VASCULAR PLANT DIVERSITY IN OKLAHOMA

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Department of Botany

Oklahoma State University

A-124

University Center for Water Research

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Stillwater, Oklahoma

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STATEMENT OF THE PROBLEM

Policy makers are increasingly becoming aware of the importance of conserving biodiversity. Unfortunately, scientists cannot keep pace with demands for information about biodiversity; the kinds of data required are incredibly difficult, time-consuming, and expensive to obtain. We therefore must supplement our quest for raw biodiversity data with the development of methodology for inferring or estimating biodiversity.

OBJECTIVES OF THE PROJECT

The objectives of this project are twofold: 1) to add to our knowledge of the biodiversity of Oklahoma by initiating a flora of the Nature Conservancy's Tallgrass Prairie Preserve in Osage County, Oklahoma, and 2) to use already-published vascular plant floras to infer the environmental and geographic determinants of plant species richness.

METHODOLOGY

Flora of the Tallgrass Prairie

The 12,250 ha Tallgrass Prairie Preserve is managed by the Nature Conservancy in Osage County, Oklahoma, for the purposes of conserving biodiversity. The Preserve ranges from 256 to 352m in elevation and consists primarily of tallgrass prairie and oak woodlands, with minor representation by various wetlands, disturbed sites, shortgrass prairie, and mesic forests.

Collecting trips were made by Jana Biehl and me at various times during the growing seasons of 1992 and 1993. I compiled a preliminary flora based on our collections, a species list resulting from a previous vegetation survey, and a list compiled in 1991 by Jeff Stewart, then an intern at the preserve. The three lists were synonymized according to Kartesz and Kartesz (1980).

Analysis of Published Floras

I located published floras from Western North America (defined for these purposes as all United States west of the Mississippi River, all of Louisiana and Minnesota, and the Canadian provinces of Alberta, British Columbia, Manitoba, Northwest Territories, Saskatchewan, and Yukon) by several methods: scanning the indices of the journals that most regularly publish floras, scanning the literature cited sections of these floras, sending out requests for data from colleagues, consulting published bibliographies, and performing on-line computer searches.

From each flora we obtained, we attempted to access the following information: the geographic coordinates, the elevation and elevational range, the area, the political jurisdiction of the surveyed area, the botanical effort (i.e., whether the flora was the result of a single survey or a result of cumulative studies), the number of parcels of land included in the study, the year of the study, and the number of families, genera, species, subspecific taxa, and exotic species encountered. Climatic data

were determined from latitude and longitude using a data set kindly supplied by Dr. David Legates of the University of Oklahoma. These data consist of mean temperature, mean precipitation, seasonality in temperature and precipitation (measured as the standard deviation of the monthly means), and potential evapotranspiration as determined by Thornthwaite's (1948) equation. The logarithm of total species richness was related to all of the above variables using stepwise linear regression with forward selection (Draper and Smith 1981).

FINDINGS

Flora of the Tallgrass Prairie

The preliminary flora of the Tallgrass Prairie Preserve consists of 78 families, 273 genera, and 496 species (Appendix 1). Fifty-seven of the species, or 11.5%, are exotic to North America. We have collected and deposited vouchers of 229 vascular plant species.

Analysis of Published Floras

We encountered references for 1,971 floras or floristic bibliographies. To date, we have sufficient data on 473 for the stepwise regression analysis, although not all of these floras are complete with respect to all of the measured variables. Basic summary statistics for the variables are given in Table 1.

Table 1. Summary statistics for the floristic data set.

Variable	Abbr.	Sample Size	Mean	Min	Max	Std Dev.
Year of study	YEAR	472	1965.4	1867	1993	24.7
Latitude (°)	LAT	472	41.3	26.2	79.7	9.4
Longitude (°)	LON	472	-105.3	-179.0	-75.4	13.9
Area (km^2)	AREA	472	88605.6	0.00032	9958523	528317
Elevation (m)	ELEV	432	1046	1	3682	965
Elevation range (m)	ELRANGE	381	787	1	4995	943
Temperature (°C)	TEMP	472	9.97	-15.1	23.1	7.7
Seasonality in temp. (°C)	STDTEMP	472	8.84	1.97	16.56	2.5
Precipitation (mm)	PREC	472	729	88	3128	439
Seasonality in prec. (mm)	STDPREC	472	24	3	155	15
Potential Evapotrans-piration (mm)	PET	472	73	24	149	23
Parcels (No.)	PARCELS	472	1.2	1	20	1.4
Botanical Effort (1 or 2)	EFFORT	406	1.4	1	2	.5
Genera (No.)	GENERA	447	322	14	1216	203
Species (No.)	RICH	472	766	17	4839	761
Total Taxa (No.)	TAXA	235	964	52	5479	983
Exotic Species (%)	EXOT	105	14.8	0	63.9	10.1

Two stepwise linear regressions were performed for the logarithm of species richness: one included most of the variables in the study (Regression 1), and the other included only the most easily obtainable data (Regression 2). The results of Regression 1 are given in Table 2.

Table 2: Results of Regression 1. Abbreviations for variables are as in Table 1. The dependent variable was the logarithm of species richness, the sample size was 331 floras, and the squared multiple R was 0.672

Variable	Coefficient	p value
CONSTANT	-4.5807641	0.08838
LOGAREA	0.1426964	0.00000
YEAR	0.0056364	0.00003
EFFORT	0.2300272	0.00018
LAT	-0.0371125	0.00336
ELEV	-0.0001835	0.00135
ELRANGE	0.0003161	0.00000
TEMP	0.0850821	0.00244
STDTEMP	0.1033818	0.00000
PREC	0.0003773	0.00011
STDPREC	-0.0045900	0.09300
PET	-0.0269892	0.00000
LON	did not enter into the model	

The following expression is used to obtain the expected number of species in any given flora:

$$\exp\left(\sum_{j} c_i x_i\right)$$

Where c_i is the coefficient for variable j (taken from Table 2) and x_i is the value of the variable in question.

For the most part, the signs of the coefficients are consistent with ecological intuition. The strong positive relationship with the logarithm of area is related to the well-known species-area relationship (Gleason 1925). The positive relationship with YEAR means that more recent floras have more species, perhaps due to accumulating botanical expertise or increasing accessibility to study sites. More species were encountered if investigators searched herbaria for specimens, as

is evidenced by the positive effects of EFFORT. The negative coefficients with LAT and ELEV are probably manifestations of the well-known latitudinal and elevational gradients, respectively (Connell and Orias 1964, Terborgh 1977). The positive relationship with elevational range is probably due to habitat heterogeneity. The relationships with climatic variables are hard to interpret, especially since there are strong interrelationships between these variables. However, it appears that high richness is associated with warm, humid locales. The negative relationship with PET is surprising, especially since Currie (1991) predicted a strong positive relationship between PET and richness in North America. LON was probably not selected into the stepwise analysis because longitudinal gradients are already taken into account in the other variables. Although the variables explain a substantial proportion of variation in biodiversity, approximately 32.8% of the variance is still unaccounted for. The results of Regression 2 are given in Table 3. Abbreviations for variables are as in Table 1.

Table 3. Results of Regression 2. The dependent variable was the logarithm of species richness, the sample size was 471 floras, and the squared multiple *R* was 0.695.

Variable	Coefficient	*p* value
CONSTANT	-5.0744714	0.02441
LOGAREA	0.1976554	0.00000
YEAR	0.0051170	0.00001
TEMP	0.1444512	0.00000
STDTEMP	0.0784645	0.00000
PREC	0.0002252	0.00039
PET	-0.0326714	0.00000
LAT	did not enter into the model	
LON	did not enter into the model	
STDPREC	did not enter into the model	

All of the variables that entered into the model in this regression had coefficients with the same sign as those in Regression 1. Despite a much larger sample size, LAT did not enter the model; this may be because latitude affects biodiversity indirectly through the climatic factors already incorporated in the model. The results of Regression 2 are more applicable than those of Regression 1 for mapping biodiversity, because one does not need to know elevation, elevational range, and botanical effort. Figure 1 on the following page is a map of the number of vascular plant species expected per 10 km^2 in Oklahoma.

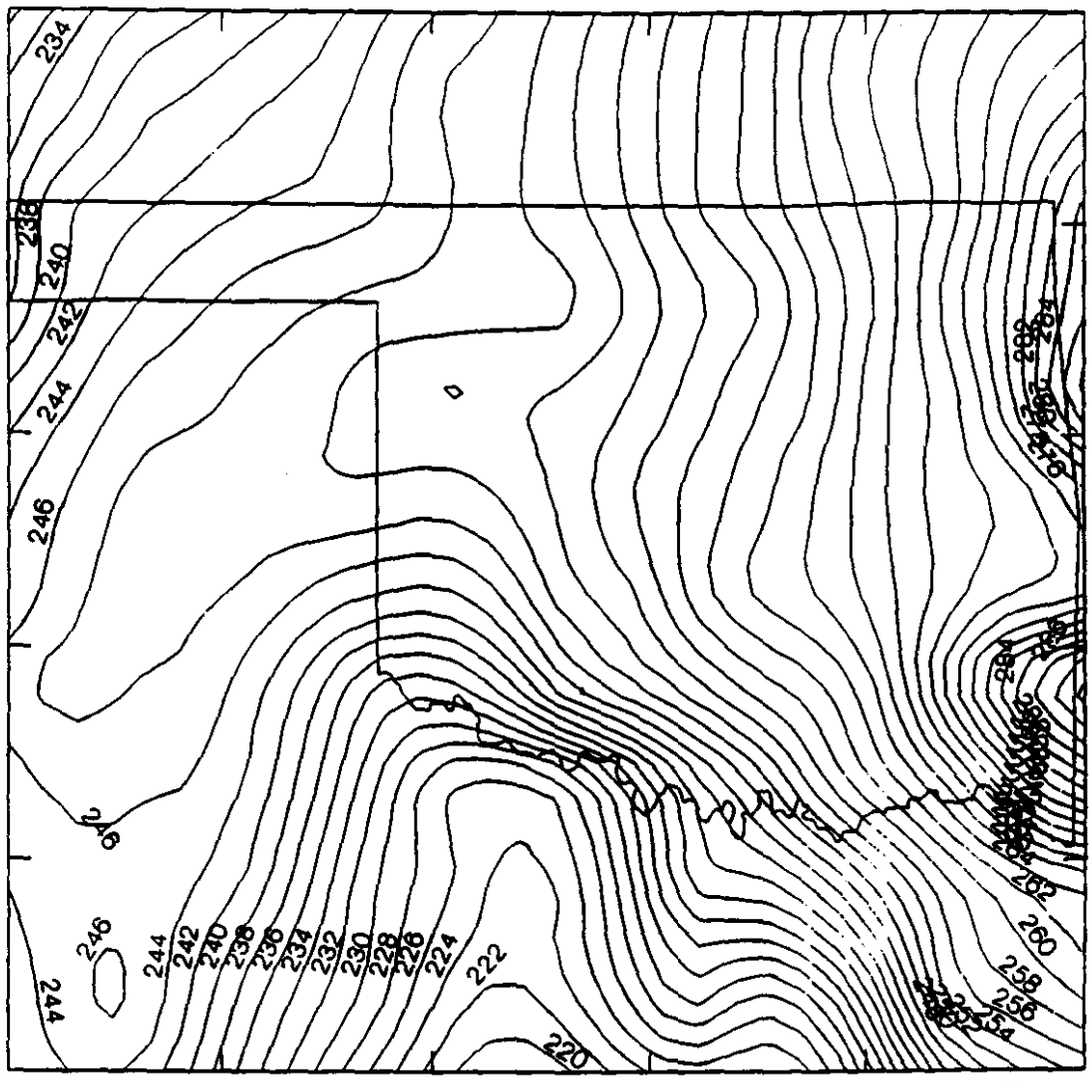

Figure 1. A map of Oklahoma with isoclines representing the number of species in hypothetical floras published in 1993 for 10 km^2 regions. Isoclines are based on the outcome of Regression 2 (Table 3).

Note in the above figure that there is a gradient of biodiversity from high values in the east (especially on the eastern highlands) and low values in the west. This is largely the result of decreasing moisture and increasing evapotrans-

piration from east to west. However, the gradient is not very steep: the number of species only ranges from 235 to 290.

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Appendix 1. Species encountered in the Tallgrass Prairie Preserve. An asterisk (*) after the family name indicates that the species has been collected and that the specimen has been deposited at the Oklahoma State University Herbarium. An "E" after the species name indicates that the species is exotic to North America.

Species Name	Family
Justicia americana	Acanthaceae *
Ruellia humilis	Acanthaceae *
Ruellia strepens	Acanthaceae
Acer negundo	Aceraceae
Amaranthus hybridus	Amaranthaceae
Rhus copallina	Anacardiaceae
Rhus glabra	Anacardiaceae
Toxicodendron radicans	Anacardiaceae
Asimina triloba	Annonaceae
Chaerophyllum tainturieri	Apiaceae *
Cicuta maculata	Apiaceae
Conium maculatum E	Apiaceae *
Daucus carota E	Apiaceae
Daucus pusillus	Apiaceae *
Eryngium leavenworthii	Apiaceae *
Eryngium yuccifolium	Apiaceae
Lomatium foeniculaceum	Apiaceae *
Sanicula canadensis	Apiaceae *
Sanicula gregaria	Apiaceae
Spermolepis divaricata	Apiaceae *
Torilis arvensis E	Apiaceae *

Apocynum cannabinum	Apocynaceae
Arisaema dracontium	Araceae *
Arisaema triphyllum	Araceae
Peltandra virginica	Araceae
Asclepias speciosa	Asclepiadaceae
Asclepias stenophylla	Asclepiadaceae
Asclepias syriaca	Asclepiadaceae *
Asclepias tuberosa	Asclepiadaceae *
Asclepias verticillata	Asclepiadaceae
Asclepias viridiflora	Asclepiadaceae
Asclepias viridis	Asclepiadaceae *
Matelea decipiens	Asclepiadaceae
Asplenium platyneuron	Aspleniaceae *
Woodsia obtusa	Aspleniaceae *
Achillea millefolium	Asteraceae *
Ambrosia artemisiifolia	Asteraceae
Ambrosia bidentata	Asteraceae
Ambrosia psilostachya	Asteraceae
Ambrosia trifida	Asteraceae
Amphiachyris dracunculoides	Asteraceae
Antennaria plantaginifolia	Asteraceae
Arctium minus E	Asteraceae
Artemisia filifolia	Asteraceae
Artemisia ludoviciana	Asteraceae *
Aster anomalus	Asteraceae
Aster drummondii	Asteraceae

Aster ericoides	Asteraceae
Aster falcatus	Asteraceae
Aster patens	Asteraceae
Aster praealtus	Asteraceae
Bidens bipinnata	Asteraceae
Bidens frondosa	Asteraceae
Cacalia plantaginea	Asteraceae
Chrysopsis pilosa	Asteraceae
Cirsium altissimum	Asteraceae *
Cirsium vulgare E	Asteraceae
Conyza canadensis	Asteraceae *
Coreopsis grandiflora	Asteraceae *
Coreopsis tinctoria	Asteraceae *
Dracopis amplexicaulis	Asteraceae *
Echinacea pallida	Asteraceae *
Elephantopus carolinianus	Asteraceae
Erechtites hieraciifolia	Asteraceae
Erigeron annuus	Asteraceae
Erigeron philadelphicus	Asteraceae *
Erigeron strigosus	Asteraceae *
Eupatorium altissimum	Asteraceae
Eupatorium coelestinum	Asteraceae
Eupatorium rugosum	Asteraceae
Eupatorium serotinum	Asteraceae *
Gnaphalium obtusifolium	Asteraceae
Gnaphalium purpureum	Asteraceae

Grindelia lanceolata	Asteraceae *
Grindelia squarrosa	Asteraceae
Helenium amarum	Asteraceae
Helenium autumnale	Asteraceae
Helianthus annuus	Asteraceae
Helianthus hirsutus	Asteraceae
Helianthus maximilianii	Asteraceae
Hieracium longipilum	Asteraceae
Iva annua	Asteraceae
Krigia caespitosa	Asteraceae *
Lactuca floridana	Asteraceae
Lactuca ludoviciana	Asteraceae
Lactuca serriola	Asteraceae *
Liatris aspera	Asteraceae
Liatris punctata	Asteraceae
Liatris pycnostachya	Asteraceae
Parthenium hysterophorus E	Asteraceae *
Parthenium integrifolium	Asteraceae
Prionopsis ciliata	Asteraceae
Pyrrhopappus carolinianus	Asteraceae
Ratibida columnifera	Asteraceae *
Rudbeckia hirta	Asteraceae *
Senecio plattensis	Asteraceae *
Silphium integrifolium	Asteraceae *
Silphium laciniatum	Asteraceae
Solidago canadensis	Asteraceae

Solidago missouriensis	Asteraceae *
Solidago radula	Asteraceae
Solidago rigida	Asteraceae
Solidago ulmifolia	Asteraceae *
Sonchus asper E	Asteraceae
Taraxacum officinale E	Asteraceae
Tragopogon dubius E	Asteraceae
Verbesina alternifolia	Asteraceae
Verbesina encelioides	Asteraceae
Verbesina virginica	Asteraceae
Vernonia arkansana	Asteraceae
Vernonia baldwinii	Asteraceae *
Xanthium strumarium	Asteraceae
Lithospermum incisum	Boraginaceae
Myosotis verna	Boraginaceae *
Capsella bursa-pastoris E	Brassicaceae *
Lepidium virginicum	Brassicaceae *
Sibara virginica	Brassicaceae *
Sisymbrium officinale E	Brassicaceae *
Thlaspi arvense E	Brassicaceae *
Opuntia macrorhiza	Cactaceae
Lobelia cardinalis	Campanulaceae *
Triodanis leptocarpa	Campanulaceae *
Triodanis perfoliata	Campanulaceae *
Sambucus canadensis	Caprifoliaceae *
Symphoricarpos orbiculatus	Caprifoliaceae *

Viburnum rufidulum	Caprifoliaceae *
Arenaria serphyllifolia E	Caryophyllaceae *
Cerastium fontanum	Caryophyllaceae *
Cerastium glomeratum E	Caryophyllaceae
Dianthus armeria E	Caryophyllaceae *
Minuartia patula	Caryophyllaceae *
Paronychia fastigiata	Caryophyllaceae *
Sagina decumbens	Caryophyllaceae
Silene antirrhina	Caryophyllaceae *
Silene stellata	Caryophyllaceae *
Celastrus scandens	Celastraceae
Euonymus atropurpureus	Celastraceae
Ceratophyllum demersum	Ceratophyllaceae
Chenopodium album E	Chenopodiaceae
Chenopodium hybridum	Chenopodiaceae
Cycloloma atriplicifolium	Chenopodiaceae
Lechea tenuifolia	Cistaceae
Lechea villosa	Cistaceae
Hypericum drummondii	Clusiaceae
Hypericum perforatum E	Clusiaceae *
Hypericum punctatum	Clusiaceae
Commelina erecta	Commelinaceae
Commelina virginica	Commelinaceae
Tradescantia ohiensis	Commelinaceae *
Convolvulus arvensis E	Convolvulaceae *
Cuscuta campestris	Convolvulaceae

Cornus drummondii	Cornaceae *
Juniperus virginiana	Cupressaceae
Carex bicknellii	Cyperaceae *
Carex blanda	Cyperaceae *
Carex bushii	Cyperaceae *
Carex caroliniana	Cyperaceae
Carex cephalophora	Cyperaceae
Carex festucacea	Cyperaceae *
Carex fissa	Cyperaceae *
Carex flaccosperma	Cyperaceae *
Carex gracilescens	Cyperaceae
Carex granularis	Cyperaceae *
Carex gravida	Cyperaceae
Carex nigromarginata	Cyperaceae
Cyperus acuminatus	Cyperaceae *
Cyperus ovularis	Cyperaceae *
Cyperus pseudovegetus	Cyperaceae
Cyperus rivularis	Cyperaceae *
Cyperus setigerus	Cyperaceae *
Cyperus strigosus	Cyperaceae
Eleocharis montevidensis	Cyperaceae *
Eleocharis obtusa	Cyperaceae *
Fimbristylis puberula	Cyperaceae *
Fuirena simplex	Cyperaceae *
Scirpus atrovirens	Cyperaceae
Scirpus koilolepis	Cyperaceae *

Scirpus lineatus	Cyperaceae
Scleria pauciflora	Cyperaceae
Diospyros virginiana	Ebenaceae *
Acalypha gracilens	Euphorbiaceae
Acalypha ostryifolia	Euphorbiaceae
Acalypha virginica	Euphorbiaceae *
Chamaesyce nutans	Euphorbiaceae *
Chamaesyce maculata	Euphorbiaceae *
Chamaesyce missurica	Euphorbiaceae
Chamaesyce serpens	Euphorbiaceae *
Croton capitatus	Euphorbiaceae *
Croton glandulosus	Euphorbiaceae *
Croton monanthogynus	Euphorbiaceae
Croton texensis	Euphorbiaceae
Euphorbia corollata	Euphorbiaceae *
Euphorbia marginata	Euphorbiaceae
Euphorbia spathulata	Euphorbiaceae *
Poinsettia cyathophora	Euphorbiaceae
Poinsettia dentata	Euphorbiaceae
Poinsettia heterophylla	Euphorbiaceae
Tragia urticifolia	Euphorbiaceae
Amorpha canescens	Fabaceae *
Amorpha fruticosa	Fabaceae *
Amphicarpaea bracteata	Fabaceae
Astragalus crassicarpus	Fabaceae *
Baptisia australis	Fabaceae

Baptisia bracteata	Fabaceae
Baptisia lactea	Fabaceae *
Baptisia leucophaea	Fabaceae *
Cassia fasciculata	Fabaceae *
Cassia marilandica	Fabaceae
Cassia nictitans	Fabaceae
Cercis canadensis	Fabaceae
Crotalaria sagittalis	Fabaceae
Dalea candida	Fabaceae
Dalea multiflora	Fabaceae
Dalea purpurea	Fabaceae
Desmanthus illinoensis	Fabaceae *
Desmodium canescens	Fabaceae
Desmodium ciliare	Fabaceae *
Desmodium cuspidatum	Fabaceae
Desmodium glutinosum	Fabaceae
Desmodium illinoense	Fabaceae *
Desmodium marilandicum	Fabaceae
Desmodium obtusum	Fabaceae
Desmodium paniculatum	Fabaceae
Desmodium pauciflorum	Fabaceae
Desmodium sessilifolium	Fabaceae *
Galactia regularis	Fabaceae
Gleditsia triacanthos	Fabaceae
Gymnocladus dioicus	Fabaceae
Kummerowia stipulacea E	Fabaceae

Kummerowia striata E	Fabaceae
Lespedeza capitata	Fabaceae *
Lespedeza cuneata	Fabaceae *
Lespedeza intermedia	Fabaceae
Lespedeza repens	Fabaceae
Lespedeza stuevei	Fabaceae
Lespedeza virginica	Fabaceae *
Medicago lupulina E	Fabaceae *
Medicago sativa E	Fabaceae *
Melilotus alba E	Fabaceae *
Melilotus officinalis E	Fabaceae *
Psoralea linearifolia	Fabaceae
Psoralea tenuiflora	Fabaceae
Schrankia uncinata	Fabaceae *
Strophostyles helvola	Fabaceae
Strophostyles leiosperma	Fabaceae
Stylosanthes biflora	Fabaceae *
Trifolium campestre E	Fabaceae *
Trifolium pratense E	Fabaceae *
Trifolium repens E	Fabaceae *
Quercus macrocarpa	Fagaceae *
Quercus marilandica	Fagaceae
Quercus muhlenbergii	Fagaceae
Quercus prinoides	Fagaceae *
Quercus shumardii	Fagaceae *
Quercus stellata	Fagaceae *

Quercus velutina	Fagaceae
Sabatia campestris	Gentianaceae *
Geranium carolinianum	Geraniaceae *
Geranium pusillum E	Geraniaceae
Ellisia nyctelea	Hydrophyllaceae *
Sisyrinchium campestre	Iridaceae
Carya cordiformis	Juglandaceae
Carya illinoensis	Juglandaceae
Carya texana	Juglandaceae
Juglans nigra	Juglandaceae
Juncus diffusissimus	Juncaceae
Juncus interior	Juncaceae *
Juncus marginatus	Juncaceae
Juncus tenuis	Juncaceae *
Juncus torreyi	Juncaceae *
Hedeoma hispidum	Lamiaceae *
Lycopus americanus	Lamiaceae *
Monarda citriodora	Lamiaceae *
Monarda fistulosa	Lamiaceae
Prunella vulgaris E	Lamiaceae *
Salvia azurea	Lamiaceae *
Scutellaria ovata	Lamiaceae
Scutellaria parvula	Lamiaceae *
Teucrium canadense	Lamiaceae *
Allium canadense	Liliaceae *
Allium stellatum	Liliaceae

Camassia scilloides	Liliaceae *
Hypoxis hirsuta	Liliaceae *
Nothoscordum bivalve	Liliaceae *
Polygonatum biflorum	Liliaceae
Zigadenus nuttallii	Liliaceae *
Linum rigidum	Linaceae
Lythrum alatum	Lythraceae *
Callirhoe alcaeoides	Malvaceae *
Sidopsis hispida	Malvaceae
Marsilea vestita	Marsileaceae *
Proboscidea louisianica	Martyniaceae
Menisperum canadense	Menispermaceae
Cannabis sativa E	Moraceae
Maclura pomifera	Moraceae
Morus alba E	Moraceae *
Morus rubra	Moraceae
Mirabilis nyctaginea	Nyctaginaceae *
Fraxinus pennsylvanica	Oleaceae *
Calylophus serrulatus	Onagraceae *
Gaura lindheimeri	Onagraceae
Gaura longiflora	Onagraceae *
Gaura parviflora	Onagraceae
Ludwigia alternifolia	Onagraceae *
Ludwigia palustris	Onagraceae
Oenothera biennis	Onagraceae
Oenothera linifolia	Onagraceae *

Oenothera speciosa	Onagraceae *
Oenothera villosa	Onagraceae *
Botrychium virginianum	Ophioglossaceae
Ophioglossum vulgatum	Ophioglossaceae
Spiranthes lacera	Orchidaceae
Spiranthes vernalis	Orchidaceae
Oxalis dillenii	Oxalidaceae *
Oxalis stricta	Oxalidaceae *
Oxalis violacea	Oxalidaceae *
Phytolacca americana	Phytolaccaceae *
Plantago aristata	Plantaginaceae *
Plantago major E	Plantaginaceae *
Platanus occidentalis	Platanaceae
Aegilops cylindrica E	Poaceae *
Agrostis elliottiana	Poaceae
Agrostis hiemalis	Poaceae *
Agrostis scabra	Poaceae
Alopecurus carolinianus	Poaceae *
Andropogon gerardii	Poaceae *
Andropogon ternarius	Poaceae
Andropogon virginicus	Poaceae
Aristida longespica	Poaceae
Aristida oligantha	Poaceae *
Bothriochloa saccharoides	Poaceae *
Bouteloua curtipendula	Poaceae *
Bouteloua gracilis	Poaceae

Bouteloua hirsuta	Poaceae
Bromus catharticus E	Poaceae
Bromus japonicus E	Poaceae *
Bromus pubescens	Poaceae *
Bromus tectorum E	Poaceae *
Buchloe dactyloides	Poaceae *
Cenchrus incertus	Poaceae
Chasmanthium latifolium	Poaceae
Chloris verticillata	Poaceae
Cynodon dactylon E	Poaceae *
Danthonia spicata	Poaceae
Dichanthelium boscii	Poaceae
Dichanthelium oligosanthes	Poaceae
Dichanthelium acuminatum	Poaceae *
Dichanthelium clandestinum	Poaceae *
Dichanthelium malacophyllum	Poaceae *
Dichanthelium sphaerocarpon	Poaceae *
Digitaria cognatum	Poaceae
Digitaria sanguinalis E	Poaceae
Echinochloa crusgalli E	Poaceae *
Eleusine indica E	Poaceae *
Elymus canadensis	Poaceae *
Elymus villosus	Poaceae
Elymus virginicus	Poaceae
Eragrostis cilianensis E	Poaceae
Eragrostis capillaris	Poaceae *

Eragrostis hirsuta	Poaceae
Eragrostis intermedia	Poaceae
Eragrostis pectinacea	Poaceae *
Eragrostis spectabilis	Poaceae *
Eragrostis trichodes	Poaceae
Festuca arundinacea *	Poaceae
Festuca elatior *	Poaceae *
Festuca obtusa	Poaceae *
Gymnopogon ambiguus	Poaceae
Hordeum pusillum	Poaceae *
Hystrix patula	Poaceae
Leersia oryzoides	Poaceae
Leersia virginica	Poaceae
Lolium multiflorum E	Poaceae *
Lolium perenne E	Poaceae *
Muhlenbergia schreberi	Poaceae
Muhlenbergia sobolifera	Poaceae
Panicum anceps	Poaceae *
Panicum capillare	Poaceae
Panicum dichotomiflorum	Poaceae *
Panicum flexile	Poaceae
Panicum rigidulum	Poaceae
Panicum virgatum	Poaceae *
Paspalum laeve	Poaceae
Paspalum pubiflorum	Poaceae *
Paspalum setaceum	Poaceae *

Phalaris canariensis E	Poaceae *
Phalaris caroliniana	Poaceae
Poa annua E	Poaceae *
Poa pratensis	Poaceae *
Poa sylvestris	Poaceae *
Schizachyrium scoparium	Poaceae *
Setaria geniculata	Poaceae *
Setaria glauca E	Poaceae *
Setaria viridis E	Poaceae
Sorghastrum nutans	Poaceae *
Sorghum halepense E	Poaceae
Spartina pectinata	Poaceae
Sphenopholis obtusata	Poaceae *
Sporobolus asper	Poaceae
Sporobolus cryptandrus	Poaceae
Sporobolus vaginiflorus	Poaceae
Stipa leucotricha	Poaceae
Tridens flavus	Poaceae
Tridens strictus	Poaceae
Tripsacum dactyloides	Poaceae *
Vulpia octoflora	Poaceae *
Polygala incarnata	Polygalaceae *
Polygala verticillata	Polygalaceae
Polygonum aviculare E	Polygonaceae
Polygonum convolvulus E	Polygonaceae *
Polygonum hydropiper E	Polygonaceae

Polygonum hydropiperoides	Polygonaceae *
Polygonum pensylvanicum	Polygonaceae *
Polygonum punctatum	Polygonaceae
Polygonum ramosissimum	Polygonaceae *
Polygonum tenue	Polygonaceae
Polygonum virginianum	Polygonaceae
Rumex altissimus	Polygonaceae *
Rumex crispus E	Polygonaceae *
Rumex hastatulus	Polygonaceae *
Claytonia virginica	Portulacaceae *
Portulaca mundula	Portulacaceae
Anagallis minima E	Primulaceae *
Samolus valerandi	Primulaceae
Clematis pitcheri	Ranunculaceae *
Delphinium carolinianum	Ranunculaceae
Delphinium virescens	Ranunculaceae *
Ranunculus abortivus	Ranunculaceae *
Ranunculus sceleratus	Ranunculaceae *
Thalictrum dasycarpum	Ranunculaceae
Agrimonia parviflora	Rosaceae
Agrimonia pubescens	Rosaceae
Crataegus crus-galli	Rosaceae *
Fragaria virginiana	Rosaceae *
Geum canadense	Rosaceae
Prunus americana	Rosaceae
Prunus angustifolia	Rosaceae

Prunus serotina	Rosaceae
Rosa carolina	Rosaceae
Rubus allegheniensis	Rosaceae
Rubus flagellaris	Rosaceae *
Cephalanthus occidentalis	Rubiaceae *
Diodia teres	Rubiaceae
Galium aparine	Rubiaceae *
Galium circaezans	Rubiaceae
Galium pilosum	Rubiaceae
Hedyotis crassifolia	Rubiaceae
Zanthoxylum americanum	Rutaceae
Populus deltoides	Salicaceae
Salix nigra	Salicaceae
Bumelia lanuginosa	Sapotaceae
Penthorum sedoides	Saxifragaceae
Agalinis aspera	Scrophulariaceae
Agalinis tenuifolia	Scrophulariaceae *
Buchnera americana	Scrophulariaceae
Dasystoma macrophylla	Scrophulariaceae
Linaria canadensis	Scrophulariaceae
Penstemon tubiflorus	Scrophulariaceae *
Verbascum thapsus E	Scrophulariaceae
Veronica arvensis E	Scrophulariaceae
Smilax bona-nox	Smilaceae
Smilax herbacea	Smilaceae *
Smilax hispida	Smilaceae *

Datura stramonium E	Solanaceae
Physalis pumila	Solanaceae
Physalis subglabrata	Solanaceae
Physalis virginiana	Solanaceae *
Solanum americanum	Solanaceae
Solanum carolinense	Solanaceae *
Solanum cornutum	Solanaceae *
Solanum dimidiatum	Solanaceae
Solanum elaegnifolium	Solanaceae
Solanum sarachoides E	Solanaceae
Staphylea trifolia	Staphyleaceae *
Celtis laevigata	Ulmaceae *
Celtis occidentalis	Ulmaceae
Ulmus americana	Ulmaceae
Ulmus rubra	Ulmaceae
Boehmeria cylindrica	Urticaceae
Parietaria pensylvanica	Urticaceae *
Valerianella radiata	Valerianaceae *
Glandularia canadensis	Verbenaceae *
Phryma leptostachya	Verbenaceae *
Phyla cuneifolia	Verbenaceae
Phyla lanceolata	Verbenaceae *
Verbena bracteata	Verbenaceae *
Verbena canescens	Verbenaceae
Verbena stricta	Verbenaceae *
Verbena urticifolia	Verbenaceae *

Viola pedata	Violaceae
Viola rafinesquii	Violaceae
Viola sororia	Violaceae
Ampelopsis arborea	Vitaceae
Parthenocissus quinquefolia	Vitaceae
Vitis riparia	Vitaceae
Tribulus terrestris	Zygophyllaceae