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Spring Flora of the Chesapeake and Ohio Canal Area,
Washington, D. C. to Seneca, Maryland

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The Chesapeake and Ohio Canal extends 184½ miles along the valley of the Potomac River from Georgetown, in Washington, D. C., to Cumberland, Maryland. Built between 1828 and 1850 to facilitate commerce with the west, the Canal became unprofitable to operate and was abandoned about 1924. Now, in modern times, the canal and its towpath afford access to the Potomac Valley for residents of the Washington area. Throngs of hikers and canoeists are to be seen on any pleasant weekend. Potential recreational value of the canal must far exceed the commercial value of the products it carried in the 1800's.

This annotated list of the spring vascular flora of the southernmost segment of the canal area was conceived as a result of casual, recreational hikes along the canal. The writer began to take notes on the flora in the spring of 1965. During the five years from 1965 through 1969, a total of about 40 trips were made along the canal during the spring season. On nearly all of these trips, lists were prepared of all species seen, with notes on flowering and abundance of plants.

The studied area is a narrow strip 22.8 miles long from Georgetown, D. C. to Seneca, Montgomery County, Maryland. Included is the canal, its towpath, and the land between the towpath and the Potomac River. Width of the strip varies from about twenty feet to about one-half mile (on Bear Island). All of this land is readily accessible to the public. Bear Island and the islands at Great Falls are included in the present study, but all other islands, especially Plummer's Island and

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Theodore Roosevelt Island, are excluded because of their relative inaccessibility. Inclusion of only the river-ward land bordering the canal excludes the usually higher, rockier hillsides on the "left bank" of the canal; these hillsides are accessible in most places only by boat because the canal effectively forms a moat. The area studied is managed by the National Park Service of the U. S. Department of the Interior.

The terrain between the canal and the river is mostly bottomland woods in which the dominant tree species are sycamore (*Platanus occidentalis*), box-elder (*Acer negundo*), elm (*Ulmus americana*), and silver maple (*Acer saccharinum*). From Lock 10 near Plummer's Island north to Great Falls, there are rocky "upland" woods on hillsides and small level areas. These woods are at most 100 feet above the river level. Rock outcrops of gneiss, granitized schist, granodiorite, and schist (Cloos and Cook 1953) are abundant. In the upland woods and on the cliffs bordering the river south of Great Falls occur a number of plant species not found in the more extensive lowland woods. In the vicinity of Chain Bridge, D. C., along the Potomac River, there is an open, rocky area termed "flats of the Potomac" in the D. C. Flora (Hitchcock and Standley 1919).

The spring season is defined here as March, April, and May. Only a few species; e. g., maples and skunk cabbage, flower before mid-March. By late March and early April a number of species are in anthesis. Spring reaches a peak about late April through early May, as far as number of flowering herbaceous forest species and floral displays are concerned. By mid May usually the forest canopy has closed and spring-flowering herbs begin to wither. In late May the vegetation has a summer aspect.

The special lure of the canal area lies less in its rare species than in its abundant species. Several species provide outstanding floral displays because of their abundance and colorful flowers. In early April *Veronica hederaefolia* and *Claytonia virginica* are conspicuous in bottomland woods. In mid April there are displays of *Dicentra canadensis*, *D. cucullaria*, and *Erythronium americanum*. By late April *Mertensia virginica* is in full bloom and is locally very abundant. In early May *Phlox divaricata* and *Senecio aureus* form massed displays. Other species locally or widely abundant are conspicuous at certain periods of the spring season: *Alliaria officinalis*, *Cerastium arvense*, *Dentaria laciniata*, *Osmorhiza longistylis*, *Phacelia purshii*, *Saxifraga virginensis*, *Stellaria pubera*, *Viola striata*, and *Zizia aurea*.

Two foreign species especially abundant in bottomland woods along the canal occur only locally elsewhere in the eastern United States:

Alliaria officinalis and *Veronica hederaefolia*. They have become more thoroughly established since 1919 when the D. C. Flora described them as occasional or only locally abundant.

The following species are of interest for their comparative rarity or for phytogeographic reasons: *Aplectrum hyemale*, *Ceanothus ovatus*, *Crepis japonica*, *Ellisia nyctelea*, *Erythronium albidum*, *Hybanthus concolor*, *Jeffersonia diphylla*, *Lathyrus venosus*, *Liparis liliifolia*, *Ophioglossum vulgatum*, *Ornithogalum nutans*, *Phacelia dubia*, *P. ranunculacea*, *Rubus phoenicolasius*, *Scutellaria saxatilis*, *S. serrata*, *Silene caroliniana*, *Smilacina stellata*, *Thalictrum steeleanum*, and *Tilia heterophylla*. Other species could be included among the preceding; it depends on the point of view of the botanist.

Certain species included in the D. C. Flora were looked for but never found, for example, *Delphinium tricornis* Michx. (mentioned in the D. C. Flora as "Islands of the Potomac and at a few other places along the river; rare and now almost extinct"), *Orchis spectabilis* L. and *Thalictrum dioicum* L.

The main concentration of study was on the spring-flowering herbs. However, to make the list more complete, an attempt was made to include all woody species, whether in anthesis or not, because they are part of the permanent, visible-year-round flora. In addition, pteridophytes and certain herbs seen only in vegetative state are also listed because of their conspicuousness in spring. No aquatic species were seen flowering in spring.

Many of the species found during the present investigation are represented by old collections in the District of Columbia Area Herbarium at the Smithsonian Institution. For this reason the writer collected only controversial or rare species to add to this herbarium. Certain duplicate specimens are deposited in the herbarium of the U. S. National Arboretum. The writer has not included old records in the present flora. These old records are represented by specimens in the D. C. Herbarium or recorded in the D. C. Flora. The present spring flora is intended to be a study of the existing flora. Undoubtedly, a number of species have become extinct in the area in recent times because of the gathering of wild flowers by hikers and the overabundance of *Lonicera japonica*.

The basic reference to the vascular flora of the Washington, D. C. area is the now out-of-print, *Flora of the District of Columbia and Vicinity* by Hitchcock and Standley (1919). Later, in 1946, Hermann published a checklist which also included the Baltimore area. Much botanical collecting has been carried on in the Washington area, particularly

the Potomac Valley, by the many professional botanists employed in the area. The first flora of the area was published in 1816, and later ones followed (see D. C. Flora, p. 13-15). Hermann's checklist cites other published additions to the flora.

In addition to the D. C. Flora and the Checklist, floristic works consulted were primarily *Gray's Manual*, 8th edition (Fernald 1950) and the *New Britton and Brown Illustrated Flora* (Gleason 1952). The order of families is that of *Gray's Manual* (Engler and Prantl system). Genera and species are listed alphabetically. Nomenclature and taxonomy generally follow either *Gray's Manual* or *Britton and Brown*.

Flowering times listed in the flora are only those determined by field observation: early = 1st to 10th days of a month; mid = 11th to 20th; late = 21st to 30th or 31st. If flowering times are not given, the species was not seen in flowering condition. Additional data on flowering dates may be found in Thomas (1963, 1965), who made detailed studies of the species occurring on Theodore Roosevelt Island (this island excluded from present study).

The frequency of occurrence is listed according to the following scale: rare—1 or 2 stations; scarce—3 or 4 stations; infrequent—5 or 6; frequent—7-9; common—generally distributed and often encountered in suitable habitats; abundant or very abundant—generally distributed and present in abundance. All such frequency data refer to stations or colonies, not to the number of "areas" in which found. Where frequency data are not listed, the species was not adequately sampled or there was some other reason to withhold judgement about frequency.

Distribution is designated according to the nine areas listed below and shown in figures 1 and 2. The locality, Great Falls, here refers to the small islands overlooking the Falls on the Maryland side; they are connected to the mainland by foot bridges.

Abbreviations:

BB=Britton and Brown Flora (Gleason 1952)

D. C. Fl.=Hitchcock and Standley 1919

Fl.=flowering

Fr.=fruiting

GM=Gray's Manual, 8th ed. (Fernald 1950)

Locations of areas studied:

Area 1—Beginning of Canal in Georgetown to Chain Bridge, D. C.

2—Chain Bridge to Lock 10 parking area opposite Plummer's Island

3—Lock 10 to Carderock, north parking lot

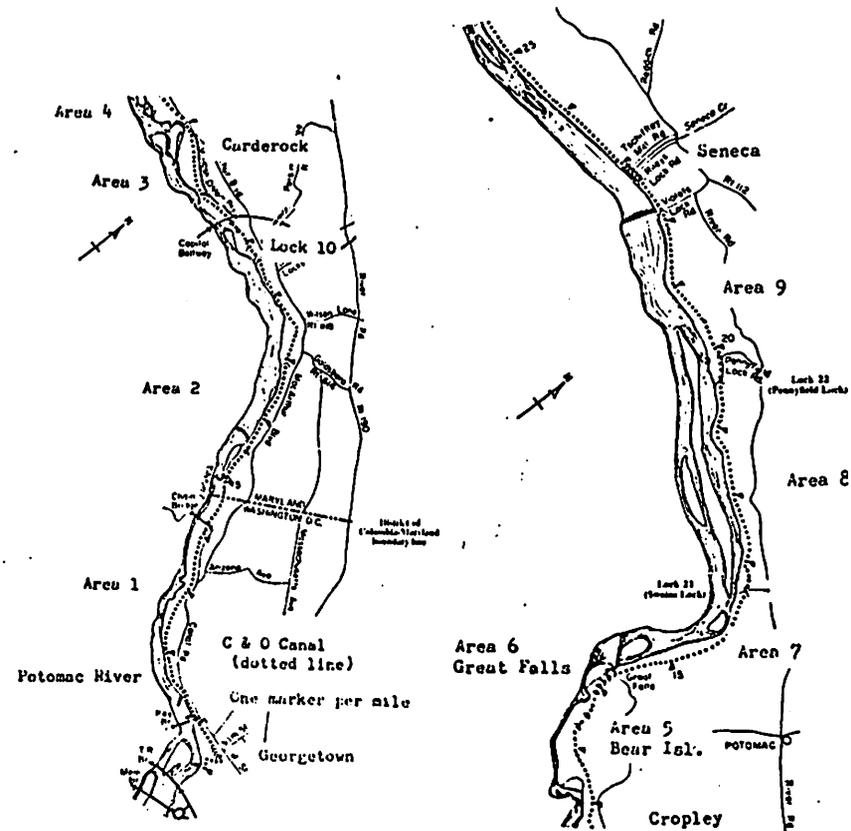


Figure 1. Washington to Carderock.

Figure 2. Cropley to Seneca.

- 4—Carderock to Cropley (parking area near Angle Inn)
- 5—Bear Island
- 6—Great Falls: islands overlooking Falls
- 7—Great Falls to Swain's Lock
- 8—Swain's Lock to Pennyfield Lock (north end)
- 9—Pennyfield Lock to Seneca

I wish to thank F. J. Hermann, C. F. Reed, and L. K. Thomas, J for critically reading the manuscript. Dr. Hermann also identified scarices and *Luzula*. Maps in figures 1 and 2 are based on three maps appearing in "184 Miles of Adventure—Hikers Guide to the C & Canal" and are used here with the kind permission of the Baltimore Area Council of the Boy Scouts of America and Dr. J. W. Wiedel, Department of Geography, University of Maryland.

Number of species listed:

Pteridophyta	19
Gymnosperms	3
Angiosperms	320
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Total	342

PTERIDOPHYTA

Equisetaceae

✓ *Equisetum arvense* L. Field Horsetail. Scarce to infrequent; moist places in areas 3, 8.

✓ *Equisetum hyemale* L. Scouring-rush. Rare; near river in areas 2, 5.

Lycopodiaceae

✓ *Lycopodium complanatum* var. *flabelliforme* Fern. Ground-pine. Rare; large colony in upland woods, Carderock (area 3).

Ophioglossaceae

✓ *Botrychium dissectum* Spreng. Both forma *dissectum* and forma *obliquum* (Muhl.) Fern. in woods in area 8. Fronds evergreen.

✓ *Botrychium virginianum* (L.) Sw. Rattlesnake Fern. Infrequent to frequent; rich woods in areas 2, 3, 4.

✓ *Ophioglossum vulgatum* L. Adder's-tongue Fern. Rare; one station in rich woods by swamp in area 3.

Osmundaceae

✓ *Osmunda cinnamomea* L. Cinnamon Fern. Rare; one station in rich woods at Carderock (area 3). Sporangia present in early May.

✓ *Osmunda regalis* var. *spectabilis* (Willd.) Gray. Royal Fern. Rare; with preceding species.

Polypodiaceae

✓ *Adiantum pedatum* L. Maidenhair Fern. Scarce; rich woods in areas 3, 4, 5.

✓ *Asplenium platyneuron* (L.) Oakes. Ebony Spleenwort. Common in dry or rocky woods; areas 3, 4, 5, 9.

✓ *Athyrium filix-femina* var. *asplenioides* (Michx.) Farw. Lady Fern. Rare in woods; Carderock (area 3).

✓ *Cystopteris fragilis* (L.) Bernh. Fragile Fern. Frequent in woods; areas 2, 3, 4, 5.

✓ *Dennstaedtia punctilobula* (Michx.) Moore. Hay-scented Fern. Rare; rocky woods at Carderock (area 3).

✓ *Dryopteris hexagonaptera* (Michx.) Christens. Broad Beech Fern. Rare; only a few plants at one station in area 4.

✓ *Dryopteris marginalis* (L.) Gray. Marginal Shield Fern. Frequent in rock crevices and on rocky hillsides; areas 3, 4, 5. Fronds evergreen.

✓ *Onclea sensibilis* L. Sensitive Fern. Frequent in moist places; areas 2, 3, 7.

✓ *Polypodium virginianum* L. Polypody Fern. Infrequent but locally abundant; crevices and rocky hillsides in areas 3, 4, 5. Fronds evergreen.

✓ *Polystichum acrostichoides* (Michx.) Schott. Christmas Fern. Common in woods; areas 4, 5, 8, 9, and probably elsewhere. Fronds evergreen.

✓ *Pteridium aquilinum* (L.) Kuhn var. *latiusculum* (Desv.) Underw. Bracken Fern. Rare; Bear Island (area 5).

SPERMATOPHYTA

GYMNOSPERMAE

Pinaceae

✓ *Juniperus virginiana* L. Red Cedar. Frequent in upland woods.

✓ *Pinus virginiana* Mill. Scrub Pine. Common in upland woods.

✓ *Tsuga canadensis* (L.) Carr. Hemlock. Rare; two saplings near river north of Carderock (area 4).

ANGIOSPERMAE

MONOCOTYLEDONEAE

Alismataceae

✓ *Sagittaria latifolia* Willd. Arrowhead. Wet places; area 3.

Gramineae

✓ *Anthoxanthum odoratum* L. Sweet Vernal Grass. Locally abundant along canal in areas 1, 4, 5, 7, 9. Fl. late April through May.

✓ *Dactylis glomerata* L. Orchard Grass. Grassy places in areas 1, 6, 8. Fl. May.

✓ *Danthonia spicata* (L.) Beauv. Poverty Grass. Locally frequent in dry woods in areas 3, 4, 6. Fl. begins late May.

✓ *Elymus virginicus* L. (sens. lat.) Virginia Wild-Rye. Woods in areas 3, 5, 7. Fl. begins late May.

✓ *Festuca arundinacea* Schreb. Tall Fescue. Common along canal banks and in grassy places. Fl. begins late May.

✓ *Festuca obtusa* Biehler. Infrequent; upland woods in areas 3, 4. Fl. begins in June, but may be as early as late May.

✓ *Glyceria striata* (Lam.) Hitchc. Area 3, where fl. late May.

✓ *Melica mutica* Walt. Melic Grass. Infrequent to frequent in rocky woods; areas 3, 4, 5. Fl. throughout May.

✓ *Panicum clandestinum* L. Low woods in area 7, where fl. late May.

Panicum depauperatum Muhl. Rare; cliff crevices at Great Falls (area 6). Fl. begins late May.

Panicum dichotomum L. Dry woods, area 3 (Carderock); fl. late May.

Phleum pratense L. Timothy. Area 5; fl. late May.

Poa annua L. Annual Bluegrass. Infrequent; canal banks and wet places in areas 1, 2, 7. Fl. throughout May.

Poa autumnalis Muhl. Scarce in rocky woods; areas 4, 5. Fl. begins late May.

Poa compressa L. Canada Bluegrass. Canal bank in area 7; fl. late May.

Poa cuspidata Nutt. Infrequent in rocky woods; areas 3, 4, 5. Fl. early-mid April.

Poa pratensis L. Kentucky Bluegrass. Common along canal and in disturbed places. Fl. late April-June.

Poa sylvestris Gray. Frequent in rocky woods; areas 2, 3, 4, 5. Fl. throughout May.

Poa trivialis L. Rough Meadow Grass. Dried canal bed in area 3; fl. late May.

Sphenopholis intermedia Rydb. Frequent in low woods and moist places; areas 1, 2, 4, 5, 6, 8. Fl. begins late May.

Sphenopholis nitida (Biehler) Scribn. Infrequent in dry woods; areas 3, 4, 5. Fl. throughout May.

Stipa avenacea L. Infrequent in dry woods; areas 4, 5, 6. Fl. begins mid May.

Cyperaceae

Carex (all specimens determined by F. J. Hermann):

Carex aggregata Mack. (?-specimen immature). Woods in area 3; fl. early May.

Carex albolutescens Schwein. Swampy place in area 3; fl. late May.

Carex amphibola var. *turgida* Fern. Canal bank in area 8; fl. mid May.

Carex annectens Bickn. Swampy place in area 3; fl. late May.

Carex blanda Dewey. Woods in areas 3, 8; fl. early-mid May.

Carex conjuncta Boott. Canal bank in area 8; fl. mid May.

Carex emmonsii Dewey. Woods in area 3; fl. mid April.

Carex emoryi Dewey. Low woods in area 1; fl. early May. - in DC only

Carex hirsutella Mack. Dry woods in area 3; fl. late May.

Carex molesta Mack. Canal bank in area 8; fl. mid May.

Carex prasina Wahl. Woods in area 3; fl. early May.

Carex rosea Schk. Woods in areas 3, 8; fl. early-mid May.

Carex squarrosa L. Swampy place in area 3; fl. late May.

Carex stipata Muhl. Canal bank in area 8; fl. mid May.

Carex torta Boott. Woods in area 3; fl. early May.

Eleocharis (at least one species seen; the single specimen collected is immature).

Araceae

Arisaema dracontium (L.) Schott. Green Dragon. Infrequent in woods; areas 1-4 incl.; not seen in flower (GM lists fl. May, June).

Arisaema triphyllum (L.) Schott. var. *triphyllum* (sens. BB; *A. atrorubens* of GM). Jack-in-the-Pulpit. Common in woods. Fl. mid April throughout May.

Symplocarpus foetidus (L.) Nutt. Skunk Cabbage. Infrequent in swampy places; areas 4, 8, 9.

Commelinaceae

Tradescantia virginiana L. Spiderwort. Scarce; flats along river in area 1; rocky places on Bear Island and Great Falls (areas 5, 6). Fl. throughout May.

Juncaceae

Juncus acuminatus Michx. Moist place in area 3; fl. late May.

Juncus effusus var. *solutus* Fern. & Wieg. With preceding; fl. late May.

Juncus tenuis Willd. Path Rush. With preceding; fl. late May. Probably frequent along canal.

Luzula echinata (Small) F. J. Herm. (sens. GM) Wood-rush. Infrequent in rocky woods; areas 3, 8. Fl. May.

Liliaceae

Allium canadense L. Wild Garlic. Frequent in woods; areas 1, 2, 3, 6; expected elsewhere. Fl. begins in May.

Allium tricoccum Ait. Wild Leek; Ramp. Infrequent in rich woods, areas 2, 3, 4. Fl. begins in June, but leaves conspicuous in spring, begin to wither in mid May, then disappear before flowering.

Allium vineale L. Field Garlic. Abundant in grassy places and disturbed woods. Fl. not seen; leaves and stems very conspicuous in early spring.

Chamaelirium luteum (L.) Gray. Rare; one station in rich woods, Carderock (area 3). Fl. not seen; rosettes only; D. C. Flora states fl. May.

Erythronium albidum Nutt. White Trout-Lily. Scarce in woods; areas 2, 3. Fl. early-mid April.

Erythronium americanum Ker. Yellow Trout-Lily. Common in woods. Fl. late March throughout April.

✓ *Hemerocallis fulva* L. Orange Day Lily. Infrequent in woods; areas 2, 8, 9. Fl. summer, but leaves conspicuous in spring.

✓ *Medeola virginiana* L. Indian Cucumber-root. Rare; rich woods at Carderock (area 3). Fl. May.

✓ *Muscari* sp. Grape Hyacinth. Frequent in woods; seen, but not collected, in areas 1, 4, 5, 8. Fl. mid April through early May. Identity uncertain whether *M. botryoides* (L.) Mill. or *M. racemosum* (L.) Mill.

✓ *Ornithogalum nutans* L. Scarce in woods; areas 3, 4. Fl. early-mid April.

✓ *Ornithogalum umbellatum* L. Star of Bethlehem. Frequent in woods; areas 3, 4, 8, 9. Fl. throughout May.

✓ *Polygonatum biflorum* (Walt.) Ell. Solomon's-seal. Frequent in upland woods; areas 3-8 incl. Fl. throughout May.

✓ *Polygonatum canaliculatum* (Muhl. Pursh. Solomon's-seal. Frequent in low woods; areas 1, 2, 3, 7, 8, 9. Fl. begins mid or late May.

✓ *Smilacina racemosa* (L.) Desf. False Solomon's-seal. Frequent in woods; areas 2, 3, 4, 5. Fl. throughout May.

✓ *Smilacina stellata* (L.) Desf. Rare; two plants in area 2. Fl. early May.

✓ *Smilax pulverulenta* Michx. Carrion Flower. Upland woods; areas 3, 5. Fl. early May.

✓ *Smilax rotundifolia* L. Common Greenbrier. Woods in areas 3, 4, 5 and probably elsewhere. Fl. early-mid May.

✓ *Trillium sessile* L. Sessile Trillium. Frequent in rich woods in areas 2, 3, 5, 7, 8. Most abundant on south part of Bear Island. Fl. mid April to early May; flowers usually purplish but yellowish ones (*forma viridiflorum* Beyer) seen in area 2.

✓ *Uvularia perfoliata* L. Bellwort. Rare in rich woods; area 4, where fl. early May.

✓ *Uvularia sessilifolia* L. Bellwort. Rare in woods; areas 3, 5. Fl. mid April.

Dioscoreaceae

✓ *Dioscorea quaternata* (Walt.) J. F. Gmel. Wild Yam. Upland woods in areas 3, 4, 5. Fl. throughout May.

✓ *Dioscorea villosa* L. Wild Yam. Rare; low woods in area 1. Fl. May.

Amaryllidaceae

✓ *Hypoxis hirsuta* (L.) Cov. Yellow Stargrass. Rare; dry woods in area 3, where fl. late May.

Iridaceae

✓ *Iris pseudacorus* L. Yellow Iris. Rare; flats near river in area 2, where fl. late May.

✓ *Sisyrinchium angustifolium* Mill. (*S. graminoides* Bickn., *S. gramineum* of D. C. Fl.) Blue-eyed-grass. Grassy places, areas 3, 7, 8. Fl. May.

✓ *Sisyrinchium montanum* Michx. Blue-eyed-grass. Low woods in area 1, where fl. early May.

Orchidaceae

✓ *Aplectrum hyemale* (Muhl.) Torr. Putty-root. Rare; rich woods in areas 3, 4. Apparently now nearly extinct here. Not seen since 1967. Fl. begins late May. Leaves evergreen, faintly purple below, very veiny and tapering at base (see *Tipularia*).

✓ *Liparis liliifolia* (L.) Rich. Twayblade. Rare; one station on rock outcrop on Bear Island (area 5). Fl. begins late May.

✓ *Tipularia discolor* (Pursh) Nutt. Cranefly Orchis. Infrequent in woods; areas 3, 4. Fl. July but leaves evergreen and present in spring. Leaves may be distinguished from *Aplectrum* (which see) by being very purple below, scarcely veiny, and truncate or subcordate at base.

DICOTYLEDONEAE

Salicaceae

✓ *Populus deltoides* Marsh. Cottonwood. Infrequent; low woods in areas 1, 2, 3, 8. A few large trees seen.

✓ *Salix babylonica* L. Weeping Willow. Along canal in areas 2, 3.

✓ *Salix caroliniana* Michx. (*S. wardii* Bebb) Ward's Willow. River bank in area 3.

✓ *Salix nigra* Marsh. Black Willow. River bank in areas 3, 8; fr. mid May. Probably elsewhere.

Juglandaceae

✓ *Carya cordiformis* (Wang.) K. Koch. Bitternut Hickory. Woods in areas 3, 6, 8.

✓ *Juglans nigra* L. Black Walnut. Infrequent; areas 2, 8.

Corylaceae

✓ *Alnus serrulata* (Ait.) Willd. Common Alder. Swampy places in areas 3, 6, 8. Fl. late March.

✓ *Betula nigra* L. River Birch. Frequent along river and in low woods.

✓ *Carpinus caroliniana* Walt. American Hornbeam. Woods in areas 6, 7, 8.

✓ *Corylus americana* Walt. Hazelnut. Woods in area 3.

✓ *Ostrya virginiana* (Mill.) K. Koch. Ironwood; Hop Hornbeam. Woods; areas 5, 8.

Fagaceae

- ✓ *Castanea dentata* (Marsh.) Borkh. Chestnut. Rare; one sprout in upland woods opposite Plummer's Island (area 3).
- ✓ *Fagus grandifolia* Ehrh. Beech. Locally common in upland woods, where often a dominant species.
- ✓ *Quercus alba* L. White Oak. Common in upland woods, where one of the dominant species.
- ✓ *Quercus bicolor* Willd. Swamp White Oak. Low woods in area 1.
- ✓ *Quercus borealis* var. *maxima* (Marsh.) Ashe (*Q. rubra* L. of GM). Red Oak. Infrequent in upland woods; areas 5, 6, 8.
- ✓ *Quercus imbricaria* Michx. Shingle Oak. Rare; rocky place in area 2.
- ✓ *Quercus palustris* Muenchh. Pin Oak. Infrequent; low woods in areas 5, 7, 8.
- ✓ *Quercus phellos* L. Willow Oak. Infrequent; areas 1, 3, 5.
- ✓ *Quercus prinus* L. (*Q. montana* of D. C. Fl.) Chestnut Oak. Locally common in rocky woods in areas 3, 4, 5.
- ✓ *Quercus stellata* Wang. Post Oak. Rare; area 6.

Ulmaceae

- ✓ *Celtis occidentalis* L. Hackberry. Frequent in woods.
- ✓ *Ulmus americana* L. American Elm. Frequent in low woods.
- ✓ *Ulmus rubra* Muhl. Slippery Elm. Low woods.

Moraceae

- ✓ *Broussonetia papyrifera* (L.) Vent. Paper Mulberry. Rare; area 2.
- ✓ *Maclura pomifera* (Raf.) Schneid. Osage Orange. Woods in area 6.
- ✓ *Morus alba* L. White Mulberry. Woods in area 1.
- ✓ *Morus rubra* L. Red Mulberry. Scarce to infrequent; areas 7, 8.

Urticaceae

- ✓ *Laportea canadensis* (L.) Wedd. Wood Nettle. Low woods; areas 2, 7, 9; probably elsewhere. Fl. July, but vegetative parts become conspicuous in May.
- ✓ *Urtica dioica* L. (sens. GM; taxonomy controversial). Stinging Nettle. Abundant in woods. Fl. from June, but vegetative parts become conspicuous in spring; basal leaves present all winter.

Santalaceae

- ✓ *Comandra umbellata* (L.) Nutt. Bastard Toadflax. Infrequent in dry woods; areas 4, 5, 6. Fl. May.

Aristolochiaceae

- ✓ *Asarum canadense* L. (sens. lat. of BB). Wild Ginger. Frequent or locally abundant in rich woods; areas 2, 3, 4, 5, 9. Fl. early April-May.

Polygonaceae

- ✓ *Polygonum cuspidatum* Sieb. & Zucc. Japanese Knotweed. Area 2, just north of Sycamore Island.
- ✓ *Rumex acetosella* L. Sheep-Sorrel. Canal bank in area 8; fl. mid May.
- ✓ *Rumex crispus* L. Yellow Dock. Canal banks in areas 7, 8; fl. mid-late May.

Portulacaceae

- ✓ *Claytonia virginica* L. Spring Beauty. Very abundant in woods; one of the most abundant species. Fl. late March through mid May.

Caryophyllaceae

- ✓ *Cerastium arvense* L. Field Chickweed. Common to locally abundant, especially along canal. Fl. mid April through May.
- ✓ *Silene antirrhina* L. Sleepy Catchfly. Rare; Great Falls (area 6). Fl. begins late May.
- ✓ *Silene caroliniana* Walt. Wild Pink. Infrequent in dry woods and rocky places near river; areas 3, 4, 5, 6. One collection is intermediate between subsp. *caroliniana* and subsp. *pensylvanica* (Michx.) Clausen. Fl. mid April to mid May.
- ✓ *Stellaria aquatica* (L.) Scop. Rare; low woods near river in area 7 (just north of Great Falls picnic ground); fl. late May.
- ✓ *Stellaria longifolia* Muhl. Rare; canal bank in area 8; fl. mid May.
- ✓ *Stellaria media* (L.) Cyrillo. Common Chickweed. Common in various habitats. Fl. April. Leaves present all winter.
- ✓ *Stellaria pubera* Michx. Star Chickweed. Frequent to common in upland woods; areas 2, 3, 4, 5, 7. Fl. throughout April and May.

Ranunculaceae

- ✓ *Anemone quinquefolia* L. Wood Anemone. Rare in woods; one station on Bear Island (area 5), where fruiting in early May.
- ✓ *Anemonella thalictroides* (L.) Spach. Rue Anemone. Infrequent to locally frequent in upland woods; areas 3, 4, 5. Fl. early April to early May.
- ✓ *Aquilegia canadensis* L. Columbine. Rare; cliffs on Bear Island and at Great Falls (areas 5, 6). Fl. mid April.
- ✓ *Cimicifuga racemosa* (L.) Nutt. Black Snakeroot. Infrequent in woods in areas 2, 4, 5. Fl. from June, but leaves become conspicuous in May.
- ✓ *Clematis viorna* L. Leather Flower. Rare; flats along river in area 2. Fl. late May.

✓ *Hepatica americana* (DC.) Ker. Hepatica. Infrequent in dry or rocky woods; areas 4, 5. Fl. late March-mid April.

✓ *Ranunculus abortivus* L. Small-flowered Crowfoot. Common in low woods and open places near river. Fl. early April-early May.

✓ *Ranunculus bulbosus* L. Bulbous Buttercup. Locally abundant along canal and in grassy places; areas 1, 2, 3, 4. Fl. May.

✓ *Ranunculus micranthus* Nutt. Frequent to common in woods. Tends to grow in more well-drained places than *R. abortivus*, to which it is closely related. Fl. early April-early May.

✓ *Ranunculus recurvatus* Poir. Hooked Buttercup. Infrequent in woods; areas 3, 4. Fl. early May.

✓ *Ranunculus sceleratus* L. Cursed Crowfoot. Locally abundant in area 3 on banks and in bed of canal. Fl. May.

✓ *Ranunculus septentrionalis* Poir. Swamp Buttercup. Low woods and swampy places; areas 1, 2, 8. Fl. mid-late April.

A3 ✓ *Thalictrum steeleanum* Boivin. Rich woods in areas 2, 3, 4, 8. Fl. May.

Berberidaceae

✓ *Berberis thunbergii* DC. Japanese Barberry. Woods in areas 2, 3. Escaped from cult.

✓ *Caulophyllum thalictroides* (L.) Michx. Blue Cohosh. Rare; rich woods in area 2. Fl. April.

✓ *Jeffersonia diphylla* (L.) Pers. Twinleaf. Infrequent to locally common; rocky hillsides and rich woods in areas 2, 3, 4, 5, 7. Fl. late March-mid April.

✓ *Podophyllum peltatum* L. May-apple. Common to locally abundant in woods. Fl. late April-early May.

Menispermaceae

✓ *Menispermum canadense* L. Moonseed. Frequent in woods; areas 2, 5, 7, 9. Fl. from June but plants conspicuous in May.

Magnoliaceae

✓ *Liriodendron tulipifera* L. Tulip Tree. Frequent in woods.

Annonaceae

✓ *Asimina triloba* (L.) Duval. Pawpaw. Abundant in low woods. Fl. late April-early May.

Lauraceae

✓ *Lindera benzoin* (L.) Blume. Spicebush. Very abundant in low woods. Fl. late March through mid April.

✓ *Sassafras albidum* (Nutt.) Nees. Sassafras. Frequent in upland woods. Fl. April.

Papaveraceae

✓ *Chelidonium majus* L. Celandine. Scarce; woods in areas 2, 3. Fl. May.

✓ *Corydalis flavula* (Raf.) DC. Frequent; woods in areas 1, 4, 5, 6, 7, 8, but only one or a few plants per location. Fl. April to mid May.

✓ *Dicentra canadensis* (Goldie) Walp. Squirrel-corn. Infrequent to locally abundant in rich woods; areas 2, 3, 4, 5. Especially abundant in woods opposite Plummer's Island where vastly outnumbering *Dicentra cucullaria*. Fl. April.

✓ *Dicentra cucullaria* (L.) Bernh. Dutchman's-Breeches. Common to locally abundant in rich woods; areas 2, 3, 4, 5, 7, 8, 9. Fl. April.

✓ *Sanguinaria canadensis* L. Bloodroot. Frequent in woods; areas 2, 4, 5, 9. Fl. late March through mid April.

Cruciferae

✓ *Alliaria officinalis* Andrz. Garlic Mustard. Very abundant in woods, especially low woods. Has become much more abundant since the D. C. Flora was published (then noted as "occasional"). Fl. throughout April and May; at peak of flowering about early May.

✓ *Arabis thaliana* (L.) Heynh. Mouse-ear Cress. Rare; Great Falls (area 6), where fl. late April.

✓ *Arabis canadensis* L. Sicklepod. Rare; Bear Island (area 5) in dry woods, where fl. late May.

✓ *Arabis laevigata* (Muhl.) Poir. Rock Cress. Frequent in rocky woods and on cliffs and rock outcrops. Recorded from areas 4, 5, 8, but probably elsewhere. Fl. April to mid May.

✓ *Arabis lyrata* L. Rock Cress. Infrequent but locally abundant; rock outcrops and cliffs in areas 4, 5, 6. Fl. April, May.

✓ *Arabis shortii* (Fern.) Gleason. (*A. dentata* of D. C. Fl.). Infrequent to frequent in woods; areas 2, 4, 7, 8, 9. Fl. late April-early May. My specimens do not entirely agree with published descriptions of this species in floras, but I conclude they belong to the *A. shortii-perstellata* group which has apparently never been adequately studied.

✓ *Barbarea vulgaris* R. Br. Winter Cress. Frequent in fields and open places; areas 2, 3, 5, 7, 8. Fl. mid April-early May.

✓ *Capsella bursa-pastoris* (L.) Medic. Shepherd's-purse. Area 1 where fl. early April.

✓ *Cardamine bulbosa* (Schreb.) BSP. Spring Cress. Frequent; moist or wet woods in areas 1, 2, 3, 5, 6, 7. Fl. mid April to early May.

✓ *Cardamine hirsuta* L. Bitter Cress. Frequent to common weed along canal. Fl. April.

✓ *Cardamine pennsylvanica* Muhl. Bitter Cress. Infrequent in wet places; areas 3, 5, 8. Fl. late April-mid May.

✓ *Dentaria heterophylla* Nutt. Toothwort. Infrequent to frequent; woods in areas 2, 3, 4, 5. Locally common on north end of Bear Island where it replaces *D. laciniata*. In area 4 from Brickyard Road north to Cropley some putative hybrids were seen of *D. heterophylla* X *D. laciniata*. Fl. early April-early May.

✓ *Dentaria laciniata* Muhl. Cut-leaved Toothwort. Common in woods. Fl. late March to early May.

✓ *Lepidium campestre* L. Grassy places in areas 5, 8. Fl. May.

✓ *Lepidium virginicum* L. Peppergrass. Along canal; areas 5, 8. Fl. May.

✓ *Rorippa islandica* (Oeder) Borbas. (sens. lat.) Dried canal bed in area 3. Fl. late May.

✓ *Rorippa sylvestris* (L.) Bess. Creeping Yellow Cress. Infrequent; areas 2, 3, 4, 8. Fl. begins mid May.

✓ *Thlaspi perfoliatum* L. Penny Cress. Rare; area 4. Fl. April.

Crassulaceae

✓ *Sedum ternatum* Michx. Stonecrop. Frequent in woods. Fl. late April through May.

Saxifragaceae

✓ *Heuchera americana* L. Alumroot. Infrequent; rocky woods in areas 3, 4, 5, 6. Fl. begins mid May.

✓ *Hydrangea arborescens* L. Wild Hydrangea. Scarce to infrequent; rocky woods in areas 4, 5.

✓ *Saxifraga virginiana* Michx. Early Saxifrage. Common in dry or rocky woods. Fl. late March to early May.

Hamamelidaceae

✓ *Hamamelis virginiana* L. Witch Hazel. Infrequent in woods; areas 4, 5.

Plantanaceae

✓ *Platanus occidentalis* L. Sycamore. Abundant in low woods.

Rosaceae

✓ *Amelanchier arborea* (Michx. f.) Fern. Shadbush. Frequent; rocky woods and cliff tops on Bear Island (area 5) and at Great Falls (area 6); also in area 2. Fl. April.

✓ *Duchesnea indica* (Andr.) Focke. False Strawberry. Frequent in woods; areas 1, 2, 4, 8, 9. Fl. April, May.

✓ *Geum vernum* (Raf.) T. & G. Spring Avens. Locally common along canal and in grassy places; areas 7, 8, 9. Fl. at peak in early May.

✓ *Gillenia trifoliata* (L.) Moench. False Ipecac. Rare; one station in woods, Carderock (area 3). Fl. late May.

✓ *Potentilla canadensis* L. Cinquefoil. Open place, Great Falls (area 6); expected elsewhere. Fl. late April-early May.

✓ *Potentilla simplex* Michx. Cinquefoil. Woods in areas 1, 4; expected elsewhere. Fl. May.

✓ *Prunus americana* Marsh. Wild Plum. Scarce; rocky woods, Bear Island and Great Falls (areas 5, 6). Fl. mid-late April.

✓ *Prunus avium* L. Sweet Cherry. Rare; one large tree at border of woods along canal in area 9.

✓ *Prunus serotina* Ehrh. Black Cherry. Infrequent in woods; areas 1, 5, 7, 8. Fl. May.

✓ *Rosa multiflora* Thunb. Multiflora Rose. Along canal in area 2. Fl. late May.

Rubus species below according to BB treatment:

✓ *Rubus allegheniensis* Porter. Blackberry. Woods border in area 3; fl. late May.

✓ *Rubus argutus* Link. Blackberry. Woods border in area 3; fl. late May.

✓ *Rubus enslenii* Tratt. Rocky place, Great Falls (area 6) where fl. late May. Identification tentative.

✓ *Rubus phoenicolasius* Maxim. Wineberry. Infrequent; woods near canal in areas 1, 2, 3, 7. Not listed in D. C. Fl.; an introduced species now becoming better established.

Leguminosae

✓ *Baptisia australis* (L.) R. Br. Blue False Indigo. Scarce; flats along river in areas 1, 2; rocky slope at Great Falls (area 6). Fl. mid-late May.

✓ *Cercis canadensis* L. Redbud. Frequent in dry or rocky woods. Fl. early April to early May.

✓ *Lathyrus venosus* Muhl. Scarce; flats along river in areas 1, 2. Fl. mid-late May.

✓ *Melilotus alba* Desr. White Sweet Clover. Area 3, where fl. late May.

✓ *Melilotus officinalis* (L.) Lam. Yellow Sweet Clover. Areas 3, 8, where fl. mid-late May.

✓ *Robinia pseudo-acacia* L. Black Locust. Infrequent; woods in areas 5, 6, 7, 8. Fl. May.

✓ *Trifolium hybridum* L. Alsike Clover. Area 8; fl. mid May.

✓ *Trifolium pratense* L. Red Clover. Area 8; fl. mid May.

✓ *Vicia angustifolia* L. Common Vetch. Frequent in grassy places. Fl. late April to late May.

✓ *Vicia caroliniana* Walt. Wood Vetch. Scarce; dry woods in areas 4, 5. Fl. early May.

✓ *Vicia villosa* Roth. Hairy Vetch. Weedy place, Widewater (area 5), where fl. early May.

Oxalidaceae

✓ *Oxalis stricta* L. (sens. BB). Scarce in woods; area 4, 6. Fl. mid-late May.

✓ *Oxalis violacea* L. Violet Wood-Sorrel. Rare; rich woods in area 3. Fl. early May.

Geraniaceae

✓ *Geranium carolinianum* L. Scarce; open places in areas 1, 6. Fl. mid-late May.

✓ *Geranium maculatum* L. Wild Geranium. Scattered and local; woods in areas 2, 3, 4, 5, 6. Fl. mid April through May.

Rutaceae

✓ *Ptelea trifoliata* L. Hop Tree. Infrequent; woods in areas 2, 3, 5. Fl. late May.

Simaroubaceae

✓ *Ailanthus altissima* (Mill.) Swingle. Tree of Heaven. Weedy places; areas 6, 7, 8.

Euphorbiaceae

✓ *Euphorbia commutata* Engelm. Wood Spurge. Infrequent in dry woods in areas 3, 4, 5. Fl. about early May.

Limnanthaceae

✓ *Floerkea proserpinacoides* Willd. False Mermaid. Frequent, sometimes locally abundant, in low woods; areas 2, 7, 8, 9. Fl. mid April-early May.

Anacardiaceae

✓ *Rhus copallina* L. Dwarf Sumac. Scarce; woods in areas 5, 6.

✓ *Rhus glabra* L. Smooth Sumac. Rare; area 5.

✓ *Rhus radicans* L. Poison Ivy. Common in woods. Fl. begins late May.

✓ *Rhus typhina* L. Staghorn Sumac. Infrequent; areas 1, 3, 5.

Aquifoliaceae

BZ ✓ *Ilex decidua* Walt. Infrequent; rocky woods in areas 4, 5, 6. Fl. begins early May.

✓ *Ilex opaca* Ait. American Holly. Frequent in woods; areas 3; 4, 5.

✓ *Celastrus scandens* L. Bittersweet. Infrequent in woods; areas 1, 4, 5, 6. Fl. May.

✓ *Euonymus alatus* (Thunb.) Sieb. Winged Euonymus. Along canal in area 2, where planted or escaped from cult. Fl. late April.

✓ *Euonymus americanus* L. Strawberry Bush. Frequent in woods; areas 3, 4, 5, 6. Fl. mid-late May.

Staphyleaceae

✓ *Staphylea trifolia* L. Bladdernut. Frequent to common in woods. Fl. late April-early May.

Aceraceae

✓ *Acer negundo* L. Box-elder. Abundant in low woods, where one of the dominant species. Fl. March-April.

✓ *Acer rubrum* L. Red Maple. Common in low woods. Fl. March-April.

✓ *Acer saccharinum* L. Silver Maple. Common to abundant in low woods.

✓ *Acer saccharum* Marsh. Sugar Maple. Infrequent; woods in areas 2-5 incl.

Rhamnaceae

✓ *Ceanothus ovatus* Desf. Rare; flats along river in areas 1, 2. Fl. begins mid May. *Pub. Misident 1 C. acer. L.M. 10/30/81*

Vitaceae

✓ *Parthenocissus quinquefolia* (L.) Planch. Virginia Creeper. Woods in areas 5, 6, 7; expected elsewhere.

✓ *Vitis*: the species of grapes were not sufficiently collected.

✓ *Vitis riparia* Michx. Wild Grape. River bank in area 3, where fl. late May.

✓ *Vitis vulpina* L. Wild Grape. Border of woods in area 3, where fl. late May.

Tiliaceae

✓ *Tilia americana* L. Basswood. Collections of typical plants came from areas 7, 8. A collection from area 3 (south of Carderock) is more or less intermediate with *T. heterophylla*.

✓ *Tilia heterophylla* Vent. Basswood. Of two collections from Bear Island (area 5), one is typical, the other tends toward *T. americana*. This species not listed in D. C. Fl. but noted by Hermann (1946).

Guttiferae

✓ *Hypericum prolificum* L. (*H. spathulatum* of GM) Shrubby St-John's-wort. Scarce; rocky places in areas 1, 5, 6.

Violaceae

Hybanthus concolor (T. F. Forst.) Spreng. Green Violet. Scarce to infrequent in woods in areas 4, 5. Fl. begins late May.

Viola hirsutula Brain. Rare; woods at Carderock (area 3), where fl. early May.

Viola papilionacea Pursh. Blue Violet. Common in woods. Fl. April to early May.

Viola pennsylvanica Michx. (*V. eriocarpa* of BB and D. C. Fl.) Yellow Violet. Frequent in rich woods. Fl. April to early May.

Viola rafinesquii Greene (sens. BB). Field Pansy. Rare; area 5, where fl. late April.

Viola sororia Willd. Woods in areas 4, 5. Fl. early-mid April.

Viola stoneana House. Rare; dry woods on Bear Island (area 5), where fl. early May.

Viola striata Ait. Cream Violet. Common in low woods. Fl. throughout April and May and into early June.

Viola triloba Schwein. Rare; rocky woods in areas 3, 4. Fl. early May.

Cactaceae

Opuntia humifusa Raf. (*O. vulgaris* of D. C. Fl.) Prickly Pear Cactus. Rare; among rocks on Bear Island (area 5). Reported in D. C. Fl. from Great Falls.

Nyssaceae

Nyssa sylvatica Marsh. Black Gum. Infrequent in woods; areas 3, 5, 6.

Onagraceae

Oenothera tetragona Roth. Sundrops. Rare; flats along river in areas 1, 2. Fl. May.

Araliaceae

Hedera helix L. English Ivy. Locally abundant in areas 1, 2. Leaves evergreen.

Umbelliferae

Chaerophyllum procumbens (L.) Crantz. Chervil. Frequent in woods; areas 2, 3, 7, 8, 9. Fl. late April-early May.

Cryptotaenia canadensis (L.) DC. Honewort. Area 3 and probably elsewhere; fl. begins late May.

Osmorhiza claytonii (Michx.) Clarke. Sweet Cicely. Infrequent in woods; areas 2, 3, 4, 5. Usually only one or a few plants present per location. Fl. at peak about early May. Without fruits this species may

be distinguished from the following by having stems with spreading pubescence.

Osmorhiza longistylis (Torr.) DC. Sweet Cicely. Common to abundant in woods. Fl. late April to late May. Stems have close pubescence.

Sanicula canadensis L. Sanicle. Rare; low woods in area 7. Fl. late May.

Sanicula gregaria Bickn. Sanicle. Frequent to common in woods; recorded from areas 1, 2, 3, 4, but probably elsewhere. Fl. May.

Thaspium barbinode (Michx.) Nutt. Meadow Parsnip. Rare; woods in area 4, where fl. late May.

Zizia aurea (L.) Koch. Golden Alexanders. Open places along the river and in low woods. Locally abundant in areas 1, 2. Frequent where its habitat occurs in areas 3, 4, 5, 6. Fl. April, May. (Although it was looked for, another species, *Z. cordata*, was not found).

Cornaceae

Cornus amomum Mill. Canal and river banks; areas 5, 8.

Cornus florida L. Flowering Dogwood. Common in woods. Fl. mid April to early May; floral bracts open before anthers dehisce.

Pyrolaceae

Chimaphila maculata (L.) Pursh. Spotted Wintergreen. Scarce to infrequent in dry woods; areas 3, 4. The evergreen plants are conspicuous in winter and spring.

Ericaceae

Epigaea repens L. Trailing Arbutus. Scarce in rocky places; areas 3, 4. Fl. early April.

Eubotrys racemosa (L.) Nutt. (*Leucothoe racemosa* (L.) Gray). Sweetbells. Rare; border of swamp on Bear Island (area 5), where fl. early May.

Gaylussacia baccata (Wang.) K. Koch. Black Huckleberry. Rocky woods and cliff tops; areas 4, 5. Fl. May.

Kalmia latifolia L. Mountain Laurel. Common in rocky woods and on cliff tops; areas 3, 4, 5, 8, 9. Fl. May, June.

Rhododendron maximum L. Rhododendron. Rare; about two plants in rich woods in area 4.

Rhododendron nudiflorum (L.) Torr. Pink Azalea; Pinxter-flower. Infrequent; rocky woods in areas 3, 4, 5, 6. Fl. May.

Vaccinium stamineum L. Deerberry. Rocky woods and cliff tops; areas 3, 4, 5. Fl. May.

Vaccinium vacillans Torr. Low Blueberry. Rocky woods and cliff tops; areas 4, 5. Fl. May.

Primulaceae

Anagallis arvensis L. Scarlet Pimpernel. Scarce; areas 4, 6. Fl. late May. ✓

Ebenaceae

Diospyros virginiana L. Persimmon. Woods in areas 2, 3. ✓

Oleaceae

Chionanthus virginicus L. Fringe Tree. Frequent; rocky woods and cliff tops in areas 4, 5, 6, 7. Fl. May. ✓

Fraxinus: the species of ash were insufficiently collected. ✓

Fraxinus americana L. White Ash. Woods in area 3; certainly expected elsewhere. ✓

Fraxinus pennsylvanica Marsh. Red Ash. Woods in area 5. ✓

Ligustrum vulgare L. Privet. Woods in areas 2, 3. ✓

Apocynaceae

Vinca minor L. Periwinkle; Myrtle. Areas 2, 4. The white-flowered form was seen in area 2 opposite Sycamore Island. Fl. April. ✓

Asclepiadaceae

Asclepias quadrifolia Jacq. Four-leaved Milkweed. Scarce in woods in areas 4, 5. Fl. late May. ✓

Polemoniaceae

Phlox divaricata L. Blue Phlox. Abundant everywhere in low woods. Responsible for one of the main displays of color; especially abundant locally in area 2, in the bottomland opposite Brickyard Road in area 4, and bottomlands of area 7. Fl. throughout April and May, but at its peak in late April and early May. Occasionally white-flowered. ✓

Phlox subulata L. Moss Pink. Local on cliffs and among rocks; areas 4, 5, 6. Fl. from late March through May. ✓

Hydrophyllaceae

Ellisia nyctelea L. Local in low woods near river in areas 2, 8; locally abundant ½-1 mile north of Great Falls in bottomland woods (area 7). Fl. late April-early May. ✓

Hydrophyllum canadense L. Waterleaf. Frequent to locally very abundant in woods; areas 2, 3, 4, 5, 7. One colony in area 2 is over 100 feet in diameter. Basal leaves spotted, in contrast to *H. virginianum*. Fl. begins late May. ✓

Hydrophyllum virginianum L. Waterleaf. Infrequent to frequent in woods; areas 1, 2, 3, 4. Fl. May. ✓

✓ *Phacelia dubia* (L.) Trel. Locally abundant on and around rock outcrops in areas 4, 5, 6, notably on Bear Island near Widewater and on the small island overlooking Great Falls. Fl. usually white, in May.

C *Phacelia purshii* Buckl. Miami Mist. Frequent in woods and open places; areas 2, 4, 5, 8, 9. Fl. late April through May.

B1 *Phacelia ranunculacea* (Nutt.) Constance (*P. covillei* S. Wats.). Infrequent in rich, often rocky, woods in areas 2, 3, 4. Fl. late April-early May.

Boraginaceae

✓ *Lithospermum arvense* L. Corn Gromwell. Along canal in area 8 where fl. late April.

✓ *Mertensia virginica* (L.) Pers. Bluebells. Rich woods in all areas, but rare in certain areas, very abundant in others. Responsible for one of the best floral displays along the canal in mid and late April. Fl. early April-early May; rarely flowers white.

✓ *Myosotis scorpioides* L. True Forget-me-not. River bank in area 3; fl. late May.

Labiatae

✓ *Glechoma hederacea* L. Ground Ivy. Abundant in woods. Fl. throughout April and May. Leaves present in winter.

✓ *Lamium amplexicaule* L. Henbit. Rare; area 1, where fl. early April.

✓ *Lamium purpureum* L. Purple Dead Nettle. Frequent to common; areas 1, 2, 7, 8, 9. Fl. April.

✓ *Salvia lyrata* L. Lyre-leaved Sage. Infrequent; areas 1, 4, 7, 8. Fl. May.

B2 *Scutellaria saxatilis* Ridd. Skullcap. Rare; rocky woods in area 5 (Bear Island), where fl. late May.

C *Scutellaria serrata* Andr. Skullcap. Infrequent; woods in areas 3, 4, 5; most numerous on Bear Island. Fl. late May.

Scrophulariaceae

✓ *Paulownia tomentosa* (Thunb.) Steud. Princess Tree. Scarce; areas 3, 5. Fl. May.

✓ *Penstemon hirsutus* (L.) Willd. Scarce; flats along river in area 2; rocky places at Great Falls (area 6). Fl. late May.

C *Penstemon laevigatus* Soland. Rare; border of woods in area 3 (Carderock), where fl. late May.

✓ *Veronica hederaefolia* L. Ivy-leaved Speedwell. Abundant in lowland woods. Fl. March to early May. One of the most abundant species.

✓ *Veronica officinalis* L. Common Speedwell. Border of woods in area 3, where fl. late May.

Veronica peregrina L. Neckweed. Open places in areas 3, 8; fl. early May. ✓

Bignoniaceae

Campsis radicans (L.) Seem. Trumpet Creeper. Areas 5-8 incl. Fl. summer, but vegetative parts become conspicuous in May. ✓

Orobanchaceae

Conopholis americana (L.) Wallr. Squaw-root. Locally abundant in rich woods in areas 3, 4, 5. Fl. May. ✓

Orobanche uniflora L. Cancer-root. Scarce to infrequent; rich, rocky woods in areas 4, 5, 6. Fl. May. ✓

Acanthaceae

Justicia americana (L.) Vahl. Water-willow. Shallow water of river in area 3; probably occasional along river. Fl. begins late May. ✓

Plantaginaceae

Plantago lanceolata L. English Plantain, Buck Plantain. Along canal in areas 1, 8. Fl. May. ✓

Plantago virginica L. Rare; open place in area 6 (Great Falls). Fl. May. ✓

Rubiaceae

Cephalanthus occidentalis L. Buttonbush. Rare; area 6. ✓

Galium aparine L. Cleavers. Abundant in low woods. Fl. late April through May. ✓

Galium circaezans Michx. Wild Licorice. In woods; areas 3, 4. ✓

Galium concinnum Torr. & Gray. Dry woods in area 3 and probably elsewhere. Like the preceding species, fl. summer but plants conspicuous in May. ✓

Houstonia caerulea L. Bluets. Frequent in woods, areas 3, 4, 5, 6. Fl. throughout April and May. ✓

Houstonia purpurea L. var. *purpurea*. Rare; woods in areas 3, 4, where fl. late May. ✓

Mitchella repens L. Partridge Berry. Frequent; rocky woods in areas 3, 4, 5. Fl. begins late May. Evergreen. ✓

Caprifoliaceae

Lonicera japonica Thunb. Japanese Honeysuckle. Very abundant in woods. This species has taken over much of area 1 and in other areas is much too abundant. Most other species do not seem able to compete with it successfully. Fl. late May-summer. ✓

Sambucus canadensis L. Elder. Frequent in woods; areas 1, 2, 8. ✓

B2 *Triosteum angustifolium* L. Horse-gentian. Rare; rocky, rich woods in area 4. Fl. May. ✓

Viburnum acerifolium L. Maple-leaved Viburnum; Arrow-wood. Frequent; rocky woods in areas 3, 4, 5. Fl. mid May-June. ✓

Viburnum prunifolium L. Black-haw. Frequent to common; woods in areas 2, 5, 6, 7, 8. Fl. late April-early May. ✓

Viburnum rafinesquianum Schult. Downy Arrow-wood. Frequent; dry rocky woods in areas 4, 5, 6. Fl. May. ✓

Valerianaceae

B3 *Valeriana pauciflora* Michx. Scarce; rich woods in areas 2, 3, 4. Fl. May. Plants seen with white flowers. ✓

Valerianella olitoria (L.) Poll. Infrequent to frequent; along canal in areas 1, 7, 8, 9. Fl. late April-mid May. ✓

Compositae

Achillea millefolium L. Yarrow. In areas 3, 5. Fl. beginning late May. ✓

Antennaria plantaginifolia (L.) Hook. Plantain-leaved Everlasting. Infrequent; dry woods in areas 3, 8. Fl. early May. ✓

C *Chrysogonum virginianum* L. Rare; woods on Bear Island (area 5). Fl. May. ✓

Crepis japonica (L.) Benth. Generally scarce: one station along canal in area 4; locally abundant in area 8 along canal near Blockhouse Point. Fl. late May. A foreign adventive generally rare in the U. S. Not listed in D. C. Fl. but noted by Hermann (1946). ✓

Erigeron philadelphicus L. Frequent in woods and along canal; areas 1, 2, 4, 7. Fl. May. ✓

Erigeron pulchellus Michx. Robin's-Plantain. Infrequent in woods; areas 4, 5. Fl. May. ✓

Hieracium pratense Tausch. King Devil. Rare; along canal in area 2, where fl. late May. Not in D. C. Fl. but noted by Hermann (1946). ✓

Hieracium venosum L. Rattlesnake-weed. Infrequent; rocky woods in areas 3, 4, 5. Fl. May. ✓

C *Krigia dandelion* (L.) Nutt. Rare; rocky woods on Bear Island near Widewater (area 5), where fl. late May. ✓

Krigia virginica (L.) Willd. Rare; among rocks, Great Falls (area 6). Fl. May. ✓

Senecio aureus L. Golden Ragwort. Common to locally very abundant in low woods and along river (especially in area 2). One of the most abundant species. Fl. early April to mid May. ✓

✓ *Senecio obovatus* Muhl. Rare; among rocks, Great Falls (area 6), where fl. late May.

✓ *Taraxacum officinale* Weber. Common Dandelion. Common along canal. Fl. April.

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An Analysis of the Vegetation and Soils of Upland Hardwood Stands in the Piedmont and Coastal Plain of Moore County, North Carolina¹

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INTRODUCTION

The Piedmont of North Carolina is geologically diverse and is a complex area vegetationally and pedologically. Relatively few papers have dealt with upland hardwood forests, the "climax" vegetation of this area. Oosting's study (1942) of upland hardwoods has been the

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major vegetation study for the area, but it was geographically restricted and did not include many soils and parent materials found in the area. The Coastal Plain contrasts with the Piedmont vegetationally, pedologically and geologically. Originally, its sandy soils supported longleaf pine forest on all upland sites (Ashe, 1897). There is overwhelming evidence, however, that this longleaf forest was a fire subclimax and that, in the absence of fire, these upland sites would eventually have supported hardwood forests as a result of succession (Garren, 1943).

Because of the need for further quantitative studies of upland hardwoods in North Carolina, upland hardwood stands and their soils were studied in Moore County. This county was chosen because it includes parts of both the Piedmont and Coastal Plain and represents an area small enough to be studied in a short length of time. The aims of this study were to: (1) sample the canopy and understory of relatively undisturbed upland hardwood stands; (2) sample herb and shrub strata; and (3) conduct field and laboratory analyses of the soils. The data were used to develop a description and comparison of the upland forest vegetation of the Piedmont and Coastal Plain sections of Moore County.

REVIEW OF LITERATURE

The North Carolina Piedmont was originally forested by oak-hickory stands on all upland sites (Ashe, 1897). As a result of clear cutting of forests for agriculture and selective logging for timber, this area today contains almost no virgin forest (Oosting, 1942). Present Piedmont forests are either pure pine or a mixture of pine and hardwoods in various stages of succession (Braun, 1950). In his 1942 analysis of upland hardwood sites in Duke Forest, Durham County, Oosting recognized several types of upland climax Oak-Hickory stands. These were a white oak (*Quercus alba*)³—black oak (*Q. velutina*)—red oak (*Q. rubra*) type occurring on better sites, a white oak-post oak (*Q. stellata*) type on poorer sites and a post oak-blackjack oak (*Q. marilandica*) type on the poorest sites. Beech (*Fagus grandifolia*) dominated protected sites and lower, well-drained slopes.

Gibbon (1966) found chestnut oak (*Q. prinus*) forest dominated the crests and all but the driest exposures of three monadnocks in the lower Piedmont. He found these forests to be very similar to chestnut oak stands in the western Piedmont and mountains. Dayton (1966) studied soils and vegetation in southern Granville County, finding that there was a distinctive vegetation associated with the Iredell soil. These soils, which are much higher in bases than other Piedmont soils, had less

³Nomenclature according to Radford *et al.*, 1968.