

THE VASCULAR FLORA OF SAVAGE GULF, TENNESSEE¹

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Remnants of pristine forests are manifestly important to both present and future generations of mankind. Such areas offer unique aesthetic experiences, demonstrate balanced ecosystems, support a rich fauna and flora, and most importantly, demand the acute awareness of persons interested in their preservation. According to Quarterman, Hemmerly and Turner (1972), a relic stand in Savage Gulf "... appears to be the only virgin tract of typical mixed mesophytic forest remaining in Tennessee. ..."

Savage Gulf is within the proposed Savage Gulf Natural Area which includes the gorges and adjacent uplands of Savage Creek, upper Collins River, and Big Creek. The Tennessee Department of Conservation now owns a significant portion of this 10,000 acre Preserve and negotiations for additional land acquisitions are underway. Now that a means for protection seems assured, it is anticipated that critical habitats will be properly managed and preserved.

Past studies of the floristics and vegetation of the gorges of the Cumberland Plateau of Tennessee are those of Caplenor (1955, 1965), Clark (1966), Quarterman *et al.* (1972), and Sherman (1958). Except for occasional herbarium vouchers deposited at the University of Tennessee, Knoxville, and Vanderbilt University, no extensive collections of vascular plants had been made from Savage Gulf.

This report on the flora of Savage Gulf represents a concerted effort to obtain detailed floristic information about a remnant virgin forest and its immediate surroundings. Data were obtained on the species of vascular plants present, the occurrence of unusual habitats, and the status of rare plants. Although no vegetative sampling or quantitative analyses of plant communities were undertaken, collections were made throughout Savage Gulf and the adjacent uplands (Figure 1).

GENERAL PHYSIOGRAPHY

Savage Gulf lies on the Cumberland Plateau in eastern Grundy County

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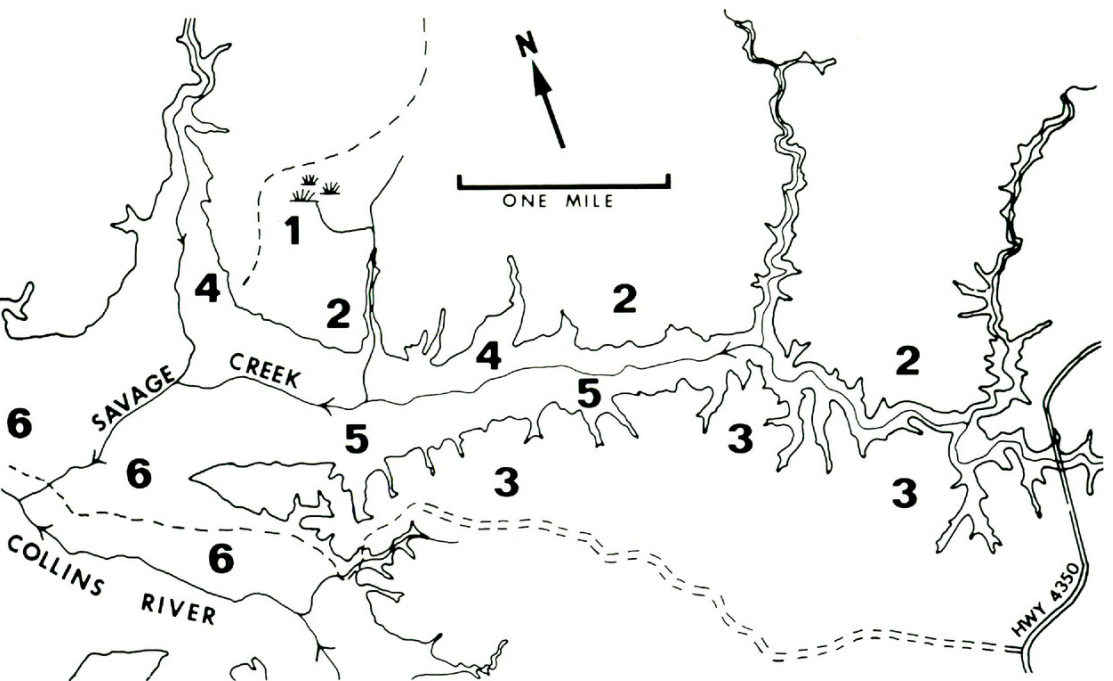


Figure 1. Savage Gulf, Grundy County, Tennessee. The gulf is outlined at the 1800 ft contour which approximates the rim. Numbers 1-6 refer to collection areas (see text for vegetation and topographic descriptions).

approximately 35 miles northwest of Chattanooga, Tennessee. The Cumberland Plateau is the southern extension of the Appalachian Plateau Province (Fenneman, 1938). Since prominent vertical escarpments are characteristics of the region, it is referred to as the "Cliff Section" by Braun (1950).

Savage Creek, the primary stream within the Gulf, flows almost due west and drops from ca. 1740 ft near its headwaters to ca. 970 ft at its confluence with the Collins River for an average gradient of 150 ft per mile. The scenic gorge is extremely steep and hazardous. The rim is roughly 1800 ft in elevation on both the north and south sides. The caprock, composed of a coarse Pennsylvanian conglomerate, is often exposed as vertical cliffs or overhangs ranging from 70 to 140 ft high. From the base of the escarpments the gorge is typically terraced and slope ranges from 45° near the base of the caprock to 15° at Savage Creek. Boulder fields of conglomerate, sandstone, and limestone bedrock fragments are common on both the north and south facing slopes.

DESCRIPTION OF THE VEGETATION

Savage Gulf is divided into six areas (Fig. 1) to facilitate annotation of the checklist and to describe the vegetation. For the most part, these areas are natural plant communities that can be defined by their unique indicator species, soils, slopes, and exposures.

Area 1 is an upland swamp that remains relatively wet during the summer and supports a rich flora throughout the growing season. Similar habitats occur infrequently throughout the Cumberland Plateau in Tennessee, but most have a depauperate flora during the drier summer months. Dominant woody species include *Nyssa sylvatica*, *Acer rubrum*, *Liquidambar styraciflua*, *Itea virginica*, and *Viburnum nudum*. The herbaceous layer is characterized by *Osmunda cinnamomea*, *O. regalis*, *Woodwardia areolata*, *W. virginica*, *Carex intumescens*, *C. joorii*, *Lilium michiganense*, *Zigadenus leimanthoides*, *Platanthera ciliaris*, *P. clavellata*, *P. cristata*, *P. integrilabia*, *Isotria verticillata*, *Xyris torta*, *Rhynchospora corniculata*, *Juncus repens*, *Parnassia asarifolia*, *Proserpinaca pectinata*, and *Aster umbellatus*. Taxa from this area that have affinities with the Coastal Plain, although not restricted to it, include *Woodwardia virginica*, *Juncus repens*, *Rhynchospora corniculata*, *Itea virginica*, and *Proserpinaca pectinata*.

Area 2, the north rim, and area 3, the south rim, include the relatively flat to rolling uplands of the surrounding Cumberland Plateau. Both areas are disturbed to varying degrees by logging and support a similar flora. In general, the vegetation of the regenerating forest is dominated by various species of *Quercus* and *Carya*. Other frequent trees and shrubs are *Pinus echinata*, *Oxydendrum arboreum*, *Calycanthus floridus*, *Nyssa sylvatica*, *Viburnum acerifolium*, *Rhododendron nudiflorum*, and *Vaccinium* spp. Occasional small streams that are perpendicular to the rim of the gorge support dense understory vegetation of *Kalmia latifolia*, *Tsuga canadensis*, *Ilex opaca*, and

Euonymus americanus. Several noteworthy herbs occur chiefly in the upland woods, namely, *Chamaelirium luteum*, *Cypripedium acaule*, *Malaxis unifolia*, and *Monotropsis odorata*. A small swamp on the extreme western end of the south rim is dominated by *Woodwardia virginica*. The distribution of this infrequent fern in Tennessee is discussed by Wofford, Webb, and Dennis (1977).

Area 4 represents the south facing slope of Savage Gulf. Extensive boulder fields with thick entanglements of *Parthenocissus quinquefolia* and *Rhus radicans* characterize much of the upper slope. The herbaceous flora is meager on these drier sites, but is relatively rich on more mesic sites near Savage Creek. A few of the more common spring wild flowers found on the lower slope are *Orchis spectabilis*, *Cypripedium calceolus* var. *pubescens*, *Hexastylis arifolia*, *Geranium maculatum*, *Sedum ternatum*, *Viola conspersa*, and *Phlox divaricata*. Quarterman *et al.* (1972) sampled the overstory on the south facing slope and found high importance values for *Quercus prinus* (85.4), *Carya tomentosa* (56.7), *Quercus rubra* (56.6), *Liriodendron tulipifera* (23.3), *Quercus alba* (23.0), *Carya ovata* (17.6), *Carya ovalis* (12.0), and *Pinus virginiana* (11.0). Furthermore, they consider this forest to be an oak-hickory-tuliptree expression of the mixed mesophytic forest type.

Area 5, the north facing slope of Savage Gulf, is the most floristically diverse area. The spring and early summer flora contain many elements of the hardwood forest of the Appalachian Mountains. Common among these are *Dryopteris intermedia*, *Disporum maculatum*, *Trillium erectum*, *Polygonatum pubescens*, *Aristolochia macrophylla*, *Claytonia caroliniana*, *Mitella diphylla*, *Viola blanda*, and *Chelone lyonii*. *Dryopteris goldiana*, *Athyrium pycnocarpon*, *Phacelia bipinnatifida*, and an occasional element more typical of the Interior Low Plateau and Central Lowland Provinces, such as *Trillium recurvatum* and *Stylophorum diphyllum*, are other features of Area 5. Two particularly northern elements, *Streptopus amplexifolius* and *Maianthemum canadense*, are reported by Quarterman *et al.* (1972), but were not observed in the present study and specimens have not been located.

Many co-dominants occupy the overstory of Area 5. Quarterman *et al.* (1972) report high importance values for *Tilia heterophylla* (61.7), *Tsuga canadensis* (54.4), *Acer saccharum* (40.0), *Liriodendron tulipifera* (37.6), *Aesculus octandra* (23.1), *Carya tomentosa* (20.8), *Fagus grandifolia* (17.1), *Quercus rubra* (12.6), and *Magnolia acuminata* (12.2). *Cladrastis lutea*, an uncommon tree of the eastern U.S., occurs sporadically in the understory. In addition, Quarterman *et al.* (1972) consider the north facing slope to more closely resemble Braun's (1950) typical mixed mesophytic forest of the Cumberland Mountains than adjacent mixed mesophytic stands in Tennessee.

Area 6 is defined as the mouth of Savage Gulf and consists of many habitats from flood plain woods to open, drier limestone outcrops. Savage Creek runs underground in the mouth of the Gulf, except for periods of high

rainfall when torrents may increase the water's height above ground by 10 to 15 ft. The flood plain woods is composed of cutover pines (*Pinus echinata* and *P. virginiana*), several oaks (*Quercus falcata*, *Q. alba*, *Q. rubra*), *Platanus occidentalis*, *Carpinus caroliniana*, *Crataegus* spp., and *Liquidambar styraciflua*. Characteristic shrubs along the bouldery channel are *Xanthorhiza simplicissima*, *Dirca palustris*, *Ilex ambigua* var. *montana*, *Cornus amomum*, *Rhododendron arborescens*, and *Viburnum rufidulum*. Herbaceous taxa that occur in abundance include *Asplenium platyneuron*, *Pachysandra procumbens*, *Phlox glaberrima*, *P. maculata*, *Collinsonia canadensis*, *Mitchella repens*, and *Marshallia trinervia*. Other open habitats support a more weedy flora of many legumes and composites.

A noteworthy limestone site occurs at an elevation of 1250 to 1300 ft in a northwesterly exposure toward the mouth of Savage Gulf. Calciphiles of this site are *Agave virginica*, *Quercus muehlenbergii*, *Bumelia lycioides*, *Fraxinus quadrangulata*, *Swertia caroliniensis*, and *Echinacea purpurea*.

RARE TENNESSEE PLANTS²

Several rare Tennessee plants, designated as such by the Committee for Tennessee Rare Plants (1978), occur in Savage Gulf. These are listed below with their degree of endangerment in Tennessee and location within the study area.

1. *Woodwardia virginica* (L.) Smith—SPECIAL CONCERN. Dense colonies in swamp on extreme western edge of south rim, 14 May 1977, *Webb & Wofford* 812; upland swamp on north rim, 15 May 1977, *Webb & Wofford* 819.

2. *Poa languida* Hitchcock—SPECIAL CONCERN. Mouth of Gulf, flood plain, 26 Apr 1977, *Phillippe & Patrick* 3769.

3. *Carex pedunculata* Muhl.—SPECIAL CONCERN. Savage Gulf below still, under hemlock, 4 May 1977, *Kral* 59910.

4. *Veratrum woodii* Robbins—ENDANGERED. Savage Gulf, nw of Sewanee, Jul 1972, M. Rhinehart s.n.; north facing slope near western end of Gulf, 23 Jul 1977, *Patrick, Phillippe, & Simmers* 289. This taxon is genuinely rare in the Southeast (Johnson, 1969) and the Savage Gulf population of about 200 individuals is the only known Tennessee locality.

5. *Zigadenus leimanthoides* Gray—THREATENED. Locally abundant in upland swamp on north rim, 22 Jun 1977, *Wofford & Webb* 77-90.

6. *Platanthera integrilabia* (Correll) Luer—ENDANGERED. Locally abundant in upland swamp on north rim, 26 Jul 1977, *Wofford & Webb* 77-219; swale along old logging road on south rim, 23 Jul 1977, *Patrick, Phillippe, Wilson, & Simmers* 300.

² *Trichomanes petersii* Gray—ENDANGERED. Dr. David K. Smith recently collected specimens of this rare fern from the Gulf. Exact data and discussion of this report will appear separately.

7. *Cimicifuga rubifolia* Kearney—THREATENED. Near base of caprock on north facing slope, 23 Jul 1977, *Patrick, Phillippe, & Simmers* 288.

8. *Hydrastis canadensis* L.—THREATENED. Deciduous woods near flood plain on south side of Savage Creek, in mouth, 14 May 1977, *Patrick & Phillippe* 83.

9. *Panax quinquefolium* L.—THREATENED. Uncommon on north facing slope, 23 Jul 1977, *Patrick, Phillippe, & Simmers* 281.

10. *Montropsis odorata* Schweinitz in Ell.—THREATENED. Well-rotted wood along trail on north rim of Savage Gulf, ca. 0.5 mi W of Meadow Creek, elev. 1820 ft, 2 Apr 1977, *M. Whitten s.n.*; pine woods along foot trail on north rim near edge of gorge, 26 Apr 1977, *Wofford, Webb, & Rader* 77-29.

In addition, *Carex hitchcockiana* Dewey was collected from the base of the south rim on limestone near Savage Creek, 8 Jun 1977, *Patrick, Phillippe, & Malter* 201. Although this is the first collection on record in a Tennessee herbarium, Fernald (1950) and Underwood (1962) include this taxon for Tennessee. Another noteworthy record is the first verification of *Chelone lyonii* from the Cumberland Plateau.

BOTANICAL-ECOLOGICAL SIGNIFICANCE

Savage Gulf is one of the more floristically diverse natural areas in Tennessee. Considering the size of the area (ca. 10 sq. mi.), it contains an extremely high number of taxa (680) with elements from the Interior Low Plateau, the Appalachian Highlands, and the southeastern Coastal Plain. Several Tennessee rare plants occur here, including the only known locality for *Veratrum woodii* in the State. Furthermore, as noted by Quarterman *et al.* (1972), the forest that occurs on much of the north facing slope is an important virgin relic of mixed mesophytic forest.

The area is presently under the management of the Tennessee Heritage Program of the Tennessee Department of Conservation, as part of the Savage Gulf Natural Area. It is our recommendation to those responsible for maintaining the antiquity and botanical uniqueness of the area that any development be limited to primitive use. All concerned citizens must shoulder the responsibility to preserve yet another small piece of our natural heritage.

ACKNOWLEDGEMENTS

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FLORISTIC SUMMARY

Collections were made throughout the study area from mid-April through

October, 1977. Voucher specimens are deposited in the University of Tennessee Herbarium, Knoxville (TENN) and duplicates will be distributed at a later date.

A total of 680 taxa from 360 genera and 111 families is represented in the flora. For the most part, nomenclature is that of Radford, Ahles, & Bell (1968). Taxa are arranged alphabetically by family, genus, and species under three major headings, as follows: PTERIDOPHYTES (ferns and fern allies), GYMNOSPERMS, and ANGIOSPERMS. Number(s) after each entry refer to the general locality or plant community from which the voucher was collected. Slight records are not included. These areas are delimited in a preceding section, as follows:

- | | |
|-----------------------------|----------------------|
| 1—Upland Swamp on North Rim | 4—South Facing Slope |
| 2—North Rim Woods | 5—North Facing Slope |
| 3—South Rim Woods | 6—Mouth of Gulf |

I. PTERIDOPHYTES

ADIANTACEAE

- Adiantum pedatum* L.—4
Cheilanthes lanosa (Michx.) D.C. Eaton—4
Pellaea atropurpurea (L.) Link—6

ASPLENIACEAE

- Asplenium montanum* Willd.—5
Asplenium platyneuron (L.) Oakes—3, 5, 6
Asplenium rhizophyllum L.—5
Athyrium asplenioides (Michx.) A. A. Eaton—1, 3
Athyrium pycnocarpon (Sprengel) Tidestrom—5
Athyrium thelypteroides (Michx.) Desvaux—5
Cystopteris bulbifera (L.) Bernh.—5
Cystopteris protrusa (Weatherby) Blasdell—4, 6
Dryopteris goldiana (Hooker) Gray—5
Dryopteris intermedia (Willd.) Gray—5
Dryopteris marginalis (L.) Gray—3, 4, 5
Polystichum acrostichoides (Michx.) Schott—4
Thelypteris hexagonoptera (Michx.) Weatherby—5
Thelypteris noveboracensis (L.) Nieuwland—3, 5

BLECHNACEAE

- Woodwardia areolata* (L.) Moore—1
Woodwardia virginica (L.) Smith—1, 3

DENNSTAEDIACEAE

- Dennstaedtia punctilobula* (Michx.) Moore—3, 5
Pteridium aquilinum L.—2

HYMENOPHYLLACEAE

- Trichomanes petersii* Gray—4

LYCOPDIACEAE

- Lycopodium lucidulum* Michx.—5
Lycopodium obscurum L.—2, 3
Lycopodium porophyllum Lloyd & Underwood—4
Lycopodium tristachyum Pursh—2, 3

OPHIOGLOSSACEAE

- Botrychium dissectum* Sprengel—3, 5, 6
Botrychium virginianum (L.) Swartz—4, 5

OSMUNDACEAE

- Osmunda cinnamomea* L.—3
Osmunda regalis (Willd.) Gray—1

POLYPODIACEAE

- Polypodium polypodioides* (L.) Watt—5
Polypodium virginianum L.—5

SCHIZAEACEAE

Lygodium palmatum (Bernh.) Swartz
—2

SELAGINELLACEAE

Selaginella apoda (L.) Spring—4

VITTARIACEAE

Vittaria sp. (gametophyte)—5

II. GYMNOSPERMS

PINACEAE

Pinus echinata Miller—3
Pinus taeda L.—3
Pinus virginiana Miller—2, 3, 4
Tsuga canadensis (L.) Carr.—5

CUPRESSACEAE

Juniperus virginiana L.—3

III. ANGIOSPERMS

ACANTHACEAE

Ruellia caroliniensis (Walt.) Steud.—6

ACERACEAE

Acer negundo L.—3
Acer pensylvanicum L.—5
Acer rubrum L.—3
Acer saccharum Marsh.—5

ALISMATACEAE

Alisma subcordatum Raf.—2
Sagittaria latifolia Willd.—2, 6
Sagittaria engelmanniana J. G. Smith
ssp. *longirostra* (Micheli) Bogin—3

AMARYLLIDACEAE

Agave virginica L.—6
Hypoxis hirsuta (L.) Coville—3, 6

ANACARDIACEAE

Rhus copallina L.—3
Rhus glabra L.—6
Rhus radicans L.—4

ANNONACEAE

Asimina triloba (L.) Dunal—5

APIACEAE

Angelica venenosa (Greenway) Fern.—
3
Chaerophyllum tainturieri Hooker—6
Cicuta maculata L.—4

Cryptotaenia canadensis (L.) DC.—6
Daucus carota L.—6

Erigenia bulbosa (Michx.) Nutt.—5

Eryngium yuccifolium Michx.—3

Ligusticum canadense (L.) Britt.—6

Osmorhiza claytonii (Michx.) Clarke
—5, 6

Oxypolis rigidior (L.) Raf.—1, 3

Sanicula canadensis L.—3, 5

Sanicula gregaria Bicknell—5

Sanicula smallii Bicknell—4

Sanicula trifoliata Bicknell—5

Taenidia integerrima (L.) Drude—6

Thaspium barbinode (Michx.) Nutt.—
4, 5

Zizia aptera (Gray) Fern.—6

AQUIFOLIACEAE

Ilex ambigua (Michx.) Torr. var. *montana* (T. & G.) Ahles—2, 3, 6

Ilex decidua Walt.—6

Ilex opaca Ait.—3, 4

ARACEAE

Arisaema triphyllum (L.) Schott—4, 5

ARALIACEAE

Aralia racemosa L.—6

Aralia spinosa L.—3, 6

Panax quinquefolium L.—5

ARISTOLOCHIACEAE

Aristolochia macrophylla Lam.—5

Aristolochia serpentaria L.—5

Asarum canadense L.—5

Hexastylis arifolia (Michx.) Small—2,
4

ASCLEPIADACEAE

Asclepias amplexicaulis Smith—3

Asclepias quadrifolia Jacq.—4, 5

Asclepias tuberosa L.—3

Asclepias variegata L.—3

Matelea carolinensis (Jacq.) Woodson
—6

ASTERACEAE

Ambrosia artemisiifolia L.—3

Ambrosia trifida L.—6

Antennaria plantaginifolia (L.) Hook.
—3

Antennaria solitaria Rydb.—4

Aster cordifolius L.—6

Aster divaricatus L.—3, 5, 6

- Aster dumosus* L.—2
Aster infirmus Michx.—3
Aster laevis L.—6
Aster lateriflorus (L.) Britt.—4, 6
Aster linariifolius L.—3
Aster lowrieianus Porter—3
Aster patens Ait.—3
Aster paternus Cronquist—2, 3
Aster shortii Lindl.—2, 6
Aster simplex Willd.—3
Aster solidagineus Michx.—3
Aster surculosus Michx.—2, 3
Aster umbellatus Mill.—1, 6
Bidens bipinnata L.—6
Bidens frondosa L.—2
Bidens polylepis Blake—3
Cacalia atriplicifolia L.—6
Chrysanthemum leucanthemum L.—3
Cirsium altissimum (L.) Sprengel—2
Cirsium muticum Michx.—6
Coreopsis auriculata L.—6
Coreopsis major Walt. var. *stellata* (Nutt.) Robinson—3
Echinacea purpurea (L.) Moench—6
Elephantopus carolinianus Willd.—6
Elephantopus tomentosus L.—6
Erechtites hieracifolia (L.) Raf.—2, 3, 6
Erigeron annuus (L.) Pers.—3
Erigeron canadensis L.—6
Erigeron pulchellus Michx.—4
Erigeron strigosus Muhl. ex Willd.—3
Eupatorium album L.—3
Eupatorium aromaticum L.—3
Eupatorium hyssopifolium L.—3
Eupatorium incarnatum Walt.—6
Eupatorium perfoliatum L.—3
Eupatorium purpureum L.—3, 5, 6
Eupatorium rotundifolium L.—3
Eupatorium rugosum Houtt.—6
Eupatorium serotinum Michx.—3
Gnaphalium helleri Britt.—3
Gnaphalium obtusifolium L.—3
Gnaphalium purpureum L.—4
Helenium autumnale L.—3
Helianthus atrorubens L.—3
Helianthus decapetalus L.—6
Helianthus hirsutus Raf.—6
Helianthus microcephalus T. & G.—6
Heliopsis helianthoides (L.) BSP—4, 6
Heterotheca graminifolia (Michx.) Shinners—3
Heterotheca mariana (L.) Shinners—2, 3
Hieracium gronovii L.—2, 3
Hieracium paniculatum L.—3
Hieracium venosum L.—3, 4
Krigia biflora (Walt.) Blake—3, 6
Lactuca canadensis L.—6
Lactuca floridana (L.) Gaertn.—6
Liatris aspera Michx.—3
Liatris microcephala (Small) K. Schumann—2
Liatris spicata (L.) Willd.—3
Marshallia trinervia (Walt.) Trelease ex Branner & Coville—6
Parthenium integrifolium L.—3
Polymnia canadensis L.—4, 5
Polymnia uvedalia L.—6
Prenanthes altissima L.—3, 6
Prenanthes serpentina Pursh—3
Pyrhopappus carolinianus (Walt.) DC.—6
Rudbeckia fulgida Ait. var. *umbrosa* (Boynton & Beadle) Cronquist—6
Rudbeckia hirta L.—3, 6
Rudbeckia laciniata L.—3, 6
Senecio aureus L.—6
Senecio obovatus Muhl. ex Willd.—4
Senecio smallii Britt.—3
Silphium trifoliatum L.—6
Solidago arguta Ait.—3
Solidago boottii Hook. var. *boottii*—6
Solidago boottii Hook. var. *caroliniana* (Gray) Cronquist—3
Solidago caesia L.—6
Solidago canadensis L. var. *scabra* (Muhl.) T. & G.—3, 6
Solidago curtisii T. & G.—3
Solidago erecta Pursh—2, 3, 6
Solidago flexicaulis L.—6
Solidago gigantea Ait.—2, 6
Solidago graminifolia (L.) Salisb. var. *nuttallii* (Greene) Fern.—2
Solidago hispida Muhl.—3
Solidago nemoralis Ait.—3
Solidago odora Ait.—2, 3, 6
Solidago roanensis Porter—6
Solidago rugosa Mill. ssp. *aspera* (Ait.) Cronquist—2, 6
Solidago ulmifolia Muhl.—3, 6
Taraxacum officinale Wiggers—6
Verbesina alternifolia (L.) Britt.—6
Vernonia altissima Nutt.—6

BALSAMINACEAE

- Impatiens capensis* Meerb.—6
Impatiens pallida Nutt.—5

BERBERIDACEAE

Caulophyllum thalictroides (L.) Michx.
—5

Podophyllum peltatum L.—5

BETULACEAE

Alnus serrulata (Ait.) Willd.—2

Betula lutea Michx. f.—4, 5

Betula nigra L.—2

Carpinus caroliniana Walt.—6

Corylus americana Walt.—6

Ostrya virginiana (Mill.) K. Koch—5

BIGNONIACEAE

Anisostichus capreolata (L.) Bureau—
4, 6

Campsis radicans (L.) Seemann—6

Paulownia tomentosa (Thunb.) Steud.
—6

BORAGINACEAE

Cynoglossum virginianum L.—4

Lithospermum tuberosum Rugel ex DC.
—4

BRASSICACEAE

Arabis canadensis L.—6

Arabis leavigata (Muhl. ex Willd.)
Poir.—4, 6

Cardamine hirsuta L.—6

Dentaria laciniata Muhl.—5

BUXACEAE

Pachysandra procumbens Michx.—6

CALYCANTHACEAE

Calycanthus floridus L.—4

CAMPANULACEAE

Campanula americana L.—6

Lobelia cardinalis L.—6

Lobelia inflata L.—2, 3

Lobelia puberula Michx.—6

Specularia perfoliata (L.) DC.—3, 6

CAPRIFOLIACEAE

Lonicera japonica Thunb.—6

Lonicera sempervirens L.—3

Sambucus canadensis L.—6

Sambucus pubens Michx.—5

Triosteum perfoliatum L.—3

Viburnum acerifolium L.—2

Viburnum cassinoides L.—2

Viburnum dentatum L.—3

Viburnum nudum L.—2, 3

Viburnum rufidulum Raf.—2, 6

CARYOPHYLLACEAE

Cerastium holosteoides Fries var. *vulgare*
(Hartman) Hylander—6

Silene rotundifolia Nutt.—4, 5

Silene stellata (L.) Ait. f.—3

Silene virginica L.—4

Stellaria pubera Michx.—5

CELASTRACEAE

Euonymus americanus L.—5, 6

Euonymus atropurpureus Jacq.—6

CISTACEAE

Lechea racemulosa Michx.—3, 6

COMMELINACEAE

Tradescantia subaspera Ker—6

CONVOLULACEAE

Calystegia spithamea (L.) R. Brown—
6

Cuscuta campestris Yuncker—6

Cuscuta compacta Juss.—3

Ipomoea purpurea (L.) Roth—6

CORNACEAE

Cornus alternifolia L. f.—5

Cornus amomum Mill.—6

Cornus florida L.—5

CRASSULACEAE

Sedum ternatum Michx.—4

CYPERACEAE

Carex aestivalis M. A. Curtis—3, 6

Carex albolutescens Schwein.—3

Carex albursina Sheldon—3

Carex amphibola Steud.—2

Carex austro-caroliniana Bailey—4

Carex baileyi Britt.—3

Carex cephalophora Muhl. ex Schkuhr
—3

Carex communis Bailey—2, 4

Carex complanata Torr. & Hook.—3

Carex crinita Lam.—3

Carex debilis Michx. var. *rudgei* Bailey
—1, 2, 3

Carex emmonsii Dewey—5

Carex flaccosperma Dewey—1

Carex gigantea Rudge—1

Carex hitchcockiana Dewey—6

Carex incompta Bicknell—3
Carex intumescens Rudge—1, 2, 3
Carex jamesii Schwein.—6
Carex jorii Bailey—1
Carex laxiflora Lam.—3, 5
Carex lurida Wahl.—3
Carex pedunculata Muhl.—5
Carex pennsylvanica Lam. var. *distan*
 Peck—4
Carex plantaginea Lam.—5
Carex purpurifera Mackenzie—2, 4, 5
Carex retroflexa Muhl. ex Schkuhr—6
Carex rosea Schkuhr—2
Carex swanii (Fern.) Mackenzie—2, 3,
 6
Carex virescens Muhl. ex Schkuhr—2, 3,
 6
Cyperus praelongatus Steud.—6
Cyperus retrofractus (L.) Torr.—3
Cyperus strigosus L.—6
Eleocharis obtusa (Willd.) Schultes—3
Rhynchospora capitellata (Michx.) Vahl
 —3, 5
Rhynchospora corniculata (Lam.) Gray
 —1
Scirpus atrovirens Willd. var. *georgianus*
 (Harper) Fern.—3, 6
Scirpus cyperinus (L.) Kunth—1
Scleria oligantha Michx.—6
Scleria triglomerata Michx.—3

DIOSCOREACEAE

Dioscorea batatas Dcne.—6
Dioscorea villosa L.—4, 6

EBENACEAE

Diospyros virginiana L.—3

ERICACEAE

Chimaphila maculata (L.) Pursh—6
Epigaea repens L.—3, 4, 6
Kalmia latifolia L.—2, 3, 4
Lyonia ligustrina (L.) DC.—3
Monotropa hypopithys L.—3
Monotropa uniflora L.—6
Monotropis odorata Schwein. in Ell.—
 2
Oxydendrum arboreum (L.) DC.—3
Rhododendron alabamense Rehder—1,
 3
Rhododendron arborescens (Pursh)
 Torr.—6
Rhododendron calendulaceum (Michx.)
 Torr.—3

Rhododendron cumberlandense Braun
 —3
Rhododendron maximum L.—5
Rhododendron nudiflorum (L.) Torr.—
 3, 4
Vaccinium arboreum Marsh.—2
Vaccinium constablaei Gray—2, 4
Vaccinium corymbosum L.—3
Vaccinium stamineum L.—3
Vaccinium vacillans Torr.—3, 4

EUPHORBIACEAE

Acalypha gracilens Gray—3
Acalypha rhomboidea Raf.—6
Croton monanthogynus Michx.—3
Euphorbia corollata L. var. *zinniiflora*
 (Small) Ahles—3
Euphorbia mercurialina Michx.—4

FABACEAE

Albizia julibrissin Durazzini—3
Amphicarpa bracteata (L.) Fern.—6
Apios americana Medicus—3
Baptisia tinctoria (L.) R. Brown—2, 3
Cassia marilandica L.—6
Cassia nictitans L.—6
Cercis canadensis L.—6
Cladrastis lutea (Michx. f.) K. Koch—
 5
Clitoria mariana L.—3
Desmodium cuspidatum (Muhl. ex
 Willd.) Loudon—6
Desmodium glutinosum (Muhl. ex
 Willd.) Wood—6
Desmodium marilandicum (L.) DC.—
 3
Desmodium nudiflorum (L.) DC.—2, 6
Desmodium paniculatum (L.) DC. var.
paniculatum—2, 6
Desmodium paniculatum (L.) DC. var.
dillenii (Darl.) Isely—3, 6
Desmodium obtusum (Muhl. ex Willd.)
 DC.—6
Desmodium pauciflorum (Nutt.) DC.
 —6
Desmodium rotundifolium DC.—6
Galactia volubilis (L.) Britt.—6
Lespedeza bicolor Turcz.—3
Lespedeza cuneata (Dumont) G. Don
 —3
Lespedeza hirta (L.) Hornemann—2, 3
Lespedeza hirta X *intermedia*—2, 3
Lespedeza intermedia (S. Wats.) Britt.
 —3, 6

Lespedeza repens (L.) Bart.—3
Lespedeza steuvei Nutt.—3
Melilotus alba Desr.—3
Psoralea psoralioides (Walt.) Cory—4
Robinia (hybrid)—2
Robinia pseudo-acacia L.—4
Schrankia microphylla (Soland. ex Sm.)
 McBride—3
Stylosanthes biflora (L.) BSP.—3
Tephrosia virginiana (L.) Pers.—2, 3
Trifolium campestre Schreb.—6
Trifolium pratense L.—6
Vicia caroliniana Walt.—6

FAGACEAE

Castanea dentata (Marsh.) Borkh.—3, 4
Fagus grandifolia Ehrhart—2
Quercus alba L.—3
Quercus coccinea Meunchh.—3
Quercus falcata Michx.—3
Quercus marilandica Muenchh.—3
Quercus muehlenbergii Engelm.—6
Quercus prinus L.—3
Quercus rubra L.—3
Quercus stellata Wang.—3
Quercus velutina Lam.—3

FUMARIACEAE

Dicentra cucullaria (L.) Bernh.—5

GENTIANACEAE

Bartonia virginica (L.) BSP.—1, 3
Gentiana quinquefolia L.—4, 6
Gentiana saponaria L.—1, 3
Gentiana villosa L.—2, 3
Sabatia brachiata Ell.—3
Swertia caroliniensis (Walt.) Kuntze—
 6

GERANIACEAE

Geranium carolinianum L.—6
Geranium maculatum L.—4

HALORATACEAE

Proserpinaca pectinata Lam.—1

HAMAMELIDACEAE

Hamamelis virginiana L.—2, 5
Liquidambar styraciflua L.—4, 6

HIPPOCASTANACEAE

Aesculus octandra Marsh.—5, 6

HYDROPHYLLACEAE

Hydrophyllum canadense L.—5

Phacelia bipinnatifida Michx.—5

HYPERICACEAE

Hypericum denticulatum Walt. var.
recognitum Fern. & Schub.—3
Hypericum gentianoides (L.) BSP.—2,
 3
Hypericum mutilum L.—3
Hypericum nudiflorum Michx. ex Willd.
 —6
Hypericum prolificum L.—6
Hypericum punctatum Lam.—2, 6
Hypericum stans (Michx.) P. Adams &
 Robson—3
Hypericum stragalum P. Adams & Rob-
 son—3, 6

IRIDACEAE

Iris cristata Ait.—4, 5
Sisyrinchium albidum Raf.—6
Sisyrinchium angustifolium Mill.—6

JUGLANDACEAE

Carya cordiformis (Wang.) K. Koch—
 5
Carya glabra (Mill.) Sweet—6
Carya ovalis (Wang.) Sarg.—6
Carya ovata (Mill.) K. Koch—5
Carya pallida (Ashe) Engler & Graebn.
 —3
Carya tomentosa (Poir.) Nutt.—6
Juglans cinerea L.—6
Juglans nigra L.—6

JUNCACEAE

Juncus canadensis J. Gay ex La Harpe
 —3
Juncus coriaceus Mackenzie—3
Juncus debilis Gray—1, 3
Juncus effusus L.—1, 3
Juncus marginatus Rostk.—3
Juncus repens Michx.—1
Juncus tenuis Willd.—2, 3
Luzula acuminata L.—6
Luzula bulbosa (Wood) Rydb.—3

LAMIACEAE

Collinsonia canadensis L.—6
Dracocephalum virginianum L.—6
Lycopus virginicus L.—2, 3, 6
Monarda clinopodia L.—4, 6
Mosla dianthera (Hamilton) Michx.—6
Perilla frutescens (L.) Britt.—6
Prunella vulgaris L.—3

Pycnanthemum incanum (L.) Michx.—
6

Pycnanthemum muticum (Michx.) Pers.—
3

Salvia lyrata L.—6

Salvia urticifolia L.—6

Scutellaria elliptica Muhl.—3, 6

Scutellaria pseudoserrata Epling—6

Trichostema dichotomum L.—6

LAURACEAE

Lindera benzoin (L.) Blume—2, 5

Sassafras albidum (Nutt.) Nees—4

LILIACEAE

Aletris farinosa L.—3

Allium canadense L.—6

Chamaelirium luteum (L.) Gray—3

Disporum lanuginosum (Michx.) Nicholson—5

Disporum maculatum (Buckl.) Britt.—
5

Erythronium americanum Ker—6

Lilium michiganense Farw.—1

Medeola virginiana L.—2

Polygonatum biflorum (Walt.) Ell.—3

Polygonatum pubescens (Willd.) Pursh—
5

Smilacina racemosa (L.) Desf.—4

Smilax bona-nox L.—6

Smilax ecirrhata (Engelm.) Watson var.
hugeri (Small) Ahles—4, 5, 6

Smilax glauca Walt.—3, 4

Smilax hispida Muhl.—6

Smilax rotundifolia L.—3, 4, 6

Trillium cuneatum Raf.—5, 6

Trillium erectum L.—5

Trillium grandiflorum (Michx.) Salisb.—
5

Trillium recurvatum Beck—5

Uvularia grandiflora Smith—5, 6

Uvularia perfoliata L.—6

Uvularia sessilifolia L.—2, 3

Veratrum woodii Robbins—5

Zigadenus leimanthoides Gray—1

LINACEAE

Linum striatum Walt.—2, 3

Linum virginianum L. var. *floridanum*
Planchon—3

LOGANIACEAE

Spigelia marilandica L.—6

LORANTHACEAE

Phoradendron serotinum (Raf.) M. C.
Johnston—5

MAGNOLIACEAE

Liriodendron tulipifera L.—4

Magnolia acuminata L.—4

Magnolia tripetala L.—6

MALVACEAE

Hibiscus syriacus L.—6

MELASTOMATACEAE

Rhexia mariana L.—3

Rhexia virginica L.—3

MORACEAE

Morus rubra L.—6

NYSSACEAE

Nyssa sylvatica Marsh.—4, 5

OLEACEAE

Chionanthus virginicus L.—3

Ligustrum vulgare L.—5

Fraxinus americana L. var. *biltmoreana*
(Beadle) J. Wright ex Fern.—6

Fraxinus quadrangulata Michx.—6

ONAGRACEAE

Circaea lutetiana L. ssp. *canadensis* (L.)
Aschers. & Magnus—6

Ludwigia alternifolia L.—2, 3

Oenothera biennis L.—6

Oenothera tetragona Roth—3

ORCHIDACEAE

Aplectrum hyemale (Muhl. ex Willd.)
Torr.—5

Corallorhiza odontorhiza (Willd.) Nutt.—
3, 6

Cypripedium acaule Ait.—2

Cypripedium calceolus L. var. *pubescens*
(Willd.) Correll—4

Goodyera pubescens (Willd.) R. Brown—
3

Hexalectris spicata (Walt.) Barnhart—
6

Isotria verticillata (Muhl. ex Willd.)
Raf.—1

Malaxis unifolia Michx.—2, 3

Orchis spectabilis L.—4

Platanthera ciliaris (L.) Lindely—1, 3

- Platanthera clavellata* (Michx.) Luer—
1, 3
Platanthera cristata (Michx.) Lindley—
1
Platanthera integrilabia (Correll) Luer
—1, 3
Tipularia discolor (Pursh) Nutt.—6
Triphora trianthophora (Swartz) Rydb.
5

OROBANCHACEAE

- Conopholis americana* (L.) Wallroth—
4
Epifagus virginiana (L.) Barton—5, 6

OXALIDACEAE

- Oxalis dillenii* Jacq.—6
Oxalis stricta L.—6
Oxalis violacea L.—6

PAPAVERACEAE

- Sanguinaria canadensis* L.—5
Stylophorum diphyllum (Michx.) Nutt.
—5

PASSIFLORACEAE

- Passiflora lutea* L.—6

PHRYMACEAE

- Phryma leptostachya* L.—4

PHYTOLACCACEAE

- Phytolacca americana* L.—6

PLANTAGINACEAE

- Plantago aristata* Michx.—3
Plantago lanceolata L.—3
Plantago rugelii Dcne.—6
Plantago virginica L.—6

PLATANACEAE

- Platanus occidentalis* L.—4, 6

POACEAE

- Agrostis perennans* (Walt.) Tuckerman
2, 3, 6
Andropogon gerardii Vitman—3
Andropogon scoparius Michx.—2, 3
Andropogon virginicus L.—6
Aristida dichotoma Michx.—3
Arundinaria gigantea (Walt.) Muhl.—
6
Brachyelytrum erectum (Schreb.) Beauv.
—6
Bromus purgans L.—6

- Bromus secalinus* L.—2
Calamagrostis cinnoides (Muhl.) Bart.
1, 3
Chasmanthium latifolium (Michx.)
Yates—6
Chasmanthium laxum (L.) Yates—3
Cinna arundinacea L.—6
Dactylis glomerata L.—3
Danthonia compressa Austin—3
Danthonia sericea Nutt.—2
Danthonia spicata (L.) Beauv. ex R. &
S.—6
Deschampsia flexuosa (L.) Trin.—2, 3
Diarrhena americana Beauv.—6
Digitaria ischaemum (Schreb.) Schreb.
ex Muhl. var. *ischaemum*—3
Digitaria ischaemum (Schreb.) Schreb.
ex Muhl. var. *violascens* (Link) Rad-
ford—3
Echinochloa muricata (Beauv.) Fern.—
3
Eleusine indica (L.) Gaertner—3
Elymus virginicus L.—3
Eragrostis spectabilis (Pursh) Steudel—
3
Erianthus alopecuroides (L.) Ell.—6
Festuca elatior L.—3
Festuca obtusa Biehler—6
Holcus lanatus L.—3
Hystrix patula Moench—6
Leersia virginica Willd.—3, 6
Lolium multiflorum Lam.—3
Melica mutica Walt.—2, 4
Microstegium vimineum (Trin.) A.
Camus—3
Muhlenbergia schreberi J. F. Gmelin—
3
Muhlenbergia sylvatica (Torr.) Torr. ex
Gray—6
Panicum anceps Michx.—3
Panicum boscii Poir.—2, 6
Panicum clandestinum L.—3
Panicum dichotomum L.—1, 3
Panicum laxiflorum Lam.—3, 6
Panicum longifolium Torr.—1
Panicum longiligulatum Nash—1
Panicum philadelphicum Bernh.—3
Panicum polyanthes Schult.—2
Panicum sphaerocarpon Ell.—3
Paspalum laeve Michx.—3
Poa compressa L.—3
Poa languida Hitchc.—6
Poa pratensis L.—6

Setaria faberi W. Herrmann—3
Setaria geniculata (Lam.) Beauv.—3
Sorghastrum nutans (L.) Nash—3
Sphenopholis nitida (Biehler) Scribner—4
Sporobolus vaginiflorus (Torr.) Wood—3
Stipa avenacea L.—2, 6
Tridens flavus (L.) Hitchc.—6

POLEMONIACEAE

Phlox amoena Sims—2
Phlox carolina L.—6
Phlox divaricata L.—4, 5, 6
Phlox glaberrima L.—6
Phlox maculata L. ssp. *pyramidalis* (Smith) Wherry—2, 6
Phlox pilosa L.—6

POLYGALACEAE

Polygala curtissii Gray—3
Polygala incarnata L.—3
Polygala senega L.—4
Polygala verticillata L.—2, 3

POLYGONACEAE

Polygonum cespitosum Blume var. *longisetum* (DeBruyn) Stewart—6
Polygonum persicaria L.—6
Polygonum punctatum Ell.—6
Polygonum scandens L.—6
Rumex acetosella L.—6
Rumex crispus L.—6
Tovara virginiana (L.) Raf.—6

PORTULACACEAE

Claytonia caroliniana Michx.—5

PRIMULACEAE

Lysimachia lanceolata Walt.—6
Lysimachia quadrifolia L.—3, 6
Lysimachia tonsa (Wood) Kunth—6

RANUNCULACEAE

Actaea pachypoda Ell.—5
Anemone quinquefolia L.—6
Anemone virginiana L.—6
Aquilegia canadensis L.—4
Cimicifuga rubifolia Kearney—5
Clematis virginiana L.—6
Delphinium tricorne Michx.—5
Hepatica acutiloba DC.—5
Hydrastis canadensis L.—6
Ranunculus abortivus L.—6

Ranunculus recurvatus Poir.—5
Thalictrum clavatum DC.—4, 5
Thalictrum pubescens Pursh—6
Thalictrum thalictroides (L.) Boivin—5, 6
Xanthorhiza simplicissima Marsh.—2, 6

RHAMNACEAE

Ceanothus americanus L.—6
Rhamnus caroliniana Walt.—6

ROSACEAE

Agrimonia parviflora Ait.—6
Agrimonia pubescens Wallroth—6
Agrimonia rostellata Wallroth—6
Amelanchier canadensis (L.) Medicus—3, 6
Aruncus dioica (Walt.) Fern.—6
Crataegus crus-galli L.—6
Crataegus flabellata (Bosc) K. Koch—3
Crataegus flava Ait.—4
Crataegus viridis L.—6
Geum canadense Jacq.—6
Gillenia stipulata (Muhl.) Baillon—6
Gillenia trifoliata (L.) Moench—3
Physocarpus opulifolius (L.) Maxim.—6
Potentilla canadensis L.—2
Potentilla norvegica L.—6
Potentilla simplex Michx.—3, 4
Prunus americana Marsh.—3, 4, 6
Prunus serotina Ehrh.—2, 6
Pyrus angustifolia Ait.—2, 3, 6
Pyrus arbutifolia (L.) L. f.—3
Pyrus melanocarpa (Michx.) Schneid.—6
Rosa carolina L.—5, 6
Rosa multiflora Thunb.—6
Rubus argutus Link—3, 6
Rubus betulifolius Small—3
Rubus hispidus L.—2, 3
Rubus occidentalis L.—4
Rubus phoenicolasius Maxim.—6
Spiraea japonica L.—6

RUBIACEAE

Cephalanthus occidentalis L.—3
Diodia teres Walt.—3
Diodia virginiana L.—6
Galium aparine L.—6
Galium circaezans Michx.—3, 6
Galium latifolium Michx.—5
Galium pilosum Ait.—3, 6

Galium triflorum Michx.—3, 6
Houstonia caerulea L.—2, 3
Houstonia purpurea L.—6
Mitchella repens L.—5, 6

SALICACEAE

Salix humilis Marsh.—3
Salix nigra Marsh.—3, 6

SANTALACEAE

Pyrularia pubera Michx.—6

SAPOTACEAE

Bumelia lycioides (L.) Pers.—6

SAXIFRAGACEAE

Astilbe biternata (Vent.) Britt.—5
Heuchera americana L.—5, 6
Heuchera praviflora Bartling—5
Heuchera villosa Michx.—5
Hydrangea arborescens L. ssp. *discolor*
 (Seringe) McClintock—5
Itea virginica L.—1, 2
Mitella diphylla L.—5
Parnassia asarifolia Vent.—1, 3
Penthorum sedoides L.—6
Tiarella cordifolia L.—5

SCROPHULARIACEAE

Agalinis tenuifolia (Vahl) Raf.—2, 3
Aureolaria laevigata (Raf.) Raf.—6
Aureolaria virginica (L.) Pennell—3
Chelone glabra L.—3
Chelone lyonii Pursh—6
Gratiola virginiana L.—3
Lindernia dubia (L.) Pennell—6
Mimulus alatus Ait.—6
Pedicularis canadensis L.—4
Penstemon canescens (Britt.) Britt. ssp.
brevisepalus (Pennell) Crosswhite—6
Verbascum blattaria L.—6
Verbascum thapsus L.—3

SIMAROUBACEAE

Ailanthus altissima (Mill.) Swingle—5

SOLANACEAE

Physalis heterophylla Nees—6
Solanum carolinense L.—3, 6

THEACEAE

Stewartia ovata (Cav.) Weatherby—4,
 6

THYMELAEACEAE

Dirca palustris L.—6

TILIACEAE

Tilia heterophylla Vent.—5

TYPHACEAE

Typha latifolia L.—3

ULMACEAE

Celtis occidentalis L.—6
Ulmus alata Michx.—6
Ulmus americana L.—5
Ulmus rubra Muhl.—4

URTICACEAE

Boehmeria cylindrica (L.) Swartz—2, 6
Laportea canadensis (L.) Weddell—5, 6
Pilea pumila (L.) Gray—6

VERBENACEAE

Verbena simplex Lehmann—3
Verbena urticifolia L.—6

VIOLACEAE

Hybanthus concolor (Forster) Sprengel
 —5
Viola affinis LeConte—4, 5, 6
Viola blanda Willd.—5
Viola canadensis L.—5
Viola conspersa Reichenb.—4, 5, 6
Viola hastata Michx.—5
Viola hirsutula Brainerd—2
Viola pedata L.—2, 3
Viola pensylvanica Michx.—5
Viola primulifolia L.—2, 3
Viola rostrata Pursh.—5
Viola triloba Schwein.—5

VITACEAE

Parthenocissus quinquefolia (L.) Planch.
 —4, 5
Vitis aestivalis Michx.—3, 4, 6
Vitis cinerea Engelm. ex Millardet—4
Vitis rotundifolia Michx.—4

XYRIDACEAE

Xyris torta Smith—1

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