

The origin of the flora of the chestnut oak upland region of Indiana

Joanna S. Guss
Butler University

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Butler University Botanical Studies

(1929-1964)

Edited by

Ray C. Friesner

The *Butler University Botanical Studies* journal was published by the Botany Department of Butler University, Indianapolis, Indiana, from 1929 to 1964. The scientific journal featured original papers primarily on plant ecology, taxonomy, and microbiology. The papers contain valuable historical studies, especially floristic surveys that document Indiana's vegetation in past decades. Authors were Butler faculty, current and former master's degree students and undergraduates, and other Indiana botanists. The journal was started by Stanley Cain, noted conservation biologist, and edited through most of its years of production by Ray C. Friesner, Butler's first botanist and founder of the department in 1919. The journal was distributed to learned societies and libraries through exchange.

During the years of the journal's publication, the Butler University Botany Department had an active program of research and student training. 201 bachelor's degrees and 75 master's degrees in Botany were conferred during this period. Thirty-five of these graduates went on to earn doctorates at other institutions.

The Botany Department attracted many notable faculty members and students. Distinguished faculty, in addition to Cain and Friesner, included John E. Potzger, a forest ecologist and palynologist, Willard Nelson Clute, co-founder of the American Fern Society, Marion T. Hall, former director of the Morton Arboretum, C. Mervin Palmer, Rex Webster, and John Pelton. Some of the former undergraduate and master's students who made active contributions to the fields of botany and ecology include Dwight W. Billings, Fay Kenoyer Daily, William A. Daily, Rexford Daudenmire, Francis Hueber, Frank McCormick, Scott McCoy, Robert Petty, Potzger, Helene Starcs, and Theodore Sperry. Cain, Daudenmire, Potzger, and Billings served as Presidents of the Ecological Society of America.

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THE ORIGIN OF THE FLORA OF THE CHESTNUT OAK UPLAND REGION OF INDIANA¹

By JOANNA S. GUSS

Indiana may be divided into six distinct botanical regions, each one being different from the others in conditions of soil, moisture, topography, and, consequently, in climate and vegetation. These regions are the Illinois Drift Plain, Prairies, Lake Region including the Dunes, Chestnut Oak Upland, Tipton Till Plain and the Lower Wabash Valley.

The object of this paper is to determine the chief directions of affinities of the species now occurring in the Chestnut Oak Upland region. It deals with the distribution of species comprising the flora both within the state and by physiographic areas outside of the state.

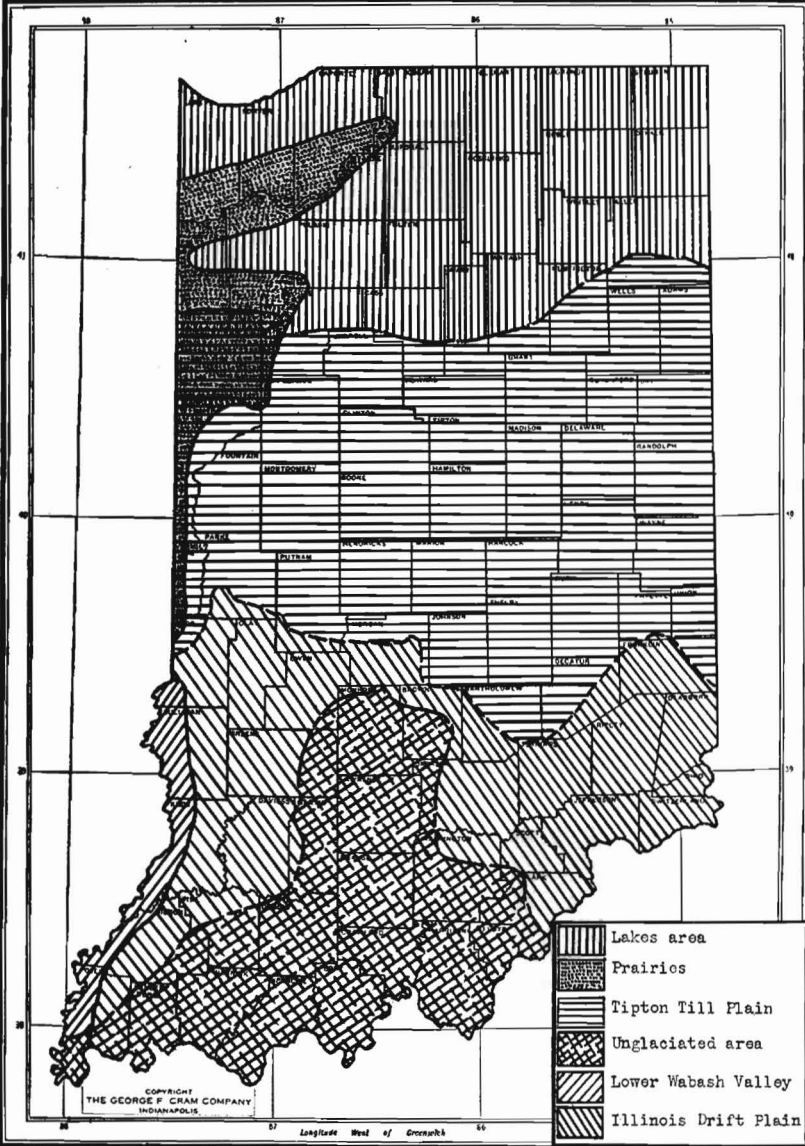
HABITAT FACTORS OF THE CHESTNUT OAK UPLAND

This region is in south central Indiana and includes all or part of the following counties: Bartholomew, Brown, Clark, Crawford, DuBois, Floyd, Greene, Harrison, Jackson, Lawrence, Martin, Monroe, Morgan, Orange, Perry, Scott and Washington. It comprises nearly all of the unglaciated part of the state and a narrow fringe of glaciated territory on the east and north margins. Its relation to other botanical areas of the state is shown in map 1. The surface is an irregular succession of high hills and deep ravines, whose final outlet is into the Ohio river on the south and into the Wabash river on the west. The highest of these hills are over 1200 feet above sea level and have a local relief up to 500 feet.

The soils are mostly residual except in the stream valleys. These residual soil are of limestone, sandstone or knobstone origin. Local habitats have a wide range of variation, varying from sheer limestone, sandstone, and knobstone cliffs, through thin soil layers on the tops of these, high knobs, steep slopes, deep ravines, darkened canyons, outwash plains, and alluvial deposits in stream valleys. There is thus a wide range of micro-climates each with its characteristic flora. According to Visher (5) the average annual rainfall

¹A portion of a thesis submitted to the Faculty of the Division of Graduate Instruction in partial fulfillment of the requirements for the degree Master of Science, in the Department of Botany, Butler University.

varies from 47 inches in the extreme southern portion to 40 inches in the extreme northern portion of the area. Rainfall for the summer months (June, July and August) averages 10 inches for most of the region but this average reaches 13 inches for a small portion



of the area near the southwest border. Along with these data the relatively high amount of relief must be taken into consideration inasmuch as this results in a high percentage of run-off and thus makes the area more dependent upon regularity of precipitation than would otherwise be true. The area is subject to erosion to a greater degree than any other part of the state, between 75% and 90% of total area being thus involved. (Visher, 6.)

NATURE OF THE FLORA AND ITS INDIANA DISTRIBUTION

The area under study has a rich and varied flora, 1471 species having come under study in the preparation of this paper. Distribution of these species is based upon the "State Flora Catalog" maintained in the botanical laboratory at Butler University. This catalog is based upon the records in Deam's "Flora" (1) and those published subsequently by the State Flora Committee of the Taxonomic Section of the Indiana Academy of Science (3, 4).

As is to be expected, the larger proportion (75.53%) of the species occurring in the area are to be found in nearly all other botanical areas of the state and the second largest group (12.71%) have their distribution outside the Chestnut Oak Upland, limited chiefly to the southern part of the state. Species exclusive in Indiana to this area comprise 4.89% of the total while a number (6.87% of the total flora) have their Indiana distribution outside of the Chestnut Oak Upland, chiefly northern. These groups will be given more detailed consideration in the following paragraphs and the data here mentioned are summarized in table I.

TABLE I

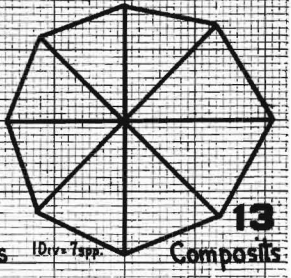
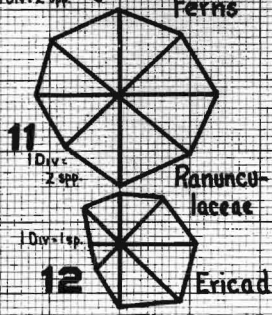
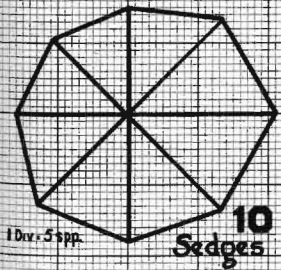
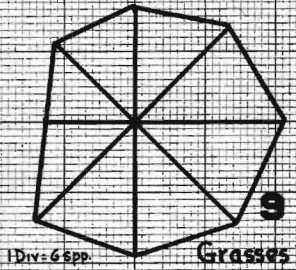
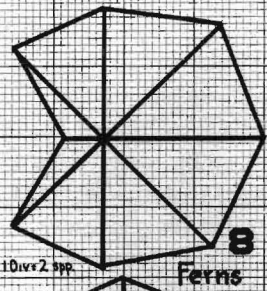
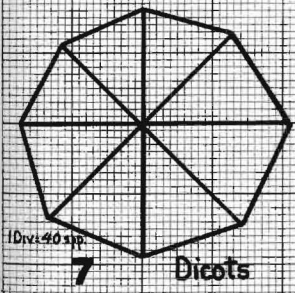
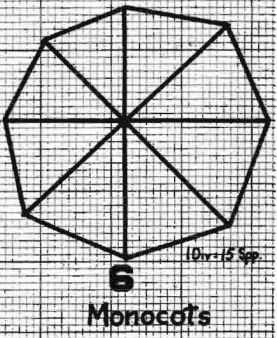
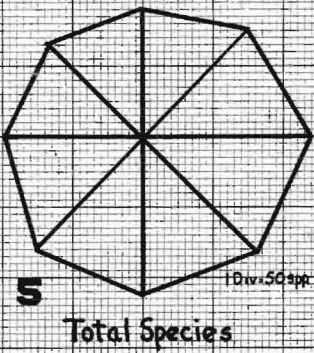
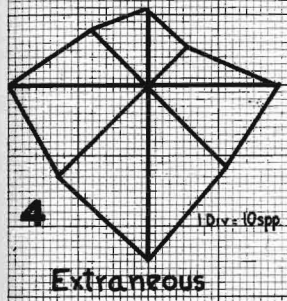
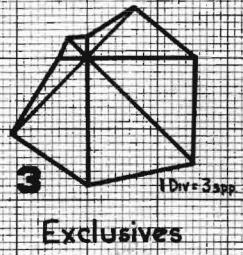
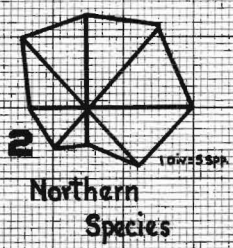
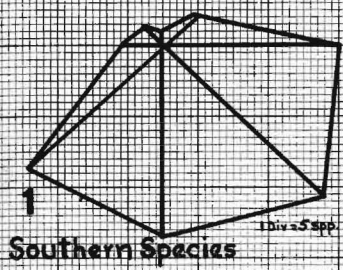
Distributional summary of the species and varieties occurring in the Chestnut Oak Upland.

Species and varieties	Number	Percent
Occurring in this area and in nearly all other botanical areas of the state	1111	75.53
Occurring in this area and with Indiana distribution outside it chiefly southern	187	12.71
Occurring in this area and with Indiana distribution outside it chiefly northern	101	6.87
Exclusive in Indiana to this area	72	4.89
Total Species	1471	100.
Extraneous, i. e. limits of range passes through this area	378	25.69
Coastal plains species	19	1.29

SPECIES OCCURRING IN THE CHESTNUT OAK UPLAND AND WITH DISTRIBUTION OUTSIDE THIS AREA CHIEFLY SOUTHERN

This study has revealed 187 species whose Indiana distribution is chiefly southern though not entirely limited to this area. These plants are almost entirely species whose main distribution outside of this area is eastern and southeastern or eastern through southeastern and southern to southwestern. Figure 1 represents the number of species of this group with main distribution on each of 8 axes of the compass. It will be observed that the largest number of species fall within the southeast quadrant of the compass. The following are some typical examples: *Acalypha ostryaefolia* (recently reported also for Tipton county), *Aesculus octandra*, *Agave virginica*, *Agrostis eliottiana*, *Andropogon eliottiana*, *Arabis virginica*, *Aruncus dioicus*, *Asclepias perennis*, *A. variegata*, *Asplenium pinnatifidum*, *Carya illinoensis*, *Cheilanthes lanosa*, *Cocculus carolinus*, *Commelina virginica*, *Corallorrhiza wisteriana*, *Cornus stricta*, *Dentaria heterophylla*, *Desmodium viridiflorum*, *Elephantopus carolinianus*, *Habenaria peramoeno*, *Iris cristata*, *Obolaria virginica*, *Oxalis grandis*, *Panicum anceps*, *P. polyanthes*, *P. stipitatum*, *P. xalapense*, *Poa chapmaniana*, *Polymnia weddalia*, *Rubus argutus*, *Scutellaria australis*, *Smilax glauca*, *Solidago bicolor*, *S. sphacelata*, *Ulmus alata*, *Viburnum pubescens* var. *deamii*, *V. rufidulum*. Species falling in this group in regard to Indiana distribution but more particularly eastern in general distribution are represented by the following: *Aristida dichotoma*, *Carex willdenovii*, *Carya glabra*, *Castanea dentata*, *Tsuga canadensis*, and *Vaccinium stamineum*.

Woldsteinia fragarioides is another species of this group whose distribution is significant. While in its general distribution it occurs from northwest through north, east, south to southwest of Indiana, it is found in but three stations within the state, all of which are talus slopes, viz. near the site of Carne's Mill, 2 miles south of Grantsburg in Crawford County, along Buck Creek, north of Dogwood in Harrison County, both of which sites lie within the Chestnut Oak Upland, and along the North Fork of the Muscatatuck River about one-half mile upstream from Vernon in Jennings County (Deam, 1). The fact that a species, intraneous to an area, is so limited in its distribution would appear to bespeak a dearth of local habitats though, from mere casual observation, apparently similar sites can be found in many places within the state yet without this



species. More detailed habitat studies will be necessary to throw light upon this striking limitation of distribution.

A few species occurring only in and near this area have a general distribution on all sides of Indiana, e. g. *Solidago bicolor*, *Aster patens*, *A. undulatus*, *Demstacdtia punctilobula* (in Parke County outside this area), *Eragrostis capillaris*, *Scirpus polyphyllus*, *Urticularia sessilifolia*, *Lilium superbum*, *Polygonatum biflorum*. However, it is apparent that most of the species in this group are on the northern, western or northwestern limits of their range here.

SPECIES OCCURRING IN THE CHESTNUT OAK UPLAND AND WITH DISTRIBUTION OUTSIDE THIS AREA CHIEFLY NORTHERN

One-hundred-one species have been found to occur in the Chestnut Oak Upland with Indiana distribution outside this area limited chiefly to the northern part of the state. This forms an interesting group of species because many of them are northern species reaching the southern limits of their range here. Some of them are northern relicts, e. g. *Betula lutea* var. *macrolepis*, *Epigaea repens*, *Gaultheria procumbens*, *Habenaria ciliaris*, *H. clavellata*, *Lycopodium flabelliforme*, *Trillium grandiflorum*, and *Tsuga canadensis*, and are restricted to one or only a few sites. Among the other species of this group is a considerable number which are absent from the central part of the state: *Acerates viridiflora* found in Harrison County and not again until the sandy areas of the northwestern and northernmost counties are reached; *Aster linariifolius*, rare on the crests of residual clay ridges in Floyd, Harrison and Perry Counties, then skipping to the sandy areas from Cass County westward and northwestward, the latter area being of Late Wisconsin origin; *Brasenia schreberi*, occurring in Jefferson and Monroe Counties, then skipping to the Lakes area: *Bartonia virginica*, occurring in a small bog 10 miles southeast of Bloomington, in three other sites just beyond the edges of the Chestnut Oak Uplands, and then skipping to the Lakes area; *Carex comosa*, found only in Floyd County, in a few sites in the Early Wisconsin drift and then in every county in the Late Wisconsin drift; *C. buxbaumii*, found only in Harrison County, in two counties of the Early Wisconsin drift and then in most of the Late Wisconsin drift area; *C. decomposita*, found only in Lawrence and Wells Counties; *C. intumescens*, found generally in the southern half of the state, skipping over the central part and occurring again in Wells County and the northern two tiers of coun-

ties; *Viola pedata*, occurring on heavy clay soils in a number of Chestnut Oak Upland sites, then skipping to the sandy areas of the north and northwest portions of the state; *Liatris scariosa*, occurring on heavy clay soils on ridge tops here, then skipping to the sandy soils of the northern quarter of the state; *Lathyrus venosus*, occurring only in Harrison County, then skipping to Lake and Porter Counties in the extreme northwest corner of the state; *Vaccinium vacillans* var. *crinitum*, found in a number of sites scattered on dry oak ridges and canyon walls here and then skipping to sandy areas of Pulaski and St. Joseph Counties. This disjunct distribution is clearly due to lack of suitable intervening habitats in some cases, e. g. in the case of *Brasenia schreberi*, but in other this is hardly true and, besides, the northern stations are on sandy soils instead of heavy clay. More detailed study of the local edaphic conditions will be necessary to throw more light on the possible factors involved in this peculiar distribution. Other species of the group include: *Bromus kalmii*, *Cardamine parviflora* var. *arenicola*, *Carex pennsylvanica*, *C. scoparia*, *C. umbellata*, *Gaylussacia baccata*, *Gentiana flavida*, *Lechea villosa*, *Liatris scariosa*, *Lysimachia quadrifolia*, *Desmodium ciliare*, *D. rigidum*, *Goodyera pubescens*, *Hedeoma hispida*, *Hypericum gentianoides*, *Kuhnia eupatorioides*, *Linum sulcatum*, *Melanthium virginicum*, *Melica nitens*, *Oenothera tetragona* var. *longistipata*, *Panicum praecocius*, *P. sphaerocarpon*, *P. flexile*, *Rumex brittanica*, *Rubus abactus*, *Scrophularia lanceolata*, *Scutellaria nervosa*, *S. ovalifolia*, *Stenanthium robustum* and *Vicia caroliniana*.

Figure 2 shows a graphic representation of the wider distribution of these species. While it is apparent that more of them are eastern to northwestern there is a considerable number that have a wider distribution on all sides of this area. The absence of these species in the central part of Indiana is probably related to edaphic rather than climatic conditions.

EXTRANEOUS AND EXCLUSIVES

Perhaps the most significant feature regarding the wider distribution of species and varieties of this area is the fact that 378 species (25.69% of the total flora) are on the limits of their range as it passes through this area. These are listed, together with the directions of their distribution from the area, in table II. The number showing distribution in each of the 8 directions of the compass is shown graphically in figure 4. The area is terminal for the dis-

tribution of species and varieties from all directions but for a larger number from the east, southeast, south, southwest and west than from other directions.

Of the total extraneous forms 72 or 19.1% (4.89% of the total flora) are exclusive in Indiana to this area. Most of these exclusives have their general distribution in the Appalachian highlands to the east, southeast and south. Some extend to the southwest and a smaller number to the northeast with a very few to the north, northwest and west. These species are indicated by an asterisk (*) in table II and the relative numbers are shown graphically in fig. 3.

A small number (14 or 3.7%) of the extraneous forms are Atlantic and Gulf coastal plains forms which have extended up the Mississippi Valley to this area and reach their range limits here. These are indicated by two asterisks (**) in table II.

Friesner (2) has pointed out the critical character of Indiana as a botanical area. In his study 131 species were found to be on the limits of their range within the Chestnut Oak Uplands. The present study lists 378 species. The difference between these figures is due to increased knowledge of Indiana plant distribution due to the publication of Deam's (1) "Flora" subsequent to the former paper.

SYSTEMATIC GROUPS

Figure 5 shows relative numbers of species and varieties of the total flora of the area extending into each of the directions of the compass. It will be noted that the figure so formed presents a greater area eastward of a north-south line than to the west of such a line. Figures 6-13 show other groups, only two of which show a markedly unsymmetrical shape, viz. pteridophytes (fig. 8) and ericads (fig. 12). The dearth of pteridophytes to the west (fig. 8) is undoubtedly due to climatic reasons while the smaller numbers of ericads west of the north-south axis is due to both climatic and habitat reasons.

SUMMARY

1. A total of 1471 species and varieties are known to occur in the Chestnut Oak Uplands of Indiana.
2. The larger percentage (75.53%) of the flora has a distribution generally over the state.
3. The second largest group (25.69% of the total) have their range limits pass through this area.

4. The third largest group (12.71%) is generally southern in its distribution within the state and in its wide distribution occurs very largely southeast of a line drawn through the area from the southwest to the northeast.

5. The fourth largest group (6.87%) has its Indiana distribution outside of this area chiefly in the northern part of the state. A larger percentage of the species of this group extend to the east, northeast, north and northwest than in other directions.

6. The smallest group (4.89%) are exclusive in Indiana to this area. The wider distribution of these forms is chiefly southeast of a line drawn from the area to the southwest and the northeast.

ACKNOWLEDGMENT

The writer wishes to express her sincere thanks to Dr. Ray C. Friesner, who suggested and supervised the preparation of this paper.

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TABLE II

Extraneous species and varieties. Wider distribution of species and varieties which are on the limits of their range in the Chestnut Oak Uplands. *==Exclusive in Indiana to this area. **==Coastal plains species.

	NW	N	NE	E	SE	S	SW	W
* <i>Ophioglossum engelmanni</i>					x	x	x	x
* <i>Cheilanthes lanosa</i>				x	x	x	x	x
<i>Pteretis nodulosa</i>		x	x	x	x			
* <i>Botrychium dissectum</i> var. <i>tenuifolium</i>							x	
<i>Asplenium pinnatifidum</i>					x	x		x
<i>Asplenosorus ebenoides</i>				x				x
<i>Polypodium polypodioides</i> var. <i>nichauxiana</i>					x	x	x	x
* <i>Lycopodium selago</i> var. <i>patens</i>		x	x	x	x	x		
<i>L. flabelliforme</i>		x	x	x	x	x		

TABLE II—(Continued)

	NW	N	NE	E	SE	S	SW	W
<i>L. lucidulum</i>	x	x	x	x	x			
* <i>Pinus virginiana</i>				x	x			
<i>Tsuga canadensis</i>	x	x	x	x	x			
* <i>Naias gracillima</i>	x	x	x					x
* <i>Lophocarpus calycinus</i>	x			x	x	x	x	x
<i>Arundinaria gigantea</i>					x	x	x	
* <i>Poa cuspidata</i>				x	x			
<i>Bromus kalmii</i>	x	x	x	x				
* <i>Glyceria acutiflora</i>			x	x	x			
<i>Uniola latifolia</i>				x	x	x	x	
* <i>Melica nutica</i>				x	x	x	x	x
<i>Aristida dichotoma</i>			x	x	x	x	x	
<i>A. ramosissima</i>						x	x	x
<i>Leptochloa filiformis</i>					x	x	x	
* <i>Muhlenbergia capillaris</i>			x	x	x	x	x	x
<i>Paspalum fluitans</i>					x	x	x	
<i>Panicum anceps</i>				x	x	x	x	
<i>P. stipitatum</i>			x	x	x	x	x	
<i>P. xalapense</i>				x	x	x	x	x
* <i>P. bicknellii</i>			x	x	x	x	x	
<i>P. microcarpon</i>			x	x	x	x	x	
* <i>P. mattamuskeetense</i> **			x	x	x			
* <i>P. yadkinense</i>			x	x	x	x	x	x
<i>P. polyanthes</i>			x	x	x	x	x	
<i>P. leibergii</i>	x	x	x					x
* <i>Erianthus alopecuroides</i>				x	x	x	x	
<i>Andropogon elliottii</i>				x	x	x	x	
<i>Cyperus elliottii</i>				x	x	x	x	
<i>C. ovularis</i>			x	x	x	x	x	
<i>C. filiculmis</i> var. <i>macilentus</i>	x	x	x	x				x
<i>Kyllingia pumila</i>				x	x	x	x	
<i>Scirpus eriophorum</i> **			x	x	x	x		
<i>S. pedicellatus</i>	x		x					
<i>Eleocharis smallii</i>			x	x			x	x
<i>E. elliptica</i>	x	x	x	x	x			x
<i>E. tenuis</i>					x	x	x	
<i>Rhynchospora corniculata</i> var. <i>interior</i>						x	x	
* <i>Scleria oligantha</i>					x	x	x	
<i>Carex retroflexa</i>			x	x	x	x	x	
<i>C. mesochorea</i>			x	x	x			
<i>C. decomposita</i>			x	x	x	x	x	
<i>C. crus-corvi</i>	x				x	x	x	x
<i>C. conjuncta</i>	x			x				x
<i>C. tenera</i>	x	x	x	x	x			x
<i>C. molesta</i>			x					x
<i>C. richii</i>			x	x				

TABLE II--(Continued)

	NW	N	NE	E	SE	S	SW	W
<i>C. albolutescens</i> **			x	x	x	x	x	
<i>C. willdenowii</i>			x	x	x	x	x	
* <i>C. nigromarginata</i> **			x	x	x	x	x	
<i>C. umbellata</i>	x	x	x	x				x
* <i>C. picta</i>						x		
<i>C. careyana</i>	x	x	x	x				x
<i>C. platyphylla</i>	x	x	x	x	x			x
<i>C. abscondita</i>			x	x	x	x	x	
<i>C. laxiflora</i> var. <i>serrulata</i>				x				
<i>C. amphibola</i>				x	x	x	x	
<i>C. glaucodea</i>			x	x	x	x	x	
<i>C. prasina</i>			x	x	x			
<i>C. debilis</i>			x	x	x	x	x	
<i>C. virescens</i>			x	x	x			
<i>C. caroliniana</i>				x	x	x	x	
<i>C. riparia</i> var. <i>lacustris</i>	x	x	x	x				
<i>C. tuckermanni</i>	x	x	x	x				
<i>C. gigantea</i>				x	x	x	x	
<i>Commelina diffusa</i>				x	x	x	x	
<i>C. virginica</i>				x	x	x	x	
<i>Juncus interior</i>	x						x	x
<i>J. diffusissimus</i>				x	x	x	x	
* <i>J. secundus</i> **			x	x	x	x	x	
<i>J. nodatus</i>								x
<i>Luzula echinata</i> **				x	x	x	x	
<i>Stenanthium robustum</i>				x	x		x	
<i>Nothoscordum bivalve</i>				x	x	x	x	x
<i>Lilium philadelphicum</i> var. <i>andinum</i>	x	x	x	x			x	x
<i>L. superbum</i>	x	x	x	x	x		x	x
<i>L. canadense</i>			x	x	x			
<i>L. michiganense</i>	x	x					x	x
<i>Medeola virginiana</i>	x	x	x	x	x			
<i>Trillium nivale</i>	x	x	x	x	x			
<i>Smilax pulverulenta</i>			x	x	x	x		
<i>S. glauca</i>					x	x	x	
* <i>S. bona-nox</i>					x	x	x	
<i>Agave virginica</i>				x	x	x	x	
<i>Dioscorea hirticaulis</i>					x			
<i>D. glauca</i>				x	x	x	x	
<i>D. quaternata</i>					x	x	x	
<i>Iris cristata</i>				x	x	x	x	
<i>Habenaria peramoena</i>				x	x	x	x	
<i>Isotria verticillata</i>			x	x	x	x	x	
<i>Spiranthes beckii</i>			x	x	x	x	x	
<i>S. ovalis</i>					x	x	x	
<i>Corallorrhiza wisteriana</i>				x	x	x	x	

TABLE II—(Continued)

	NW	N	NE	E	SE	S	SW	W
<i>C. maculata</i>		x	x	x	x	x		
<i>Tipularia discolor</i>					x	x	x	
* <i>Hexalectris spicata</i>						x	x	x
<i>Populus grandidentata</i>		x	x	x	x	x		x
<i>Salix interior</i> var. <i>wheeleri</i>		x	x	x	x			
<i>S. discolor</i>		x	x	x	x	x		x
<i>S. sericea</i>				x	x	x		
<i>S. tristis</i>		x	x	x	x			x
<i>Carya pecan</i>							x	x
<i>Betula lutea</i> var. <i>macrolepis</i>		x	x	x	x	x		
<i>Quercus prinus</i>					x	x	x	x
<i>Q. montana</i>				x	x	x	x	
* <i>Q. stellata</i>				x	x	x	x	x
*X <i>Q. schuettei</i>		x	x	x				
*X <i>Q. fernowii</i>						x	x	x
<i>Q. coccinea</i> var. <i>tuberculata</i>				x	x	x	x	
<i>Q. falcata</i>					x	x	x	x
<i>Q. marilandica</i>				x	x	x	x	x
<i>Ulmus alata</i>						x	x	x
<i>Celtis laevigata</i>						x	x	x
* <i>C. pumila</i>					x	x	x	x
<i>Phoradendron flavescens</i>					x	x	x	x
<i>Commandra richardsiana</i>		x	x	x	x			x
<i>Asarum reflexum</i>				x			x	x
<i>Rumex triangulivalvis</i>		x	x	x				x
<i>R. brittanica</i>		x	x	x	x			x
<i>Polygonum arifolium</i> var. <i>lentiforme</i>				x	x			
<i>Oxybaphus nyctaginens</i>		x					x	x
<i>Stellaria pubera</i> var. <i>sylvatica</i>							x	
<i>Sagina decumbens</i>				x	x	x	x	x
<i>Silene stellata</i>					x	x	x	
<i>S. nivea</i>		x	x	x	x			x
<i>S. cucubalus</i>		x	x	x	x			x
* <i>Aconitum uncinatum</i>		x			x	x		
<i>Anemone quinquefolia</i> var. <i>interior</i>		x	x	x	x			x
* <i>Trautvetteria carolinensis</i>					x	x	x	x
<i>Ranunculus pusillus</i> **				x	x	x	x	x
<i>R. septentrionalis</i> var. <i>caricetorum</i>		x			x			x
<i>Thalictrum dasycarpum</i>		x			x			x
* <i>Magnolia acuminata</i>				x	x	x	x	x
<i>Thlaspi arvense</i>		x	x	x	x			x
<i>Sisymbrium altissimum</i>		x	x	x	x			x
<i>Dentaria multifida</i>					x	x	x	
<i>D. diphylla</i>		x	x	x	x	x		x
<i>D. heterophylla</i>					x	x		
<i>Arabis virginica</i>						x	x	x

TABLE II—(Continued)

	NW	N	NE	E	SE	S	SW	W
* <i>A. patens</i>				x	x			
<i>A. glabra</i>	x	x	x	x				
* <i>Leavenworthia uniflora</i>						x	x	
<i>Erysimum repandum</i>	x			x			x	x
<i>Conringia orientalis</i>	x	x	x	x				x
* <i>Sedum telephioides</i>			x	x	x			
<i>S. ternatum</i>		x	x	x	x			
<i>Saxifraga virginensis</i>			x	x	x			
<i>S. pennsylvanica</i>	x	x	x	x				x
<i>Heuchera americana</i> var. <i>interior</i>							x	x
<i>H. americana</i> var. <i>hirsuticaulis</i>								x
* <i>H. villosa</i> var. <i>macrochiza</i>					x	x	x	
* <i>H. parviflora</i> var. <i>rugellii</i>					x	x	x	
<i>Grossularia missouriensis</i>	x					x	x	x
<i>Liquidambar stryaciflua</i>				x	x	x	x	
<i>Physocarpus opulifolius</i>	x	x	x	x	x			
<i>Aruncus dioicus</i>							x	x
<i>Gillenia stipulata</i>			x	x	x	x	x	
<i>Aronia melanocarpa</i>		x	x	x	x			
<i>Crataegus regalis</i>					x	x	x	
<i>C. acutifolia</i>							x	
* <i>C. gattingeri</i> var. <i>rigida</i>							x	
<i>C. disperma</i>					x			x
<i>C. intricata</i>			x	x	x			
* <i>C. rubella</i>				x	x			
* <i>C. biltmoreana</i>			x	x	x	x	x	
* <i>C. prona</i>			x	x				
<i>C. putnamiana</i>				x	x			
* <i>C. incaedua</i>								x
* <i>Rubus odoratus</i>			x	x	x			
* <i>R. enslenii</i>	x	x	x	x	x	x		
<i>R. centralis</i>				x				
<i>R. deamii</i>							x	
<i>R. argutus</i>				x	x			
<i>R. abactus</i>	x	x	x					
<i>Potentilla arguta</i>	x	x	x	x				x
<i>P. recta</i>	x	x	x	x				x
<i>Waldsteinia fragarioides</i>	x	x	x	x	x			x
<i>Geum canadense</i> var. <i>grimesii</i>				x	x			
<i>G. laciniatum</i>	x	x	x	x				x
<i>Prunus lanata</i>								x
<i>P. hortulana</i>							x	x
* <i>Cassia nictitans</i> var. <i>leiocarpa</i>				x	x			
* <i>C. occidentalis</i>					x	x	x	
<i>C. hebecarpa</i>			x	x	x			
* <i>Cladrastis lutea</i>					x	x	x	

TABLE II—(Continued)

	NW	N	NE	E	SE	S	SW	W
<i>Baptisia australis</i>			x	x	x			
<i>Psoralea psoralioides</i> var. <i>eglandulosa</i>				x	x	x	x	
<i>Petalostemum purpureum</i>	x						x	x
* <i>Wisteria macrostachya</i>						x	x	
<i>Stylosanthes biflora</i>			x	x	x	x	x	
* <i>Desmodium laevigatum</i>			x	x	x	x	x	
<i>D. viridiflorum</i>			x	x	x	x	x	
<i>Lespedeza striata</i>				x	x	x	x	
* <i>L. nuttallii</i>			x	x	x	x	x	
<i>L. repens</i>	x		x	x	x	x	x	x
<i>L. procumbens</i>	x		x	x	x	x	x	x
<i>Lathyrus venosus</i>				x				
<i>Clitoria mariana</i>			x	x	x	x	x	x
<i>Galactia volubilis</i> var. <i>mississippiensis</i>								x
<i>Phascolus polystachus</i> **	x		x	x	x	x	x	
<i>Strophostyles umbellata</i> **			x	x	x	x	x	
<i>S. leiosperma</i>	x						x	x
<i>Oxalis grandis</i>				x	x	x	x	
<i>O. florida</i>			x	x	x			
<i>Linum striatum</i>			x	x	x	x	x	
<i>Polygala ambigua</i>			x	x	x	x	x	
<i>Phyllanthus caroliniensis</i>				x	x	x	x	x
* <i>Croton capitatus</i> **				x	x	x	x	x
<i>Tragia cordata</i>					x	x	x	
<i>Callitriche austini</i>			x	x				
<i>Evonymus americanus</i>			x	x	x	x	x	x
<i>E. obovatus</i>		x	x	x	x	x		x
<i>Acer negundo</i> var. <i>violaceum</i>	x	x	x	x			x	x
<i>Aesculus octandra</i>				x	x	x	x	
* <i>Rhamnus caroliniana</i>					x	x	x	x
<i>Vitis labrusca</i>			x	x	x			
<i>Ampelopsis cordata</i>					x	x	x	x
<i>Tilia heterophylla</i>				x	x	x		
<i>Hibiscus palustris</i> **						x		
<i>Ascyrum hypericoides</i> var. <i>multicaule</i>			x	x	x	x	x	x
<i>Hypericum ascyron</i>	x	x	x					x
* <i>H. dolabriforme</i>					x			
<i>H. drummondii</i>					x	x	x	x
<i>H. tubulosum</i>				x	x	x	x	
<i>H. tubulosum</i> var. <i>walteri</i>						x	x	
* <i>Lechea racemosula</i>			x	x	x			
<i>Viola cucullata</i>			x	x	x			
<i>V. missouriensis</i>							x	
<i>V. blanda</i>	x	x	x	x	x			
<i>Passiflora incarnata</i>				x	x	x	x	
<i>Rotala ramosior</i> var. <i>interior</i>			x	x	x	x	x	x

TABLE II--(Continued)

	NW	N	NE	E	SE	S	SW	W
<i>Ammannia coccinea</i>	x			x	x	x	x	x
<i>Cuphea petiolata</i>			x	x	x	x	x	
<i>Decodon verticillatus**</i>							x	
<i>Epilobium densum</i>	x	x	x	x				x
<i>Oenothera tetragona</i> var. <i>longistipata</i>	x	x	x	x	x			
<i>Oe. triloba</i>							x	x
<i>Aralia spinosa</i>			x	x	x	x	x	
<i>Sanicula trifoliata</i>	x	x	x	x	x			
* <i>Zizia aptera</i>	x		x	x	x			x
* <i>Ligusticum canadense</i>				x	x	x	x	
<i>Polytaenia nuttallii</i>	x						x	x
<i>Cornus stricta</i>						x	x	x
<i>C. obliqua</i>	x	x	x	x				x
<i>C. amomum</i>			x	x	x			
* <i>Kalnia latifolia</i>			x	x	x	x		
* <i>Oxydendrum arboreum</i>				x	x	x		
<i>Epigaea repens</i>	x	x	x	x	x			
<i>Gaultheria procumbens</i>	x	x	x	x	x	x		
<i>Gaylussacia baccata</i>	x	x	x	x	x	x		
* <i>Vaccinium stamineum</i>			x	x	x			
* <i>V. stamineum</i> var. <i>neglectum</i>				x	x			
* <i>V. arboreum</i>						x	x	x
<i>Hottonia inflata</i>			x	x	x	x	x	
<i>Lysimachia nummularia</i>	x	x	x	x				x
<i>L. longifolia</i>	x	x	x	x				x
<i>Centunculus minimus</i>	x					x	x	x
<i>Obolaria virginica</i>					x	x	x	x
* <i>Gentiana villosa</i>					x	x	x	x
<i>Apocynum sibiricum</i> var. <i>farwellii</i>				x				
<i>Acerates hirtella</i>		x					x	x
<i>Asclepias perennis</i>						x	x	x
<i>A. variegata</i>				x	x	x	x	x
<i>Gonolobus obliquus</i>					x	x	x	x
<i>Cuscuta glomerata</i>	x	x					x	x
<i>Convolvulus spithameus</i>	x	x	x	x	x			
<i>C. scpium</i> var. <i>fraterniflorus</i>	x						x	x
<i>C. repens</i>			x	x	x			
<i>Ipomoea lacunosa</i>					x	x	x	x
<i>Quamoclit coccinea</i>			x	x	x	x	x	
<i>Phlox amplifolia</i>							x	x
<i>P. ovata</i>					x	x		
<i>P. glaberrima</i>	x					x	x	x
<i>P. pilosa</i> var. <i>amplexicaulis</i>						x	x	x
<i>P. bifida</i>	x	x					x	x
<i>Hydrophyllum canadense</i>	x	x	x	x	x			
<i>Cynoglossum virginianum</i>				x	x	x	x	x

TABLE II—(Continued)

	NW	N	NE	E	SE	S	SW	W
<i>Lithospermum incisum</i>	x						x	x
<i>Verbena canadensis</i>					x	x	x	x
<i>V. urticaefolia</i> var. <i>leiocarpa</i>			x	x	x			
<i>Scutellaria nervosa</i>				x	x	x	x	x
<i>S. australis</i>						x	x	
* <i>S. saxatilis</i>				x	x	x	x	
<i>Synandra hispidula</i>				x	x			x
<i>Stachys riddellii</i>				x	x			x
<i>S. clingmani</i>					x			x
<i>Salvia lyrata</i>				x	x	x	x	
<i>Monarda clinopodia</i>				x	x	x		
<i>Satureja vulgaris</i>	x	x	x	x				
<i>Pycnanthemum pycnanthemoides</i>				x	x			
* <i>P. incanum</i>				x	x	x	x	x
* <i>Cunila organoides</i>				x	x	x	x	x
<i>Lycopus uniflorus</i>	x	x	x	x	x			
<i>L. americanus</i> var. <i>longii</i>				x	x			
<i>Perilla frutescens</i> var. <i>crispa</i>				x	x	x	x	x
* <i>Physalis nyctaginea</i>				x	x	x	x	
<i>P. pruinosa</i>				x	x	x		x
<i>Kickxia elatine</i> **							x	
<i>Chaenorrhinum minus</i>	x	x	x	x				x
<i>Collinsia verna</i>	x	x	x	x	x		x	x
<i>Chelone obliqua</i> var. <i>speciosa</i>							x	x
<i>C. glabra</i> var. <i>elongata</i>					x	x	x	x
<i>C. glabra</i> var. <i>linifolia</i>	x	x	x	x				x
* <i>C. glabra</i> var. <i>elatior</i>					x	x	x	
<i>Penstemon alluviorum</i>					x	x	x	x
<i>P. deamii</i>								x
<i>P. canescens</i>					x	x	x	
<i>Hydrantheium rotundifolium</i>							x	x
<i>Gerardia tenuifolia</i> var. <i>parviflora</i>	x	x	x				x	x
<i>Bignonia capreolata</i>						x	x	x
<i>Conopholis americana</i>				x	x	x		
<i>Ruellia caroliniensis</i> var. <i>parviflora</i>					x	x	x	x
<i>Dicliptera brachiata</i> var. <i>glandulosa</i>						x	x	x
<i>Plantago pusilla</i>	x						x	x
<i>Houstonia nigricans</i>						x	x	x
<i>Diodia teres</i> var. <i>setifolia</i>				x				x
* <i>Galium circaezans</i>				x	x	x	x	x
<i>G. lanceolatum</i>	x	x	x	x	x			
* <i>G. parisiense</i>						x	x	
<i>Viburnum rufidulum</i>					x	x	x	x
<i>V. pubescens</i> var. <i>deamii</i>							x	x
<i>V. pubescens</i> var. <i>indianense</i>					x			
<i>Triosteum aurantiacum</i>	x		x	x				x

TABLE II—(Continued)

	NW	N	NE	E	SE	S	SW	W
<i>T. aurantiacum</i> var. <i>illinoicense</i>				x			x	
<i>T. angustifolium</i>			x	x	x		x	
<i>Lonicera japonica</i>			x	x	x			
<i>L. dioica</i> var. <i>glaucescens</i>	x	x	x	x	x			
<i>L. prolifera</i>	x	x	x	x	x			
<i>Dipsacus sylvester</i>			x	x	x			
* <i>Melothria pendula</i>				x	x	x	x	
<i>Echinocystis lobata</i>	x	x	x	x	x		x	x
<i>Lobelia puberula</i>				x	x	x	x	x
<i>Elephantopus carolinianus</i>				x	x	x	x	x
* <i>Eupatorium incarnatum</i>					x	x	x	
* <i>Solidago erecta</i>				x	x	x		
* <i>S. squarrosa</i>			x	x	x			
<i>S. canadensis</i>	x	x	x	x	x			
<i>S. canadensis</i> var. <i>gilvocanescens</i>			x	x				x
<i>S. sphacelata</i>				x	x	x		
* <i>S. ovata</i> (endemic)								
<i>S. riddellii</i>	x	x	x	x				
<i>Aster paniculatus</i>	x	x	x				x	x
<i>A. lateriflorus</i>			x	x	x			
<i>A. vimineus</i>			x	x				
* <i>Sericocarpus linifolius</i>			x	x	x	x	x	
<i>Antennaria neglecta</i>	x	x	x	x				x
<i>A. neodioica</i>	x	x	x	x				
* <i>A. solitaria</i>				x	x	x	x	
<i>A. parlinii</i>	x	x	x	x	x			x
<i>A. fallax</i>	x	x	x	x		x	x	x
<i>A. fallax</i> var. <i>calophylla</i>				x	x	x	x	
<i>Anaphalis margaritacea</i> var. <i>intercedens</i>	x	x	x	x				x
<i>Polymnia uvcdalia</i>			x	x	x	x	x	
<i>Silphium trifoliatum</i>			x	x	x			
<i>S. trifoliatum</i> var. <i>latifolium</i>				x	x	x		
<i>Ambrosia bidentata</i>							x	x
* <i>Rudbeckia fulgida</i>			x	x	x	x	x	
<i>R. umbrosa</i>					x	x		
<i>Helianthus rigidus</i>	x						x	x
<i>Verbesina helianthoides</i>				x	x	x	x	x
<i>Bidens coronata</i>	x	x	x	x	x			
<i>Helenium nudiflorum</i>			x	x	x	x	x	
<i>Dyssodia papposa</i>	x						x	x
<i>Senecio glabellus</i>					x	x	x	
* <i>Cirsium virginianum</i>					x	x	x	
<i>Krigia dandlion</i>				x	x	x	x	x
<i>Tragopogon pratensis</i>	x	x	x	x				x
<i>Lactuca canadensis</i> var. <i>obovata</i>			x	x			x	x
<i>Hieracium paniculatum</i>			x	x	x	x		