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The purpose of ONPS is to encourage the study, protection, propagation, appreciation and use of the native plants of Oklahoma. Membership in ONPS is open to any person who supports the aims of the Society. ONPS offers individual, student, family, and life memberships.

Cover photo: *Lobelia cardinalis* L.
Cardinal flower, courtesy of Marion Homier, taken at Horseshoe Bend in Beaver's Bend State Park, September 2006.

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Foreword

F. H. Means' 1969 doctoral thesis, "Vascular Plants of Southeastern Oklahoma from San Bois to Kiamichi Mountains", includes most species now listed for that area in the Oklahoma Vascular Plant Database housed at the Oklahoma Biological Survey. Though not engaged in agricultural or botanical research since that time, he had some extraordinary experiences and worked with several of the state's top botanists, whose names you will recognize. It was a pleasure to talk with him about his professional life and about teaching, his favorite activity.

A native Oklahoman from Newkirk and a graduate student at KSU, he joined a team of faculty and students from Oklahoma and Kansas who studied the tallgrass prairie at the request of Kenneth S. "Boots" Adams, who owned the ranch near Foraker which later became the Tallgrass Prairie Preserve. For his Ph.D., he worked with Umaldy Ted Waterfall (yes, that's U.T.) as his major professor. His memories of U.T. include tall boots racing across the prairie and a big Buick everyone complained about having to park around. He also related stories about Charles Wallis, George Goodman (an enviable instructor), and his friend Paul Nighswonger, as well as Kling Anderson, professor at Kansas State University and artist of grasses, who worked on the Donaldson Ranch Pastures, which later became the Konza Prairie.

Stan Rice and Phil Gibson have given us a preliminary research paper about the reproductive status of seaside alder. This is an example of the type of biodiversity research that needs to be done in Oklahoma. Oklahoma's combination of flat topography made of clay soil along with a pattern of alternating drought and flood often washes out the banks of our rivers. This may be interacting with the reproductive habit of riparian species such as seaside alders in such a way that young seedlings cannot get established. It makes you ask how they ever got established in the first place and whether the alder will eventually be extirpated from Oklahoma.

Many readers have expressed their appreciation for the species lists that Bruce Hoagland of the Oklahoma Biological Survey provides us each year from the Oklahoma Vascular Plant Database. One of these days we'll have published species lists from all areas of the state, but by then the first ones will be out of date and he'll have to do them again. This year, he and Newell McCarty bring us "Composition and Structure of Bottomland Forest Vegetation at the Tiak Research Natural Area, McCurtain County, Oklahoma". It's a little known, but beautiful area in the far southeastern corner of the state. His article makes you want to see it for yourself.

Last year Bruce Smith reported on several rare ferns in Oklahoma. Realizing that two of those species may have completely disappeared, he has issued a full report on them. His article, "Whatever Happened to *Cheilanthes horridula* and *Cheilanthes lindheimeri* in Oklahoma?" describes the two ferns and their habitats in detail, in hope of enlisting some help finding them again.

Chadwick Cox has been filling the post of Conservation Chair for the Society for several years. He has recently become involved in a national organization promoting conservation of native species in their natural habitats. In his essay, "Invasive Plants Versus Oklahoma's Biodiversity", he gives us insight into this important problem and the role the Society's new affiliate, the Oklahoma Invasive Plant Council (OkIPC) is going to be playing in finding solutions.

It's been another great year for the *Oklahoma Native Plant Record*, which will be available online beginning in 2010. It just keeps getting better and better thanks to your input and support.

Sheila Strawn
Managing Editor

VASCULAR PLANTS OF SOUTHEASTERN OKLAHOMA FROM THE SANS BOIS TO THE KIAMICHI MOUNTAINS

Submitted to the Faculty of the Graduate College of the Oklahoma State University in partial fulfillment of the requirements for the Degree of Doctor of Philosophy May 1969

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The author grew up in the prairie region of Kay County where he learned to appreciate proper management of the soil and the native grass flora. After graduation from college, he moved to Eastern Oklahoma State College where he took a position as Instructor in Botany and Agronomy. In the course of conducting botany field trips and working with local residents on their plant problems, the author became increasingly interested in the flora of that area and of the State of Oklahoma. This led to an extensive study of the northern portion of the Oauchita Highlands with collections currently numbering approximately 4,200. The specimens have been processed according to standard herbarium procedures. The first set has been placed in the Herbarium of Oklahoma State University with the second set going to Eastern Oklahoma State College at Wilburton.

Editor's note: The original species list included habitat characteristics and collection notes. These are omitted here but are available in the dissertation housed at the Edmon-Low Library at OSU or in digital form by request to the editor. [SS]

PHYSICAL FEATURES

Location and Area

The area studied is located primarily in the Ouachita Highlands of eastern Oklahoma. The specific area is generally bounded on the west by State Highway 2, on the south by the Kiamichi Mountains, on the east by the Oklahoma-Arkansas State Line, and on the north by the Sans Bois Mountains. The area includes the southern two-thirds of Latimer County, the southern half of LeFlore County, and the northeast corner of Pushmataha County.

Most of the area is mountainous with prairie sites lying generally west to east in narrow valleys. One large prairie site lies in northern Latimer County and central LeFlore County, between the Sans Bois and Winding Stair Mountain ranges. A second large valley lies across the southern part of Latimer and LeFlore counties between the Winding Stair and Kiamichi mountain ranges.

Geology

The Sans Bois Mountains of northern Latimer and LeFlore counties are primarily Savanna and McAlester formations of the Krebs group, dating from the Pennsylvanian (Snider 1917). The valleys to the west and east of Wilburton in Latimer County and extending eastward into LeFlore County are alluvium and low terrace deposits underlain by Pennsylvanian strata (Snider 1917). These valleys are generally associated with Gaines Creek in Latimer County, Fourche Maline Creek in Latimer and LeFlore

Means, F.H.
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counties, and Poteau River in LeFlore County. These also are associated with the coal basin of eastern Oklahoma, with numerous coal deposits occurring in the Pennsylvanian strata.

The Ouachita Overthrust, forming the Winding Stair Mountain Range, is of Cambrian to Lower Pennsylvanian rocks formed during the second period of mountain formation in eastern Oklahoma (Dott 1928). The leading edge, to the north and west, formed a great arc and is now known as the Choctaw Fault (Dott 1928), which runs from west to east across central Latimer and LeFlore counties. The Wapanucka limestone outcrops along this fault through Latimer County and dates to the early Pennsylvanian (Fellows 1964). To the south of the Choctaw Fault lie the Winding Stair Mountains. They are heavily faulted, with alternating layers of sandstones and shales. The principal strata are the Atoka Formation of Pennsylvanian, the Jackfork of Upper Mississippian, the John's Valley Formation of Upper Mississippian and Lower Pennsylvanian, and the Stanley Shale of Upper Mississippian (Fellows 1964). Characteristically the valleys are formed from shales and the mountains from sandstones. The deeper riverbeds contain belts of Pleistocene materials. The Atoka Formation is principally gray shale with sandstones distributed throughout, while the Jackfork is composed of heavy, massive beds of brown sandstone separated by thinner bands of gray shale (Snider 1917). The Atoka strata are more resistant to erosion than is the Stanley Shale. The John's Valley Formation is gray-green clay shale with interbedded sandstone that is easily eroded and is a valley former (Snider 1917). The Stanley Shale is a bluish, greenish-black slaty shale with thin sandstone layers and considerable chert (Snider 1917). Some Caney Shale, which is black and green in color, is also present.

The Winding Stair Mountains are separated from the Kiamichi Mountains by a valley through which flows the Kiamichi River. This valley runs from Big Cedar in LeFlore County westward through Talihina, across Latimer County, and into Pushmataha County near Clayton. It is formed from the Stanley Shale of Upper Mississippian (Snider 1917) that is easily eroded and forms valley floors.

Lying to the west of Talihina in southeast Latimer County and along the northeastern edge of Pushmataha County are the Potato Hills. They are remnants of Ordovican black shales and sandstones underlain by shales of Lower Pennsylvanian (Snider 1917). At many places the Arkansas Novaculite-Stanley complex is present. The Ordovican consists of bluish, greenish, and white chert with thin cherty and slaty shales with thin lenticels of limestone (Snider 1917). The Kiamichi Mountains are Jackfork Shale of Pennsylvanian underlain by Stanley Shale (Snider 1917). The sandstone is resistant to weathering. The faulting is severe, and these mountains are more rugged than the Winding Stair Mountains. Rich Mountain, of southeast LeFlore County, is of like composition. It is the highest in the area, reaching an elevation of approximately 3000 feet (914.4 m) above sea level (Snider 1917), which is approximately 2000 feet (609.6 m) above the streams at its base. The lower elevations in the area are approximately 500 feet (152.4 m) above sea level.

Topography by Counties

According to Snider (1917), Latimer County covers approximately 735 sq. miles (1903.64 sq. km), lying in an area of Pennsylvanian rocks with the southern part in the Ouachita Mountain region. Both the northern and southern parts consist of alternating sandstones and shales of considerable thickness, folded into steep, northeast-southwest folds. The southern formations are the oldest and are steeper.

The northern part is drained by Fourche Maline eastward into the Poteau River; the southern part drains into the Kiamichi River through several small tributaries; and the southwestern part drains northwest into the Canadian River by way of Gaines Creek (Figure).

LeFlore County is one of the larger counties in the state, covering approximately 1614 sq. miles (4180.24 sq. km). The northern part lies in the Arkansas Valley geologic and physiographic province while the southern part lies in the Ouachita Mountains. The formations are the same as those of Latimer County, with the Ouachita Mountains being especially rough. Included are the Winding Stair, Kiamichi, and Jackfork mountains. The middle and northern part drains into the Arkansas River by way of the Poteau River and its tributaries. The southern part drains into the Kiamichi River, which lies north of Kiamichi Mountain. The southern edge, south of Kiamichi Mountain, is drained by Little River toward the Red River.

Pushmataha County covers approximately 1430 sq. miles (3703.68 sq. km.). It lies in the Ouachita Mountains except for the southwest corner. The hills are rugged with much surface sandstone, separated by narrow valleys. The Jackfork Mountains and the Potato Hills are the areas of highest elevation in the county. The eastern part of the county drains toward the Red River by means of Little River. Most of the county is drained toward the Red River by Kiamichi River and its tributaries. The Kiamichi has its origin in Arkansas, flows westward, then southward, then southeast to the Red River. The Kiamichi River is paralleled by Little River to the east, which has its origin in the southwest corner of LeFlore County.

Soils

According to Gray and Galloway (1959) there are four principal soil series within the Ouachita Highlands, with several additional localized series. They are acid red-yellow podzolic soils developed from gray and brown shales and sandstones. The surface soils are generally light colored and strongly leached. The major soil series are the Hector-Pottsville, Enders-Conway-Hector, Atkins-Pope, and the Parsons-Dennis-Bates.

South of the Choctaw Fault, much of the mountains are rough with some of the formations steeply tilted (as much as 60 degrees to the horizontal). On these mountains, forest vegetation can easily penetrate the more weathered layers of the slopes. The Sans Bois Mountains have soils of the same series as the Winding Stair and Kiamichi mountains, but the strata are more horizontal, which results in poorer forest sites.

The soil association characteristic of the Sans Bois, Winding Stair, and Kiamichi mountain ranges is the Hector-Pottsville series (see Fig.). In the Hector series, the topsoil is a dark brown sandy loam, characteristically formed on hills and mountains under forest type vegetation. In the Pottsville series, topsoil is a brown, fine sandy loam or loam a few inches deep, formed on hills and mountains under forest vegetation. In both Hector and Pottsville, it is not uncommon for slopes to be steep. Ledges and surface rocks are also a common occurrence.

The soils of the Potato Hills include the Clebit series in addition to the Hector and Pottsville series. The Clebit topsoil varies from a dark gray-brown stony silt loam to a pale brown silt loam, formed under forest vegetation of rocky steep slopes.

The soil of the prairie west of Wilburton, in Latimer County, is the Parson-Dennis-Bates Association (see Figure). This association also forms part of the prairie north of the Kiamichi River, south and east of Talihina. The Parson topsoil is a grayish brown medium acid silt loam. The topography is nearly level to gentle slopes and is covered by tall grass

vegetation. The permeability of the soil is slow; it is seasonally wet and of low fertility. The Dennis series topsoil is dark grayish brown, medium acid silt loam of low fertility, and is
subject to erosion. The Bates series topsoil is a dark grayish brown loam or fine sandy loam of medium acidity. Shallow spots with surface rock are common and the soil is easily eroded.

The large prairie of eastern Latimer County and northern LeFlore County, north of the Ouachita Highlands, is of the Enders-Conway-Hector Association (see Figure). The Enders soil is a brown, fine, sandy loam found on gentle slopes and ridges and is of low fertility, erosive, and droughty. The Conway series is a brown silt loam. Parent material is gray and brown clay and sandy shales of gentle slopes and valleys. It is of low fertility, slow draining, and it commonly has silt mounds. The Hector series, which is a part of this association, has been previously discussed.

The Poteau River valley has soils of the Atkins-Pope Association (see Figure). The Atkins series is a light gray acid silt loam or gray loam mottled with brown and yellow. The parent materials are gray acid mottled clay loams, loams, and loamy alluviums. The terrain is flood plain, subject to overflow, and is of low fertility with poor drainage. The Pope soil is a brown acid fine sandy loam. Parent materials are brown stratified alluviums of flood plains and naturally elevated dikes. It is subject to overflow, is of low fertility, but is sandier and better drained than the Atkins.

CLIMATE

The climate of the Ouachita Highlands is of the continental type. It is moderated by seasonal influences of warm moist winds from the Gulf of Mexico. The annual temperature extremes range from a few degrees below zero to 103° F (-20° to 40° C).

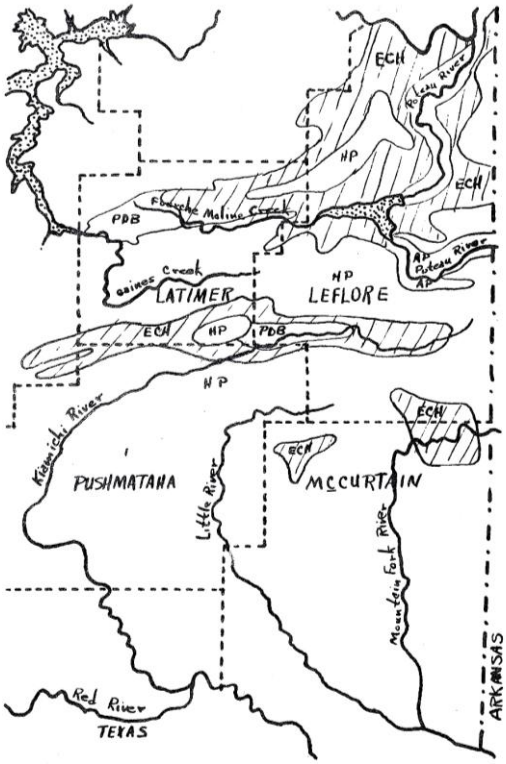

Figure Generalized soil map of southeastern Oklahoma. Symbols are: PDB – Parson, Dennis, Bates; ECH – Enders, Conway, Hector; HP – Hector, Pottsville; and AP – Adkins, Pope (Gray and Galloway 1959).

The average temperature for the years 1962 through 1967 was approximately 62° F (17 °C; Table I).

Precipitation is high, ranging from just under 40 inches (101.6 cm) in the northern part to nearly 50 (127 cm) inches in the southern mountainous part (Table II). During the relatively dry year of 1963, just over 20 inches (50.8 cm) fell at Wilburton, whereas in 1967, over 62 inches (157.5 cm) fell at the Kiamichi Tower on Kiamichi Mountain in Southwest LeFlore County (Table II).

The distribution of rainfall is more uniform over the entire year than is usual for the rest of Oklahoma. Spring is characterized by heavy rainfall, resulting in considerable local flooding. The summer months often become droughty with

moisture again being plentiful during the fall. Eastern Oklahoma and the adjoining states receive, on the average, more precipitation in the spring than any other state east of the Rocky Mountains (Wahlgren 1941).

High summer temperatures usually occur with clear skies and are accompanied by light wind. In winter, occasional sleet, ice storms, or snows occur but are few in number and of short duration. The last killing frost in spring falls in March to late April, with the first frost in fall occurring in late October.

TABLE I
AVERAGE TEMPERATURES

Station	1962	1963	1964	1965	1966	1967
Clayton 2N			63.3M			
Kiamichi Tower						
Poteau	62.3	63.1	62.5	62.0	60.9	62.1
Smithville 2NNW	60.5	60.9				60.1M
Wilburton	62.2	63.4	62.5	62.4M	59.7M	
Wister Dam	63.1	63.7	63.3	63.8M	60.4M	60.7

Source: U.S. Dept. of Commerce, Weather Bureau, Climatological Data, Oklahoma, Annual Summaries, 1962-1967. Temperature averages followed by an M indicate one or more months of missing data.

TABLE II
AVERAGE PRECIPITATION

Station	1962	1963	1964	1965	1966	1967
Clayton 2N	48.5	29.4E	50.4	36.0E	37.0E	53.8E
Kiamichi Tower	59.0E	28.0E	45.4	58.2E	44.1E	62.1
Poteau	41.8	20.9	38.6	31.6	33.1	49.6
Smithville 2NNW	51.3	29.7	43.5	56.9	39.2E	59.2
Wilburton	45.7	20.7	41.9	35.7	45.9	48.8E
Wister Dam	38.7	22.0	40.3	32.6	36.9	50.5

Source: U.S. Dept. of Commerce, Weather Bureau, Climatological Data, Oklahoma, Annual Summaries, 1962-1967. Precipitation averages followed by an E indicate one or more months of missing data.

TAXONOMIC HISTORY

The first plant collecting in the Ouachita Highlands of eastern Oklahoma was done by Thomas Nuttall in 1819. During a stay of several weeks at Ft. Smith on the Arkansas River in western Arkansas, he made several short collecting trips into surrounding territory. On May 16, 1819, Nuttall left Ft. Smith with Major Bradford and a company of soldiers on a trip to the confluence of the Kiamichi River and the Red River. They followed the Poteau and Kiamichi rivers, crossing the mountains that separate the two drainage systems.

The following are excerpts from *Nuttall's Journal of his Travels into the Arkansas Territory* (as reprinted in Early Western Travels, Volume XIII. Thwaites 1905).

> [April] 27. Yesterday I took a walk of about five miles up the banks of the Pottoe [Poteau], and found my labour well repayed by the discovery of several new or undescribed plants… The whole expanse of forest, hill and dale was now richly enameled with a profusion of beautiful and curious flowers; among the most conspicuous was the charming Daisy of America [*Astranthium integrifolium* (Michx.) Nutt.] of a delicate lilac colour, and altogether corresponding in general aspect with the European species; intermingled, appears a new species of Phlox, the *Verbena subletia,* and the esculent *Scilla* [*camassia*].

Nuttall made interesting notes about the terrain and flora. After passing the Poteau River, he noted the conic shape of Sugar Loaf Mountain and Cavanah Mountain, likening them to the Allegheny Mountains (Thwaites 1905). On May 17, he recorded the following:

> These vast plains, beautiful almost as the fancied Elysium, were now enamelled with innumerable flowers, among the most splendid of which were the azur Larkspur [*Delphinium carolinianum* Walt.], gilded Coreopsides [*Coreopsis*], Rudbeckias [*Rudbeckia*], fragrant Phloxes, and the purple *Psilotria.*

After crossing the divide from the Poteau River to the Kiamichi River, he again likened the ridges to the Allegheny of Pennsylvania, noting that they were rocky and thinly wooded with pines and oaks (Thwaites 1905).

On his return trip to Ft. Smith, Nuttall notes passing with great difficulty along the summit of a mountain covered with thickets of "dwarf oaks (*Quercus chinquapin*, *Q. montana* and *Q. alba*), none of them scarcely exceeding the height of a man" (Thwaites 1905).

Many other botanists traveled and collected plants in Oklahoma. Zina Pitcher, a surgeon in the U. S. Army, apparently traveled the same general route as did Nuttall (McKelvey 1955). Melines C. Leavenworth, Heinrich Karl Beyrich, Charles Joseph Latrobe, and Edward James all collected in Oklahoma but passed by the Ouachita Highlands while enroute to more western or southern destinations. (McKelvey 1955).

G. D. Butler collected *Isoetes* at Limestone Gap, approximately 70 miles north of Texas and 100 miles west of Arkansas (Butler 1878). This is probably the present town of Gap in northern Atoka County, situated in a break of the Ouachita Highlands.

Stevens collected plants from the vicinity of Page, Oklahoma, in southeastern Oklahoma, during 1913 prior to his and Shannon's joint publication of plant life in Oklahoma (Stevens and Shannon 1917).

Palmer (1924) made a study of the ligneous flora of Rich Mountain in southeastern Oklahoma and Featherly (1928) listed the grasses of Oklahoma. In addition, occasional collections from the area of study by E. Little, R. Stratton, and

G. Goodman are in the herbarium of Oklahoma State University. Collections of significance include those of U. T. Waterfall.

ECOLOGICAL CONSIDERATIONS

The vegetation of the Ouachita Highlands is the Oak-Hickory Association of the Deciduous Forest Formation (Bruner 1931). This association is composed of two communities that are similar and intergrade considerably. One community is the upland forests of the rough hills and mountainous areas and the other is the lowland forest of stream valleys and more mesic lower slopes. Overlapping into the forests, primarily in the valleys, is the tall grass prairie. There is intergradation to a limited extent between the lowland forests and the prairie community.

The oak-hickory forest is most extensive on the lower slopes and level fertile valleys. The dominant species are *Quercus shumardii*, var. s*chnecki*, *Q. nigra*, *Q. falcata*, var. *falcata*, *Q. velutina*, *Q. stellata*, *Carya aquatic*, *C. cordiformis*, *C. myristicaeformis,* and *C. texana.* Other species commonly present in the valleys and lower slopes include *Acer saccharum, A. saccharinum*, *A. negundo*, *Diospyros virginiana*, *Sassafras albida*, *Liquidambar styraciflua*, *Juglans nigra*, *Prunus serotina*, *Robinia pseudoacacia*, *Nyssa sylvatica*, *Ostrya virginiana*, *Tilia neglecta*, *Quercus macrocarpa*, *Q. muhlenbergii*, *Q. lyrata*, *Q. alba*, *Ulmus alata*, *Carya illinoensis*, *Celtis laevigata*, *Pinus echinata*, *Salix caroliniana*, *S. nigra*, *Platanus occidentalis*, *Gleditsia tricanthos*, *Fraxinus americana*, *Maclura pomifera, and Salix interior.*

Characteristic dominant species of the more xeric upland sites include *Quercus velutina*, *Q. stellata*, *Q. palustris*, *Q. marilandica*, *Carya cordiformis*, *C. texana, Ulmus alata,* and *Pinus echinata.* Other species, including shrubs, present in the upland forest include the following: *Aesculus glabra*, *Ascyrum hypericoides*, *Vaccinium arboretum*, *V. stamineum*, *Bumelia lanuginosae*, *Ceanothus herbaceous*, *Hypericum spathulatum*, *H. punctatum*, *Ilex deciduas,* and *Rhus copallina*. Shrubs more characteristic of the more mesic lower slopes include *Crataegus crus-galli*, *C. spathulata*, *Cornus drummondii*, *C. obliquae*, *Prunus mexicana*, *P. americana*, *Rhus toxicodendron*, *R. glabra*, *R. radicans,* and *Virburnum prunifolium*.

Shrubs of the mesic lower slopes and valleys include *Cornus florida*, *Alnus serrulata*, *Betula nigra*, *Ostrya virginiana*, *Carpinus caroliniana*, *Callicarpa americana*, *Hamamelis vernalis*, *Prunus serotina*, *Amorpha fruticosa*, *Hydrangea arborescens,* and *Asimina triloba. Magnolia acuminata* is found only on the mesic northern slope of Rich Mountain in Southeast LeFlore County. *Ilex opaca* is restricted to wet sandy loam soils along Kiamichi River and Little River.

Common lianas found in the Oak-Hickory Association include the following: *Clematis versicolor*, *Calycocarpum lyoni*, *Cocculus carolinus*, *Vitis rotundifolia*, *V. vulpina*, *V. acerifolia*, *V. aestivalis*, *Parthenocissus quinquefolia*, *Menisperma canadense*, *Ampelopsis cordata*, *Berchemia scandens*, *Cissus incisa*, *Smilax glauca*, *S. bona-nox*, *S. rotundifolia*, *Rhododendron oblongifolium*, and *Campsis radicans*.

The herbaceous flora varies with the seasons and the density of the forest. The prevernal and vernal species include the following: *Sanguinaria canadensis*, *Podophyllum peltatum*, *Polygonatum canaliculatum*, *Arisaema dracontium*, *Erythronium americanum*, *Danthonia spicata*, *Panicum sphaerocarpon*, *Carex brevior*, *C. caroliniana*, *C. lurida*, *Trillium viride*, *Viola pedata*, var. *linearilobа*, *V. sororia*, *V. kitaibeliana*, *Valerianella longiflora*, *V. stenocarpa*, *Ranuculus hispidus*, *R. fascicularis*, *Antennaria plantaginifolia*, *Senecio obovatus*, *Oenothera laciniata*, *Anemonella thalictroides*, *Lepidium virginianum,* and *Callirhoe alcaeoides*.

Common estival species include the following: *Silene stellata*, *Salvia lyrata*, *Monarda fistulosa*, *Teucrium canadense*, *Geum canadense*, *Tovara virginiana*, *Boehmeria cylindrica*, *Utrica chamaedryoides*, *Commelina communis*, *Polygonum hydropiperoides*, var. *opelousanum*, *Rumex crispus*,

R. pulcher, *Froelichia gracilis*, *Tephrosia virginiana*, *Zizia aurea*, *Cassia fasciculata*, *Clitoria mariana*, *Desmondium sessilifolium*, *Elymus canadensis*, *Panicum hians*, *Eleocharis obtusa*, *Lobelia spicata,* and *Passiflora incarnata*.

The serotinal species include the following: *Lobelia cardinalis*, *Aster azureus*, *Boltonia diffusa*, *Elephantopus carolinianus*, *Eupatorium coelastinum*, *E. serotinum*, *Iresine rhizomotosa*, *Impatiens capensis*, *Agastache nepetoides*, *Helianthus hirsutus*, *Uniola latifolia*, *Tridens flavus*, *Croton monanthogynus*, *Euphorbia corollata*, *E. supine*, *Pycnanthemum albescens*, *Prunella vulgaris*, *Plantago rugelii*, *Coreopsis grandiflora,* and *Solidago delicatula*.

Subclimax prairie is found between the Winding Stair Mountains and the Sans Bois Mountains, and between the Kiamichi Mountains and the Winding Stair Mountains.

Dominant prairie species are as follows: *Andropogon gerardi*, *A. scoparius*, *Sorghastrum nutans*, and *Panicum virgatum*. Other common species include *Andropogon saccharoides*, *A. ternarius*, *Setaria geniculata*, *Echinochloa crusgalli*, *Panicum anceps*, *P. agrostoides*, var. *condensatum*, *Paspalum setaceum*, *Agrostis hyemalis*, *Aristida oligantha*, *Spehnopholis obtusata*, *Tridens strictus*, *Carex amphibola*, var. *turgid*, *C. lupuliformis*, *Scirpus lineatus*, *Aristida longespica*, *Elymus virginicus*, *Manisuris cylindrical*, *Eragrostis trichodes*, *Bromus secalinus*, *Festuca octaflora*, and *Hordeum pussillum*.

Prevernal and vernal species of the prairies include the following: *Sisyrinchium campestre*, *Hypoxis hirsuta*, *Tradescantia ohiensis*, *T. ernestiana*, *Baptisia leucophaea*, *B. nuttalina*, *B. sphaerocarpa*, *Collinsia violacea*, *Ranunculus fascicularis*, *Bromus japonicus*, *B. mollis*, *Penstemon arkansanus*, *P. digitalis*, *Claytonia virginica*, *Anemone caroliniana*, *Linaria canadensis*, *Camassia angusta*, and *Luzula bulbosa*.

Species that are a little later but still vernal include *Daucus pusillus*, *Ptilimnium nuttallii*, *Potentilla canadensis*, *Amsonia tabernaemontana*, *Phacelia hirsuta*, *Astranthium integrifolium*, *Phlox pilosa*, *Psoralea psoralioides*, *P. tenuiflora*, *Silene stellata*, *Astragulus distortus*, *Rosa carolina*, *Stylosanthes biflora*, *Polygala incarnate*, *Acalypha virginica*, and *Verbena canadensis*.

Estival species of the prairie include *Rudbeckia grandiflora*, *R. triloba*, *Cicuta maculata*, *Asclepias tuberosa*, *Oenothera laciniata*, *Zizia aurea*, *Eryngium yuccifolium*, *Gaura filiformis*, *Liatris pycnostachya*, *Spiranthes vernalis,* and *Cuscuta cuspidata*.

Some serotinal species of the prairie include *Solidago radula*, *S. rigida*, *Helianthus mollis*, *Vernonia baldwinii*, *Silphium laciniatum,* and *Euphorbia nutans*.

Vegetation associated with the streams, ponds and lakes of the area varies from free floating aquatics to those growing along the edge of water. Common free floating or bottom rooted species include *Nuphar advena*, var. *advena*, *Lemna valdiviana*, *Myriophyllum heterophyllum*, *Utricularia biflora*, *Potamogeton diversifolius,* and *Najas guadalupensis*. Species rooted at the edge of the water include *Typha latifolia*, *Sagittaria gramineum*, *S. ambigua*, *Zizaniopsis miliacea*, *Hydrolea ovata*, *Justicia americana*, *Polygonum pensylvanicum*, *P. persicaria*, *Ludwigia palustris*, *Eleocharis obtusa*, *E. quadrangulata*, *Rhynchospora corniculata,* and various species of *Carex*.

RANGE EXTENSIONS AND SPECIES OF SPECIAL INTEREST

This chapter covers range extensions and species having a rather restricted distribution in the area studied.

Range Extensions

Bidens aristosa (Michx.) Britt. var. *mutica* (Gray) Gattinger, reported by Waterfall (1954a) for McCurtain County, was collected in early October (Means 2837) near Lake Nahih Wayia in Pushmataha County and (Means 2210) in the Poteau River valley 5 mi. (8.05 km) south of Poteau in LeFlore County.

Carex lactebracteata Waterfall, a new species described by Waterfall (1954a) with the TYPE (Waterfall 11380) from a rocky wooded ridge 16.4 mi.(26.39 km) north of Broken Bow, in McCurtain County; it was collected May 1968 by the author (3252) on rocky wooded hillsides of Cucumber Creek in LeFlore County, approximately 22 mi. (35.41 km) north of the original collection site.

Species of Special Interest

Pinus teada L., although occurring in large stands in Southeast McCurtain County, was collected (Means 2499) as an occasional tree of mixed hardwood forest of Kiamichi River valley approximately 2 mi. (3.22 km) southeast of Tuskahoma in Pushmataha County in October.

Taxodium distichum (L.) Richard, collected in August, 1965 (Means 2066) and early April, 1966 (Means 2403) in shallow water along the banks of Poteau River, near an old home site in LeFlore County. Reproduction has occurred.

Buchloe dactyloides (Nutt.) Engelm., common further west in the grasslands, collected (Means 1521) on clay site along creek 1.5 mi. (2.41 km) east of the Latimer-LeFlore county line along Highway 270 in LeFlore County in early June, 1965.

Cynosurus echinatus L., naturalized from Europe; collected (Means 2597) in open woods on a rocky hillside near a stream 1 mi. (1.61 km) south of Clayton in Pushmataha County in early June, 1968.

Xyris torta J. E. Smith, var. *occidentalis* Malme, collected (Waterfall 10547) in a slew 1.1 mi. (1.77km) west of Talihina in Latimer County, October 14, 1951.

Populus deltoides Marsh., although fairly common in central and western Oklahoma, collected (Means 2361) at the base of wooded north slope of a ridge north of Eastern Oklahoma State College at Wilburton in Latimer County, April 5, 1966.

Brasenia schreberi Gmel., abundant in upper end of Lake Nanih Wayia, June 16, 1968 (Means 3608) in Pushmataha County and less commonly in a farm pond 2 mi. (3.22 km) east of Buffalo Valley School, July 13, 1968 (Means 3790) in southeastern Latimer County.

Magnolia acuminata L., reported by Palmer (1924) as occurring on the lower north slopes of Rich Mountain in LeFlore County, collected in June 1932 (Stevens 2771); June 1968 (Means 3553); and May 1968 (Means 3279) only at that site, approximately 0.5 mi. (0.8 km) west of the Arkansas border in early June.

Asimina triloba (L.) Dunal, indicated as common near Page, Oklahoma by Palmer (1924), collected in fruit (Means 790) in the wooded valley of Cucumber Creek in LeFlore County, August 17, 1963.

Drosera annua Reed, collected (Barclay and Doty sin. Num.) May 1961, on sides of low mounds in prairie along Highway 2 approximately 4 mi. (6.44 km) north of Clayton) in Pushmataha County.

Sedum nuttallianum Raf., collected May 23, 1966 (Means 2453) from a rather dense stand on a wet weather seep at the edge of a blue shale outcrop along the highway, approximately 1.2 mi. (1.93 km) west and 0.7 mi. (1.13 km) north of Tuskahoma in Pushmataha County.

Ribes cynosbati L., reported by Palmer (1924) from Rich Mountain, collected (Means 2507) from mixed hardwood forest of Kiamichi River valley 0.5 mi. (0.8 km) south and 1.5 mi. (2.41 km) east of Tuskahoma in Pushmataha County, May 22, 1966 and (Means 2893) from the rocky north slope of Kiamichi Mountain 1 mi. (1.61 km) south of Big Cedar in LeFlore County, April 15, 1967.

Andrachne phyllanthoides (Nutt.) Coulter, occasional shrubby plant of rock-strewn small streams, collected (Means 3656) along edge of small rocky stream 1 mi.(1.61 km) northwest of Albion in Pushmataha County, June 30, 1968. Also collected (Waterfall

8542) along rocky stream west of Talihina October 11, 1964 and (Waterfall 17171) along a rocky stream 9 mi. (14.48 km) north of Tuskahoma, August 9, 1948, both in Latimer County.

Ilex opaca Ait., collected (Means 1408) May 26, 1965 and (Means 2436) April 22, 1966 in deep sandy soil of Kiamichi River valley 0.7 mi. (1.13 km) south of Big Cedar; (Clark 350) May 3, 1935 and (Stevens 1406) April 1914 in wooded valley near Page; (Means 3220) in Little River valley 6 mi. (9.65 km) southeast of Nahoba May 27, 1968; (Sellers sin.num.) July 16, 1966 9 mi. (14.48 km) northwest of Clayton in Pushmataha County.

Proserpinaca palustris L., var. *crebra* Fern. & Grisc., collected (Means 3585) in a stream 1 mi. (1.61 km) south of Clayton in Pushmataha County, June 16, 1968.

Myriophyllum pinnatum (Walt.) BSP., collected (Means 3401) in shallow water of Fourche Maline Creek 4 mi. (6.44 km) south of Red Oak in Latimer County, May 28, 1968.

Liatris elegans (Walt.) Willd., collected (Means 3944) August 26, 1968 and (Waterfall 147) July 31, 1932 in native prairie west of Albion in Pushmataha County; (Stratton 604) September 1927 and (Waterfall 15173) October 11, 1958 in prairies east of Wilburton in Latimer County.

Rudbeckia maxima Nutt., collected (Means 1507) from a wet prairie site 1 mi. (1.61 km) west of Red Oak in Latimer County, June 16, 1965.

TABULAR VIEW OF THE FAMILIES
GENERA (G) and SPECIES AND SUBSPECIFIC TAXA (SS)

Family	G	SS	Family	G	SS
OSMUNDACEAE	1	1	PHYTOLACCACEAE	1	1
POLYPODIACEAE	11	13	AIZOACEAE	1	1
PINACEAE	3	4	PORTULACACEAE	3	4
TYPHACEAE	1	3	CARYOPHYLLACEAE	6	12
SPARGANIACEAE	1	1	NYMPHACEAE	4	7
ZOSTERACEAE	1	2	RANUNCULACEAE	7	16
NAJADACEAE	1	1	BERBERIDACEAE	1	1
ALISMATACEAE	3	6	MENISPERMACEAE	2	2
GRAMINEAE	52	149	MAGNOLIACEAE	1	1
CYPERACEAE	6	59	ANONACEAE	1	1
ARACEAE	1	2	LAURACEAE	2	3
LEMNACEAE	2	2	PAPAVERACEAE	1	1
XYRIDACEAE	1	2	FUMARIACEAE	1	2
COMMELINACEAE	2	13	CRUCIFERAE	11	14
JUNCACEAE	2	15	CAPPARIDACEAE	2	2
LILACEAE	14	25	DROSERACEAE	1	1
AMARYLLIDACEAE	3	4	CRASSULACEAE	1	1
DIOSCOREACEAE	1	2	SAXIFRAGACEAE	6	6
IRIDACEAE	2	3	HAMAMELIDACEAE	2	2
MARANTACEAE	1	1	PLATANACEAE	1	1
ORCHIDACEAE	2	4	ROSACEAE	10	32
SAURURACEAE	1	1	LEGUMINOSAE	25	71
SALICACEAE	2	5	GERANIACEAE	1	1
JUGLANDACEAE	2	8	OXALIDACEAE	1	5
BETULACEAE	4	4	LINACEAE	1	2
FAGACEAE	3	19	ZYGOPHYLLACEAE	1	1
ULMACEAE	2	4	RUTACEAE	1	1
MORACEAE	2	3	MELIACEAE	1	1
UTRICACEAE	4	4	POLYGALACEAE	1	5
LORANTHACEAE	1	1	EUPHORBIACEAE	9	26
ARISTOLACHIACEAE	1	1	CALLITRICHACEAE	1	1
POLYGONACEAE	5	20	ANACARDIACEAE	1	5
CHENOPODIACEAE	2	5	AQUIFOLIACEAE	1	2
AMARANTHACEAE	3	6	CELASTRACEAE	1	2
NYCTAGINACEAE	1	2	STAPHYLEACEAE	1	1

ACERACEAE	1	4
HIPPOCASTANACEAE	1	1
SAPINDACEAE	1	1
BALSAMINACEAE	1	1
RHAMNACEAE	3	4
VITACEAE	4	11
TILIACEAE	1	3
MALVACEAE	5	8
GUTTIFERAE	2	9
CISTACEAE	1	2
VIOLACEAE	1	15
PASSIFLORACEAE	1	3
CACTACEAE	1	2
LYTHRACEAE	3	3
MELASTOMACEAE	1	1
ONAGRACEAE	4	15
HALORAGACEAE	2	4
UMBELLIFERAE	17	21
CORNACEAE	1	3
NYSSACEAE	1	1
ERICACEAE	3	6
PRIMULACEAE	3	3
SAPOTACEAE	1	1
EBENACEAE	1	2
STYRACACEAE	1	1
OLEACEAE	2	3
LOGANIACEAE	3	3
GENTIANACEAE	2	4
APOCYNACEAE	3	4
ASCLEPIADACEAE	2	12
CONVOLVULACEAE	3	12
POLEMONIACEAE	2	3
HYDROPHYLLACEAE	3	5
BORAGINACEAE	5	5
VERBENACEAE	2	7
LABIATAE	18	28
SOLANACEAE	3	15
SCROPHULARIACEAE	15	27
BIGNONIACEAE	2	2
LENTIBULARIACEAE	1	1
ACANTHACEAE	3	6
PHRYMACEAE	1	1
PLANTAGINACEAE	1	5
RUBIACEAE	5	11
CAPRIFOLIACEAE	4	7
VALERIANACEAE	1	4
CUCURBITACEAE	2	2
CAMPANULACEAE	2	8
COMPOSITAE	56	137
TOTALS	457	1067

Out of a total of 119 families, the ten families with the largest number of species and subspecies are as follows:

GRAMINEAE	52	149
COMPOSITAE	56	137
LEGUMINOSAE	25	71
CYPERACEAE	6	59
ROSACEAE	10	32
LABIATAE	18	28
SCROPHULARIACEAE	15	27
EUPHORBIACEAE	9	26
UMBELLIFERAE	17	21
POLYGONACEAE	5	20
TOTALS	213	570

SUMMARY

After moving to Eastern Oklahoma State College as Instructor in Botany and becoming aware of the variety in the local flora, the author began an extensive study of the northern Ouachita Highlands. The author has authenticated approximately 4,500 sheets which have been processed according to standard herbarium procedures. The first set has been placed in the Herbarium of Oklahoma State University with duplicates going to Eastern Oklahoma State College at Wilburton, Oklahoma.

Monographs, revisions, and other taxonomic literature from the Oklahoma State University Library and the personal libraries of Dr. U.T. Waterfall and the author were used in the identification of the specimens.

A total of 1067 species and subspecific taxa representing 457 genera and 119 familes were identified. The families having the greatest number of species and subordinate taxa were *Gramineae* 149, *Compositae* 137, *Leguminosae* 71, *Cyperaceae* 59, *Rosaceae* 32, *Labiatae* 28, *Scrophulariaceae* 27, *Euphorbiaceae* 26, *Umbelliferae* 21, and *Polygonaceae* 20. These 10 families contain 53% of the total species and subordinate taxa.

In 1969, no taxa were reported as new records for the state, although 17 species were listed as range extensions or of special interest due to their limited distribution.

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APPENDIX

Updated Flora of Southeastern Oklahoma from the Sans Bois to the Kiamichi Mountains.

Editor's note: Originally this listing followed the Engler-Prantl system for families, as used in the *Keys to Flora of Oklahoma* (Waterfall 1966). Nomenclature has been revised according to the National Plant Data Center, Baton Rouge, LA (http://plants.usda.gov) and organized based on the Angiosperm Phylogeny Group, Missouri Botanical Gardens http://www.mobot.org/MOBOT/research/APweb/) Accessed December 2009. [EM]

FERNS

ASPLENIACEAE
Asplenium pinnatifidum Nutt.
Asplenium platyneuron (L.) Britton, Sterns & Poggenb.

DENNSTAEDTIACEAE
Pteridium aquilinum (L.) Kuhn var. *pseudocaudatum* (Clute) A. Heller

DRYOPTERIDACEAE
Athyrium filix-femina (L.) Roth. ssp. *asplenioides* (Michx.) Hultén
Cystopteris tennesseensis Shaver [syn = *Cystopteris fragilis* var. *simulans*]
Dryopteris marginalis (L.) A. Gray
Polystichum acrostichoides (Michx.) Schott
Woodsia obtusa (Spreng.) Torr.

OSMUNDACEAE
Osmunda regalis L. var. s*pectabilis* (Willd.) Gray

POLYPODIACEAE
Pleopeltis polypodioides (L.) Andrews & Windham ssp. *michauxiana* (Weath.) Andrews & Windham

PTERIDACEAE
Adianthum pedatum L.
Cheilanthes lanosa (Michx.) D.C. Eaton [syn = *Cheilanthes vestita*]
Pellaea atropurpurea (L.) Link

GYMNOSPERMS

CUPRESSACEAE
Juniperus virginiana L.
Taxodium distichum (L.) Rich.

PINACEAE
Pinus echinata Mill.
Pinus taeda L.

BASAL ANGIOSPERMS

ANNONACEAE
Asimina triloba (L.) Dunal

ARISTOLOCHIACEAE
Aristolochia tomentosa Sims

LAURACEAE
Lindera benzoin (L.) Blume var. *benzoin*
Sassafras albidum (Nutt.) Nees. [syn = *Sassafras albidum* var. *molle*]

MAGNOLIACEAE
Magnolia acuminata (L.) L.

NYMPHACEAE
Brasenia schreberi J.F. Gmel.
Nelumbo lutea Willd.
Nuphar lutea (L.) Sm. ssp. *advena* (Aiton) Kartesz & Gandhi [syn = *Nuphar advena, Nuphar advena* var. *tomentosa, Nuphar ovata, Nuphar ozarkana*]
Nymphaea odorata Aiton

SAURURACEAE
Saururus cernuus L.

MONOCOTS

AGAVACEAE

Manfreda virginica (L.) Salisb. ex Rose [syn = *Agave lata*, *Agave virginica*]

ALISMATACEAE

Alisma plantago-aquatica L.
Echinodorus cordifolius (L.) Griseb.
Sagittaria ambigua J. G. Sm.
Sagittaria graminea Michx.
Sagittaria latifolia Willd.
Sagittaria platyphylla (Engelm.) J. G. Sm.

ARACEAE

Arisaema dracontium (L.) Schott.
Arisaema triphyllum (L.) Schott. ssp. *triphyllum* [syn = *Arisaema atrorubens*]

COMMELINACEAE

Commelina communis L.
Commelina diffusa Burm. f.
Commelina erecta L. var. *angustifolia* (Michx.) Fernald
Commelina erecta L. var. *deamiana* Fernald
Commelina erecta L. var. *erecta*
Commelina virginica L.
Tradescantia ernestiana E.S. Anderson & Woodson
Tradescantia hirsuticaulis Small
Tradescantia hirsutiflora Bush
Tradescantia ohiensis Raf.
Tradescantia tharpii E.S. Anderson & Woodson

CYPERACEAE

Carex amphibola Steud.
Carex annectens (E.P. Bicknell) E.P. Bicknell
Carex bicknellii Britton
Carex blanda Dewey
Carex brevior (Dewey) Mack.
Carex bushii Mack. [syn = *Carex caroliniana* var. *cuspidata*]
Carex cephalophora Muhl. ex Willd.
Carex crinita Lam. var. *brevicrinis* Fernald
Carex crus-corvi Shuttlw. ex Kunze
Carex flaccosperma Dewey
Carex frankii Kunth
Carex gravida L.H. Bailey var. *lunelliana* (Mack) F.J. Herm.
Carex hyalina Boott
Carex joori L.H. Bailey
Carex laevivaginata (Kük.) Mack.
Carex latebracteata Waterf.
Carex lupuliformis Sartwell ex Dewey
Carex lurida Wahlenb.
Carex meadii Dewey
Carex microrhyncha Mack.
Carex muhlenbergii Schkuhr ex Willd. var. *enervis* Boott
Carex oklahomensis Mack. [syn = *Carex stipata* var. *oklahomensis*]
Carex oxylepis Torr. & Hook.
Carex retroflexa Muhl. ex Willd.
Carex squarrosa L.
Carex stipata Muhl. ex Willd. var. *stipata*
Carex texensis (Torr.) L. H. Bailey
Carex tribuloides Wahlenb.
Carex vulpinoidea Michx.
Cyperus acuminatus Torr. & Hook. ex Torr.
Cyperus echinatus (L.) Alph. Wood [syn = *Cyperus ovularis* var. *sphaericus*]
Cyperus erythrorhizos Muhl.
Cyperus lupulinus (Spreng.) Marcks ssp. *lupulinus*
Cyperus strigosus L.
Cyperus virens Michx.
Eleocharis acicularis (L.) Roem. & Schult. var. *acicularis*
Eleocharis compressa Sull. var. *acutisquamata* (Buckley) S.G. Sm. [syn = *Eleocharis acutisquamata*]
Eleocharis montevidensis Kunth
Eleocharis obtusa (Willd.) Schult.
Eleocharis quadrangulata (Michx.) Roem. & Schult.
Fimbristylis autumnalis (L.) Roem. & Schult.
Fimbristylis dichotoma (L.) Vahl.
Fimbristylis thermalis S. Watson [syn = *Fimbristylis spadicea*]
Fimbristylis vahlii (Lam.) Link.
Isolepis carinata Hook. & Arn. ex Torr. [syn = *Scirpus koilolepis*]

Kyllinga brevifolia Rottb. [syn = *Cyperus brevifolius*]
Rhynchospora capitellata (Michx.) Vahl.
Rhynchospora corniculata (Lam.) A. Gray
Rhynchospora glomerata (L.) Vahl.
Rhynchospora harveyi Wm. Boott
Rhynchospora macrostachya Torr. ex A. Gray
Rhynchospora recognita (Gale) Kral [syn = *Rhynchospora globularis* var. *recognita*]
Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller [syn = *Scirpus americanus*]
Schoenoplectus californicus (C.A. Mey.) Palla [syn = *Scirpus californicus*]
Scirpus atrovirens Willd.
Scirpus cyperinus (L.) Kunth
Scirpus lineatus Michx.

DIOSCOREACEAE
Dioscorea quaternata J.F. Gmel. [syn = *Dioscorea villosa* var. *glabrifolia*]

IRIDACEAE
Iris cristata Aiton
Sisyrinchium angustifolium Mill.
Sisyrinchium campestre E.P. Bicknell

JUNCACEAE
Juncus acuminatus Michx.
Juncus brachycarpus Engelm.
Juncus bufonius L.
Juncus coriaceus Mack.
Juncus diffusissimus Buckley
Juncus effusus L. var. *solutus* Fernald & Wiegand
Juncus interior Wiegand
Juncus marginatus Rostk.
Juncus repens Michx.
Juncus scirpoides Lam.
Juncus tenuis Willd.
Juncus validus Coville var. *validus* [syn = *Juncus crassifolius*]
Luzula bulbosa (Alph. Wood) Smyth & Smyth
Luzula echinata (Small) F.J. Herm.

LILIACEAE
Aletris farinosa L.
Allium canadense L. var. *canadense*
Allium canadense L. var. *fraseri* Ownbey
Allium canadense L. var. *hyacinthoides* (Bush) Ownbey & Aase
Allium canadense L. var. *mobilense* (Regel) Ownbey
Allium perdulce S.V. Fraser
Allium vineale L. ssp. *compactum* (Thuill.) Coss & Germ.
Amianthium muscitoxicum (Walter) A. Gray
Camassia angusta (Engelm. & A. Gray) Blank.
Camassia scilloides (Raf.) Cory
Cooperia drummondii Herbert [syn = *Zephyranthes brazosensis*]
Erythronium albidum Nutt.
Erythronium americanum Ker Gawl.
Hypoxis hirsuta (L.) Coville
Maiathemum racemosum (L.) Link ssp. *racemosum* [syn = *Smilacina racemosa* var. *cylindrata*]
Nothoscordum bivalve (L.) Britton
Polygonatum biflorum (Walter) Elliot var. *commutatum* (Schult. & Schult. f.) Morong [syn = *Polygonatum canaliculatum*]
Smilax bona-nox L.
Smilax glauca Walter
Smilax herbacea L.
Smilax tamnoides L.
Trillium viride Beck
Uvularia grandiflora Sm.
Veratrum woodii J.W. Robbins ex Alph. Wood
Yucca glauca Nutt.
Zigadenus nuttallii (A. Gray) S. Watson

LEMNACEAE
Lemna valdiviana Phil.
Spirodela polyrrhiza (L.) Schleid.

MARANTACEAE
Thalia dealbata Fraser ex Roscoe

NAJADACEAE
Najas guadalupensis (Spreng.) Magnus

ORCHIDACEAE

Calopogon tuberosus (L.) Britton, Sterns & Poggenb. var. *tuberosus* [syn = *Calopogon pulchellus*]
Spiranthes cernua (L.) Rich.
Spiranthes tuberosa Raf.
Spiranthes vernalis Engelm. & A. Gray

POACEAE

Agrostis stolonifera L. [syn = *Agrostis alba*]
Agrostis elliottiana Schult.
Agrostis hyemalis (Walt.) Britton, Sterns & Poggenb.
Agrostis perennans (Walt.) Tuck.
Aira elegans Willd. ex Kunth.
Alopecurus carolinianus Walter
Andropogon gerardii Vitman
Andropogon glomeratus (Walter) Britton, Sterns & Poggenb. var. *glomeratus* [syn = *Andropogon virginicus* var. *abbreviatus*]
Andropogon gyrans Ashe var. *gyrans* [syn = *A. elliottii*]
Andropogon ternarius Michx.
Andropogon virginicus L. var. *virginicus*
Aristida dichotoma Michx. var. *curtissii* Gray
Aristida dichotoma Michx. var. *dichotoma*
Aristida longespica Poir.
Aristida oligantha Michx.
Aristida purpurascens Poir.
Arundinaria gigantea (Walter) Muhl.
Axonopus festifolius (Raddi) Kuhlm. [syn = *Axonopus affinis*]
Bothriochloa barbinodis Lag. [syn = *Andropogon barbinodis*]
Bothriochloa saccharoides (Sw.) Rydb. [syn = *Andropogon saccharoides*]
Bouteloua curtipendula (Michx.) Torr.
Bouteloua dactyloides (Nutt.) J.T. Columbus [syn = *Buchloe dactyloides*]
Brachyelytrum erectum (Schreb. ex Spreng.) P. Beauv.
Bromus arvensis L. [syn = *Bromus japonicus*]
Bromus catharticus Vahl
Bromus hordeaceus L. ssp. *hordeaceus* [syn = *Bromus mollis*]
Bromus inermis Leyss.
Bromus kalmii A. Gray [syn = *Bromus purgans*]
Bromus secalinus L.
Bromus tectorum L.
Cenchrus spinifex Cav. [syn = *Cenchrus incertus*, *Cenchrus pauciflorus*]
Chasmanthium latifolium (Michx.) Yates [syn = *Uniola latifolia*]
Chasmanthium laxum (L.) Yates [syn = *Uniola laxa*]
Chasmanthium sesiliflorum (Poir.) Yates [syn = *Uniola sessiliflora*]
Chloris verticillata Nutt.
Chloris virgata Sw.
Cinna arundinaceae L.
Coelorachis cylindrica (Michx.) Nash [syn = *Manisuris cylindrica*]
Cynosurus echinatus L.
Dactylis glomerata L.
Danthonia spicata (L.) P. Beauv. ex Roem. & Schult.
Diarrhena obovata (Gleason) Brandenburg [syn = *Diarrhena americana* var. *obovata*]
Dichanthelium acuminatum (Sw.) Gould & C.A. Clark var. *fasciculatum* (Torr.) Freckmann [syn = *Panicum lanuginosum* var. *fasciculatum*]
Dichanthelium acuminatum (Sw.) Gould & C.A. Clark var. *lindheimeri* (Nash) & C.A. Clark [syn = *Panicum lanuginosum* var. *lindheimeri*]
Dichanthelium boscii (Poir.) Gould & C.A. Clark [syn = *Panicum boscii*]
Dichanthelium dichotomum (L.) Gould var. *dichotomum* [syn = *Panicum dichotomum*]
Dichanthelium laxiflorum (Lam.) Gould [syn = *Panicum laxiflorum*]
Dichanthelium linearifolium (Scribn. ex Nash) Gould
Dichanthelium malacophyllum (Nash) Gould [syn = *Panicum malacophyllum*]
Dichanthelium oligosanthes (Schult.) Gould var. *scribnerianum* (Nash) Gould [syn = *Panicum oligosanthes* var. *helleri*, *Panicum oligosanthes* var. *scribnerianum*]
Dichanthelium scoparium (Lam.) Gould [syn = *Panicum scoparium*]
Dichanthelium sphaerocarpon (Elliot) Gould var. *isophyllum* (Scribn.) Gould & C.A.

Clark [syn = *Panicum microcarpon*, *Panicum polyanthes*]
Dichanthelium sphaerocarpon (Elliot) Gould var. *sphaerocarpon* [syn = *Panicum sphaerocarpon*]
Dichanthelium villosissimum (Nash) Freckmann var. *praecocius* (Hitch. & Chase) Freckmann [syn = *Panicum praecocius*]
Dichanthelium wilcoxianum (Vasey) Freckmann [syn = *Panicum wilcoxianum*]
Digitaria villosa (Walter) Pers. [syn = *Digitaria filiformis* var. *villosa*]
Digitaria ischaemum (Schreb.) Schreb. ex Muhl.
Digitaria sanguinalis (L.) Scop.
Digitaria violascens Link
Echinochloa colona (L.) Link
Echinochloa crus-galli (L.) P. Beauv.
Eleusine indica (L.) Gaertn.
Elymus canadensis L.
Elymus hystrix L. var. *hystrix* [syn = *Hystrix patula*]
Elymus interruptus Buckley
Elymus submuticus (Hook.) Smyth & Smyth [syn = *Elymus virginicus* var. *submuticus*]
Elymus virginicus L. var. *virginicus* [syn = *Elymus virginicus* var. *glabriflorus*, *Elymus virginicus* var. *jejunus*]
Eragrostis capillaris (L.) Nees
Eragrostis frankii C.A. Mey. ex Steud.
Eragrostis hirsuta (Michx.) Nees
Eragrostis hypnoides (Lam.) Britton, Sterns & Poggenb.
Eragrostis intermedia Hitchc.
Eragrostis japonica (Thunb.) Trin. [syn = *Eragrostis glomerata*]
Eragrostis minor Host [syn = *Eragrostis poaeoides*]
Eragrostis pilosa (L.) P. Beauv.
Eragrostis spectabilis (Pursh) Steud.
Eragrostis trichodes (Nutt.) Alph. Wood
Eriochloa contracta Hitchc.
Festuca paradoxa Desv.
Festuca subverticillata (Pers.) Alexeev [syn = *Festuca obtusa*]
Gymnopogon ambiguus (Michx.) Britton, Sterns & Poggenb.
Hordeum pusillum Nutt.
Leersia oryzoides (L.) Sw.
Leersia virginica Willd.
Leptochloa panicea (Retz) Ohwi ssp. *brachiata* (Steud.) N. Snow [syn = *Leptochloa filiformis*]
Lolium perenne L.
Lolium perenne L. ssp. *multiforum* (Lam.) Husnot [syn = *Lolium multiflorum*]
Melica mutica Walter
Muhlenbergia capillaris (Lam.) Trin.
Muhlenbergia sobolifera (Muhl. ex Willd.) Trin.
Muhlenbergia tenuiflora (Kunth.) Trin.
Panicum anceps Michx.
Panicum brachyanthum Steud.
Panicum capillare L.
Panicum dichotomiflorum Michx.
Panicum rigidulum Bosc ex Nees var. *rigidulum* [syn = *Panicum agrostoides*]
Panicum virgatum L.
Paspalum dilatatum Poir.
Paspalum dissectum (L.) L.
Paspalum distichum L.
Paspalum floridanum Michx.
Paspalum laeve Michx.
Paspalum setaceum Michx.
Paspalum urvillei Steud.
Phalaris canariensis L.
Phalaris caroliniana Walter
Piptochaetium avenaceum (L.) Parodi [syn = *Stipa avenacea*]
Poa annua L.
Poa pratensis L.
Poa sylvestris A. Gray
Saccharum brevibarbe (Michx.) Pers. var. *contortum* (Elliot) R. Webster [syn = *Erianthus contortus*]
Saccharum giganteum (Walter) Pers. [syn = *Erianthus giganteus*]
Sacciolepis striata (L.) Nash
Schedonorus pratensis (Huds.) P. Beauv. [syn = *Festuca elatior*]
Schizachyrium scoparium (Michx.) Nash var. *scoparium* [syn = *Andropogon scoparius*]
Setaria italica (L.) P. Beauv.

Setaria parviflora (Poir.) Kerguélen [syn = *Setaria geniculata*]
Setaria pumila (Poir.) Roem. & Schult. ssp. *pumila* [syn = *Setaria glauca*]
Setaria viridis (L.) P. Beauv.
Sorghastrum nutans (L.) Nash
Sorghum halepense (L.) Pers.
Sphenopholis intermedia (Rydb.) Rydb.
Sphenopholis obtusata (Michx.) Scribn.
Sporobolus clandestinus (Biehler) Hitchc. [syn = *Sporobolus asper* var. *canovirens*]
Sporobolus compositus (Poir.) Merr. var. *macer* (Trin.) Kartesz & Gandhi [syn = *Sporobolus asper* var. *macer*]
Sporobolus cryptandrus (Torr.) A. Gray
Sporobolus indicus (L.) R. Br. var. *indicus* [syn = *Sporobolus poiretii*]
Sporobolus pyramidatus (Lam.) Hitchc.
Sporobolus vaginiflorus (Torr. ex A. Gray) Alph. Wood var. *vaginiflorus*
Steinchisma hians (Elliot) Nash [syn = *Panicum hians*]
Tridens flavus (L.) Hitchc.
Tridens strictus (Nutt.) Nash
Triplasis purpurea (Walter) Chapm.
Tripsacum dactyloides (L.) L.
Urochloa platyphylla (Munro ex C. Wright) R.D. Webster [syn = *Brachiaria platyphylla*]
Vulpia myuros (L.) C.C. Gmel. [syn = *Festuca myuros*]
Vulpia octoflora (Walter) Rydb. var. *octoflora* [syn = *Festuca octoflora*]
Zizaniopsis miliacea (Michx.) Döll & Asch.

POTOMOGETONACEAE
Potamogeton diversifolius Raf.
Potamogeton pulcher Tuck.

SPARGANIACEAE
Sparganium americanum Nutt.

TYPHACEAE
Typha angustifolia L.
Typha domingensis Pers.
Typha latifolia L.

XYRIDACEAE
Xyris difformis Chapm.
Xyris torta Sm.

EUDICOTS

BERBERIDACEAE
Podophyllum peltatum L.

FUMARIACEAE
Corydalis crystallina Engelm.
Corydalis micrantha (Engelm. ex A. Gray) A. Gray

MENISPERMACEAE
Calycocarpum lyonii (Pursh) A. Gray
Cocculus carolinus (L.) DC.

PAPAVERACEAE
Sanguinaria canadensis L.

PLATANACEAE
Platanus occidentalis L.

RANUNCULACEAE
Anemone berlandieri Pritz. [syn = *Anemone decapetala*]
Anemone caroliniana Walter
Aquilegia canadensis L.
Clematis pitcheri Torr. & A. Gray
Clematis versicolor Small ex Rydb.
Delphinium carolinianum Walter
Delphinium tricorne Michx.
Delphinium wootonii Rydb. [syn = *Delphinium virescens*]
Ranunculus abortivus L.
Ranunculus fascicularis Muhl. ex Bigelow
Ranunculus laxicaulis (Torr. & A. Gray) Darby
Ranunculus micranthus Nutt.
Ranunculus recurvatus Poir.
Thalictrum dasycarpum Fisch. & Avé-Lall.
Thalictrum thalictroides (L.) Spach. [syn = *Anemonella thalictroides*]

ROSIDS

ACERACEAE
Acer negundo L. var. *negundo*
Acer rubrum L.
Acer saccharum Marsh.

ANACARDIACEAE
Rhus aromatica Aiton var. *aromatica*
Rhus copallinum L. var. *latifolia* Engl.
Rhus glabra L.
Toxicodendron radicans (L.) Kuntze ssp. *radicans* [syn = *Rhus radicans*]
Toxicodendron pubescens Mill. [syn = *Rhus toxicodendron*]

BETULACEAE
Alnus serrulata (Aiton) Willd.
Betula nigra L.
Carpinus caroliniana Walter
Ostrya virginiana (Mill.) K. Koch var. *virginiana*

BRASSICACEAE
Arabis canadensis L.
Arabis missouriensis Greene
Capsella bursa-pastoris (L.) Medik.
Cardamine concatenata (Michx.) Sw. [syn = *Dentaria laciniata*]
Cardamine parviflora L. var. *arenicola* (Britton) O. E. Schulz
Cardamine pensylvanica Muhl. ex Willd.
Draba brachycarpa Nutt. ex Torr. & A. Gray
Lepidium densiflorum Schrad.
Lepidium virginicum L.
Rorippa palustris (L.) Besser ssp. *fernaldiana* (Butters & Abbe) Jonsell [syn = *Rorippa islandica* ssp. *fernaldiana*]
Selenia aurea Nutt.
Sibara virginica (L.) Rollins
Streptanthus maculatus Nutt.
Thlaspi arvense L.

CAPPARACEAE
Cleome spinosa Jacq.
Polanisia dodecandra (L.) DC. ssp. *trachysperma* (Torr. & A. Gray) Iltis

CELASTRACEAE
Euonymus americanus L.
Euonymus atropurpureus Jacq.

CISTACEAE
Lechea mucronata Raf.
Lechea tenuifolia Michx.

CLUSIACEAE
Hypericum densiflorum Pursh
Hypericum lobocarpum Gattinger ex J.M. Coult. [syn = *Hypericum densiflorum* var. *lobocarpum, Hypericum oklahomense*]
Hypericum drummondii (Grev. & Hook.) Torr. & A. Gray
Hypericum gentianoides (L.) Britton, Sterns & Poggenb.
Hypericum hypericoides (L.) Crantz ssp. *hypericoides* [syn = *Ascyrum hypericoides]*
Hypericum mutilum L.
Hypericum prolificum L. [syn = *Hypericum spathulatum*]
Hypericum pseudomaculatum Bush
Hypericum punctatum Lam.
Triadenum tubulosum (Walter) Gleason

CRASSULACEAE
Penthorum sedoides L.
Sedum nuttallianum Raf.

CUCURBITACEAE
Melothria pendula L.
Cucurbita foetidissima Kunth

EUPHORBIACEAE
Acalypha gracilens A. Gray [syn = *Acalypha gracilens* var. *fraseri*]
Acalypha monococca (Engelm. ex A. Gray) Lill. W. Mill. & Gandhi [syn = *Acalypha gracilens* ssp. *monococca*]
Acalypha virginica L.
Chamaesyce maculata (L.) Small [syn = *Euphorbia supina*]
Chamaesyce missurica (Raf.) Shinners [syn = *Euphorbia missurica*]
Chamaesyce nutans (Lag.) Small [syn = *Euphorbia nutans*]

Chamaesyce prostrata (Aiton) Small [syn = *Euphorbia prostrata*]
Cnidoscolus texanus (Müll. Arg.) Small
Croton capitatus Michx. var. *capitatus*
Croton capitatus Michx. var. *lindheimeri* (Engelm. and A. Gray) Müll. Arg.
Croton glanulosus L. var. *septentrionalis* Müll. Arg.
Croton lindheimerianus Scheel
Croton michauxii G.L. Webster [syn = *Crotonopsis linearis*]
Croton monanthogynus Michx.
Euphorbia cyathophora Murray [syn = *Euphorbia heterophylla* var. *graminifolia*]
Euphorbia dentata Michx. var. *dentata*
Euphorbia pubentissima Michx. [syn = *Euphorbia corollata* var. *paniculata*]
Euphorbia spathulata Lam. [syn = *Euphorbia obtusata*]
Euphorbia tetrapora Engelm.
Leptopus phyllanthoides (Nutt.) G.L. Webster [syn = *Andrachne phyllanthoides*]
Phyllanthus caroliniensis Walter
Stillingia sylvatica L.
Tragia betonicifolia Nutt.

FABACEAE
Amorpha fruticosa L. [syn = *Amorpha virgata*]
Amorpha laevigata Nutt.
Apios americana Medik.
Astragalus canadensis L.
Astragalus crassicarpus Nutt. var. *crassicarpus*
Astragalus crassicarpus Nutt. var. *trichocalyx* (Nutt.) Barneby
Astragalus distortus Torr. & A. Gray var. *distortus*
Baptisia alba (L.) Vent. var. *macrophylla* (Larisey) Isely [syn = *Baptisia leucantha*]
Baptisia australis (L.) R. Br. var. *minor* (Lehm.) Fernald
Baptisia bracteata Muhl. ex Elliot var. *leucophaea* (Nutt.) Kartesz & Gandhi [syn = *Baptisia leucophaea, Baptisia leucophaea* var. *glabrescens*]
Baptisia nuttalliana Small
Baptisia spaerocarpa Nutt.
Baptisia stricta Nutt.
Chamaecrista fasciculata (Michx.) Greene var. *fasciculata* [syn = *Cassia fasciculata*, *Cassia fasciculata* var. *rostrata*]
Chamaecrista nictitans (L.) Moench ssp. *nictitans* var. *nictitans*
Cercis canadensis L. var. *canadensis*
Clitoria mariana L.
Dalea candida Michx. ex Willd. var. *candida*
Dalea purpurea Vent.
Desmanthus illinoensis (Michx.) MacMill. ex B.L. Rob. & Fernald
Desmodium glutinosum (Muhl. ex Willd.) Alph. Wood
Desmodium laevigatum (Nutt.) DC.
Desmodium marilandicum (L.) DC.
Desmodium nudiflorum (L.) DC.
Desmodium obtusum (Muhl. ex Willd.) DC. [syn = *Desmodium rigidum*]
Desmodium perplexum B.G. Schub. [syn = *Desmodium paniculatum* var. *dillenii*]
Desmodium paniculatum (L.) DC. var. *paniculatum*
Desmodium sessilifolium (Torr.) Torr. & A. Gray
Galactia volubilis (L.) Britt.
Gleditsia triacanthos L.
Kummerowia stipulacea (Maxim.) Makino [syn = *Lespedeza stipulacea*]
Kummerowia striata (Thunb.) Schindl. [syn = *Lespedeza striata*]
Lathyrus latifolius L.
Lathyrus pusillus Elliot
Lespedeza capitata Michx.
Lespedeza cuneata (Dum. Cours.) G. Don
Lespedeza hirta (L.) Hornem. ssp. *hirta*
Lespedeza procumbens Michx.
Lespedeza repens (L.) W. Bartram
Lespedeza stuevei Nutt. [syn = *Lespedeza stuevei* var. *angustifolia*]
Lespedeza violacea (L.) Pers.
Lespedeza virginica (L.) Britt.
Mimosa microphylla Dryand. [syn = *Schrankia uncinata*]
Neptunia lutea (Leavenworth) Benth.
Orbexilum pedunculatum (Mill.) Rydb. var. *pedunculatum* [syn = *Psoralea psoralioides* var. *eglandulosa*]

Orbexilum simplex (Nutt. ex Torr. & A. Gray) Rydb. [syn = *Psoralea simplex*]
Psoralidium tenuiflora (Pursh) Rydb. [syn = *Psoralea tenuiflora*]
Rynchosia latifolia Nutt. ex Torr. & A. Gray
Robinia pseudoacacia L.
Securigera varia (L.) Lassen [syn = *Coronilla varia*]
Senna marilandica (L.) Link [syn = *Cassia marilandica*]
Senna occidentalis (L.) Link [syn = *Cassia occidentalis*]
Strophostyles helvola (L.) Elliot
Strophostyles leiosperma (Torr. & A. Gray) Piper
Strophostyles umbellata (Muhl. ex Willd.) Britton
Stylosanthes biflora (L.) Britton, Sterns & Poggenb. [syn = *Stylosanthes biflora* var. *hispidissima*]
Tephrosia onobrychoides Nutt.
Tephrosia virginiana (L.) Pers. [syn = *Tephrosia virginiana* var. *holosericea*]
Trifolium arvense L.
Trifolium carolinianum Michx.
Trifolium dubium Sibth.
Trifolium incarnatum L.
Trifolium pratense L.
Trifolium reflexum L.
Vicia caroliniana Walter
Vicia minutiflora F.G Dietr.

FAGACEAE
Castanea pumila (L.) Mill. var. *ozarkensis* (Ashe) Tucker [syn = *Castanea ozarkensis*]
Fagus grandifolia Ehrh.
Quercus alba L.
Quercus coccinea Münchh.
Quercus falcata Michx. [syn = *Quercus falcata* var. *triloba*]
Quercus lyrata Walter
Quercus macrocarpa Michx.
Quercus marilandica Münchh.
Quercus muehlenbergii Engelm.
Quercus nigra L.
Quercus pagoda Raf. [syn = *Quercus falcata* var. *pagodifolia*]
Quercus palustris Münchh.
Quercus phellos L.
Quercus rubra L. var. *ambigua* (A. Gray) Fernald [syn = *Quercus rubra* var. *borealis*]
Quercus shumardii Buckley var. *shumardii*
Quercus shumardii Buckley var. *schneckii* (Britton) Sarg.
Quercus stellata Wangenh.
Quercus velutina Lam.

GERANIACEAE
Geranium carolinianum L.

GROSSULARIACEAE
Itea virginica L.
Ribes cynosbati L.

HALORAGACEAE
Myriophyllum aquaticum (Vell.) Verdc. [syn = *Myriophyllum brasiliense*]
Myriophyllum heterophyllum Michx.
Myriophyllum pinnatum (Walt.) Britton, Sterns & Poggenb.
Proserpinaca palustris L. var. *crebra* Fernald & Grisc.

HAMAMELIDACEAE
Hamamelis vernalis Sarg.
Liquidambar styraciflua L.

HIPPOCASTANACEAE
Aesculus glabra Willd.

JUGLANDACEAE
Carya alba (L.) Nutt. [syn = *Carya tomentosa*]
Carya aquatica (Michx. f.) Nutt.
Carya cordiformis (Wangenh.) K. Koch
Carya illinoinensis (Wangenh.) K. Koch
Carya myristiciformis (Michx. f.) Nutt.
Carya ovata (Mill.) K. Koch
Carya texana Buckley
Juglans nigra L.

LINACEAE
Linum medium (Planch.) Britton var. *texanum* (Planch.) Fernald

Linum sulcatum Riddell

LYTHRACEAE

Didiplis diandra (Nutt. ex DC.) Alph. Wood [syn = *Peplis diandra*]
Lythrum alatum Pursh var. *alatum*
Rotala ramosior (L.) Koehne

MALVACEAE

Abutilon theophrasti Medik.
Callirhoe alcaeoides (Michx.) A. Gray
Callirhoe pedata (Nutt. ex Hook.) A. Gray [syn = *Callirhoe digitata* var. *stipulata*]
Hibiscus lasiocarpos Cav.
Hibiscus laevis All. [syn = *Hibiscus militaris*]
Malva pusilla L. [syn = *Malva rotundifolia*]
Sida rhombifolia L.
Sida spinosa L.

MELASTOMATACEAE

Rhexia mariana L. var. *interior* (Pennell) Kral & Bostick [syn = *Rhexia interior*]

MELIACEAE

Melia azedarach L.

MORACEAE

Maclura pomifera (Raf.) C.K. Schneid.
Morus alba L.
Morus rubra L.

ONAGRACEAE

Gaura longiflora Spach [syn = *Gaura filiformis*]
Gaura sinuata Nutt. ex Ser.
Ludwigia alternifolia L.
Ludwigia decurrens Walter [syn = *Jussiaea decurrens*]
Ludwigia glandulosa Walter ssp. *glandulosa*
Ludwigia palustris (L.) Elliot
Ludwigia peploides (Kunth) P.H. Raven ssp. *peploides* [syn = *Jussiaea peploides*]
Oenothera elata Kunth. ssp. *hirsutissima* (A. Gray ex S. Watson) W. Dietr. [syn = *Oenothera biennis* var. *hirsutissima*]
Oenothera fruticosa L.
Oenothera laciniata Hill
Oenothera linifolia Nutt.
Oenothera speciosa Nutt.
Oenothera villosa Thunb. ssp. *villosa* [syn = *Oenothera biennis* var. *canescens*]

OXALIDACEAE

Oxalis corniculata L.
Oxalis stricta L.
Oxalis violacea L.

PASSIFLORACEAE

Passiflora incarnata L.
Passiflora lutea L.

POLYGALACEAE

Polygala incarnata L.
Polygala polygama Walter
Polygala sanguinea L.
Polygala verticillata L., var. *isocycla* Fernald

RHAMNACEAE

Berchemia scandens (Hill.) K. Koch
Ceanothus americanus L.
Ceanothus herbaceus Raf. var. *pubescens* (T. & G.) Shinners
Frangula caroliniana (Walter) A. Gray [syn = *Rhamnus caroliniana*]

ROSACEAE

Agrimonia parviflora Aiton
Agrimonia pubescens Wallr.
Agrimonia rostellata Wallr.
Amelanchier arborea (Michx. f.) Fernald
Crataegus crus-galli L.
Crataegus marshallii Eggl.
Crataegus pruinosa (Wendl. f.) Koch. [syn = *Crataegus mackenziei*]
Crataegus punctata Jacq. [syn = *Crataegus collina*]
Crataegus spathulata Michx.
Crataegus uniflora Münchh.
Crataegus viridis L.
Geum canadense Jacq. var. *canadense*
Geum canadense Jacq. var. *texanum* Fernald & Weath.
Gillenia stipulata (Muhl. ex Willd.) Baill.
Potentilla simplex Michx.

Prunus americana Marsh., var. *americana*
Prunus angustifolia Marsh.
Prunus mexicana S. Watson
Prunus munsoniana W. Wright & Hedrick
Prunus serotina Ehrh.
Rosa carolina L.
Rosa foliolosa Nutt. ex Torr. & A. Gray
Rosa setigera Michx. var. *setigera*
Rosa setigera Michx. var. *tomentosa* Torr. & A. Gray
Rubus aboriginum Rydb.
Rubus argutus Link. [syn = *Rubus louisianus*]
Rubus bushii L.H. Bailey [syn = *Rubus ozarkensis*, *Rubus scibilis*]
Rubus oklahomus L.H. Bailey
Rubus trivialis Michx.
Sanguisorba annua (Nutt. ex Hook.) Nutt. ex Torr. & A. Gray

RUTACEAE
Ptelea trifoliata L. ssp. *trifoliata*

SALICACEAE
Populus deltoides Bartram ex Marsh.
Salix caroliniana Michx.
Salix humilis Marsh. var. *humilis*
Salix interior Rowlee
Salix nigra Marsh.

SAPINDACEAE
Sapindus saponaria L. var. *drummondii* (Hook. & Arn.) L.D. Benson [syn = *Sapindus drummondii*]

SAXIFRAGACEAE
Heuchera americana L. var. *americana*
Saxifraga texana Buckley

STAPHYLEACEAE
Staphylea trifolia L.
TILIACEAE
Tilia americana L.
Tilia americana L. var. *americana* [syn = *Tilia neglecta*]

ULMACEAE
Celtis laevigata Willd.
Celtis occidentalis L.
Celtis tenuifolia Nutt.
Ulmus alata Michx.

URTICACEAE
Boehmeria cylindrica (L.) Sw.
Laportea canadensis (L.) Weddell
Parietaria pensylvanica Muhl. ex Willd.
Pilea pumila (L.) A. Gray

VISCACEAE
Phoradendron leucarpum (Raf.) Reveal & M.C. Johnst. [syn = *Phoradendron serotinum*]

VITACEAE
Ampelopsis arborea (L.) Koehne
Ampelopsis cordata Michx.
Cissus trifoliata (L.) L.
Parthenocissus quinquefolia (L.) Planch
Vitis acerifolia Raf.
Vitis aestivalis Michx.
Vitis cinerea (Engelm.) Engelm. ex Millard
Vitis rotundifolia Michx.
Vitis rupestris Scheele
Vitis vulpina L.

ZYGOPHYLLACEAE
Tribulus terrestris L.

ASTERIDS

ACANTHACEAE
Dicliptera brachiata (Pursh) Spreng.
Justicia americana (L.) Vahl
Ruellia humilis Nutt.
Ruellia pedunculata Torr. ex A. Gray
Ruellia strepens L.

AMARANTHACEAE
Amaranthus albus L. [syn = *Amaranthus graecizans*]
Amaranthus retroflexus L.
Amaranthus spinosus L.
Froelichia gracilis (Hook.) Moq.
Iresine rhizomatosa Standl.

APIACEAE
Ammoselinum butleri (Engelm. ex S. Watson) J.M. Coult. & Rose
Chaerophyllum tainturieri Hook. var. *tainturieri* [syn = *Chaerophyllum texanum*]
Cicuta maculata L.
Cryptotaenia canadensis (L.) DC.
Cynosciadium digitatum DC.
Daucus pusillus Michx.
Eryngium prostratum Nutt. ex DC.
Eryngium yuccifolium Michx. var. *synchaetum* A. Gray ex J.M. Coult. & Rose
Hydrocotyle verticillata Thunb.
Limnosciadium pinnatum (DC.) Mathias & Constance
Osmorhiza longistylis (Torr.) DC.
Polytaenia nuttallii DC.
Ptilimnium capillaceum (Michx.) Raf.
Ptilimnium nuttallii (DC.) Britton
Sanicula canadensis L.
Spermolepis echinata (Nutt. ex DC.) A. Heller
Spermolepis inermis (Nutt. ex DC.) Mathias & Constance
Thaspium barbinode (Michx.) Nutt.
Trepocarpus aethusae Nutt. ex DC.
Zizia aurea (L.) W.D.J. Koch

APOCYNACEAE
Amsonia illustris Woodson
Amsonia tabernaemontana Walter
Apocynum cannabinum L.
Trachelospermum difforme (Walter) A. Gray

AQUIFOLIACEAE
Ilex decidua Walter
Ilex opaca Aiton

ASCLEPIADACEAE
Asclepias amplexicaulis Sm.
sclepias hirtella (Pennell) Woodson
Asclepias obovata Elliot
Asclepias quadrifolia Jacq.
Asclepias syriaca L.
Asclepias tuberosa L.
Asclepias verticillata L.
Asclepias viridiflora Raf. [syn = *Asclepias viridiflora* var. *lanceolata*]
Asclepias viridis Walter
Matelea baldwyniana (Sweet) Woodson
Matelea gonocarpos (Walter) Shinners

ASTERACEAE
Achillea millefolium L. var. *occidentalis* DC. [syn = *Achillea lanulosa*]
Ageratina altissima (L.) King & H. Rob. var. *altissima* [syn = *Eupatorium rugosum*]
Ambrosia artemisiifolia L. var. *elatior* (L.) Descourtils
Ambrosia bidentata Michx.
Ambrosia psilostachya DC. [syn = *Ambrosia psilostachya* var. *lindheimeriana*]
Ambrosia trifida L. var. *texana* Scheele
Antennaria plantaginifolia (L.) Richardson
Anthemis cotula L.
Arctium minus Bernh.
Arnoglossum plantagineum Raf. [syn = *Cacalia plantaginea*]
Astranthium integrifolium (Michx.) Nutt.
Baccharis halimifolia L.
Bidens aristosa (Michx.) Britton [syn = *Bidens polylepis, Bidens aristosa* var. *mutica*]
Bidens bipinnata L.
Bidens discoidea (Torr. & A. Gray) Britton
Bidens frondosa L.
Boltonia asteroides (L.) L'Hér. var. *latisquama* (A. Gray) Cronquist
Boltonia asteroides (L.) L'Hér. var. *recognita* (Fernald & Grisc.) Cronquist
Boltonia diffusa Elliot
Brickellia eupatorioides (L.) Shinners var. *texana* (Shinners) Shinners [syn = *Kuhnia eupatorioides* var. *ozarkana*]
Centaurea americana Nutt.
Chaetopappa asteroides Nutt. ex DC.
Chrysopsis pilosa Nutt.
Cirsium altissimum (L.) Hill
Cirsium carolinianum (Walter) Fernald & B.G. Schub.
Conoclinium coelestinum (L.) DC. [syn = *Eupatorium coelestinum*]
Conyza canadensis (L.) Cronquist var. *canadensis*
Conyza canadensis (L.) Cronquist var. *glabrata* (A. Gray) Cronquist

Coreopsis grandiflora Hogg ex Sweet var. *grandiflora*
Coreopsis grandiflora Hogg ex Sweet var. *harveyana* (A. Gray) Sherff
Coreopsis palmata Nutt.
Coreopsis tinctoria Nutt. var. *tinctoria*
Coreopsis tripteris L.
Crepis pulchra L.
Croptilon divaricatum (Nutt.) Raf. [syn = *Haplopappus divaricatus*]
Echinacea angustifolia DC. var. *angustifolia*
Echinacea angustifolia DC. var. *strigosa* R.L. McGregor
Echinacea pallida (Nutt.) Nutt.
Echinacea purpurea (L.) Moench
Eclipta prostrata (L.) L. [syn = *Eclipta alba*]
Elephantopus carolinianus Raeusch.
Erechtites hieracifolia (L.) Raf. ex DC.
Erigeron pulchellus Michx.
Erigeron strigosus Muhl. ex. Willd.
Erigeron tenuis Torr. & A. Gray
Eupatorium perfoliatum L.
Eupatorium serotinum Michx.
Eurybia hemispherica (Alexander) G.L. Nesom [syn = *Aster hemisphericus*]
Euthamia gymnospermoides Greene [syn = *Solidago gymnospermoides*]
Facelis retusa (Lam.) Sch. Bip. [syn = *Facelis apiculata*]
Fleischmannia incarnata (Walter) King & H. Rob. [syn = *Eupatorium incarnatum*]
Gaillardia aestivalis (Walter) H. Rock var. *aestivalis* [syn = *Gaillardia lanceolata* var. *fastigiata*, *Gaillardia serotina*]
Gamochaeta purpurea (L.) Cabrera [syn = *Gnaphalium purpureum*]
Grindelia lanceolata Nutt.
Helenium amarum (Raf.) H. Rock var. *amarum*
Helenium flexuosum Raf.
Helianthus angustifolius L.
Helianthus annuus L.
Helianthus hirsutus Raf. [syn = *Helianthus hirsutus* var. *trachyphyllus*, *Helianthus hirsutus* var. *stenophyllus*]
Helianthus mollis Lam.
Heliopsis helianthoides (L.) Sweet var. *scabra* (Dunal) Fernald
Heterotheca subaxillaris (Lam.) Britton & Rusby [syn = *Heterotheca latifolia*]
Hieracium gronovii L.
Hieracium longipilum Torr.
Hymenopappus scabiosaeus L'Hér. var. *scabiosaeus*
Krigia caespitosa (Raf.) K.L. Chambers [syn = *Krigia oppositifolia*]
Krigia dandelion (L.) Nutt.
Krigia occidentalis Nutt.
Krigia virginica (L.) Willd.
Lactuca canadensis L. [syn = *Lactuca canadensis* var. *latifolia*]
Lactuca serriola L. [syn = *Lactuca scariola*]
Liatris aspera Michx. var. *aspera*
Liatris aspera Michx. var. *intermedia* (Lunell) Gaiser
Liatris elegans (Walter) Michx.
Liatris mucronata DC.
Liatris pycnostachya Michx.
Liatris squarrosa (L.) Michx. var. *glabrata* (Rydb.) Gaiser
Liatris squarrosa (L.) Michx. var. *hirsuta* (Rydb.) Gaiser
Liatris squarrulosa Michx. [syn = *Liatris scabra*]
Marshallia caespitosa Nutt. ex DC.
Mikania scandens (L.) Willd.
Oligoneuron nitidum (Torr. & A. Gray) Small [syn = *Solidago nitida*]
Pakera obovata (Muhl. ex Willd.) W.A. Weber & A. Löve [syn = *Senecio obovatus* var. *rotundus*]
Pakera tomentosa (Michx.) C. Jeffrey [syn = *Senecio tomentosus*]
Parthenium integrifolium L.
Pluchea camphorata (L.) DC.
Pityopsis graminifolia (Michx.) Nutt. var. *tenuifolia* (Torr.) Semple & F.D. Bowers [syn = *Chrysopsis microcephala*]
Polymnia canadensis L.
Prenanthes altissima L.
Pseudognaphalium obtusifolium (L.) Hilliard & B.L. Burtt ssp. *obtusifolium* [syn = *Gnaphalium obtusifolium*]
Pyrrhopappus grandiflorus (Nutt.) Nutt. [syn = *Pyrrhopappus scaposus*]

Rudbeckia grandiflora (D. Don) J.F. Gmel. ex DC.
Rudbeckia hirta L. var. *pulcherrima* Farw.
Rudbeckia maxima Nutt.
Rudbeckia subtomentosa Pursh
Rudbeckia triloba L.
Silphium asteriscus L.
Silphium laciniatum Torr. var. *robinsonii* L.M. Perry
Smallanthus uvedalius (L.) Mack. ex Small [syn = *Polymnia uvedalia* var. *densipilis*]
Solidago altissima L. [syn = *Solidago canadensis* var. *scabra*]
Solidago caesia L.
Solidago canadensis L. var. *gilvocanescens* Rydb.
Solidago hispida Muhl. ex Willd.
Solidago missouriensis Nutt. var. *fasciculata* Holz.
Solidago nemoralis Aiton
Solidago odora Aiton
Solidago petiolaris Aiton
Solidago radula Nutt.
Solidago rugosa Mill. ssp. *aspera* (Aiton) Cronquist
Solidago speciosa Nutt. var. *rigidiscula* Torr. & A. Gray [syn = *Solidago speciosa* var. *angustata*]
Solidago ulmifolia Muhl. ex Willd. var. *microphylla* A. Gray [syn = *Solidago delicatula*]
Sonchus asper (L.) Hill
Symphyotrichum anomalum (Engelm.) G.L. Nesom [syn = *Aster anomalus*]
Symphyotrichum cordifolium (L.) G.L. Nesom [syn = *Aster sagittifolius*]
Symphyotrichum ericoides (L.) G.L. Nesom var. *ericoides* [syn = *Aster ericoides*]
Symphyotrichum lateriflorum (L.) A. Löve & D. Löve var. *lateriflorum* [syn = *Aster lateriflorus*]
Symphyotrichum oolentangiense (Riddell) G.L. Nesom var. *oolentangiens* [syn = *Aster azureus*]
Symphyotrichum patens (Aiton) G.L. Nesom var. *patentissimum* (Lindl. ex DC.) G.L. Nesom [syn = *Aster patens* var. *patentissimus*]
Symphyotrichum praealtum (Poir.) G.L. Nesom var. *praealtum* [syn = *Aster praealtus*]
Symphyotrichum turbinellum (Lindl.) G.L. Nesom [syn = *Aster turbinellus*]
Taraxacum laevigatum (Willd.) DC. [syn = *Taraxacum erythrospermum*]
Verbesina alternifolia (L.) Britton ex Kearney [syn = *Actinomeris alternifolia*]
Verbesina encelioides (Cav.) Benth. & Hook. f. ex A. Gray
Verbesina helianthoides Michx.
Verbesina virginica L.
Vernonia baldwinii Torr. ssp. *baldwinii*
Vernonia fasciculata Michx.
Vernonia gigantea (Walter) Trel. ssp. *gigantea* [syn = *Vernonia altissima*]
Vernonia lettermannii Engelm. ex A. Gray
Vernonia missurica Raf.
Xanthium strumarium L.

BALSAMINACEAE
Impatiens capensis Meerb.

BIGNONIACEAE
Campsis radicans (L.) Seem. ex Bureau
Catalpa bignonioides Walter

BORAGINACEAE
Cynoglossum virginianum L.
Hackelia virginiana (L.) I.M. Johnst.
Heliotropium indicum L.
Lithospermum incisum Lehm.
Myosotis verna Nutt.

BUDDLEJACEAE
Polypremum procumbens L.

CACTACEAE
Opuntia ficus-indica (L.) Mill. [syn = *Opuntia compressa*]
Opuntia macrorhiza Engelm. var. *macrorhiza* [syn = *Opuntia tortispina*]

CALLITRICHACEAE
Callitriche heterophylla Pursh

CAMPANULACEAE
Lobelia appendiculata A. DC.
Lobelia cardinalis L.
Lobelia puberula Michx.
Lobelia spicata Lam. var. *leptostachys* (A. DC.) Mack. and Bush
Triodanis biflora (Ruiz & Pav.) Greene [syn = *Specularia biflora*]
Triodanis lamprosperma McVaugh [syn = *Specularia lamprosperma*]
Triodanis leptocarpa (Nutt.) Nieuwl. [syn = *Specularia leptocarpa*]
Triodanis perfoliata (L.) Nieuwl. [syn = *Specularia perfoliata*]

CAPRIFOLIACEAE
Lonicera flava Sims
Lonicera japonica Thunb.
Lonicera sempervirens L.
Sambucus nigra L. ssp. *canadensis* (L.) R. Bolli
Symphoricarpos orbiculatus Moench
Viburnum rufidulum Raf. [syn = *Viburnum prunifolium* var. *ferrugineum*]

CARYOPHYLLACEAE
Cerastium brachypodum (Engelm. ex A. Gray) B.L. Rob.
Cerastium fontanum Buamg. ssp. *vulgare* (Hartm.) Greuter & Burdet [syn = *Cerastium vulgatum*]
Cerastium glomeratum Till. [syn = *Cerastium viscosum*]
Minuartia drummondii (Shinners) McNeill [syn = *Arenaria drummondii*]
Minuartia patula (Michx.) Mattf. [syn = *Arenaria patula*]
Paronychia fastigiata (Raf.) Fern.
Paronychia virginica Spreng.
Sagina decumbens (Elliot) Torr. & A. Gray
Silene antirrhina L.
Silene stellata (L.) W.T. Aiton
Silene virginica L.
Stellaria media (L.) Vill.

CHENOPODIACEAE
Chenopodium album L.
Chenopodium ambrosioides L. var. *ambrosioides*
Chenopodium pumilio R. Br.
Monolepis nuttalliana (Schult.) Greene

CONVOLVULACEAE
Convolvulus arvensis L.
Ipomoea hederacea Jacq.
Ipomoea lacunosa L.
Ipomoea pandurata (L.) G. Mey.
Ipomoea purpurea (L.) Roth.
Ipomoea quamoclit L.

CORNACEAE
Cornus drummondii C.A. Mey.
Cornus florida L.
Cornus obliqua Raf.
Nyssa sylvatica Marsh.

CUSCUTACEAE
Cuscuta compacta Juss. ex Choisy
Cuscuta cuspidata Engelm.
Cuscuta glomerata Choisy
Cuscuta indecora Choisy
Cuscuta pentagona Engelm. var. *glabrior* (Engelm.) Gandhi, R.D. Thomas & S.L. Hatch [syn = *Cuscuta glabrior*]
Cuscuta pentagona Engelm. var. *pentagona* [syn = *Cuscuta campestris*]

DROSERACEAE
Drosera brevifolia Pursh. [syn = *Drosera annua*]

EBENACEAE
Diospyros virginiana L. [syn = *Diospyros virginiana* var. *pubescens*]

ERICACEAE
Lyonia ligustrina (L.) DC. var. *foliosiflora* (Michx.) Fernald [syn = *Lyonia ligustrina* var. *salicifolia*]
Rhododendron oblongifolium (Small) Millais
Vaccinium arboreum Marsh.
Vaccinium pallidum Aiton [syn = *Vaccinium vacillans*]
Vaccinium stamineum L.
Vaccinium virgatum Aiton

GENTIANACEAE
Gentiana saponaria L.
Sabatia angularis (L.) Pursh
Sabatia campestris Nutt.

HYDRANGEACEAE
Hydrangea arborescens L.

HYDROPHYLLACEAE
Hydrolea ovata Nutt. ex Choisy
Hydrolea uniflora Raf.
Nemophila phacelioides Nutt.
Phacelia glabra Nutt.
Phacelia hirsuta Nutt.

LAMIACEAE
Agastache nepetoides (L.) Kuntze
Blephilia ciliata (L.) Benth.
Cunila origanoides (L.) Britton
Hedeoma hispida Pursh
Lamium amplexicaule L.
Lycopus americanus Muhl. ex W. Bartram [syn = *Lycopus americanus* var. *scabrifolius*]
Lycopus rubellus Moench
Lycopus virginicus L.
Marrubium vulgare L.
Mentha spicata L.
Monarda fistulosa L. ssp. *fistulosa* var. *fistulosa*
Monarda punctata L. ssp. *punctata* var. *villicaulis* (Pennell) Palmer & Steyerm.
Monarda russeliana Nutt. ex Sims [syn = *Monarda virgata*]
Perilla frutescens (L.) Britt.
Physostegia angustifolia Fernald
Physostegia intermedia (Nutt.) Engelm. & A. Gray
Physostegia virginiana (L.) Benth.
Prunella vulgaris L. ssp. *lanceolata* (W. Bartram) Hultén
Pycnanthemum albescens Torr. & A. Gray
Pycnanthemum tenuifolium Schrad.
Salvia azurea Michx. ex Lam. var. *grandiflora* Benth.
Salvia lyrata L.
Scutellaria elliptica Muhl. ex Spreng.
Scutellaria ovata Hill
Stachys palustris Nutt. var. *pilosa*
Stachys tenuifolia Willd.
Teucrium canadense L. var. *canadense* [syn = *Teucrium canadense* var. *virginicum*]
Trichostema brachiatum L.

LENTIBULARIACEAE
Utricularia gibba L. [syn = *Utricularia biflora*]

LOGANIACEAE
Mitreola petiolata (J.F. Gmel.) Torr. & A. Gray [syn = *Cynoctonum mitreola*]
Spigelia marilandica (L.) L.

MOLLUGINACEAE
Mollugo verticillata L.

NYCTAGINACEAE
Mirabilis albida (Walter) Heimerl
Mirabilis nyctaginea (Michx.) MacMill.

OLEACEAE
Chionanthus virginicus L.
Fraxinus americana L.
Fraxinus pennsylvanica Marsh.

PHYTOLACCACEAE
Phytolacca americana L.

PLANTAGINACEAE
Plantago aristata Michx.
Plantago lanceolata L.
Plantago rhodosperma Decne.
Plantago rugelii Decne.
Plantago virginica L.

POLEMONIACEAE
Ipomopsis rubra (L.) Wherry [syn = *Gilia rubra*]
Phlox cuspidata Scheele
Phlox pilosa L.

POLYGONACEAE
Brunnichia ovata (Walter) Shinners [syn = *Brunnichia cirrhosa*]
Eriogonum longifolium Nutt. var. *longifolium* [syn = *Eriogonum vespinum*]
Polygonum convolvulus L.
Polygonum hydropiper L.

Polygonum hydropiperoides Michx. [syn = *Polygonum hydropiperoides* var. *bushianum*, *Polygonum hydropiperoides* var. *opelousanum*]
Polygonum orientale L.
Polygonum pensylvanicum L.
Polygonum persicaria L.
Polygonum punctatum Elliot
Polygonum ramosissimum Michx.
Polygonum scandens L. var. *scandens*
Polygonum tenue Michx.
Polygonum viginianum L. [syn = *Tovara virginiana*]
Rumex acetosella L.
Rumex altissimus Alph. Wood
Rumex crispus L.
Rumex hastatulus Baldw.
Rumex pulcher L.

PORTULACACEAE
Claytonia virginica L.
Portulaca halimoides L. [syn = *Portulaca parvula*]
Portulaca oleracea L.
Phemeranthus parviflorum (Nutt.) Kiger [syn = *Talinum parviflorum*]

PRIMULACEAE
Dodecatheon meadia L.
Hottonia inflata Elliot
Lysimachia lanceolata Walter

RUBIACEAE
Cephalanthus occidentalis L. var. *occidentalis*
Diodia teres Walter var. *teres* [syn = *Diodia teres* var. *setifera*]
Diodia virginiana L.
Galium aparine L.
Galium arkansanum A. Gray
Galium pilosum Aiton var. *pilosum*
Houstonia longifolia Gaertn. [syn = *Hedyotis purpurea* var. *longifolia*]
Houstonia purpurea L. var. *purpurea* [syn = *Hedyotis purpurea*]
Houstonia pusilla Schoepf [syn = *Hedyotis crassifolia*]
Mitchella repens L.
Stenaria nigricans (Lam.) Terrell var. *nigricans* [syn = *Hedyotis nigricans*]

SAPOTACEAE
Sideroxylon lanuginosum Michx. ssp. *lanuginosum* [syn = *Bumelia lanuginosa*]

SCROPHULARIACEAE
Agalinis fasciculata (Elliot) Raf. [syn = *Gerardia fasciculata*]
Agalinis gattingeri (Small) Small [syn = *Gerardia gattingeri*]
Agalinis tenuifolia (Vahl.) Raf. var. *parviflora* (Nutt.) Pennell [syn = *Gerardia tenuifolia* ssp. *parviflora*]
Aureolaria grandiflora (Benth.) Pennell var. *grandiflora* [syn = *Gerardia grandiflora*]
Aureolaria pectinata (Nutt.) Pennell [syn = *Gerardia pectinata*]
Bacopa rotundifolia (Michx.) Wettst.
Buchnera americana L.
Castilleja coccinea (L.) Spreng.
Castilleja indivisa Engelm.
Collinsia violacea Nutt.
Gratiola brevifolia Raf.
Gratiola virginiana L.
Lindernia dubia (L.) Pennell var. *anagallidea* (Michx.) Cooperr. [syn = *Lindernia anagallidea*]
Lindernia dubia (L.) Pennell var. *dubia*
Mecardonia acuminata (Walter) Small var. *acuminata* [syn = *Bacopa acuminata*]
Mimulus alatus Aiton
Nutallanthus texanus (Scheele) D.A. Sutton [syn = *Linaria canadensis* var. *texana*]
Pedicularis canadensis L. ssp. *canadensis* [syn = *Pedicularis canadensis* var. *dobbsii*]
Penstemon arkansanus Pennell
Penstemon digitalis Nutt. ex Sims
Penstemon tubiflorus Nutt.
Scrophularia marilandica L.
Verbascum blattaria L.
Verbascum thapsus L.
Veronica arvensis L.
Veronica peregrina L. ssp. *peregrina*
Veronicastrum virginicum (L.) Farw.

SOLANACEAE
Datura stramonium L.
Physalis angulata L. [syn = *Physalis angulata* var. *lanceifolia*, *Physalis angulata* var. *pendula*]
Physalis cinerascens (Dunal) Hitch. var. *cinerascens* [syn = *Physalis viscosa* var. *cinerascens*]
Physalis cordata Mill.
Physalis heterophylla Nees
Physalis pubescens L. var. *integrifolia* (Dunal) Waterf.
Physalis pumila Nutt.
Physalis turbinata Medik.
Physalis virginiana Mill. var. *virginiana*
Solanum carolinense L.
Solanum elaeagnifolium Cav.
Solanum nigrum L.
Solanum rostratum Dunal

STYRACACEAE
Halesia carolina L.

VALERIANACEAE
Valerianella longiflora (Torr. & A. Gray) Walp.
Valerianella nuttallii (Torr. & A. Gray) Walp.
Valerianella radiata (L.) Dufr. [syn = *Valerianella stenocarpa* var. *parviflora*]

VERBENACEAE
Callicarpa americana L.
Glandularia canadensis (L.) Nutt. [syn = *Verbena canadensis*]
Glandularia pumila (Rydb.) Umber [syn = *Verbena pumila*]
Phryma leptostachya L.
Verbena bracteata Cav. ex Lag. & Rodr.
Verbena halei Small
Verbena stricta Vent.
Verbena urticifolia L.

VIOLACEAE
Viola bicolor Pursh [syn = *Viola kitaibeliana* var. *rafinesquei*]
Viola langloisii Greene, nom. inq.
Viola × *lovelliana* Brainerd (pro sp.) [*missouriensis* × *triloba*]
Viola missouriensis Greene
Viola pedata L. [syn = *Viola pedata* var. *lineariloba*]
Viola pubescens Aiton var. *pubescens* [syn = *Viola pensylvanica*]
Viola pubescencs Aiton var. *scabruiscula* Swein. ex Torr. & A. Gray [syn = *Viola pensylvanica* var. *leiocarpon*]
Viola × *primulifolia* L. (pro sp.) [*lanceolata* × *macloskeyi*]
Viola sagittata Aiton
Viola sororia Willd. [syn = *Viola papilionacea*]
Viola triloba Schwein. var. *dilatata* (Elliot) Brainerd
Viola villosa Walter

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Composition and Structure of Bottomland Forest Vegetation at the Tiak Research Natural Area, McCurtain County, Oklahoma

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ABSTRACT

Although southeastern Oklahoma has substantial areas of bottomland forest, few studies exist of this vegetation type. We analyzed forest community structure at the Tiak Research Natural Area of the Ouachita National Forest on the Upper Gulf Coastal Plain. Vegetation data were collected from 24 12m x 8m macroplots. Percent cover data were recorded for ferns, fern-allies, and herbaceous angiosperms. Tree sapling and shrub species were recorded in diameter classes, and numbers of stems in estimated height classes were recorded for midlevel and canopy trees. One hundred fifty-two taxa of woody and herbaceous plants were encountered. *Toxicodendron radicans* and *Arundinaria gigantea* were the common understory species. *Acer rubrum, A. saccharum, Carpinus caroliniana, Carya alba, C. texana, Cornus florida, Fraxinus americana, Liquidambar styraciflua,* and *Nyssa sylvatica* were common as mid-level species. *Quercus lyrata* and *Q. phellos* were the most common canopy layer trees.

INTRODUCTION

The constituent tree species of bottomland forests in Oklahoma varies from east to west, as does the upland vegetation. Some tree species can be found in bottomland forests at most localities throughout the state, such as *Acer negundo, A. saccharum, Celtis laevigata*, *Fraxinus pennsylvanica,* and *Ulmus americana* (Bruner 1931, Blair and Hubbell 1938, Collins et al. 1981). But the most diverse assemblages of bottomland forest tree species occur in eastern Oklahoma, which is fostered by numerous oak species (i.e., *Quercus lyrata, Q. nigra, Q. michauxii, Q. pagoda, Q. palustris, Q. phellos,* and *Q. texana*). *Quercus lyrata, Q. michauxii,* and *Q. texana* are restricted to the Upper Gulf Coastal Plain (UGCP) extension of southeastern Oklahoma (Blair and Hubbell 1938). Other bottomland tree species limited to this area are *Pinus taeda* and *Taxodium distichum* (Bruner 1931).

Despite the diversity of woody and understory species in the bottomland forests of the UGCP in southeastern Oklahoma, few vegetation studies have focused on this area. The dominant species in this forest type are water tolerant *Carya* and *Quercus* species, as well as *Acer rubrum*, *Liquidambar styraciflua,* and *Nyssa sylvatica* (Bruner 1931; Brabander, et al. 1985). A quantitative analysis of woody vegetation at the Little River National Wildlife Refuge (LRNWR), located in McCurtain County, identified three major forest types: *Quercus phellos, Carpinus caroliniana,* and *Taxodium distichum*. Co-dominant trees at the LRNWR included *A. rubrum, Liquidambar styraciflua,* and *Quercus alba* (Hoagland et al. 1996).

The objective of this study was to quantify species composition and aspects of forest community structure at the TRNA of

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the Ouachita National Forest. The data collected are intended to serve as a baseline for analysis of temporal change in bottomland hardwood forests. This research area occupies 80.9 ha in North Caney Creek, McCurtain County, Oklahoma (Fig. 1). It was established in June of 1990 to protect the bottomland hardwood forest community and was the first Research Natural Area representing the Society of American Foresters (SAF) type 88 willow oak - water oak - diamondleaf oak cover type (Devall 1989).

The TRNA is located within the UGCP physiographic province of southeastern Oklahoma (Hunt 1974, Curtis et al. 2008). The region is composed of deep alluvial deposits underlain by limestones and shales of the Washita and Kiamichi formations (Davis 1960). Relief ranges from 100.9 to 102.1 m above sea-level. Soils are composed of deep alluvial deposits of Guyton silt loam group, a poorly drained soil type found on floodplains throughout southeastern McCurtain County (Reasoner 1974). The climate is Subtropical Humid (Trewartha 1968) with warm humid summers and a mean July temperature of 26.9 °C (80 °F) and short, mild winters with a mean January temperature of 4.0 °C (39 °F). Mean annual precipitation is 136 cm (53.5 in.; Oklahoma Climatological Survey 2009).

METHODS

In order to evaluate habitat structure and establish baseline stand conditions, it is necessary to collect data listing the species present, the number of individuals, and area occupied. These types of data are of use to ecologists, foresters, and zoologists, as well as botanists.

Prior to field data collection, the locations of macroplots were equidistantly spaced and established on a 1:24,000 scale topographic map. Macroplots were then located and established in the field. Plots were established in April of 1993 and data collected in late April, mid July, and early October of the 1993 field season.

Understory Vegetation data were collected from units referred to as macroplots, each of which measured 12 m x 8 m with long axis oriented north to south. Microplots, measuring 1.0 m x 1.0 m, were placed in each corner of each macroplot. All species present in the microplot were recorded and percent cover visually estimated in 5% increments. The percent cover of bryophytes, forest litter, open water, and exposed soil was recorded. Cover data for ferns, fern-allies, and herbaceous angiosperms were also recorded.

Data for **Tree Saplings and Shrub** species were collected from a subplot within the macroplot measuring 8.0 m x 6.0 m.(26.25 ft. x 19.69 ft). Woody species were assigned to the following classes based on diameter-at-breast-height (DBH): CL1 = 0 - 2.0 cm, CL2 = 2.1- 6.0 cm, and CL3 = 6.1 - 10.0 cm. These data were collected to characterize shrub composition and regeneration potential of canopy tree species.

Data for **Mid-level and Canopy** species were collected from the entire macroplot. The species names of all trees in the macroplot were recorded and the height of each estimated and assigned to the mid-level category, defined as trees and shrubs 3.0 - 15.0m in height; or "canopy", defined as trees in excess of 15.1 m in height. Taxonomy follows that of the USDA Plants Database (USDA-NRCS 2009). No voucher specimens were prepared.

RESULTS AND DISCUSSION

One hundred fifty-two taxa of woody and herbaceous plants were encountered at the TRNA in the 1993 field season. Thirty-four were trees or shrubs (22.4%), 12 woody vines (7.9%), and 106 were herbaceous plants (69.7%). There were 134 (89.3%) perennials, 11 (7.3%) annuals, and 6 (4.0%) biennials. *Carex* and *Quercus* were the

largest genera with 10 and 7 species, respectively. *Galium aparine*, *Lonicera japonica, Morus alba, Vicia villosa,* and *Trifolium dubium* were non-native species present at the TNRA. The Oklahoma Natural Heritage Inventory (2009) tracks nine species at the TRNA as state rare, though globally secure: *Aralia spinosa* (G5S1S2), *Aristolochia reticulata* (G4S2), *Bignonia capreolata* (G5S1), *Carex debilis* (G5S1), *Desmodium pauciflorum* (G5S1), *Justicia ovata* (G5S?), *Quercus texana* (G4G5S1), *Triadenum tubulosum* (G4S1S2), and *Uvularia sessilifolia* (G5S1). No federally listed threatened or endangered species were present.

Understory Vegetation

Of the 152 species encountered in the microplots, 44 (28.9%) were recorded from all three sample dates, 50 (32.9%) in two seasons, and 58 (38.2%) in one season only (Table 1). Of the taxa recorded in one season, 23 (39.7%) were in spring only, 21(36.2%) in summer, and 14 (24.3%) only in fall. The highest mean covers were "litter" (49.2%) and "exposed soil" (16.20%).

Seven plant taxa scored annual mean cover values greater than 1.0%: *Toxicodendron radicans* (5.33%), *Arundinaria gigantea* (2.23%), *Vitis vulpina* (1.94%), *Parthenocissus quinquefolia* (1.75%), *Quercus phellos* seedlings (1.63%), *Carex* sp. (1.20%), and *Acer rubrum* (1.15%). A total of 11 *Carex* species were identified, with mean cover values ranging from 0.55% (*C. gravida*) to 0.01% (*C. laxiflora*).

Mean cover values for each sample period were comparable; spring, 41%; summer, 38%; fall, 33%. There was greater variance in the number of species encountered between sampling periods. The most species were recorded for the summer (108), followed closely by the spring (101), and fall (83). *Toxicodendron radicans* had the highest mean cover for all three sampling periods. In the spring, *T. radicans* (6.94%), *Parthenocissus quinquefolia* (3.5%), and *Vitis vulpina* (3.46%) had the largest average cover. Likewise in the summer, *Toxicodendron radicans* (7.58%) had a substantially larger cover average value than *Arundinaria gigantea* (3.82%) and *Quercus phellos* seedlings (2.43%). Fewer species were recorded in the fall. Only in the fall data did other species outscore *T. radicans* in average cover: *A. gigantea* (2.01%), *Carex* sp. (1.74%), *Q. phellos* (1.65%) and *Q. nigra* (1.50%) seedling *T. radicans* (1.47%), and *Chasmanthium latifolium* (1.46%). Nevertheless, litter and bare ground had the highest percent cover in all seasons.

Tree Sapling and Shrub

Nineteen woody species and 281 stems were recorded in the shrub/sapling plots (Table 2). All 19 species were represented in CL1, but only 13 in CL2 and 10 in CL3. Nine species occurred in all three DBH classes; *Acer rubrum, A. saccharum, Carpinus caroliniana, Carya alba, C. texana, Cornus florida, Fraxinus americana, Liquidambar styraciflua,* and *Nyssa sylvatica*. With the exception of *C. texana*, these species are typical of bottomland forest habitats on the UGCP.

Each of the three species with 20 or more stems represents one level in the forest: *Rhododendron canescens*, shrub; *Ostrya virginiana*, mid-level; and *Nyssa sylvatica*, canopy. No tree species exceeded 20 stems in the remaining DBH classes. *Liquidambar styraciflua*, a species of second growth bottomland forests, had the greatest number of stems in CL2 and *Carpinus caroliniana*, a common understory tree of bottomland forests, in CL3.

Mid-level and Canopy

Twenty-three species and 3,797 stems were included in the two height categories (Table 3). Twelve species occurred in both the mid-level and canopy categories. Twenty-two species and the majority of stems (2,087; 55%) were in the mid-level category. *Liquidambar styraciflua* had the most

stems (385; 18.4%). The stem counts for *Acer rubrum* (275, 13.2%), *C. texana* (245, 11.7%), *Q. alba* (220, 10.5%), and *N. sylvatica* (210, 10.1%) were also high, but substantially less than *L. styraciflua*.

The canopy category consisted of 12 species and 1,710 (45%) stems. *Quercus texana* was the only species in the canopy category that was not in the mid-level category. *Quercus lyrata* (330 stems, 19.3%) and *Q. phellos* (315 stems, 18.4%) were the most abundant species in the canopy layer. *Quercus rubra* (265 stems, 15.5%) and *Liquidambar styraciflua* (260 stems, 15.2%) were also common in the canopy of TRNA. *Acer rubrum*, represented by 275 stems in the mid-level, had only 30 stems (1.8%) in the canopy. Of the most prominent trees in the mid-level, only *Quercus alba* had similar numbers of stems in the canopy (220 vs. 195).

CONCLUSIONS

Fewer woody plant species were found at the TRNA (27) than the Little River National Wildlife Refuge (LRNWR; 47; Hoagland et al. 1996). Furthermore, with the exception of *Asimina triloba* and *Rhododendron canescens*, all woody species reported from TRNA were present at the LRWNR. The disparity in species numbers is intriguing. Although the LRNWR is larger than the TRNA, it was sampled with fewer plots. The greater number of species at LRNWR might reflect a higher degree of habitat variability. The TRNA is predominately inundated to seasonally inundated habitat, but also includes upland vegetation, though limited to the southeast (plots 4, 5, 8, and 9) and northeast corners of the site (plots 19, 20, 21, and 22; see Fig. 1).

The macroplot approach adopted for this study was successful for assessing the predominant plant species present at the TRNA, and data collected from microplots for herbaceous species were informative. However there are shortcomings in the types of data collected for woody plant species. Rather than assigning species to pre-established classes, actual measurement of tree and shrub DBH and height would allow for thorough analysis of woody species composition and forest structure. Likewise, a detailed inventory of vascular plants in the TRNA would benefit future monitoring projects.

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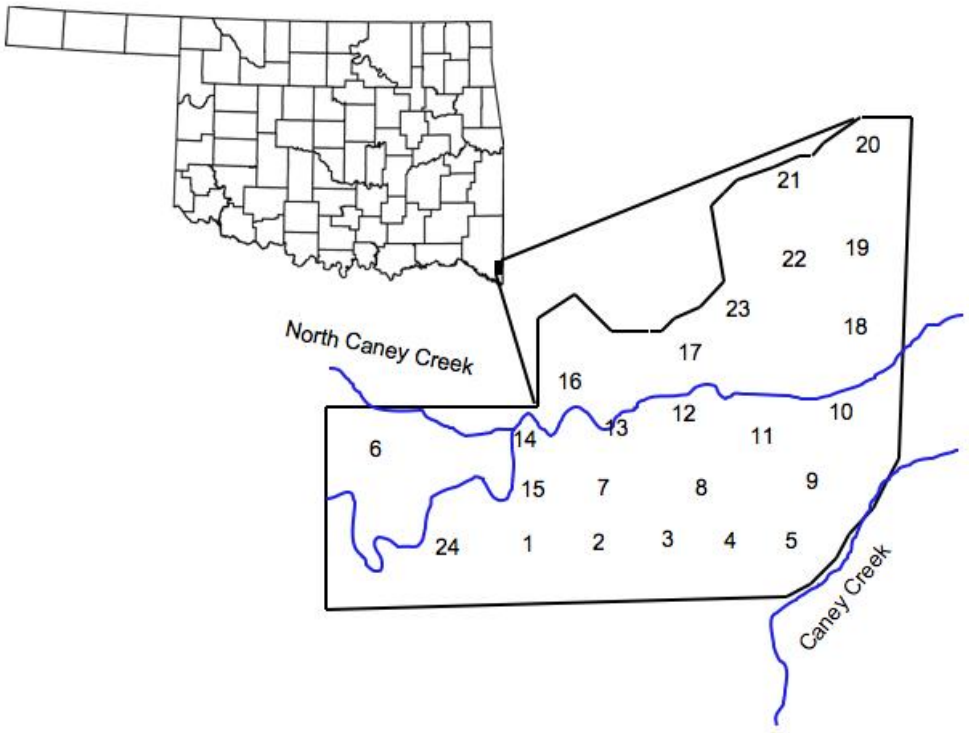

Figure Location of the Tiak Research Natural Area, Ouachita National Forest, McCurtain County, Oklahoma. Numbers indicate locations of macroplots.

Table 1 Species composition of microplots at the Tiak Research Natural Area, Ouachita National Forest, McCurtain County, Oklahoma. Columns denoted represent average cover value for all seasons (MEAN), number of macroplots (n=24) in which a species was encountered (FREQ), and percentage or relative frequency (RF) of macroplots in which a species occurred. The remaining columns provided the same data for the spring (April), summer (July), and fall (October) sampling periods.

	ANNUAL			SPRING			SUMMER			FALL		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
Acalypha rhomboidea	0.04	2	8.3	0.02	1	4	0.01	1	4	0.10	1	4
Acer rubrum	1.15	19	79.2	1.42	14	58	1.29	12	50	0.74	14	58
Acer saccharum	0.24	7	29.2	0.04	1	4	0.38	5	21	0.30	6	25
Agrimonia parviflora	0.09	2	8.3	0.23	2	8	0.04	1	4	0.00	0	0
Agrostis hyemalis	0.08	3	12.5	0.00	0	0	0.13	2	8	0.10	3	13
Allium canadense	0.14	5	20.8	0.41	6	25	0.00	0	0	0.00	0	0
Aralia spinosa	0.01	1	0.0	0.00	0	0	0.04	1	4	0.00	0	0
Arisaema dracontium	0.01	2	8.3	0.04	2	8	0.00	0	0	0.00	0	0
Aristida sp.	0.23	1	4.2	0.00	0	0	0.68	2	8	0.00	0	0
Aristolochia reticulata	0.04	2	8.3	0.00	0	0	0.05	1	4	0.06	2	8
Arundinaria gigiantea	2.23	11	45.8	0.84	9	38	3.82	8	33	2.01	10	42
Asimina triloba	0.20	4	16.7	0.17	3	13	0.13	3	13	0.30	4	17
Athyrium filix-femina	0.01	1	4.2	0.04	1	4	0.00	0	0	0.00	0	0

	ANNUAL			SPRING			SUMMER			FALL		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
Berchemia scandens	0.56	11	45.8	0.56	8	33	0.54	7	29	0.58	10	42
Betula nigra	0.03	1	4.2	0.00	0	0	0.00	0	0	0.10	1	4
Bignonia capreolata	0.28	5	20.8	0.00	0	0	0.26	3	13	0.59	5	21
Boehmeria cylindrica	0.30	4	16.7	0.00	0	0	0.78	5	21	0.12	4	17
Botrychium virginianum	0.11	5	20.8	0.05	1	4	0.00	0	0	0.27	7	29
Callicarpa americana	0.19	6	25.0	0.04	1	4	0.25	6	25	0.27	7	29
Campsis radicans	0.39	8	33.3	0.00	0	0	0.61	5	21	0.56	8	33
Carex complanata	0.55	15	62.5	1.54	14	58	0.00	0	0	0.10	1	4
Carex debilis	0.36	6	25.0	1.07	1	4	0.00	0	0	0.00	0	0
Carex gravida	0.65	18	75.0	0.81	11	46	0.51	10	42	0.63	12	50
Carex grayi	0.07	1	4.2	0.00	0	0	0.22	1	4	0.00	0	0
Carex intumescens	0.38	11	45.8	0.74	8	33	0.00	0	0	0.40	7	29
Carex laxiflora	0.01	0	0.0	0.00	0	0	0.02	1	4	0.00	0	0
Carex lupulina	0.54	15	62.5	0.10	2	8	1.35	13	54	0.18	2	8
Carex oligocarpa	0.18	9	37.5	0.00	0	0	0.43	8	33	0.10	1	4

	ANNUAL			SPRING			SUMMER			FALL		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
Carex sp.	1.20	21	87.5	1.67	1	4	0.19	2	8	1.74	14	58
Carex squarrosa	0.03	3	12.5	0.04	1	4	0.06	2	8	0.00	0	0
Carex tribuloides	0.28	5	20.8	0.00	0	0	0.83	1	4	0.00	0	0
Carpinus caroliniana	0.39	10	41.7	0.42	5	21	0.38	6	25	0.39	4	17
Carya alba	0.05	4	16.7	0.02	1	4	0.13	3	13	0.00	0	0
Carya aquatica	0.05	3	12.5	0.11	2	8	0.04	1	4	0.00	0	0
Carya sp.	0.19	9	37.5	0.15	5	21	0.00	0	0	0.42	10	42
Carya texana	0.26	12	50.0	0.23	3	13	0.45	12	50	0.10	1	4
Cercis canadensis	0.05	1	4.2	0.06	1	4	0.00	0	0	0.10	1	4
Chasmanthium latifolium	0.05	2	8.3	0.00	1	4	0.15	2	8	0.00	0	0
Chasmanthium laxum	0.40	8	33.3	0.05	1	4	1.14	9	38	0.00	0	0
Chasmanthium sessiliflorum	0.53	10	41.7	0.00	0	0	0.12	2	8	1.46	11	46
Clitoria mariana	0.04	2	8.3	0.00	0	0	0.05	2	8	0.08	2	8
Convolvulus sp.	0.02	1	4.2	0.00	0	0	0.06	2	8	0.00	0	0
Cornus florida	0.15	7	29.2	0.24	6	25	0.21	3	13	0.00	0	0

	ANNUAL			SPRING			SUMMER			FALL		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
Crataegus marshallii	0.17	2	8.3	0.26	3	13	0.12	3	13	0.14	3	13
Desmodium nudiflorum	0.07	2	8.3	0.00	0	0	0.10	2	8	0.10	1	4
Desmodium pauciflorum	0.03	1	4.2	0.00	0	0	0.00	0	0	0.10	2	8
Desmodium sp.	0.08	4	16.7	0.00	0	0	0.13	4	17	0.10	1	4
Dichanthelium acuminatum var. *fasciculatum*	0.01	2	8.3	0.00	0	0	0.03	2	8	0.00	0	0
Dichanthelium boscii	0.18	12	50.0	0.03	1	4	0.52	12	50	0.00	0	0
Dioscorea quaternata	0.68	16	66.7	0.95	10	42	0.98	14	58	0.10	1	4
Diospyros virginiana	0.07	3	12.5	0.11	2	8	0.00	0	0	0.08	2	8
Elephantopus carolinianus	0.12	6	25.0	0.00	0	0	0.23	5	21	0.13	5	21
Elephantopus tomentosus	0.01	2	8.3	0.00	0	0	0.04	1	4	0.00	0	0
Elymus virginicus	0.02	0	0.0	0.05	1	4	0.00	0	0	0.00	0	0
Euonymus americana	0.16	7	29.2	0.07	2	8	0.27	6	25	0.13	4	17
Fraxinus americana	0.07	3	12.5	0.13	1	4	0.04	1	4	0.05	1	4
Galium aparine	0.07	5	20.8	0.13	2	8	0.08	3	13	0.00	0	0

	ANNUAL			SPRING			SUMMER			FALL		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
Galium circaezans	0.08	3	12.5	0.24	4	17	0.00	0	0	0.00	0	0
Galium concinnum	0.14	6	25.0	0.42	6	25	0.00	0	0	0.00	0	0
Geum canadense	0.15	6	25.0	0.26	3	13	0.10	3	13	0.10	2	8
Gillenia stipulata	0.01	1	4.2	0.00	0	0	0.02	1	4	0.00	0	0
Gratiola neglecta	0.03	2	8.3	0.08	2	8	0.00	0	0	0.00	0	0
Hypericum hypericoides	0.17	6	25.0	0.05	1	4	0.15	5	21	0.29	7	29
Hypericum mutilum	0.03	0	0.0	0.00	0	0	0.00	0	0	0.10	0	0
Hypericum punctatum	0.03	1	4.2	0.00	0	0	0.00	0	0	0.10	1	4
Ilex opaca	0.14	4	16.7	0.11	3	13	0.17	3	13	0.14	4	17
Impatiens capensis	0.50	13	54.2	1.49	13	54	0.00	0	0	0.00	0	0
Juncus coriaceus	0.01	1	4.2	0.04	1	4	0.00	0	0	0.00	0	0
Justicia ovata	0.64	5	20.8	1.62	1	4	0.20	4	17	0.09	2	8
Lactuca canadensis	0.02	2	8.3	0.03	2	8	0.04	1	4	0.00	0	0
Lactuca floridana	0.03	3	12.5	0.06	2	8	0.02	1	4	0.00	0	0
Lactuca sp.	0.01	1	4.2	0.00	0	0	0.04	1	4	0.00	0	0

	ANNUAL			SPRING			SUMMER			FALL		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
Liquidambar styraciflua	0.43	15	62.5	0.30	9	38	0.42	11	46	0.56	13	54
Lonicera japonica	0.03	2	8.3	0.00	0	0	0.00	0	0	0.08	3	13
Maianthemum racemosum	0.03	1	4.2	0.06	1	4	0.02	1	4	0.00	0	0
Matelea biflora	0.08	3	12.5	0.23	3	13	0.00	0	0	0.00	0	0
Mitchella repens	0.23	7	29.2	0.11	3	13	0.15	2	8	0.44	6	25
Monarda punctata	0.02	1	4.2	0.00	0	0	0.00	0	0	0.05	1	4
Monarda sp.	0.03	1	4.2	0.00	0	0	0.00	0	0	0.10	1	4
Monarda russeliana	0.01	0	0.0	0.00	0	0	0.04	1	4	0.00	0	0
Morus alba	0.05	2	8.3	0.04	1	4	0.02	1	4	0.10	1	4
Morus rubra	0.03	1	4.2	0.00	0	0	0.00	0	0	0.10	1	4
Muhlenbergia sp.	0.03	2	8.3	0.00	0	0	0.08	2	8	0.00	0	0
Nyssa sylvatica	0.12	6	25.0	0.00	0	0	0.31	5	21	0.05	2	8
Oligoneuron nitidum	0.19	0	0.0	0.09	2	8	0.26	1	4	0.20	2	8
Onoclea sensibilis	0.02	2	8.3	0.04	1	4	0.01	1	4	0.00	0	0
Ostrya virginiana	0.42	8	33.3	0.50	7	29	0.66	5	21	0.10	1	4

	ANNUAL			SPRING			SUMMER			FALL		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
Oxalis stricta	0.13	9	37.5	0.40	10	42	0.00	0	0	0.00	0	0
Packera obovata	0.02	2	8.3	0.02	1	4	0.04	1	4	0.00	0	0
Panium anceps	0.25	12	50.0	0.56	10	42	0.00	0	0	0.19	5	21
Parthenocissus quinquefolia	1.75	16	66.7	3.50	15	63	1.64	12	50	0.10	1	4
Passiflora lutea	0.09	7	29.2	0.00	0	0	0.18	6	25	0.10	2	8
Penstemon digitalis	0.09	1	4.2	0.24	3	13	0.04	1	4	0.00	0	0
Penthorum sedoides	0.02	1	4.2	0.00	0	0	0.05	1	4	0.00	0	0
Poa autumnalis	0.14	9	37.5	0.31	7	29	0.11	2	8	0.00	0	0
Podophyllum peltatum	0.01	1	4.2	0.02	1	4	0.00	0	0	0.00	0	0
Polygonatum biflorum	0.01	1	4.2	0.00	0	0	0.01	1	4	0.00	0	0
Polygonum hydropiperoides	0.01	1	4.2	0.00	0	0	0.02	1	4	0.00	0	0
Polygonum virginianum	0.17	5	20.8	0.11	2	8	0.18	5	21	0.21	6	25
Prunella vulgaris	0.01	1	4.2	0.00	0	0	0.03	1	4	0.00	0	0
Prunus serotina	0.05	2	8.3	0.06	2	8	0.04	1	4	0.05	2	8
Pycnanthemum tenufolium	0.04	1	4.2	0.08	2	8	0.04	1	4	0.00	0	0

	ANNUAL			SPRING			SUMMER			FALL		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
Quercus alba	0.23	10	41.7	0.20	6	25	0.40	9	38	0.10	2	8
Quercus lyrata	0.05	4	16.7	0.00	0	0	0.10	5	21	0.06	1	4
Quercus nigra	0.92	17	70.8	0.32	7	29	0.95	13	54	1.50	13	54
Quercus phellos	1.63	20	83.3	0.83	18	75	2.43	13	54	1.65	10	42
Quercus rubra	0.02	3	12.5	0.05	3	13	0.01	1	4	0.00	0	0
Quercus sp.	0.33	16	66.7	0.36	11	4	0.00	0	0	0.62	11	46
Quercus velutina	0.11	1	4.2	0.33	1	4	0.00	0	0	0.00	0	0
Ranunculus abortivus	0.03	3	12.5	0.10	3	13	0.00	0	0	0.00	0	0
Rhododendron canescens	0.24	6	25.0	0.40	6	25	0.20	3	13	0.14	2	8
Rosa sp.	0.05	3	12.5	0.03	1	4	0.05	2	8	0.06	3	13
Rubus trivalis	0.29	9	37.5	0.38	6	25	0.20	2	8	0.30	6	25
Salvia lyrata	0.03	3	12.5	0.06	3	13	0.03	2	8	0.00	0	0
Sanicula canadensis	0.04	4	16.7	0.00	0	0	0.13	5	21	0.00	0	0
Sassifras albidum	0.03	1	4.2	0.07	1	4	0.02	1	4	0.00	0	0
Saururus cernuus	0.33	3	12.5	0.25	2	8	0.47	3	13	0.26	1	4

	ANNUAL			SPRING			SUMMER			FALL		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
Scleria oligantha	0.18	8	33.3	0.00	0	0	0.55	9	38	0.00	0	0
Sisyrinchium angustifolium	0.01	1	4.2	0.03	1	4	0.00	0	0	0.00	0	0
Smilax bona-nox	0.24	14	58.3	0.34	10	42	0.37	9	38	0.00	0	0
Smilax glauca	0.32	16	66.7	0.05	1	4	0.15	3	13	0.76	17	71
Smilax rotundifolia	0.48	18	75.0	0.35	11	46	0.70	15	63	0.39	9	38
Smilax sp.	0.05	4	16.7	0.00	0	0	0.06	3	13	0.10	1	4
Solidago sp.	0.09	2	8.3	0.00	0	0	0.00	5	21	0.28	3	13
Symphyotrichum cordifolium	0.02	1	4.2	0.00	0	0	0.05	1	4	0.00	0	0
Symphyotrichum praealtum	0.08	3	12.5	0.05	1	4	0.18	4	17	0.02	1	4
Symphyotrichum pratens	0.01	0	0.0	0.00	0	0	0.04	1	4	0.00	0	0
Symphyotrichum sp.	0.18	4	16.7	0.10	1	4	0.02	1	4	0.41	4	17
Thalictrum thalictroides	0.02	1	4.2	0.03	1	4	0.04	1	4	0.00	0	0
Tilia americana	0.17	4	16.7	0.31	1	4	0.10	3	13	0.50	1	4
Toxicodendron radicans	5.33	21	87.5	6.94	19	79	7.58	18	75	1.47	16	67
Tradescantia ohiensis	0.10	2	8.3	0.23	3	13	0.06	2	8	0.00	0	0

	ANNUAL			SPRING			SUMMER			FALL		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
Triadenum tubulosum	0.19	2	8.3	0.00	0	0	0.35	3	13	0.22	2	8
Trifolium dubium	0.03	0	0.0	0.00	0	0	0.00	0	0	0.10	1	4
Ulmus alata	0.03	2	8.3	0.00	0	0	0.00	0	0	0.08	2	8
Ulmus rubra	0.18	10	41.7	0.00	0	0	0.00	0	0	0.54	12	50
Ulmus serotina	0.11	5	20.8	0.10	1	4	0.21	6	25	0.00	0	0
Uvularia sessiliflora	0.01	1	4.2	0.04	1	4	0.00	0	0	0.00	0	0
Vaccinium corymbosum	0.05	2	8.3	0.04	1	4	0.10	1	4	0.00	0	0
Vaccinium stamineum	0.60	3	12.5	0.21	3	13	0.94	3	13	0.65	4	17
Viburnum rufidulum	0.02	1	4.2	0.06	1	4	0.00	0	0	0.00	0	0
Vicia villosa	0.02	2	8.3	0.05	2	8	0.00	1	4	0.00	1	4
Viola bicolor	0.33	13	54.2	0.99	13	54	0.00	0	0	0.00	0	0
Viola pubescens	0.01	1	4.2	0.02	1	4	0.00	0	0	0.00	0	0
Viola sp.	0.05	3	12.5	0.05	1	4	0.11	4	17	0.00	0	0
Vitis aestivalis	0.12	2	8.3	0.03	1	4	0.25	2	8	0.08	1	4
Vitis vulpina	1.94	19	79.2	3.46	13	54	1.02	13	54	1.34	18	75

	ANNUAL			SPRING			SUMMER			FALL		
	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF	MEAN	FREQ	RF
Woodwardia areolata	0.13	2	8.3	0.00	0	0	0.33	2	8	0.05	1	4
Zizea aurea	0.08	4	16.7	0.23	4	17	0.00	0	0	0.00	0	0
Bryophytes	4.61	8	33.3	3.87	5	21	5.95	8	33	4.01	7	29
Exposed soil	16.29	20	83.3	18.19	18	75	20.02	20	83	10.65	20	83
Organic litter	49.24	19	79.2	18.19	19	79	57.57	22	92	71.98	19	79
Pooled water	1.90	4	16.7	2.53	3	13	0.04	1	4	3.13	1	4

Table 2 Tree sapling and shrub species composition at the Tiak Research Natural Area, Ouachita National Forest, McCurtain County, Oklahoma. Columns denoted number of stems within each DBH class (CL1 = 0-2.0 cm, CL2 = 2.1-6.0 cm, and CL3 = 6.1-10.0 cm), number of macroplots (n=24) in which a species was encountered (FREQ), and percentage or relative frequency (RF)of macroplots in which a species occurred.

	CL1			CL2			CL3		
	#Stems	FREQ	RF	#Stems	FREQ	RF	#Stems	FREQ	RF
Acer rubrum	15	11	45.8	3	2	8.3	5	4	16.7
Acer saccharum	16	5	20.8	3	1	4.2	2	2	8.3
Asimina triloba	4	1	4.2	0	0	0.0	0	0	0.0
Carpinus caroliniana	19	8	33.3	7	7	29.2	8	7	29.2
Carya alba	11	6	25.0	7	6	25.0	6	5	20.8
Carya aquatica	1	1	4.2	0	0	0.0	0	0	0.0
Carya texana	12	9	37.5	9	6	25.0	2	2	8.3
Cersis canadensis	3	1	4.2	0	0	0.0	0	0	0.0
Cornus florida	6	3	12.5	1	1	4.2	1	1	4.2
Euonymus americana	1	1	4.2	0	0	0.0	0	0	0.0

	CL1			CL2			CL3		
	#Stems	FREQ	RF	#Stems	FREQ	RF	#Stems	FREQ	RF
Fraxinus americana	2	2	8.3	2	2	8.3	1	1	4.2
Ilex opaca	8	5	20.8	1	1	4.2	0	0	0.0
Liquidambar styraciflua	7	6	25.0	10	5	20.8	6	5	20.8
Nyssa sylvatica	25	12	50.0	8	5	20.8	5	4	16.7
Ostrya virginiana	21	9	37.5	1	1	4.2	0	0	0.0
Quercus alba	3	3	12.5	0	0	0.0	1	1	4.2
Quercus nigra	1	1	4.2	0	0	0.0	0	0	0.0
Rhododendron canescens	21	4	16.7	1	1	4.2	0	0	0.0
Ulmus alata	7	4	16.7	7	4	16.7	0	0	0.0
Total stems	184			60			37		

Table 3 Woody species composition within Mid-level and Canopy height classes at the Tiak Research Natural Area, Ouachita National Forest, McCurtain County, Oklahoma. Mid-level woody plants are defined as trees and shrubs 3-15 m in height and Canopy as trees in excess of 16 m. The first column in each category represents the number of macroplots (n=24) in which a species was encountered (FREQ), followed by the percentage or relative frequency (RF) of macroplots in which a species occurred, the total number of stems (#Stems) and mean number of stems (MStems) for a species.

	Mid-level				Canopy			
	FREQ	RF	#Stems	MStems	FREQ	RF	#Stems	MStems
Acer rubrum	10	42	275	11.4	0	0	30	1.2
Acer saccharum	3	13	55	2.3	0	0	0	0.0
Carpinus caroliniana	4	17	100	4.2	0	0	0	0.0
Carya alba	4	17	105	4.4	0	0	0	0.0
Carya aquatica	1	4	35	1.5	1	4	40	1.7
Carya texana	11	46	245	10.2	1	4	25	1.0
Cornus florida	3	13	15	0.6	0	0	0	0.0
Euonymus americana	1	4	20	0.8	0	0	0	0.0
Fraxinus americana		4	25	1.0	0	0	0	0.0
Ilex opaca	2	8	45	1.9	0	0	0	0.0

	Mid-level				Canopy			
	FREQ	RF	#Stems	MStems	FREQ	RF	#Stems	MStems
Liquidambar styraciflua	13	54	385	16.0	9	38	260	10.8
Nyssa sylvatica	10	42	210	8.8	2	8	45	1.9
Ostrya virginiana	2	8	65	2.7	0	0	0	0.0
Quercus alba	8	33	220	9.2	6	25	195	8.1
Quercus lyrata	3	13	65	2.7	7	29	330	13.8
Quercus nigra	1	4	15	0.6	2	8	60	2.5
Quercus texana	0	0	0	0.0	2	8	70	2.9
Quercus phellos	3	13	25	1.0	6	25	315	13.1
Quercus rubra	3	13	70	2.9	8	33	265	11.0
Quercus sp.	1	4	15	0.6	3	13	45	1.9
Rhododendron canescens	2	8	35	1.5	0	0	0	0.0

	Mid-level				Canopy			
	FREQ	RF	#Stems	MStems	FREQ	RF	#Stems	MStems
Tilia americana	2	8	17	0.7	0	0	0	0.0
Ulmus serotina	2	8	45	2.7	1	4	30	13.8
Total Stems			2,087				1,710	

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Is Seedling Establishment Very Rare in the Oklahoma Seaside Alder, *Alnus maritima* ssp. *oklahomensis*?

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The Oklahoma seaside alder (*Alnus maritima* ssp. *oklahomensis*) is a shrub that grows almost exclusively in Johnston County. While individuals resprout vigorously from rootstocks, few seedlings have been observed in the wild. We surveyed 1,848 one-meter-square plots of suitable microhabitat at two locations on the Blue River and a location on Pennington Creek. We found only 20 alder seedlings, all of them in their first year, and most of them in unsuitable, shaded conditions. These observations are consistent with the interpretation that, despite its abundant production of viable seeds, the Oklahoma seaside alder has effectively no long-term successful seedling establishment. These observations serve as a basis for seedling establishment experiments planned for the near future.

INTRODUCTION

The Oklahoma seaside alder is one of three subspecies of the seaside alder (Betulaceae: *Alnus maritima* (Marshall) Muhl. ex. Nutt.). All three subspecies are rare and have limited geographical distributions (Schrader and Graves 2002). Subspecies *maritima* J. A. Schrader and W. R. Graves grows in some of the swamps on the Delmarva Peninsula east of Chesapeake Bay; subspecies *georgiensis* J. A. Schrader and W. R. Graves grows in a single swamp in Bartow County, northwestern Georgia; and subspecies *oklahomensis* J. A. Schrader and W. R. Graves grows only along the Blue River and nearby creeks such as Pennington Creek in Johnston County, Oklahoma, and Canyon Creek in Pontotoc County, Oklahoma. A few individuals also occur in Pontotoc County. The three subspecies are genetically distinct and probably represent relicts of a previously widespread species (Gibson, Rice, and Stucke 2008).

In contrast, the hazel alder (*Alnus serrulata* (Aiton) Willdenow) is abundant, growing in swamps, around lakes, and along streams and rivers throughout eastern North America. One reason for its greater abundance appears to be that individuals of *A. serrulata* can persist in partially to completely shaded conditions, whereas *A. maritima* flourishes in mostly to fully sunny conditions (Schrader, Graves, Rice, and Gibson 2006).

The Oklahoma seaside alder (Fig. 1) grows back vigorously from its rootstock after floods. The floods in the summer of 2007 tore away the aboveground stems of many of the plants, but new branches began to grow from the clumps later that summer. Nearly all of the alders grow as clumps of numerous small trunks rather than forming a single trunk. This may perhaps be the result of past flood events. We have seen only two seaside alders in Oklahoma that had single trunks: one on Canyon Creek in Pontotoc County and one on Pennington Creek near Reagan, Oklahoma. They were growing in locations that may have allowed them to escape severe flooding.

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Seaside alder seedlings appear to establish best under moist, sunny conditions, a hypothesis that we plan to test in an upcoming field experiment. Such conditions were probably widespread throughout North America at the end of the most recent ice age. Since the end of the most recent ice age, alder seedling establishment might have been very sporadic, dependent upon occasional disturbances - perhaps on the scale of decades or centuries. If this is the case, we would expect to find alder populations that consist mostly of even-aged stands. Unfortunately, the multi-trunked growth form does not permit an assessment of the age of any individual. Even the rare single-trunked individuals have rotten heartwood.

The apparently rare establishment of seaside alder seedlings contrasts with the production and viability of the seeds. Reproductive *A. maritima* stems produce pendulous male and strobilus-like female catkins. Pollination occurs in early autumn, which is characteristic of *Alnus* subgenus *Clethropsis,* of which *A. maritima* is the only North American representative. The following year, the female catkins expand. In the autumn, brown female catkins open their bracts and release the seeds which are dispersed by water. Each catkin can produce dozens of seeds, and many clumps produce several dozen female catkins. When we have collected seeds for experiments, we have usually had no difficulty obtaining thousands of them. Under artificial conditions nearly all of the seeds germinate and grow into healthy seedlings. We propose that the limited seedling establishment of *A. maritima* in the wild is not the result of poor seed production or viability.

Our hypothesis is that seedling establishment of seaside alder in Oklahoma is extremely rare in a typical growing season. To test this hypothesis, we undertook a thorough search for *A. maritima* seedlings in May 2008, the year following major flooding along the Blue River and the creeks where *A. maritima* grows.

METHODS

Study locations. We selected three locations in Johnston County (Table) that have large populations of *A. maritima.*

- Hughes Crossing of the Blue River is in the Blue River Wildlife Management Area north of Bullard Chapel Road near Tishomingo (N 34° 19' W 96° 35'). Alders grow along both east and west banks and on shallow islands north and south of the crossing. We surveyed riverbank and island substrate on or near the west bank along transects (total length about 1.2 kilometers) about one-half kilometer north and one-half kilometer south of the crossing (designated Area 1 by the Oklahoma Department of Wildlife Conservation), as well as a short transect (about 0.2 kilometer) about a kilometer north of the crossing (designated Area 2 by the Oklahoma Department of Wildlife Conservation).
- State Highway 7 crosses the Blue River in the Blue River Wildlife Management Area (N 34° 21' W 96° 35'). Footpaths lead to the river on its east and west banks, both north and south of the bridge. Alders are abundant along the banks and on shallow islands in all of these locations. We surveyed riverbank and island substrate on or near the west bank along transects (total length about one-half kilometer) about a kilometer north of the highway.
- Reagan Road crosses Pennington Creek near Reagan, OK (N 34° 21'

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W 96° 41'). Alders are moderately abundant in this location. We surveyed along a transect about a quarter of a kilometer west of the crossing.

Dominant tree species above the alders were sycamore (*Platanus occidentalis*), American and slippery elms (*Ulmus americana* and *U. rubra*), chinkapin oak (*Quercus muehlenbergi*), walnut (*Juglans nigra*), box elder (*Acer negundo*), persimmon (*Diospyros virginiana*), and white ash (*Fraxinus americana*). Red cedar (*Juniperus virginiana*), redbud (*Cercis canadensis*), rough dogwood (*Cornus drummondii*), buckbrush (*Rhamnus caroliniana*), and chittamwood (*Sideroxylon lanuginosa*) were also common.

The Blue River and Pennington Creek populations are in different watersheds despite their proximity, and are genetically distinct (Gibson, Rice, and Stucke 2008).

Survey method. We searched for seedlings in 1,848 plots, each approximately 1 m^2 in size based on visual estimation. This method, though not precise, was adequate for this survey, given the very low abundance of alder seedlings. We conducted the surveys on 11 and 12 May 2008.

Choice of survey locations. Along the transects within each of the three study areas, we looked for alder seedlings in each meter-square plot that met the following characteristics:

- Large reproductive alders were nearby. Our major interest is to eventually understand regeneration within existing alder populations.
- There was evidence of recent flooding.
- Seedlings of other species were growing. We did not examine locations in which seedlings would have been unable to grow, such as rocks or flotsam.
- Other herbaceous plants (such as sedges) did not form dense stands. Previous surveys have shown that seedlings are unable to grow in these dense stands.

Recognition of alder seedlings. *A. maritima* was the only alder species growing in these locations. We grew seedlings of *A. maritima* (Fig. 2) in order to learn to distinguish their characteristics from those of other seedlings. Alder sprouts could be distinguished from seedlings by their thicker stem and lack of cotyledons.

RESULTS

Most plots contained no alder seedlings. Seedlings were usually solitary, although in one case there were three in close proximity (Figure 3). We located only 20 seedlings in the 1,848 plots. There was therefore an average of 0.01 seedlings per m^2. Considering the rarity of seedlings, the inverse of that value, one seedling in each 92.4 m^2, is easier to conceptualize. There were far fewer seedlings than adults, of which there were hundreds.

DISCUSSION AND CONCLUSION

If this survey method had detected no alder seedlings, our ability to find them might be suspect. The survey took place in the growing season after floods had created new and potentially suitable substrate for seedling germination, although the floods may also have reduced the number of seeds available. The 1,848 plots that we surveyed consisted only of suitable microhabitat. The estimate of one seedling per 92.4 m^2 is therefore a conservative estimate. Although our survey represented only day of one year for each site, our observations were

consistent with our informal surveys in previous years, dating back to 2001.

All of the seedlings were in their first year of growth; we found no older seedlings. Most of the seedlings were in the shade and were unlikely to survive into a second year, given the requirement that *A. maritima* appears to have for bright sunlight (Schrader et al. 2006).

This survey was intended as background to further research. Since it appears that conditions are unsuitable for seedling establishment in the areas where adult Oklahoma seaside alders grow, we now wish to experimentally determine what the conditions of light, substrate, and water depth would be for successful seedling establishment. Because the alders appear to persist only by re-sprouting, preservation of this subspecies appears to require the preservation of the existing adult individuals. It is also possible that we can manipulate substrate conditions in such a way as to encourage seedling recruitment. This is included in the next phase of our research.

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Table Areas surveyed and number of *Alnus maritima* seedlings found in the three locations surveyed in this study.

Location	Area surveyed (m^2)	Number of seedlings	Density seedlings m^{-2}	m^2 per seedling
Hughes Crossing	1329	16	0.012	83.1
State Highway 7	398	3	0.008	132.7
Pennington Creek	121	1	0.008	121.0
Total	1848	20	0.011	92.4

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Figure 1 New stems of an Oklahoma seaside alder (in the center of the photograph) grow profusely when old stems are damaged or destroyed by flooding or other disturbances. This photograph is from a side channel along the Blue River.

Figure 2 This *Alnus maritima* seedling was grown in a pot so that the investigators could compare field seedlings to it.

Figure 3 Three seaside alder seedlings closest to photographer's finger are growing at the Highway 7 location. The seedling further to the right is not an alder.

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Whatever Happened to *Cheilanthes horridula* and *Cheilanthes lindheimeri* in Oklahoma?

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INTRODUCTION

Oklahoma is where several ferns reach their northern or eastern range limits. Among them are two species of lip ferns in the family Pteridaceae, *Cheilanthes horridula* Maxon and *Cheilanthes lindheimeri* Hook (Hoagland et al. 2007). *C. horridula* (prickly lip fern) is primarily found on dry limestone slopes in the Chihuahuan Desert region of northeastern Mexico. Its range extends northward to southwestern Oklahoma. *C. lindheimeri* Hook (fairy swords) is widespread in central and northern Mexico as well as the southwestern United States (Mickel and Smith 2004). In Oklahoma, the distributions of both are limited, and the numbers of individual plants of each species are likely to be relatively small, compared with other Oklahoma members of the genus *Cheilanthes*.

The last record of these two plants in Oklahoma goes back to 1980 for *Cheilanthes horridula* (Figs. 1 and 2) and 1942 for *Cheilanthes lindheimerii* (Figs. 3 and 4). There are only four herbarium sheets of fairy swords in Oklahoma herbaria. All four specimens are from the same collector on the same date:

Cheilanthes lindheimeri Hooker.

- Comanche CO: F.B. McMurry #1273 (OKL). 8/23/1942.
- one s.n. (OKL). 8/23/1942.
- two s.n. (OKLA). 8/23/1942.

Only four collections of the prickly lip fern from the Arbuckle Mountains are known:

Cheilanthes horridula Maxon.

- Murray CO: Unknown, s.n. (OKLA) 11/28/1926.
- Murray CO: H.I. Featherly, s.n. (OKLA) 8/21/1932.
- Murray CO: M. Huft, D. Johnson, and R. Cranfill, #1002. (OKL) 3/7/1980.
- Murray CO: J. and C. Taylor, #28907. (BRIT) 5/15/1980.

As the citations show, the Bebb Herbarium (OKL) in Norman and Oklahoma State University Herbarium (OKLA) in Stillwater have holdings of both species.

If you have seen them, you have seen two of Oklahoma's rarest ferns. According to Amy Buthod at the Bebb Herbarium (pers.com. Nov. 11, 2009), both have been designated SH, since all records are older than 20 years. SH refers to a species that is possibly extirpated and known only from historical records. However, while they are in danger of being extirpated in Oklahoma, both are globally secure in more southern regions. These designations have recently been revised (NatureServe 2008).

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What could explain this rarity? These ferns could still be out there growing in nature but botanists are simply not looking where they are, or do not recognize them, have overlooked them, or perhaps they no longer exist in Oklahoma; they are gone! I prefer the first scenario.

WHERE TO LOOK

Cheilanthes horridula has previously only been reported in the Arbuckle Mountains (Hoagland et al.). I have looked and not found it at Camp Classen and Turner Falls. Both locations are in Murray County in the Arbuckle Mountains. Their rarity there may lie in the fact that these areas are popular sites to visit and send young people to YMCA and church camps. Thus, development and other human impacts may have contributed to the rarity of this species.

Cheilanthes lindheimeri has only been reported in the Wichita Mountains in Comanche County. While both species are xeric ferns growing in rock crevices, *C. horridula* is almost always found on calcareous substrates, whereas plants of *C. lindheimeri* occur on a variety of acidic and mildly basic rock types (Windham and Rabe 1993).

WHAT THEY LOOK LIKE

You will not have a problem getting a positive identification of *Cheilanthes horridula* if you view the adaxial (upper) surface with magnification. The blades are scabrous; with white, pustulate hairs (see Fig. 1). *Cheilanthes lindheimeri* is a little more difficult to identify. It can easily be confused with *Cheilanthes wootonii* Maxon (Figs. 5 and 6), which has a much larger Oklahoma range and has been found in at least four Oklahoma counties including Comanche County (Hoagland et al. 2007)

The quickest way to distinguish between the two is by examining the fronds with magnification. Though technically glabrous, *C. lindheimeri* appears tomentose (hairy) on its adaxial (upper) surface because the scales on the adaxial (lower) surface have relatively long wooly hairs along the margins with tips extending between the beadlike segments onto their upper surface (see Fig. 4). In *C. wootonii*, the beadlike segments of the adaxial surface appear glabrous and the scales on the abaxial surface have fine marginal hairs that are not woolly (see Fig. 5; Windham and Rabe 1993).

CONCLUSION

I hope you will keep a keen eye open for both these ferns when you visit the Arbuckle and Wichita Mountains. Remember that these are rare species and it is important to practice good conservation. If you think you have found either of these two ferns, take careful notes on the number of plants you see and their exact location. Take a set of habit and habitat photos as well as shots of both the abaxial and adaxial frond surfaces. Please contact the Oklahoma Biological Survey at the University of Oklahoma or myself if you think you have found them. I would love to see them.

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Figure 1 Adaxial view of *cheilanthes horridula.* Photo courtesy of P. J. Alexander

Figure 2 Abaxial view of *Cheilanthes horridula.* Photo courtesy of P. J. Alexander

Figure 3 Adaxial view of *Cheilanthes lindheimeri.* Photo courtesy of P. J. Alexander

Figure 4 Abaxial view of *Cheilanthes lindheimeri.* Photo courtesy of P. J. Alexander

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Figure 5 Adaxial view of *Cheilanthes wootonii.* Photo by author.

Figure 6 Abaxial view of *Cheilanthes wootonii.* Photo by author.

(Article facing page.) Introduced to the U.S. in 1876 and widely cultivated after that as an ornamental, kudzu, *Pueraria montana* var. *lobata*, is a vine from Japan that has gained the title of "Scourge of the South". Government agencies promoted kudzu for forage and erosion control for about 30 years, but it easily escaped cultivation. Growing rapidly, about a foot a day, and rooting at nodes, kudzu spreads quickly. Although dying back to the ground during Oklahoma winters, it completely re-covers shrubs and even mature trees the next season. Its invasiveness finally recognized, kudzu was designated first by the USDA as a noxious weed and then listed as a federal noxious weed in 1997. Photo by author.

Kudzu's inflorescence is an axillary raceme in which the pea type flowers are whorled about the stem. It has a grape-leaf. like fragrance which adds to its appeal as an ornamental. Photo by author.

The leaves with 3 leaflets are arranged and often shaped similarly to those of a large poison ivy However, the vine and leaf stalks are covered with stiff hairs. Photo by Bruce Hoagland.

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Critic's Choice

Invasive Plants Versus Oklahoma's Biodiversity

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E. O. Wilson stated that invasive species are second only to habitat loss for reducing biodiversity, and that threat to biodiversity by invasive plants is the subject of this report. For that purpose, the standard definition of invasive species as one that causes harm to humans or other species when introduced to an ecosystem is too broad to be helpful. Under that definition, several native species are classified as invasive because they grow in cultivated fields, but biodiversity does not exist there. Even so, for this purpose, control of invasive plants in agriculture and less so at recreational sites, consumes an estimated $34.5 billion per year in the United States; whereas in natural systems only about $160 million is spent (Pimentel 2002). Herein, we are concerned with the displacement of the species in natural ecosystems.

Invasive plants are not native to the ecosystems that they alter. Their predators are left behind so they are at a competitive advantage in the new setting. Seldom are invasive species naturally introduced. Most are the result of human manipulation. Although most are from other continents, an invasive plant can be a native in one part of the continent but exotic (non-native) in another. Whether from aquatic, riparian, or terrestrial habitats, these plants usually invade only that type of habitat from which they come.

The following story illustrates several points about invasive plants. *Spartina alterniflora* (smooth cordgrass) from the east coast was transported to Willapa Bay, Washington where it proved very invasive and threatened a variety of species by virtue of converting mudflats into grassy meadows. It was thoughtlessly transported along with oyster "spat" to seed Willapa Bay with a replacement for the depleted native oysters. This is an example of the unwitting introduction of an invasive species (*S. alterniflora)* which thrived and the purposeful introduction of a non-native species of oyster that, had it thrived, would have prevented the recovery of the native oyster variety. This story, told so poetically by Florence Caplow (2009), should be read by those wanting a concise, yet thorough education about invasive plants.

Most of our worst invasive plants were introduced either as hitchhikers, like *S. alterniflora*, or purposely transported but with unforeseen consequences. Many are now naturalized and would require enormous funds for eradication and vast amounts of herbicides, possibly with even more unwanted consequences.

In the past, a knowledgeable group of biologists would develop a list of known problem species as well as those species "to watch" in a given area. This often led to watched species being allowed to become naturalized in areas where removal would have been prohibitively expensive for even the more aggressive ones. Now that we recognize that invasive plants cannot be just watched, we are struggling with what controlling them would require. So the emphasis now is to control the spread of those already here and to prevent infestations of new invasive species. This will require monitoring all vulnerable areas and having the mechanism to quickly remove new introductions. This policy is now called early detection/rapid response or simply "ED/RR".

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Furthermore, since non-native species are not all equally invasive, we will first need to develop a ranking system of invasiveness; the inherent ability of the species to spread and displace native species. Such a ranking would provide a rational approach for control so that funds are spent for the most aggressive species first.

However, the threat of reducing biodiversity does not register significant attention at the state level in much of the U.S. For that reason, concerned citizens have established organizations to attempt to control invasive plants in their states. Here, the Oklahoma Invasive Plant Council (OkIPC) was established in 2008. Oklahoma is one of 35 states with an organization composed of interested stakeholders in biodiversity. In affiliation with the Oklahoma Native Plant Society, OkIPC educates Oklahomans about invasive plants and advocates for the efficient and effective management of invasive plants for the protection of the economic and natural resources of Oklahoma's private and public land and water.

To learn more about solutions to the problems of invasive species, visit us at www.ok-invasive-plant-council.org.

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Editorial Policies and Practices

Oklahoma Native Plant Record is published annually by Oklahoma Native Plant Society. Submission for publication in the journal is open to all. Manuscripts will be accepted on topics related to Oklahoma's regional botany, including historical research reports, current research articles, site record species lists, and descriptions of new or important species sightings in Oklahoma. Oklahoma's environmental gradients of human impact, climate, and elevation make us a prime target for research on habitat edges, species ranges, and edge species, therefore, articles of other themes may be included as well. Research overlooked by journals of broader geographic regions will be considered for publication in the Record.

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Manuscripts will be reviewed for content and appropriateness by at least two reviewers. The title page should state the affiliation and complete addresses of all authors and telephone number or email address for the corresponding author. Research and technical papers should include a one-paragraph abstract of not more than 250 words. It should concisely state the goals, principal results, and major conclusions of the paper. All references, figures, and tables should be cited in the text. Site descriptions should include latitude, longitude, total area and elevation. Common names should be referenced to a scientific name using nomenclature that has been revised according to the National Plant Data Center, Baton Rouge, LA (http://plants.usda.gov) and organized based on the Angiosperm Phylogeny Group, Missouri Botanical Gardens http://www.mobot.org/MOBOT/research/APweb/). Abbreviations of authorities for scientific names should follow Authors of Plant Names (Brummitt and Powell 1992). Titles of periodicals should be abbreviated following Botanico-Peridoicum-Huntianum and its supplement except in historic publications when original format will be used.

Authors with access to PC-compatible microcomputers are encouraged to send a copy of the manuscript on CD or as an email file attachment. If the manuscript is typed, manuscripts should be double-spaced on 8 ½ X 11 inch paper with minimum one-inch margins and should be submitted in duplicate. Use no headers, footers, nor auto page numbering. Proof-read and verify taxa numbers before submission. Color photos may be submitted. CDs, email files, or hardcopy manuscripts should be sent to the managing editor at the address below by June 1.

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Five Year Index to *Oklahoma Native Plant Record*

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