



**THE VEGETATION OF OKLAHOMA:  
A CLASSIFICATION FOR LANDSCAPE MAPPING AND  
CONSERVATION PLANNING**

**Bruce Hoagland**

**Oklahoma Natural Heritage Inventory  
And Department of Geography, University of Oklahoma**

**Norman, OK 73019**

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**ABSTRACT** -- A state or regional vegetation classification has become a key component of conservation planning. Unfortunately, a monograph of Oklahoma vegetation has not been produced in fifty years. To redress this issue, extant literature regarding the vegetation of Oklahoma was reviewed. The results were reported in the format of in the Federal Geographic Data Committees vegetation classification protocols so as to be available to the broadest possible audience. A total of 164 publications were reviewed and 151 vegetation associations were recognized. The Ozark Plateau and Panhandle were identified as regions in the state most warranting further investigation. Of Oklahoma's 77 counties, no data were found for Grant and Harper counties.

Resumen – La clasificación de la vegetación regional o estatal se ha convertido en un componente clave de los planes de conservación. Desafortunadamente, no se ha producido una monografía de la vegetación de Oklahoma en cincuenta años. Para enmendar esta asunto, se ha revisado y estudiado la literatura existente con respecto a la vegetación de Oklahoma. Las agencias gubernamentales y organizaciones de conservación han adoptado los protocolos de clasificación de la vegetación de los Comités Regionales de Datos Geográficos (Federal Geographic Data Committees). Además, los resultados se anuncian en un formato que permita su disponibilidad a la mayoría posibles de audiencia. Se han revisado 164 publicaciones y reconocido unas 151 organizaciones. La Placa de Ozark y Panhandle han sido identificados como la regiones del estados que garantizan futuras investigaciones. De los 77 condados de Oklahoma, de tan sólo dos, Grant y Harper, no se encontraron datos disponibles.

**INTRODUCTION**—Vegetation and land-use classification is a process of ordering information to facilitate understanding and interpretation of relationships between units (Bailey et al., 1978; Gauch, 1982; Bailey, 1996). In an applied context, vegetation classification is an important tool in conservation planning. One example is coarse filter conservation planning, a process which uses vegetation classifications to identify examples of natural vegetation within a state or region. The objective is to then acquire representative areas of natural communities to maximize the number of species protected (Brown, 1991; Chaplin et al., 1996).

Probably the most systematic effort to classify vegetation at the state level has been conducted by Natural Heritage Programs (NHP), which serves as a centralized repository for data regarding geographical distribution, status, and trends of sensitive species and unique natural communities (known collectively as “elements”; Groves et al., 1995). These data are garnered by a variety of methods, including field surveys and reviews of museum records and extant literature. Once a list of potential elements (vegetation associations in this case) is prepared, conservation priorities are established through a ranking process (Groves et al., 1995). Thus, a current vegetation classification is paramount to identify and monitor unique natural communities. The earliest monographs of Oklahoma vegetation were prepared by Bruner (1931) and Blair and Hubbell (1938). The first potential vegetation map for Oklahoma was prepared by Duck and Fletcher (1943), with descriptions of vegetation units appearing in a later publication (Duck and Fletcher, 1945). These efforts are of historical significance, but to fulfill conservation goals in Oklahoma a contemporary vegetation monograph is needed, one which amalgamates results of existing studies into a comprehensive classification system.

Objectives of this paper are to provide a review of Oklahoma vegetation and organize this information using the vegetation classification framework developed by the Federal Geographic Data Committee (FGDC, 1997). The results of this study are in a format adopted by many State and Federal agencies and private conservation organizations.

**METHODS – Study Area** – The east-west orientation of Oklahoma, spanning 6.5 degrees of longitude (94°30' west longitude to 103° west), places the state at a biogeographical crossroads between the biotas of the eastern and western United States. There are an estimated 2,549 species of vascular plants in 850 genera and 172 families in Oklahoma (Taylor and Taylor, 1994). Floristic components from the eastern deciduous forest, Great Plains, montane west, and desert southwest are represented in the

state. Vegetation types range from *Juniperus monosperma*-*Pinus edulis* woodlands and shortgrass prairie in the panhandle to mixed oak forests and *Taxodium distichum* swamps in southeast Oklahoma (Fig. 1; Bruner, 1931; Blair and Hubbell, 1938; Caire, 1989). An estimated 24% of the state is forested, the majority of which is located in eastern Oklahoma (Phillips et al., 1959).

Oklahoma is situated along the boundary of the Temperate Continental and the Subtropical Humid climate types (Trewartha, 1968). Weather patterns are strongly influenced by the Rocky Mountains and Gulf of Mexico (Johnson and Duchon, 1995).

Average annual precipitation is inversely related to longitude, decreasing from 1,303 mm in McCurtain Co. in the southeast to 411 mm in Cimarron Co. in the northwest. Average annual precipitation statewide is 848 mm (Oklahoma Climatological Survey, 1998). Periods of extreme drought tend to occur at 20-year intervals (Rice and Penfound, 1959; Harper 1960; Johnson and Risser, 1973). Average annual temperature statewide is 16°C. Temperature and length of growing season decline latitudinally in Oklahoma (Johnson and Duchon, 1995). Highest average winter-low temperature (4.7°C) was reported from the south-central counties of Jefferson and Carter (Oklahoma Climatological Survey, 1998). Highest average monthly temperature typically occurs in July and ranges from 29°C in the southwestern counties of Harmon and Jackson to 25.4°C in Cimarron Co. (Oklahoma Climatological Survey, 1998).

Geology often affects local distribution of plant species and, therefore, vegetation associations (Rhodes, 1980). Elevations above-sea-level in Oklahoma range from 110 meters above sea level in McCurtain Co. to 1,516 meters above sea level in northwest Cimarron Co. The surface geology of Oklahoma is composed primarily of sandstone formations, some areas of which have weathered into unique landforms harboring plant populations of biogeographic significance. For example, the Caddo Canyons, located in Canadian and Caddo counties, are products of deep erosion into Permian sandstone (Suneson and Johnson, 1996). The resulting micro-environment sustains disjunct populations of *Acer saccharum* and other eastern deciduous forest species (Little, 1939; Rice, 1960; Taylor, 1961).

A major vegetation unit, the *Quercus stellata* - *Q. marilandica* forest and woodland in central and east-central Oklahoma, referred to as the Cross Timbers, is associated with sandstone geology and coarse, arenaceous soils. Estimated combined basal areas of *Q. stellata* and *Q. marilandica* account for 70% of the total woody basal area in Oklahoma (Rice and Penfound, 1959). Sandstone formations within the Cross Timbers region are interbed-

ded with shale and, in some cases, limestone. Grasslands persist on clay soils derived from these substrates producing a mosaic of forest, woodland, and grassland (Hoagland et al., 1999).

Surface exposures of dolomite, limestone, and conglomerates are limited. Extensive outcroppings of Devonian-Silurian and Ordovician limestones occur in the Ozark Plateau, Ouachita Mountains, Arbuckle Mountains, and Ardmore basin. In the Arbuckle Mountains, limestone and conglomerates account for the occurrence of calciphilic species common to the Edwards Plateau of Texas, such as *Juniperus ashei*, *Opuntia engelmannii* var. *lindeheimerii*, and *Quercus sinuata* var. *breviloba* (Hopkins, 1941; Dale, 1956). Limestone glades of Mayes Co., in the Ozark uplands, also support populations of *J. ashei* (Little, 1975).

Permian deposits of shale, red sandstone, and white outcrops of gypsum characterize the Gypsum Hills physiographic province. These deposits vary in depth from 305 m to 1,371 m (Branson and Johnson, 1979). The Mangum Gypsum Hills occur in the extreme southwestern counties of Oklahoma. The flora has affinities to the southwestern United States, as characterized by the presence of *Juniperus pinchotii* and *Ziziphus obtusifolia*. This region is dotted with saline springs and salt flats dominated by halophytic wetland species such as *Baccharis salicina*, *Distichlis spicata*, *Scirpus americana*, and *Sporobolus airoides* (Ortenberger and Bird, 1933; Johnson, 1972).

Six major soil groups occur in Oklahoma: Alfisols, Entisols, Inceptisols, Mollisols, Ultisols, Vertisols and stony-rocky land. Entisols occupy the least area in the state and are most abundant in northwest Cimarron Co. Vegetation in this region consists of shortgrass prairie and *Juniperus monosperma*-*Pinus edulis* woodlands. Alfisols and Mollisols are the most abundant soil groups in Oklahoma. Mollisols are typically dark in color and associated with a variety of grassland vegetation types (Gray and Roozitalab, 1976). Alfisols are light colored and sandy, and range from deep to shallow sandy soils. The Darnell-Stephensville association is the characteristic soil association of the Cross Timbers region (Hoagland et al., 1999).

Ultisols are found in the forested portions of the Ozark Plateau and Ouachita Mountain regions of the state. The vegetation is predominantly *Quercus* - *Carya* forest and *Pinus* - *Quercus* - *Carya* forests. Inceptisols occur in western Oklahoma excluding the Panhandle (Gray and Roozitalab, 1976), where mixed and shortgrass prairie vegetation is characteristic. Vertisols occur in southeastern and south-central Oklahoma. These soils are closely related to the Blackland Prairie soils of Texas (Aandahl, 1982). Soils are dark loam to clay derived from limestone

and marine clay (Gray and Galloway, 1959) and vegetation is primarily tallgrass prairie dominated by *Sorghastrum nutans*, *Panicum virgatum*, and *Andropogon gerardii* (Rice, 1952).

The stony rockland type is found in the Arbuckle and Wichita Mountains. These shallow soils support a variety of woodland vegetation types dominated by *Quercus marilandica*, *Q. stellata*, and *Ulmus alata*. Grasslands on stony rockland are dominated by *Schizachyrium scoparium*, *Bouteloua curtipendula*, and *B. hirsuta*. Cactus species, such as *Echinocereus reichenbachii* and *Opuntia macrorhiza*, are also common.

*Classification system* -- The classification system adopted for this paper is based on standards developed by the Federal Geographic Data Committee, Vegetation Subcommittee for Classification and Information Standards (FGDC, 1997) and is an amalgamation of previous systems (UNESCO, 1973; Driscoll et al., 1984), as modified by The Nature Conservancy (Grossman et al., 1998).

The FGDC system is hierarchically arranged into seven levels. The five upper levels distinguish vegetation types based on physiognomy and the two remaining levels are distinguished by floristic criteria. This structure allows investigators to apply the classification at a variety of spatial scales. For example, physiognomic levels may be most appropriate for land cover studies involving digital satellite data. Floristic levels, however, may be only discernible on aerial photography in conjunction with intensive ground surveys. Physiognomic units are assigned either a numeric or alphabetic code. At the floristic level, units of vegetation are recognized by species composition. Associations are given the name of two to three dominant species. Slash-listed species represent the dominants in lower vegetation strata within the community. In some vegetation types, diagnostic species are listed parenthetically in addition to the dominants.

Collecting a statistically valid quantitative vegetation sample at the state-level is fraught with logistical and financial constraints and temporal difficulties. Therefore, extant literature regarding the vegetation of Oklahoma was reviewed to develop a list of vegetation alliances and associations (for a listing of botanical literature in Oklahoma from 1819 to 1989 see Johnson and Milby, 1989). Each vegetation type reported in a publication was then interpreted and placed into the FGDC (1997) scheme. Both quantitative and descriptive studies were considered. Additional natural vegetation types were added to the classification and verified through review by state and regional botanists. Because extensive areas in Oklahoma have been converted to exotic pasture grasses (i.e., *Bothriochloa ischaemum*, *Cynodon dactylon*, and *Eragrostis curvula*) several anthropogenic vegetation types were

included. The FGDC (1997) scheme provides allowances for planted/cultivated vegetation types.

Scientific name of dominants, geographical distribution within Oklahoma, habitat, associated species, comments (when appropriate), and literature cited were provided for each vegetation association. Distribution data were based on geographic range of the dominant species and was determined using McGregor and Barkley (1977), Taylor and Taylor (1994), Williams (1973) and Little (1996).

Geographically, studies reviewed were categorized by counties from which data had been collected, physiographic province, and geographic region (i.e., northwest, north-central, northeast, southwest, south-central, southeast, and Panhandle). County data were tallied as the number of sites from which quantitative data had been collected from a given county. For example, Rice and Penfound (1959) reported vegetation data collected from several counties. In these cases, each county from which data were collected was tallied and compiled into a map of number of sampling points by county. A sample site was only tallied once if it was presented in a thesis or dissertation which as subsequently published in a refereed journal (e.g., Buck, 1962, 1964). Finally, distribution of vegetation studies in Oklahoma was evaluated through time. This involved assigning extant studies into 5-year intervals (i.e., 1956 to 1960, 1961 to 1965, etc.).

**RESULTS – Vegetation classification –** A total of 121 alliances in 151 associations were recognized. Specific information about each vegetation association can be found in Appendix 1. Ratios of alliances to associations in the classification were 45 forest associations in 30 forest alliances to, 17 woodland associations in 15 woodland alliances, 21 shrubland associations in 20 shrubland alliances, and 68 herbaceous associations in 56 herbaceous alliances. No references were available for 16 associations (*Pinus taeda/Rhus copallina* forest association, *Quercus stellata* - *Q. shumardii* - *Carya cordiformis* forest association, *Ulmus (americana/rubra)* - *Q. muehlenbergii* forest association, *Juniperus pinchotii* woodland association, *Quercus incana* - *Q. stellata* woodland association, *Pueraria montana* vine-shrubland association, *Forestiera acuminata* - *Cephalanthus occidentalis* shrubland association, *Bouteloua gracilis* - *Gutierrezia sarothrae* herbaceous association, *Brasenia schreberi* herbaceous association, *Carex crus-corvii* herbaceous association, *Dichanthelium scoparium* - *Boehmeria cylindrica/Sphagnum subsecundum* - *Polytrichum commune* herbaceous association, *Iva annua* herbaceous association, *Kochia scoparia* - *Salsola kali* herbaceous association, and *Nasturtium officinale* herbaceous association). These represent

vegetation associations based on unpublished studies or nominated by botanists within the state.

Several vegetation associations had restricted distributions in Oklahoma. For example, *Pinus ponderosa/Bouteloua gracilis* - *Schizachyrium scoparium*, *Juniperus monosperma* / *Bouteloua curtipendula*, *Juniperus monosperma* - *Pinus edulis/Bouteloua curtipendula* woodland associations were only reported from northwestern Cimarron Co. The most geographically disjunct vegetation association was the *Alnus maritima* - *Amorpha fruticosa* shrubland association, which occurs only in the Blue River drainage of south-central Oklahoma and the Delmarva Peninsula of Delaware (Little, 1996). In eastern Oklahoma, the *Quercus alba/Carex pensylvanica* - *Carex ouachitana* dwarf forest association occurs only in the Ouachita Mountains, specifically Black Fork, Rich, Kiamichi, and Winding Stair Mountains. Forests dominated by *Fagus grandifolia* forest associations were restricted to the Ouachita Mountains.

No exotic species were listed as dominant or co-dominant in the forest and woodland associations. However, two shrubland associations (*Tamarix chinensis* shrubland association and *Pueraria montana* var. *lobata* vine-shrubland association) and nine herbaceous associations listed exotic species as dominants. Of the herbaceous vegetation associations, six were listed as cultivated/planted (*Bothriochloa ischaemum* herbaceous association, *Cynodon dactylon* herbaceous association, *Eragrostis curvula* herbaceous association, *Festuca arundinacea* herbaceous association, *Lespedeza cuneata* herbaceous association, *Sorghum halepense* herbaceous association) and three were not (*Leptochloa fascicularis* - *Echinochloa crus-galli* herbaceous association, *Kochia scoparia* - *Salsola kali* herbaceous association, *Nasturtium officinale* herbaceous association).

In recent decades, abundance of *Juniperus* species has increased dramatically in Oklahoma and pose a threat to grassland ecosystems (Snook, 1985; Engle et al., 1997). Seven vegetation associations composed of *Juniperus* species were reported; three associations included *J. virginiana*, two *J. monosperma*, and one each of *J. ashei* and *J. pinchotii*. However, *J. monosperma* is not regarded as a severe threat to Oklahoma grasslands.

A total of 164 publications were reviewed: 112 primary sources, 15 secondary sources and 36 theses and dissertations. Papers ranged from regional and state level studies (e.g., Bruner, 1931; Blair and Hubbell, 1938; Duck and Fletcher, 1943, 1945; Allred and Mitchell, 1955) to local studies (i.e., Barclay, 1947; Eddy, 1990). The remaining sixteen journals appeared in five or fewer instances. The earliest reference consulted was Nuttall's (1821) journal of an 1819 expedition through Arkansas

Territory. The most frequently listed authors were William T. Penfound and Elroy L. Rice.

No vegetation studies were reported from Grant and Harper counties (Fig. 3). Fifty-five of Oklahoma's 77 counties were included in one to five studies, 13 in 6 to 10 studies, and 7 in 10 or more studies. The majority of counties included in ten or more studies harbored or were adjacent to a major academic institutions. The high number of studies reported from McClain Co. originate from a site referred to as both the Grasslands Investigation Project (Rice and Penfound, 1954; Penfound and Rice 1957b) and Johnson's Pasture (Carpenter 1935).

Regionally, south-central Oklahoma (51), southwest Oklahoma (33) and north-central (25) had the highest number of studies. Only four studies were reported from the Oklahoma Panhandle. Fifty-one investigations were reported from the central Oklahoma Red Bed Plains among studies reported by physiographic geomorphic province. This is almost four times greater than the second highest province, the sandstone hills (13). Only two studies were found from the Ozark Plateau. Thirty-seven literature items, typically state or regional studies, could not be assigned to a physiographic province.

No vegetation studies from 1900 to 1905 were found (Fig. 4), but there was an increase beginning in 1931 to 1935. The most active years for vegetation studies in Oklahoma were from 1961 to 1965, during which 32 studies were published. The period following has been marked by a gradual decline in published vegetation studies.

**DISCUSSION** – Many of the vegetation associations reported here extend into neighboring states. For example, playa lake basins occur in the High Plains regions of southeast Colorado, southwest Kansas, northeast New Mexico, and the Texas Panhandle. In each state, rangeland playa vegetation was composed of *Pascopyrum smithii* - *Buchloë dactyloides* (*Phyla cuneifolia* - *Oenothera canescens*) herbaceous association (Hoagland and Collins, 1997). Lauver, et al. (1999) also reported *Eleocharis macrostachya* - *Leptochloa fascicularis* herbaceous vegetation in temporarily flooded playas.

Previous studies of the Arbuckle Mountains have noted floristic similarities with the Edwards Plateau of Texas (Hopkins, 1941; Dale, 1956). This study also reveals similarities in vegetation associations. The *Quercus buckleyi* forest series, *Quercus fusiformis* forest series, *Juniperus ashei* - *Quercus* sp. forest series were reported by Diamond et al. (1987) as occurring on the Edwards Plateau. Diamond et al. (1987) used the Driscoll et al. (1984) system, a forerunner of the FGDC (1997) scheme, in which the Series is equivalent to an Alliance. Although

*Quercus sinuata* var. *breviloba* occurs as a floristic component of the Edwards Plateau, it was not reported as a vegetation type (Diamond et al., 1987). The *Juniperus ashei* - *Quercus* sp. forest series and the *Quercus fusiformis* forest series occur together on the Edwards Plateau, but *Q. fusiformis* and *J. ashei* are allopatric in Oklahoma, occurring in the Quartz Mountains and Arbuckle Mountains respectively (Little, 1996).

One of the most widely distributed vegetation types shared between Oklahoma, Texas, and portions of southeast Kansas is the *Quercus stellata* - *Q. marilandica* forest and woodland associations. Known regionally as the Cross Timbers, this vegetation type is a mosaic of forests, woodlands, and grasslands, the composition and density of which is influenced by fire (Hoagland et al., 1999). Hale (1955) reports that the abundance of *Q. stellata*-*Q. marilandica* forest and woodlands in southeast Kansas was much lower prior to post-settlement fire suppression. The physiognomy of the Cross Timbers has been described as a, "pathless thicket of somber timber," (Nuttall, 1821; pg. 228) and, "forests of cast iron," (Irving, 1835; pg. 79), implying a closed canopy aspect and dense understory. But Marcy (in Foreman, 1947; pg. 95) reported that, "At six different points where I have passed through it, I have found it characterized by these peculiarities; the trees, consisting primarily of post-oak and black-jack, standing at such intervals that wagons can without difficulty pass between them in any direction." In general, closed canopy stands of *Q. stellata*-*Q. marilandica* are lower in species diversity than adjacent woodlands and grasslands (McPherson and Thompson, 1972).

Arkansas and Oklahoma share many eastern deciduous forest vegetation associations (Foti et al., 1994). The *Quercus alba*/*Carex pensylvanica* - *Carex ouachitana* dwarf forest association is a unique community type that occurs in the Ouachita Mountains of both states in which trees rarely exceed 2 to 3 m in height (Johnson, 1986). The stature of these trees is maintained by high winds, ice scour (Foti et al., 1994), and edaphic conditions promoted by shallow soils with a large cobble component. Three *Juniperus ashei* vegetation associations were listed for Arkansas. Foti, et al. (1994) also reported a woodland association composed of *J. ashei* - *Quercus sinuata* var. *durandii* from the Coastal Plain on chalk, and a *J. ashei* - *Q. muehlenbergii* - *Fraxinus quadrangulata* woodland on dolomite outcrops on the Ozark Plateau, neither of which was reported from Oklahoma.

Vegetation classification is an interactive process between plant ecologists and the object being perceived (Whittaker, 1962). Although a considerable amount of information exists regarding the vegetation of Oklahoma, active research is needed in several areas to continue this

process. These research opportunities can be categorized as quantitative studies of specific vegetation types and regional vegetation studies.

Of the 16 associations lacking literature citations, *Dichanthelium scoparium* - *Boehmeria cylindrica*/*Sphagnum subsecundum* - *Polytrichum commune* and *Iva annua* herbaceous associations harbor species of special concern and should be the focus of future study. But further quantitative investigation is warranted for several vegetation associations for which literature citation were reported. For example, *Quercus fusiformis*/*Schizachyrium scoparium* woodland association, which is of biogeographical significant (Little, 1996), lacks compositional data and comparisons with stands on the Edwards Plateau are lacking. There also is a need for quantitative studies of the *Alnus maritima* - *Amorpha fruticosa* shrubland association. How do the Oklahoma stands differ in environment and species composition from those on the Delmarva Peninsula?

Vegetation inventories are needed for Grant and Harper counties. Large areas in both counties are covered by *Artemisia filifolia* and grassland vegetation. Interdunal swales also are located in sandy geomorphic regions within those counties. Only five studies involved the Oklahoma Panhandle region. Interestingly, two of these studies considered pattern and composition of wetland vegetation (Penfound, 1953; Hoagland and Collins, 1997). Two studies were from northwest Cimarron Co. at Black Mesa (Rogers, 1949, 1953), an area long of interest to Oklahoma biologists. Shortgrass prairie and *Artemisia filifolia* shrubland occupy the greatest area in the Panhandle (Fig. 1); however, no investigations of remnant shortgrass prairie areas were reported and only one study of *Artemisia filifolia* shrublands was conducted in Beaver Co. (Jones, 1963).

Two of the least studied physiographic provinces occurred in the mountainous portion of eastern Oklahoma: the Ozark Plateau and Ouachita Mountains. Ironically, these regions represent the highest floristic and vegetational diversity in the state. The Ozark Plateau, from which only two studies have been reported, certainly merits quantitative study. The Gypsum Hills physiographic province is also deserves quantitative study, but the only data available from this region is floristic in nature (Barber, 1974, 1979). The region is of interest in a biogeographic context, because many species with floristic affinities to the southwestern United States occur in Oklahoma only in the Gypsum Hills (i.e., *Echinocactus texensis*, *Ephedra antisiphilitca*, *Ziziphus obtusifolia*). Research pertinent to the Gypsum Hills would include the extent and timing of *Juniperus pinchotii* and *Prosopis*

*glandulosa* encroachment relative to mixed-grass prairie abundance.

Wetland conservation has become a national priority, but limited data are available regarding wetland vegetation types in Oklahoma. Penfound (1953) provided the only inclusive study on the subject (but see also Hefley [1937], Featherly [1940], Johnson [1984], Stinnet, et al. [1987], Hoagland [1998], Hoagland, et al. [1996], and Hoagland and Collins [1997]). This is particularly true of wetland vegetation in saline conditions. Salt flats, such as the Great Salt Plains, are common in western Oklahoma, but little data are available regarding species composition.

*Caveats for field application* -- Development and application of an inclusive vegetation classification at the state or regional level is a problematic exercise, one which often is confounded by human occupation and land-use history. A long history of human vegetation alterations preceded Oklahoma's admittance to statehood in 1907. European settlement altered the frequency of fire and duration of grazing by large ungulates. Native American's had made extensive use of fire as a management tool prior to European contact (Blinn, 1958; Pyne, 1982).

In recent history, bison occupied the region in large numbers, although estimates of population size vary (Flores, 1991). Indian commissioner Henry Ellsworth (in Williams and Simison, 1937; pg 83), an early nineteenth century traveler, reported that "close eaten praries (sic) spread with buffalo dung, showed we were near the great herd." Wild horses often intermingled with bison herds. The reintroduction of horses to the North American continent had a profound impact on Native American cultures, but the ecological impact is elusive (Flores, 1991).

A marked increase in human population density and land-use intensity began with the relocation of Native American Tribes from the eastern United States to Indian Territory (present-day eastern Oklahoma) in the early nineteenth century (Foreman, 1953). Several of these tribes were agrarian and cleared small bottomland acreages for crop cultivation and release domestic animals which reverted to a feral state (Foreman, 1953; Stevens, 1996). Settlement by Anglo-Americans of the Unassigned Lands and old Oklahoma Territory (present-day western Oklahoma) accelerated in the late nineteenth century with the land runs. In western Oklahoma, the Cheyenne and Arapaho tribes leased land for the cattle drives from Texas along the Great Western Trail. The impacts of this and the Chisolm Trail, which opened following the Civil War, on Oklahoma vegetation are unclear. Indeed, the route of the Chisolm Trail was selected because it flanked the western edge of the Cross Timbers, a substantial obstacle for cattle drovers (Thompson, 1961), but much of the route is now

mapped as *Q. stellata*-*Q. marilandica* forest (Duck and Fletcher, 1943; Küchler, 1964).

Within 40 years of the last land run, much of Oklahoma was subjected to intensive wind and water erosion due to the removal of vegetation. Land was so extensively plowed in central and western Oklahoma by 1902 that grazing land was scarce (McDonald, 1938). The environmental effects of the plow were seen during the 1901 drought, when wind erosion depleted the soil to the full depth of plowing. This drought was followed by an extremely wet period lasting from 1905 to 1908 which produced extensive gullying in central Oklahoma. These areas had been planted in corn and cotton, and were susceptible to the effects of heavy rains.

Attempts were made to reestablish native grasses to stem the loss of soil following the droughts, but results were deemed neither satisfactory nor efficacious. Landowners, with encouragement from the cooperative extension service, began to plant exotic grasses such as *Cynodon dactylon*, *Eragrostis curvula* and *Sorghum halepense* to hold the soil (McDonald, 1938). It was also at this time that President F. D. Roosevelt initiated the Plains Shelterbelt project, which directly involved the western-most tier of Oklahoma counties. As a result, species such as *Catalpa speciosa*, *Robinia pseudoacacia*, and *Ulmus pumila* were planted extensively in western Oklahoma (Droze, 1977). Remnants of the shelterbelt project, in addition to contemporary shelterbelt plantings, persist in that region today. Several of the species listed for planting have since naturalized in riparian areas.

An example of local human impacts affecting vegetation patterns in Oklahoma forest vegetation include removal of *Juglans nigra* logs by the Creek Indians from tribal lands for sale to Germany at the turn-of-the-century (Blackburn, 1984). Also, bottomland forests along the Deep Fork River in central Oklahoma were renowned for large-diameter *Diospyros virginiana* and *Quercus macrocarpa* trees. According to local residents, much of the *D. virginiana* was harvested and the lumber exported to Japan for fine woodcrafting. The lumber of *Q. macrocarpa* was transported to Arkansas for barrel stave production.

Contemporary land use is a complex blend of large scale industrial farming, pine plantations, cattle ranching, confined animal operations, and urban expansion. These changes often are implicated in the marked increase of woody plant cover at the expense of prairie (Harlan, 1957; Rice and Penfound, 1959; Snook, 1985; Boren et al., 1997). The rate of encroachment by *Juniperus* species has accelerated, from an estimated 607,000 hectares in the 1950s to 1.4 million hectares in 1985 (Snook, 1985). *Juniperus virginiana* is a broadly distributed species and has long been recognized as a threat to the ecological

integrity of grassland ecosystems (Rice and Penfound, 1959; Johnson and Risser, 1975). Two additional species, *J. ashei* in the Arbuckle Mountains and *J. pinchotii* in the gypsum hills regions of western Oklahoma, also have increased in abundance (Little, 1975; Engle et al., 1997).

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## Literature Cited

- Aandahl, A. R. 1982. Soils of the Great Plains: land use, crops, and grasses. University of Nebraska Press, Lincoln.
- Allgood, F. P., and F. Gray. 1974. An ecological interpretation for the small mounds in landscapes of eastern Oklahoma. *Journal of Environmental Quality* 3:37-41.
- Allred, B. W. 1949. Distribution and control of several woody plants in Oklahoma and Texas. *Journal of Range Management* 2:17-29.
- Allred, B. W., and H. C. Mitchell. 1955. Major plant types of Arkansas, Louisiana, Oklahoma and Texas and their relation to climate and soil. *Texas Journal of Science* 7: 7-19.
- Baalman, R. J. 1965. Vegetation of the Salt Plains National Wildlife Refuge, Jet, Oklahoma. Unpublished Ph.D. dissertation., University of Oklahoma, Norman, Oklahoma.
- Bailey, R. G. 1996. Ecosystem geography. Springer-Verlag, New York.
- Bailey, R. G., R. D. Pfister, and J. A. Henderson. 1978. Nature of land and resource classification: a review. *Journal of Forestry* 76:650-655.
- Barber, S. C. 1974. A floristic study of the vascular plants of the gypsum hills and redbed plains area of southwestern Oklahoma. Unpublished M.S. thesis, Oklahoma State University, Stillwater.
- Barber, S. C. 1979. Floristic components of the gypsum hills and redbed plains area of southwest Oklahoma. *Southwestern Naturalist* 24:431-437.
- Barclay, H. G. 1937. A preliminary report of the ecology of a *Drosera* meadow. *Proceedings of the Oklahoma Academy of Science* 18:22-25.
- Barclay, H. G. 1947. The woody vegetation of Bear's Glen, a Washington Irving stopover. *Proceedings of the Oklahoma Academy of Science* 28:39-57.
- Barclay, J. S. 1978. The effects of channelization on riparian vegetation and wildlife in south central Oklahoma. In: Johnson R. R. and J. F. McCormick, editors. *Strategies for protection and management of floodplain wetlands and other riparian ecosystems*. United States Department of Agriculture Forest Service, Washington, D.C.
- Barker, B. M., and W. C. Jameson. 1975. Platt National Park: environment and ecology. University of Oklahoma Press, Norman.
- Barkley, E. A. 1933. A preliminary survey of the vascular plants of Pottawatomie County, Oklahoma. *Proceedings of the Oklahoma Academy of Science* 14:44-46.
- Barkley, F. A., and C. C. Smith. 1933. A preliminary study of the buffalo wallows in the vicinity of Norman, Oklahoma. *Proceedings of the Oklahoma Academy of Science* 14:47-49.
- Berg, W. A. 1993. Old world bluestem response to fire and nitrogen fertilizers. *Journal of Range Management* 46:421-425.
- Blackburn, B. L. 1984. *Images of Oklahoma : a pictorial history with text*. Oklahoma Historical Society, Oklahoma City, Oklahoma.
- Blair, W. F. 1938. Ecological relationships of the mammals of the Bird Creek region, northeastern Oklahoma. *American Midland Naturalist* 20:473-526.
- Blair, W. F., and T. H. Hubbell. 1938. The biotic districts of Oklahoma. *American Midland Naturalist* 20:425-454.
- Blinn, W. C. 1958. The short-grass plains and post oak-blackjack woodland of Oklahoma in historical perspective. Unpublished M.S. thesis, Oklahoma State University, Stillwater.
- Booth, W. E. 1941. Revegetation of abandoned fields in Kansas and Oklahoma. *American Journal of Botany* 28:415-422.
- Booth, W. E. 1932. The relation of plant communities to soil erosion in Cleveland County, Oklahoma. Unpublished M.S. thesis, University of Oklahoma, Norman.
- Boren, J. C., D. M. Engle, M. S. Gregory, R. E. Masters, T. G. Bidwell, and V. A. Mast. 1997. Landscape structure and change in a hardwood forest-tallgrass prairie ecotone. *Journal of Range Management* 50:244-249.
- Branson, C. C., and K. S. Johnson. 1979. Generalized geologic map of Oklahoma. In: Johnson K.S., C. C. Branson, N. M. Curtis, W. E. Ham, W. E. Harrison, M. V. Marcher, and J. F. Roberts, editors. *Geology and Earth resources of Oklahoma*. Oklahoma Geological Survey, Norman.
- Brown, B. A. 1991. Landscape protection and the Nature Conservancy. In: Hudson, W. E., editor. *Landscape linkages and biodiversity*. Island Press, Washington, D.C.
- Bruner, W. E. 1931. The vegetation of Oklahoma. *Ecological Monographs* 1:100-188.

- Buck, P. 1962. Relationships of the woody vegetation of the Wichita Mountains Wildlife Refuge to geologic formations and soil types. Unpublished Ph.D. dissertation, University of Oklahoma, Norman.
- Buck, P. 1964. Relationships of the woody vegetation of the Wichita Mountains Wildlife Refuge to geologic formations and soil types. *Ecology* 45:336-344.
- Buck, P., and R. W. Kelting. 1962. A survey of the tall-grass prairie in northeastern Oklahoma. *Southwestern Naturalist* 7:163-175.
- Burns, P. Y. 1940. Ecological studies in an eastern Oklahoma flood plain. *Proceedings of the Oklahoma Academy of Science* 21:49-52.
- Caire, W. 1989. Physiognomic regions of Oklahoma. In: Caire, W., J. D. Tyler, B. P. Glass, and M. A. Mares, editors. *Mammals of Oklahoma*. University of Oklahoma Press, Norman.
- Cantwell, H. D. 1981. The changing phytosociology of the oak-hickory forest of the Ozark Mountains of Oklahoma. Unpublished M.A. thesis, University of Oklahoma, Norman.
- Carleton, M. A. 1892. Observations on the native plants of Oklahoma Territory and adjacent districts. *United States National Herbarium Contributions* 1:220-232.
- Carpenter, R. J. 1935. Plant distribution on a central Oklahoma prairie. *Proceedings of the Oklahoma Academy of Science* 15:32.
- Carpenter, R. J. 1939. Fluctuations in biotic communities, V.: Aspection in a mixed-grass prairie in central Oklahoma. *American Midland Naturalist* 22:420-435.
- Chaplin, S. J., W. R. Ostlie, R. E. Schneider, and J. S. Kennedy. 1996. A multi-scale approach to conservation planning in the Great Plains. In: Samson, F. B. and F. L. Knopf, editors. *Prairie conservation: preserving North America's most endangered ecosystem*. Island Press, Washington, D.C.
- Collins, S. L., and D. E. Adams. 1983. Succession in grasslands: thirty-two years of change in a central Oklahoma tallgrass prairie. *Vegetatio* 51:181-190.
- Collins, S. L., and G. E. Uno. 1983. The effect of early spring burning on vegetation in buffalo wallows. *Bulletin of the Torrey Botanical Club* 110:474-481.
- Collins, S. L., and S. C. Klahr. 1991. Tree dispersion in oak-dominated forests along an environmental gradient. *Oecologia* 86:471-477.
- Collins, S. L., G. S. Mitchell, and S. C. Klahr. 1989. Vegetation-environment relationships in a rock outcrop community in southern Oklahoma. *American Midland Naturalist* 122:339-348.
- Collins, S. L., P. G. Risser, and E. L. Rice. 1981. Ordination and classification of mature bottomland forests in north central Oklahoma. *Bulletin of the Torrey Botanical Club* 108:152-165.
- Coppock, R. K., C. A. Ely, R. W. Ficken, and M. G. Smith. 1955. An evaluation of the quadrat method in the blackjack-post oak forest. *Proceedings of the Oklahoma Academy of Science* 36:49-50.
- Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. Biological Service Program, United States Fish and Wildlife Service, Washington, DC, Publication No. FWS/OBS-79/31.
- Crockett, J. J. 1962a. Preliminary studies in the evaluation of grassland sampling techniques in tall-grass prairie sites. *Proceedings of the Oklahoma Academy of Science* 43:43-46.
- Crockett, J. J. 1962b. Grassland communities of the Wichita Mountains Wildlife Refuge. Unpublished Ph.D. dissertation, University of Oklahoma, Norman.
- Crockett, J. J. 1964. Influence of soils and parent material on grasslands of the Wichita Mountains Wildlife Refuge, Oklahoma. *Ecology* 45:326-335.
- Dale, E. E. 1959. The grasslands of Platt National Park, Oklahoma. *Southwestern Naturalist* 4:45-60.
- Dale, E. E. 1956. A preliminary survey of the flora of the Arbuckle Mountains. *Texas Journal of Science* 8:41-73.
- Diamond, D. D., D. H. Riskind, and S. L. Orzell. 1987. A framework for plant community classification and conservation in Texas. *Texas Journal of Science* 39:203-221.
- Dooley, K. L. 1983. Description and dynamics of some western oak forests in Oklahoma. Unpublished Ph.D. dissertation, University of Oklahoma, Norman.
- Dooley, K. L., and S. L. Collins. 1984. Ordination and classification of western oak forests in Oklahoma. *American Journal of Botany* 71:1221-1227.

- Driscoll, R. S., D. L. Merkel, D. L. Radloff, D. E. Snyder, and J. S. Hagihara. 1984. An ecological land classification framework for the United States, Miscellaneous Publication Number 1439. United States Department of Agriculture Forest Service, Washington, D.C.
- Droze, W. H. 1977. Trees, prairies, and people: a history of tree planting in the Plains States. Texas Women's University, Denton.
- Duck, L. G., and J. B. Fletcher. 1943. A game type map of Oklahoma. A Survey of the Game and Furbearing Animals of Oklahoma. Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma.
- Duck, L. G., and J. B. Fletcher. 1945. The game types of Oklahoma: Introduction. In: State Bulletin No. 3, A Survey of the Game and Furbearing Animals of Oklahoma. Oklahoma Dept. of Wildlife Conservation, Oklahoma City.
- Dwyer, D. D. 1958. An annotated plant list for Adam's Ranch, Osage County, Oklahoma. Unpublished M.S. thesis, Fort Hays State College, Hays, Kansas.
- Dwyer, D. D., and P. W. Santelmann. 1964. A comparison of post oak-blackjack oak communities on two major soil types in north central Oklahoma. Oklahoma State University, Oklahoma Agricultural Research Experiment Station, Stillwater.
- Eddy, A. 1990. Vegetation of Ten-Acre Rock. Transactions of the Oklahoma Junior Academy of Science 17:4-10.
- Engle, D. M., T. G. Bidwell, and M. E. Moseley. 1997. Invasion of Oklahoma rangelands and forests by eastern redcedar and Ashe juniper. Oklahoma Cooperative Extension Service, Oklahoma State University, Circular E-947.
- Erye, F. H. 1980. Forest cover types of the United States and Canada. Society of American Foresters, Washington, D.C.
- Ewing, A. L., J. F. Stritzke, and J. D. Kulbeth. 1984. Vegetation of the Cross Timbers experimental range, Payne County, Oklahoma. Research Report P-856, Oklahoma State University, Oklahoma Agricultural Experimental Station, Stillwater.
- Featherly, H. I. 1940. Silting and forest succession on Deep Fork in southwestern Creek County, Oklahoma. Proceedings of the Oklahoma Academy of Science 21: 63-68.
- Federal Geographic Data Committee. 1997. Vegetation information and classification standard. Federal Geographic Data Committee, United States Geological Survey, Reston, Virginia.
- Fishman, A. G. 1936. The relative distribution of herbaceous plants in Oklahoma County, Oklahoma. Proceedings of the Oklahoma Academy of Science 16:40-41.
- Flint, T. (ed.) 1930. The personal narrative of James O. Pattie of Kentucky. Lakeside Press, Chicago, Illinois.
- Flores, D. 1991. Bison ecology and bison diplomacy: the Southern Plains from 1800 to 1850. Journal of American History 78:465-485.
- Foreman, C. 1947. The cross timbers. The Star Printery, Muskogee, Oklahoma.
- Foreman, G. 1953. Indian removal; the emigration of the five civilized tribes. University of Oklahoma Press, Norman, Oklahoma.
- Foti, T., X. Li, M. Blaney, and K. G. Smith. 1994. A classification system for the natural vegetation of Arkansas. Proceedings of the Arkansas Academy of Science 48:50-63.
- Gaertner, F. 1955. Honeylocust (*Gleditsia triacanthos* L.) in field shelterbelts of western Oklahoma. M.S. thesis. Oklahoma State University, Stillwater.
- Galloway, L. A. 1963. The vegetation of an actively eroding canyon in Canadian County, Oklahoma. Unpublished M.S. thesis, University of Oklahoma, Norman.
- Galloway, L. A. 1964. The vegetation of an actively eroding canyon in Canadian County, Oklahoma. Proceedings of the Oklahoma Academy of Science 45:20-23.
- Gardner, C., J. A. Jewell, H. Dunn, and I. Y. Mahmoud. 1957. Effects of mowing on a native tallgrass prairie in central Oklahoma. Proceedings of the Oklahoma Academy of Science 38:30-31.
- Gardner, R. G. 1958. A vegetational analysis of the Phillips Agricultural Demonstration Project Ranch, Foraker, Oklahoma. Unpublished M.S. thesis, Texas A&M College, College Station.
- Gauch, H. G. 1982. Multivariate analysis in community ecology. Cambridge University Press, New York.
- Gibson, D. J. 1982. The natural revegetation of lead/zinc mine spoils in northeastern Oklahoma. Southwestern Naturalist 27:425-436.
- Gray, F., and H. M. Galloway. 1959. Soils of Oklahoma. Oklahoma State University, Oklahoma Agricultural Experiment Station, Stillwater.
- Gray, F., and H. Roozitalab. 1976. Benchmark and key soils of Oklahoma. Oklahoma State University, Oklahoma Agricultural Experiment Station, Stillwater.

- Grossman, D. H., D. Faber-Langendoen, A. S. Weakley, M. Anderson, P. Bourgeron, R. Crawford, K. Goodin, S. Landaal, K. Metzler, K. D. Patterson, M. Pyne, M. Reid, and L. Sneddon. 1998. International classification of ecological communities: terrestrial vegetation of the United States, Volume II. The National Vegetation Classification: development, status, and applications. The Nature Conservancy, Arlington, Virginia.
- Groves, C. R., M. L. Klein, and T. F. Breden. 1995. Natural Heritage Programs: public-private partnerships for biodiversity conservation. *Wildlife Society Bulletin* 23:784-790.
- Hale, M. E. 1955. A survey of upland forests in the Chautauqua Hills, Kansas. *Transactions of the Kansas Academy of Science* 58:165-168.
- Harlan, J. R. 1957. Grasslands of Oklahoma. Oklahoma State University, Stillwater.
- Harper, H. J. 1960. Drought years in central Oklahoma from 1710 to 1959 calculated from annual rings of post oak trees. *Proceedings of the Oklahoma Academy of Science* 41:23-29.
- Hazell, D. B. 1965. The claypan range site in northern Osage County, Oklahoma. *Journal of Range Management* 18:94-96.
- Hazell, D. B. 1967. Effect of grazing intensity on plant composition, vigor and production. *Journal of Range Management* 20:249-254.
- Heath, M. E., D. S. Metcalfe, and R. E. Barnes. 1973. Forages: the science of grassland agriculture. Iowa State University Press, Ames.
- Hefley, H. M. 1937. Ecological studies on the Canadian River floodplain in Cleveland County, Oklahoma. *Ecological Monographs* 7:346-402.
- Hoagland, B. W. 1998. Oklahoma riparian vegetation. In: Fallon, A. and M. Smolen, editors., *Riparian area management handbook*. Oklahoma Cooperative Extension Service, Oklahoma State University, Stillwater. Publication number E-952.
- Hoagland, B. W., and S. L. Collins. 1997. Heterogeneity in shortgrass prairie vegetation: the role of playa lakes. *Journal of Vegetation Science* 8:277-286.
- Hoagland, B. W., I. Butler, and F. L. Johnson. 1999. Ecology and vegetation of the Cross Timbers in Kansas, Oklahoma and Texas. In: Anderson, R. C., J. Fralish, and J. Baskin, editors. *The savanna, barren and rock outcrop communities of North America*. Cambridge University Press.
- Hoagland, B. W., L. R. Sorrels, and S. M. Glenn. 1996. Woody species composition of floodplain forests of the Little River, McCurtain and LeFlore Counties, Oklahoma. *Proceedings of the Oklahoma Academy of Science* 76:23-26.
- Hoisington, P. B. 1937. Aspection in a central Oklahoma tension zone area. Unpublished M.S. thesis, University of Oklahoma, Norman.
- Hopkins, M. 1938. Notes from the herbarium of the University of Oklahoma - I. *Rhodora* 40:425-434.
- Hopkins, M. 1941. The floristic affinities of the Arbuckle Mountains in Oklahoma. *American Journal of Botany* 28:16.
- Hutcheson, H.L. 1965. Vegetation in relation to slope exposure and geology in the Arbuckle Mountains. Unpublished Ph.D. dissertation, University of Oklahoma, Norman.
- Hutchinson, G. P., R. K. Anderson, and J. J. Crockett. 1966. Change in species composition of grassland communities in response to grazing intensity. *Proceedings of the Oklahoma Academy of Science* 47:25-27.
- Irving, W. 1835. *A tour of the prairies*. Carey, Lea and Blanchard, Philadelphia, Pennsylvania.
- Johnson, F. L. 1970. Some vegetation-environment relationships in the upland forests of Oklahoma. Unpublished M.S. thesis, University of Oklahoma, Norman.
- Johnson, F. L. 1984. Vegetational changes in a black willow forest over a 23-period. *Proceedings of the Oklahoma Academy of Science* 64:11-13.
- Johnson, F. L. 1986. Woody vegetation of southeastern LeFlore County, Oklahoma, in relation to topography. *Proceedings of the Oklahoma Academy of Science* 66:1-6.
- Johnson, F. L., and P. G. Risser. 1972. Some vegetation-environment relationships in the upland forests of Oklahoma. *Journal of Ecology* 60:655-663.
- Johnson, F. L., and P. G. Risser. 1973. Correlation analysis of rainfall and annual ring index of central Oklahoma blackjack and post oak. *American Journal of Botany* 60:475-478.
- Johnson, F. L., and P. G. Risser. 1975. A quantitative comparison between and oak forest and an oak savannah in central Oklahoma. *Southwestern Naturalist* 20:75-84.
- Johnson, F. L., and T. H. Milby. 1989. *Oklahoma botanical literature*. University of Oklahoma Press, Norman.
- Johnson, H. L., and C. E. Duchon. 1995. *Atlas of Oklahoma Climate*. University of Oklahoma Press, Norman.

- Johnson, K. S. 1972. Gypsum and salt resources in Oklahoma. *Industrial Minerals* 62:33-39.
- Jones, R. E. 1961. The quantitative phenology of two plant communities in Osage County, Oklahoma. *Proceedings of the Oklahoma Academy of Science* 42:31-38.
- Jones, R. E. 1963. Identification and analysis of lesser and greater prairie chicken habitat. *Journal of Wildlife Management* 27:758-778.
- Kapustka, L. A., and F. L. Moleski. 1976. Changes in community structure in Oklahoma old field succession. *Botanical Gazette* 137:7-10.
- Kelting, R. W. 1948. Changes in vegetation on stock pond dams near Norman, Oklahoma. Unpublished M.S. thesis, University of Oklahoma, Norman.
- Kelting, R. W. 1951. Vegetation and soil conditions of prairie and pasture plots in central Oklahoma. Unpublished Ph.D. dissertation, University of Oklahoma, Norman.
- Kelting, R. W. 1954. Effects of moderate grazing on the composition and plant production of a native tall-grass prairie in central Oklahoma. *Ecology* 35:200-207.
- Kelting, R. W. 1957. Winter burning in a central Oklahoma grassland. *Ecology* 38:520-522.
- Kelting, R. W., and W. T. Penfound. 1950. The vegetation of stock pond dams in central Oklahoma. *American Midland Naturalist* 44:69-75.
- Kennedy, R. K. 1973. An analysis of selected Oklahoma upland forest stands including both overstory and understory. Unpublished Ph.D. dissertation, University of Oklahoma, Norman.
- Klahr, S. C. 1989. Spatial pattern in post oak - blackjack oak forest along an environmental gradient in Oklahoma. Unpublished M.S. thesis, University of Oklahoma, Norman.
- Kohlbacher, G. C. 1978. The effects of periodic flooding on upland forest succession. Unpublished M.S. thesis, University of Oklahoma, Norman.
- Kreiter, S. D. 1995. Dynamics and spatial pattern of a virgin old-growth hardwood - pine forest in the Ouachita Mountains, Oklahoma, from 1896 to 1994. Unpublished M. S. thesis, Oklahoma State University, Stillwater.
- Küchler, A. W. 1964. Potential natural vegetation of the conterminous United States (1:3,168,000 scale map), American Geographical Society, Washington, D.C. Special Publication Number 36.
- Lauver, C. L., K. Kindscher, D. Faber-Langendoen, and R. Schneider. 1999. A classification of the natural vegetation of Kansas. *Southwest Naturalist* 44:421-443.
- Little, E. L. 1938. The vegetation of Muskogee County, Oklahoma. *American Midland Naturalist* 19:559-572.
- Little, E. L. 1939. The vegetation of the Caddo County canyons, Oklahoma. *Ecology* 20:1-10.
- Little, E. L. 1943. American smoketree (*Cotinus obovatus* Raf.), one of Oklahoma's rarest tree species. *Proceedings of the Oklahoma Academy of Science* 23:21-23.
- Little, E. L. 1975. Rare and local conifers in the United States. United States Forest Service, Conservation Research Report No. 19.
- Little, E. L. 1980. Baldcypress (*Taxodium distichum*) in Oklahoma. *Proceedings of the Oklahoma Academy of Science* 60:105-107.
- Little, E. L. 1996. Forest trees of Oklahoma. Fourteenth ed. Oklahoma Department of Agriculture, Forestry Services. Oklahoma City.
- Little, E. L., and C. E. Olmstead. 1935. Trees and shrubs of the Southeastern Oklahoma Protective Unit. Unpublished manuscript in the University of Oklahoma Library.
- Long, A. W. 1970. Ecological factors affecting the distribution of woody vegetation near the Arkansas River, Tulsa County, with special reference to the smoke-tree (*Cotinus obovatus*). Unpublished M.S. thesis, University of Tulsa, Tulsa, Oklahoma.
- Luckhardt, R. L., and H. G. Barclay. 1937. A study of the environment and floristic composition of an oak-hickory woodland in northeastern Oklahoma. *Proceedings of the Oklahoma Academy of Science* 18: 25-32.
- Masters, R. E., J. E. Skeen, and J. Whitehead. 1995. Preliminary fire history of McCurtain County Wilderness Area and implications for red-cockaded woodpecker management. In: Kulhavy, D. L., R. G. Hooper, and R. Costa, editors. Red-cockaded woodpecker management. Center for Applied Studies, Stephen F. Austin University, Nacogdoches, Texas.
- McCoy, D. A. 1958. Vascular plants of Pontotoc County, Oklahoma. *American Midland Naturalist* 59:371-396.
- McDonald, A. 1938. Erosion and its control in Oklahoma Territory. United States Department of Agriculture, Miscellaneous Publication 301, Washington, D.C.

- McDonald, C. B. 1976. A floristic study of Washington County, Oklahoma. *Proceedings of the Oklahoma Academy of Science* 56:53-54.
- McGregor, R. L., and T. M. Barkley. 1977. *Atlas of the Flora of the Great Plains*. Iowa State University Press, Ames.
- McPherson, J. K., and G. L. Thompson. 1972. Competitive and allelopathic suppression of understory by Oklahoma oak forests. *Bulletin of the Torrey Botanical Club* 99:293-300.
- Murray, C. L. 1974. A vegetation analysis of a pimped prairie in northeastern Oklahoma. Unpublished M.S. thesis, University of Tulsa, Tulsa, Oklahoma.
- Nease, F. R. 1948. Range deterioration in south central Oklahoma. Unpublished M.S. thesis, University of Oklahoma, Norman.
- Netherland, L. 1979. The effect of disturbance in tall grass sites on an index of diversity and equitability. *Southwestern Naturalist* 24:267-274.
- Nuttall, T. 1821. *Journal of travels into the Arkansas Territory during the year 1819, with occasional observations on the manners of aborigines*. T. N. Palmer, Philadelphia, Pennsylvania.
- Oklahoma Climatological Survey. 1998. Weather and climatological data. <http://www.ocs.ou.edu>. Oklahoma Climatological Survey, Norman.
- Ortenberger, A. I., and R. D. Bird. 1933. The ecology of the western Oklahoma salt plains. *Publications of the University of Oklahoma Biological Survey* 5:49-64.
- Osborn, B. 1941. Biotic type mapping of Oklahoma watersheds. *Proceedings of the Oklahoma Academy of Science* 22:31-33.
- Osborn, B. 1942. Prairie dog in shinnery (oak scrub) savannah. *Ecology* 23:110-115.
- Osborn, B., and P. F. Allan. 1949. Vegetation of an abandoned prairie-dog town in tall grass prairie. *Ecology* 30:322-332.
- Osborn, B., and W. H. Kellogg. 1943. Wildlife occurrence and habitat conditions in Roger Mills and Custer counties, Oklahoma. *Proceedings of the Oklahoma Academy of Science* 23:41-43.
- Palmer, E. J. 1924. The ligneous flora of Rich Mountain, Arkansas and Oklahoma. *Journal of the Arnold Arboretum* 5:108-134.
- Palmer, E. J. 1934. Notes on some plants of Oklahoma. *Journal of the Arnold Arboretum* 15:127-134.
- Parker, G. R. 1967. Edaphic and topographic effects on forest communities in Payne County, Oklahoma. Unpublished M.S. thesis, Oklahoma State University, Stillwater.
- Parks, J. M., and H.G. Barclay. 1966. The increasing importance of vines in southern Oklahoma. *Proceedings of the Oklahoma Academy of Science* 46:9-16.
- Penfound, W. T. 1948. An analysis of an elm-ash floodplain community near Norman, Oklahoma. *Proceedings of the Oklahoma Academy of Science* 28:59-60.
- Penfound, W. T. 1949. Plants of Oklahoma Lakes. *Proceedings of the Oklahoma Academy of Science* 30:13-14.
- Penfound, W. T. 1953. Plant communities of Oklahoma lakes. *Ecology* 34:561-583.
- Penfound, W. T. 1961. The composition of a black willow forest in south central Oklahoma. *Proceedings of the Oklahoma Academy of Science* 41:30-31.
- Penfound, W. T. 1962. The savanna concept in Oklahoma. *Ecology* 43:774-775.
- Penfound, W. T. 1963. The composition of a post oak forest in south-central Oklahoma. *Southwestern Naturalist* 8:114-115.
- Penfound, W. T. 1964*a*. Effects of denudation on the productivity of grassland. *Ecology* 45:838-845.
- Penfound, W. T. 1964*b*. The relation of grazing to plant succession in the tall grass prairie. *Journal of Range Management* 17:256-260.
- Penfound, W. T. 1965. Vegetational changes in a black willow forest over a four-year period. *Proceedings of the Oklahoma Academy of Science* 45:39.
- Penfound, W. T. 1968. Influence of a wildfire in the Wichita Mountains Wildlife Refuge, Oklahoma. *Ecology* 49:1003-1006.
- Penfound, W. T., and E. L. Rice. 1957*a*. Plant population changes in a native prairie plot plowed annually over a five-year period. *Ecology* 38:148-150.
- Penfound, W. T., and E. L. Rice. 1957*b*. Effects of fencing and plowing on plant succession in a revegetating field. *Journal of Range Management* 10:21-22.

- Penfound, W. T., J. S. Shed, and M. C. Jennison. 1965*b*. A plant community dominated by vines. *Proceedings of the Oklahoma Academy of Science* 45:41-43.
- Penfound, W. T., M. C. Jennison, and J. S. Shed. 1965*a*. Replacement of a population of Johnson grass by a vine-forb community. *Proceedings of the Oklahoma Academy of Science* 45:40-41.
- Petranka, J. W., and J. K. McPherson. 1979. The role of *Rhus copallina* in the dynamics of the forest-prairie ecotone of north-central Oklahoma. *Ecology* 60:956-965.
- Petranka, J. W., and R. Holland. 1980. A quantitative analysis of bottomland communities in south-central Oklahoma. *Southwestern Naturalist* 25:207-214.
- Phillips, G. R., F. J. Gibbs, and W. R. Mattoon. 1959. *Forest trees of Oklahoma*. Ninth ed. Forestry Division, State Board of Agriculture, Oklahoma City, Oklahoma.
- Polley, H. W., and L. L. Wallace. 1986. The relationship of plant species heterogeneity to soil variation in buffalo wallows. *Southwestern Naturalist* 31:493-501.
- Polley, H. W., and S.L. Collins. 1984. Relationships of vegetation and environment in Buffalo Wallows. *American Midland Naturalist* 112:178-186.
- Pyne, S. J. 1982. *Fire in America: a cultural history of wildland and rural fire*. Princeton University Press, Princeton, New Jersey.
- Ray, R. J. 1957. A phytosociological analysis of the tall-grass prairie in northeastern Oklahoma. Unpublished M.S. thesis, University of Tulsa, Tulsa, Oklahoma.
- Rhodes, L. K. 1980. Correlation between vegetation and geologic formations in Oklahoma. *Oklahoma Geology Notes* 40: 47-62.
- Rice, E. L. 1952. Phytosociological analysis of a tall-grass prairie in Marshall County, Oklahoma. *Ecology* 33:112-116.
- Rice, E. L. 1960. The microclimate of a relict stand of sugar maple in Devil's Canyon in Canadian County, Oklahoma. *Ecology* 41:445-452.
- Rice, E. L. 1962. The microclimate of sugar maple stands in Oklahoma. *Ecology* 43:19-25.
- Rice, E. L. 1963. Vegetation of Beavers Bend State Park. *Oklahoma Geological Survey Guide Book* 9:39-45.
- Rice, E. L. 1967. A statistical method for determining quadrat size and adequacy sampling. *Ecology* 48:1047-1049.
- Rice, E. L. 1965. Bottomland forests of north-central Oklahoma. *Ecology* 46:708-714.
- Rice, E. L., and W. T. Penfound. 1954. Plant succession and yield of living plant material in a plowed prairie in central Oklahoma. *Ecology* 35:176-180.
- Rice, E. L., and W. T. Penfound. 1955. An evaluation of the variable-radius and paired-tree methods in the blackjack-post oak forest. *Ecology* 36:315-320.
- Rice, E. L., and W. T. Penfound. 1956. Composition of a green ash forest near Norman, Oklahoma. *Southwestern Naturalist* 1:145-147.
- Rice, E. L., and W. T. Penfound. 1959. The upland forests of Oklahoma. *Ecology* 40:592-608.
- Roe, S. A. 1998. The vegetation of a tract of ancient cross timbers in Osage County, Oklahoma. Unpublished M.S. thesis, Oklahoma State University, Stillwater.
- Rogers, C. M. 1949. The vegetation of the Mesa De Maya region of Colorado, New Mexico, and Oklahoma. Unpublished Ph.D. dissertation, University of Michigan, Ann arbor.
- Rogers, C. M. 1953. The vegetation of the Mesa de Maya region of Colorado, New Mexico, and Oklahoma. *Lloydia* 16:257-291.
- Rogers, C. M. 1954. Some botanical studies in the Black Mesa region of Oklahoma. *Rhodora* 56:205-212.
- Rosson, J. F. 1994. *Quercus stellata* growth and stand characteristic in the *Quercus stellata* - *Quercus marilandica* forest type in the Cross Timbers region of central Oklahoma. In: Fralish, J. S., R. C. Anderson, J. E. Ebinger, and R. Szafoni, editors. North American conference on barrens and savannas. Illinois State University, Normal.
- Rosson, J. F. 1995. The timberland and woodland resources of central and western Oklahoma. Southern Forest Experiment Station, United States Department of Agriculture, New Orleans, Louisiana.
- Roux, E. R., and M. Warren. 1963. Plant succession on abandoned fields in central Oklahoma and in the Transvaal Highveld. *Ecology* 44:576-579.
- Sherwood, R. T., 1980. Vegetation of the Woods County, Oklahoma Sand Dunes. Unpublished Ph.D. dissertation, University of Oklahoma, Norman.
- Sherwood, R. T., and P. G. Risser. 1980. Annotated checklist of the vascular plants of Little Sahara State Park, Oklahoma. *Southwestern Naturalist* 25:323-338.

- Shirley, J. C. 1949. Oklahoma forests and woodlands. *Proceedings of the Oklahoma Academy of Science* 30:3-10.
- Sims, P. L., and D. D. Dwyer. 1965. Pattern of retrogression of native vegetation in north central Oklahoma. *Journal of Range Management* 18:20-25.
- Smith, A. L. 1998. Environmental and management effects on plant species composition within ecological sites of the Black Kettle National Grassland in western Oklahoma. Unpublished M.S. thesis, Oklahoma State University, Stillwater.
- Smith, C. C. 1940. Biotic and physiographic succession on abandoned eroded farmland. *Ecological Monographs* 10:421-484.
- Snook, E. C. 1985. Distribution of eastern red cedar on Oklahoma rangelands. In: Wittwer, R. F., and D. M. Engle, editors. *Conference proceedings, eastern red cedar in Oklahoma*. Cooperative Extension Service, Division of Agriculture, Oklahoma State University, Stillwater.
- Stebler, A. M., and S. D. Schmenitz. 1955. Habitat description and the life-form concept. *Proceedings of the Oklahoma Academy of Science* 36:154-157.
- Stevens, G. W., and C. W. Shannon. 1917. Plant life in Oklahoma. In: Shannon, C. W., editor, *Animal and plant life of Oklahoma*. Oklahoma Geological Survey, Norman, Oklahoma.
- Stevens, R. L. 1996. The feral hog in Oklahoma. Samuel Roberts Noble Foundation Publication, Ardmore, Oklahoma.
- Stinnet, D. P., R. W. Smith, and S. W. Conrady. 1987. Riparian areas of western Oklahoma. United States Fish and Wildlife Service, Tulsa, Oklahoma.
- Suneson, N. H., and K. S. Johnson. 1996. Geology of Red Rock Canyon State Park. *Oklahoma Geology Notes* 56: 88-105.
- Tarr, J., G. Botkin, E. L. Rice, E. Carpenter, and M. Hart. 1980. A broad analysis of fifteen sites in the tall-grass prairie of Oklahoma. *Proceedings of the Oklahoma Academy of Science* 60:39-42.
- Tate, R. C. 1928. Some observations on the spread of mesquite to the north in Cimarron County, Oklahoma. *Proceedings of the Oklahoma Academy of Science* 8:58.
- Taylor, C. E. 1961. Ecology and taxonomy of Water Canyon, Canadian County, Oklahoma. Unpublished M.S. thesis, University of Oklahoma, Norman.
- Taylor, J. R., and C. S. Taylor. 1994. An annotated list of the ferns, fern allies, gymnosperms, and flowering plants of Oklahoma. Biology Department Herbarium. Southeastern Oklahoma State University, Durant.
- Taylor, R. J. 1965. Shortleaf pine (*Pinus echinata*) in Bryan County, Oklahoma. *Southwestern Naturalist* 10:42-47.
- Taylor, R. J. 1967. The relation of forest vegetation to soils and geology in the Gulf Coastal Plain in Oklahoma. Unpublished Ph.D. dissertation, University of Oklahoma, Norman.
- Taylor, R. J., and W. T. Penfound. 1961. The grassland communities of the Baum limestone in Johnston County, Oklahoma. *Southwestern Naturalist* 6:98-99.
- Thompson, G. L. 1961. The Chisholm Trail in geographic perspective. *Proceedings of the Oklahoma Academy of Science* 42:253-259.
- Trewartha, G. T. 1968. An introduction to climate. Fourth ed. McGraw-Hill Book Co., Inc., New York.
- UNESCO. 1973. International classification and mapping of vegetation; series 6, ecology and conservation. United Nations Educational, Scientific, and Cultural Organization. Paris, France.
- Ungar, I. A. 1968. Species-soil relationships on the Great Salt Plains of northern Oklahoma. *American Midland Naturalist* 80:392-406.
- Uno, G. E., and S. L. Collins. 1987. Primary succession on granite outcrops in southwestern Oklahoma. *Bulletin of the Torrey Botanical Club* 114:387-392.
- Ware, G. H., and W. T. Penfound. 1949. The vegetation of the lower levels of the floodplain of the South Canadian River in central Oklahoma. *Ecology* 30:478-484.
- Waterfall, U. T. 1949. Some results of a summer's botanizing in Oklahoma. *Rhodora* 51:18-28.
- Welbourne, F. F. 1962. The comparative ecology of two canyons and an upland area in west central Oklahoma. Unpublished Ph.D. dissertation, University of Oklahoma, Norman.
- Welch, P. 1929. A reconnaissance of a typical central Oklahoma prairie. Unpublished M.S. thesis, University of Oklahoma, Norman.
- Whittaker, R. H. 1962. Classification of natural communities. *Botanical Review* 28: 1-239.
- Wiedeman, V. E. 1960. Preliminary ecological study of the shinnery oak area of western Oklahoma. Unpublished M.S. thesis, University of Oklahoma, Norman.



- Wiedeman, V. E., and W. T. Penfound. 1960. A preliminary study of the shinnery in Oklahoma. *Southwestern Naturalist* 5:117-122.
- Wilkinson, D. L., K. Schneller-McDonald, R. W. Olson, and G. T. Auble. 1987. Synopsis of wetland functions and values: bottomland hardwoods with special emphasis on eastern Texas and Oklahoma. United States Fish Wildlife Service Biological Report 87(12).
- Williams, J. E. 1973. Atlas of the woody plants of Oklahoma. Oklahoma Biological Survey, Norman.
- Williams, S. T., and B. D. Simison, editors. 1937. Washington Irving on the prairie. American Book Company, New York.
- Zanoni, T. A., P. G. Risser, and I. H. Butler. 1979. Natural areas for Oklahoma. Oklahoma Natural Heritage Program, Norman.

## Appendix 1

FDGC classification code	Oklahoma community types
I.	FOREST. Trees with their crowns overlapping (generally forming 60-100% cover).
I.A.	Evergreen forest. Evergreen species generally contribute >75% of the total tree cover.
I.A.8.	Temperate or subpolar needle-leaved evergreen forest. (Mostly needle-leaved or scale-leaved trees).
I.A.8.C.	Planted/Cultivated.
I.A.8.C.x.	PINUS TAEDA/RHUS COPALLINA PLANTED FOREST ALLIANCE
I.A.8.C.x.	<i>Pinus taeda/Rhus copallina</i> forest association. Distribution: the natural range of <i>P. taeda</i> is limited to the Coastal Plain physiographic province of McCurtain Co. Many plantations occur north of the natural range of <i>P. taeda</i> . Habitat: pine plantations. Associates: <i>Hypericum densiflorum</i> , <i>Liquidambar styraciflua</i> , <i>Toxicodendron radicans</i> . Comments: Corresponds to SAF 81 (Erye, 1980).
I.A.8.N.	Natural/semi-natural.
I.A.8.N.b.	Rounded-crowned temperate or subpolar needle-leaved evergreen forest.
I.A.8.N.b.	PINUS TAEDA FOREST ALLIANCE
I.A.8.N.b.	<i>Pinus taeda - Fraxinus pennsylvanica - Ulmus americana/Chasmanthium sessiliflorum</i> forest association Distribution: limited to the Coastal Plain physiographic province of McCurtain Co. Habitat: floodplains and backswamps. Associates: <i>Arundinaria gigantea</i> , <i>Berchemia scandens</i> , <i>Carex lupulina</i> , <i>Carpinus caroliniana</i> , <i>Crataegus marshallii</i> , <i>Ilex opaca</i> , <i>Morus rubra</i> , <i>Nyssa biflora</i> , <i>Quercus falcata</i> , <i>Quercus shumardii</i> . Comments: occurrences of <i>P. taeda</i> outside the Oklahoma the Coastal Plain have been planted. Corresponds to SAF 82 (Erye, 1980). References: Blair and Hubbell, 1938; Duck and Fletcher, 1945.
I.B.	Deciduous forest. Deciduous tree species generally contribute >75% of the total tree cover.
I.B.2.	Cold-deciduous forest.
I.B.2.N.	Natural/Semi-natural.
I.B.2.N.a.	Lowland or submontane cold-deciduous forest (e.g., broadleaf forests of the Midwest).
I.B.2.N.a.	ACER SACCHARUM FOREST ALLIANCE
I.B.2.N.a.	<i>Acer saccharum - Quercus alba - Carya alba</i> forest association Distribution: eastern-most tier of Oklahoma counties (Adair, Cherokee, Delaware, LeFlore, Mayes, McCurtain, Muskogee, Ottawa, and Sequoyah counties). Habitat: floodplains and mesic slopes. Associates: <i>Arundinaria gigantea</i> , <i>Fraxinus americana</i> , <i>Ilex opaca</i> , <i>Liquidambar styraciflua</i> , <i>Ostrya virginiana</i> , <i>Quercus velutina</i> , <i>Ulmus americana</i> . References: Rice, 1963.
I.B.2.N.a.	<i>Acer saccharum - Quercus muehlenbergii/Cotinus obovatus</i> forest association Distribution: Cherokee, Muskogee, and Wagoner counties along the Neosho River. Habitat: rugged limestone topography. Associates: <i>Antennaria parlinii</i> ,

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
	<i>Carya alba</i> , <i>Cladrastis lutea</i> , <i>Philadelphus pubescens</i> , <i>Staphylea trifoliata</i> , <i>Tradescantia ozarkana</i> , <i>Woodsia obtusa</i> . References: Little, 1943; Long, 1970.
I.B.2.N.a.	<i>Acer saccharum</i> - <i>Quercus rubra</i> - <i>Carya cordiformis</i> forest association Distribution: eastern tier counties of Oklahoma (Adair, Cherokee, Delaware, LeFlore, Mayes, McCurtain, Muskogee, Ottawa, and Sequoyah counties). Habitat: floodplains and mesic slopes. Associates: <i>Asimina triloba</i> , <i>Celtis laevigata</i> , <i>Elymus virginicus</i> , <i>Euonymus atropurpurea</i> , <i>Ilex decidua</i> , <i>Staphylea trifoliata</i> . References: Blair, 1938.
I.B.2.N.a.	<i>Acer saccharum</i> - <i>Ulmus rubra</i> - <i>Juglans nigra</i> forest association Distribution: Caddo, Canadian and Comanche counties. Habitat: Permian sandstone canyons in west central Oklahoma. Also in canyons and north-facing slopes in the Wichita Mountains. These sites, however, are composed of granite and gabbro. Associates: <i>Chasmanthium latifolium</i> , <i>Elymus virginicus</i> , <i>Galium aparine</i> , <i>Parthenocissus quinquefolia</i> , <i>Quercus muehlenbergii</i> , <i>Q. shumardii</i> , <i>Q. stellata</i> , <i>Thalictrum dasycarpum</i> . References: Little, 1939; Rice, 1960; Taylor, 1961; Buck, 1962; Rice, 1962; Welbourne, 1962; Galloway, 1963, 1964.
I.B.2.N.a.	FAGUS GRANDIFOLIA FOREST ALLIANCE
I.B.2.N.a.	<i>Fagus grandifolia</i> - <i>Quercus alba</i> / <i>Ilex opaca</i> forest association Distribution: rare or localized in two southeastern Oklahoma (northeastern McCurtain and southeastern Le Flore counties). Habitat: mesic slopes and streamsides. Associates: <i>Acer saccharum</i> , <i>Arisaema triphyllum</i> , <i>Cornus florida</i> , <i>Magnolia acuminata</i> , <i>Prunus serotina</i> , <i>Quercus rubra</i> , <i>Tilia americana</i> . References: Zanoni et al., 1979.
I.B.2.N.a.	QUERCUS ALBA FOREST ALLIANCE
I.B.2.N.a.	<i>Quercus alba</i> - <i>Carya alba</i> - <i>Tilia americana</i> forest association Distribution: rare to localized in five eastern tier counties of Oklahoma (Adair, Cherokee, Delaware, LeFlore, and Sequoyah counties). Ouachita Mountains, Ozark Plateau and northern Coastal Plain Provinces. Habitat: moist soils, floodplains and mesic slopes. Associates: <i>Acer saccharum</i> , <i>Asimina triloba</i> , <i>Carya alba</i> , <i>C. ovata</i> , <i>Cornus florida</i> , <i>Lindera benzoin</i> , <i>Ostrya virginiana</i> , <i>Quercus shumardii</i> , <i>Q. velutina</i> . References: Little and Olmstead, 1935; Blair and Hubbell, 1938; Rice, 1963, Zanoni et al., 1979.
I.B.2.N.a.	QUERCUS FALCATA FOREST ALLIANCE
I.B.2.N.a.	<i>Quercus falcata</i> - <i>Carya alba</i> forest association Distribution: eastern tier counties of Oklahoma (Adair, Cherokee, Haskell, Latimer, LeFlore, McCurtain, Pushmataha, and Choctaw counties). Habitat: mesic valleys and uplands. Associates: <i>Carya ovata</i> , <i>Quercus stellata</i> , <i>Q. velutina</i> , <i>Vaccinium arborea</i> . References: Rice and Penfound, 1959.
I.B.2.N.a.	QUERCUS MUEHLENBERGII FOREST ALLIANCE
I.B.2.N.a.	<i>Quercus muehlenbergii</i> - <i>Acer saccharum</i> forest association Distribution: eastern tier of Oklahoma counties (Adair, Cherokee, Delaware, LeFlore, Mayes, McCurtain, Muskogee, Ottawa, and Sequoyah counties). Habitat: floodplains, ravines, and mesic slopes. Associates: <i>Carya cordiformis</i> , <i>Celtis laevigata</i> , <i>Fraxinus pennsylvanica</i> , <i>Lindera benzoin</i> , <i>Parietaria pensyl</i>

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
	<i>vanica</i> , <i>Podophyllum peltatum</i> , <i>Staphylea trifoliata</i> . References: Little, 1938; Rice and Penfound, 1959; Kohlbacher, 1978; Zanoni et al., 1979; Dooley, 1983; Dooley and Collins, 1984.
I.B.2.N.a.	<i>Quercus muehlenbergii</i> - <i>Quercus shumardii</i> forest association Distribution: abundant in the eastern half of Oklahoma with localized occurrences in the west. Habitat: lowlands and mesic slopes. Associates: <i>Aesculus glabra</i> , <i>Carya cordiformis</i> , <i>C. illinoensis</i> , <i>Desmodium glutinosum</i> , <i>Myosotis verna</i> , <i>Quercus macrocarpa</i> , <i>Rhamnus caroliniana</i> . References: Blair and Hubbell, 1938; Galloway, 1963, 1964; Roe, 1998.
I.B.2.N.a.	QUERCUS RUBRA FOREST ALLIANCE
I.B.2.N.a.	<i>Quercus rubra</i> - <i>Quercus shumardii</i> forest association Distribution: Eastern Oklahoma (Adair, Cherokee, Craig, Delaware, Haskell, Latimer, LeFlore, Mayes, McCurtain, Muskogee, Ottawa, Pushmataha, and Sequoyah counties). Habitat: lowlands and mesic slopes. Associates: <i>Acer saccharum</i> , <i>Carya alba</i> , <i>C. tomentosa</i> , <i>Crataegus viridis</i> , <i>Elymus pilosa</i> , <i>Parietaria pensylvanica</i> , <i>Quercus velutina</i> . References: Bruner, 1931; Osborn, 1941; Duck and Fletcher, 1945.
I.B.2.N.a.	QUERCUS STELLATA - QUERCUS MARILANDICA FOREST ALLIANCE
I.B.2.N.a.	<i>Quercus stellata</i> - <i>Quercus marilandica</i> - <i>Carya (glabra, texana)/Vaccinium arboreum</i> forest association Distribution: eastern Oklahoma and portions of Seminole Co. Associates: <i>Amelanchier arborea</i> , <i>Antennaria parlinii</i> , <i>Bumelia lanuginosa</i> , <i>Cercis canadensis</i> , <i>Danthonia spicata</i> , <i>Helianthus hirsutus</i> , <i>Quercus velutina</i> , <i>Schizachyrium scoparium</i> , <i>Ulmus alata</i> , <i>Viburnum rufidulum</i> . References: Rice and Penfound, 1955; McCoy, 1958; Buck, 1962, 1964; Taylor, 1967; Kennedy, 1973; Roe, 1998.
I.B.2.N.a.	<i>Quercus stellata</i> - <i>Quercus marilandica</i> - <i>Carya texana</i> forest association Distribution: eastern and central Oklahoma. Associates: <i>Antennaria parlinii</i> , <i>Cercis canadensis</i> , <i>Danthonia spicata</i> , <i>Helianthus hirsutus</i> , <i>Lespedeza procumbens</i> , <i>Monarda fistulosa</i> , <i>Prunus mexicana</i> , <i>Symphoricarpos orbiculatus</i> , <i>Viburnum rufidulum</i> , <i>Schizachyrium scoparium</i> . Comments: Corresponds to SAF 40 (Erye, 1980). Habitat: upland forest, intergrading with woodlands and prairies. References: Bruner, 1931; Barkley, 1933; Booth, 1932; Blair, 1938; Blair and Hubbell, 1938; Little, 1938; Booth 1941; Osborn, 1941; Duck and Fletcher, 1945; Barclay, 1947; Coppock et al., 1955; Harlan, 1957; Rice and Penfound, 1955; McCoy, 1958; Rice and Penfound, 1959; Buck 1962, Penfound, 1963; Buck, 1964; Dwyer and Santelmann, 1964; Hutcheson, 1965; Parker, 1967; Taylor, 1967; Johnson 1970; Johnson and Risser, 1972; Kennedy, 1973; Johnson and Risser, 1975; McDonald, 1976; Zanoni et al., 1979; Dooley and Collins, 1984; Rosson, 1994,1995; Roe, 1998.
I.B.2.N.a.	<i>Quercus stellata</i> - <i>Quercus shumardii</i> - <i>Carya cordiformis</i> forest association Distribution: eastern and central Oklahoma. Habitat: variants of this association are the product of topographic position (i.e., lowlands and protected slopes). Associates: <i>Carya cordiformis</i> , <i>C. illinoensis</i> , <i>Desmodium glutinosum</i> , <i>Myosotis verna</i> , <i>Quercus macrocarpa</i> , <i>Rhamnus caroliniana</i> .

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
I.B.2.N.a.	<i>Quercus stellata</i> - <i>Ulmus alata</i> forest association Distribution: eastern and central Oklahoma. Habitat: upland forest, inter-grading with woodlands and prairies. Associates: <i>Andropogon gerardii</i> , <i>Carya texana</i> , <i>Cercis canadensis</i> , <i>Helianthus hirsutus</i> , <i>Prunus mexicana</i> , <i>Viburnum rufidulum</i> , <i>Schizachyrium scoparium</i> . References: Penfound, 1948; Rice and Penfound, 1959; Hutcheson, 1965; Taylor, 1967; Kohlbacher, 1978; Zandoni et al., 1979.
I.B.2.N.a.	QUERCUS TEXANA FOREST ALLIANCE
I.B.2.N.a.	<i>Quercus texana</i> - <i>Fraxinus texensis</i> - <i>Quercus muehlenbergii</i> forest association Distribution: Arbuckle Mountains (Carter and Murray counties). Habitat: rocky slopes over conglomerate or limestone. Associates: <i>Bouteloua curtipendula</i> , <i>B. hirsuta</i> , <i>B. rigidiseta</i> , <i>Engelmannia pinnatifida</i> , <i>Forestiera pubescens</i> , <i>Quercus stellata</i> . References: Barker and Jameson, 1975.
I.B.2.N.b.	Montane or boreal cold-deciduous forest (e.g., broadleaf forests of the mountains).
I.B.2.N.b.	QUERCUS ALBA FOREST ALLIANCE
I.B.2.N.b.	<i>Quercus alba</i> / <i>Carex pensylvanica</i> - <i>Carex ouachitana</i> dwarf forest association Distribution: Ouachita Mountains; Latimer and LeFlore counties. Rare. Occurs on Black Fork, Rich, Kiamichi, and Winding Stair Mountains. Associates: <i>Aesculus glabra</i> , <i>Carya texana</i> , <i>C. tomentosa</i> , <i>Celtis reticulata</i> , <i>Chionanthus virginicus</i> , <i>Hamamelis virginicus</i> , <i>Quercus marilandica</i> , <i>Q. stellata</i> , <i>Rubus</i> sp., <i>Vaccinium pallidum</i> . <i>Trillium pusillum</i> var. <i>ozarkanum</i> , a species of special concern, occurs in this habitat. Comments: A dense understory accompanies sites on north-facing slopes. References: Nuttall, 1821; Palmer, 1924; Little and Olmstead, 1935; Johnson, 1986.
I.B.2.N.d.	Temporarily flooded cold-deciduous forest (e.g., alluvial bottomland hardwoods).
I.B.2.N.d.	ACER SACCHARINUM FOREST ALLIANCE
I.B.2.N.d.	<i>Acer saccharinum</i> - <i>Acer negundo</i> forest association Distribution: stream margins throughout eastern Oklahoma. Habitat: riparian corridors. Associates: <i>Amorpha fruticosa</i> , <i>Arundinaria gigantea</i> , <i>Berchemia scandens</i> , <i>Betula nigra</i> , <i>Boehmeria cylindrica</i> , <i>Lindera benzoin</i> , <i>Toxicodendron radicans</i> . References: Blair, 1938.
I.B.2.N.d.	BETULA NIGRA FOREST ALLIANCE
I.B.2.N.d.	<i>Betula nigra</i> - <i>Platanus occidentalis</i> / <i>Alnus serrulata</i> forest association Distribution: eastern Oklahoma (Adair, Atoka, Cherokee, Choctaw, Delaware, Haskell, Kay, Latimer, Leflore, Mayes, McCurtain [excluding the coastal plain], McIntosh, Muskogee, Osage, Ottawa, Pittsburg, Pushmataha, Sequoyah, Tulsa, and Wagoner counties). Habitat: riparian corridors. Associates: <i>Acer negundo</i> , <i>Arundinaria gigantea</i> , <i>Berchemia scandens</i> , <i>Carpinus caroliniana</i> , <i>Chasmanthium latifolium</i> , <i>Fraxinus pennsylvanica</i> , <i>Lindera benzoin</i> , <i>Salix nigra</i> . Comments: Corresponds to SAF 61 (Erye, 1980). References: Bruner, 1931; Little and Olmstead, 1935; Blair and Hubbell, 1938.
I.B.2.N.d.	CARYA ILLINOENSIS - CELTIS LAEVIGATA FOREST ALLIANCE
I.B.2.N.d.	<i>Carya illinoensis</i> - <i>Celtis laevigata</i> forest association

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
	Distribution: eastern and central Oklahoma. Habitat: floodplains and riparian corridors. Associates: <i>Fraxinus pennsylvanica</i> , <i>Ilex decidua</i> , <i>Quercus shumardii</i> , <i>Sapindus drummondii</i> , <i>Toxicodendron radicans</i> . Comments: includes pecan orchards. References: Rice, 1965.
I.B.2.N.d.	FRAXINUS PENNSYLVANICA FOREST ALLIANCE
I.B.2.N.d.	<i>Fraxinus pennsylvanica</i> - <i>Ulmus americana</i> forest association
	Distribution: frequent throughout Oklahoma, excluding the Panhandle. Habitat: floodplains and riparian corridors. Associates: <i>Celtis laevigata</i> , <i>Populus deltoides</i> , <i>Quercus macrocarpa</i> , <i>Q. shumardii</i> , <i>Ulmus rubra</i> . Comments: Corresponds to SAF 93 (Erye, 1980). References: Penfound, 1948, 1953; Rice and Penfound, 1956; Rosson, 1995.
I.B.2.N.d.	<i>Fraxinus pennsylvanica</i> - <i>Ulmus crassifolia</i> - <i>Celtis laevigata</i> forest association
	Distribution: Localized in the Red River drainage (Bryan, Choctaw, Love, Marshall, and McCurtain counties). Habitat: wet to moist soils in riparian corridors. Associates: <i>Crataegus mollis</i> , <i>C. viridis</i> , <i>Gleditsia triacanthos</i> , <i>Maclura pomifera</i> , <i>Populus deltoides</i> , <i>Quercus macrocarpa</i> , <i>Q. nigra</i> , <i>Ulmus rubra</i> . References: Taylor, 1967.
I.B.2.N.d.	NYSSA SYLVATICA FOREST ALLIANCE
I.B.2.N.d.	<i>Nyssa sylvatica</i> - <i>Acer rubrum</i> forest association
	Distribution: eastern Oklahoma (Adair, Atoka, Bryan, Cherokee, Choctaw, Delaware, Latimer, LeFlore, McCurtain, Pushmataha, Sequoyah counties). Habitat: wet to moist soils of bottomlands and floodplains. Associates: <i>Carex lupulina</i> , <i>Carya cordiformis</i> , <i>Celtis laevigata</i> , <i>Crataegus marshallii</i> , <i>Fraxinus pennsylvanica</i> , <i>Lindera benzoin</i> , <i>Liquidambar styraciflua</i> , <i>Toxicodendron radicans</i> . References: Bruner, 1931; Blair and Hubbell, 1938.
I.B.2.N.d.	<i>Nyssa sylvatica</i> - <i>Liquidambar styraciflua</i> forest association
	Distribution: eastern Oklahoma (Bryan, Choctaw, Latimer, LeFlore, Pushmataha counties). Habitat: wet to moist soils of bottomlands and floodplains. Associates: <i>Acer rubrum</i> , <i>Carex lupulina</i> , <i>C. squarrosa</i> , <i>Carya cordiformis</i> , <i>Crataegus marshallii</i> , <i>Fraxinus pennsylvanica</i> , <i>Lindera benzoin</i> , <i>Toxicodendron radicans</i> . References: Little and Olmstead, 1935; Blair and Hubbell, 1938.
I.B.2.N.d.	PLATANUS OCCIDENTALIS - ACER NEGUNDO FOREST ALLIANCE
I.B.2.N.d.	<i>Platanus occidentalis</i> - <i>Acer negundo</i> forest association
	Distribution: eastern half of Oklahoma. Habitat: wet to moist soils on floodplains. Associates: <i>Acer saccharinum</i> , <i>Amorpha fruticosa</i> , <i>Arundinaria gigantea</i> , <i>Populus deltoides</i> , <i>Toxicodendron radicans</i> . References: Bruner, 1931; Blair, 1938; Blair and Hubbell, 1938.
I.B.2.N.d.	POPULUS DELTOIDES FOREST ALLIANCE
I.B.2.N.d.	<i>Populus deltoides</i> / <i>Salix (exigua, nigra)</i> forest association
	Distribution: frequent along streams throughout Oklahoma, excluding the Panhandle. Habitat: wet to moist soils in riparian corridors. Associates: <i>Acer negundo</i> , <i>Ampelopsis cordata</i> , <i>Carya illinoensis</i> , <i>Celtis laevigata</i> , <i>Cephalanthus occidentalis</i> , <i>Teucrium canadense</i> , <i>Toxicodendron radicans</i> . References: Bruner, 1931; Hefley, 1937; Ware and Penfound, 1949; Rogers, 1953; Galloway, 1963, 1964; Zanoni et al., 1979; Collins et al., 1981.

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
I.B.2.N.d.	<i>Populus deltoides</i> - <i>Ulmus americana</i> - <i>Celtis laevigata</i> forest association Distribution: frequent along streams throughout Oklahoma, excluding the Panhandle. Habitat: wet to moist soils in riparian corridors. Associates: <i>Acer negundo</i> , <i>Carya illinoensis</i> , <i>Celtis occidentalis</i> , <i>Elymus pilosa</i> , <i>Fraxinus pennsylvanica</i> , <i>Symphoricarpos orbiculatus</i> , <i>Toxicodendron radicans</i> . Comments: Corresponds to SAF 92 (Erye, 1980). References: Duck and Fletcher, 1945; Taylor, 1967.
I.B.2.N.d.	QUERCUS MACROCARPA FOREST ALLIANCE
I.B.2.N.d.	<i>Quercus macrocarpa</i> - <i>Quercus shumardii</i> - <i>Carya cordiformis</i> forest association Distribution: north-east Oklahoma and the Arbuckle Mountains. Habitat: floodplains and other mesic habitats. Associates: <i>Botrychium virginianum</i> , <i>Carya illinoensis</i> , <i>Chasmanthium latifolium</i> , <i>Elymus villosa</i> , <i>Populus deltoides</i> , <i>Panicum virgatum</i> , <i>Quercus muehlenbergii</i> , <i>Rhamnus caroliniana</i> , <i>Ulmus americana</i> . Comments: Corresponds to SAF 52 (Erye, 1980). References: Hefley, 1937; Blair, 1938; Featherly, 1940.
I.B.2.N.d.	QUERCUS NIGRA FOREST ALLIANCE Distribution: southeastern Oklahoma (Choctaw, Latimer, LeFlore, McCurtain, and Pushmataha counties).
I.B.2.N.d.	<i>Quercus nigra</i> - <i>Ulmus rubra</i> - <i>Liquidambar styraciflua</i> / <i>Carpinus caroliniana</i> forest association Habitat: moist to wet soils of bottomlands and floodplains. Associates: <i>Carpinus caroliniana</i> , <i>Carya ovata</i> , <i>Crataegus marshallii</i> , <i>Ilex decidua</i> , <i>Quercus rubra</i> , <i>Q. shumardii</i> , <i>Ulmus rubra</i> . <i>Sabal minor</i> is an associate in forests located in far southeastern McCurtain Co. References: Bruner, 1931.
I.B.2.N.d.	<i>Quercus nigra</i> - <i>Quercus phellos</i> / <i>Carpinus caroliniana</i> forest association Habitat: moist to wet soils of bottomlands and floodplains. Associates: <i>Carpinus caroliniana</i> , <i>Carya myristiciformis</i> , <i>Crataegus marshallii</i> , <i>Ilex decidua</i> , <i>Quercus rubra</i> , <i>Q. shumardii</i> , <i>Ulmus rubra</i> . References: Bruner, 1931; Hoagland et al., 1996.
I.B.2.N.d.	QUERCUS PHELLOS FOREST ALLIANCE
I.B.2.N.d.	<i>Quercus phellos</i> - <i>Nyssa biflora</i> / <i>Carpinus caroliniana</i> forest association Distribution: eastern Oklahoma (Choctaw, LeFlore, McCurtain, and Pushmataha counties). Habitat: wet to moist soils of bottomlands and floodplains. Associates: <i>Celtis laevigata</i> , <i>Carya cordiformis</i> , <i>Cornus amomum</i> , <i>Crataegus marshallii</i> , <i>C. viridis</i> , <i>Fraxinus americana</i> , <i>Ilex opaca</i> , <i>Quercus nigra</i> , <i>Ulmus rubra</i> . References: Hoagland et al., 1996.
I.B.2.N.d.	ULMUS (AMERICANA/RUBRA) FOREST ALLIANCE Habitat: wet to mesic soils in riparian corridors.
I.B.2.N.d.	<i>Ulmus (americana/rubra)</i> - <i>Celtis (laevigata, occidentalis)</i> - <i>Fraxinus pennsylvanica</i> forest association Distribution: frequent throughout Oklahoma, excluding the Panhandle. Associates: <i>Arisaema dracontium</i> , <i>Carya cordiformis</i> , <i>C. illinoensis</i> , <i>Chasmanthium latifolium</i> , <i>Cocculus carolinus</i> , <i>Elephantopus caroliniana</i> , <i>Elymus virginicus</i> , <i>Juglans nigra</i> , <i>Quercus macrocarpa</i> , <i>Q. shumardii</i> , <i>Sambucus canadensis</i> , <i>Sapindus drummondii</i> . <i>Juglans microcarpa</i> is a common associate in Coman

## Appendix 1-Continued

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code	Oklahoma community types
	che, Caddo, Kiowa and Greer counties. Comments: Corresponds to SAF 93 (Erye, 1980). References: Hefley, 1937; Hoisington, 1937; Blair and Hubbell, 1938; Little, 1938; Burns, 1940; Osborn and Kellogg, 1943; Penfound, 1948; Baalman, 1965; Rice, 1965; Parker, 1967.
I.B.2.N.d.	<i>Ulmus (americana/rubra) - Quercus muehlenbergii</i> forest association Distribution: eastern Oklahoma with localized occurrences in the west. Associates: <i>Aesculus glabra</i> , <i>Celtis laevigata</i> , <i>Quercus macrocarpa</i> , <i>Q. rubra</i> , <i>Rhamnus caroliniana</i> .
I.B.2.N.e.	Seasonally flooded cold-deciduous forest.
I.B.2.N.e.	ACER RUBRUM FOREST ALLIANCE
I.B.2.N.e.	<i>Acer rubrum - Liquidambar styraciflua</i> forest association Distribution: southeastern Oklahoma (Bryan, Choctaw, Latimer, LeFlore, McCurtain, and Pushmataha counties). Habitat: wet to moist soils in riparian corridors. Associates: <i>Acer saccharum</i> , <i>Carex gigantea</i> , <i>Carpinus caroliniana</i> , <i>Crataegus marshallii</i> , <i>Nyssa biflora</i> , <i>Quercus phellos</i> , <i>Q. rubra</i> , <i>Toxicodendron radicans</i> , <i>Zanthoxylum clava-herculis</i> . Comments: Corresponds to SAF 108 (Erye, 1980). References: Hoagland et al., 1996.
I.B.2.N.e.	LIQUIDAMBAR STYRACIFLUA FOREST ALLIANCE Distribution: southeastern Oklahoma (Choctaw, Latimer, LeFlore, McCurtain, and Pushmataha counties).
I.B.2.N.e.	<i>Liquidambar styraciflua - Quercus nigra/Carpinus caroliniana</i> forest association Habitat: wet to moist soils of bottomlands and floodplains. Associates: <i>Carex lupulina</i> , <i>C. squarrosa</i> , <i>Carya cordiformis</i> , <i>Crataegus marshallii</i> , <i>Fraxinus pennsylvanica</i> , <i>Lindera benzoin</i> , <i>Toxicodendron radicans</i> . References: Bruner, 1931; Blair and Hubbell, 1938; Osborn, 1941.
I.B.2.N.e.	<i>Liquidambar styraciflua - Quercus phellos/Carpinus caroliniana</i> forest association Habitat: wet to moist soils of bottomlands and floodplains. Associates: <i>Asimina triloba</i> , <i>Acer rubrum</i> , <i>Crataegus marshallii</i> , <i>Ilex decidua</i> , <i>I. opaca</i> . Comments: Corresponds to SAF 92 (Erye, 1980). References: Blair and Hubbell, 1938; Hoagland et al., 1996.
I.B.2.N.e.	QUERCUS LYRATA FOREST ALLIANCE
I.B.2.N.e.	<i>Quercus lyrata - Carya aquatica</i> forest association Distribution: distribution restricted to the Coastal Plain physiographic province of McCurtain Co. Habitat: backswamps and sloughs. Associates: <i>Acer rubrum</i> , <i>Carya myristiciformis</i> , <i>Crataegus marshallii</i> , <i>Planera aquatica</i> , <i>Quercus phellos</i> . References: Blair and Hubbell, 1938.
I.B.2.N.e.	QUERCUS PALUSTRIS FOREST ALLIANCE
I.B.2.N.e.	<i>Quercus palustris - Carya illinoensis/Ilex decidua</i> forest association Distribution: Most common along the Deep Fork, Verdigris, and Neosho Rivers in northeastern Oklahoma (Cherokee, Craig, Haskell, McIntosh, Muskogee, Nowata, Okmulgee, Ottawa, Rogers, Sequoyah, and Tulsa counties). Habitat: moist to wet soils of bottomlands and floodplains. Associates: <i>Ampelopsis cor</i>



## Appendix 1-Continued

FDGC classification code	Oklahoma community types
	<i>data</i> , <i>Celtis laevigata</i> , <i>Cinna arundinacea</i> , <i>Crataegus viridis</i> , <i>Gleditsia triacanthos</i> , <i>Morus rubra</i> , <i>Senecio glabellus</i> , <i>Ulmus rubra</i> . References: Blair, 1938.
I.B.2.N.f.	Semipermanently flooded cold-deciduous forest (e.g., cypress swamp).
I.B.2.N.f.	TAXODIUM DISTICHUM FOREST ALLIANCE
I.B.2.N.f.	<i>Taxodium distichum</i> / <i>Lemna minor</i> forest association Distribution: Coastal Plain physiographic province of McCurtain Co. Habitat: sloughs, backswamps, and other deepwater habitats. Associates: <i>Alnus serrulata</i> , <i>Cephalanthus occidentalis</i> , <i>Cornus foemina</i> , <i>Hydrocotyle umbellata</i> , <i>Ilex decidua</i> , <i>Planera aquatica</i> , <i>Ranunculus longirostris</i> . Comments: Corresponds to SAF 101 (Erye, 1980). <i>Taxodium distichum</i> has been planted on the margin of several State Park lakes in eastern Oklahoma. Persisting populations also exist southeast of Ada (Pontotoc Co.) and as part of an erosion control project along the Red River in Cotton Co. References: Bruner, 1931; Little and Olmstead, 1935; Blair and Hubbell, 1938; Osborn, 1941; Duck and Fletcher, 1945; Rice, 1963; Little, 1980; Hoagland et al., 1996.
I.C.	Mixed evergreen-deciduous forest. Evergreen and deciduous species generally contribute 26 to 75% of total tree cover.
I.C.3.N.	Natural/Semi-natural.
I.C.3.N.a.	Mixed needle-leaved evergreen - cold-deciduous forest.
I.C.3.N.a.	PINUS ECHINATA FOREST ALLIANCE
I.C.3.N.a.	<i>Pinus echinata</i> - <i>Quercus alba</i> - <i>Quercus velutina</i> forest association Distribution: localized in five eastern tier counties of Oklahoma (Adair, Cherokee, Delaware, LeFlore, and Sequoyah counties). Habitat: mesic slopes in the Ouachita Mountains and Ozark plateau. Associates: <i>Amelanchier arborea</i> , <i>Callicarpa americana</i> , <i>Carya alba</i> , <i>Lyonia ligustrina</i> , <i>Parthenocissus quinquefolia</i> , <i>Toxicodendron radicans</i> , <i>Vaccinium pallidum</i> . Comments: Corresponds to SAF cover type 76 (Erye, 1980). References: Bruner, 1931; Duck and Fletcher, 1945; Rice and Penfound, 1959; Rice, 1963; Johnson, 1986; Krieter, 1995; Masters et al., 1995.
I.C.3.N.a.	<i>Pinus echinata</i> - <i>Quercus stellata</i> - <i>Quercus marilandica</i> forest association Distribution: eastern Oklahoma (Adair, Atoka, Bryan, Cherokee, Choctaw, Coal, Delaware, Haskell, Latimer, McCurtain, and Pushmataha counties). Habitat: uplands and exposed, xeric slopes. Associates: <i>Antennaria parlinii</i> , <i>Carya texana</i> , <i>Helianthus hirsutus</i> , <i>Hypericum prolificum</i> , <i>H. hypericoides</i> , <i>Juniperus virginiana</i> , <i>Quercus velutina</i> , <i>Vaccinium arboreum</i> , <i>V. pallidum</i> . Comments: Corresponds to SAF cover type 76 (Erye, 1980). References: Bruner, 1931; Little and Olmstead, 1935; Little, 1938; Osborn, 1941; Duck and Fletcher, 1945; Rice and Penfound, 1959; Rice, 1963; Taylor, 1965; Kennedy, 1973; Zaroni et al., 1979; Cantwell, 1981; Johnson, 1986; Masters et al., 1995; Rosson, 1995.
I.C.3.N.a.	<i>Pinus echinata</i> - <i>Quercus rubra</i> - <i>Q. velutina</i> forest association Distribution: eastern Oklahoma (Adair, Atoka, Cherokee, Choctaw, Coal, Delaware, Haskell, Latimer, McCurtain, and Pushmataha counties). Habitat: uplands and exposed, xeric slopes. Associates: <i>Amelanchier arborea</i> , <i>Antennaria parlinii</i> , <i>Danthonia spicata</i> , <i>Helianthus hirsutus</i> , <i>Hypericum hypericoides</i> , <i>Quer</i>

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
	<i>cus stellata</i> . Comments: Corresponds to SAF cover type 76 (Erye, 1980). References: Rice and Penfound, 1959; Kennedy, 1973; Johnson, 1986; Kreiter, 1995.
I.C.3.N.a.	QUERCUS STELLATA - JUNIPERUS VIRGINIANA FOREST ALLIANCE
I.C.3.N.a.	<i>Quercus stellata</i> - <i>Juniperus virginiana</i> forest association Distribution: throughout Oklahoma, excluding the Panhandle. Habitat: rocky slopes and abandoned pastures. Associates: <i>Andropogon gerardii</i> , <i>Carya texana</i> , <i>Quercus marilandica</i> , <i>Rhus aromatica</i> , <i>R. glabra</i> , <i>Schizachyrium scoparium</i> , <i>Symphoricarpos orbiculatus</i> , <i>Tridens flavus</i> . Comments: The statewide increase in the abundance of <i>J. virginiana</i> is product of rangeland fire suppression. References: Penfound, 1968, Zanoni et al., 1979.
I.C.3.N.b.	Temporarily flooded mixed needle-leaved evergreen - cold-deciduous forest.
I.C.3.N.b.	PINUS TAEDA - LIQUIDAMBAR STYRACIFLUA FOREST ALLIANCE
I.C.3.N.b.	<i>Pinus taeda</i> - <i>Liquidambar styraciflua</i> forest association Habitat: floodplains. Associates: <i>Acer rubrum</i> , <i>Arundinaria gigantea</i> , <i>Carex lupulina</i> , <i>Carpinus caroliniana</i> , <i>Crataegus marshallii</i> , <i>Gleditsia triacanthos</i> , <i>Ilex opaca</i> , <i>Nyssa biflora</i> , <i>Quercus nigra</i> , <i>Q. phellos</i> , <i>Q. shumardii</i> . Comments: includes abandoned and second growth pine plantations. Corresponds to SAF 81 (Erye, 1980). References: Zanoni et al., 1979.
II.	WOODLAND. Open stands of trees with crowns not usually touching (generally forming 25 to 60% cover. Canopy tree cover (rarely) may be less than 25% in cases when the cover of each of the other lifeforms present (i.e., shrub, dwarf-shrub, herb, nonvascular) is less than 25% and tree cover exceeds the cover of the other lifeforms.
II.A.	Evergreen woodland. Evergreen species generally contribute >75% of the total tree cover.
II.A.2.N.	Natural/Semi-natural.
II.A.2.N.a.	Temperate broad-leaved evergreen woodland.
II.A.2.N.a.	QUERCUS FUSIFORMIS WOODLAND ALLIANCE
II.A.2.N.a.	<i>Quercus fusiformis</i> - <i>Quercus stellata</i> / <i>Schizachyrium scoparium</i> woodland association Distribution: localized occurrences in the Wichita and Quartz mountains of western Oklahoma (Comanche, Greer, and Kiowa counties). Habitat: rocky, granite slopes. Associates: <i>Bouteloua curtipendula</i> , <i>Bumelia lanuginosa</i> , <i>Celtis reticulata</i> , <i>Forestiera pubescens</i> , <i>Rhus aromatica</i> . References: Zanoni et al., 1979.
II.A.4.	Temperate or subpolar needle-leaved evergreen woodland.
II.A.4.N.	Natural/Semi-natural.
II.A.4.N.a.	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (e.g. pine, western juniper).
II.A.4.N.a.	JUNIPERUS ASHEI WOODLAND ALLIANCE
II.A.4.N.a.	<i>Juniperus ashei</i> / <i>Bouteloua (curtipendula, hirsuta)</i> woodland association Distribution: The distribution of <i>Juniperus ashei</i> in Oklahoma is restricted primarily to the Arbuckle Mountains (Johnston, Marshall, Murray, and Pontotoc counties), with occurrences in glade habitats in Mayes Co. Habitat: shal

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FDGC classification code	Oklahoma community types
	low soils and rocky limestone slopes. Associates: <i>Bouteloua curtipendula</i> , <i>Bouteloua hirsuta</i> , <i>Bouteloua rigidisetata</i> , <i>Engelmannia pinnatifida</i> , <i>Forestiera pubescens</i> , <i>Fraxinus texensis</i> . References: Hopkins, 1938; Little 1975, 1996.
II.A.4.N.a.	JUNIPERUS MONOSPERMA WOODLAND ALLIANCE
II.A.4.N.a.	<i>Juniperus monosperma</i> / <i>Bouteloua curtipendula</i> woodland association Distribution: northwestern Cimarron Co. Habitat: talus slopes, rocky and thin soils. Associates: <i>Bothriochloa saccharoides</i> , <i>Bouteloua hirsuta</i> , <i>B. gracilis</i> , <i>Buchloë dactyloides</i> , <i>Cercocarpus montanus</i> , <i>Opuntia imbricata</i> , <i>Rhus aromatica</i> , <i>Yucca glauca</i> . Comments: Corresponds to SAF 239 (Erye, 1980). References: Rogers 1949, 1953, 1954; Harlan, 1957.
II.A.4.N.a.	<i>Juniperus monosperma</i> - <i>Pinus edulis</i> / <i>Bouteloua curtipendula</i> woodland association Distribution: northwestern Cimarron Co. Habitat: talus slopes, rocky and thin soils. Associates: <i>Bothriochloa saccharoides</i> , <i>Bouteloua hirsuta</i> , <i>B. gracilis</i> , <i>Buchloë dactyloides</i> , <i>Cercocarpus montanus</i> , <i>Opuntia polyacantha</i> , <i>Quercus gambelii</i> , <i>Quercus trilobata</i> , <i>Rhus aromatica</i> , <i>Yucca glauca</i> . Comments: Corresponds to SAF 239 (Erye, 1980). References: Bruner, 1931; Blair and Hubbell, 1938; Duck and Fletcher, 1945; Rogers, 1949, 1953, 1954; Caire, 1989.
II.A.4.N.a.	JUNIPERUS PINCHOTII WOODLAND ALLIANCE
II.A.4.N.a.	<i>Juniperus pinchotii</i> / <i>Bouteloua (curtipendula, hirsuta)</i> woodland association Distribution: southwestern Oklahoma. The association is of greatest extent in Beckham Co. <i>Juniperus pinchotii</i> can also be found in Greer, Harmon, Jackson counties. Habitat: soils derived from gypsum. Associates: <i>Bouteloua curtipendula</i> , <i>Opuntia leptocaulis</i> , <i>Prosopis juliflora</i> , <i>Psilostrophe villosa</i> , <i>Schizachyrium scoparium</i> .
II.A.4.N.a.	PINUS ECHINATA WOODLAND ALLIANCE
II.A.4.N.a.	<i>Pinus echinata</i> / <i>Schizachyrium scoparium</i> woodland association Distribution: greatly reduced in the Ozarks and Ouachita mountains (limited to McCurtain Co.). Habitat: shallow rocky soils and south-facing slopes. Associates: <i>Antennaria parlinii</i> , <i>Danthonia spicata</i> , <i>Quercus marilandica</i> , <i>Q. stellata</i> , <i>Toxicodendron radicans</i> , <i>V. pallidum</i> . References: Blair and Hubbell, 1938; Rice, 1963.
II.A.4.N.a.	PINUS PONDEROSA WOODLAND ALLIANCE
II.A.4.N.a.	<i>Pinus ponderosa</i> / <i>Bouteloua gracilis</i> - <i>Schizachyrium scoparium</i> woodland association Distribution: Known from only one location in western Cimarron Co. Habitat: Rocky slopes and sandstone canyons. Associates: <i>Bouteloua curtipendula</i> , <i>Hilaria jamesii</i> , <i>Melampodium leucanthum</i> , <i>Polygala alba</i> , <i>Rhus trilobata</i> . References: Bruner, 1931.
II.A.4.N.b.	Conical-crowned temperate or subpolar needle-leaved evergreen woodland.
II.A.4.N.b.	JUNIPERUS VIRGINIANA WOODLAND ALLIANCE
II.A.4.N.b.	<i>Juniperus virginiana</i> / <i>Schizachyrium scoparium</i> woodland association Distribution: throughout Oklahoma, excluding the Panhandle. Habitat: old-fields and prairies, the product of fire suppression. Associates: <i>Ambrosia</i>

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
	<i>artemisiifolia</i> , <i>Andropogon virginicus</i> , <i>Aristida oligantha</i> , <i>Gymnopogon ambiguus</i> , <i>Quercus marilandica</i> , <i>Q. stellata</i> . Comments: Corresponds to SAF 46 (Erye, 1980). References: Rice, 1960; Rosson, 1995.
II.B.	Deciduous woodland. Deciduous tree species generally contribute to >75% of the total tree cover.
II.B.2.	Cold-deciduous woodland.
II.B.2.N.	Natural/Semi-natural.
II.B.2.N.a.	Cold-deciduous woodland.
II.B.2.N.a.	QUERCUS INCANA WOODLAND ALLIANCE
II.B.2.N.a.	<i>Quercus incana</i> - <i>Quercus stellata</i> woodland association Distribution: localized and of limited extent in southeastern Oklahoma (Atoka, Choctaw, McCurtain and Pushmataha counties). Habitat: dry, sandy uplands. Associates: <i>Berchemia scandens</i> , <i>Froelichia floridana</i> , <i>Polygonella americana</i> , <i>Quercus marilandica</i> , <i>Q. stellata</i> .
II.B.2.N.a.	QUERCUS MARILANDICA WOODLAND ALLIANCE
II.B.2.N.a.	<i>Quercus marilandica</i> / <i>Schizachyrium scoparium</i> woodland association Distribution: throughout Oklahoma, excluding the Panhandle. Habitat: sandy soils and south-facing slopes. Associates: <i>Juniperus virginiana</i> , <i>Prunus angustifolia</i> , <i>Rhus aromatica</i> , <i>R. glabra</i> , <i>Symphoricarpos orbiculatus</i> . References: Little, 1939; Rice and Penfound, 1959; Welbourne, 1962.
II.B.2.N.a.	QUERCUS STELLATA - QUERCUS MARILANDICA WOODLAND ALLIANCE
II.B.2.N.a.	<i>Quercus stellata</i> - <i>Quercus marilandica</i> / <i>Schizachyrium scoparium</i> woodland association Distribution: throughout Oklahoma, excluding the Panhandle. Habitat: coarse soils and south-facing slopes. Associates: <i>Andropogon gerardii</i> , <i>Antennaria parlinii</i> , <i>Baptisia bracteata</i> , <i>Carya texana</i> , <i>Crataegus crus-galli</i> , <i>Cornus drummondii</i> , <i>Juniperus virginiana</i> , <i>Prunus mexicana</i> , <i>Viburnum rufidulum</i> , <i>Rhus glabra</i> , <i>Schizachyrium scoparium</i> , <i>Symphoricarpos orbiculatus</i> . References: Bruner, 1931; Luckhardt and Barclay, 1937; Allred and Mitchell, 1955; Rice and Penfound, 1959; Penfound, 1962; Kennedy, 1973; Johnson and Risser, 1975; Ewing et al., 1984; Klahr, 1989; Collins and Klahr, 1991.
II.B.2.N.a.	ROBINIA PSEUDOACACIA WOODLAND ALLIANCE
II.B.2.N.a.	<i>Robinia pseudoacacia</i> woodland association Distribution: Native range in eastern Oklahoma, but now extends throughout much of the state. Uncommon in the northwest and the Panhandle. Habitat: a variety of habitats, often planted. Comments: Corresponds to SAF 50 (Erye, 1980). The historically range of <i>R. pseudoacacia</i> was restricted to the Ozark Plateau and Ouachita Mountains. Since settlement, the range of <i>R. pseudoacacia</i> has been extended westward due to its utility in erosion control, fence posts, shelter belt plantings, and strip mine reclamation. References: McDonald, 1938; Gaertner, 1955; Baalman, 1965.
II.B.2.N.a.	SAPINDUS SAPONARIA WOODLAND ALLIANCE
II.B.2.N.a.	<i>Sapindus saponaria</i> woodland association Distribution: throughout Oklahoma, but most common in central and western Oklahoma. Habitat: The habitat occupied by <i>S. drummondii</i> is highly variable.

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
	It occurs in fencerows, on the margins of other forest and woodland associations, or as mottes on floodplains and on sand dunes. It can also be found on Talus slopes on Black Mesa. Associates: <i>Andropogon gerardii</i> , <i>Celtis reticulata</i> , <i>Quercus macrocarpa</i> , <i>Rhus aromatica</i> , <i>Schizachyrium scoparium</i> , <i>Smilax bona-nox</i> , <i>Ulmus americana</i> . <i>Zanthoxylum hirsutum</i> is often a co-dominant species in this association in the Red River counties of Love, Jefferson, and Cotton. References: Baalman, 1965; Rice, 1965; Collins et al., 1981.
II.B.2.N.a.	ULMUS PUMILA WOODLAND ALLIANCE
II.B.2.N.a.	<i>Ulmus pumila</i> woodland association Distribution: central and western Oklahoma. Habitat: uplands, margins of agricultural fields. Comments: <i>Ulmus pumila</i> is a native species of eastern Asia. It has been planted extensively in shelterbelts throughout western Oklahoma. This tree has also escaped into riparian zones in western Oklahoma. References: Shirley, 1949; Gaertner, 1955.
II.B.2.N.b.	Temporarily flooded cold-deciduous woodland.
II.B.2.N.b.	POPULUS DELTOIDES WOODLAND ALLIANCE
II.B.2.N.b.	Habitat: moist to wet soils in riparian corridors. <i>Populus deltoides</i> - <i>Salix exigua</i> woodland association Distribution: localized on sandbars and streambanks in western Oklahoma. Habitat: moist to wet soils in riparian corridors. Associates: <i>Acer negundo</i> , <i>Chasmanthium latifolium</i> , <i>Teucrium canadense</i> , <i>Toxicodendron radicans</i> . References: Blair and Hubbell, 1938; Rogers, 1949, 1953; Penfound, 1953; Baalman, 1965.
II.B.2.N.b.	<i>Populus deltoides</i> - <i>Salix nigra</i> woodland association Distribution: frequent along streams throughout Oklahoma, excluding the Panhandle. Habitat: moist to wet soils in riparian corridors. This association also represents mid-successional stages in old-fields and other disturbed areas. Associates: <i>Acer negundo</i> , <i>Chasmanthium latifolium</i> , <i>Teucrium canadense</i> , <i>Toxicodendron radicans</i> . References: Hefley, 1937; Featherly, 1940; Galloway, 1963, 1964; Gibson, 1982.
II.B.2.N.b.	SALIX NIGRA WOODLAND ALLIANCE
II.B.2.N.b.	<i>Salix nigra</i> woodland association Distribution: throughout Oklahoma, excluding the Panhandle. Habitat: occurs along the margin of streams and lakes. Associates: <i>Ampelopsis arborea</i> , <i>Amorpha fruticosa</i> , <i>Celtis laevigata</i> , <i>occidentalis</i> , <i>Fraxinus pennsylvanica</i> , <i>Eupatorium serotinum</i> , <i>Polygonum hydropiperoides</i> , <i>Populus deltoides</i> . Comments: Corresponds to SAF 95 (Erye, 1980). References: Hefley, 1937; Blair, 1938; Blair and Hubbell, 1938; Kelting and Penfound, 1950; Penfound, 1953; McCoy, 1958; Penfound, 1961; Baalman, 1965; Penfound, 1965; Petranka and Holland, 1980; Johnson, 1984.
III.	SHRUBLAND (SCRUB). Shrubs generally greater than 0.5 m tall with individuals or clumps not touching to overlapping (generally forming >25% canopy cover -- tree cover generally <25%). Shrub cover (rarely) may be less than 25% in cases when the cover of each of the other lifeforms present

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
	(i.e., tree, dwarf-shrub, herb, nonvascular) is less than 25% and shrub cover exceeds the cover of the other lifeforms.
III.A.	Evergreen shrubland (scrub). Evergreen species generally contribute >75% of the total shrub cover.
III.A.2.	Temperate broad-leaved evergreen shrubland with or without scattered tree canopy.
III.A.2.N.	Natural/Semi-natural.
III.A.2.N.c.	Sclerophyllous temperate broad-leaved evergreen shrubland.
III.A.2.N.c.	QUERCUS HAVARDII SHRUBLAND ALLIANCE
III.A.2.N.c.	<i>Quercus havardii</i> / <i>Sporobolus cryptandrus</i> - <i>Schizachyrium scoparium</i> shrubland association Distribution: western Oklahoma (Beckham, Custer, Dewey, Greer, Harmon, Kiowa, Roger Mills and Woodward counties). Habitat: deep, sandy soil. Associates: <i>Artemisia filifolia</i> , <i>Bouteloua gracilis</i> , <i>Calamovilfa gigantea</i> , <i>Celtis reticulata</i> , <i>Cenchrus pauciflora</i> , <i>Dalea villosa</i> , <i>Dimorphocarpa palmeri</i> , <i>Rhus aromatica</i> , <i>Yucca glauca</i> , <i>Vitis vulpina</i> . Comments: <i>Quercus havardii</i> forms mottes that range in height from 10 to 200cm. It is a clonal plant, and although individual mottes may contain many stems they often constitute an individual plant. References: Bruner, 1931; Palmer, 1934; Blair and Hubbell, 1938; Osborn, 1941, 1942; Osborn and Kellogg, 1943; Duck and Fletcher, 1945; Allred and Mitchell, 1955; Harlan, 1957; Rice and Penfound, 1959; Wiedeman, 1960; Wiedeman and Penfound, 1960; Kennedy, 1973; Zanoni et al., 1979; Smith, 1998.
III.A.2.N.g.	Temporarily flooded temperate broad-leaved evergreen shrubland.
III.A.2.N.g.	ARUNDINARIA GIGANTEA SHRUBLAND ALLIANCE
III.A.2.N.g.	<i>Arundinaria gigantea</i> shrubland association Distribution: eastern Oklahoma. Habitat: floodplains and alluvial soils. Associates: <i>Acer negundo</i> , <i>Betula nigra</i> , <i>Boehmeria cylindrica</i> , <i>Impatiens capensis</i> , <i>Lindera benzoin</i> , <i>Toxicodendron radicans</i> . Comments: <i>Arundinaria gigantea</i> is also an important understory component in eastern Oklahoma bottomland forests. The woodland association is intended to represent canebrakes in open or edge situations. This vegetation association is known colloquially as a canebrake and once occupied extensive areas in eastern Oklahoma bottomlands. The areal extent of this plant association was greatly reduced by the Spanish introduction of domestic livestock in the 17 <sup>th</sup> century (Wilkinson et al., 1987). Nuttall (1821) reported a canebrake 3.2 km in width near the confluence of the Grand and Verdigris Rivers. References: Nuttall, 1821; Blair, 1938; Hoagland, 1998.
III.A.4.	Microphyllous evergreen shrubland (e.g., sagebrush).
III.A.4.N.	Natural/Semi-natural.
III.A.4.N.a.	Microphyllous evergreen shrubland.
III.A.4.N.a.	ARTEMISIA FILIFOLIA SHRUBLAND ALLIANCE
III.A.4.N.a.	<i>Artemisia filifolia</i> / <i>Sporobolus cryptandrus</i> - <i>Schizachyrium scoparium</i> shrubland association

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
	Distribution: throughout western Oklahoma, including the Panhandle. Habitat: sandy soils and stabilized dunes. Associates: <i>Andropogon hallii</i> , <i>Bouteloua curtipendula</i> , <i>B. gracilis</i> , <i>Calamovilfa gigantea</i> , <i>Prunus angustifolia</i> , <i>Calylophus serrulatus</i> , <i>Cyperus schweinitzii</i> , <i>Eriogonum anuum</i> , <i>Rhus aromatica</i> . References: Bruner, 1931; Blair and Hubbell, 1938; Osborn, 1941; Osborn and Kellogg, 1943; Duck and Fletcher, 1945; Harlan, 1957; Jones, 1963; Baalman, 1965; Zanoni et al., 1979; Sherwood, 1980; Sherwood and Risser, 1980; Smith, 1998.
III.A.4.N.c.	Temporarily flooded microphyllous shrubland
III.A.4.N.c.	TAMARIX CHINENSIS SHRUBLAND ALLIANCE
III.A.4.N.c.	<i>Tamarix chinensis</i> shrubland association
	Distribution: western Oklahoma and the Panhandle. Habitat: common along streams and the margins of lakes and reservoirs. Associates: <i>Aster subulatus</i> , <i>Baccharis salicina</i> , <i>Distichlis spicata</i> , <i>Panicum virgatum</i> , <i>Populus deltoides</i> , <i>Salix exigua</i> . Comments: <i>Tamarix chinensis</i> was introduced to North America from eastern Asia. It was utilized as an ornamental and for shelterbelt plant. It subsequently escaped from cultivation and is now considered a noxious weed in riparian areas. References: Stevens and Shannon, 1917; Ortenburger and Bird, 1933; Ware and Penfound, 1949; Baalman, 1965; Ungar, 1968.
III.B.	Deciduous shrubland (scrub). Deciduous species generally contribute to >75% of the total shrub cover.
III.B.2.	Cold-deciduous shrubland.
III.B.2.N.	Natural/Semi-natural.
III.B.2.N.a.	Temperate cold-deciduous shrubland (e.g., some oaks).
III.B.2.N.a.	CORNUS DRUMMONDII SHRUBLAND ALLIANCE
III.B.2.N.a.	<i>Cornus drummondii</i> shrubland association
	Distribution: throughout Oklahoma, excluding the Panhandle and parts of the far southwest. Habitat: Forest margins, disturbed areas, and old-fields. Associates: <i>Helianthus hirsutus</i> , <i>Prunus angustifolia</i> , <i>Rhus aromatica</i> , <i>Rhus glabra</i> , <i>Symphoricarpos orbiculatus</i> , <i>Toxicodendron radicans</i> . References: Galloway, 1963, 1964; Baalman, 1965; Ewing et al., 1984.
III.B.2.N.a.	PRUNUS ANGUSTIFOLIA SHRUBLAND ALLIANCE
III.B.2.N.a.	<i>Prunus angustifolia</i> / <i>Schizachyrium scoparium</i> shrubland association
	Distribution: central and western Oklahoma, including Beaver Co. Habitat: sand dunes, old-fields and disturbed areas. Often abundant in pastures where <i>Artemisia filifolia</i> has been removed. Associates: <i>Andropogon hallii</i> , <i>Bouteloua curtipendula</i> , <i>Gaillardia pulchellum</i> , <i>Prunus gracilis</i> , <i>Rhus aromatica</i> . References: Palmer, 1934; Blair, 1938; Blair and Hubbell, 1938; Penfound, 1953; Stebler and Schmenitz, 1955; Hutcheson, 1965.
III.B.2.N.a.	PUERARIA MONTANA VINE-SHRUBLAND ALLIANCE
III.B.2.N.a.	<i>Pueraria montana</i> var. <i>lobata</i> vine-shrubland association
	Distribution: Southeastern Oklahoma, with localized occurrences in central Oklahoma (e.g., Cleveland, Pontotoc and Seminole counties). Habitat: Roadsides and other disturbed areas. Associates: Stands of <i>P. montana</i> are often monotypic, but may include <i>Ampelopsis cordata</i> , <i>Toxicodendron radicans</i> and

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
	<i>Vitis cinerea</i> . Comments: <i>Pueraria montana</i> was introduced to North America from Asia.
III.B.2.N.a.	QUERCUS SINUATA VAR. BREVILOBA SHRUBLAND ALLIANCE
III.B.2.N.a.	<i>Quercus sinuata</i> var. <i>breviloba</i> shrubland association Distribution: Arbuckle Mountains (Garvin, Johnston, and Murray counties). Habitat: limestone outcrops. Associates: <i>Bouteloua curtipendula</i> , <i>Bouteloua hirsuta</i> , <i>Bouteloua rigidiseta</i> , <i>Engelmannia pinnatifida</i> , <i>Forestiera pubescens</i> , <i>Fraxinus texensis</i> , <i>Quercus buckleyi</i> . References: Barker and Jameson, 1975.
III.B.2.N.a.	RHUS GLABRA SHRUBLAND ALLIANCE
III.B.2.N.a.	<i>Rhus glabra</i> shrubland associations Distribution: throughout much of Oklahoma, excluding the Panhandle. Habitat: woodland margins, old-fields and disturbed areas. Associates: <i>Rhus aromatica</i> , <i>R. copallina</i> , <i>Smilax bona-nox</i> , <i>Sorghum halepense</i> , <i>Tridens flavus</i> , <i>Toxicodendron radicans</i> . References: Little and Olmstead, 1935; Little, 1938; Osborn, 1941; Petranka and McPherson, 1979.
III.B.2.N.a.	RHUS AROMATICA SHRUBLAND ALLIANCE
III.B.2.N.a.	<i>Rhus aromatica</i> shrubland association Distribution: throughout, but most abundant in central and western Oklahoma. Habitat: sand dunes, woodland margins and old-fields. Associates: <i>Cornus drummondii</i> , <i>Prunus angustifolia</i> , <i>Rhus glabra</i> , <i>Smilax bona-nox</i> , <i>Schizachyrium scoparium</i> , <i>Vitis acerifolia</i> , <i>Toxicodendron radicans</i> . References: Bruner, 1931; Osborn, 1941; Osborn and Kellogg, 1943; Stebler and Schemnitz, 1955; McCoy, 1958; Jones, 1963; Baalman, 1965.
III.B.2.N.a.	SMILAX BONA-NOX SHRUB-VINELAND ALLIANCE
III.B.2.N.a.	<i>Smilax bona-nox</i> - <i>Rubus</i> sp. shrub - vineland association Distribution: eastern and central Oklahoma. Habitat: old-fields and disturbed areas. Associates: <i>Ampelopsis cordata</i> , <i>Andropogon virginicus</i> , <i>Diospyros virginiana</i> , <i>Rhus glabra</i> , <i>Rosa setigera</i> , <i>Vitis cinerea</i> , <i>V. vulpina</i> . References: Penfound et al., 1965a, b; Parks and Barclay, 1966; Petranka and Holland, 1980.
III.B.2.N.a.	TOXICODENDRON RADICANS SHRUB-VINELAND ALLIANCE
III.B.2.N.a.	<i>Toxicodendron radicans</i> - <i>Ribes curvatum</i> - <i>Asimina triloba</i> shrub - vineland association Distribution: Ouachita Mountains in southeastern Oklahoma. Habitat: rock glaciers (e.g., scree fields and talus slopes). Associates: <i>Dryopteris marginalis</i> , <i>Hydrangea arborescens</i> , <i>Parthenocissus quinquefolia</i> , <i>Polymnia canadensis</i> , <i>R. cynosbati</i> , <i>Staphylea trifoliata</i> . References: Palmer, 1924; Little and Olmstead, 1935.
III.B.2.N.d.	Temporarily flooded cold-deciduous shrubland.
III.B.2.N.d.	ALNUS MARITIMA SHRUBLAND ALLIANCE
III.B.2.N.d.	<i>Alnus maritima</i> - <i>Amorpha fruticosa</i> shrubland association Distribution: restricted to the Blue River drainage in Johnston and Pontotoc counties. Habitat: cobble bars and riparian zones. Associates: <i>Boehmeria cylindrica</i> , <i>Chasmanthium latifolium</i> , <i>Equisetum laevigatum</i> , <i>Platanus occidentalis</i> . Comments: <i>Alnus maritima</i> is known from two widely disjunct locations: Oklahoma and the Delmarva Peninsula of Delaware and Maryland. The distri

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
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bution of *A. maritima* is a biogeographic enigma that has yet to be suitably explained. References: Little, 1996; McCoy, 1958; Hoagland, 1998.

III.B.2.N.d.

ALNUS SERRULATA SHRUBLAND ALLIANCE

III.B.2.N.d.

*Alnus serrulata* - *Amorpha fruticosa* shrubland association

Distribution: southeastern Oklahoma (Choctaw, Latimer, Leflore, McCurtain, and Pushmataha counties). Habitat: common in palustrine and lacustrine wetland habitats. Associates: *Cephalanthus occidentalis*, *Cornus amomum*, *Salix nigra*, *Typha latifolia*, *Zizaniopsis milacea*. References: Penfound, 1953; Little, 1980.

III.B.2.N.d.

CRATAEGUS VIRIDIS SHRUBLAND ALLIANCE

III.B.2.N.d.

*Crataegus (crus-galli, viridis, mollis)* shrubland association

Distribution: localized in east-central and eastern Oklahoma. Habitat: old-fields, floodplains and mesic slopes. Associates: *Celtis laevigata*, *Diospyros virginiana*, *Laportea canadensis*, *Parthenocissus quinquefolia*, *Ulmus alata*, *Smilax rotundifolia*. Comments: Corresponds to SAF 109 (Erye, 1980). Carleton (1892) reported these species of *Crataegus* "in the Cherokee and Creek Nations haws are extremely abundant." References: Taylor, 1967; Hoagland, 1998.

III.B.2.N.d.

HAMAMELIS VERNALIS SHRUBLAND ALLIANCE

III.B.2.N.d.

*Hamamelis vernalis* - *Cornus amomum* shrubland association

Distribution: eastern Oklahoma (Adair, Cherokee, Delaware, Haskell, Latimer, LeFlore, McCurtain, and Sequoyah counties). Habitat: cobble bars and small streams with beds composed of large rubble. Associates: *Alnus serrulata*, *Amorpha fruticosa*, *Andrachne phyllanthoides*, *Hypericum prolificum*, *Salix caroliniana*. References: Little and Olmstead, 1935.

III.B.2.N.d.

SALIX EXIGUA SHRUBLAND ALLIANCE

III.B.2.N.d.

*Salix exigua/Panicum virgatum* shrubland association

Distribution: western Oklahoma and along the Arkansas River. Habitat: occurs along the margin of streams and lakes. Associates: *Cephalanthus occidentalis*, *Eupatorium serotinum*, *Panicum virgatum*, *Parthenocissus quinquefolia*, *Pluchea odorata*, *Tamarix chinensis*, *Vitis acerifolia*. *Salix amygdaloides* is a common associate in the Oklahoma Panhandle. References: Hoagland, 1998.

III.B.2.N.f.

Semipermanently flooded cold-deciduous shrubland.

III.B.2.N.f.

CEPHALANTHUS OCCIDENTALIS SHRUBLAND ALLIANCE

III.B.2.N.f.

*Cephalanthus occidentalis* shrubland association

Distribution: throughout Oklahoma, excluding the Panhandle. Habitat: common in palustrine and lacustrine wetland habitats. Associates: *Amorpha fruticosa*, *Carex lupulina*, *Cornus amomum*, *Hydrocotyle verticillata*, *Polygonum hydropiperoides*, *Salix nigra*. References: Little and Olmstead, 1935; Blair, 1938; Duck and Fletcher, 1945; McCoy, 1958; Roe, 1998.

III.B.2.N.f.

FORESTIERA ACUMINATA SHRUBLAND ALLIANCE

III.B.2.N.f.

*Forestiera acuminata* - *Cephalanthus occidentalis* shrubland association

Distribution: This association occurs along the Deep Fork, Verdigris, and Neosho Rivers (Cherokee, Creek, Delaware, Lincoln, Muskogee, Okmulgee,

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
	Ottawa, Rogers, Tulsa, and Wagoner counties). Habitat: backswamp, sloughs and flooded habitats. Associates: <i>Amorpha fruticosa</i> , <i>Cyperus</i> sp., <i>Hibiscus laevis</i> , <i>Nelumbo lutea</i> , <i>Polygonum hydropiperoides</i> , <i>Zizaniopsis milacea</i> .
II.B.3.	Extremely xeromorphic deciduous shrubland.
III.B.3.N.	Natural/Semi-natural.
III.B.3.N.a.	Extremely xeromorphic deciduous shrubland.
III.B.3.N.a.	PROSOPIS GLANDULOSA SHRUBLAND ALLIANCE
III.B.3.N.a.	<i>Prosopis glandulosa</i> / <i>Bouteloua gracilis</i> - <i>Buchloë dactyloides</i> shrubland association Distribution: western and west-central Oklahoma (Beckham, Comanche, Cotton, Ellis, Greer, Harmon, Jackson, Jefferson, Kiowa, Major, Roger Mills, Stephens, and Tillman counties). Habitat: sandy plains and valleys. Associates: <i>Ambrosia artemisiifolia</i> , <i>Amphiachyris dracunculoides</i> , <i>Bothriochloa saccharoides</i> , <i>Bouteloua gracilis</i> , <i>Opuntia polyacantha</i> , <i>Schizachyrium scoparium</i> . Comments: Corresponds to SAF 68 (Erye, 1980). The abundance of <i>P. glandulosa</i> has increased markedly since the turn-of-the-century as result of land-use practices (Tate, 1928; Allred, 1949). References: Bruner, 1931; Blair and Hubbell, 1938; Osborn, 1941; Harlan, 1957; Zandoni et al., 1979.
III.B.3.N.a.	<i>Prosopis glandulosa</i> - <i>Ziziphus obtusifolia</i> shrubland association Distribution: western Jackson and southern Harmon counties. Habitat: primarily in the gypsum hills. Associates: <i>Bouteloua gracilis</i> , <i>Buchloë dactyloides</i> , <i>Lesquerella gordonii</i> , <i>Opuntia leptocaulis</i> , <i>Schizachyrium scoparium</i> , <i>Yucca glauca</i> . References: Bruner, 1931; Blair and Hubbell, 1938; Barber 1974, 1979.
V.	HERBACEOUS VEGETATION. Herbs (graminoids, forbs, and ferns) dominant (generally forming at least 25% cover). Trees, shrubs, and dwarf-shrubs generally with less than 25% cover. Herbaceous cover (rarely) may be less than 25% in cases when the cover of each of the other lifeforms present (i.e., tree, shrub, dwarf-shrub, nonvascular) is less than 25% and herbaceous cover exceeds the cover of the other lifeforms.
V.A.	Perennial graminoid vegetation (grasslands). Perennial graminoids generally contribute to >50% of total herbaceous cover.
V.A.5.	Temperate or subpolar grassland.
V.A.5.N.	Natural/Semi-natural.
V.A.5.N.a.	Tall sod temperate grassland (includes mixed sod and bunch graminoids).
V.A.5.N.a.	ANDROPOGON GERARDII HERBACEOUS ALLIANCE
V.A.5.N.a.	<i>Andropogon gerardii</i> - <i>Panicum virgatum</i> herbaceous association Distribution: throughout the state, but most abundant in northeastern and central Oklahoma. Habitat: lowland prairies. Associates: <i>Amorpha canescens</i> , <i>Aster ericoides</i> , <i>Elymus canadensis</i> , <i>Eryngium yuccifolium</i> , <i>Petalostemum purpurea</i> , <i>Sorghastrum nutans</i> , <i>Tripsacum dactyloides</i> . References: Booth, 1932; Blair, 1938; Blair and Hubbell, 1938; Booth 1941; Osborn and Kellogg, 1943; Osborn and Allan, 1949; Rice, 1952.
V.A.5.N.a.	<i>Andropogon gerardii</i> - <i>Schizachyrium scoparium</i> - <i>Sorghastrum nutans</i> herbaceous association

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FDGC classification code	Oklahoma community types
	Distribution: throughout Oklahoma, but common in northeastern and central. Habitats: mesic soils and uplands. Associates: <i>Amorpha canescens</i> , <i>Arnoglossum plantagineum</i> , <i>Aster ericoides</i> , <i>A. patens</i> , <i>Dichantherium oligosanthes</i> , <i>Echinacea pallida</i> , <i>Helianthus mollis</i> , <i>Panicum virgatum</i> , <i>Solidago missouriensis</i> , <i>Sorghastrum nutans</i> , <i>Sporobolus asper</i> . References: Carleton, 1892; Bruner, 1931; Barkley, 1933; Fishman, 1936; Barclay, 1937; Hoisington, 1937; Little, 1938; Rice, 1952; Rice and Penfound, 1954; Harlan, 1957; Dwyer, 1958; Crockett, 1962a, 1962b, 1964; Penfound, 1964a; Sims and Dwyer, 1965; Hutchinson et al., 1966; Rice, 1967; Murray, 1974; McDonald, 1976; Zandoni et al., 1979; Collins and Adams, 1983.
V.A.5.N.a.	ANDROPOGON HALLII HERBACEOUS ALLIANCE
V.A.5.N.a.	<i>Andropogon hallii</i> - <i>Calamovilfa gigantea</i> herbaceous association Distribution: western Oklahoma. Habitat: sand dunes and deep sandy soils. Associates: <i>Artemisia filifolia</i> , <i>Cenchrus pauciflora</i> , <i>Cyperus schweinitzi</i> , <i>Eriogonum annuum</i> , <i>Prunus angustifolia</i> , <i>Rhus aromatica</i> . References: Penfound, 1953; Baalman, 1965.
V.A.5.N.a.	PANICUM VIRGATUM HERBACEOUS ALLIANCE
V.A.5.N.a.	<i>Panicum virgatum</i> - <i>Tripsacum dactyloides</i> herbaceous association Distribution: throughout Oklahoma. Habitat: moist soils and lowlands. Associates: <i>Andropogon gerardii</i> , <i>Amorpha canescens</i> , <i>Aster ericoides</i> , <i>Eryngium yuccifolium</i> , <i>Helianthus mollis</i> , <i>Solidago missouriensis</i> , <i>Sorghastrum nutans</i> . References: Baalman, 1965; Allgood and Gray, 1974; Hoagland, 1998.
V.A.5.N.a.	SCHIZACHYRIUM SCOPARIUM - SORGHASTRUM NUTANS HERBACEOUS ALLIANCE
V.A.5.N.a.	<i>Schizachyrium scoparium</i> - <i>Sorghastrum nutans</i> herbaceous association Distribution: throughout Oklahoma. Habitat: upland; calcareous and well drained soils. May include some glade habitats in eastern Oklahoma. Associates: <i>Aster ericoides</i> , <i>Andropogon gerardii</i> , <i>Amorpha canescens</i> , <i>Aristida purpurascens</i> , <i>Bouteloua curtipendula</i> , <i>Dichantherium oligosanthes</i> , <i>Panicum virgatum</i> , <i>Paspalum laeve</i> , <i>Sporobolus asper</i> . References: Kelting, 1951, 1954, 1957; Gardner et al., 1957; Gardner, 1958; Penfound, 1964b; Baalman, 1965; Murray, 1974; Netherland, 1979; Zandoni et al., 1979; Ewing et al., 1984.
V.A.5.N.a.	<i>Schizachyrium scoparium</i> - <i>Andropogon gerardii</i> herbaceous association Distribution: throughout much of Oklahoma. Habitat: mesic soils and uplands. Associates: <i>Amorpha canescens</i> , <i>Aster ericoides</i> , <i>Bouteloua curtipendula</i> , <i>Coelorachis cylindrica</i> , <i>Dichantherium oligosanthes</i> , <i>Panicum virgatum</i> , <i>Sorghastrum nutans</i> , <i>Symphoricarpos orbiculatus</i> . References: Welch, 1929; Bruner, 1931; Carpenter, 1935, 1939; Little, 1939; Nease, 1948; Kelting, 1951; Allred and Mitchell, 1955; Gardner et al., 1957; Gardner, 1958; Penfound and Rice, 1957a; Ray, 1957; Jones, 1961; Buck and Kelting, 1962; Crockett, 1962a, 1962b; Jones, 1963; Crockett, 1964; Hazell, 1967; Kapustka and Moleski, 1976.
V.A.5.N.c.	Medium-tall sod temperate or subpolar grassland (includes sod or mixed sod-bunch graminoids).
V.A.5.N.c.	ANDROPOGON VIRGINICUS HERBACEOUS ALLIANCE

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FDGC classification code	Oklahoma community types
V.A.5.N.c.	<i>Andropogon virginicus/Diospyros virginiana - Rhus glabra</i> herbaceous association Distribution: east-central and eastern Oklahoma. Habitat: uplands, primarily degraded prairies and abandoned agricultural land. Associates: <i>Rhus copallina</i> , <i>R. glabra</i> , <i>Rubus ostryifolius</i> , <i>Smilax bona-nox</i> , <i>Toxicodendron radicans</i> . References: Penfound, 1953; Tarr et al., 1980.
V.A.5.N.c.	<b>BOTHRIOCHLOA SACCHAROIDES HERBACEOUS ALLIANCE</b>
V.A.5.N.c.	<i>Bothriochloa saccharoides</i> herbaceous association Distribution: central, western, and the Oklahoma Panhandle. Habitat: upland prairies and pastures. Also, roadsides and degraded grasslands. Associates: <i>Amphiachyris dracunculoides</i> , <i>Aristida oligantha</i> , <i>Bouteloua curtipendula</i> , <i>Helenium amarum</i> , <i>Hordeum jubatum</i> . Comments: Although the presence of <i>B. saccharoides</i> herbaceous vegetation often indicates disturbance, it also occurs on claypan or shallow soils. References: Bruner, 1931; Booth, 1932, 1941; Osborn and Allan, 1949.
V.A.5.N.c.	<b>MUHLENBERGIA REVERCHONII HERBACEOUS ALLIANCE</b>
V.A.5.N.c.	<i>Muhlenbergia reverchonii - Croton monanthogynus</i> herbaceous association Distribution: infrequent to localized in central Oklahoma. Habitat: seasonal seeps on calcareous, clay soils. Associates: <i>Dodecatheon meadia</i> , <i>Hedyotis nigricans</i> , <i>Hypoxis hirsuta</i> , <i>Lesquerella ovalifolia</i> var. <i>alba</i> , <i>Opuntia macrorhiza</i> . References: Dale, 1959.
V.A.5.N.c.	<b>PANICUM OBTUSUM HERBACEOUS ALLIANCE</b>
V.A.5.N.c.	<i>Panicum obtusum - Buchloë dactyloides</i> herbaceous association Distribution: central, western and the Oklahoma Panhandle. Habitat: mesic soils in pastures, prairies, riparian areas, and playa lakes. Associates: <i>Bouteloua gracilis</i> , <i>Iva axillaris</i> , <i>Pascopyrum smithii</i> , <i>Ratibida tagetes</i> , <i>Schedonnardus paniculatus</i> . References: Hoagland and Collins, 1997.
V.A.5.N.c.	<b>SCHIZACHYRIUM SCOPARIUM - BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE</b>
V.A.5.N.c.	<i>Schizachyrium scoparium - Bouteloua curtipendula - Bouteloua gracilis</i> herbaceous association Distribution: common in central, western, and Panhandle of Oklahoma, but occurs throughout. Habitat: well drained soils and rocky slopes. Includes some glade habitats in eastern Oklahoma. Associates: <i>Andropogon gerardii</i> , <i>Aster ericoides</i> , <i>Helianthus hirsutus</i> , <i>Lesquerella ovalifolia</i> , <i>Sorghastrum nutans</i> , <i>Sporobolus asper</i> . References: Bruner, 1931; Smith, 1940; Osborn and Kellogg, 1943; Crockett, 1962b, 1964; Smith, 1998.
V.A.5.N.c.	<i>Schizachyrium scoparium - Bouteloua hirsuta</i> herbaceous association Distribution: throughout much of Oklahoma. Habitat: well drained soils and rocky slopes. Includes some glade habitats in eastern Oklahoma. Associates: <i>Andropogon gerardii</i> , <i>Bouteloua curtipendula</i> , <i>Echinacea pallida</i> , <i>Eryngium leavenworthii</i> , <i>Ruellia humilis</i> , <i>Sporobolus asper</i> , <i>Thelesperma filifolia</i> . References: Bruner, 1931; McCoy, 1958; Dale, 1959; Taylor and Penfound, 1961; Crockett, 1962b, 1964.

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
V.A.5.N.c.	<i>Schizachyrium scoparium</i> - <i>Castilleja purpurea</i> var. <i>citrina</i> - <i>Lesquerella gordonii</i> herbaceous association Distribution: western Oklahoma. Habitat: limited to shallow soils over gypsum. Associates: <i>Bouteloua hirsuta</i> , <i>Hymenoxys scaposa</i> , <i>Juniperus pinchotii</i> , <i>Liatris punctata</i> , <i>Lithospermum incisa</i> , <i>Lomatium foeniculaceum</i> . References: Barber, 1974, 1979.
V.A.5.N.d.	Medium-tall bunch temperate or subpolar grassland.
V.A.5.N.d.	BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE
V.A.5.N.d.	<i>Bouteloua curtipendula</i> herbaceous association Distribution: eastern and central Oklahoma. Habitat: well drained soils and rocky slopes. Includes some glade habitats in eastern Oklahoma. Associates: <i>Bothriochloa saccharoides</i> , <i>Heliotropium tenellum</i> , <i>Lesquerella ovalifolia</i> , <i>Opuntia humifusa</i> , <i>Schizachyrium scoparium</i> , <i>Yucca glauca</i> . References: Blair and Hubbell, 1938; Harlan, 1957.
V.A.5.N.d.	<i>Bouteloua curtipendula</i> - <i>Bouteloua gracilis</i> - <i>Buchloë dactyloides</i> herbaceous association Distribution: the Panhandle and western Oklahoma. Habitat: well drained soils and rocky slopes. Includes some glade habitats in eastern Oklahoma. Associates: <i>Bouteloua hirsuta</i> , <i>Opuntia humifusa</i> , <i>O. imbricata</i> (in Cimarron Co.), <i>Schizachyrium scoparium</i> , <i>Yucca glauca</i> . References: Bruner, 1931; Blair, 1938; Dwyer, 1958.
V.A.5.N.e.	Short sod temperate or subpolar grassland (including sod or mixed sod-bunch graminoids, e.g., shortgrass prairie).
V.A.5.N.e.	BOUTELOUA GRACILIS HERBACEOUS ALLIANCE Distribution: extensive in far western and the Oklahoma Panhandle. Also occurs on clay lenses in central Oklahoma.
V.A.5.N.e.	<i>Bouteloua gracilis</i> - <i>Bouteloua (curtipendula/hirsuta)</i> herbaceous association Habitat: occupies a range of habitats, from coarse, shallow soils to loamy or sandy soils. Associates: <i>Bouteloua curtipendula</i> , <i>Muhlenbergia torreyi</i> , <i>Ratibida columnifera</i> , <i>Schedonnardus paniculatus</i> , <i>Sitanion hystrix</i> , <i>Sphaeralcea coccinea</i> . References: Bruner, 1931; Carpenter, 1935; Hoisington, 1937; Rogers, 1953; Gardner, 1958; Sims and Dwyer, 1965; Smith, 1998.
V.A.5.N.e.	<i>Bouteloua gracilis</i> - <i>Buchloë dactyloides</i> herbaceous association Habitat: clay based soils. Associates: <i>Ambrosia artemisiifolia</i> , <i>Aristida oligantha</i> , <i>Panicum obtusum</i> , <i>Machaeranthera tanacetifolia</i> , <i>Melampodium leucanthum</i> , <i>Muhlenbergia torreyi</i> , <i>Sporobolus asper</i> , <i>S. cryptandrus</i> , <i>Zinnia grandiflora</i> . Comments: most extensive shortgrass prairie vegetation type. References: Bruner, 1931; Blair and Hubbell, 1938; Osborn, 1941; Osborn and Allan, 1949; Allred and Mitchell, 1955; Crockett, 1962b, 1964; Jones, 1963; Zaroni et al., 1979; Hoagland and Collins, 1997.
V.A.5.N.e.	<i>Bouteloua gracilis</i> - <i>Hilaria jamesii</i> herbaceous association Distribution: northwestern Cimarron Co. Habitat: slopes and uplands. Associates: <i>Bothriochloa saccharoides</i> , <i>Bouteloua eriopoda</i> , <i>Eriogonum jamesii</i> , <i>Melampodium leucanthum</i> , <i>Opuntia imbricata</i> , <i>Zinnia grandiflora</i> . References: Waterfall, 1949.

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
V.A.5.N.e.	<i>Bouteloua gracilis</i> - <i>Gutierrezia sarothrae</i> herbaceous association Distribution: west-central, western and the Oklahoma Panhandle. Habitat: upland prairies and pastures. Associates: <i>Buchloë dactyloides</i> , <i>Hordeum jubatum</i> , <i>Hymenopappus spinulosa</i> , <i>Salsola kali</i> , <i>Schedonnardus paniculatus</i> . Comments: this vegetation type represents degraded grasslands and pastures.
V.A.5.N.e.	<b>BOUTELOUA HIRSUTA HERBACEOUS ALLIANCE</b>
V.A.5.N.e.	<i>Bouteloua hirsuta</i> - <i>Bouteloua curtipendula</i> herbaceous association Distribution: central and western Oklahoma. Habitat: shallow or coarse soils. May include some glade habitats in eastern Oklahoma. Associates: <i>Aristida purpurascens</i> , <i>Bouteloua rigidiseta</i> , <i>Crotonopsis elliptica</i> , <i>Chaetopappus asteroides</i> , <i>Echinocereus caespitosus</i> , <i>Lithospermum tenellum</i> , <i>Opuntia macrorhiza</i> , <i>Schizachyrium scoparium</i> , <i>Rhus glabra</i> , <i>Sida procumbens</i> , <i>Thelesperma filifolia</i> . References: Carleton, 1892; Blair and Hubbell, 1938; Dale, 1959; Crockett, 1962b, 1964; McDonald, 1976.
V.A.5.N.e.	<b>BUCHLOË DACTYLOIDES HERBACEOUS ALLIANCE</b>
V.A.5.N.e.	<i>Buchloë dactyloides</i> herbaceous association Distribution: throughout Oklahoma. Habitat: clay soils, but also disturbed areas with compacted soils. Associates: <i>Aristida oligantha</i> , <i>Artemisia psilostachya</i> , <i>Bouteloua gracilis</i> , <i>Sporobolus asper</i> . References: Duck and Fletcher, 1945; Harlan, 1957; Hazell 1965, 1967.
V.A.5.N.i.	Intermittently flooded temperate or subpolar grassland (e.g., playa lakes).
V.A.5.N.i.	<b>PASCOPYRUM SMITHII HERBACEOUS ALLIANCE</b>
V.A.5.N.i.	<i>Pascopyrum smithii</i> - <i>Bouteloua gracilis</i> herbaceous association Distribution: northwestern Oklahoma and the Panhandle. Habitat: wet-moist, well-drained bottomland soils and depressions. Associates: <i>Aster subulatus</i> , <i>Buchloë dactyloides</i> , <i>Distichlis spicata</i> , <i>Hordeum jubatum</i> , <i>Polypogon monspeliensis</i> . References: Bruner, 1931; Rogers, 1953; Harlan, 1957; Zandoni et al., 1979.
V.A.5.N.i.	<i>Pascopyrum smithii</i> - <i>Buchloë dactyloides</i> ( <i>Phyla cuneifolia</i> - <i>Oenothera canescens</i> ) herbaceous associ
V.A.5.N.j.	Temporarily flooded temperate or subpolar grassland
V.A.5.N.j.	<b>DISTICHLIS SPICATA HERBACEOUS ALLIANCE</b>
V.A.5.N.j.	<i>Distichlis spicata</i> - ( <i>Hordeum jubatum</i> , <i>Sporobolus airoides</i> ) herbaceous association Distribution: central and western Oklahoma. Habitat: moist, saline soils (i.e., salt flats and some playa lake basins). Associates: <i>Ambrosia psilostachya</i> , <i>Aster subulatus</i> , <i>Baccharis salicina</i> , <i>Chenopodium letophyllum</i> , <i>Heliotropium curvassavicum</i> , <i>Kochia scoparia</i> , <i>Polypogon monspeliensis</i> , <i>Scirpus americanus</i> . References: Carleton, 1892; Ortenburger and Bird, 1933; Rogers, 1953; Penfound, 1953; Baalman, 1965; Ungar, 1968; Hoagland and Collins, 1997.
V.A.5.N.j.	<i>Distichlis spicata</i> - <i>Scirpus americana</i> herbaceous association

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
	Distribution: central and western Oklahoma. Habitat: moist, saline soils. Associates: <i>Aster subulatus</i> , <i>Eleocharis macrostachya</i> , <i>Polypogon monspeliensis</i> . References: Stevens and Shannon, 1917; Baalman, 1965.
V.A.5.N.j.	ELEOCHARIS MACROSTACHYA HERBACEOUS ALLIANCE
V.A.5.N.j.	<i>Eleocharis macrostachya</i> - <i>Marsilea vestita</i> herbaceous association
	Distribution: Western Oklahoma and the Panhandle. Habitat: wet depressions, buffalo wallows, interdunal swales, and playa lakes. Associates: <i>Ambrosia artemisiifolia</i> , <i>Coreopsis tinctoria</i> , <i>Cyperus sp.</i> , <i>Echinochloa crus-galli</i> , <i>Iva ciliata</i> . References: Barkley and Smith, 1933; Collins and Uno, 1983; Polley and Collins, 1984; Polley and Wallace, 1986.
V.A.5.N.j.	LEPTOCHLOA FASCICULARIS HERBACEOUS ALLIANCE
V.A.5.N.j.	<i>Leptochloa fascicularis</i> - <i>Echinochloa crus-galli</i> herbaceous association
	Distribution: abundant in central and western Oklahoma. Habitat: mudflats, wet depression and the margins of interdunal swales. Associates: <i>Echinochloa muricata</i> , <i>Eleocharis macrostachya</i> , <i>Polygonum lapathifolium</i> , <i>P. pennsylvanicum</i> , <i>Rumex altissimus</i> . Comments: <i>Echinochloa crus-galli</i> was introduced to North America from Europe. It was planted as a pasture grass. The achenes are considered to be highly nutritious waterfowl food. References: Hoagland, 1998.
V.A.5.N.j.	SPARTINA PECTINATA HERBACEOUS ALLIANCE
V.A.5.N.j.	<i>Spartina pectinata</i> - <i>Eleocharis (montevidensis, tenuis)</i> herbaceous association
	Distribution: northeastern, central and western Oklahoma, excluding the Coastal plain physiographic province. Habitat: floodplains, backswamp, and lake margins. Associates: <i>Ammania coccinea</i> , <i>Panicum virgatum</i> , <i>Paspalum laeve</i> , <i>Pluchea odorata</i> , <i>Vernonia baldwinii</i> . References: Baalman, 1965; Hoagland, 1998.
V.A.5.N.k.	Seasonally flooded temperate or subpolar grassland.
V.A.5.N.k.	CAREX CRUS-CORVI HERBACEOUS ALLIANCE
V.A.5.N.k.	<i>Carex crus-corvi</i> herbaceous association
	Distribution: eastern and central Oklahoma. Habitat: lakeshore marshes. <i>Carex crus-corvi</i> is an important understory species in several bottomland forest associations. Associates: <i>Aster subulatus</i> , <i>Eclipta alba</i> , <i>Juncus torreyi</i> , <i>Justicia americana</i> .
V.A.5.N.k.	JUNCUS EFFUSUS HERBACEOUS ALLIANCE
V.A.5.N.k.	<i>Juncus effusus</i> herbaceous association
	Distribution: eastern Oklahoma. Habitat: marshes, seeps, shorelines and sloughs. Associates: <i>Cephalanthus occidentalis</i> , <i>Ludwigia palustris</i> , <i>Polygonum hydropiperoides</i> , <i>Typha latifolia</i> . References: Hoagland, 1998.
V.A.5.N.k.	ZIZANIOPSIS MILIACEA HERBACEOUS ALLIANCE
V.A.5.N.k.	<i>Zizaniopsis miliacea</i> herbaceous association
	Distribution: eastern Oklahoma. Habitat: sloughs and lake margins on clay and silt soils. Associates: <i>Cephalanthus occidentalis</i> , <i>Eclipta alba</i> , <i>Eragrostis hypnoides</i> , <i>Polygonum hydropiperoides</i> , <i>Typha latifolia</i> . References: Little and Olmstead, 1935; Penfound, 1953.
V.A.5.N.l.	Semipermanently flooded temperate or subpolar grassland.

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
V.A.5.N.1.	PHRAGMITES AUSTRALIS HERBACEOUS ALLIANCE
V.A.5.N.1.	<i>Phragmites australis</i> herbaceous association Distribution: northeastern, central and western Oklahoma, excluding the coastal plain physiographic province and the Panhandle. Habitat: floodplains, backswamp, and lake margins. <i>Phragmites australis</i> has been seeded along some streams in western Oklahoma. Associates: <i>Aster subulatus</i> , <i>Pluchea odorata</i> , <i>Rumex altissimus</i> , <i>Scirpus americanus</i> , <i>Typha angustifolia</i> . References: Hoagland, 1998.
V.A.5.N.1.	SCIRPUS AMERICANUS HERBACEOUS ALLIANCE
V.A.5.N.1.	<i>Scirpus americanus</i> - <i>Eleocharis</i> spp. herbaceous association Distribution: throughout the state, but is of greatest extent in western Oklahoma and the Panhandle. Habitat: floodplains, backswamp, and lake margins. Associates: <i>Aster subulatus</i> , <i>Distichlis spicata</i> , <i>Eleocharis macrostachya</i> , <i>E. montevidensis</i> , <i>Juncus torreyi</i> , <i>Polypogon monspeliensis</i> , <i>Scirpus paludosus</i> . References: Penfound, 1953.
V.A.5.N.1.	SCIRPUS TABERNAEMONTANI HERBACEOUS ALLIANCE
V.A.5.N.1.	<i>Scirpus tabernaemontani</i> - <i>Eleocharis</i> ( <i>montevidensis</i> , <i>tenuis</i> ) herbaceous association Distribution: throughout Oklahoma, less common the Panhandle. Habitat: floodplains, backswamp, interdunal swales, and lake margins. Associates: <i>Cephalanthus occidentalis</i> , <i>Eleocharis acuminata</i> , <i>Scirpus americanus</i> , <i>Salix nigra</i> , <i>Typha domingensis</i> , <i>T. latifolia</i> . References: Baalman, 1965.
V.A.5.N.1.	TYPHA (ANGUSTIFOLIA, DOMINGENSIS) HERBACEOUS ALLIANCE
V.A.5.N.1.	<i>Typha</i> ( <i>angustifolia</i> , <i>domingensis</i> ) herbaceous association Distribution: throughout Oklahoma. Habitat: floodplains, backswamp, and lake margins. Associates: <i>Cicuta maculata</i> , <i>Lemna minor</i> , <i>Lobelia cardinalis</i> , <i>Nelumbo lutea</i> , <i>Phyla nodiflora</i> , <i>Pluchea odorata</i> , <i>Rumex altissimus</i> , <i>Scirpus tabernaemontani</i> . References: Hoagland, 1998.
V.A.5.N.1.	TYPHA LATIFOLIA HERBACEOUS ALLIANCE
V.A.5.N.1.	<i>Typha latifolia</i> herbaceous association Distribution: throughout Oklahoma, but absent from parts of northwest Oklahoma and the Panhandle. Habitat: floodplains, backswamp, and lake margins. Associates: <i>Cicuta maculata</i> , <i>Nelumbo lutea</i> , <i>Pluchea odorata</i> , <i>Polygonum amphibium</i> , <i>Rumex altissimus</i> , <i>Scirpus tabernaemontani</i> . References: Blair and Hubbell, 1938; McCoy, 1958.
V.A.5.N.1.	<i>Typha latifolia</i> - <i>Thalia dealbata</i> herbaceous association Distribution: infrequent in eastern (i.e., McCurtain counties) and central (Creek and Jefferson Counties) Oklahoma. Habitat: marshes, ponds, and lake margins. Associates: <i>Hibiscus laevis</i> , <i>Justicia americana</i> , <i>Polygonum amphibium</i> , <i>Pontederia cordata</i> , and <i>Scirpus fluvitalis</i> . References: Hoagland, 1998.
V.A.5.N.m.	Saturated temperate or subpolar grassland.
V.A.5.N.m.	DICHANTHELIUM SCOPARIUM HERBACEOUS ALLIANCE
V.A.5.N.m.	<i>Dichanthelium scoparium</i> - <i>Boehmeria cylindrica</i> / <i>Sphagnum subsecundum</i> - <i>Polytrichum commune</i> herbaceous association



## Appendix 1-Continued

FDGC classification code	Oklahoma community types
	Distribution: southeastern Oklahoma. Habitat: seeps and sandy or peaty depressions. Associates: <i>Juncus effusus</i> , <i>J. interior</i> , <i>Panicum anceps</i> . In Oklahoma, <i>Eriocaulon kornickianum</i> , a species of concern, is associated with this habitat (Atoka, Choctaw, and Pushmataha counties).
V.A.5.C.x.	Planted/cultivated
V.A.5.C.x.	<b>BOTHRIOCHLOA ISCHAEMUM HERBACEOUS ALLIANCE</b>
V.A.5.C.x.	<i>Bothriochloa ischaemum</i> herbaceous association
	Distribution: throughout Oklahoma. Habitat: <i>Bothriochloa ischaemum</i> was introduced to North America from central Europe and Asia. It has been planted extensively along roadside right-of-ways and in converted native pastures and hay meadows. References: Berg, 1993.
V.A.5.N.x.	<b>CYNODON DACTYLON HERBACEOUS ALLIANCE</b>
V.A.5.N.x.	<i>Cynodon dactylon</i> herbaceous association
	Distribution: central and western Oklahoma. Habitat: converted pastures, disturbed areas. Associates: <i>Ambrosia artemisiifolia</i> , <i>Amphiachyris dracunculoides</i> , <i>Melilotus alba</i> . Comments: <i>Cynodon dactylon</i> was introduced to North America from Africa in the late nineteenth century. The aggressive promotion and planting of <i>C. dactylon</i> began in Oklahoma about 1902. It was recommended for the control of wind and water erosion in addition to the conversion of native pastures. References: McDonald, 1938; Kelting, 1948; Kelting and Penfound, 1950; Penfound, 1953; Heath et al., 1973; Barclay, 1978; Petranka and Holland, 1980.
V.A.5.C.x.	<b>ERAGROSTIS CURVULA HERBACEOUS ALLIANCE</b>
V.A.5.C.x.	<i>Eragrostis curvula</i> herbaceous association
	Distribution: throughout much of Oklahoma, excluding the Panhandle. Habitat: <i>Eragrostis curvula</i> was introduced to North America from East Africa. It has been planted extensively in pastures with low-fertility, highly eroded areas, and highway rights-of-ways. References: Heath et al., 1973.
V.A.5.C.x.	<b>FESTUCA ARUNDINACEA HERBACEOUS ALLIANCE</b>
V.A.5.C.x.	<i>Festuca arundinacea</i> herbaceous association
	Distribution: primarily in northeastern Oklahoma. Habitat: <i>Festuca arundinacea</i> was introduced to North America from Europe. It has been used extensively in the conversion pastures and hay meadows of native grasses. References: Heath et al., 1973.
V.A.5.C.x.	<b>SORGHUM HALEPENSE HERBACEOUS ALLIANCE</b>
V.A.5.C.x.	<i>Sorghum halepense</i> herbaceous association
	Distribution: throughout Oklahoma, but most common in eastern and central portions of the state. Habitat: <i>Sorghum halepense</i> was introduced to North America from Mediterranean Europe and Africa in the 1830s. Although originally introduced as a forage species it has become a nuisance weed. Established stands in old-fields and bottomland may persist for many years. Associates: <i>Ambrosia trifida</i> , <i>Conyza canadensis</i> , <i>Digitaria sanguinalis</i> , <i>Lactuca canadensis</i> , <i>Rhus glabra</i> . References: Duck and Fletcher, 1945; Harlan, 1957; McCoy, 1958; Galloway, 1963, 1964; Parks and Barclay, 1966; Heath et al., 1973.

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
V.A.6.	Temperate or subpolar grassland with a sparse tree layer.
V.A.6.N.	Natural/Semi-natural.
V.A.6.N.f.	Medium-tall temperate or subpolar grassland with sparse needle-leaved evergreen or mixed trees.
V.A.6.N.f.	SCHIZACHYRIUM SCOPARIUM/JUNIPERUS VIRGINIANA HERBACEOUS ALLIANCE
V.A.6.N.f.	<i>Schizachyrium scoparium/Juniperus virginiana</i> herbaceous association Distribution: throughout Oklahoma, excluding far western and the Oklahoma Panhandle. Habitat: old-fields and some glade habitats in eastern Oklahoma. Associates: <i>Andropogon gerardii</i> , <i>Bouteloua curtipendula</i> , <i>Ruellia humilis</i> , <i>Sporobolus asper</i> , <i>Thelesperma filifolia</i> . References: Rice, 1960; Rosson, 1995.
V.B.	Perennial forb vegetation. Perennial forbs (including ferns and biennials) generally contributing to >50% of total herbaceous cover.
V.B.2.	Temperate or subpolar perennial forb vegetation.
V.B.2.N.	Natural/Semi-natural.
V.B.2.N.b.	Low temperate or subpolar perennial forb vegetation.
V.B.2.N.b.	LESQUERELLA (GORDONII, OVALIFOLIA) HERBACEOUS ALLIANCE
V.B.2.N.b.	<i>Lesquerella (gordonii, ovalifolia)- Schizachyrium scoparium</i> herbaceous association Distribution: localized in central, western Oklahoma and the Panhandle. Habitat: shallow, rocky soils. Associates: <i>Bouteloua curtipendula</i> , <i>Bouteloua hirsuta</i> , <i>Croton monanthogynus</i> , <i>Mentzelia oligosperma</i> , <i>Oenothera missouriensis</i> , <i>Opuntia humifusa</i> .
V.B.2.N.d.	Temporarily flooded temperate perennial forb vegetation.
V.B.2.N.d.	JUSTICIA AMERICANA HERBACEOUS ALLIANCE
V.B.2.N.d.	<i>Justicia americana</i> herbaceous association Distribution: east and east-central Oklahoma. Habitat: banks and cobble bars of slow moving streams and lake margins. Associates: <i>Ammania coccinea</i> , <i>Amorpha fruticosa</i> , <i>Aster subulatus</i> , <i>Cyperus aristata</i> , <i>Leersia oryzoides</i> , <i>Leucospora multifida</i> . References: Little and Olmstead, 1935; Penfound, 1953; McCoy, 1958.
V.B.2.N.e.	Semipermanently flooded temperate perennial forb vegetation
V.B.2.N.e.	NELUMBO LUTEA HERBACEOUS ALLIANCE
V.B.2.N.e.	<i>Nelumbo lutea</i> herbaceous association Distribution: eastern and central Oklahoma. Habitat: lakes, ponds and sloughs. Associates: <i>Hibiscus laevis</i> , <i>Lemna minor</i> , <i>Potamogeton pectinatus</i> , <i>Polygonum amphibium</i> , <i>Typha latifolia</i> . References: Penfound, 1953.
V.B.2.N.e.	<i>Nelumbo lutea - Jussiaea peploides</i> herbaceous association Distribution: eastern and central Oklahoma. Habitat: lakes, ponds and sloughs. Associates: <i>Echinodorus rostratus</i> , <i>Hibiscus laevis</i> , <i>Lemna minor</i> , <i>Polygonum amphibium</i> , <i>P. hydropiperoides</i> , <i>Potamogeton pectinatus</i> , <i>Typha latifolia</i> , <i>Utricularia biflora</i> , <i>U. vulgaris</i> . References: Blair, 1938; Blair and Hubbell, 1938.
V.B.2.N.e.	POLYGONUM SP. (SECTION PERSICARIA) HERBACEOUS ALLIANCE
V.B.2.N.e.	<i>Polygonum amphibium</i> herbaceous association

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
V.B.2.N.e.	Distribution: throughout Oklahoma. Habitat: wet depressions, lakes and ponds. Associates: <i>Echinochloa crus-galli</i> , <i>Juncus torreyi</i> , <i>Polygonum lapathifolium</i> , <i>P. pensylvanicum</i> , <i>Potamogeton pectinatus</i> , <i>Typha latifolia</i> . References: Penfound, 1953; Hoagland and Collins, 1997. <i>Polygonum pensylvanicum</i> - <i>Polygonum lapathifolium</i> herbaceous association
V.B.2.N.e.	Distribution: occur throughout Oklahoma. Habitat: wet depressions, lakes and ponds. Associates: <i>Ammania coccinea</i> , <i>Helianthus annuus</i> , <i>Lemna minor</i> , <i>Potamogeton pectinatus</i> , <i>Spirodela polyrhiza</i> , <i>Utricularia biflora</i> , <i>Xanthium strumarium</i> . Comments: the seeds of both <i>Polygonum</i> species have been planted extensively as a food source for waterfowl. References: Penfound, 1953; Hoagland, 1998.
V.B.2.N.e.	SAGITTARIA LATIFOLIA HERBACEOUS ALLIANCE
V.B.2.N.e.	<i>Sagittaria latifolia</i> - <i>Sagittaria longiloba</i> herbaceous association Distribution: throughout Oklahoma, rare or absent in the Panhandle. Habitat: ponds, interdunal swales, and sloughs. Associates: <i>Echinochloa crus-galli</i> , <i>Eleocharis macrostachya</i> , <i>Heteranthera limosa</i> , <i>Spirodela polyrhiza</i> . References: Hoagland, 1998.
V.B.2.C.x.	Planted/cultivated.
V.B.2.C.x.	LESPEDEZA CUNEATA HERBACEOUS ALLIANCE
V.B.2.C.x.	<i>Lespedeza cuneata</i> herbaceous association Distribution: eastern and central Oklahoma. Habitat: old-field and disturbed areas. Comments: <i>Lespedeza cuneata</i> was introduced to North America from eastern Asia in the 1930s for erosion control and wildlife habitat improvement. It escaped from cultivation and is now considered a nuisance weed. Once established, this plant can persist for many years. References: Jones, 1963; Heath et al., 1973.
V.C.	Hydromorphic rooted vegetation. Non-emergent graminoids or forbs structurally supported by water and rooted in substrate (e.g., pond weeds and water lilies) (free floating vegetation belongs in aquatic system of the Cowardin et al. [1979] classification).
V.C.2.	Temperate or subpolar hydromorphic rooted vegetation.
V.C.2.N.	Natural/Semi-natural.
V.C.2.N.a.	Permanently flooded temperate or subpolar hydromorphic rooted vegetation.
V.C.2.N.a.	BRASENIA SCHREBERI HERBACEOUS ALLIANCE
V.C.2.N.a.	<i>Brasenia schreberi</i> herbaceous association Distribution: southeastern Oklahoma (including Atoka, Choctaw, Haskell, Latimer, Leflore, McCurtain, Pittsburg, and Pushmataha counties). Habitat: farm ponds, beaver ponds, lake margins. Associates: <i>Leersia oryzoides</i> , <i>Lemna valdiviana</i> , <i>Juncus effusus</i> , <i>Potamogeton pectinatus</i> , <i>Spirodela polyrhiza</i> .
V.C.2.N.a.	CERATOPHYLLUM DEMERSUM HERBACEOUS ALLIANCE
V.C.2.N.a.	<i>Ceratophyllum demersum</i> - <i>Potamogeton pectinatus</i> herbaceous association Distribution: throughout Oklahoma; of limited extent in the Panhandle. Habitat: interdunal swales, ponds, and lakes. Associates: <i>Lemna minor</i> , <i>L. valdiviana</i> , <i>Ludwigia palustris</i> , <i>Spirodela polyrhiza</i> , <i>Utricularia vulgaris</i> . Com

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
	ments: <i>Potamogeton pectinatus</i> is often seeded as a waterfowl food source. References: Penfound, 1953.
V.C.2.N.a.	HETERANTHERA LIMOSA HERBACEOUS ALLIANCE
V.C.2.N.a.	<i>Heteranthera limosa</i> - <i>Bacopa rotundifolia</i> - <i>Sagittaria latifolia</i> herbaceous association Distribution: most abundant in western and central Oklahoma along major streams (i.e., Cimarron, Canadian, and North Fork of the Red River) and quaternary deposits in the vicinity of Enid (Garfield Co.) and Weatherford (Custer Co.). Habitat: interdunal swales. Associates: <i>Ammania coccinea</i> , <i>Echinochloa crus-galli</i> , <i>Leptochloa fascicularis</i> , <i>Marsilea vestita</i> , <i>Sagittaria longiloba</i> . References: Penfound, 1953; Hoagland, 1998.
V.C.2.N.a.	JUSSIAEA PEPLOIDES HERBACEOUS ALLIANCE
V.C.2.N.a.	<i>Jussiaea peploides</i> - <i>Polygonum hydropiperoides</i> herbaceous association Distribution: throughout much of eastern and central Oklahoma. Habitat: lacustrine wetlands. Associates: <i>Cephalanthus occidentalis</i> , <i>Hibiscus laevis</i> , <i>Nelumbo lutea</i> , <i>Sagittaria latifolia</i> . References: Blair, 1938; Penfound, 1953.
V.C.2.N.a.	NASTURTIUM OFFICINALE HERBACEOUS ALLIANCE
V.C.2.N.a.	<i>Nasturtium officinale</i> herbaceous association Distribution: localized statewide. Habitat: seeps, springs, and spring-fed streams. Associates: <i>Ammania coccinea</i> , <i>Justicia americana</i> , <i>Ludwigia palustris</i> , <i>Mimulus glabratus</i> , <i>Ranunculus longirostris</i> . Comments: <i>Nasturtium officinale</i> was introduced to North America from Europe.
V.C.2.N.a.	NUPHAR LUTEA HERBACEOUS ALLIANCE
V.C.2.N.a.	<i>Nuphar lutea</i> herbaceous association Distribution: primarily in eastern Oklahoma. Habitat: lakes, ponds and sloughs. Associates: <i>Hibiscus laevis</i> , <i>Lemna minor</i> , <i>Polygonum hydropiperoides</i> , <i>Potamogeton pectinatus</i> , <i>Typha latifolia</i> , <i>Utricularia vulgaris</i> . References: Little and Olmstead, 1935; Penfound 1953; Zaroni et al., 1979.
V.C.2.N.a.	NYMPHAEA ODORATA HERBACEOUS ALLIANCE
V.C.2.N.a.	<i>Nymphaea odorata</i> herbaceous association Distribution: This association occurs primarily in eastern Oklahoma. Habitat: lakes, ponds and sloughs. Associates: <i>Echinodorus rostratus</i> , <i>Eragrostis hypnoides</i> , <i>Hibiscus laevis</i> , <i>Lemna minor</i> , <i>Polygonum hydropiperoides</i> , <i>Utricularia biflora</i> .
V.C.2.N.a.	PODOSTEMUM CERATOPHYLLUM HERBACEOUS ALLIANCE
V.C.2.N.a.	<i>Podostemum ceratophyllum</i> herbaceous association Distribution: limited to eastern Oklahoma (i.e., Glover, Little, and Mountain Fork Rivers). Habitat: riffles in rapid to slow moving streams. Associates: <i>Justicia americana</i> . References: Little and Olmstead, 1935.
V.C.2.N.a.	POTAMOGETON NODOSUS HERBACEOUS ALLIANCE
V.C.2.N.a.	<i>Potamogeton nodosus</i> herbaceous association Distribution: throughout Oklahoma, infrequent in the northwest and the Panhandle. Habitat: lakes, ponds and sloughs. Associates: <i>Echinodorus rostratus</i> , <i>Lemna minor</i> , <i>Polygonum amphibium</i> , <i>Potamogeton pectinatus</i> , <i>Typha latifolia</i> , <i>Utricularia biflora</i> . References: Penfound, 1953.

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
V.D.	Annual graminoid or forb vegetation.
V.D.2.	Temperate or subpolar annual grasslands or forb vegetation.
V.D.2.N.	Natural/Semi-natural.
V.D.2.N.b.	Tall temperate or subpolar annual forb vegetation.
V.D.2.N.b.	HELIANTHUS ANNUUS HERBACEOUS ALLIANCE
V.D.2.N.b.	<i>Helianthus (annuus/petiolaris) - Ambrosia psilostachya</i> herbaceous alliance Distribution: throughout Oklahoma, excluding most of the Panhandle. Habitat: disturbed areas, moist soils and lowlands. Associates: <i>Ambrosia trifida</i> , <i>Coreopsis tinctoria</i> , <i>Digitaria sanguinalis</i> , <i>Euphorbia marginata</i> , <i>Xanthium strumarium</i> . References: Booth, 1941; Kelting and Penfound, 1950; Penfound, 1953; Penfound and Rice, 1957a; Parks and Barclay, 1966; Collins and Adams, 1983.
V.D.2.N.b.	KOCHIA SCOPARIA HERBACEOUS ALLIANCE
V.D.2.N.b.	<i>Kochia scoparia - Salsola kali</i> herbaceous association Distribution: throughout western Oklahoma. Habitat: disturbed areas, degraded prairie and pastures.
V.D.2.N.d.	Short temperate annual grassland.
V.D.2.N.d.	AMPHIACHYRIS DRACUNCULOIDES HERBACEOUS ALLIANCE
V.D.2.N.d.	<i>Amphiachyris dracunculoides - Aristida</i> sp. herbaceous association Distribution: throughout the state, but most common in central and western Oklahoma. Habitat: disturbed areas and degraded grasslands. Associates: <i>Ambrosia psilostachya</i> , <i>Bouteloua curtipendula</i> , <i>B. hirsuta</i> , <i>Hordeum jubatum</i> , <i>Schizachyrium scoparium</i> . References: Carpenter, 1935.
V.D.2.N.d.	ARISTIDA OLIGANTHA HERBACEOUS ALLIANCE
V.D.2.N.d.	<i>Aristida oligantha - Ambrosia psilostachya</i> herbaceous association Distribution: central, western and the Oklahoma Panhandle. Habitat: upland prairies, prairie dog towns, and pastures. Associates: <i>Bouteloua gracilis</i> , <i>Chloris verticillata</i> , <i>Conyza canadensis</i> , <i>Coreopsis tinctoria</i> , <i>Dichanthelium oligosanthes</i> , <i>Eragrostis spectabilis</i> , <i>Erigeron canadensis</i> , <i>Gymnopogon ambiguus</i> , <i>Haplopappus ciliata</i> , <i>Lespedeza stipulacea</i> , <i>Solanum carolinense</i> . Comments: old-fields, disturbed areas and degraded grasslands. This association may persist in old-fields for 9 to 13 years before yielding to prairie bunch grasses. References: Booth, 1932, 1941; Hoisington, 1937; Little, 1938; Smith, 1940; Osborn and Allan, 1949; Kelting, 1951; Penfound and Rice, 1957b; Roux and Warren, 1963; Kapustka and Moleski, 1976.
V.D.2.N.h.	Seasonally flooded temperate annual forb vegetation
V.D.2.N.h.	IVA ANNUA HERBACEOUS ALLIANCE
V.D.2.N.h.	<i>Iva annua - Coreopsis tinctoria</i> herbaceous association Distribution: throughout Oklahoma, excluding most of the Panhandle. Habitat: disturbed areas, moist soils and lowlands. Associates: <i>Ambrosia trifida</i> , <i>Bothriochloa saccharoides</i> , <i>Cnidoscolus texanus</i> , <i>Lespedeza sericea</i> , <i>Passiflora incarnata</i> , <i>Sorghum halepense</i> . <i>Iva annua</i> is a host for <i>Cuscuta attenuata</i> , a species of concern. It has been found at only four sites in Oklahoma (McCurtain, Beckham, Cleveland, and Comanche counties), five sites in Texas, and one in Kansas.

## Appendix 1-Continued

FDGC classification code	Oklahoma community types
V.D.2.N.h.	SESUVIUM VERRUCOSUM - SUAEDA DEPRESSA HERBACEOUS ALLIANCE
V.D.2.N.h.	<i>Sesuvium verrucosum</i> - <i>Suaeda depressa</i> herbaceous association Distribution: western Oklahoma. Habitat: salt flats. Associates: <i>Aster subulatus</i> , <i>Baccharis salicina</i> , <i>Distichlis spicata</i> , <i>Eleocharis macrostachya</i> , <i>Polypogon monspeliensis</i> . References: Carleton, 1892; Ortenburger and Bird, 1933; Penfound, 1953; Baalman, 1965; Ungar, 1968.
VII.	SPARSE VEGETATION. Vegetation is scattered or nearly absent; total vegetation cover, excluding crustose lichens (which can sometimes have greater than 10% cover) is generally 1% to 10%.
VII.A.	Consolidated rock sparse vegetation. (Cliffs, pavement, etc.). (Vegetation characterized by herbs, shrubs, trees, and/or nonvascular plants growing in fissures of rocks or walls, or growing adnate to these surfaces).
VII.A.2.	Sparsely vegetated pavement (level/gently sloping bedrock).
VII.A.2.N.	Natural/Semi-natural.
VII.A.2.N.a.	Pavement with sparse vascular vegetation.
VII.A.2.N.a.	SEDUM NUTTALLIANUM - PLANTAGO WRIGHTIANA SPARSE VEGETATION ALLIANCE
VII.A.2.N.a.	<i>Sedum nuttallianum</i> - <i>Plantago wrightiana</i> sparse vegetation association Distribution: localized in eastern, central, and western Oklahoma. Habitat: thin soil on rock outcrops. Associates: <i>Aristida oligantha</i> , <i>Bouteloua hirsuta</i> , <i>Chaetopappus asterioides</i> , <i>Diodia teres</i> , <i>Eleocharis tenuis</i> , <i>Festuca octoflora</i> , <i>Selaginella peruviana</i> . Comments: species composition is a function of soil depth. <i>Bouteloua hirsuta</i> is dominant on deeper soil, whereas <i>S. nuttallianum</i> predominates on shallow soil. References: Uno and Collins, 1987; Collins et al., 1989; Eddy, 1990.

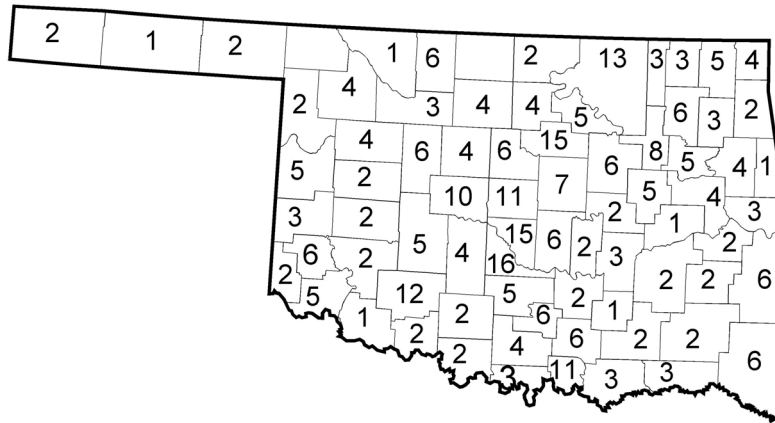


Fig. - 1: The number of data points per county from publications cited in this study.

Fig. - 2: Numbers of publications related to the vegetation of Oklahoma appearing in five year intervals

