANTS 2011-2015), and whether or not it is a native Iowa prairie plant). In the checklist, we also provide information about the habitat preferences of each plant encountered at AHP during the current inventory, utilizing the following habitat codes (adapted from Norris et al. 2001): tree dominated (T), prairie (P), wetland (W), and open (O); the latter category represents sites primarily associated with human
disturbance, including the preserve’s roadway and storm sewer repair work. Within each of these main categories, there are several subcategories as described in Table 1. Finally, we present an abundance code (slightly modified from Eilers and Roosa 1994 and Norris et al. 2001) for each vascular plant taxon encountered during the current study, as follows:

Common: widely distributed and often found growing in large quantities in several different habitats.
Frequent: widespread but not abundant and usually found in only one type of habitat.
Infrequent: not widespread and often not found in places where it might be expected to occur.
Sparse: found in only one or a few places.

In this paper we describe the status of vascular plant taxa at AHP that are of special interest and conservation concern to botanists and natural resource managers. These include taxa listed as of “special concern” in Iowa (Iowa Administrative Code 2002), taxa new to the published checklist of Iowa vascular plants (Eilers and Roosa 1994), and conspicuous introduced taxa we encountered at AHP.

Floristic Comparisons with other Iowa Prairie Remnants. We compared the native Iowa prairie flora of AHP with that documented from 26 other prairies protected in the Iowa State preserve system (summarized in Freese and Norris 2015) in several ways. First, we compiled the floras documented from these other prairies from available sources (e.g., published floras, plant lists available in M.S theses or Ph.D. dissertations, plant lists and vegetation plot data available in unpublished reports to sponsoring conservation agencies, etc.) into a spreadsheet. We categorized a given native vascular plant taxon in these floras as a “native Iowa prairie species” if 1) it was listed as occurring in prairie habitat by Eilers and Roosa 1994, or 2) if it occurs in a list of Iowa prairie plants compiled by John A. Pearson (plant ecologist, IDNR) in the late 1980s and early 1990s (Pearson 1993, available in Norris 1995, Appendix C). We then compared the number of “Iowa prairie species” documented from each of these 27 prairies (including AHP) that are protected in the Iowa state preserve system.

We then compared the number of native Iowa prairie plant taxa of high conservation concern in AHP with those documented from the other 26 prairies. Specifically, we used Iowa Coefficient of

Fig. 7. Prairie management conducted by Ames High School students (2011): a) collecting seed; b) cutting heads of musk thistle; c) hoeing exotic plants; d) spreading seed.
Table 1. Codes used to describe preferred habitats of vascular plants in Ames High School Prairie.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>Tree dominated habitats</td>
</tr>
<tr>
<td>df</td>
<td>dry forest</td>
</tr>
<tr>
<td>mf</td>
<td>moist forest</td>
</tr>
<tr>
<td>wf</td>
<td>wet forest—typically in bottomlands</td>
</tr>
<tr>
<td>ed</td>
<td>edge</td>
</tr>
<tr>
<td>P</td>
<td>Prairie habitats</td>
</tr>
<tr>
<td>dr</td>
<td>dry prairie</td>
</tr>
<tr>
<td>ms</td>
<td>moist prairie</td>
</tr>
<tr>
<td>wt</td>
<td>wet prairie—including wet meadow vegetation</td>
</tr>
<tr>
<td>rp</td>
<td>riparian—grassy stream edges and sandbars</td>
</tr>
<tr>
<td>ss</td>
<td>sanitary sewer excavation work soil disturbance</td>
</tr>
<tr>
<td>dw</td>
<td>preserve access driveway</td>
</tr>
</tbody>
</table>

Table 2. Floristic Composition of the Ames High Prairie flora.

<table>
<thead>
<tr>
<th>A) Major Groups, Families, Genera and Taxa</th>
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<tbody>
<tr>
<td><strong>Major Groups</strong></td>
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<tr>
<td>------------------</td>
</tr>
<tr>
<td>Ferns and Fern Allies</td>
</tr>
<tr>
<td>Conifers</td>
</tr>
<tr>
<td>Magnoliids</td>
</tr>
<tr>
<td>Monocots</td>
</tr>
<tr>
<td>Eudicots</td>
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<tr>
<td>Total</td>
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B) Ten Largest Families

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<th>Native to Central Iowa</th>
<th>Non-Native to United States</th>
<th>Total (Hybrid)</th>
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<tbody>
<tr>
<td>Asteraceae</td>
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<td>14</td>
<td>70</td>
</tr>
<tr>
<td>Poaceae</td>
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<td>29</td>
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<tr>
<td>Rosaceae</td>
<td>19</td>
<td>6</td>
<td>25 (1)</td>
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<tr>
<td>Cyperaceae</td>
<td>24</td>
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</tr>
<tr>
<td>Fabaceae</td>
<td>16</td>
<td>1</td>
<td>6</td>
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<tr>
<td>Lamiaceae</td>
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<td>Brassicaceae</td>
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<tr>
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<tr>
<td>Apiaceae</td>
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<td>Amaranthaceae</td>
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<td>9</td>
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C) Eleven Largest Genera

<table>
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<th>Non-Native to United States</th>
<th>Total</th>
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<td>Symphyotrichum</td>
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<td>Poa</td>
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<td>Dianthus</td>
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<td>Solidago</td>
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<td>Viburnum</td>
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</table>

RESULTS

Conservatism (ICC) values assigned by a panel of experts to each native vascular plant taxon in the Iowa flora (Drobney et al. 2001). As typically developed and implemented in numerous states, coefficients of conservatism values range from 0 to 10, and reflect the likelihood that a given plant taxon will occur in natural habitat (Swink and Wilhelm 1994, Bourdagh et al. 2006). Following Taft et al. (1997), who state that Illinois plant taxa assigned coefficient of conservatism values of 7-10 associate mostly with (or are restricted to) natural areas, we tallied the number of native Iowa prairie taxa with ICC values equal to 7, 8, 9, or 10 reported for each prairie to allow comparison. Although it was tempting to calculate and compare floristic quality indices (Swink and Wilhelm 1994) and mean ICC values among all 27 prairies protected as Iowa State Preserves, we decided against this because of potential effects of area on these measures (Matthews 2003, Matthews et al. 2005) and because of the great range in area of prairie vegetation (1.3-121.4 ha) represented among the 27 prairies included in this comparison.

Flora Analysis

Checklist of Vascular Plants. The checklist of vascular plants compiled for AHP from this and the two previous floristic studies (Freckmann 1966; Norris 1995) includes 465 taxa (329 native, 70.8% (Appendix). The occurrences of all but 9 of the above taxa at AHP are documented by at least 1 voucher specimen housed in the Ada Hayden Herbarium (ISC). The most diverse plant families in the AHP flora are Asteraceae (70 taxa), Poaceae (68), Rosaceae (25), and Cyperaceae (24), and the most diverse genera in this flora are Carex (21 taxa), Symphyotrichum (11), Persicaria (6), and Poa (6) (Table 2). During field work for the current study (2011-2015), Thompson found 306 taxa not reported in either of the two previous studies. Among these are 20 taxa not listed in the checklist of Iowa vascular plants (Eilers and Roosa 1994), the majority of which (19 taxa; 95%) are not native to central Iowa (Table 3). (Note: 9 of these 20 taxa have previously been reported in Iowa in floristic studies conducted since publication of Eilers and Roosa 1994, and the remaining 11 taxa are reported as naturalized in Iowa for the first time.)

The plants at AHP were encountered in a variety of habitats (Table 4) and varied widely in abundance (Table 5). Five taxa in this flora are considered to be of “special concern” by the Iowa Natural Resource Commission (Iowa Administrative Code 2002): glomerate sedge (Carex aggregata Mack.), quill sedge (Carex echinodes (Fernald) P. Rothr., Reznick & Hipp), Richardson’s sedge (Carex richardsonii R. Br.), Hill’s thistle (Cirsium billii (Canby) Fem.), and meadow bluegrass (Poa wolfii Scribn).

Analysis of Floristic Change at Ames High Prairie. The 447 vascular plant taxa encountered at AHP during the current study include 309 taxa (69%) native to central Iowa. In comparison, Freckmann (1966) reported 143 vascular plant taxa occurring on the prairie at AHP in the early 1960s, of which 112 (78%) are native to central Iowa. During the current study, Thompson documented the occurrences of 318 vascular plant taxa at AHP not reported by Freckmann (1966). Of these previously unreported taxa, 210 (66.0%) are native to central Iowa, and 59 (18.6%) are native Iowa prairie taxa, by the criteria explained above. In contrast, Freckmann (1966) documented the occurrence of 16 vascular plant taxa at AHP in the 1960s not encountered during the current study, including 13 (81.3%) which are native, and 11 (68.8%) which are native Iowa prairie taxa.

Similar comparisons with the early 1990s flora of AHP (Norns 1995) are not possible, because that study focused solely on prairie taxa while ignoring non-native taxa as well as native taxa characteristic of other habitats.
Table 3. Taxa collected at Ames High Prairie and which are not listed in the Iowa checklist of vascular plants (Eilers and Roosa 1994).

<table>
<thead>
<tr>
<th>Taxa</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Berberis × koreana</em> Palib. × <em>B. thunbergii</em> DC. (Korean barberry × Japanese barberry)</td>
</tr>
<tr>
<td><em>Clematis cf. terniflora</em> de Candolle (sweet Autumn clematis)</td>
</tr>
<tr>
<td><em>Euonymus fortunei</em> (Turcz.) Hand.-Maz. (winter creeper)</td>
</tr>
<tr>
<td><em>Geranium sibiricum</em> L. (Siberian geranium)</td>
</tr>
<tr>
<td><em>Ligustrum obtusifolium</em> Sieb. &amp; Zucc. (border privet)</td>
</tr>
<tr>
<td><em>Lonicera × bella</em> Zabel (L. <em>tatarica</em> × <em>L. morrowii</em>) (showy fly honeysuckle)</td>
</tr>
<tr>
<td><em>Lonicera maackii</em> (Rupr.) Maxim. (Amur honeysuckle)</td>
</tr>
<tr>
<td><em>Lonicera cf. rugosissima</em> Regel (Manchurian honeysuckle)</td>
</tr>
<tr>
<td><em>Lunaria annua</em> L. (money-plant, silver dollar)</td>
</tr>
<tr>
<td><em>Myositis sylvestris</em> Hoffm. (garden forget-me-not)</td>
</tr>
<tr>
<td><em>Phellodendron</em> sp. (corktree)</td>
</tr>
<tr>
<td><em>Polygonum aviculare</em> L. subsp. <em>neglectum</em> (Besser) Arcangeli (narrow-leaf knotweed)</td>
</tr>
<tr>
<td><em>Prunus</em> × <em>cerasifera</em> Ehrh. (group) (cherry plum, purple-leaved plum)</td>
</tr>
<tr>
<td><em>Rosa × ruddii</em> Greene (<em>R. arkansana</em> × <em>R. carolina</em>) (hybrid rose)</td>
</tr>
<tr>
<td><em>Rubus × parvifolius</em> L. (Asian raspberry)</td>
</tr>
<tr>
<td><em>Salix × rubens</em> Schrank (<em>S. alba</em> × <em>S. fragilis</em>) (hybrid crack willow)</td>
</tr>
<tr>
<td><em>Syringa reticulata</em> (Blume) H. Hara (Japanese tree lilac)</td>
</tr>
<tr>
<td><em>Veronica polita</em> Fr. (gray field speedwell)</td>
</tr>
<tr>
<td><em>Viburnum lantana</em> L. (wayfaringtree)</td>
</tr>
<tr>
<td><em>Viburnum sieboldii</em> Miq. (Siebold’s arrowwood)</td>
</tr>
</tbody>
</table>

Floristic Comparisons With Other Prairies Protected In The Iowa State Preserve System. The AHP flora documented by Freckmann (1966), Norris (1995), and the current study includes 147 native Iowa prairie taxa, and in this regard ranks 8th among 27 Iowa state preserves that protect prairie vegetation (Fig. 8a). Among these native Iowa prairie taxa at AHP are 45 that are assigned high (7-10) Iowa coefficient of conservatism values. In this comparison, the AHP flora ranks 15th in comparison to the other 26 Iowa state preserves which feature prairie vegetation. Richardson’s sedge and Hill’s thistle, the larger (occupying 100 m²) on the west hill prairie, the smaller (20 m²) on the east hill prairie. Likewise, Hill’s thistle grew in two widely separated populations on these same east and west hill prairies. In 2014, two plants in both the east (50 m², 30 rosettes) and west (40 m², 12 plants) Hill’s thistle populations bolted and produced flower heads.

Two additional Iowa special-concern sedge taxa occurred in both open prairie and forest habitats at AHP: glomerate sedge (frequent in some areas of both prairie and forest) and quill sedge (represented by large populations in open prairies and one small population in dense forest). Large tree stumps are present in the now open prairie areas where these two sedge taxa were found, suggesting that conditions may have been shaded when these sedge populations were established. The fifth state-listed special-concern species, meadow bluegrass, is a forest bluegrass species that Thompson vouchered from a large population that he encountered in the floodplain forest of Squaw Creek.

Table 4. Habitat of Ames High Prairie flora documented during current study. Habitat codes defined in Table 1.

<table>
<thead>
<tr>
<th>Habitat Type</th>
<th>No. of Taxa</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prairie</td>
<td>282</td>
<td>63</td>
</tr>
<tr>
<td>Tree-dominated</td>
<td>212</td>
<td>47</td>
</tr>
<tr>
<td>Wetland</td>
<td>67</td>
<td>15</td>
</tr>
<tr>
<td>Other</td>
<td>44</td>
<td>10</td>
</tr>
<tr>
<td>More than one</td>
<td>115</td>
<td>26</td>
</tr>
</tbody>
</table>

Table 5. Abundance of Ames High Prairie flora documented during current study. Abundance codes defined in text.

<table>
<thead>
<tr>
<th>Abundance</th>
<th>No. of Taxa</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common</td>
<td>127</td>
<td>28</td>
</tr>
<tr>
<td>Frequent</td>
<td>68</td>
<td>15</td>
</tr>
<tr>
<td>Infrequent</td>
<td>54</td>
<td>12</td>
</tr>
<tr>
<td>Sparse</td>
<td>198</td>
<td>44</td>
</tr>
</tbody>
</table>

Fig. 8. Floristic comparison of AHP with 26 other prairies protected in the Iowa State Preserves System. a) Relationship between total number of native Iowa prairie plant taxa versus total prairie area for 27 prairies protected in the Iowa state preserve system; b) relationship between total number of native Iowa prairie plant taxa assigned high (7, 8, 9 or 10) values of the Iowa Coefficient of Conservatism (ICC) versus total prairie area. AHP is identified with an arrow in each figure.
the floodplain through seed dispersal during periods of flooding. Thompson found gray field-speedwell (Veronica polita Fr.) (population extent: ~10m in diameter) growing on the prairie edge bordering the floodplain forest. Finally, Thompson encountered the other two Barberry taxa new to the Iowa checklist growing along a creek-edge mudbar: forget-me-not (Myosotis sylvester Hoffm.), and narrow-leaf knotweed (Polygonum aviculare L. subsp. neglectum (Besser Arcangeli)). This mudbar occurs along the large north-south drainage, fully mentioned above, suggesting that the seed source for these two taxa may have been garden waste from a wooded ridge on high school property or from a retirement community adjacent to the preserve.

Thompson found eight woody plant taxa not listed in Eilers and Roosa (1994) growing in forest and edge habitats at AHP. The most common of these were Amur honeysuckle (Lonicera maackii (Rupr. Maxim.) and showy fly honeysuckle (Lonicera ×bella Zabel), which varied in size from small seedlings to 3m tall and which grew prolifically (frequently in bloom) in shrub thickets throughout the preserve’s floodplain forest among other honeysuckle taxa vouchered from the preserve.

The following seven woody plant taxa, also new to the Iowa checklist of vascular plants, were infrequent or sparse in the understory of AHP forests: crape myrtle (Phellodendron Amurica) and showy fly honeysuckle (Lonicera ×bella Zabel), which varied in size from small seedlings to 3m tall and which grew prolifically (frequently in bloom) in shrub thickets throughout the preserve’s floodplain forest among other honeysuckle taxa vouchered from the preserve.

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Waterways that drain areas surrounding the preserve are the preferred habitat of hybrid crack willow (Salix × rubens Schrank) that, while not listed in the checklist of Iowa vascular plants, has recently been reported as naturalized in several other central Iowa locations. Thompson observed two of these willow hybrids at AHP—one approximately 10m tall, and the other (uprooted many years ago with several surviving vertical branches) with a trunk measuring approximately 1m in diameter.

Finally, Thompson discovered five woody plant taxa not listed in the state checklist that occur in prairie habitats at AHP. One of these, rough rose (Rosa x indutua Greene), is the lone native plant taxon found during the current study that does not appear in the state checklist (Eilers and Roosa 1994). Significantly, we determined that all native roses collected at AHP are this hybrid taxon. Cherry plum tree (Prunus cerasifera Ehrh.; a single, approximately 1.5m tall tree growing on the open, lower hillside of the west, main hill prairie), crape myrtle (<1m tall saplings; supplementing their occurrence in forest edge habitat mentioned above), Asian raspberry (Rubus parvifolius; observed by Thompson to occur elsewhere in Ames and surrounding areas), and an unnamed barberry hybrid, Berberis cf. korana Palib. × B. thunbergii DC (which is cultivated elsewhere in Ames; M.P. Widrlechner, pers. comm., 2011) were also encountered growing in prairie habitats at AHP.

Introduced and Invasive Species. AHP is located in the center of an urban area and its flora is susceptible to influence by a variety of human activities that occur almost daily, both outside and inside its boundaries. Below, we describe specific human activities and flood events that we have seen directly contribute to the introduction of many of the 137 non-native taxa (Appendix) into the preserve.

Garden and Yard Waste. Some plant taxa found in the preserve, both native and non-native, are undoubtedly introductions from a woodland ridge top inside of high school property and from a retirement community. Both of these facilities are located just north of AHP at the head of the large north-south drainage gully that transects the preserve for its entire length, from the northeast corner to the southwest corner (Fig. 2). Gardens and flowerbeds in the retirement community, and tree trimmings, flower bed, yard and garden waste regularly disposed of along the ridge top on the north edge of a high school parking lot, are likely sources of plant introductions at AHP. Over the years, many heavy rains have flowed in torrents down this gully into Squaw Creek and undoubtedly transported discarded vegetation and seeds of numerous non-native species into the preserve. The most abundant of these, garlic mustard (Alliaria petiolata (Bieb.) Cavara & Grande), was first observed at AHP in 2011 growing on the high school ridge; it soon expanded into the preserve along the large drainage gully, as well as into a low-lying area of open prairie and throughout the floodplain forest.

Stormwater Runoff. Additional sources of non-native plants at AHP are closed courtyards within the high school building. One of the courtyards contains a greenhouse and a pond with water that overflows into these storm drains. In the past, teachers at Ames High School planted many ornamental plants in the pond and around the greenhouse, including purple loosestrife (Lythrum salicaria L.). These storm drains discharge into two underground tile (M. Todd, pers. comm., Jan. 28, 2015), which then empty directly onto the ground on the west side of the high school. This drainage water has over time eroded a shallow trench at the head of a small drainage gully that enters the larger drainage gully mentioned above. Consequently, several purple loosestrife plants currently grow along the entire length of the smaller gully.

Agriculture. From the mid-1960s until the spring of 1991, teachers cared for beehives for educational purposes behind the high school immediately adjacent to the preserve (M. Todd, pers. comm., summer 2012). A large population of honeyweed (Lewureus sibiricus L.), most likely planted for use by the bees, currently grows in this area, and is no doubt the source of a large population of this plant which currently occurs within the preserve on one of the open prairie hilltops.

Flood Events. The Squaw Creek floodplain forest currently covers nearly half of the southern tier of AHP (Fig. 4f). With the occurrence of several major flood events in central Iowa since the early 1990s, the seeds of many native and non-native species have been deposited in the floodplain of the preserve. Non-native bush honeysuckles (Lonicera spp.) and garlic mustard that currently occur throughout this floodplain forest, and shrub species (common buckthorn (Rhamnus cathartica L.), black raspberry (Rubus occidentalis L.), and rough-leaf dogwood (Cornus drummondii C. A. Meyer), which are now common in ecotone habitats at the junction of floodplain forest and prairie, were probably introduced (at least in part) by flood waters.

Potential Future Management Problems. Several species may present ongoing or new management problems at AHP in the future. These include bird’s-foot trefoil (Lotus corniculatus L.), which is currently scattered throughout the prairie in large, dense populations that are displacing native prairie species. A large number of American plum (Prunus americana Marsh.) saplings (1-2m tall) have re-sprouted from previously removed mature trees on the prairie and have the potential to proliferate. Following removal of woody shrubs in the ongoing effort to expand prairie habitat at AHP, numerous invasive plants rapidly colonized these newly opened areas—especially common burdock (Arctium minus Berhn.), common mullein
Muhl. ex Willd.), Canada anemone (Anemone canadensis L.), Culver’s root (Veronicastrum virginicum (L.) Farw.), Richard’s alumroot (Heuchera richardsonii R. Br.), downy gentian (Gentiana puberulenta J. Pringle), and Missouri goldenrod (Solidago missouriensis Nutt.).

Even though zones 1 and 2 have the highest diversity of native prairie species, excessive growth by invasive taxa (including some native taxa) is evident in some management units within each. Zone 1 has a number of these species, including Canada goldenrod (Solidago altissima L.), bird’s-foot trefoil, sweet clover (Melilotus officinalis (L.) Pallas), crown vetch (Securigera varia (L.) Lassen), common burdock, common mullein, beggarlice (Hedelis virginiana (L.) M.J. Johnston), poison ivy (Toxicodendron radicans (L.) Kuntze ssp. neglecto (Greene) Gillies), wild parsnip (Pastinaca sativa L.), rough-leaved dogwood, American plum, giant foxtail (Setaria faberi Herrm.), Kentucky bluegrass (Poa pratensis L.), and smooth brome (Bromus inermis Leysser). Poison ivy and Kentucky bluegrass are also conspicuous in some management units of zone 2.

Until 2014, the forest edge vegetation of zones 1 (north, south, and west margins) and 2 (north, south, and east margins) were dominated by invasive woody shrub species, (e.g., common buckthorn, bush honeysuckle species, and black raspberry), which spread aggressively into the prairie habitats. During the spring, summer, and fall of 2014, Thompson spent several months cutting, stump-treating, and removing all mature invasive shrubs and young tree saplings from all of zone 1. His stump treatment using Pathfinder® II resulted in approximately 95% elimination of target shrubs. Thompson sowed seed collected at AHP over the clear-cut units of the lower south slope of zone 1 in 2014, and then over the clear-cut north units of zone 1 in 2015.

In late 2011, personnel from Conservation Corp Iowa (Conservation Corp Iowa 2013) cut and stump-treated shrubs with herbicide on the north margins of zone 2, but this treatment was mostly ineffective. In spring 2014, a TNC work crew used chainsaws and a brush mower to remove all of the extensive two-year regrowth of the invasive shrubs along the north edge of zone 2, and all mature invasive shrubs from the south and east margins of this same zone. They treated cut stumps with Element 4 (Garlon® 4 generic), which was very effective. In contrast, they allowed the rough-cut, brush-mowed shrubs to re-sprout during the summer and then foliar-treated this regrowth with Element 3A (Garlon® 3A generic) in the fall after a hard freeze. However, because leaf drop had commenced prior to the first hard freeze that fall, this foliar treatment was not as effective.

Zone 3. Because this zone is mostly upland dry soil, at one time it probably supported diverse native prairie taxa similar to those present in zones 1 and 2 (Fig. 4b-c). However, with a combination of past overgrowth of large, mature tree species (some nearly 1m in diameter) and the over-seeding of tall native grasses in management units 3B-3E, this zone has recovered very little of its former state despite recent management efforts. None of the native taxa listed above for zones 1 and 2 as indicative of diverse prairie were observed in zone 3. However, a small population (12 plants) of butterfly milkweed (Asclepias tuberosa L. ssp. interior Woodson)–the most for any zone at AHP–persists in unit 3A, and a small population of Hill’s thistle (an Iowa special concern species) occurs here. However, invasive forb and graminoid taxa are much more conspicuous in zone 3 than in zones 1 and 2, especially common burdock, common mullein, giant foxtail grass, honeyweed, ground ivy (Glechoma hederacea L.), wild parsnip, and Kentucky bluegrass.

Although zone 3 was mostly open in the 1930s (Fig. 4b), by the 1970s it had filled with large, mature trees (Fig. 4d). Prior to this study, volunteers removed these trees from all regions of zone 3 except for unit 3F. All of the trees in the latter unit were girdled, but some remain standing. After years of shading by canopy trees, most of the prairie forb and grass taxa that presumably occurred here have disappeared from these areas. In the past decade, volunteers

Vegetation Map

Fig. 9 (Fig. 1 in Filipiak and Friends of Ames High Prairie 2010, reproduced by permission) presents a map of AHP divided into 10 management zones (i.e., zones 1-10). Zones 1-3, in which most of the prairie vegetation featured at AHP occurs, are subdivided into management units labelled by zone and by letter (e.g., unit 1C). Below, we describe the vegetation community in each management zone, as well as recent management activities that have occurred therein.

Prairie

Zones 1-2. Management units 1A-1F and 2A-2E (Fig. 9) are the most pristine prairie zones with the highest diversity of prairie species. The preserve’s highest hilltops, with dry, well-drained soil, are found throughout the length of the center of these zones. This is the favored habitat of plains muley (Mulenbergia capsidata (Torrey) Rydb.), hairy grama (Bouteloua bursa Lag.), prairie dandelion (Nobocalais cupidata (Pursh) Greene), silky aster (Symphyotrichum sericeum (Vent.) G.L. Nesom), ground plum (Astragalus cassinicus Nutt.), white prairie clover (Dalea subfasciata Willd.), purple prairie clover (Dalea pratensis Vent.), fringed puccoon (Lithospermum incisum Lehm.), and gray goldenrod (Solidago nemolditis Aiton). On the lower, moister perimeter of the above zones, the following prairie species reach the peak of their abundance: American vetch (Vicia americana Muhl. ex Willd.), Canada anemone (Anemone canadensis L.), Culver’s root (Veronicastrum virginicum (L.) Farw.), Richard’s alumroot (Veronicastrum virginicum (L.) Farw.), Canada anemone (Anemone canadensis L.), Culver’s root (Veronicastrum virginicum (L.) Farw.), Richard’s alumroot

(Veronicastrum virginicum (L.) Farw.), Canada thistle (Cirsium arvense (L.) Scop.), foxtail species (Setaria spp.), common motherwort (Leonurus cardiaca L.), and Canada horseweed (Cynzyza canadensis (L.) Cronq.). Land managers at AHP will be challenged to keep the above invasive species, as well as any new ones, in check.

Fig. 9. Management zones (1-10) and units (identified by letter within each zone) at AHP (Filipiak and Friends of Ames High Prairie 2010). Reproduced by permission of The Nature Conservancy (Iowa Chapter).
harvested seeds of native grass species from within the preserve for reseeding of units 3B-3E, especially big bluestem (Andropogon gerardii Vitman) and Indiangrass (Sorghastrum nutans (L.) Nash) (J. Murdock, pers. comm., summer 2012). Subsequent overseeding of big bluestem and Indiangrass was done to the extent that these tall native grasses, along with several naturally occurring sedge (Carex) taxa, are currently the predominant prairie plants in these units.

Zone 3 is bordered by forest vegetation on both the north and east margins. Encroachment of common buckthorn and bush honeysuckle shrub taxa from these forest edges into prairie was extensive, almost completely covering the prairie in unit 3A, completely covering the prairie in 3F, and thwarting the reestablishment of prairie vegetation in these areas. However, the TNC work crew mentioned above removed and herbicide-treated a portion of the mature shrub growth in unit 3F in the spring of 2014, and Thompson removed and stump-treated the remaining mature shrubs in this unit and in unit 3A in the fall of that year. TNC’s and Thompson’s removal and herbicide treatments were the same as mentioned above, with the same results for each. Thompson sowed seed collected on site in clear-cut regions of units 3A and 3F in 2015.

Zone 4. This zone (Fig. 4f) is a low, moist-wet drainage area between hilltop prairies in zones 2 and 3. In late 2011, the Iowa Conservation Corp crew removed and stump-treated the buckthorn and bush honeysuckle blanketing the upper north and south perimeters, as well as scattered populations throughout the remainder of zone 4. The effectiveness of their herbicide treatment was minimal, and with no follow-up management, zone 4 once again became overgrown with mature, seed-producing shrubs. In 2014, the TNC crew used the same management methods as in 2011 to treat all of the invasive mature shrubs over all of zone 4, obtaining the same results. Until 2012, the remaining three quarters of this zone not in dense shrub shade (~5,000 m²) was covered by Canada thistle, supplemented by large populations of Japanese brome (Bromus japonicus Thunb. ex Murray) and giant foxtail, and smaller populations of reed canary grass and cup grass (Elymus villosus (Thunb.) Kunth). This zone does contain sparse native grass and sedge species, but very few native forb species. In 2012 and 2013, Thompson applied herbicide to the entire population of Canada thistle, with virtually 100% eradication, and to several smaller populations of reed canary grass, with good success. Annual follow-up work needs to be done in this zone to control buckthorn and bush honeysuckle shrub species as well as invasive, non-native annual grass species (e.g. giant foxtail, Japanese brome, and cup grass).

Forest

Zones 5-10 are now all dense, mature forest communities (Fig. 4f) that in the 1930s were almost entirely open, with sparse, scattered trees (Fig. 4b). Zones 5, 6, and the upper area of zone 7 occur at topographic positions above the preserve’s floodplain, while zones 8, 9, and 10 are located entirely in the floodplain of Squaw Creek. The drainage gully that originates northeast of the preserve (mentioned previously) flows through the center of zones 5, 6, and 8 and along the west edge of zone 9. This drainage area is dry as it passes through zones 5 and 6 except during periods of heavy rainfall. At the far north edge of zone 9, this usually dry drainage area turns into a continuously flowing stream through zones 8, 9, and finally empties into Squaw Creek approximately 20m south of the preserve’s southwest boundary. This stream develops at the above-ground outlet of a large storm sewer line there and floods the prairie in the spring of every year. A large portion of the northeastern corner of this zone.

The forest in the south end of zone 5 and all of zone 6 contains a higher diversity of tree species (black walnut (Juglans nigra L.), American basswood (Tilia americana L.), American elm, red elm (Ulmus rubra Muhl.), black maple (Acer negrum Michx.f.), black cherry (Prunus serotina Ehrh.), and choke cherry (Prunus virginiana L.) than that described above. Native forb species characteristic of forest vegetation are also more diverse here, including Jack-in-the-pulpit (Arisaema triphyllum (L.) Schott), bloodroot (Sanguinaria canadensis L.), showy orchis (Galearis spectabilis (L.) Raf.), and blue phlox (Phlox divaricata L.). However, prior to this study the lower end of zone 5 had become nearly impenetrable with a significant growth of buckthorn and bush honeysuckle shrub species. During the winter of 2014/2015, a crew from TNC cleared most of these shrubs, but with minimal stump treatment; thus, the large amount of spring sprout regrowth needs continuing follow-up management.

Most of zone 7 is on a south-facing hillside above the Squaw Creek floodplain. It currently supports a mature forest dominated by hackberry (Celtis occidentalis L.), bitternut hickory (Carya cordiformis (Wang.) K. Koch), honey locust (Gleditsia triacanthos L.), and black walnut. Bush honeysuckle shrub species are beginning to encroach into the understory of this forest, but are not yet dense. Native forb and graminoid species found here include jimpseg (Persicaria virginiana (L.) Gaertn.), American bellflower (Campanula americana (L.) Small), yellow giant hyssop (Agastache nepetoides (L.) Kuntze), tall hairy agrimony (Agrimonia gypsolepala Wallr.), obovate beak grass (Diarrhena obovata Beauv. var. obovata Gl.), slender wild rye (Elymus villosus Muhl. ex Willd.), James’s sedge (Carex jamesii Schwein.), and glomerate sedge. The TNC crew also removed some invasive shrubs in zone 7 in the winter of 2014-2015.

Zones 8-10. These three zones, which formerly were nearly open landscapes containing sparse trees (Fig. 4b-c), are currently occupied by a mature floodplain forest (Fig. 4f) dominated by the following tree species: eastern cottonwood, black walnut, honey locust, American and red elm, white mulberry (Morus alba L.), downy hawthorn (Crataegus mollis (T. & G.) Scheele), and pear hawthorn (Crataegus calpodendron (Ehrh.) Medicus). As mentioned above, many shrub and forb species have entered these floodplain zones as the result of the many major flood events in recent years. Because common buckthorn is more of an edge species, this shrub species is sparse in the interior of these forests, but two of the invasive, non-native bush honeysuckle taxa—showy fly honeysuckle and amur honeysuckle—have proliferated throughout these floodplain zones.

Non-native (winged wahoo (Euonymus alatus (Thunb.) Sieb.), autumn olive (Elaeagnus umbellata (Thunb.), Siebold’s arrowwood, and European cranberrybush (Viburnum opulus L)) and native (southern arrowwood (Viburnum dentatum L.), nannberry (Viburnum lentago L.), alternate-leaved dogwood (Cornus alternifolia Lf.), and American bladdernut (Staphylea trifolia L.)) shrub species have entered the floodplain zones. Non-native forbs found in the floodplain forest include money-plant, garden forget-me-not, Siberian geranium, Asiatic dayflower (Commelina communis L.), garlic mustard, bouncing bet (Saponaria officinalis L.), henbit deadnettle (Lamium amplexicaule L.), and Peruvian daisy (Galinsoga parviflora Cav.). However, native forb and sedge species also commonly occur in the floodplain forests of AHP. These include spearscale (Atriplex patula L.), spreading chervil (Chaerophyllum procumbens (L.) Crantz), common cowparsnip (Heracleum maximum American elm (Ulmus americana L.), and green ash (Fraxinus pennsylvanica Marsh.), and until recently an almost impenetrable understory of common buckthorn. During the school years of 2014 and 2015, environmental science classes and the student ECO Club at Ames High School (supervised by Ames High School teacher Mike Todd) cleared all mature buckthorn and most small trees from a large portion of the northeast corner of this zone.
DISCUSSION

Role of Ames High Prairie as a Vegetation Remnant

Saunders et al. (1991), in a seminal paper focused on native vegetation remnants in Australia, justified their preservation with respect to four criteria. These include: a) species-oriented reasons, in which individual species and their gene pools are preserved; b) example-oriented reasons, in which remnants preserve particular ecosystems, communities, habitats, and vegetation assemblages; c) process-oriented reasons, by which remnants preserve important ecological and evolutionary processes; and d) social-oriented reasons, in which remnants provide opportunities for people to experience nature in a variety of ways. Below, we describe how the tallgrass prairie remnants at AHP fulfill each of the above criteria.

By providing a refuge for tallgrass prairie plants within an urban landscape, AHP satisfies the first criterion above. Despite being among the smallest of 27 prairies protected as Iowa state preserves, the AHP flora ranks 8th in total number of prairie plant taxa preserved, and 15th in total number of prairie plant taxa of conservation concern (Fig. 8a-b). Furthermore, the AHP flora, when considered in its entirety, protects five taxa considered to be of “special concern” by the State of Iowa.

AHP fulfills the second criterion above by protecting an example of tallgrass prairie, which was the predominant vegetation in Iowa at the time of settlement by Europeans in the early 19th century (Smith 1998). Although conservation efforts usually focus on establishing large conservation reserves, Shafer (1995) and Schwartz and van Mantgem (1997) argued that large reserves should be augmented with smaller ones because the latter may be the only available representative of a given vegetation type. This justification for preservation of small preserves is especially germane in Iowa, where only a miniscule amount (< 0.1%) of historic tallgrass prairie vegetation remains (Smith 1998).

Ecological and evolutionary processes (third criterion above) certainly continue at AHP, highly influenced by its proximity to residential areas and the high school that gives this preserve its name. These include succession of vegetation communities in which former tallgrass prairie (Figs. 4a, 4b) has given way to forest vegetation (Fig. 4c, 4d), with fire suppression enforced by the City of Ames. The AHP flora has admitted many invasive plants in recent years, with the entry of some taxa facilitated by human landscape plantings and other activities observed by the authors.

Finally, AHP satisfies Saunders’ et al. (1991) fourth criterion, justifying preservation of vegetation remnants in providing opportunities for people to experience prairie. Numerous field trips (Fig. 10) to the preserve sponsored by various environmental agencies (e.g., TNC, Iowa Prairie Network (IPN)) and educational institutions (e.g., Ames High School, ISU) have given participants the opportunity to learn about tallgrass prairie plant identification and prairie management. AHP has for many years been one of the outdoor teaching areas most utilized by ISU courses (Joens 1978, Gucciardo 1987). A late 1970s study of student use of outdoor teaching laboratories showed that AHP was utilized by 13 different ISU courses offered among 6 different academic departments, accounting for more than 2,000 student hours (Joens 1978). Since 1978, the Outdoor Teaching Laboratories Committee (OTL), composed of ISU faculty members from multiple academic departments, has served an advisory role regarding use of AHP for teaching and research (Gucciardo 1987; J.L. Pease, pers. comm., Sept. 22, 2015). More recently (since 2006), Ames High School students have spent many hours working on prairie management projects at AHP (M. Todd, pers. comm., July 8, 2015).
Citizen use of AHP is subject to state and municipal regulations (e.g., hunting, trapping) and TNC regulations that prohibit horseback riding, bicycles, off-road vehicles, and camping in the preserve (Reiners 1997). Current signs posted at the east and west main entrances/exits to the preserve declare that the latter activities, as well as off-road vehicles, pets, digging plants, and firewood cutting, are prohibited. Nonetheless, a trail passing across the original main prairie, connecting the Ames High School parking lot and ISU housing via floodplain forest, was frequently used by bikers despite the above signage. However, bikers have not used the trail as frequently in the past several years.

SUMMARY

In a landscape in which the majority of the state’s former tallgrass prairie cover is already depleted, the amount of prairie protected at AHP ranks in the lower 20% of the 27 Iowa state preserves established primarily to protect native grassland. Yet, the species richness of prairie plant taxa protected in this Iowa state preserve ranks in the top third of these same 27 state preserves. This is remarkable, given that ownership and management responsibility for AHP have so frequently changed hands, and also given the unique threats to the prairie remnants posed by their close proximity to urban areas. We thus propose that the case study presented in this paper supports Schwartz and van Mantgem’s (1997) assertion, modified by us with the insertion of two italicized words: that “small urban preserves can play a critical role in conservation programs.”

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CONVALLARIAEAE [LILIACEAE in part]
*Convallaria majalis* L. (lily-of-the-valley) C; *C. 2088* (6)—Twf—sparse

Maianthemum racemosum (L.) Link [Smilacina racemosa (L.) Desf.] (false Solomon’s-seal) C; *C. 2140* (6)—T—common

Maianthemum stellatum (L.) Link [Smilacina stellata (L.) Desf.] (starry false Solomon’s-seal) C; *C. 2052* (8)—T—common

Polygonatum biflorum (Walters) Ell. (Solomon’s seal) C; *C. 2050* (8)—T—frequent

CYPERACEAE
Carex aggregata Mack. (glomerate sedge) C; *C. 2167* (6)—Tmf,ed; Pms—frequent

Carex bicknellii Britton (Bicknell’s sedge) N, C; *C. 2272* (2D)—Pms—in frequent

Carex blanda Dewey (eastern woodland sedge) C; *C. 2166* (6)—T; Pms; Wrp—O—common

Carex brevior (Dewey) Mack. ex Lunell (short-beak sedge) N, C; *C. 2263B* (3A)—Pdr,ms—common

Carex conjuncta Boott (soft fox sedge) C; *C. 2168* (6)—Ted; Pms,wt—frequent

Carex davisi Schein. & Torrey (Davis’ sedge) N, C; *C. 2229* (3C)—Ted; Pms—frequent

Carex echioides (Fern.) Rothr. Reznicek & Hipp (quill sedge) C; *C. 2194* (3A)—Tmf; Pms—in frequent

Carex gratrix Bailey (heavy sedge) N, C; *C. 2677* (1B)—Pdr—sparse

Carex grayi. (Gray’s sedge) C; *C. 2253* (8)—Tmf,wd—spEed; C

Carex gracilis Wahlenb. (*C. angustifolia* Steudel var. turgida Fern.) (inflated narrow-leaf sedge) C; *C. 2268B* (7)—7; P; W; O—common

Carex inops L. Bailey ssp. *bicolor* (Mack.) Crins (soft fox sedge) C; *C. 2095* (3D)—Pdr—sparse

Carex jamesii Schein. & Stebbins (James’ sedge) C; *C. 2087* (9)—Ted,msf; Pms—frequent

Carex leavenworthii Dewey (Leavenworth’s sedge) C; *C. 2223* (1B)—Pdr,ms; Owdf—in frequent

Carex meadii Dewey (Mead’s sedge) F, N, C; *C. 2092* (3A)—Pdr,ms—common

Carex melesta Mack. ex Bright (tumbled sedge) C; *C. 2264B* (3A)—Pms—sparse

Carex oligosperma Willd. (richwoods sedge) C; *C. 2211* (3E)—Pms—sparse

Carex pennsylvanica Lam. (Pennsylvania sedge) C; *C. 2119* (2C)—Pdr,ms—common

Carex richardsonii R. Br. (Richardson’s sedge) C; *C. 2022* (1E)—Pms—sparse

Carex sprengelii Dewey ex Sprengel (Sprengel’s sedge) C; *C. 2059* (3A)—Twf; Pms—common

Carex vulpinoidea Michx. (fox sedge) C; *C. 2289* (3A)—Pwt; Wrp—sparse

Cyperus strangulatus L. (straw-colored flatseed) C; *C. 2406* (3A)—Pdr—sparse

*Cyperus ciliatus* L. (*papyrus*) C; *C. 2692* (5)—Wrp—sparse

Siscium paludatum (Britton) Fernald (prairie blue-eyed grass) F, N, C; *C. 2039* (1B)—Pdr,ms—common

HYPOXIDACEAE [LILIACEAE, in part]
Hypoxis hirsuta (L.) Cov. (yellow stargrass) F, N, C; *C. 2074* (1C)—Pms—common

IRIDACEAE
*Belamcanda chinensis* (L.) DC. (blackberry lily) C; *C. 2317* (10)—Tmf—sparse

*Iris* sp. L. (iris) C; *C. 2493* (5)—Wrp—sparse

Sisyrinchium campestre Britton (prairie blue-eyed grass) F, N, C; *C. 2039* (1B)—Pdr,ms—common

JUNCACEAE
Juncus tenuis Willd. (path rush) C; *C. 2327* (3A)—Pdr,ms; Owdf—common

ORCHIDACEAE
Galaxias spectabilis (L.) Raf. (showy orchis) C; *C. 2091* (9)—Tmf—sparse

POACEAE
*Agrostis gigantea* Roth (redtop) C; *C. 2341* (1E)—Pms; Wrp—in frequent

Andropogon gerardii Vitman (big bluestem) F, N, C; *C. 2396* (3D)—Pdr,ms—common

Bouteloua curtipendula (Michx.) Torrey (side-oats grama) F, N, C; *C. 2364* (1D)—Pdr,ms—common

Bouteloua brevifolia Lag. (hairy grama) F, N, C; *C. 2495* (1C)—Pdr—sparse

*Bromus commutatus* Schrad. (hairy chess) C; *C. 2219* (1C)—Pms—sparse

*Bromus inermis* Leysser (smooth brome) F, C; *C. 2150* (3D)—T; P; W; O—common

*Bromus japonicus* Thunb. ex Murray (Japanese brome) F, C; *C. 2264* (3A)—Pms,wt—common

*Bromus tectorum* L. (downy chess) C; *C. 2292* (10)—Tmf—sparse

Cinna arundinacea L. (wood reed) C; *C. 2453* (3A)—Pms—sparse

*Danthyllum gramineum* L. (orchard grass) C; *C. 2098* (7)—Pms; Wrp—Owdf—in frequent

Diarrheoblastobartodorsatum (Gleason) Brandenburg [*D. americana* Beav.] (ovate beakgrass) C; *C. 2415* (8)—Ted—sparse

 Dichanthelium acuminatum (Sw.) Gould & Clark subsp. implicatum (Scribner) Freckmann & Lelong [*D. acuminatum* (Sw.) Gould & Clark var. implicatum (Scribner) Gould & Clark] (western panicgrass) F, N, C; *C. 2397* (3F)—P—common

 Dichanthelium oligosanthes (Schultes) Gould ssp. scriberianum (Nash) Gould (Scribner’s rosette grass) F, N, C; *C. 2279* (1F)—P—common

 Dichanthelium ovale (Ell.) Gould & A. Clark ssp. praecoxius (Hitchoch. & Chase) Freckmann & Lelong [*D. acuminatum* (Sw.) Gould & Clark var. *villosus* (Gray) Gould & Clark] (eggleaf rosettegrass) F, C; *C. 2277* (2E)—P—common

 Dichanthelium perplexum (Nash) Freckmann (long-stalked panicgrass) F

 Dichanthelium villosanthes (Vasey) Freckmann [*D. oligosanthes* (Schultes) Gould var. *villosanthes* (Vasey) Gould & Clark] (fall rosette grass) F; *C. 2610* (2C)—Pdr—sparse

*Digitaria ischaemum* (Schreber ex Schweigert) Schreber ex Muhl. (smooth crabgrass) C; *C. 2475* (9)—Pdr,ms; Wrp; Owdf—in frequent

*Digitaria sanguinalis* (L.) Scop. (common crabgrass) C; *C. 2434* (8)—Pdr,ms; Wrp; Owdf—in frequent

*Echinochloa crus-galli* (L.) Beauv. (barnyardgrass) C; *C. 2578* (4)—P—W—infrequent

*Elusine indica* (L.) Gaertner (goose grass) C; *C. 2685* (8)—Tmf—Owdf—sparse

*Elymus canadensis* L. var. *canadensis* [E. canadensis L.] (Canada wild rye) F, N, C; *C. 2416* (1B)—Pdr,ms—frequent

*Elymus repens* (L.) Gould [*Agropyron repens* (L.) Beauv.] (quack grass) C; *C. 2293* (1A)—Pdr,ms—sparse

*Elymus villosus* Muhl. var. *villosus* [E. *villosus* Muhl.] (slender wild rye) C; *C. 2321* (7)—Tmf,wd—ed; Pwt—common

*Elymus virgincus* L. var. *virgincus* [E. *virginicus* L.] (Virginia wild rye) C; *C. 2384* (5)—Tmf,wd—ed; Pwt—common

*Eragrostis cilianensis* (All.) Link ex E. Mosher (stinkgrass) C; *C. 2703* (5)—Twf—sparse

*Eragrostis pectinacea* (Michx.) Nees ex Steud. var. *pectinacea* (tufted lovegrass) C; *C. 2503* (8)—Orw—sparse

*Eriochloa villosa* (Thunb.) Kunth (cup grass) C; *C. 2427* (4)—Pms,wt—sparse

Festuca paradoxa Desv. (clustered fescue) C; *C. 2400* (3C)—Pms—sparse

*Festuca rubra* L. (red fescue) C; *C. 2274* (2D)—Pdr—sparse

Festuca subverticillata (Pers.) E. B. Alexeev [*F. obtusa* Biehler] (nodding fescue) C; *C. 2245* (7)—T—common
Glyceria striata (Lam.) A.S. Hitchc. (fowl manna grass) C; C 2712 (1D)—Pms—sparse

Hesperostipa spartea Trin. [Stipa spartea Trin.] (porcupine grass) F, N, C; C 2169 (3D)—Pdr,ms—common

Hordeum jubatum L. (squirrel-tail barley) F; C 2152 (3A)—Pms,wt—infrequent

#Hordeum pusillum Nutt. (little barley) C; C 2661 (3F)—Pms—sparse

Koeleria macrantha (LedList.) Schult. (June grass) F, N, C; C 2172 (1A)—Pdr—infrequent

Leersia oryzoides (L.) Sw. (rice cut-grass) C; C 2580 (1A)—T; P—common

Leersia virginica Willd. (whitegrass) C; C 2439 (8)—T; P—common

* Lotus perennis L. (perennial rye grass) C; C 2215 (7)—Wrp; Odw—sparse

Muhlenbergia cuspidata (Torrey) Rydb. (plains muhly) F, N, C; C 2472 (2E)—Pdr—common

Muhlenbergia frondosa (Poir.) Fern. (wirestem muhly) C; C 2519 (3D)—T; P—common

Muhlenbergia intermediate between Muhlenbergia mexicana (L.) Trin. (Mexican muhly) and Muhlenbergia sylvatica (Torrey) Torrey and Gray (forest muhly) C; C 2663 (10)—Twf—infrequent

Muhlenbergia schreberi J. F. Gmelin (nimblewill) C; C 2394 (3D)—T; P; W; O—common

Panicum capillare L. spp. capillare [P. capillare L.] (witchgrass) C; C 2577 (4)—Ted; Pms—sparse

Panicum dichotomiflorum Michx. (knee grass) C; C 2619 (8)—Wrp—common

* Panicum miliaecum L. ssp. miliaecum (proso millet) C; C 2706 (1B)—Pms—common

Panicum virgatum (L.) Sw. (witchgrass) F, N, C; C 2454 (3A)—P—frequent

Paspalum setaceum Michx. (bead grass) F; Freckenham 1396

Phalaris arundinacea L. (reed canary grass) C; C 2175 (3A)—Twf,ed; Pms,wt; Wrp—frequent

* Phleum pratense L. (timothy) C; C 2320 (1A)—Pdr—sparse

* Poa annua L. (annual bluegrass) F; C 2020 (7)—Odw—sparse

* Poa compressa L. (Canadian bluegrass) F; C 2239 (2C)—Pdr—frequent

* Poa pratensis L. (Kentucky bluegrass) F, C; C 2031 (3C)—T; P; W; O—common

Poa sylvestris Gray (woodland bluegrass) C; C 2235 (6)—Wrp—sparse

* Poa trivialis L. (meadow grass) C; C 2296 (9)—Wrp—sparse

Poa wolffii Scribn. (meadow bluegrass) C; C 2671 (10)—Twf—sparse

* Schiedonorus arundinaceus (Schreb.) Dumort. [Festuca arundinacea Schreb.] (alta fescue) C; C 2287 (7)—P—frequent

Schizachyrium scoparium (Michx.) Nash (little bluestem) F, N, C; C 2493 (1E)—Pdr—common

* Setaria farii Herm. (giant foxtail) C; C 2502 (4)—P—common

* Setaria pumila (Poir.) Roem. & Schult. spp. pumila [S. glauca (L.) Beauv.] (yellow foxtail) F, C; C 2402 (5)—P—common

* Setaria verticillata (L.) Beauv. (bristly foxtail) C; C 2700 (1A)—Pms—sparse

* Setaria viridis (L.) Beauv. var. viridis [S. viridis (L.) Beauv.] (green foxtail) F, C; C 2501 (9)—P; W—sparse

Sorghastrum nutans (L.) Nash (Indian grass) F, N, C; C 2453 (3A)—P—common

* Sorghum halepense (L.) Pers. (Johnson grass) C; C 2000 (3C)—Pdr—sparse

Sphenopholis intermedia Rydb. [S. obtusata (Michx.) Scribn. var. major (Torrey) R. S. Erdman] (slender wedgescale) C; C 2217 (3A)—Pwt—common

Sphenopholis obtusata (Michx.) Scribn. (prairie wedgescale) C; C 2268 (3A)—Pdr—sparse

Sporobolus compositus (Poir.) Merr. [S. asper (Michx.) Kunth] (dropped) F, N, C; C 2616 (1B)—Pdr—frequent

Sporobolus heterolepis (Gray) Gray (prairie dropped) F, N, C; C 2517 (1E)—Pdr—common

Tridens flavus (L.) A. S. Hitchc. (purple top) C; C 2484 (2A)—P—common

SMILACACEAE [LILIACEAE in part]

Smilax coccinea L. (carrion flower) C; C 2349 (8)—T—sparse

Smilax herbacea L. (carrion flower) C; C 2205 (1F)—T—sparse

Smilax tamnoides L. [S. hispida Muhl.] (greenbrier) C; C 2082 (9)—T—common

TYPHACEAE

Typha angustifolia L. (narrow-leaved cattail) C; C 2714 (1A)—Wrp—common

(EUDICOTS)

ADOXACEAE [CAPRIFOLIACEAE, in part]

Sambucus nigra L. ssp. canadensis (L.) R. Bolli [S. canadensis L.] (elderberry) F, C; C 2303 (10)—T—common

Viburnum dentatum L. (southern arrowwood) C; C 2431 (9)—Twf; Wrp—infrequent

Viburnum lantana L. (wayfaringtree) C; C 2062 (5)—T—sparse

Viburnum lentago L. (nannyberry) C; C 2639 (8)—Tmf—sparse

Viburnum opulus L. (European cranberrybush) C; C 2064 (10)—T—frequent

Viburnum sieboldii Miq. (Siebold’s arrowwood) C; C 2063 (8)—Tmf—sparse

AMARANTHACEAE [includes CHENOPODIACEAE]

Amaranthus albus L. (pigweed) C; C 2588 (1D)—Oss—sparse

* Amaranthus retroflexus L. (pigweed) F, C; C 2605 (1D)—Oss—sparse

Amaranthus tuberculatus (Moq.) Sauer (water hemp) C; C 2587 (5)—T; P; Oss—common

Atriplex patula L. (sparseroot) C; C 2527 (9)—Wrp—sparse

* Chenopodium album L. var. album (lamb’s quarters) F, C; C 2611 (4)—T; P; Oss—common

* Chenopodium berlandieri Moq. (pitsed goosefoot) C; C 2586 (1F)—Twf,ms—Pms—frequent

* Chenopodium simplex (Torrey) Raf. [C. hybridum L.] (maple-leaved goosefoot) C; C 2379 (10)—Tmf—sparse

* Chenopodium standleyanum Aellen (woodland goosefoot) C; C 2469 (3B)—T; P; Wrp—common

* Chenopodium strictum Roth (lateflowering goosefoot) C; C 2538 (3A)—Twf,ms—Pms—frequent

ANACARDIACEAE

Rhus aromatica Aiton (fragrant sumac) C; C 2333 (1E)—Pms—sparse

Rhus glabra L. (smooth sumac) F, C; C 2080 (1B)—Pdr—ms—frequent

Rhus typhina L. (staghorn sumac) C; C 2078 (1A)—Pms—sparse

Toxicodendron radicans (L.) Kutz. spp. negundo (Greene) Gillis (poison ivy) C; C 2061 (5)—T; P; W—common

APIACEAE

Chaerophyllum procumens (L.) Crantz (chervil) C; C 2003 (10)—Twf—frequent

Conium maculatum L. (poison hemlock) C; C 2109 (8)—T—Tmf—sparse

* Cryptotaenia canadensis (L.) DC. (hemwort) C; C 2207 (6)—Tmf—frequent

* Daucus carota L. (Queen Anne’s lace) C; C 2342 (3A)—P; Odw—frequent

Heracleum maximum Bartram [H. lanatum Michx.] (cow parsnip) C; C 2409 (8)—Twf—sparse

Osmorhiza longistylis (Torrey) DC. (nine root) C; C 2120 (8)—T; P—frequent

* Pastinaca sativa L. (wild parsnip) C; C 2019 (1A)—T; P; W—common

Sanicula canadensis L. (black snakeroot) C; C 2282 (1A)—Tmf—common

Sanicula odorata (Raf.) K. M. Pryer & L. R. Phillisep [S. gregaria Bickn.] (common snakeroot) C; C 2121 (8)—Tmf—common
*Torilis arvensis* (Hudson) Link (hedge parsley) C; C 2713 [3A]—Pms—sparse

Zizia aurea (L.) Koch (golden alexanders) N, C; C 2089 [1B]—Pdr—sparse

APOCYNACEAE [includes ASCLEPIADACEAE]

*Apocynum cannabinum* L. [includes *A. sibiricum* Jacq.] (Indian hemp) F; C; C 2301 [1F]—Pms—common

Asclepias syriaca L. (common milkweed) F; C; C 2280 [1B]—T; P; W; O—common

Asclepias tuberosa L. sspp. interior Woodson (butterfly weed) N, C; C 2308 [3A]—Pdr,ms—infrequent

Asclepias verticillata L. (whorled milkweed) F, N, C; C 2494 [1D]—Pdr,ms—infrequent

*Asclepias viridiflora* L. (green milkweed) N, C; C 2472 [7]—T; P; O—common

*Achillea millefolium* Greene (pussytoes) F, C; C 2423 [3A]—Twf—Pms—sparse

ASTERACEAE

*Achillea millefolium* L. [ *A. millefolium* L. sspp. lanulosa (Nutt.) Piper] (western yarrow) F, C; C 2307 [3D]—Pdr—infrequent

Ageratina altissima (L.) King & H. E. Robins. var. altissima [Eupatorium rugosum Houtt.] (white snakeroot) C; C 2408 [8]—T; P—common

*Ambrosia artemisiaefolia* L. (common ragweed) F, C; C 2492 [7]—P; Odw—infrequent

*Ambrosia psilostachya* Nutt. (giant ragweed) F, C; C 2398 [2E]—P—common

*Ambrosia trifida* L. (giant ragweed) F, C; C 2474 [8]—Twf,ed; P—infrequent

Antennaria neglecta Greene (pussytoes) F, C; C 2201 [1C]—Pdr—sparse

*Anthemis cotula* L. (dog fennel) F; Lelong 9 July 1961

*Ariton minus* Bernh. (common burdock) F, C; C 2006 [1B]—T; P; W; O—common

*Nodocalais corymbulosa* L. (compass plant) F, C; C 2285 [1F]—Pms—common

*Artemisia ludoviciana* Nutt. (white sage) F, N, C; C 2526 [3E]—P—common

Bidens connata Muhl. ex Willd. (purplestem beggarticks) C; C 2512 [1A]—Wrp—sparse

Bidens frondosa L. (beggar-ticks) C; C 2581 [1A]—Wrp—sparse

Bidens vulgaris Greene (tall beggar-ticks) C; C 2536 [1A]—Wrp—sparse

Brickellia eupatorioides (L.) Barnh. (spiny-leaved sow-thistle) C; C 2418 [1B]—Pms—infrequent

*Carduus nutans* L. (musk thistle) C; C 2007 [1B]—Pms—infrequent

Cirsium altissimum (L.) Sprengel (tall thistle) N; no herbarium voucher

*Cirsium arvense* (L.) Scop. (Canada thistle) C; C 2288 [4]—Ted; Pms,wt—common

*Cirsium discolor* (Muhl. ex Willd.) Sprengel (field thistle) N, C; C 2450 [3A]—T; P—common

*Cirsium billii* (Canby) Fern. (Hill's thistle) F, C; C 2081 [1D]—Pdr—sparse

*Cirsium vulgare* (Savi) Tenore (bull thistle) C; C 2407 [3B]—P—common

Conyza canadensis (L.) Cronq. (horseweed) F, C; C 2407 [3B]—P—common

Coreopsis palmata Nutt. (prairie coreopsis) F, N, C; C 2298 [1F]—Pms—infrequent

Echinacea pallida (Nutt.) Nutt. (pale coneflower) F, N, C; C 2242 [2C]—Pdr,ms—common

Erechtites hieracifolius (L.) Raf. ex DC. [Erechtites hieracifolia (L.) Raf. ex DC.] (fireweed) C; C 2511 [1B]—Pms—common

Erigeron annuus (L.) Pers. (annual fleabane) C; C 2181 [3D]—P—common

Erigeron philadelphicus L. (fleabane) C; C 2165 [1D]—Twf—sparse

Erigeron strigosus Muhl. ex Willd. (daisy fleabane) F, N, C; C 2182 [2E]—Pdr—infrequent

Eupatorium altissimum L. (tall thoroughwort) C; C 2480 [1A]—Pms—infrequent

Eutrochium purpureum (L.) E. E. Lamont [Eupatorium purpureum L.] (purple Joe-pye-weed) C; C 2409 [7]—Twf,ed—infrequent

*Galinsoga parviflora* Cav. (Peruvian daisy) C; C 2528 [9]—Wrp—sparse

Helianthus annuus L. (common sunflower) C; C 2697 [1A]—Pms—common

Helianthus grosseserratus Martens (saw-tooth sunflower) F, N, C; C 2445 [1C]—Pdr,ms—infrequent

Helianthus tuberosus L. (Jerusalem artichoke) C; C 2479 [1A]—Pms—infrequent

*Heliopsis helianthoides* L. (sweet (ox-eye) N, C; C 2248 [1E]—Pms—frequent

Lactuca canadensis L. (wild lettuce) F, N, C; C 2424 [3A]—T; P—common

Lactuca floridana (L.) Gaertner (blue lettuce) C; C 2457 [6]—T—frequent

Notobocalis cuspidata (Pursh) Greene (prairie dandelion) F, N, C; C 2032 [1B]—Pdr,ms—infrequent

Packera plattensis (Nutt.) W. A. Weber & Á. L. Löve [Senecio plattensis Nutt.] (prairie ragwort) C; C 2097 [2C]—Pdr,ms—infrequent

Pseudognaphaliium obtusifolium (L.) Hilliard & Burtt spp. obtusifolium [Gnaphalium obtusifolium L.] (everlasting) C; C 2551 [1E]—Pms—sparse

Ratibida pinnata (Vent.) Barnh. (gray-headed coneflower) F, N, C; C 2354 [1B]—P—common

Rudbeckia hirta L. (black-eyed Susan) F, N, C; C 2243 [2A]—P—frequent

Rudbeckia triloba L. (brown-eyed Susan) C; C 2413 [9]—Twf,ed—sparse

*Solidago altissima* L. subsp. gilvocanescens (Rydb.) Semple [Solidago canadensis L., in part] (Canada goldenrod) F, N, C; C 2449 [1A]—P—common

*Solidago gigantea* Aiton (smooth goldenrod) C; C 2444 [3B]—Pms,wt—Wrp—infrequent

*Solidago missouriensis* Nutt. (Missouri goldenrod) C; C 2516 [1E]—Pms—sparse

Solidago nemoralis Aiton (gray goldenrod) F, C; C 2514 [2C]—Pdr—sparse

*Solidago rigida* L. (stiff goldenrod) F, N, C; C 2496 [1A]—P—common

*Sonchus asper* (L.) Hill (spiny-leaved sow-thistle) C; C 2462 [8]—Twf,ed—sparse

*Symphyotrichum cordifolium* (L.) G. L. Nesom [Aster cordifolius L.] (blue wood aster) C; C 2607 [8]—Twf,ed—sparse

*Symphyotrichum ericoides* (L.) G. L. Nesom [Aster ericoides L.] (heath aster) F, N, C; C 2547 [1E]—Pdr,ms—common

*Symphyotrichum lanceolatum* (Willd.) G. L. Nesom (Aster lanceolatus Willd.) (white paniced aster) F, N; no herbarium voucher

*Symphyotrichum novae-angliae* (L.) G. L. Nesom [Aster novae-angliae L.] (New England aster) N, C; C 2615 [1E]—Pms—sparse
Sympotrichrum oblongifolium (Nutt.) G. L. Nesom [Aster oblongifolius Nutt.] (aromatic aster) C; C 2592 (2C)–Pms–sparse
Sympotrichrum ontoris (Wiegand) G. L. Nesom var. ontoris [Aster ontoris Wieg.] (Ontario aster) C; C 2606 (8)–Twf, ed–common
Sympotrichrum oolentangiense (Riddell) G. L. Nesom [Aster azureus Lindl.] (sky-blue aster) F, N, C; C 2548 (2C)–P–common
Sympotrichrum pilosum (Willd.) G. L. Nesom [Aster pilosus Willd.] (hairy aster) N, C; C 2590 (1E)–Ted; P–common
Sympotrichrum praecatum (Poir.) G. L. Nesom [Aster praecatus Poir.] (willow aster) C; C 2593 (8)–Twf, ed–sparse
Sympotrichrum sericeum (Vent.) Nesom [Aster sericus Vent.] (silky aster) F, N, C; C 2573 (1C)–Pdr–frequent
* Taraxacum erythropleurum Andrejewski ex Besser [Taraxacum laeavigatum (Willd.) DC.] (red-seeded dandelion) C; C 2170 (3D)–Pdr–sparse
* Taraxacum officinale Weber (common dandelion) C; C 2014 (3A)–T; P; W; O–common
* Tragojogen dubius Scop. (goat’s beard) F, C; C 2221 (1D)–Pdr, ms–infrequent
Vernonia baldwinii Torrey (Baldwin’s ironweed) F, N, C; C 2382 (1C)–Pdr, ms–infrequent
* Xanthium strumarium L. (cocklebur) C; C 2702 (5)–Twf, ed–sparse
BALSAMINACEAE
Impatiens capensis Meerb. (spotted touch-me-not) C; C 2508 (8)–Twf, ed; Wrp–frequent
Impatiens pallida Nutt. (pale touch-me-not) C; C 2365 (9)–Twf, ed; Wrp–infrequent
BERBERIDACEAE
* Berberis cf. koreana Palib. × B. thunbergii DC. (Korean barberry × Japanese barberry) C; C 2331 (2A)–Pms–sparse
* Berberis thunbergii DC. (Japanese barberry) C; C 2035 (2A)–Pms–sparse
BIGNONIACEAE
* Catalpa speciosa Warder (cigar tree) C; C 2247 (8)–Twf–in frequent
BORAGINACEAE [includes HYDROPHYLLACEAE]
Ellista nyctela L. (waterpod) C; C 2066 (10)–T–common
Hackelia virginiana (L.) I. M. Johnston (stickleseed) C; C 2360 (4)–T; P; O–common
Hydrophyllum virginianum L. (Virginia waterleaf) C; C 2111 (7)–Twf–common
* Lappula squarrosa (Retz.) Dumort. [L. ebinata Gilib.] (beegar’s-lice) F; J. W. Parsons 16 July 1948
Lithospermum canescens (Michx.) Lehm. (hoary puccoon) F, N, C; C 2055 (28)–Pdr–infrequent
Lithospermum incisum Lehm. (fringed puccoon) F, N, C; C 2079 (1E)–Pdr–infrequent
* Moovis sybeiris Hoffm. (forget-me-not) C; C 2648 (9)–Wrp–sparse
Onosmodium bejariense DC. ex A. DC. var. occidentale (Mack.) B. L. Turner [O. molle Michx. var. occidentale (Mack.) I. M. Johnston] (false gumwell) F, N, C; C 2213 (1B)–Pdr–frequent
BRASSICACEAE
* Allaria petiolata (Biebr.) Cavara & Grande (garlic mustard) C; C 2010 (5)–Twf; Pwt; Wrp–frequent
Bocearea dentata (Rafinesque) Al-Sherbaz & Zarucchi [Arabis shortii (Fern.) Gil.] (rock cress) C; C 2085 (6)–Twf–common
* Barbarea vulgaris R. Br. (yellowrocket) C; C 2027 (4)–Ted; Pdr–infrequent
* Capsella bursa-pastoris (L.) Medicus (shepherd’s purse) C; C 2038 (4)–Twf; Pwt–sparse
Descarainia pinnata (Walter) Britton ssp. brachycarpa (Richardson) Detling [Descarainia pinnata (Walter) Britton var. brachycarpa (Richardson) Fern.] (tansy mustard) C; C 2106 (1B)–Twf, ed; Oss–sparse
* Lepidium campestre (L. R. Br. (field cress) F; C 2096 (3D)–Pdr–sparsle
Lepidium densiflorum Schrader (pepper grass) C; C 2435 (8)–Twf; Wrp–sparse
Lepidium virginicum L. ssp. virginicum (poor-man’s pepper) C; C 2367 (8)–Twf; Wrp–sparse
Lunaria annua L. (annual honesty) C; C 2638, 2646 (8)–Twf–sparse
Korippa palustris (L.) Besser (marsh cress) C; C 2346 (8)–Twf–sparse
* Sinapis arvensis L. (charlock) F; LeHong 1961
* Stizymbium loselli L. (small tumbleweed mustard) C; C 2116 (3C)–Pdr, ms–sparse
* Thlaspi arvense L. (field pennygrass) C; C 2118 (3A)–Twf, ed; Oss–sparse
CAMPANULACEAE
Campanulastrum americanum (L.) Small [Campanula americana L.] (tall bellflower) C; C 2388 (8)–T–common
Lobelia siphilitica L. (great lobelia) C; C 2513 (5)–Pms, wt; Wrp–infrequent
Lobelia spicata Lam. (spiked lobelia) F, N, C; C 2200 (1A)–P–common
Triodanis perfoliata (L.) Nieuw. (Venus’ looking-glass) C; C 2329 (2A)–Pms–sparse
CANNABACEAE [includes MORACEAE, in part, and ULMA CEAE, in part]
* Cannabis sativa L. (hemp) F, C; C 2281 (1B)–Pdr–sparse
Celtis occidentalis L. (hackberry) C; C 2110 (7)–T–frequent
* Humulus japonicus Sieb. & Zucc. (Japanese hops) C; C 2642 (8)–Twf–sparse
Humulus lupulus L. (common hops) C; C 2623 (8)–Twf, ed–in frequent
CAPRIFOLIACEAE
* Lonicera × bella Zabel (L. tatarica L. × L. morrowii A. Gray) (showy fly honeysuckle) C; C 2112 (10)–T–common
* Lonicera maackii (Rupr.) Maxim. (amur honeysuckle) C; C 2136 (8)–T–common
* Lonicera morrowii Gray (Morrow’s honeysuckle) C; C 2630 (10)–Twf–sparse
* Lonicera cf. nuprechittiana Regel (Manchurian honeysuckle) C; C 2134 (8)–T–sparse
Symphoricarpos orbilicus Moench (coralberry) C; C 2441 (2E)–Pdr, ms–sparse
CARYOPHYLLACEAE
* Cerastium fontanum Baumg. ssp. vulgar (Hartman) Greuter & Burdet [C. vulgarum L.] (mouse-ear chickweed) C; C 2144 (1A)–Wrp; Pms–in frequent
* Dianthus armeria L. (Deptford pink) C; C 2705 (3F)–Ted–sparse
* Saponaria officinalis L. (bouncing bet) C; C 2684 (9)–Wrp–sparse
Silene antirrhina L. (sleepy catchfly) F, C; C 2266 (3A)–Pms; Oss–sparse
Silene latifolia Poir. [S. pratensis (Rafn) Gren. & Godron] (white campion) C; C 2196 (3C)–Pms–sparse
Silene stellata (L.) Aiton f. (starry campion) C; C 2356 (1A)–Ted; Pms–sparse
* Stellaria media (L.) Vill. (common chickweed) C; C 2036 (4)–Twf; Pwt; Wrp–common
CELASTRACEAE
Celastrus scandens L. (bittersweet) C; C 2220 (1B)–Twf; Pms–common
* Euonyms datus (Thunb.) Sieb. (winged wahoo) C; C 2051 (8)–Twf–sparse
Euonymus atropurpureus Jacq. (wahoo) C; C 2339 (8)–Twf–sparse
ROLE OF AN URBAN TALLGRASS PRARIE REMNANT

*Esoreynus fortunii* (Turez.) Hand.-Maz. (winter creeper) C; *C 2193* [5]—Twf—spars

**CISTACEAE**

*Helianthemum bicknellii* Fern. (rockrose) F; *Michel LeLong M263

**CONVOLVULACEAE**

*Calystegia sepium* (L.) Br. (hedge false bindweed) F; *no herbarium voucher*

*Cuscuta conylii* Engel. (hazel dodder) C; *C 2463* [1A]—Pms—spars

**CORNACEAE**

*Corus alternifolia* f. f. (alternate-leaved dogwood) C; *C 2107* [8]—Twf—spars

*Corus amomum* S. Miller sp. obliqua (Raf.) J. S. Wilson (silky dogwood) C; *C 2510* [8]—Twf—spars

*Corus drummondii* C. A. Meyer (rough-leaved dogwood) C; *C 2250* [1A]—Twf,ed; P—common

**ELAEAGNACEAE**

*Elaeagnus umbellata* Thunb. (autumn olive) C; *C 2034* [2A]—Ted; Pms—spars

**EUPHORBIACEAE**

*Acalypha rhomboidea* Raf. (three-seeded mercury) C; *C 2422* [5]—T—common

*Chamaesyce glyptosperma* (Engelm.) Small [Euphorbia glyptosperma Engelm.] (ribseed sandmat) C; *C 2686* [3D]—Pdr—spars

*Chamaesyce maculata* (L.) Small [Euphorbia maculata L.] (carpet spurge) C; *C 2691* [7]—Odwd—spars

*Chamaesyce nutsan* (Engelm.) Small [Euphorbia nutsan Lag.] (noodling spurge) C; *C 2701* [3D]—Pdr—spars

#Chamaesyce serpulifolia (Pers.) Small sp. serpulifolia [Euphorbia serpulifolia Pers.] (thymeleaf sandmat) F; *no herbarium voucher*

*Euphorbia dentata* Michx. (toothed spurge) F; C; *C 2568* [1A]—Ted—spars

**FABACEAE**

*Amorpha canescens* Pursh (lead plant) F, N, C; *C 2299* [1F]—Pdr,ms—common

*Amphicarpaea bracteata* (L.) Fern. (hug peanut) F, C; *C 2521* [1A]—Twf,ed—spars

*Astragalus canadensis* L. (milk vetch) F; *no herbarium voucher*

*Astragalus crassicarpus* Nutt. (ground plum) F, N, C; *C 2025* [1B]—Pdr,ms—infrars

*Baptisia alba* (L.) Vent. var. *macrophylla* (Larisey) Isely [B. lactea (Raf.) Thiere] (white wild indigo) F, N, C; *C 2238* [2A]—P—common

*Baptisia bracteata* Muhl. ex Ell. var. *leucophylla* (Nutt.) Kartesz & Gandhi [B. bracteata Muhl. ex Ell. var. glabrescens (Larisey) Isely] (cream wild indigo) F, N, C; *C 2075* [1A]—Pdr,ms—infrars

~Cercis canadensis L. (redbud) C; *C 2084* [9]—Ted—infrars

*Chamaecrista fasciculata* (Michx.) Greene var. *fasciculata* (partridge pea) F, N, C; *C 2704* [1C]—Pms—common

*Delesia candida* Willd. var. *candida* (white prairie clover) F, N, C; *C 2324* [1B]—Pdr,ms—common

*Delesia purpurea* Vent. (purple prairie clover) F, N, C; *C 2325* [1E]—Pdr,ms—common

*Desmodium canadense* (L.) DC. (showy tick-trefoil) F, N; *Lelong M353

*Desmodium illinoense* Gray (Illinois tick-trefoil) F, N, C; *C 2679* [1B]—Pdr—common

*Gleditsia triacanthos* L. (honeylocust) F, C; *C 2069* [5]—T—common

*Gymnocladus dioica* (L.) Koch (Kentucky coffee tree) C; *C 2438* [8]—Twf,ed—infrars

*Lepedeza capitata* Michx. (round-headed lespedeza) F, N, C; *C 2390* [1E]—Pdr,ms—common

*Lotus corniculatus* L. (bird’s-foot trefoil) F, C; *C 2180* [3D]—T; P; W; O—common

*Medicago lupulina* L. (black medick) F, C; *C 2126* [3C]—Pdr,ms—infrars

*Mellotus officinalis* (L.) Pallas [includes *M. alba* Medicus] (sweet clover) F; C; *C 2204* [1B]—T; P; O—common

*Pedieolum argyrophyllum* (Parsh) Grimes (silvery scurf-pea) F, N, C; *C 2297* [1C]—Pms—infrars

*Securigera varia* (L.) Lassen [Coronilla varia L.] (crown vetch) F; C; *C 2202* [1B]—P—common

*Trifolium pratense* L. (red clover) F, C; *C 2143* [3C]—Pdr,ms; Odwd—infrars

*Trifolium repens* L. (white clover) F, C; *C 2154* [6]—T; P; W; O—common

*Vicia americana* Muhl. ex Willd. (vetch) F, C; *C 2073* [1C]—Pdr,ms—infrars

**FAGACEAE**

~Quercus imbricaria* Michx. (shingle oak) C; *C 2665* [1B]—Pdr—spars

*Quercus macrocarpa* Michx. (bur oak) C; *C 2100* [6]—T—spars

*Quercus rubra* L. [Q. borealis Michx. f. var. *maxima* (Marsh.) Ashe] (northern red oak) C; *C 2101* [6]—T—spars

**GENTIANACEAE**

*Gentiana andrewsii* Griseb. (bottle gentian) F; *no herbarium voucher*

*Gentiana pulchrella* J. Pringle (downy gentian) N, C; *C 2589* [1C]—Pdr,ms—common

**GERANIACEAE**

*Geranium sibiricum* L. (Siberian geranium) C; *C 2515* [8]—Twf—infrars

**GROSSULARIACEAE (SAXIFRAGACEAE, in part)**

*Ribes missouriense* Nutt. ex T. & G. (Missouri gooseberry) C; *C 2018* [9]—T—P—common

**HYPERICACEAE**

*Hypericum ascyron* L. [H. pyramidatum Aiton] (giant St. John’s wort) F, N, C; *C 2326* [1C]—Tmf,ed; P—common

**JUGLANIDAEAE**

*Carya cordiformis* (Wang.) K. Koch (bitternut hickory) C; *C 2252* [7]—T—frequent

*Juglans nigra* L. (black walnut) C; *C 2076* [1A]—T—P—common

**LAMIACEAE**

*Agastache nepetoides* (L.) Kunzete (yellow giant-hyssop) C; *C 2473* [8]—T—spars

*Glechoma bedarica* L. (ground ivy) C; *C 2626* [4]—T; P; W; O—common

*Hedoma bispidum* Pursh (rough pennyroyal) F; *Jane Magee 1948

~Lamium amplexicaule* L. (dead nettle) C; *C 2065* [10]—Twf—infrars

*Leonurus cardiaca* L. (motherwort) C; *C 2195* [3A]—T—common

*Leonurus sibiricus* L. (honeyweed) C; *C 2465* [3A]—Pms—infrars

*Monarda fistulosa* L. (wild bergamot) F, N, C; *C 2381* [1B]—P—common

* Nepeta cataria* L. (catnip) F; C; *C 2015* [4]—T—P—common

*Prunella vulgaris* L. (self heal) F, C; *C 2420* [1A]—Ted; Wrp—infrars

*Pyrentherum virginianum* (L.) Dur. & Jackson (Virginia mountain mint) F, N, C; *C 2359* [1A]—P—common

*Scutellaria lateriflora* L. (mad-dog skullcap) C; *C 2437* [8]—Twf—infrars

*Scutellaria parvula* Michx. var. *missouriensis* (Torr.) Goodman & Lawson [S. leonardii Epling] (Leonard’s skullcap) F, N, C; *C 2186* [2A]—Pdr,ms—infrars

*Stachys tenuifolia* Wild. (smooth hedgenettle) C; *C 2433* [10]—Twf,ed—infrars
Teucrium canadense L. var. canadense (germander) C; C 2387 [4]—Twf; ed; Pwt—frequent

LINACEAE
Linum sulphatum Riddell (wild flax) F, N, C; C 2313 [1E]—Pdr—infrequent

LINDENIACEAE [SCROPHULARIACEAE, in part]
Lindernia dubia (L.) Pennell (false pimpernel) C; C 2708 [1A]—Pwt—sparse

LYTHRACEAE
Ammannia coccinea (Lythraceae) C

MALVACEAE [includes TILIACEAE]
*Abutilon theophrasti Medicus (velvet leaf) F, C; C 2680 [2A]—Pms—sparse
* Hibiscus trionum L. (flower-of-an-hour) C; C 2682 [1A]—Pms—sparse
* Tilia americana L. (basswood) C; C 2053 [8]—Tmf; wl—sparse

MENISPERMAEAE
Menispernum canadense L. (moonseed) C; C 2203 [1B]—Ted—infrequent

MOLLUGINACEAE [AZOACEAE]
Mollugo verticillata L. (carpetweed) C; C 2550 [1D]—Oss—sparse

MORACEAE
*Morus alba L. (white mulberry) C; C 2102 [1C]—T; P—common

MYRSINACEAE
Lysimachia ciliata L. (fringed loosestrife) F, N, C; C 2309 [1C]—Pms; wt; Wrp—infrequent

OLEACEAE
Fraxinus americana L. (white ash) C; C 2614 [3A]—Ted—sparse
Fraxinus pennsylvanica Marsh. var. lanceolata (Borkh.) Sarg. (green ash) C; C 2190 [6]—T; P—common
*Ligustrum obtusifolium Sieb. & Zucc. (border privet) C; C 2237 [6]—T—frequent
*Ligustrum vulgare L. (European privet) C; C 2662 [1F]—Ted—sparse
* Syringa reticulata (Blume) H. Harra (Japanese tree lilac) C; C 2304 [10]—Ted—sparse

ONAGRACEAE
Calyptraria saccifera (Nutt.) Raven (toothed evening primrose) F, N, C; C 2232 [1E]—Pdr; ms—common
Circea lutetiana L. ssp. canadensis (L.) Ascherson & Magnus (enchanter's nightshade) C; C 2358 [5]—T—in frequent
Epihydrum coloratum Biehler (cinnamon willowherb) C; C 2564 [6]—Pwt; Wrp—sparse
Oenothera biennis L. (common evening-primrose) [Oenothera biennis L. ssp. centralis Munz] N, C; C 2432 [1B]—P—frequent
Oenothera villosa Thunb. (gray evening-primrose) C; C 2509 [2B]—P—sparse

OXALIDACEAE
Oxalis dillenii Jacq. (yellow wood sorrel) C; C 2179 [3B]—T; P—frequent
Oxalis stricta L. (yellow wood sorrel) C; C 2412 [7]—T; P—frequent
Oxalis violacea L. (violet wood sorrel) F, N, C; C 2044 [1B]—Pdr; ms—frequent

PAPAVERACEAE [includes FUMARIACEAE]
Sanguinaria canadensis L. (bloodroot) C; C 2024 [6]—Tmf; ed—sparse

PHYRMAEACEAE [includes SCROPHULARIACEAE, in part]
Phryma leptostachya L. (l没收eed) C; C 2372 [1C]—T—in frequent

PHYTOLACCACEAE
Phytolacca americana L. (pokeweed) C; C 2254 [8]—Twf; ed—sparse

PLANTAGINACEAE [includes CALLITRICHACEAE; SCROPHULARIACEAE, in part]
*Plantago lanceolata L. (buckhorn plantain) C; C 2188 [1F]—Pms—sparse
*Plantago major L. (common plantain) F, C; C 2368 [1B]—Twf; Oss—sparse
Plantago rugelii Dnc. (common plantain) F, C; C 2332 [1F]—T; P; W; O—common
* Veronica arvensis L. (corn speedwell) C; C 2042 [10]—Twf; Wrp—infrequent
Veronica peregrina L. (neckweed) C; C 2131 [10]—Twf; Wrp—sparse
* Veronica polia Fr. (gray field speedwell) C, C 2690, 2694, 2695 [1F]—Ted; Pms—sparse
Veronicastrum virginicum (L.) Farw. (Culver's root) N, C; C 2383 [1A]—Pms; wt; Wrp—infrequent

PLATANACEAE
Platanus occidentalis L. (sycamore) C; C 2011 [1F]—T—sparse

POLEMONIACEAE
*Phlox divaricata L. (blue phlox) C; C 2028 [5]—T—in frequent
#Phlox paniculata L. (garden phlox) C; C 2683 [9]—Wrp—sparse
Phlox pilosa L. (prairie phlox) N, C; C 2149 [1A]—Pms—sparse

POLYGONACEAE
*Fallopia convolvulus (L.) Á宏伟 (Polygonum convolvulus L.) (black bindweed) C; C 2352 [1D]—Twf; ed; Pms—frequent
Fallopia scandens (L.) Holub [Polygonum scandens L.] (climbing false buckwheat) C; C 2563 [8]—Twf; ed—frequent
Persicaria amphitheatrum (L.) Gray [Polygonum amphitheatrum L. var. emersum Michx.—Polygonum amphitheatrum L. var. stipulaceum (Coleman) Fern.] (water smartweed) C; C 2440 [8]—Twf; ed—sparse
Persicaria hydropiper (L.) Spach (water-pepper) C; C 2597 [8]—Pms; wt—sparse
*Persicaria maculosa Gray [Polygonum persicaria L.] (lady's-thumb) F, C; C 2458 [9]—Pms; wt—frequent
Persicaria pensylvanica (L.) M. Gómez [Polygonum pensylvanica L. var. laevigatum Fern. (Pennsylvania smartweed) F, C; C 2594 [3C]—Pms; wt—sparse
Persicaria punctata (Elliott) Small [Polygonum punctatum Ell.] (water smartweed) C; C 2596 [3C]—Pms; wt—in frequent
Persicaria virginiana (L.) Gaertner [Polygonum virginianum L.] (jumpspeed) C; C 2414 [7]—T—in frequent
*Polygonum aviculare L. ssp. aviculare (knotweed) C; C 2430 [9]—Wrp—sparse
*Polygonum aviculare L. ssp. neglectum (Besser) Arcangeli (narrowleaf knotweed) C; C 2459 [9], 2504 [8]—Wrp; Ow—sparse
*Polygonum reptansum Michx. (busby knotweed) C; C 2565 [3A]—Pms—sparse
* Rumex crispus L. (curly dock) F, C; C 2269 [3A]—T; P; Ow—frequent

PORTULACACEAE
Claytonia virginica L. (spring beauty) C; C 2004 [8]—Twf—sparse
*Portulaca oleracea L. (common purslane) C; C 2549 [1D]—Oss—sparse

RANUNCULACEAE
Anemone canadensis L. (Canada anemone) F, C; C 2123 [1A]—Pms—in frequent
Anemone cylindrica Gray (thimbleweed) F, N, C; C 2231 [1C]—Pdr; ms—in frequent
Anemone virginiana L. (tall anemone) C; C 2302 [1F]—Twf; ed—in frequent
* Clematis × terniflora de Candolle (sweet autumn virginbower) C; C 2617 [8], 2618 [8]—Twf—sparse
Delphinium carolinianum Walter spp. virens (Nutt.) R. E. Brooks [D. virens (Nutt.)] (prairie larkspur) F, N, C; C 2241 [2E]—Pdr; ms—in frequent
Ranunculus abortivus L. (small-flowered buttercup) C; C 2021 [5]—Twf; Wrp—common
Potentilla simplex (Michx.) T. Duncan [R. septentrionalis Poir] (swamp buttercup) C; C 2041 [10]–Twf–common

Thalictrum daysycarpum Fischer & Ave-Lall. (purple meadow-rue) C; C 2233 [6]–Ted–sparse

RHAMNACEAE

Ceanothus americanus L. var. pitcheri T. & G. (New Jersey tea) N, C; C 2139 [1B]–Pms–sparse

Rosmarinus cistatica L. (common buckthorn) C; C 2159 [1F]–T; P; W; O–common

RUBUS

Agrimonia gryposepala Wallr. (tall agrimony) C; C 2520 [2A]–T–infrquent

Agrimonia pedata L. (sweet agrimony) C; C 2403 [1B]–Pms–sparse

Agrimonia pubescens Wallr. (soft agrimony) C; C 2429 [9]–T;

Pms,wt–infrquent

Crateagus calpodon (Ehrh.) Medicus (pear Hawthorn) C; C 2157 [8]–Twp–sparse

Crateagus mollis (T. & G.) Scheele (downy Hawthorn) F, C; C 2056 [3C]–T; P–common

Crateagus punctata Jacq. (dotted Hawthorn) C; C 2142 [6]–Ted–sparse

Duchesnea indica (Andrew) Focke (Indian Hawthorn) C; C 2178 [3A]–Pms–sparse

Fragaria virginiana Duchesne (wild strawberry) F, N, C; C 2117 [3B]–Pms–sparse

Geum canadense Jacq. (white avens) C; C 2259 [10]–T–common

Malus ioensis (Wood) Britton (wild crab) F, N, C; C 2048 [1A]–Ted;

P–common

*Malus sylvestris (L.) P. Miller (apple) C; C 2047 [10]–T–sparse

*Potentilla argentea L var. argentea (silver cinquefoil) C; C 2644 [1D]–Oss–sparse

Potentilla arguta Pursh (tall cinquefoil) F, N, C; C 2373 [1E]–Pdr,ms–sparse

Potentilla norvegica L. (Norwegian cinquefoil) F, C; C 2311 [1B]–Wrp;

Oss–sparse

*Potentilla recta L. (sulphur cinquefoil) F, C; C 2263 [3C]–Pdr–sparse

Potentilla simplex Michx. (common cinquefoil) F; Lelong 1961

Prunus americana Marsh. (wild plum) C; C 2148 [1C]–Pdr,ms–frequent

Prunus cf. cerasifera Ehrh. (cherry plum) C; C 2093 [3D]–Pdr,ms–sparse

Prunus serotina Ehrh. (wild black cherry) C; C 2262 [1D]–T–common

Prunus virginiana L. (cherry) C; C 2057 [8]–T–common

Rosa arkanansa Porter var. suffulta (Green) Cockerell (sunshine rose) F; N; no herbarium voucher

*Rosa multiflora Thunb. ex Murray (multiflora rose) C; C 2216 [3C]–Ted;

P–sparse

Rosa × rubricanadica Greene (R. arkanansa × R. carolina) (hybrid rose) C; C 2489 [2E]–P–common

Rubus occidentalis L. (black raspberry) C; C 2132 [10]–T; P; W; O–common

Rubus parvifolius L. (Japanese raspberry) C; C 2197 [3D]–Ted;

Pdr–sparse

RUBIACEAE

Galium aparine L. (cleavers) C; C 2094 [3D]–T–common

Galium triflorum Michx. (sweet-scented bedstraw) C; C 2466 [3A]–T–common

RUTACEAE

*Phellodendron sp. (corktree) C; C 2177 [3C]–Ted; Pdr–infrquent

Zanthoxylum americanum F. Miller (prickly ash) C; C 2086 [6]–Ted;

Pms–sparse

SALICACEAE

Populus deltoides Bartram ex Marsh. ssp. monilifera (Aiton) Eckenwalder (plains cottonwood) C; C 2068 [5]–T–common

*Salix fragilis L. (crack willow) C; C 2037 [1C]–Wrp–sparse

*Salix × rubens Schrank (S. alba × S. fragilis) (hybrid crack willow) C; C 2337 [6]–Wrp–sparse

SANTALACEAE

Comandra umbellata (L.) Nutt. (bassard toadflax) F, N, C; C 2054 [2B]–Pdr,ms–common

SAPINDACEAE

includes ACERACEAE, HIPPOCASTANACEAE

*Acer ginnala Maxim. (amar maple) C; C 2046 [1A]–Ted;

P–infrquent

*Acer negundo L. (box elder) C; C 2030 [8]–T–common

*Acer negrum Michx. f. (black maple) C; C 2153 [6]–T–sparse

*Acer saccharinum L. (silver maple) C; C 2108 [8]–T–common

*Acer saccharum Marsh. (sugar maple) C; C 2164 [10]–T–sparse

~Aesculus glabra Willd. (Ohio buckeye) C; C 2710 [1A]–Pms–sparse

SAXIFRAGACEAE

Heuchera richardsonii R. Br. (alumroot) F, N, C; C 2147 [1E]–Pms–sparse

SCROPHULARIACEAE

Scrophularia marilandica L. (carpetsner’s square) C; C 2361 [4]–Twp,ms–infrquent

*Verbascum thapsus L. (common mullein) C; C 2625 [2D]–P–frequent

SIMAROUBACEAE

*Anhialus allisissima (Mill.) (tree of heaven) C; C 2477 [8]–Ted–sparse

SOLANACEAE

Physalis heterophylla Nees (ground cherry) F, N, C; C 2249 [1B]–Pdr,ms–infrquent

Physalis virginiana Mill. (ground cherry) F, N, C; C 2187 [2C]–Pdr,ms–frequent

Solanium carolinense L. (horse nettle) F, C; C 2269 [3D]–Pdr–sparse

*Solanium dulcamara L. (European bittersweet) C; C 2328 [2A]–Ted;

Pms–sparse

Solanium pyracanthum Dunal [S. americanum P. Miller] (black nightshade) F, C; C 2569 [5]–Ted;

Pms,wt–frequent

STAPHYLOCEAE

Staphylea trifolia L. (American bladdernut) C; C 2130 [8]–Twp–sparse

ULMACEAE

Ulmus americana L. (American elm) C; C 2128 [7]–T–P–common

*Ulmus pumila L. (Siberian elm) C; C 2067 [1B]–Pdr–sparse

Ulmus rubra Muhl. (slippery elm) C; C 2099 [6]–T–sparse

URTIACEAE

Laportea canadensis (L.) Wedd. (wood nettle) C; C 2347 [8]–Twp–common

Parietaria pensylvanica Muhl. ex Willd. (pellitory) C; C 2176 [1A]–T;

P–infrquent

Pilea pumila (L.) Gray (clearweed) C; C 2598 [8]–Tmf,wf–common

Urtica dioica L. (stinging nettle) C; C 2348 [8]–T–sparse

VERBENACEAE

Verbena bracteata Cav. ex Lag. & Rodr. (creeping vervain) C; C 2369 [9]–Wrp–sparse

Verbena hastata L. (blue vervain) C; C 2342 [4]–Wrp–sparse

Verbena stricta Vent. (hoary vervain) F, N, C; C 2310 [1A]–Pdr,ms–infrquent

Verbena urticifolia L. (hybrid rose) C; C 2263 [1E]–T–P–common

VIOLACEAE

Viola × bernardii Greene (V. pedatitida × V. sororia) (Bernard violet) C; C 2013 [3E]–Pdr,ms–infrquent
Viola pedatifida G. Don (prairie violet) F, N, C; C 2029 {1B}—Pdr, ms—frequent
Viola pubescens Aiton (downy yellow violet) C; C 2008 {9}—T; P—common
Viola sororia Willd. (hairy blue violet) C; C 2009 {9}—T; P; W; O—common

VITACEAE
Parthenocissus quinquefolia (L.) Planchon (Virginia creeper) C; C 2060 {5}—T; P—common
Parthenocissus vitacea (Knerr) A. S. Hitchc. (woodbine) C; C 2040 {10}—T—common
Vitis riparia Michx. (riverbank grape) C; C 2077 {1A}—T; P—common