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**A FLORISTIC STUDY AND SPECIES CHECKLIST FOR  
THE REPUBLICAN RIVER VALLEY IN NEBRASKA,  
WITH EMPHASIS ON PLANTS OF CONCERN FOR CONSERVATION**

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**ABSTRACT**

A botanical survey of the Republican River Valley in Nebraska was initiated during the 1995 growing season and continued through 1998. A major objective of this study was to discover and tabulate rare plants (as designated by the Nebraska Natural Heritage Program), but a general floristic study was also completed. Natural areas, selected because of species composition or location, were identified and described. The study area is characterized by a high degree of human disturbance. Most county floras, with the exception of Webster, are poorly represented. Seven species of conservation concern are reported, which is 1.4% of the total collected flora of 499 species. Dominant vegetation types are riparian forest, tallgrass prairie, mixed-grass prairie, sandsage prairie, and wetlands. Most of the floodplain has been cultivated or grazed and is also subject to fluctuating ground water levels, resulting in a general decline in the diversity of native plant species. The loss of wet meadows throughout the valley has contributed to this lack of diversity.

† † †

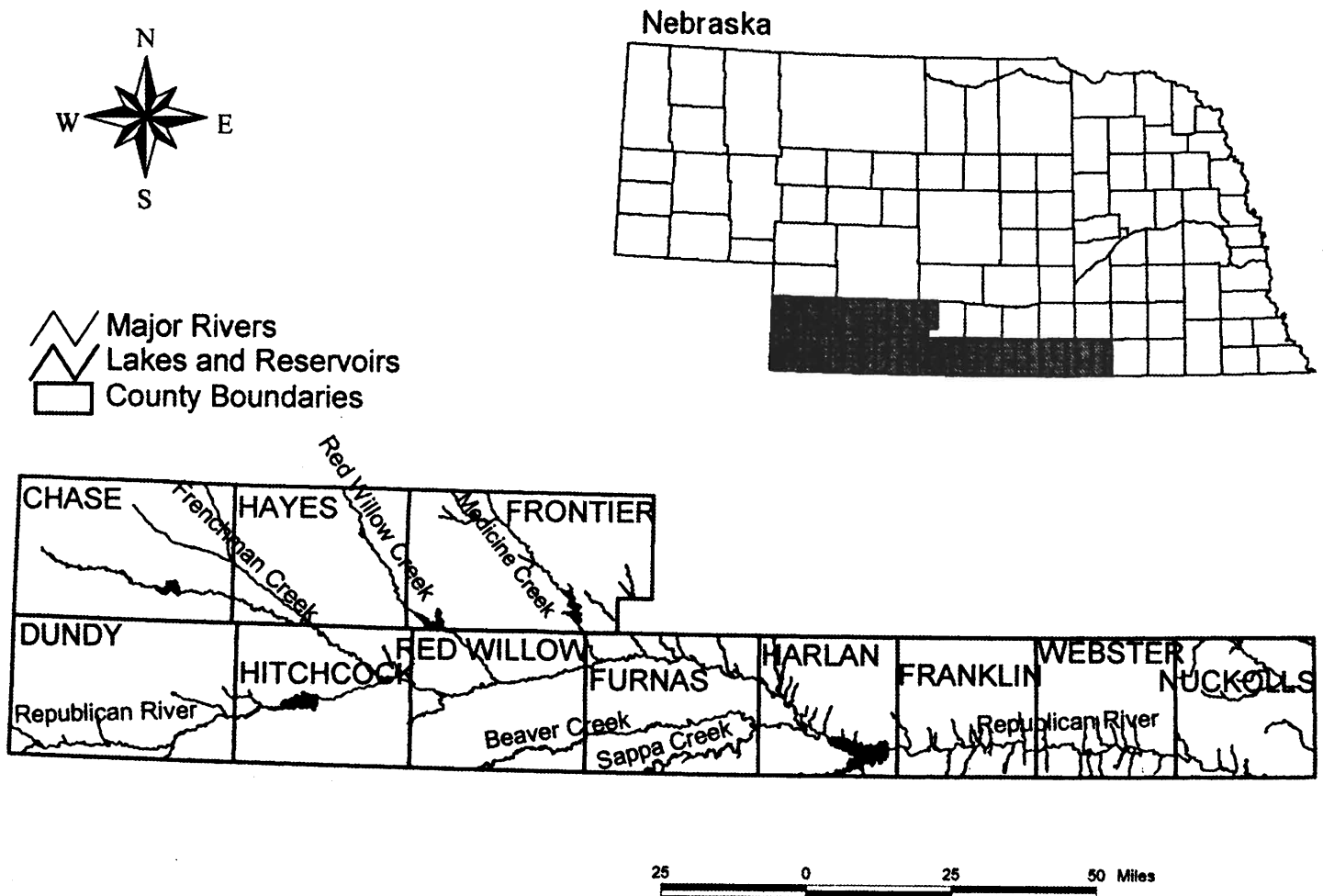
The Republican River traverses nine counties along the southwestern and south-central border of Nebraska (Fig. 1). Both the north and south forks of the river originate in Colorado, and the basin covers  $6.73 \times 10^6$  ha (26,000 mi<sup>2</sup>). About 40% or  $2.70 \times 10^6$  ha (10,000 mi<sup>2</sup>) of the basin is in Nebraska. The river and its tributaries are close to a number of diverse ecosystem types, including sand-sage prairie, mixed-grass prairie, tallgrass prairie, riparian forest, and wet-meadow habitats (Kaul and Rolfsmeier 1993). The river provides a corridor for plants and animals of the southeast to extend westward into the drier plains, where their survival would normally be unlikely or severely restricted. Biologically, the region is of much significance, and the river valley west of Harlan County has been the subject of few intensive biological surveys.

The creeks and streams that comprise a significant part of the Republican basin are quite variable in their size and characteristics. They range from larger streams, such as the Arikaree River and the Frenchman Creek, to smaller tributaries draining the calcareous uplands south of the river in Webster County. Another small tributary, Elm Creek, in Webster County, is a fast-flowing stream with a designated special management area for trout. Two of the larger tributaries included in this study were Red Willow Creek in Frontier and Red Willow counties and Medicine Creek in Frontier County.

The numbers of known species collected from counties in the study area are listed in Table 1. With the exception of Webster County, all other area counties are floristically incompletely known or undercollected (Kaul and Rolfsmeier 1994). For example, the 246

Table 1. Counties in the study area, with total plant species collected in the past 130 years (Kaul and Rolfsmeier 1994).

<b>County</b>	<b>Total plant species collected since ca. 1870</b>
Chase	287
Dundy	301
Franklin	385
Frontier	215
Furnas	246
Gosper	153
Hayes	212
Harlan	291
Hitchcock	244
Nuckolls	271
Red Willow	289
Webster	561



Map Created By Andrew Bishop  
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Figure 1. The eleven-county study area and the Republican River Valley in Nebraska.

plant species reported for Furnas County under-represent its potential, especially when floristic studies from adjacent areas are considered. For comparison, Schultz (259 ha) and Willa Cather Memorial prairies (247 ha), in Webster County, were found to contain 239 species and 235 species respectively (Nagel et al. 1994, Rothenberger 1994). In summary, the Republican River Valley flora, including rare and unusual species, is poorly documented in much of the study area.

The objectives of this study were: (1) to survey the Republican River Valley and selected tributaries in Nebraska for potentially rare plant species (as listed by the Nebraska Natural Heritage Program) and determine the present status of these species; (2) to identify and describe potential natural areas that, because of their location and/or species composition, are thought to have ecological value; and (3) to compile a plant-species checklist for the study area in order to better

understand species distribution patterns.

## METHODS

Natural sites in the study area were selected by the use of infrared aerial photos and topographic maps provided by the Nebraska Game and Parks Commission, and by ground reconnaissance. The study sites were located along the Republican River and several of its tributaries in Nuckolls, Webster, Harlan, Hayes, Franklin, Furnas, Frontier, Red Willow, Dundy, Hitchcock, and Chase Counties in Nebraska. Site condition (degree of disturbance) and location within the study area were important selection factors. These areas were surveyed for rare and unusual plants using field reconnaissance methods. The overall plant diversity of these sites was also of interest, because it is a significant indicator of an area's ability to support rare or endangered as well as common species.

Intensive field studies were made during the 1995 and 1996 growing seasons, followed by additional reconnaissance and collecting in 1997 and 1998. A comprehensive floristic list for the region was compiled, and the occurrence of rare species was documented. Specific natural areas were also documented and are listed in the Results and Discussion section.

Nomenclature follows the Great Plains Flora Association (1991) except in a few instances where updated names are suggested by the *Flora of North America* (1993 et seq.). All taxa reported in this study are documented by voucher specimens deposited at the University of Nebraska at Kearney. A number of common prairie plants and exotics were underrepresented because of the collecting emphasis placed on the river flood plain.

## RESULTS AND DISCUSSION

The Republican River Valley in Nebraska crosses an area of transitional grasslands on both an east-west and a north-south basis. Originally, much of this region was classified as Kansas mixed-grass prairie (Kaul 1975), which differs from the loess hills mixed-grass prairie more common to Nebraska. The ecotone between eastern tallgrass prairie to the east and mixed-grass prairie to the west passes through eastern Webster County (Kaul and Rolfsmeier 1993, Weaver and Bruner 1954). The river valley represents a biological crossroads, where species with eastern and western affinities intermix (Rothenberger 1994). For these reasons, its biological significance cannot be overemphasized.

Unfortunately, much of the Republican River Valley is either cultivated, grazed heavily, or in an intermediate state of use/disuse. Natural meadows of significant size are almost nonexistent. Many of the sites investigated in this study were remaining fragments along the river or small remnants of vegetation that have persisted in some way. Despite these shortcomings, a number of areas of botanical interest were discovered that provided the basis for this study.

Plant species distributions are the result of many interacting factors. Competition, soils, water relations, disease, and herbivory are but a few of these factors. Human activities are also a major influence. Natural areas have been altered or destroyed and instream river flows have been tapped for human use. The effects of seasonal precipitation, canal irrigation, and deep-well irrigation, which has increased markedly throughout the Republican basin, all have an impact on river levels and plant species occurrences. The endangered western prairie fringed orchid (*Platanthera praeclara*) is a good example of a species that is affected by fluctuations in soil moisture caused by flooding as

well as drought (Sieg and Wolken 1999). The control of flooding has allowed additional agricultural development of the valley to occur and resulted in the loss of habitat for native species.

The lack of rare (in this area) species is not surprising when one considers these changes. Of the rare plants detailed in this report, only *Cyclanthera dissecta*, *Eleocharis rostellata*, and *Lobelia cardinalis* are found on the floodplain. Even the potential range of the western prairie fringed orchid once extended into Nuckolls and Webster counties (Fritz 1993), but few of the wet meadows needed to support this species remain.

## Basic vegetation types

**Lowland riparian forest**—The major dominant species is *Populus deltoides* ssp. *monilifera* (eastern cottonwood) with *Salix amygdaloides*, *Salix exigua*, *Celtis occidentalis*, *Ulmus americana*, *Morus alba*, *Acer negundo*, and *Gleditsia triacanthos* all playing major roles. The southeastern reach of the river is more diverse botanically as *Juglans nigra*, *Acer saccharinum*, and *Catalpa speciosa* intermix with those species previously mentioned. The westward extent of these species is surprising. *Juglans nigra* occurs in Franklin, Harlan, and Furnas counties and was also collected along the Frenchman Creek in Chase County. *Catalpa speciosa* was also quite widespread. *Quercus macrocarpa* is common to the bluffs on the south side of the river and occasionally spreads onto the better-drained lowlands. In Webster County, several large trees were observed just north of the river, while a bur oak of exceptional size (1.1 m diameter) is located on Schultz Prairie on the Kansas border. The devastating flood of 1935 rearranged parts of the river channel and has likely had an impact on the distribution of woody species (Farrar 1995). Massive pumping of groundwater in the basin has resulted in a general decline in instream flows that again may alter plant species distributions.

**Upland prairie**—The upland prairie sites were not sampled extensively because they are spatially separated from the Republican Valley. However, they did provide some floristic diversity to contrast with the riverbottom forest. These prairies range from calcareous breaks in Webster County, to typical mixed-grass prairie along most of the southern tier of counties, to sandsage prairie in Chase and Dundy counties. Mixed-grass prairie to the south of the Republican River is sometimes referred to as southern mixed-grass prairie because it differs both physically and botanically from more northern mixed-grass prairie types (Locklear 1997). The unique sandsage prairies of Perkins, Chase, and Dundy counties are worthy of additional investigations (Farrar 1993). Three potentially rare plant spe-

cies on upland sites are *Aster fendleri*, *Clematis fremontii*, and *Oenothera macrocarpa* ssp. *fremontii*.

**Wetlands**—Several wet meadows and wetland sites associated with present or abandoned river channels were sampled. The best actual wet meadow site was located southwest of Stratton in Hitchcock Co. and contained an impressive array of *Eustoma grandiflorum* (prairie gentian) and *Liatris lancifolia* (gay-feather). Unfortunately, heavy grazing during the early summer of 1996 and further abuse during the past few years have damaged this meadow and markedly changed its appearance from 1995. Wetland species were also collected in excavations and sand pit operations.

### Plants of conservation concern

***Aster fendleri*** A. Gray (Fendler's aster)—Fendler's aster is a calcareous upland prairie species collected on a northeast facing upland prairie site on the south side of the river in Webster County. This species is also known from Schultz Prairie and other Webster County prairies, but it has been reported in only two Nebraska counties (Great Plains Flora Association 1977).

***Clematis fremontii*** S. Wats. (Fremont's clematis)—This species prefers rocky prairie hillsides and limestone soils. A roadside population in southern Webster County occurs in rocky ground between the fence line and the county road in a strip approximately 3 m wide. It is reported for only three counties in Nebraska.

***Cyclanthera dissecta*** (T. & G.) Arn. (cyclanthera)—Uncommon in Nebraska, cyclanthera was first found in 1995 along the Republican River on the south side of the Edison bridge (Furnas Co.). This population was missing in 1996. Cyclanthera was discovered in 1996 at the Cambridge Canal Diversion area on Game and Parks land (Furnas Co.). It climbs over trees and shrubs and the population here has spread into the railroad right-of-way on the north side of this site. It is known only from Furnas and Red Willow counties in Nebraska.

***Eleocharis rostellata*** (Torr.) Torr. (beaked spikerush)—Beaked spikerush was reported by Rolfsmeier (1995) from the Frenchman River in Chase County above Enders Reservoir. I was unable to locate this population.

***Juncus effusus*** L. (bog rush)—Bog rush was collected in an overflow area where Lost Creek, a tributary in southern Webster County, flows north across a region of mixed-grass prairie. This plant is rare and is known only from Richardson and Webster counties in Nebraska.

***Lobelia cardinalis*** L. (cardinal flower)—This species was listed among the 1995 rare plant elements, but its status has been subject to question in recent years. It grows along marshes, stream banks, and seepage areas and was discovered along Crystal Creek on the south side of Harlan County Reservoir (Harlan Co.) and along the spillway below Enders Reservoir (Chase Co.) in 1995. In 1996, only 6 plants persisted along Crystal Creek and none could be located at the Enders Reservoir location. The species is rarely encountered, as most of the collections in the UNK herbarium are from a single Buffalo County location.

***Oenothera macrocarpa*** Nutt. ssp. *fremontii* (S. Wats.) W. L. Wagner (Fremont's evening primrose)—Common to chalk badlands, rocky hillsides, and bluffs, Fremont's evening primrose is known in the study area from only Franklin and Webster counties. This species was associated with Fendler's aster on the same north-east-facing slope in Webster County.

### SPECIES CHECKLIST

The following checklist of plant species (Table 2) is a listing of plants collected by county. For convenience, the list is arranged alphabetically rather than phylogenetically. The checklist includes the lower vascular plants *Botrychium virginianum* (Ophioglossaceae), *Cystopteris fragilis* (Polypodiaceae), *Equisetum arvense*, *E. hyemale*, and *E. laevigatum* (Equisetaceae), and a nonvascular aquatic macrophyte, *Chara* sp. Because this study concentrated on the river valley, there are several species common to the area that were not attributed to all counties in the study area. Several rare or unusual plants occupied only upland sites usually located some distance from the river flood plain.

### CONCLUSIONS

The Republican River Valley contains a botanically diverse combination of native and introduced plants. Dominant vegetation types include tallgrass prairie, mixed-grass prairie, sandsage prairie, riparian forest, and wetlands. The number of plant species of conservation concern is low when compared to a total flora of 499 species, making up only 1.4% of this amount. Very little natural vegetation remains in the river valley, where cultivation and grazing have claimed much of the floodplain. Upland prairies persist but they vary greatly as to range condition. Fluctuating river flows as a result of agricultural activities have had an impact on species distributions and the present day flora of this region.



Table 2. Continued.

Species	CHA	DUN	FRA	FRO	FUR	HAR	HAY	HIT	NUC	REW	WEB
<i>Asclepias verticillata</i> L. ....						N				+	+
<i>Asclepias viridiflora</i> Raf. ....					+						+
<i>Asparagus officinalis</i> L. ....											N
<i>Aster ericoides</i> L. ....	+	+	+			+		+	+	N	+
<i>Aster fendleri</i> A. Gray ....											+
<i>Aster hesperius</i> A. Gray ....						+					
<i>Aster lanceolatus</i> Willd. ....									+	+	+
<i>Aster oblongifolius</i> Nutt. ....											+
<i>Astragalus canadensis</i> L. ....				N							+
<i>Astragalus crassicaarpus</i> Nutt. var. <i>crassicaarpus</i> .....											+
<i>Astragalus gracilis</i> Nutt. ....										+	
<i>Astragalus lotiflorus</i> Hook. ....			+						N		+
<i>Astragalus mollissimus</i> Torr. ....			+								+
<i>Astragalus plattensis</i> Nutt. ex T. & G. ....											+
<i>Astragalus racemosus</i> Pursh ....			+								+
<i>Avena fatua</i> L. ....											N
<i>Avena sativa</i> L. ....			N								
<i>Berula erecta</i> (Huds.) Cov. ....	+				+					+	
<i>Bidens cernua</i> L. ....				+					+		+
<i>Bidens comosa</i> (A. Gray) Wiegand .....						N				N	
<i>Bidens frondosa</i> L. ....				+	+	+					
<i>Boehmeria cylindrica</i> (L.) Sw. ....	+									N	+
<i>Botrychium virginianum</i> (L.) Sw. ....									N		
<i>Bouteloua curtipendula</i> (Michx.) Torr. ....	N	+	+	+	+	+					N
<i>Bouteloua gracilis</i> (H.K.B.) Lag. ex Griffiths .....	N					+		+			N
<i>Bouteloua hirsuta</i> Lag. ....											N
<i>Brickellia grandiflora</i> (Hook.) Nutt. ....											+
<i>Bromus inermis</i> Leyss. ....			N								+
<i>Bromus japonicus</i> Thunb. ex Murr. ....	+		N			+			N		+
<i>Bromus tectorum</i> L. ....									+		+
<i>Buchloe dactyloides</i> (Nutt.) Engelm. ....			+								+
<i>Calamovilfa longifolia</i> (Hook.) Scribn. ....	+	+						+			N
<i>Callirhoe involucrata</i> (T. & G.) A. Gray .....			+			+					+
<i>Calylophus serrulatus</i> (Nutt.) Raven .....	+		+	+	+	+				+	+
<i>Calystegia sepium</i> (L.) R. Br. ....			+	N	N	+			N		
<i>Camelina microcarpa</i> Andr. ex DC .....	N		N								
<i>Cannabis sativa</i> L. ....											+
<i>Capsella bursa-pastoris</i> (L.) Medic. ....											+
<i>Carduus nutans</i> L. ....						N					+
<i>Carex blanda</i> Dew. ....			N					+			+
<i>Carex brevior</i> (Dew.) Mack. ex Lunell .....			+	+	+	+					+
<i>Carex comosa</i> F. Boott. ....	N										
<i>Carex cristatella</i> Britt. ....											+
<i>Carex eleocharis</i> Bailey .....											+
<i>Carex emoryi</i> Dew. ....	N	N	N		N				N		N
<i>Carex gravida</i> Bailey var. <i>gravida</i> .....	N		N	+	+	+		N		+	N
<i>Carex heliophila</i> Mack. ....											+
<i>Carex hystericina</i> Muhl. ex Willd. ....	+	+	+	N		N				N	+
<i>Carex laeviconica</i> Dew. ....				N		N					N
<i>Carex molesta</i> Mack. ....						N					N
<i>Carex pellita</i> Muhl. ....	+	+	+	+	N	N		N		+	+
<i>Carex praegracilis</i> W. Boott. ....	+	+				N				+	+
<i>Carex stipata</i> Muhl. ....				+							+
<i>Carex tribuloides</i> Wahl. ....				N							
<i>Carex vulpinoidea</i> Michx. ....			+	+						N	+

Table 2. Continued.

Species	CHA	DUN	FRA	FRO	FUR	HAR	HAY	HIT	NUC	REW	WEB
<i>Catalpa speciosa</i> Warder			N		N	N					N
<i>Celastrus scandens</i> L.			+		+	+			N		+
<i>Celtis occidentalis</i> L.			+								
<i>Cenchrus longispinus</i> (Hack.) Fern.			+								+
<i>Ceratophyllum demersum</i> L.			N			N					+
<i>Chara</i> sp.				N							
<i>Chenopodium berlandieri</i> Moq.		N				+					N
<i>Chenopodium glaucum</i> L.			N			N					N
<i>Chenopodium pratericola</i> Rydb.			+		+	N				+	
<i>Chenopodium simplex</i> (Torr.) Raf.		N	N		N				N	+	
<i>Chloris verticillata</i> Nutt.		+		+	+	+				+	+
<i>Chorispora tenella</i> (Pall.) DC			N						N		
<i>Chrysopsis villosa</i> (Pursh) Nutt.	+										
<i>Cicuta maculata</i> L.		+		N		N					
<i>Cirsium altissimum</i> (L.) Spreng.			+			+				N	+
<i>Cirsium arvense</i> (L.) Scop.	N			N		N				+	
<i>Cirsium flodmanii</i> (Rydb.) Arthur											+
<i>Cirsium ochrocentrum</i> A. Gray											+
<i>Cirsium undulatum</i> (Nutt.) Spreng.	+									+	+
<i>Cirsium vulgare</i> (Savi) Ten.		N				N				N	+
<i>Clematis fremontii</i> S. Wats.											+
<i>Cleome serrulata</i> Pursh									N		N
<i>Commelina erecta</i> L.		+									
<i>Conium maculatum</i> L.	+	N			N						+
<i>Consolida ambigua</i> (L.) Ball & Heywood					N						
<i>Convolvulus arvensis</i> L.	+	N				N			+		+
<i>Conyza canadensis</i> (L.) Cronq.	+			N							+
<i>Coreopsis lanceolata</i> L.											N
<i>Coreopsis tinctoria</i> Nutt.										N	
<i>Cornus drummondii</i> C. A. Mey.			+								+
<i>Cornus stolonifera</i> Michx.						+					
<i>Coronilla varia</i> L.						N					
<i>Corydalis micrantha</i> (Engelm.) A. Gray											N
<i>Crepis runcinata</i> (James) T. & G.						N					
<i>Croton texensis</i> (Kl.) Muell. Arg.	+	+	N						+	+	+
<i>Cucurbita foetidissima</i> Kunth	N	+		+	N					+	
<i>Cyclanthera dissecta</i> (T. & G.) Arn.				+	+						
<i>Cyperus acuminatus</i> Torr. & Hook.					+	+					
<i>Cyperus aristatus</i> Rottb.					+	+					
<i>Cyperus erythrorhizos</i> Muhl.				+		+				+	
<i>Cyperus esculentus</i> L.					+				+		+
<i>Cyperus lupulinus</i> (Spreng.) Marcks											+
<i>Cyperus odoratus</i> L.				+	+	+					+
<i>Cyperus strigosus</i> L.				N							+
<i>Cystopteris fragilis</i> (L.) Bernh.									N		
<i>Dactylis glomerata</i> L.			N								
<i>Dalea aurea</i> Nutt. ex Pursh											N
<i>Dalea candida</i> Michx. ex Willd. var. <i>oligophylla</i> (Torr.) Shinnars	N			N							N
<i>Dalea enneandra</i> Nutt.		+	+							+	+
<i>Dalea leporina</i> Spreng.									+		
<i>Dalea purpurea</i> Vent. var. <i>purpurea</i>				N	+				N		+
<i>Delphinium tricornis</i> Michx.											+
<i>Delphinium virescens</i> Nutt.						+					N
<i>Descurainia pinnata</i> (Walt) Britt.			N						N		N



Table 2. Continued.

Species	CHA	DUN	FRA	FRO	FUR	HAR	HAY	HIT	NUC	REW	WEB
<i>Descurainia sophia</i> (L.) Webb	N		+							+	N
<i>Desmanthus illinoensis</i> (Michx.) MacM.	+				+	+		N	N		
<i>Desmodium canescens</i> (L.) DC.			N			N					N
<i>Desmodium illinoense</i> A. Gray			N								
<i>Dichantheium oligosanthes</i> (Sch.) Gould			+			+					N
var. <i>scribnerianum</i> (Nash) Gould											
<i>Digitaria ciliaris</i> (Retz.) Koel.			+		N						
<i>Digitaria sanguinalis</i> (L.) Scop.								N			
<i>Distichlis spicata</i> (L.) Greene var. <i>stricta</i>	N	+	N		N	N		+		+	
(Torr.) Beetle											
<i>Draba reptans</i> (Lam.) Fern.											+
<i>Dyssodia papposa</i> (Vent.) Hitchc.					N						+
<i>Echinacea angustifolia</i> DC.											+
<i>Echinochloa crusgalli</i> (L.) Beauv.					N					N	+
<i>Echinochloa muricata</i> (Beauv.) Fern.			+						+		+
<i>Echinocystis lobata</i> (Michx.) T. & G.	N	+			N						+
<i>Eclipta prostrata</i> (L.) L.						N					
<i>Elaeagnus angustifolia</i> L.		+	+					N		N	
<i>Eleocharis erythropoda</i> Steud.	+	+	+		+	N				+	+
<i>Eleocharis palustris</i> (L.) R.&S.				N		N				N	N
<i>Eleusine indica</i> (L.) Gaertn.			N		+	N					+
<i>Ellisia nyctelea</i> (L.) L.			N						+		+
<i>Elodea canadensis</i> Michx.											+
<i>Elymus canadensis</i> L.	+	+		+	+	+			+	+	+
<i>Elymus trachycaulus</i> (Link) Gould ex Shinners						N		N			+
<i>Elymus virginicus</i> L.				+		+					+
<i>Elytrigia intermedia</i> (Host) Nevski						N					
<i>Elytrigia repens</i> (L.) Nevski	N				N					N	N
<i>Epilobium ciliatum</i> Raf.				N							
<i>Epilobium coloratum</i> Biehler										N	
<i>Equisetum arvense</i> L.				N							
<i>Equisetum hyemale</i> L.			+			+			+		+
<i>Equisetum laevigatum</i> A. Br.	+			+							+
<i>Eragrostis cilianensis</i> (All.) E. Mosher				+		+					+
<i>Eragrostis hypnoides</i> (Lam.) B.S.P.										N	
<i>Eragrostis pectinacea</i> Michx.			+	N						+	+
<i>Eragrostis spectabilis</i> (Pursh) Steud.									+		+
<i>Eragrostis trichodes</i> (Nutt.) Wood			+								+
<i>Erechtites hieraciifolia</i> (L.) Raf. ex DC.											N
<i>Erigeron bellidiastrum</i> Nutt.		+				N		N			
<i>Erigeron strigosus</i> Muhl. ex Willd.											+
<i>Eriogonum annuum</i> Nutt.	+	+						+			
<i>Eupatorium altissimum</i> L.											+
<i>Eupatorium rugosum</i> Houtt.											N
<i>Euphorbia dentata</i> Michx.	N	+	+	+	+	+			+		+
<i>Euphorbia glyptosperma</i> Engelm.											+
<i>Euphorbia hexagona</i> Nutt.	+		+		+	+		+		+	+
<i>Euphorbia maculata</i> L.											+
<i>Euphorbia marginata</i> Pursh	+	+	+	+		+					+
<i>Euphorbia missurica</i> Raf.								+			
<i>Euphorbia nutans</i> Lag.			N						N		
<i>Euphorbia spathulata</i> Lam.											+
<i>Eustoma grandiflorum</i> (Raf.) Shinners								+			
<i>Euthamia gymnospermoides</i> Greene		+						N			
<i>Festuca arundinacea</i> Schreb.			N			N					

Table 2. Continued.

Species	CHA	DUN	FRA	FRO	FUR	HAR	HAY	HIT	NUC	REW	WEB
<i>Festuca octoflora</i> Walt.			+								+
<i>Fraxinus pennsylvanica</i> Marsh. var. <i>subintegerrima</i> (Vahl) Fern.			+			+					+
<i>Galium aparine</i> L.	+		+						N		+
<i>Galium triflorum</i> Michx.						N					
<i>Gaura coccinea</i> Pursh				N	+	+					+
<i>Gaura parviflora</i> Dougl.	+	+		N		N		+	+	+	N
<i>Geum canadense</i> Jacq.			N			+			N	N	+
<i>Glechoma hederacea</i> L.											+
<i>Gleditsia triacanthos</i> L.			N			N			N		
<i>Glyceria striata</i> (Lam.) Hitchc.	N			N							
<i>Glycyrrhiza lepidota</i> Pursh	+	N				N		N			+
<i>Grindelia squarrosa</i> (Pursh) Dun.			N			N			N	N	N
<i>Gutierrezia sarothrae</i> (Pursh) Britt. & Rusby	+	+			+					+	
<i>Hackelia virginiana</i> (L.) I.M. Johnst.					N	+					+
<i>Haplopappus spinulosus</i> (Pursh) DC.				+							+
<i>Hedeoma hispida</i> Pursh			+								+
<i>Hedyotis nigricans</i> (Lam.) Fosb.			+			+					+
<i>Helianthus annuus</i> L.				N							+
<i>Helianthus maximiliani</i> Schrad.		+							+		+
<i>Helianthus petiolaris</i> Nutt.	+							N			+
<i>Helianthus tuberosus</i> L.						+			+		+
<i>Heliopsis helianthoides</i> (L.) Sweet var. <i>scabra</i> (Dun.) Fern.											+
<i>Hesperis matronalis</i> L.			N					N			+
<i>Hibiscus trionum</i> L.		N				N					
<i>Hordeum jubatum</i> L.			+			+				N	+
<i>Hordeum pusillum</i> Nutt.			+								+
<i>Hymenopappus tenuifolius</i> Pursh		+	+								
<i>Impatiens capensis</i> Meerb.	N			N						N	+
<i>Ipomoea leptophylla</i> Torr.		+		N							
<i>Iva xanthifolia</i> Nutt.	N							N			
<i>Juglans nigra</i> L.	+		+		+	+					
<i>Juncus balticus</i> Willd.	+	+	N			N		+			
<i>Juncus bufonius</i> L.						N					
<i>Juncus dudleyi</i> Wieg.	N			N		N				N	+
<i>Juncus effusus</i> L.											N
<i>Juncus interior</i> Wieg.			+			N		N			+
<i>Juncus tenuis</i> Willd.											N
<i>Juncus torreyi</i> Cov.		+	+	N	+	+		+		+	+
<i>Juniperus virginiana</i> L.											N
<i>Kochia scoparia</i> (L.) Schrad.											+
<i>Koeleria macrantha</i> (Schultes) Ledeb.											+
<i>Kuhnia eupatoriodes</i> L.		+		+		+					+
<i>Lactuca canadensis</i> L.											+
<i>Lactuca oblongifolia</i> Nutt.		+									+
<i>Lactuca serriola</i> L.	+		N								+
<i>Lamium amplexicaule</i> L.									N		
<i>Leersia oryzoides</i> (L.) Sw.				N		+			N		+
<i>Leersia virginica</i> Willd.						N					N
<i>Lemna minor</i> L.											N
<i>Lemna perpusilla</i> Torr.											N
<i>Leonurus cardiaca</i> L.			N		N	N					+
<i>Lepidium densiflorum</i> Schrad.		+	+								+
<i>Leptochloa fascicularis</i> (Lam.) A.Gray						+				+	+

Table 2. Continued.

Species	CHA	DUN	FRA	FRO	FUR	HAR	HAY	HIT	NUC	REW	WEB
<i>Lespedeza capitata</i> Michx. ....									N		
<i>Liatris aspera</i> Michx. ....		N									
<i>Liatris lancifolia</i> (Greene) Kittell .....								N			
<i>Liatris punctata</i> Hook. ....									+		+
<i>Lindernia dubia</i> (L.) Penn. var. <i>dubia</i> .....				N		+					
<i>Linum perenne</i> L. var. <i>lewisii</i> (Pursh) Eat. & Wright ...					+						
<i>Linum rigidum</i> Pursh var. <i>compactum</i> .....					N						+
(A.Nels.) Rogers											
<i>Linum rigidum</i> Pursh var. <i>rigidum</i> .....					N					N	
<i>Lippia lanceolata</i> Michx. ....				N	+	N		N			
<i>Lithospermum incisum</i> Lehm. ....			N						N		+
<i>Lobelia cardinalis</i> L. ....	N					+					+
<i>Lobelia</i> cf. <i>siphilitica</i> L. ....		+									
<i>Lomatium orientale</i> Coult. & Rose .....											+
<i>Lonicera morrowii</i> Gray .....						N					
<i>Lonicera tartarica</i> L. ....			N						N		
<i>Lotus corniculatus</i> L. ....									N		N
<i>Lotus purshianus</i> Clem. & Clem. ....									N		+
<i>Lotus tenuis</i> Waldst. & Kit. ex Willd. ....									N		+
<i>Lupinus plattensis</i> S. Wats. ....											+
<i>Lycopus americanus</i> Muhl. ex Bart. ....	+	+	N	N		+		+		+	+
<i>Lycopus asper</i> Greene .....			N	N							
<i>Lygodesmia juncea</i> (Pursh) Hook. ....				N							
<i>Lysimachia thyrsoiflora</i> L. ....	N										
<i>Lythrum alatum</i> Pursh .....	+	+									
<i>Machaeranthera canescens</i> (Pursh) A.Gray .....								+			
<i>Machaeranthera linearis</i> Greene .....				+	+						
<i>Maclura pomifera</i> (Raf.) Schneid. ....											+
<i>Medicago lupulina</i> L. ....			+			N					+
<i>Melilotus alba</i> Medic. ....						N					
<i>Melilotus officinalis</i> (L.) Pall. ....			N			N					+
<i>Mentha arvensis</i> L. ....	N			N	N	+				N	+
<i>Mentzelia decapetala</i> (Pursh) Urban & Gilg .....											+
<i>Mentzelia nuda</i> (Pursh) T. & G. ....	+	+						+			
<i>Mimulus glabratus</i> H.B.K. var. <i>fremontii</i> .....		+									
(Benth.) Grant											
<i>Mirabilis hirsuta</i> (Pursh) MacM. ....		N									
<i>Mirabilis linearis</i> (Pursh) Heimerl. ....				N	+				N		
<i>Mirabilis nyctaginea</i> (Michx.) MacM. ....						N					
<i>Monarda fistulosa</i> L. var. <i>fistulosa</i> .....			+	N							+
<i>Morus alba</i> L. ....			N								+
<i>Muhlenbergia asperifolia</i> (Nees & Mey.) Parodi .....		+		N		+		+	N		
<i>Muhlenbergia bushii</i> R. Pohl .....											N
<i>Muhlenbergia frondosa</i> (Poir.) Fern. ....					N	+					+
<i>Muhlenbergia racemosa</i> (Michx.) B.S.P. ....				+	+				+		
<i>Muhlenbergia mexicana</i> (L.) Trin. ....	N						N				
<i>Myriophyllum exalbescens</i> Fern. ....		+									
<i>Nepeta cataria</i> L. ....	+		N	+		+					
<i>Nymphaea tuberosa</i> Paine .....		+									
<i>Oenothera biennis</i> L. ....											+
<i>Oenothera laciniata</i> Hill .....				+							+
<i>Oenothera latifolia</i> (Rydb.) Munz .....							N				
<i>Oenothera macrocarpa</i> Nutt. ssp. <i>fremontii</i> .....										N	+
(Wats.) Wagner											
<i>Oenothera villosa</i> Thunb. ....	N	+	N		N			N		+	

Table 2. Continued.

Species	CHA	DUN	FRA	FRO	FUR	HAR	HAY	HIT	NUC	REW	WEB
<i>Onosmodium molle</i> Michx. var. <i>occidentale</i> ..... (Mack.) Johnst.						+					+
<i>Opuntia macrorhiza</i> Engelm. ....				N	+	+					N
<i>Osmorhiza longistylis</i> (Torr.) DC. var. <i>longistylis</i> .....			N								
<i>Oxalis dillenii</i> Jaq. ....											+
<i>Oxalis stricta</i> L. ....			N			N			N		
<i>Oxalis violacea</i> L. ....											+
<i>Oxytropis lambertii</i> Pursh .....			+								+
<i>Panicum capillare</i> L. ....	+	+		+	+				+	+	+
<i>Panicum dichotomiflorum</i> Michx. ....									N		
<i>Panicum virgatum</i> L. ....	+	+	+	+		+		+	+	+	+
<i>Parietaria pensylvanica</i> Muhl. ex Willd. ....	+		N	+		N			N	+	
<i>Parthenocissis vitacea</i> (Knerr) Hitchc. ....	+		N							+	
<i>Pascopyrum smithii</i> (Rydb.) Á. Löve .....	+	+		+		+		+			+
<i>Paspalum setaceum</i> Michx. var. <i>stramineum</i> .....						+			N		+
(Nash.) D.Banks											
<i>Pennisetum glaucum</i> (L.) R.Br. ....									+		
<i>Penstemon albidus</i> Nutt. ....			+								
<i>Phalaris arundinacea</i> L. ....			N				N				+
<i>Phleum pratense</i> L. ....										N	
<i>Phryma leptostachya</i> L. ....				N		N			N		
<i>Physalis heterophylla</i> Nees .....						N					N
<i>Physalis longifolia</i> Nutt. ....	+	+				+			N	+	N
<i>Phytolacca americana</i> L. ....									N		N
<i>Plantago major</i> L. ....			+								+
<i>Plantago patagonica</i> Jacq. var. <i>patagonica</i> .....			+								+
<i>Plantago rugelii</i> Dcne. ....											N
<i>Poa compressa</i> L. ....						N			N		
<i>Poa cf. palustris</i> L. ....											+
<i>Poa pratensis</i> L. ....	N		+								+
<i>Polanisia dodecandra</i> (L.) DC. subsp. <i>trachysperma</i> .... (T. & G.) Iltis											+
<i>Polanisia jamesii</i> (T. & G.) Iltis .....	N										
<i>Polygala alba</i> Nutt. ....										+	+
<i>Polygonatum biflorum</i> (Walt.) Ell. ....			N								
<i>Polygonum aviculare</i> L. ....					N	N					
<i>Polygonum bicornne</i> Raf. ....					+				+		+
<i>Polygonum coccineum</i> Muhl. ....					N				N		+
<i>Polygonum hydropiperoides</i> Michx. ....		N	N					N			N
<i>Polygonum lapathifolium</i> L. ....											+
<i>Polygonum pennsylvanicum</i> L. ....					+				N		+
<i>Polygonum persicaria</i> L. ....		+				N					+
<i>Polygonum punctatum</i> Ell. ....						+			N		+
<i>Polygonum scandens</i> L. ....					+	+			N		+
<i>Polypogon monspeliensis</i> (L.) Desf. ....	+	N	N	+				+		N	
<i>Populus deltoides</i> Michx. ssp. <i>monilifera</i> .....	+	+	N	+	+	+		+	+	+	+
(Ait.) Eckenw.											
<i>Potamogeton gramineus</i> L. ....				+							
<i>Potamogeton nodosus</i> Poir. ....	N		N								+
<i>Potentilla norvegica</i> L. ....			N	N		N				N	
<i>Potentilla rivalis</i> Nutt. ....						N					
<i>Proboscidea louisianica</i> (P.Mill) Thell .....		+									+
<i>Prunus americana</i> Marsh .....						+					+
<i>Prunus virginiana</i> L. ....	+		+						N		+
<i>Psoralea argophylla</i> Pursh .....			+			+					

Table 2. Continued.

Species	CHA	DUN	FRA	FRO	FUR	HAR	HAY	HIT	NUC	REW	WEB
<i>Psoralea digitata</i> Nutt.				+							
<i>Psoralea tenuiflora</i> Pursh var. <i>tenuiflora</i>						+					N
<i>Quercus macrocarpa</i> Michx.	N								N		+
<i>Ranunculus abortivus</i> L.									N		+
<i>Ranunculus longirostris</i> Godr.	+									N	+
<i>Ranunculus sceleratus</i> L. var. <i>sceleratus</i>	N		+	N		+			N		+
<i>Ratibida columnifera</i> (Nutt.) Woot. & Standl.	+	+						+			+
<i>Ratibida pinnata</i> (Vent.) Barnh.			N						N		N
<i>Rhamnus cathartica</i> L.			N	N	N	N					N
<i>Rhus aromatica</i> Ait. var. <i>serotina</i> (Greene) Rehd.			N	+		+					+
<i>Rhus glabra</i> L.			N			N					
<i>Ribes americanum</i> P.Mill.	N			N						+	
<i>Ribes missouriense</i> Nutt.				N		N			N		+
<i>Ribes odoratum</i> Wendl.	N					N		N		+	
<i>Robinia pseudoacacia</i> L.	N		N	N		N					
<i>Rorippa austriaca</i> (Crantz) Bess.		N									
<i>Rorippa nasturtium-aquaticum</i> (L.) Hayek											N
<i>Rorippa palustris</i> (L.) Bess. var. <i>fernaldiana</i> (Butt. & Abbe) Stuckey		+			N	N			+	+	+
<i>Rorippa sessiliflora</i> (Nutt.) Hitchc.		+									N
<i>Rorippa sinuata</i> (Nutt.) Hitchc.											+
<i>Rosa arkansana</i> Porter											+
<i>Rosa multiflora</i> Thunb.						N			N		N
<i>Rosa woodsii</i> Lindl.		+									
<i>Rubus occidentalis</i> L.									N		+
<i>Rudbeckia hirta</i> L.											N
<i>Rudbeckia laciniata</i> L.		+			N						+
<i>Rumex altissimus</i> Wood.											+
<i>Rumex crispus</i> L.	N			N		N					+
<i>Rumex patientia</i> L. ssp. <i>patientia</i>						N					
<i>Rumex stenophyllus</i> Ledeb.						N			N		
<i>Rumex venosus</i> Pursh		+									+
<i>Sagittaria brevirostra</i> Mack. & Bush						N					N
<i>Sagittaria calycina</i> Engelm.											N
<i>Sagittaria cuneata</i> Sheld.	+										
<i>Sagittaria latifolia</i> Willd.	+								N		+
<i>Salix amygdaloides</i> Anderss.	N				+	+				+	
<i>Salix exigua</i> Nutt.	+	+	+								
<i>Salix rigida</i> Muhl. var. <i>rigida</i>											+
<i>Salsola collina</i> Pall.						N					
<i>Salvia azurea</i> Lam.			N			N			N		
<i>Salvia reflexa</i> Hornem.								N			+
<i>Sambucus canadensis</i> L.	+	N		N		+			N	+	+
<i>Sanicula canadensis</i> L.			+		+	+					+
<i>Saponaria officinalis</i> L.			N								N
<i>Schedonnardus paniculatus</i> (Nutt.) Trel.										+	
<i>Schrankia nuttallii</i> (DC.) Standl.				+							+
<i>Scirpus acutus</i> Muhl.	+	+						+			
<i>Scirpus fluviatilis</i> (Torr.) A.Gray				N							
<i>Scirpus pallidus</i> (Britt.) Fern.		+		+	N	N				+	+
<i>Scirpus pendulus</i> Muhl.											N
<i>Scirpus pungens</i> Vahl	+	+	+		+	N				+	+
<i>Scirpus validus</i> Vahl		+	+	N	N	N	+	+	N	+	+
<i>Scutellaria lateriflora</i> L.		+		N							+
<i>Senecio plattensis</i> Nutt.			+						+		+

Table 2. Continued.

Species	CHA	DUN	FRA	FRO	FUR	HAR	HAY	HIT	NUC	REW	WEB
<i>Setaria faberi</i> Herrm. ....											N
<i>Setaria glauca</i> (L.) Beauv. ....				N		+				+	+
<i>Setaria verticillata</i> (L.) Beauv. ....				+						+	
<i>Setaria viridis</i> (L.) Beauv. ....					+	+					+
<i>Shepherdia argentea</i> (Pursh) Nutt. ....			+								
<i>Sicyos angulatus</i> L. ....			N			+			N		
<i>Silene antirrhina</i> L. ....											+
<i>Silphium integrifolium</i> Michx. var. <i>laeve</i> T. & G. ....											N
<i>Silphium laciniatum</i> L. ....		N									
<i>Smilacina stellata</i> (L.) Desf. ....			+	N					N		+
<i>Smilax hispida</i> Muhl. ....									N		
<i>Solanum carolinense</i> L. ....						N					
<i>Solanum interius</i> Rydb. ....					+	+			N		
<i>Solanum ptychanthum</i> Dun. ex DC. ....											N
<i>Solanum rostratum</i> Dun. ....											+
<i>Solidago canadensis</i> L. ....	+	+	+		N	N			+	N	+
<i>Solidago gigantea</i> Ait. ....	N	N		N	N	+		+		+	+
<i>Solidago missouriensis</i> Nutt. ....				+	N	+		+	+	+	+
<i>Solidago mollis</i> Bartl. ....								+			N
<i>Solidago nemoralis</i> Ait. ....											N
<i>Solidago rigida</i> L. ....		+	N		N	N			N	N	+
<i>Sonchus asper</i> (L.) Hill. ....						N					
<i>Sorghastrum nutans</i> (L.) Beauv. ....	+	+	N					+	+		+
<i>Sparganium eurycarpum</i> Engelm. ....	+	N									+
<i>Spartina pectinata</i> Link. ....	+	+			+	+		N	N	+	
<i>Spermolepis inermis</i> (Nutt.) Math. & Const. ....			+						N		x
<i>Sphaeralcea coccinea</i> (Pursh) Rydb. ....						+					
<i>Sphenopholis obtusata</i> (Michx.) Scribn. var. <i>obtusata</i> .. N	N	N		N	N	N					+
<i>Sporobolus asper</i> (Michx.) Kunth var. <i>asper</i> ..								+			N
<i>Sporobolus cryptandrus</i> (Torr.) A.Gray. ....			+	+	N	+	N				+
<i>Stellaria longifolia</i> Muhl. ex Willd. ....											+
<i>Stellaria media</i> (L.) Vill. ....											+
<i>Stenosiphon linifolius</i> (Nutt.) Heynh. ....			+								+
<i>Strophostyles helvula</i> (L.) Ell. ....			+								+
<i>Strophostyles leiosperma</i> (T. & G.) Piper. ....					+				+		+
<i>Symphoricarpos occidentalis</i> Hook. ....	+		+	+		+		+		+	+
<i>Symphoricarpos orbiculatus</i> Moench. ....						+			N		
<i>Tamarix ramosissima</i> Ledeb. ....		+				N		N			
<i>Taraxacum officinale</i> Weber. ....											+
<i>Teucrium canadense</i> L. var. <i>canadense</i> ..			+	N	+	N		N	N		+
<i>Thalictrum dasycarpum</i> Fisch. & Ave-Lall. ....						N					+
<i>Thelesperma filifolium</i> (Hook.) A. Gray. ....											N
<i>Thelesperma megapotamicum</i> (Spreng.) O.Ktze. ....				N	+						+
<i>Thinopyrum elongatum</i> (Host) D.R. Dewey. ....		N	N	N		N			N		N
<i>Townsendia exscapa</i> (Richards.) Porter. ....											N
<i>Toxicodendron radicans</i> (L.) O. Ktze. ....											+
<i>Tragopogon dubius</i> Scop. ....			+								+
<i>Tribulus terrestris</i> L. ....					+						+
<i>Tridens flavus</i> (L.) Hitchc. ....			+		N				N		+
<i>Trifolium hybridum</i> L. ....									N		
<i>Triodanis leptocarpa</i> (Nutt.) Nieuw. ....											+
<i>Triodanis perfoliata</i> (L.) Nieuw. ....											+
<i>Typha angustifolia</i> L. ....	+				N	N				N	
<i>Typha latifolia</i> L. ....											N
<i>Ulmus americana</i> L. ....			N						N	N	+

Table 2. Concluded.

Species	CHA	DUN	FRA	FRO	FUR	HAR	HAY	HIT	NUC	REW	WEB
<i>Ulmus pumila</i> L. ....											+
<i>Ulmus rubra</i> Muhl. ....											N
<i>Urtica dioica</i> L. ....				N		+				+	+
<i>Verbascum thapsus</i> L. ....			N			N					+
<i>Verbena bipinnatifida</i> Nutt. ....						+					+
<i>Verbena bracteata</i> Lag. & Rodr. ....	+		+	N		+					+
<i>Verbena hastata</i> L. ....	+	+	N	N	+			N		+	+
<i>Verbena stricta</i> Vent. ....	+					+					+
<i>Verbena urticifolia</i> L. ....			+	N	+	+				+	+
<i>Vernonia baldwinii</i> Torr. ....	+			+	+	+		+	+	+	+
<i>Vernonia fasciculata</i> Michx. ....			+						+		+
<i>Veronica anagallis-aquatica</i> L. ....					+	N	N			+	+
<i>Veronica arvensis</i> L. ....			N								
<i>Veronica catenata</i> Penn. ....			N						N		N
<i>Veronica peregrina</i> L. var. <i>xalapensis</i> (H.B.K.) St. J. & War. ....			+						N		+
<i>Vicia americana</i> Muhl. ex Willd. var. <i>americana</i> .....											N
<i>Vicia villosa</i> Roth .....							N		N		+
<i>Viola pedatifida</i> G. Don .....											+
<i>Viola pratincola</i> Greene .....			+						N		+
<i>Vitis riparia</i> Michx. ....	+		+	N		+					N
<i>Xanthium strumarium</i> L. ....						+					+
<i>Yucca glauca</i> Nutt. ....			N								
<i>Zannichellia palustris</i> L. ....				N		N					+
<i>Zanthoxylum americanum</i> P.Mill. ....									N		+

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