The Making of a Student-Driven Online Campus Flora: an example from Rutgers University

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DOI: 10.3732/psb.1400008
Submitted 6 November 2013
Accepted 25 May 2014

ABSTRACT

Student participation in floristics at the university level is essential for the longevity and expansion of botany, plant ecology, and their many associated fields, but knowledge and college course options have been decreasing. In many cases students are unaware of the botanical biodiversity that is right in front of their eyes. We started a project called Flora of Rutgers Campus (FoRC), which provides students with hands-on outdoor fieldwork as an engaging and effective way to experience botany first hand. In 2011, 32 students participated in this project and uploaded 580 vouchered observations to a database. In total, we found 98 families, 200 genera, and 259 species on the Cook/Douglass campus of Rutgers University in New Jersey. Nearly 10% of the state's flora was found on 317 urban/suburban acres. This project strongly increased the students' knowledge of local plants, opened their eyes to "see" plants everywhere, and encouraged students to work cooperatively.

Key words: botany; biodiversity; campus; education; plant blindness; plant systematics

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INTRODUCTION

Humans are completely dependent on plants for our survival as the source of food for ourselves or for the animals that we eat, as providers of ecosystem services (e.g., oxygen generation, carbon dioxide sinks, soil stabilization) and as synthesizers of biofuels, building materials, medicines, oils, and other natural products (Costanza et al., 1997). Furthermore, in the current age of rapid urbanization, biotic invasion and climate change, basic botanical literacy is as important as ever if the public is to recognize and cope with the real threats to plants and plant communities that we depend on and that define each region ecologically. Plant blindness, the increasingly common lack of knowledge and "seeing" of plants in everyday life is also a powerful phenomenon that affects students personally, as well as the focus of media, educators, and popular culture (Wandersee & Schussler, 2001, see also Hershey, 2002). Many people nowadays see plants just as the green background to more important things such as cars, buildings, golf balls, dogs, and the erratic groundhog. This is at least partially due to less of a personal connection with plants (and nature) during our upbringing, and also to the agricultural production of plants as food, and an overwhelmingly zoo-centric media culture, especially by producers such as Disney, Discovery Channel, and National Geographic.

Despite the universal importance of plants and the current need for more plant awareness, plant science knowledge and course offerings, especially field- and taxon-based botany, have been reduced during the last decades at high school and college levels (Hershey, 1996; Reinsvold, 1999). The National Science Education Standards are also weak when it comes to plant knowledge and understanding (Hershey, 2013). In our own experience, few children and teenagers today can identify more than 100 plant species, and the ones they know are mostly supermarket or garden plants (see also Adams et al., 2010).

At Rutgers University, we teach a combined undergraduate and graduate level class in plant diversity and evolution and advanced plant systematics, which includes lectures, labs and written and practical assignments. In the labs, we bring in over 1000 species or cultivars of representative plants, highlighting plants of ethnobotanical use, including landscaping, agriculture, food and spices. To increase student knowledge of plants in the local ecosystems, we developed the project Flora of Rutgers Campus in 2011, which aims to provide students with a variety of skills.

Field-based botanical inventories strengthen skills in morphology, identification, vouchering and other biodocumentation, family recognition, georeferencing, and description. Any teaching that focuses on local and personally relevant issues and brings with it a "sense of place" for students has a higher chance of being found important to students (Gruenewald, 2003; Semken & Butler Freeman, 2008; Kudryavtsev et al. 2012). The project provided students with a focused, but open-ended research question, a positive challenge, and a valuable goal—the first floristic biodiversity inventory of any Rutgers campus in the history of our university.

Rutgers, The State University of New Jersey (aka "Rutgers University") is located in three locations in New Jersey (Camden, Newark, and New Brunswick). Our project took place in the New Brunswick location, which is the largest part of the university. Of five Rutgers campuses located within the New Brunswick area, the campus flora project included two of them: the George H. Cook Campus, which is the old agricultural land grant school, and the adjoining Rutgers' Douglass Campus, the former New Jersey College for Women. The Cook/Douglass campuses are located at approximately 40.48 N, 74.43 W on the east coast of the United States, in central New Jersey, and the local environment is influenced by the tidal Raritan River (Ashley & Renwick, 1983). New Brunswick is 8.5 miles (13.7 km) away from the Raritan Bay of the Atlantic Ocean and the distance to the outer coastline at Sandy Hook is 24 miles (38.6 km).

Our area of inventory covered 317 acres (1.3 km^2), which included an abundance of maintained lawns, a remnant of an old growth hardwood forest (Frank G. Helyar Woods), ditches, wetlands (natural and artificial), and retention basins, a few small ponds (including Passion Puddle), one dammed lake (Weston Mill Pond), asphalted roads and parking lots, horse and cow fields, a pig, goat and sheep farm, a horticultural garden (Rutgers Garden), a research farm, an organic community garden, abandoned lots and fields, rocky cliffs, and several intensively used highways (Route 18 and US Route 1).

METHODS

During the fall of 2011, we challenged 32 graduate and undergraduate students to create a campus-wide floristic survey of all wild and naturalized plant species on Cook/Douglass campuses (317 acres, Rutgers University, NJ, USA). Students used both traditional tools (floras, hand lenses, knives, bags, herbarium presses, dissecting microscopes, and rubber boots) and high-tech equipment (smart phones with instant GPS, cameras, and internet identification resources). All newly found species had to be vouchered with herbarium specimens, and all observations had to have a photo of the plant either in the field or after being pressed (or both).

Identification was accomplished by keying out plants using floras or online-keys, or with comparison with other herbarium materials available at Chrysler Herbarium (CHRB, at Rutgers University). To help with the project, we provided manuals on (1) how to press plants, (2) georeferencing, (3) using Google Maps to find coordinates, and (4) how to identify the 50 most common plant families of temperate regions. All herbarium vouchers were photographed and included in the online database. Afterwards they could be donated to the CHRB at Rutgers University if the student so wished.

The observation data were uploaded by students to an online web portal housed by Consortium of Northeastern Herbaria (http://neherbaria.org/), a Symbiota Software Project portal (http://symbiota.org/tiki/tiki-index.php). Taxonomy for vascular plants follows the one used in the USDA-PLANTS database, which is the taxonomy utilized in the CNH portal. Classification for lichens followed Esslinger (2011).

The students' resulting herbarium specimens, field observations, and photos formed a Flora of Rutgers Campus species list, image bank, and maps of species locations now publicly available online (http://portal.neherbaria.org/portal/checklists/checklist.php?cl=28). Included in the inventory were all vascular plants (flowering plants, conifers, ferns and fern allies, and lycopods), as well as lichens, mosses, liverworts, and algae. Generally specimens representing plants grown in cultivation were not included in the inventory.

Cultivated native plants were included, but plants that were non-native or unlikely in their natural range were only included if they appeared to be escaped and/or naturalized to uncultivated areas of campus.

In order to identify their specimens, students had access to a variety of taxonomic keys, and they often collaborated when keying out difficult specimens. Students also had access to botanists who could verify their tentative identifications: the Professor (LS) and Teaching Assistant (CZ) for vascular plants, Bill Buck of The New York Botanical Garden for mosses and liverworts, and Richard Harris of The New York Botanical Garden for lichens. Many identifications were incorrect at first, and this input and subsequent feedback was important for quality control of the database. Most students relied on keys in Rhoads and Block's (2007) *The Plants of Pennsylvania* and Haines' (2011) *Flora Novae-Angliae.* Gleason and Cronquist's (1991) *Manual of the Vascular Plants of the Northeastern United States and Adjacent Canada* was also available, although students then had to compare the nomenclature to the USDA-PLANTS Database to ensure that names were current. For difficult groups, students used Barkworth et al.'s (2007) *Manual of Grasses for North America,* Brodo et al.'s (2001) *Lichens of North America,* Hinds and Hinds' (2007) *Macrolichens of New England*, Lincoln's (2008) *Liverworts of New England,* and Crum and Anderson's (1981) *Mosses of Eastern North America.*

To provide additional incentives to students we set up a system of gaining points according to the following schedule: 10 points for finding a new family, 5 points for finding a new genus, 5 points for finding a new species, and 1 point per observation overall. Ten observations were mandatory for each student. We recruited donations of prizes (books, botanical items, living plants, garden clippers, etc.) from faculty, deans, and department chairs.

At the end of the project, we arranged for a special celebration and the students got to select among the prizes in order of the number of points they had achieved. We also got the chair of the Department of Ecology, Evolution and Natural Resources to promise a pizza party for the whole class at the end of the project, if the class managed to find over 250 species on our campus.

As a separate small project, we ran a logo design competition, where the students provided brand-new logos which were then voted on by the students (Figure 1). This was an optional assignment and brought out some of the design and art skills in some students.

Figure 1. Logo for Flora of Rutgers Campus, developed and designed by Clayton Leadbetter, winner in the logo design competition.

RESULTS

The project started in late September 2011 and ran until mid-December 2011, three months total, and over that time period, 580 observations of 259 species were uploaded by 32 students. (Twenty-eight observations were plants that students had collected in July and August, before the start of the class.)

Right before our project started, our campus was hit by Hurricane Irene, which led to massive tree destruction in our area, which made epiphytes more accessible, but otherwise appeared not to affect our floristic work. However, in late October, the project was interrupted by an unusually early snowstorm that covered all vegetation in deep, wet snow for a few days. Some herbaceous plants recovered from this, others did not. Most of the plant observations (400) were recorded in September and October, before the storm.

The inventory resulted in us finding 259 species in 200 genera, distributed among 98 families (Figures 2 and 3). Compared with the reported species from Middlesex County, NJ on the USDA-PLANTS database, our findings represent 19% of the vascular plant species found in our county, 35% of the vascular plant genera, and 64% of the vascular plant families. Compared with the total number of land plant species reported from New Jersey (3207 species) in the USDA-PLANTS database, we found 8%.

Figure 2. Example of a species found on Rutgers University's Cook Campus: rosehips from Rosa canina *(Rosaceae), easily identified based on its leaf and fruit characteristics. Photo by Lena Struwe.*

Of the 580 observations, the most commonly reported species was *Trifolium repens* (white clover, Fabaceae), which was reported 15 times. The most species-rich family for this late fall time period was unsurprisingly Asteraceae, which included 27 species on campus (10.5% of all species reported). The genus with the most species was *Polygonum* (Polygonaceae), with nine different species. Approximately half of the reported vascular plant species can be considered weedy species (listed in floristic works on weeds and/or invasive species), either native or non-native. Thirteen of the species found are classified by the USDA as invasive plants in the Northeast.

Although students are often loosely familiar with tree groups, most of the observations of the plants were of forbs (356, 61% of all observations). Students also made many observations of trees, shrubs and vines (129, or 23%). Other groups were less well represented in the collections: 49 observations (8%) were grasses, sedges, or rushes, 24 (4%) were mosses, 15 (2%) were lichens, 4 (1%) were ferns, and one was a liverwort.

As part of the class the students had to hand in 10 pressed herbarium collections from 10 different plant families, and included in these were vouchers for any new species found during the Flora of Rutgers Campus project. Of the total of 310 collections that were handed in (by 31 students), only 33 (11%) collections were incorrectly identified or were lacking critical material that made species identification possible. The genera that were most frequently misidentified were *Cyperus* (9 collections), *Persicaria* (4), *Plantago* (3), *Setaria* (2), *Digitaria* (2), and *Solidago* (2), which are groups known for being challenging to identify. The *Cyperus* specimens were so difficult to identify using the literature that the CHRB Collections Manager had to pull reference materials from the main collection for comparison before the teaching assistant was sure about the species identification. Only four collections were misidentified at the generic level and those were in the Asteraceae. The students had access to expert help and floristic literature during all weeks before hand-in of the herbarium collections, and identification was practiced frequently during the indoor regular labs. It should be noted that most students in the class had never keyed out a plant before this class. The student that specialized in mosses and lichens (NH) estimated that her initial identifications were about 40% wrong for lichens and 75% for mosses, when she first started to look at these groups for the project, but then she went to The New York Botanical Garden and was taught there how to identify these correctly.

Figure 3. Graduate student April Jackson collecting species of Asclepias *(milkweed, Apocynaceae) and* Lonicera *(honeysuckle, Caprifoliaceae) behind the old dairy barn on Cook Campus at Rutgers University. Photo by Lena Struwe.*

A large majority of students were strongly engaged in the project and spent a large amount of time outside of regular class collecting and determining plants, and then uploading specimen data. We estimate that the time spent outside of the classroom for this project amounts to an average of 6-8 hours per student, with some students exceeding this average by far. The most active student (NH) put in over 60 hours outside the classroom.

The students visited many different parts of campus for the project. As expected, most of the observations were recorded close to the lab building (Foran Hall). The distance to Helyar Woods is 0.9 miles (1.6 miles following roads) and predictably most students did not visit this area but stayed closer to home. The types of habitats in which students recorded observations included: mixed hardwood forests and patchy wood lots (21% of observations); campus lawns and landscaped areas (20%); weedy parking lots, roadsides, and sidewalks (15%); pond edges and stream banks (7%); garden plots and agricultural areas (7%); abandoned meadows and fields (6%); and aquatic habitats (2%). Twenty two percent of observations did not include adequate habitat information to classify their habitat type. Twenty-two of the students (69%) submitted more than the 10 required observations. Only the professor (LS) got poison ivy dermatitis and the project as a whole provided a great learning experience to the students of the class.

Critical non-plant related skills learned during this class included species collection techniques, photography and resizing of digital images, and the basics of georeferencing and GPS use, including understanding latitude and longitude data and uncertainty in GPS coordinates. All students in the class quickly learned that the longitude of New Jersey needs to be negative, or their specimens would end up in Kazakhstan on the Google Map in the flora list portal (Figure 4).

At the end of the class when the points were tallied up, it was clear that the winner was the student that had largely focused on bryophytes and lichens (i.e., Natalie Howe, co-author on this paper). Her work lead to a large swath of new families and genera and a large lead compared to other students working mostly with vascular plants. She ended as the winner with 809 points total, based on 59 uploaded observations, and won the three subcategories of most new families, genera, and species reported. The runner-up (Clayton Leadbetter) reported the most species and most genera within vascular plants, accumulating 499 points, based on 54 observations. He also won the category of 'fastest point gain' when he went from to 0 to 315 points in 10 days half-way through the semester.

BROADER IMPACTS AND CONCLUSIONS

Our learning goals for this project were accomplished by most of our students, and are listed here:

- strongly increase knowledge of and interest in local plants
- gain essential botanical skills in field identification, inventorying, and data management
- gain critical spatial skills in georeferencing and GPS use
- heighten appreciation and understanding of the biodiversity of semi-natural and urban landscapes
- increase ability to 'see' plants everywhere, especially in human-influenced habitats
- work cooperatively even when competing

In addition to these personal goals for individual students, this project provided the start of a long-term dataset that can be used both as an educational tool in future classes, as well as for ecological and biodiversity research on campus. It is the first floristic biodiversity inventory of any Rutgers campus, at a university that is nearly 250 years old, and is the beginning of building a database of the flora and its ecology and biodiversity to be used in future classes and research.

A project of this kind is a perfect example of how a college campus can become a living laboratory, field station, and specimen exhibit, right outside the classroom doors. The fact that students were able to record 110 observations of wild plants on the lawns and landscaped areas of campus, suggests that most college campuses will harbor unanticipated plant diversity, even if they aren't associated with old growth forests or wetland areas. Additionally, the fact that 121 of the observations were in wooded areas, and over half of those (66) were in the old growth forest area far from the main campus, suggests that projects of this type encourage students to spend time in natural areas that they might not have otherwise visited. After the class was over in 2011, it was clear that most students loved finding new species and exploring the botanical diversity outside the classroom.

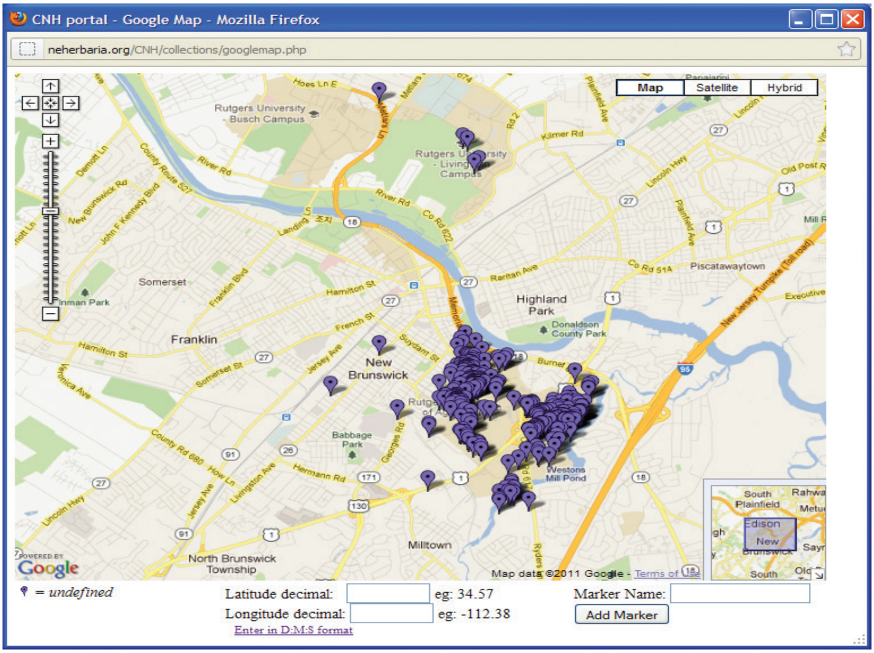

Figure 4. Map view in Google map of all collections and observations uploaded to the Flora of Rutgers Campus project. The map is centered over New Brunswick, NJ, and Raritan River crosses the map from northwest to east. Interstate 95 (aka NJ turnpike) is the highway a few miles to the east side of Cook/Douglass Campus.

This project strongly increased the students' knowledge of local plants, heightened their appreciation of the natural or human-disturbed world and their university campus, opened their eyes to 'see' plants everywhere, and encouraged students to work cooperatively.

Another feature of our findings is that it is ultimately important to make the plant groups accessible to students by providing accurate and straightforward keys and to have access to experts to verify tentative identifications. Particularly in the moss group, most of the original student identifications were incorrect even after using the dichotomous key, so having a verification step was key to maintaining an accurate and useful database.

At the time of the submission of this article (Fall 2013), we are running the Flora of Rutgers Campus project with 34 new students and the same incentives and learning goals. We have also expanded the flora area to all five campuses in New Brunswick, New Jersey, so we have increased the habitat diversity as well as area size significantly. The students are building on the database we started in 2011, and we expect to find new species, new populations, and new campus areas that show high levels of biodiversity this year. We are also letting students develop small field identification guides to difficult groups or genera, which will build up a library of online tools for local plant identification.

ACKNOWLEDGMENTS

This project would not have been possible without the Consortium of Northeastern Herbaria and the implementation of the Symbiota software framework (developed by Ed Gilbert) on their website. The School of Environmental and Biological Sciences at Rutgers University provided funding for the Chrysler Herbarium, and the Departments of Ecology, Evolution and Natural Resources as well as Plant Biology and Pathology provided funding for the class and this particular project. We also thank the following sponsors of student prizes for the Flora of Rutgers Campus project: Rutgers University School of Environmental and Biological Sciences, New Jersey Agricultural Experiment Station, Chrysler Herbarium, Mark Vodak, Steven Handel, Jason Grabosky, and Henry John-Alder in the Department of Ecology, Evolution, & Natural

Resources, Joan Bennett in the Department of Plant Biology and Pathology, Nicoletta Graf at the Floriculture Greenhouse, Bruce Crawford at Rutgers Gardens, Consortium of Northeastern Herbaria, Executive Dean Bob Goodman, Mike Green in the Media and Marketing Office, Jean Marie Hartman in the Landscape Architecture department; and Richard Harris, James Lendemer, and Bill Buck at the New York Botanical Garden for taxonomic expertise in mosses and lichens. The FoRC logo was designed by Clayton Leadbetter. This project was supported by the New Jersey Agricultural Experiment Station and by the USDA-National Institute for Food and Agriculture, Hatch project number NJ17610 to LS. The co-authors on this paper consist of the professor leading the project and class (LS), the 2011 Teaching Assistant (CZ), the winner of the 2011 student competition and the 2013 Teaching Assistant (NH), CHRB Collections Manager and also student in the 2011 class (LSP), and the Administrator of the Consortium of Northeast Herbaria's Symbiota website and collaborator at Yale University (PS).

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Appendix 1.

Species list from Flora of Rutgers Campus project as of December 2011. These species were all found in the field by students in the Plant Systematics class. A total of 259 species in 200 genera and 98 families were found, and non-seed plant groups are indicated in parentheses after family names below.

ADOXACEAE
Viburnum acerifolium
Viburnum dentatum

ALTINGIACEAE
Liquidambar styraciflua

AMARANTHACEAE s.str.
Amaranthus hybridus
Amaranthus retroflexus

AMARYLLIDACEAE s.lat. (ALLIACEAE s.str.)
Allium oleraceum
Allium schoenoprasum

AMBLYSTEGIACEAE (MOSSES)
Leptodictyum riparium

ANACARDIACEAE
Rhus aromatica
Rhus typhina
Toxicodendron radicans

ANNONACEAE
Asimina triloba

ANOMODONTACEAE (MOSSES)
Anomodon attenuatus
Anomodon rostratus

APIACEAE
Daucus carota

AQUIFOLIACEAE
Ilex laevigata
Ilex opaca
Ilex verticillata

ARACEAE
Arisaema triphyllum
Lemna minor
Peltandra virginica
Symplocarpus foetidus

ARALIACEAE
Hedera helix

ASCOMYCOTA (LICHENS)
Amandinea polyspora
Candelaria concolor
Cladonia chlorophaea
Cladonia coniocraea
Cladonia cristatella
Flavoparmelia caperata
Lecanora strobilina
Parmelia sulcata
Parmotrema perforatum
Peltigera didactyla
Physcia millegrana
Punctelia caseana
Pyrrhospora varians

ASPARAGACEAE
Maianthemum racemosum

ASPLENIACEAE (FERNS)
Asplenium platyneuron

ASTERACEAE
Achillea millefolium
Ageratina altissima
Ambrosia artemisiifolia
Anthemis arvensis
Arctium minus
Artemisia ludoviciana
Bidens bipinnata
Bidens frondosa
Cichorium intybus
Cirsium vulgare
Conyza canadensis
Erechtites hieracifolia
Erigeron annuus
Eupatorium dubium
Eupatorium serotinum
Eurybia divaricata
Euthamia graminifolia

Galinsoga quadriradiata
Helianthus annuus
Hieracium flagellare
Matricaria discoidea
Mikania scandens
Senecio vulgaris
Solidago canadensis
Solidago gigantea
Solidago rugosa
Taraxacum officinale

BALSAMINACEAE
Impatiens capensis

BERBERIDACEAE
Berberis thunbergii

BETULACEAE
Alnus serrulata
Betula alleghaniensis
Betula nigra
Carpinus caroliniana
Ostrya virginiana

BIGNONIACEAE
Catalpa speciosa

BRACHYTHECIACEAE (MOSSES)
Brachythecium plumosum
Brachythecium populeum

BRASSICACEAE
Alliaria petiolata
Capsella bursa-pastoris
Cardamine hirsuta
Lepidium virginicum
Sinapis arvensis
Sisymbrium officinale

BRYACEAE (MOSSES)
Bryum capillare
Bryum pseudotriquetrum

CABOMBACEAE
Cabomba caroliniana

CALYCANTHACEAE
Calycanthus floridus

CAMPANULACEAE
Lobelia inflata

CANNABACEAE
Celtis occidentalis
Humulus japonicus

CAPRIFOLIACEAE
Lonicera japonica
Lonicera maackii

CARYOPHYLLACEAE
Cerastium pumilum
Silene latifolia
Spergularia rubra
Stellaria media

CELASTRACEAE
Celastrus orbiculatus
Euonymus alatus

CEPHALOZIACEAE (MOSSES)
Cephalozia lunulifolia

CERATOPHYLLACEAE
Ceratophyllum demersum

CHENOPODIACEAE (AMARANTHACEAE s. lat.)
Chenopodium album

CLETHRACEAE
Clethra alnifolia

COMMELINACEAE
Commelina communis

CONVOLVULACEAE
Ipomoea hederacea
Ipomoea purpurea

CORNACEAE
Cornus amomum
Cornus florida

CUCURBITACEAE
Cucumis anguria
Sicyos angulatus

CUPRESSACEAE (CONIFERS)
Juniperus virginiana

CYPERACEAE
Cyperus esculentus
Cyperus microiria
Cyperus strigosus
Scirpus cyperinus

DENNSTAEDTIACEAE (FERNS)
Dennstaedtia punctilobula

DICRANACEAE (MOSSES)
Dicranella heteromalla
Thuidium delicatulum

DITRICHACEAE (MOSSES)
Ceratodon purpureus

DRYOPTERIDACEAE (FERNS)
Dryopteris marginalis

EBENACEAE
Diospyros virginiana

ENTODONTACEAE (MOSSES)
Entodon seductrix

ERICACEAE
Vaccinium pallidum

EUPHORBIACEAE
Acalypha rhomboidea
Acalypha virginica
Euphorbia maculata
Euphorbia vermiculata

FABACEAE
Cercis canadensis
Gymnocladus dioicus
Medicago lupulina
Medicago sativa
Robinia pseudoacacia
Trifolium campestre
Trifolium pratense
Trifolium repens
FAGACEAE
Fagus grandifolia
Quercus alba
Quercus palustris
Quercus rubra

GEOCALYCACEAE (LIVERWORTS)
Lophocolea minor

GERANIACEAE
Geranium carolinianum

HAMAMELIDACEAE
Hamamelis virginiana

HEDWIGIACEAE (MOSSES)
Hedwigia ciliata

HYPNACEAE (MOSSES)
Hypnum imponens
Platygyrium repens
Pseudotaxiphyllum elegans

IRIDACEAE
Iris versicolor

JUBULACEAE (LIVERWORTS)
Frullania eboracensis

JUGLANDACEAE
Carya glabra
Carya ovata
Juglans nigra

JUNCACEAE
Juncus tenuis

LAMIACEAE
Collinsonia canadensis
Glechoma hederacea
Lamium amplexicaule
Lamium purpureum
Lycopus sp.
Prunella vulgaris

LAURACEAE
Lindera benzoin
Sassafras albidum

LESKEACEAE (MOSSES)
Leskea gracilescens

MAGNOLIACEAE
Liriodendron tulipifera
Magnolia tripetala

MALVACEAE
Abutilon theophrasti
Althaea officinalis
Hibiscus trionum
Malva neglecta

MNIACEAE (MOSSES)
Plagiomnium cuspidatum

MOLLUGINACEAE
Mollugo verticillata

MORACEAE
Ficus carica
Maclura pomifera
Morus alba

MYRICACEAE
Morella pensylvanica

NYMPHAEACEAE
Nymphaea odorata

OLEACEAE
Fraxinus americana
Fraxinus pennsylvanica
Ligustrum vulgare

ONAGRACEAE
Ludwigia palustris

OROBANCHACEAE
Epifagus virginiana

OXALIDACEAE
Oxalis stricta

PAULOWNIACEAE
Paulownia tomentosa

PHRYMACEAE
Mazus pumilus

PHYTOLACCACEAE
Phytolacca americana

PINACEAE (CONIFERS)
Pinus strobus

PLANTAGINACEAE
Callitriche heterophylla
Chelone glabra
Linaria vulgaris
Plantago lanceolata
Plantago major
Plantago rugelii

PLATANACEAE
Platanus occidentalis

POACEAE
Digitaria ciliaris
Digitaria ischaemum
Digitaria sanuinalis
Echinochloa muricata
Leersia oryzoides
Panicum virgatum
Phragmites australis
Poa autumnalis
Setaria faberi
Setaria glauca
Setaria pumila
Setaria viridis
Tridens flavus

POLYGONACEAE
Fallopia japonica
Persicaria longiseta
Polygonum arenastrum
Polygonum aviculare
Polygonum cespitosum
Polygonum cespitosum var. *longisetum*
Polygonum cespitosum var. *cespitosum*
Polygonum lapathifolium
Polygonum pensylvanicum
Polygonum perfoliatum
Polygonum persicaria
Rumex obtusifolius

POLYTRICHACEAE (MOSSES)
Atrichum angustatum
Pogonatum pensilvanicum
Polytrichum commune

PONTEDERIACEAE
Heteranthera reniformis
Pontederia cordata

PORTULACACEAE
Portulaca oleracea

PRIMULACEAE
Anagallis arvensis
Lysimachia quadrifolia

RANUNCULACEAE
Ranunculus hispidus

ROSACEAE
Duchesnea indica
Photinia pyrifolia
Prunus serotina
Pyrus calleryana
Rhodotypos scandens
Rosa canina
Rosa multiflora
Rubus pensilvanicus
Rubus phoenicolasius

RUBIACEAE
Cephalanthus occidentalis
Galium mollugo

SAPINDACEAE
Acer negundo
Acer nigrum
Acer platanoides
Acer saccharinum
Acer saccharum
Aesculus glabra

SCROPHULARIACEAE
Verbascum thapsus

SIMAROUBACEAE
Ailanthus altissima

SMILACACEAE
Smilax rotundifolia

SOLANACEAE
Datura stramonium
Physalis philadelphica
Solanum carolinense
Solanum dulcamara
Solanum ptycanthum

TYPHACEAE
Typha latifolia

URTICACEAE
Boehmeria cylindrica
Pilea pumila

VIOLACEAE
Viola blanda
Viola cucullata
Viola sororia

VITACEAE
Ampelopsis brevipedunculata
Vitis vulpina

WOODSIACEAE (FERNS)
Athyrium filix-femina
Cystopteris tenuis