Transactions of the Illinois State Academy of Science
(2007), Volume 100, #3&4, pp. 209-221

received 4/26/07
accepted 9/30/07

Fire Maintained, Closed Canopy Barren Communities in Western Illinois

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ABSTRACT

Barrens were common in Illinois at the time of European settlement. These communities were fire-maintained, had an open canopy, and a grass-dominated ground layer containing both forest and prairie species. Barrens were commonly underlain by nutrient poor, clayey soils, and were found on rolling topography. Fire suppression following the arrival of European settlers resulted in canopy closure and the loss of many prairie species. The barrens studied are currently being managed by fire. *Quercus alba* (white oak) dominated the overstory and accounted for more than 65% of the importance value on both barrens. Other overstory species were *Carya tomentosa* (mockernut hickory), *Q. stellata* (post oak), and *Q. velutina* (black oak). Woody seedlings were common, but few shrubs and saplings were present, probably due to recurring fires. Overstory cover at Argyle Hollow Barrens Nature Preserve averaged 77%, while cover at McKee Creek Barrens averaged 85%. Numerous prairie species were found on these barrens but most were restricted to canopy openings.

INTRODUCTION

Barrens were described as open forest communities with a ground layer of prairie grasses and forbs, but also with an unusually high proportion of forest herbs (Ellsworth 1838, Vestal 1936). The woody vegetation of barrens consisted of stunted trees of *Quercus stellata* (post oak), *Q. alba* (white oak), *Carya* spp. (hickories), with the common shrubs being *Corylus americana* (hazel), *Rhus glabra* (smooth sumac), and *R. copallina* (winged sumac) (Peck 1837, Worthen 1868). Grubs, commonly described as brushy trees that had been repeatedly top-killed by recurring fires, were common (Peck 1837). In some instances the grubs were more than 100 years old and consisted of numerous basal branches that sometimes exceeded 3 meters in height (Curtis 1959).

Barrens were fire maintained communities. Bourne (1820) describes the disappearance of barrens after Native Americans left and fires were stopped. Worthen (1868, 1870) also described barrens as fire maintained communities, and Peck (1837) described the growth of vigorous sprouts from grubs once there were no more fires. By the 1860s it was realized that barrens were transient communities and, due to fire suppression, would soon be replaced by forest (Engelmann 1863). Presently few good quality examples of barrens exist in Illinois (Edgin 2000, Taft 2003, Edgin et al. 2005, McClain et al. 2007). Most have been degraded due to fire suppression and currently retain little of the species diversity and community structure that existed in the early 1800s.

In general, the few remaining barrens have been subjected to occasional fires, have very poor quality soils, have been relatively undisturbed by human activity, and are restricted to regions of rolling topography (Bowles and McBride 1994, Bowles et al. 1994, Ebinger et al. 1994, Homoya 1994, Taft 2003, Edgin et al. 2005). As this community is uncommon, attempts are being made to re-establish barrens where they previously existed. The present study was undertaken to determine the composition and structure of the vegetation of two barrens in western Illinois that are presently being managed as barren communities. According to Government Land Office (GLO) survey records, these two areas were barrens in early settlement times (Hutchinson 1988).

DESCRIPTION OF THE STUDY AREA

The barrens examined were located in the Western Forest-Prairie Natural Division, a strongly dissected glacial till plain subjected to the Illinoian stage of Pleistocene Glaciation approximately 125,000 years ago (Schwegman 1973). At the time of European settlement oak-hickory forests, woodlands, and barrens dominated the rugged topography associated with the well developed and extensive drainage systems of this Division (Anderson 1991). Prairies were also common, but mostly restricted to the level uplands (Anderson 1991).

The barrens studied were located on rolling topography and had many floristic similarities to woodlands and forests on dry-mesic to xeric sites. Both barrens were on steep, southwest-facing hillsides, were less than 2 ha in size, and had small canopy openings in which some prairie vegetation was present. Both would presently be classified as mature second-growth dry to dry-mesic upland forests using the classification of White and Madany (1978). The more open canopy, which varied from 77 to 85%, and the open understory were probably the result of recent fire management.

Argyle Hollow Barrens

This dedicated nature preserve is within Lake Argyle State Park about 2 kms north of Colchester, McDonough County, Illinois (NE1/4 S36 T6N R4W). The barrens community was located on the rolling uplands on the east side of Argyle Lake. Sandstone and shale outcrops were common on the steep slope with a sandstone cliff at the edge of the lake. The soils were classified as Hickory loam with 10 to 18% slope (Walker 1997).

McKee Creek Barrens

This natural area was in Siloam Springs State Park about 18 kms south of Clayton, Adams County, Illinois (SE1/4 S24 T2S R5W). The barren overlooks McKee Creek that forms the southern boundary of the park. A cliff at the base of the barrens was about 15 meters high. The soils were classified as Marseilles silt loam with 18 to 35% slope (Tegeler 2003).

The climate is continental, characterized by humid, hot summers and cold winters. Weather records for Quincy, Illinois, gives an average annual precipitation of 98 cm that falls mostly as rain from March through October (www.sws.uiuc.edu 2005). January is the coldest month with an average high temperature of 0°C and an average low of –9°C. July is the hottest month with an average low of 19'C and an average high of 30°C. The frost-free growing period averages 191 days with a low of 166 and a high of 232 days.

MATERIALS AND METHODS

The study sites were visited throughout the growing seasons of 1995 and 1996, and at least once each growing season since that time to complete the vascular plant species list. Voucher specimens of each species were collected, identified, and deposited in the Stover-Ebinger Herbarium of Eastern Illinois University, Charleston, Illinois (EIU). Criteria for designating exotic species followed Mohlenbrock (2002), and Gleason and Cronquist (1991), while nomenclature follows Mohlenbrock (2002).

During the late summer of 1996 the woody overstory was surveyed using a 25 m x 50 m plot. This plot was placed as near the middle of the site as possible to eliminate edge effect. In each quadrate all living woody individuals ≥10.0 cm dbh were identified and their diameters recorded. From these data, the living-stem density (stems/ha), basal area (m^2/ha), relative density, relative dominance, importance value (IV), and average diameter (cm) were calculated for each species. The IV was the sum of the relative density and relative dominance (basal area) (McIntosh 1957). Overstory cover was determined by photographing the canopy and projecting the photo onto a 100 point grid.

To study ground layer vegetation, two transects 25 m long were located randomly in each study area. Along each transect, 1 m^2 quadrates were located at 1 m intervals (n=25/transect), odd-numbered quadrates to the right even-numbered to the left. A random numbers table was used to determine the number of meters (0 to 9) a quadrate was located from the transect line. Cover was determined by using the Daubenmire cover class system (Daubenmire 1959) as modified by Bailey and Poulton (1968). The modified Daubenmire cover scale is as follows: class 1 = 0 to 1%; class 2 = >1 to 5%; class 3 = >5 to 25%; class 4 = >25 to 50%; class 5 = >50 to 75%; class 6 = >75 to 95%; class 7 = >95 to 100%. Importance value (IV) for ground layer species was determined by summing relative cover and relative frequency.

RESULTS

Within the barrens studied a total of 139 plant species representing 46 families and 98 genera were documented (Appendix I). Only one fern species was encountered, while 40 were monocots in eight families, and 98 were dicots in 37 families. Seven exotic species

were found, none being common in the plots. Of the species encountered 114 were found on Argyle Hollow Barrens, 104 were collected from McKee Creek Barrens, and 82 were found on both barrens. Nearly 25% of the herbaceous species collected were associated with prairie vegetation (Appendix I).

Quercus alba dominated the overstories of both barrens, accounting for more than 65% of the IV (Table 1). At Argyle Hollow Barrens *Carya tomentosa* was second in IV, while on McKee Creek Barrens *Q. stellata* was second in IV. *Quercus velutina* (black oak) was third in IV on both barrens. The slightly more mesic McKee Creek Barrens had higher species diversity in the overstory, and a canopy closure of 85%. Very few dead-standing trees were encountered.

As a result of management with periodic fires, both barrens had a park-like appearance; the understory was open. Small saplings averaging between 800 and 1375 stems/ha and large saplings averaged 120 to 288 stems/ha on the barrens (Table 2). Numerous tree seedlings were present, however, and averaged between 15,000 and 17,500 stems/ha. Management fires top-killed most seedlings, but many had an enlarged caudex indicating that they re-sprouted after each fire. These sprouts rarely reached the sapling layer.

Ground layer vegetation was sparse on the study sites. Bare ground and litter had cover values of 62.14 and 67.09 on Argyle Hollow and McKee Creek barrens respectively (Table 3). On Argyle Hollow Barrens *Parthenocissus quinquefolia* (IV of 54.) dominated with *Carex pensylvanica, Rubus flagellaris, Solidago ulmifolia,* and *Helianthus divaricatus* being the common species encountered, having a combined IV of 148.0 (possible 200). Similar results were obtained on McKee Creek Barrens except these species differed somewhat in IV and *Rubus flagellaris* was replaced by *Muhlenbergia sobolifera*. On this barren the five dominant species had a combined IV of 110.2. The ground layer of both barrens consisted of a mixture of forest and prairie grasses and forbs (Table 3, Appendix I). Forest species were, by far, the most important, and the few species listed as "others" in the table included many of the prairie species encountered. Other prairie species were growing near the barren edges, or in very low frequencies on the barrens, and did not occurr in the survey quadrates.

DISCUSSION

At the time of European settlement in the early 1800s a broad mosaic of prairie and open- to closed-canopy oak-dominated communities (forest, woodland, savanna, barren) existed in Illinois (Davies 1977, Anderson 1983). Most forested areas persisted on the lee side of topographic and wetland fire breaks. Fire frequency and intensity were important in determining the composition and structure of these wooded areas. Intense and frequent fires created prairie and savanna, less intense and less frequent fires causing barrens and woodlands, while low intensity, infrequent fires allowed closed forests to persist (Ebinger and McClain 1991).

Based on early literature and GLO survey notes, it is evident that most upland forests in Illinois had open canopies (Vestal 1936, Anderson and Anderson 1975, Ebinger and McClain 1991). These open canopy forests (woodlands, barrens, savannas) represented a transition between prairies and closed-canopy forests of the dissected terrain of river val-

leys. These open woodlands, savannas, and barrens were fashioned by climate, topography, edaphic factors, and periodic fires (Heikens and Robertson 1994, McClain and Elzinga 1994). With the cessation of landscape fires soon after the arrival of European settlers, woody plant encroachment usually resulted in canopy closure except where edaphic factors slowed tree growth. Native aborigines were probably responsible for most of these fires (Williams 1989, Davies 1994, McClain and Elzinga 1994).

During the past 15 years attempts wave been underway to re-create the barren aspect at both Argyle Hollow and McKee Creek barrens. Occasional prescribed fires are being used to slowly open the canopy. Presently the ground layer is dominated by species associated with forest communities. Very few of the herbaceous species presently found in the ground layer of these two barrens are prairie species (Table 3). Also the shrub layer of sumac, hazel, and the stunted trees reported by the early GLO surveyors are lacking, as are the dense oak grubs (Vestal 1936). It is possible that under the present management of occasional prescribed fires, the "barrens of the early 1800s" cannot be attained on these sites. It is likely that more intense, landscape fires are necessary; the slow moving ground fires presently being used are not hot enough or intense enough. These ground fires are not killing the large canopy trees, and the canopy is still mostly closed. The continued management with fire, however, will slowly open the canopy and promote an increase in some prairie species. The year after the 1996 fire at the McKee Creek Barrens, *Trifolium reflexum* (buffalo clover) was found. Apparently the seeds of this Illinois endangered species had been lying dormant in the soil and the heat from the fire promoted germination.

ACKNOWLEDGMENTS

The authors would like to thank the Illinois Department of Natural Resources for permission to examine the barrens at Argyle Hollow Nature Preserve at Lake Argyle State Park, and the McKee Creek Barrens at Siloam Springs State Park. Dr. Gorden Tucker, Eastern Illinois University, was very helpful in the identification of the *Carex* species.

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Table 1. Density (#/ha), basal area (m^2/ha), relative values, importance values, and average diameters (cm) of the tree species encountered at Argyle Hollow Barrens, McDonough County, and McKee Creek Barrens, Adams County, Illinois.

Species	Density (#/ha)	Basal Area (m^2/ha)	Rel. Den.	Rel. Dom.	I.V.	Average Diameter (cm)
Argyle Hollow Barrens						
Quercus alba	144	20.2	69.2	94.6	163.8	41.4
Carya tomentosa	32	0.7	15.4	3.3	18.7	16.1
Quercus velutina	16	0.2	7.7	1.1	8.8	13.7
Carya ovata	16	0.2	7.7	1.0	8.7	13.3
Totals	208	21.3	100.0	100.0	200.0	
McKee Creek Barrens						
Quercus alba	128	21.7	50.0	82.0	132.0	45.7
Quercus stellata	48	3.7	18.8	14.0	32.8	31.0
Quercus velutina	24	0.5	9.4	1.9	11.3	15.8
Acer saccharum	24	0.2	9.4	0.8	10.2	10.7
Juglans nigra	8	0.1	3.1	0.4	3.5	13.4
Ostrya virginiana	8	0.1	3.1	0.3	3.4	10.5
Carya ovata	8	0.1	3.1	0.3	3.4	12.0
Fraxinus americana	8	0.1	3.1	0.3	3.4	10.5
Totals	256	26.5	100.0	100.0	200.0	

Table 2. Density (stems/ha) of woody seedlings, shrubs, small saplings, and large saplings encountered at the Argyle Hollow Barrens, McDonough County, and the McKee Greek Barrens, Adams County, Illinois.

Species	Seedlings	Small Saplings	Large Saplings
Argyle Hollow Barrens			
Quercus alba	11250	125	--
Quercus imbricaria	1250	--	--
Viburnum prunifolium	1250	--	--
Quercus velutina	833	208	8
Prunus serotina	833	542	--
Amelanchier arborea	833	--	--
Sassafras albidum	833	--	--
Carya tomentosa	417	125	56
Ostrya virginiana	--	125	--
Fraxinus americana	--	125	--
Carya ovata	--	83	40
Cercis canadensis	--	42	--
Acer saccharum	--	--	16
Totals	17499	1375	120
McKee Creek Barrens			
Viburnum prunifolium	4000	--	--
Quercus alba	2333	100	--
Quercus stellata	1667	100	8
Carya ovata	1667	133	64
Ostrya virginiana	1667	--	120
Ulmus rubra	1333	33	8
Quercus velutina	1000	167	32
Sassafras albidum	667	--	--
Acer saccharum	333	167	40
Amelanchier arborea	333	--	16
Prunus serotina	--	100	--
Totals	15000	800	288

Table 3. Frequency (%), average cover, and importance values of the ground layer species encountered at the Argyle Hollow Barrens, McDonough County, and the McKee Greek Barrens, Adams County, Illinois. (*exotic species)

Species	Argyle Hollow Barrens			McKee Creek Barrens		
	Freq.	Mean Cover	I.V.	Freq.	Mean Cover	I.V.
Parthenocissus quinquefolia	74	13.76	54.0	28	2.04	12.0
Carex pensylvanica	84	10.88	48.5	62	3.00	21.5
Rubus flagellaris	42	3.80	19.8	4	0.60	2.8
Solidago ulmifolia	30	3.17	15.4	82	5.93	34.9
Helianthus divaricatus	26	1.64	10.3	22	4.54	19.0
Dichanthelium acuminatum	36	0.33	9.1	4	0.02	0.9
Antennaria plantaginifolia	20	0.64	6.2	--	--	--
Viola pedata	20	0.35	5.4	--	--	--
Danthonia spicata	10	0.25	3.0	6	0.08	1.4
Toxicodendron radicans	8	0.38	2.8	2	0.06	0.6
Smilacina racemosa	6	0.42	2.5	2	0.06	0.6
Rosa carolina	8	0.19	2.3	16	0.48	4.6
Potentilla simplex	4	0.36	2.0	4	0.12	1.2
Aster turbinellus	6	0.18	1.9	--	--	--
Anemonella thalictroides	8	0.04	1.9	10	0.10	2.2
Carex hirsutella	6	0.08	1.6	12	0.16	2.8
Galium concinnum	6	0.08	1.6	20	1.08	7.3
Hieracium gronovii	6	0.03	1.5	--	--	--
Elymus virginicus	4	0.07	1.2	8	0.04	1.6
Galium circaezans	4	0.07	1.2	10	0.30	2.8
Carex muhlenbergii	4	0.02	1.1	16	0.13	3.4
Acalypha virginica	4	0.02	1.1	16	0.08	3.3
**Poa compressa*	4	0.02	1.1	--	--	--
Muhlenberegia sobolifera	--	--	--	32	5.13	22.8
Desmodium glutinosum	--	--	--	20	1.51	8.7
Aster anomalus	--	--	--	24	1.20	8.4
Phlox divaricata	--	--	--	22	1.09	7.8
Bromus pubescens	--	--	--	14	0.42	4.0
Festuca subverticillata	--	--	--	16	0.18	3.6
Sanicula canadensis	--	--	--	16	0.18	3.6
Amphicarpaea bracteata	--	--	--	10	0.49	3.5
Ageratina altissima	--	--	--	10	0.49	3.5
Tradescantia ohiensis	--	--	--	12	0.31	3.3
Lactuca canadensis	--	--	--	4	0.31	1.8
Geum canadense	--	--	--	6	0.13	1.5
Lespedeza intermedia	--	--	--	4	0.07	1.0
Others	--	0.20	4.5	--	0.28	3.6
Totals		36.98	200.0		30.61	200.0
Bare ground and litter		62.14			67.09	

APPENDIX I.

Vascular taxa encountered at the western Illinois barren communities listed alphabetically by family under major plant groups. An asterisk indicates non-native (exotic) species. For each species the author's collection number (JEE) is given followed by the barrens in which each species was collected (a = Argyle Hollow Barrens, m = McKee Creek Barrens. Nomenclature follows Mohlenbrock (2002).

FERN AND FERN-ALLIES
Ophioglossaceae
Botrychium virginianum (L.) Sw., 29643a, 29652m

MONOCOTS
Amaryllidaceae
Hyposis hirsuta (L.) Coville, 29644a

Araceae
Arisaema dracontium (L.) Schott., 30097a
Arisaema triphyllum (L.) Schott., 30794a, 30776m

Commelinaceae
Tradescantia ohiensis Raf., 30098a, 26181m

Cyperaceae
Carex albicans Willd., 26189m
Carex blanda Dewey, 30795a, 26187m
Carex cristatella Britt., 29651a
Carex hirsutella Mack., 26303a, 26190m
Carex muhlenbergii Schk., 26308a, 26192m
Carex pensylvanica Lam., 29457a, 29662m
Carex rosea Schk., 26191m

Juncuaceae
Juncus tenuis Willd., 30099a, 30106m

Liliaceae
Allium canadense L., 30796a
Smilacina racemosa (L.) Desf., 30797a, 29667m
Trillium recurvatum Beck, 29450a

Poaceae
Agrostis perennans (Walt.) Tuckerm., 30509a, 30491m
Andropogon gerardii Vitman, 30510a, 30492m
Bromus pubescens Muhl., 30100a, 30107m
Cinna arundinacea L., 31001a, 30493m
**Dactylis glomerata* L., 30798a, 30777m
Danthonia spicata (L.) Roem. & Schultes, 26297a, 26173m
Dichanthelium acuminatum (Sw.) Gould & Clark, 26305a, 30111m
Dichanthelium latifolium (L.) Gould & Clark, 30104a, 26174m
Dichanthelium linearifolium (Scribn.) Gould, 26299a, 30781m
Elymus hystrix L., 30101a, 30108m
Elymus villosus Muhl., 30511a
Elymus virginicus L., 30102a, 30109m
**Festuca pratensis* Huds., 30799a, 30778m
Festuca subverticillata (Pers.) E.B. Alexeev., 30103a, 30110m
Glyceria striata (Lam.) Hitchc., 30801a, 30780m
Muhlenbergia schreberi J.F. Gmel., 30512a, 30494m
Muhlenbergia sobolifera (Muhl.) Trin., 30513a, 30495m
**Poa compressa* L. 30105a, 30112m
**Poa pratensis* L. 29650a, 26172m
Poa sylvestris Gray, 26176m
Schizachyrium scoparium (Michx.) Nash, 30514a, 30496m
Sphenopholus obtusata (Michx.) Scribn, 30802a, 26175m
Tridens flavus (L.) Hitchc. 31191a, 30497m
Vulpia octoflora (Walt.) Rydb., 30782m

Smilacaceae
Smilax tamnoides L., 30515a, 30783m

DICOTS
Acanthaceae
Ruellia humilis Nutt., 30516a, 30113m

Anacardiaceae
Rhus aromatica Ait., 29663m
Rhus glabra L., 31014m
Toxicodendron radicans (L.) Kuntze, 30803a, 30784m

Apiaceae
Sanicula canadensis L., 30075a, 30114m
Taenidia integerrima (L.) Drude, 30813a, 29658m

Aristolochiaceae
Aristolochia serpentaria L., 31008a

Asclepiaadaceae
Asclepias quadrifolia Jacq., 26300a, 26182m

Asteraceae
Ageratina altissima (L.) King & Robins., 30522a, 30501m
Antennaria plataginifolia (L.) Hook., 29453a, 29653m
Aster anomalus Engelm., 30517a, 30498m
Aster lateriflorus (L.) Britt., 30519a, 30499m
Aster pilosus Willd., 30520a
Aster turbinellus Lindl., 30521a, 30500m
Aster urophyllus Lindl., 30518a
Coreopsis palmata Nutt., 30117m
Erigeron annuus (L.) Pers., 30077a, 30115m
Erigeron philadelphicus L., 30804a, 30785m
Eupatorium serotinum Michx., 31192a
Helianthus divaricatus L., 30076a, 30116m
Hieracium gronovii L., 31005a
Krigia biflora (Walt.) Blake, 29645a
Lactuca canadensis L., 31007a
Lactuca floridana (L.) Gaertn., 31009m
Liatris aspera Michx., 30523a, 30502m
Prenanthes alba L., 30524a
Solidago nemoralis Ait., 30526a, 30503m
Solidago speciosa Nutt., 31193a
Solidago ulmifolia Muhl., 30525a, 30504m

Berberidaceae
Podophyllum peltatum L., 30810a, 29665m

Boraginaceae
Hackelia virginiana (L.) I.M.Johnston, 30078a

Brassicaceae
Arabis canadensis L., 30805a, 29654m
Arabis laevigata (Willd.) Poir., 30079a

Caesalpiniaceae
Chamaecrista fasciculata (Michx.) Greene, 30082a

Campanulaceae
Campanulastrum americanum (L.) Small, 30080a, 31010m
Lobelia inflata L., 30081a, 30118m
Lobelia spicata Lam., 26311a, 30119m
Triodanis perfoliata (L.) Nieuwl., 30807a, 30786m

Caprifoliaceae
**Lonicera maackii* (Rupr.) Maxim., 30527a
Viburnum prunifolium L., 30528a, 30505m

Caryophyllaceae
**Cerastium glomeratum* Thuill., 26183m

Convolvulaceae
Calystegia spithamaea (L.) Pursh, 30806a

Corylaceae
Corylus americana Walt., 30083a

Elaeagnaceae
**Elaeagnus umbellata* Thunb., 30529a, 30506m

Eupohorbiaceae
Acalypha virginica L., 31003a, 30507m
Euphorbia corollata L., 31002a, 31011m

Fabaceae
Amorpha canescens Pursh, 26307a, 30120m
Amphicarpaea bracteata (L.) Fern., 30787m
Dalea candida (Michx.) Willd., 26312a, 30123m
Desmodium glutinosum (Muhl.) A. Wood, 30084a, 30122m
Desmodium nudiflorum (L.) DC., 30121m
Lespedeza intermedia (S. Wats.) Britt., 31196m
Lespedeza virginica (L.) Britt., 31194a, 30608m
Tephrosia virginiana (L.) Pers., 30126m
Trifolium reflexum L., 26186m

Grossulariaceae
Ribes missouriense Nutt., 29449a

Hypericaceae
Hypericum punctatum Lam., 26310a

Lamiaceae
Pycnanthemum pilosum Nutt., 30530a
Pycnanthemum tenuifolium Schrad., 26306a, 30124m
Teucrium canadense L., 30085a

Menispermaceae
Menispermum canadense L., 30808a

Onagraceae
Circaea lutetiana L., 30086a

Oxalidaceae
Oxalis fontana Bunge, 30087a
Oxalis violacea L., 29452a, 29656m

Phrymaceae
Phryma leptostachya L., 30088a, 30125m

Polygalaceae
Polygala sanguinea L., 30089a

Portulacaceae
Claytonia virginica L., 29456a

Ranunculaceae
Anemone virginiana L., 30090a, 30127m
Anemonella thalictroides (L.) Spach, 29455a, 26179m
Ranunculus abortivus L., 30809a
Ranunculus micranthus Torr. & Gray, 29655m

Rhamnaceae
Ceanothus americanus L., 30128m

Rosaceae
Agrimonia gryposepala Wallr., 30091a, 30129m
Geum canadense Jacq., 30092a, 30130m
Potentilla simplex Michx., 26304a, 26184m
Rosa carolina L., 30093a, 30131m
Rubus allegheniensis Porter, 29647a
Rubus flagellaris Willd., 29646a, 29666m
Rubus occidentalis L., 30811a, 30788m
Rubus pensilvanicus Poir., 29670m

Rubiaceae
Galium aparine L., 29648a, 26185m
Galium circaezans Michx., 26301a, 30789m
Galium concinnum Torr. & Gray, 26298a, 30133m
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Rutaceae
Ptelea trifoliata L., 31013m
Zanthoxylum americanum Mill., 30094a

Santalaceae
Comandra umbellata (L.) Nutt., 30095a

Scrophulariaceae
Agalinus tenuifolia (Vahl) Raf.,30531a, 31197m
Aureolaria grandiflora (Benth.) Pennell, 30532a, S31012m
Penstemon pallidus Small, 29649a, 26178m
**Veronica arvensis* L., 30812a, 30790m

Solanaceae
Physalis subglabrata Mack. & Bush, 26180m
Physalis virginiana Mill., 29668m

Violaceae
Viola palmata L., 31004a, 30793m
Viola pedata L., 29454a, 30791m
Viola sororia Willd., 29451a, 30792m

Vitaceae
Parthenocissus quinquefolia (L.) Planch, 30096a, 30134m