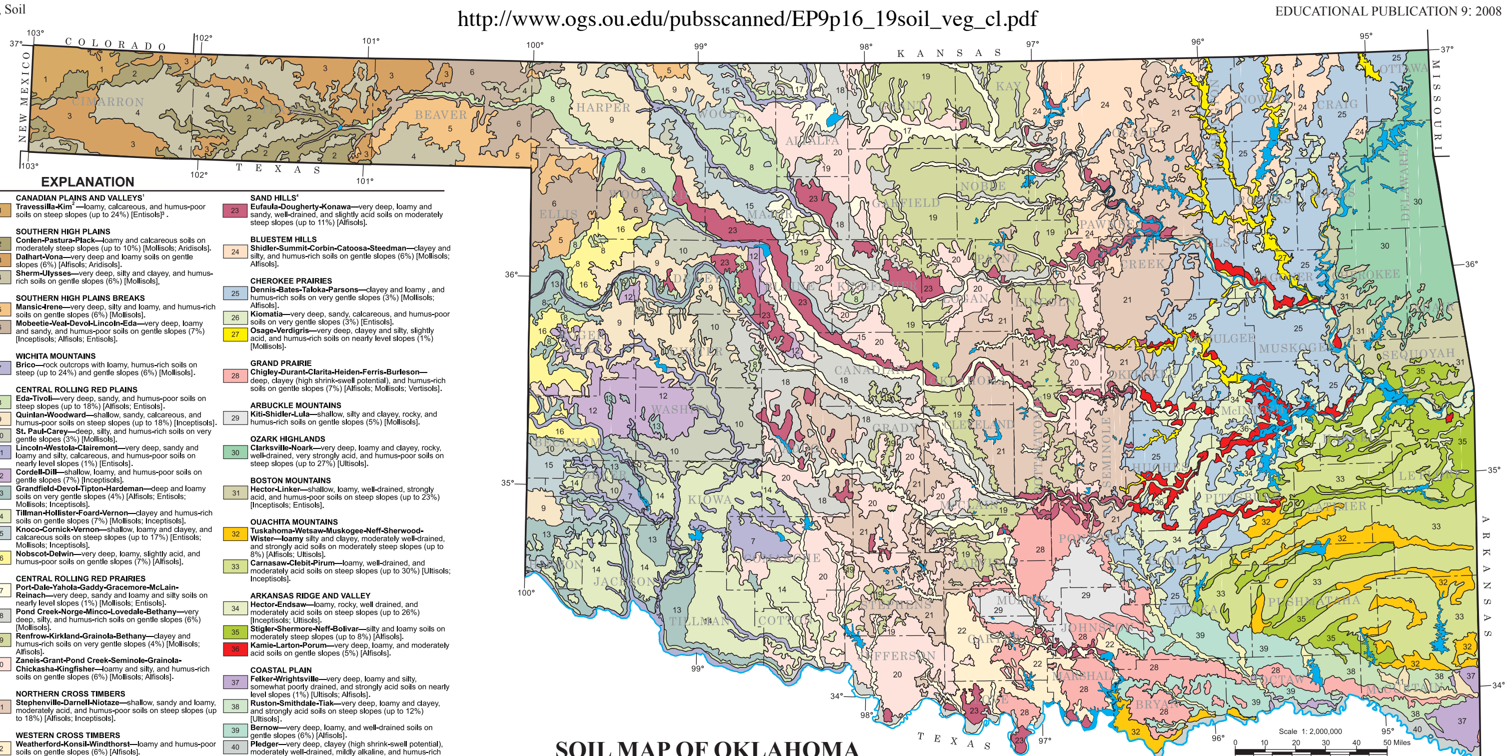

EXPLANATION

CANADIAN PLAINS AND VALLEYS[1]
- 1 — **Travessilla-Kim[2]**—loamy, calcareous, and humus-poor soils on steep slopes (up to 24%) [Entisols][3].

SOUTHERN HIGH PLAINS
- 2 — **Conlen-Pastura-Plack**—loamy and calcareous soils on moderately steep slopes (up to 10%) [Mollisols; Aridisols].
- 3 — **Dalhart-Vona**—very deep and loamy soils on gentle slopes (6%) [Alfisols; Aridisols].
- 4 — **Sherm-Ulysses**—very deep, silty and clayey, and humus-rich soils on gentle slopes (6%) [Mollisols].

SOUTHERN HIGH PLAINS BREAKS
- 5 — **Mansic-Irene**—very deep, silty and loamy, and humus-rich soils on gentle slopes (6%) [Mollisols].
- 6 — **Mobeetie-Veal-Devol-Lincoln-Eda**—very deep, loamy and sandy, and humus-poor soils on gentle slopes (7%) [Inceptisols; Alfisols; Entisols].

WICHITA MOUNTAINS
- 7 — **Brico**—rock outcrops with loamy, humus-rich soils on steep (up to 24%) and gentle slopes (6%) [Mollisols].

CENTRAL ROLLING RED PLAINS
- 8 — **Eda-Tivoli**—very deep, sandy, and humus-poor soils on steep slopes (up to 18%) [Alfisols; Entisols].
- 9 — **Quinlan-Woodward**—shallow, sandy, calcareous, and humus-poor soils on steep slopes (up to 18%) [Inceptisols].
- 10 — **St. Paul-Carey**—deep, silty, and humus-rich soils on very gentle slopes (3%) [Mollisols].
- 11 — **Lincoln-Westola-Clairemont**—very deep, sandy and loamy and silty, calcareous, and humus-poor soils on nearly level slopes (1%) [Entisols].
- 12 — **Cordell-Dill**—shallow, loamy, and humus-poor soils on gentle slopes (7%) [Inceptisols].
- 13 — **Grandfield-Devol-Tipton-Hardeman**—deep and loamy soils on very gentle slopes (4%) [Alfisols; Entisols; Mollisols; Inceptisols].
- 14 — **Tillman-Hollister-Foard-Vernon**—clayey and humus-rich soils on gentle slopes (7%) [Mollisols; Inceptisols].
- 15 — **Knoco-Cornick-Vernon**—shallow, loamy and clayey, and calcareous soils on steep slopes (up to 17%) [Entisols; Mollisols; Inceptisols].
- 16 — **Nobscot-Delwin**—very deep, loamy, slightly acid, and humus-poor soils on gentle slopes (7%) [Alfisols].

CENTRAL ROLLING RED PRAIRIES
- 17 — **Port-Dale-Yahola-Gaddy-Gracemore-McLain-Reinach**—very deep, sandy and loamy and silty soils on nearly level slopes (1%) [Mollisols; Entisols].
- 18 — **Pond Creek-Norge-Minco-Lovedale-Bethany**—very deep, silty, and humus-rich soils on gentle slopes (6%) [Mollisols].
- 19 — **Renfrow-Kirkland-Grainola-Bethany**—clayey and humus-rich soils on very gentle slopes (4%) [Mollisols; Alfisols].
- 20 — **Zaneis-Grant-Pond Creek-Seminole-Grainola-Chickasha-Kingfisher**—loamy and silty, and humus-rich soils on gentle slopes (6%) [Mollisols; Alfisols].

NORTHERN CROSS TIMBERS
- 21 — **Stephenville-Darnell-Niotaze**—shallow, sandy and loamy, moderately acid, and humus-poor soils on steep slopes (up to 18%) [Alfisols; Inceptisols].

WESTERN CROSS TIMBERS
- 22 — **Weatherford-Konsil-Windthorst**—loamy and humus-poor soils on gentle slopes (6%) [Alfisols].

SAND HILLS[4]
- 23 — **Eufaula-Dougherty-Konawa**—very deep, loamy and sandy, well-drained, and slightly acid soils on moderately steep slopes (up to 11%) [Alfisols].

BLUESTEM HILLS
- 24 — **Shidler-Summit-Corbin-Catoosa-Steedman**—clayey and silty, and humus-rich soils on gentle slopes (6%) [Mollisols; Alfisols].

CHEROKEE PRAIRIES
- 25 — **Dennis-Bates-Taloka-Parsons**—clayey and loamy , and humus-rich soils on very gentle slopes (3%) [Mollisols; Alfisols].
- 26 — **Kiomatia**—very deep, sandy, calcareous, and humus-poor soils on very gentle slopes (3%) [Entisols].
- 27 — **Osage-Verdigris**—very deep, clayey and silty, slightly acid, and humus-rich soils on nearly level slopes (1%) [Mollisols].

GRAND PRAIRIE
- 28 — **Chigley-Durant-Clarita-Heiden-Ferris-Burleson**—deep, clayey (high shrink-swell potential), and humus-rich soils on gentle slopes (7%) [Alfisols; Mollisols; Vertisols].

ARBUCKLE MOUNTAINS
- 29 — **Kiti-Shidler-Lula**—shallow, silty and clayey, rocky, and humus-rich soils on gentle slopes (5%) [Mollisols].

OZARK HIGHLANDS
- 30 — **Clarksville-Noark**—very deep, loamy and clayey, rocky, well-drained, very strongly acid, and humus-poor soils on steep slopes (up to 27%) [Ultisols].

BOSTON MOUNTAINS
- 31 — **Hector-Linker**—shallow, loamy, well-drained, strongly acid, and humus-poor soils on steep slopes (up to 23%) [Inceptisols; Entisols].

OUACHITA MOUNTAINS
- 32 — **Tuskahoma-Wetsaw-Muskogee-Neff-Sherwood-Wister—loamy** silty and clayey, moderately well-drained, and strongly acid soils on moderately steep slopes (up to 8%) [Alfisols; Ultisols].
- 33 — **Carnasaw-Clebit-Pirum**—loamy, well-drained, and moderately acid soils on steep slopes (up to 30%) [Ultisols; Inceptisols].

ARKANSAS RIDGE AND VALLEY
- 34 — **Hector-Endsaw**—loamy, rocky, well drained, and moderately acid soils on steep slopes (up to 26%) [Inceptisols; Ultisols].
- 35 — **Stigler-Shermore-Neff-Bolivar**—silty and loamy soils on moderately steep slopes (up to 8%) [Alfisols].
- 36 — **Kamie-Larton-Porum**—very deep, loamy, and moderately acid soils on gentle slopes (5%) [Alfisols].

COASTAL PLAIN
- 37 — **Felker-Wrightsville**—very deep, loamy and silty, somewhat poorly drained, and strongly acid soils on nearly level slopes (1%) [Ultisols; Alfisols].
- 38 — **Ruston-Smithdale-Tiak**—very deep, loamy and clayey, and strongly acid soils on steep slopes (up to 12%) [Ultisols].
- 39 — **Bernow**—very deep, loamy, and well-drained soils on gentle slopes (6%) [Alfisols].
- 40 — **Pledger**—very deep, clayey (high shrink-swell potential), moderately well-drained, mildly alkaline, and humus-rich soils on level areas [Vertisols].
- 41 — **Guyton-Kaufman**—very deep, silty and clayey soils on nearly level slopes (1%) [Alfisols; Vertisols].

[1]Major Land Resource Area: area of similar land use based on soils, climate, and water resources.
[2]Soil Association: two or more prevalent soil series in a Major Land Resource Area (MLRA).
[3][Soil Order]: grouping of one or more soil series by a major property. (Each order is defined in the Glossary.)
[4]Sand Hills: eolian deposits occur across the boundaries of several Major Land Resource Areas (MLRA).

SOIL MAP OF OKLAHOMA

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Soil-survey staff of the Natural Resources Conservation Service (NRCS), U.S. Department of Agriculture, have identified and mapped over 20,000 different kinds of soil in the United States. Most soils are given a name that typically comes from the place where the soil was first mapped. Named soils are referred to as a soil series.

Geology, topography, climate, plants and animals, and time are major factors in soil formation. Color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, pH, and other features are used to characterize soils. After a soil is described and its properties are determined, soil scientists assign the soil to one of 12 taxonomic orders and/or one of many suborders. Seven of 12 orders (shown in brackets in the explanation) are represented on this map. The taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the soil profile (NRCS, 1999). Carter and Gregory (1996) and Gray and Galloway (1959) group Oklahoma's major soil associations by Major Land Resource Areas (MLRA) and/or geographic regions.

Western Oklahoma—The Canadian Plains and Valleys MLRA contains brown, loamy soils developed on sandstone escarpments, basalt, and associated foot slopes (breaks) under mid and short grasses. Soils in the High Plains and Breaks consist of dark-colored loams and clay loams with moderately clayey subsoil on limey unconsolidated loams, silts, and caliche developed under mid and short grasses. In the Central Rolling Red Plains, dark to various shades of red soils with clay to loam subsoils are developed on Permian shales, mudstones, and siltstones under mid and short grasses. This MLRA contains brown to light-brown loams and sands with clay-loam to sand under mid grasses, scrub oaks, cedars, and shrubs.

Central Oklahoma—Soils in the Central Rolling Red Prairies are dark and loamy with clayey to loamy subsoils developed on Permian shales, mudstones, sandstones and/or alluvial deposits under tall grasses. Soils of the Cross Timbers are light colored, sandy with reddish subsoils on various sandy materials developed under mostly post oak, blackjack oak, and some hickory forests with prairie openings (savannah). The Bluestem Hills–Cherokee Prairies contain deep, dark-colored soils mostly with clay subsoils developed on shales, sandstones, and limestones under tall grasses. Soils in the Grand Prairie–Arbuckle Mountains MLRAs are dark and loamy to clayey with subsoils developed in shales and limestones under tall grasses near the Arbuckle Mountains and southeastern Oklahoma. Thin and stony soils develop on Precambrian granites in the Arbuckle Mountains beneath mid grasses, scrub oaks, cedars, and shrubs.

Eastern Oklahoma—The Ozark Highlands–Boston Mountains have brown to light-brown, silty soils with reddish clay subsoils on cherty limestones (Ozarks) and sandstones and shales (Boston Mountains). These soils develop under oak-hickory-pine forests and tall grasses. Soils in the Ouachita Mountains are light colored, acid, sandy, and loamy with clayey subsoils developed on sandstones and shales under oak-hickory-pine forests. Arkansas Ridge and Valley soils are loamy, rocky, and well drained where developed on steep slopes and ridges or are very deep and loamy on gentle slopes and shales in valleys. Coastal Plain soils are light colored, acid, and sandy with clay-loam to clay subsoils developed mostly on sandstones under pine-oak (east) and oak-hickory (west) forests.

Detailed information for each major soil type is published by the NRCS in its soil surveys of nearly all 77 Oklahoma counties. The surveys can be examined at local NRCS offices, typically located in county seats.

zinnia, ring muhly grass, and dropseed, tansy aster, vine mesquite grass, and yellow spine prairie thistle.

2 **Mixedgrass Eroded Plains** occupies much of western Oklahoma, and much of it has been converted to wheat or cotton production. The best examples of mixedgrass eroded plains can be found on shallow soils overlying red sandstone and shale or granite in the Wichita Mountains. Predominant species include dropseeds, little bluestem, and sideoats grama. Common grasses include hairy grama and Indiangrass. Associated species include biscuitroot, crowpoison, Engelmann's daisy, hedgehog cactus, old plainsman, prairie clover, skunkbrush, spider milkweed, plains pricklypear, and threadleaf daisy.

3 **Tallgrass Prairie** has declined in acreage, but large expanses still occur in Osage and adjacent counties. Smaller remnants occur throughout eastern Oklahoma as native haymeadows. It intergrades with oak-hickory forests in eastern Oklahoma and mixedgrass eroded plains to the west. Forest and woodland vegetation readily replace tallgrass prairie following land abandonment and fire suppression. Predominant grasses are little bluestem, big bluestem, Indiangrass, and switchgrass. Associated species include lead plant, Indian plantain, prairie clover, heath aster, small panic grass, pallid coneflower, ashy sunflower, and Missouri goldenrod.

WOODLANDS

4 **Piñon Pine–Juniper Mesa** is found in the northwestern corner of the Panhandle. Vegetation and plant species in this region are typical of the Rocky Mountain front range in Colorado and New Mexico. Although oneseed juniper and piñon pine are predominant, oneseed juniper often occurs without piñon pine. Common grass species include buffalograss, gramas (blue, black, hairy, and sideoats), and silver bluestem. Associated woody plants include cholla, Gambel oak, mesquite, mountain mahogany, skunkbrush, and soapweed. A stand of ponderosa pine also occurs in this region.

5 **Sandsage Grasslands** is common on deep sand deposits and dunes in western Oklahoma. Sandsage is a low-growing shrub with narrow, gray-green leaves, which is often cleared to increase the productivity of pasture grasses for cattle grazing. Predominant grasses include sand reed, little bluestem, sand bluestem, and sand dropseed. Mapleleaf grape, netleaf hackberry, sand plum, silky prairie clover, skunkbrush, soapweed, and spectacle pod are also common. Most species occurring in sandsage grasslands also can be found in stabilized dunes and shinnery-oak grasslands. These three vegetation types so thoroughly intergrade that they are indistinguishable in parts of western Oklahoma.

extends east along the Red River into Jefferson County. Mesquite was first documented in Oklahoma in 1853, and its abundance has steadily increased over time. Note that Duck and Fletcher (1943) did not map mesquite grasslands in northwestern Oklahoma, where it is now common on gypsum. Mesquite is readily transportable in digestive systems of cattle, and isolated populations are present in northeastern Oklahoma as a result. Predominant grasses include bromes, little bluestem, sideoats grama, and silver bluestem. Common species include broomweed, green antelopehorn milkweed, plains pricklypear, wavyleaf thistle, and western ragweed.

8 **Shinnery Oak Grasslands** is restricted to western Oklahoma. Shinnery is typically a small, shrubby tree, ranging in height from a few inches to several feet. Larger trees are hybrids with post oaks. Shinnery reproduces by sprouts from a dense network of underground roots; most shinnery stems and biomass are below ground. As a result, dense mottes are formed that can cover several acres.

FORESTS

9 **Post Oak–Blackjack Forest** is known locally as the Cross Timbers, and presents a mosaic of forest, woodland, and grassland vegetation. The most important trees in this vegetation type are post oak and blackjack oak. Blackhaw, black oak, black hickory, buckbrush, gum bumelia, Mexican plum, redbud, roughleaf dogwood, and smooth and winged sumac are common woody plants. Common plants include beebalm, big bluestem, hairy sunflower, Indiangrass, little bluestem, poverty grass, pussytoes, trailing lespedeza, and purpletop.

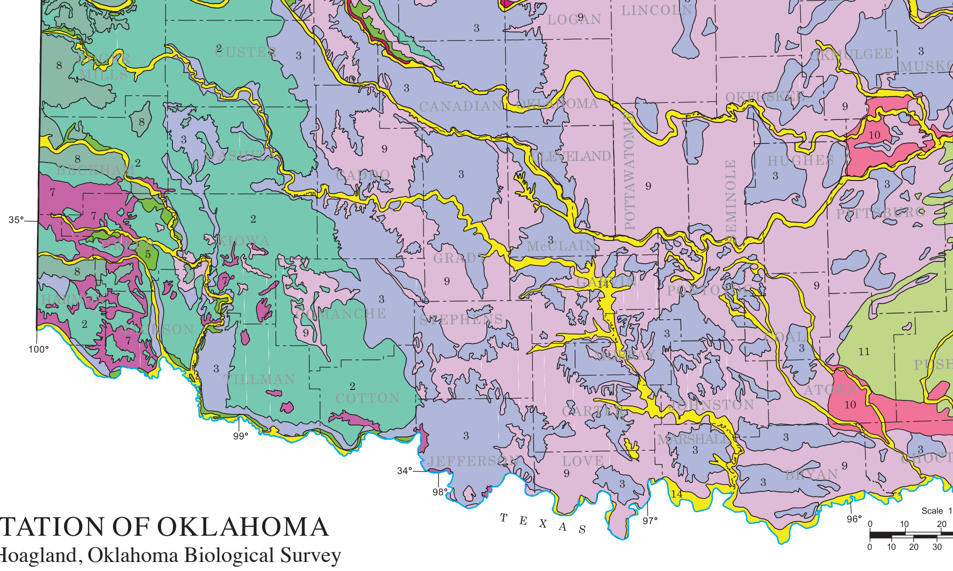
10 **Oak–Hickory Forest** occurs primarily in the Ouachita Mountains and Ozark Plateau. Common oak species include black, blackjack, post, northern red, southern red, and white. Shagbark, black, pignut, mockernut, and bitternut are common hickories. Associated trees and shrubs include flowering dogwood, highbush and lowbush blueberries, hophorn beam, redbud, serviceberry, and sugar maple. There is a profusion of flowering herbaceous plants in the oak–hickory forest, most notably spring ephemerals, of which Dutchman's breeches, Solomon's seal, troutlillies, Virginia waterleaf, wake robin, and wild ginger are but a few.

11 **Oak–Pine Forest** is limited to the Ouachita Mountains and Ozark Plateau. The presence of shortleaf pine distinguishes oak–pine forest from oak–hickory forest. Otherwise, associated species are similar to those of the oak–hickory forest. Shortleaf pine forests vary from closed canopy, pine–mixed oak stands to open canopy woodlands of predominantly shortleaf pine. The degree of canopy closure is controlled by fire.

13 **Cypress Bottoms** is limited to the Little River drainage in McCurtain County, where it occurs in sloughs and backswamps. In addition to bald cypress, American snowbell, buttonbush, hazel alder, water elm, water hickory, and overcup and water oaks are common woody plants. Wetland plants, both rooted and floating, include duckweeds, spongeweed, pennywort, water crowfoot, and pondweed.

14 **Bottomland Forest** extends from eastern to western Oklahoma along major rivers as mapped by Duck and Fletcher (1943). As a result, there is tremendous variation in the species present. Throughout much of the bottomland forest, hackberry, red elm, sugarberry, and green ash are common. In eastern Oklahoma, common bottomland trees include black gum, boxelder, red maple, river birch, silver maple, and sycamore. In the southeast, sweetgums and water and willow oaks are common. In western Oklahoma, there are fewer tree species, but bur oak, eastern cottonwood, pecan, Shumard oak, soapberry, and sandbar and black willows are common. In the Panhandle, eastern cottonwood is the predominant tree with peachleaf willow in the understory.

* Modified from Duck and Fletcher's (1943) original map, A Game Type Map of Oklahoma.
Detailed descriptions were published in a separate report by the same authors (Duck and Fletcher, 1945?).



VEGETATION OF OKLAHOMA

Bruce W. Hoagland, Oklahoma Biological Survey

The best reference for the study of Oklahoma vegetation is A Game Type Map of Oklahoma (Duck and Fletcher, 1943) published by the State of Oklahoma Game and Fish Commission (now the Oklahoma Department of Wildlife Conservation). Duck and Fletcher and a team of researchers used aerial photography, soils maps, and extensive eld surveys to map the distribution of major vegetation types. Their map is considered a potential vegetation map; it shows the distribution of vegetation in the absence of human intervention. The map is still widely used to study Oklahoma vegetation, ecology, and geography and is a testament to their thorough and conscientious work.

Duck and Fletcher's map clearly reveals the in uence of climate, particularly the precipitation gradient, on the distribution of vegetation in Oklahoma. As rainfall decreases from 55 inches in the southeast to 13 inches in the northwest, forests give way to grasslands. However, the boundary between grassland and forest vegetation is dynamic; prolonged droughts can change the boundary between the two vegetation types. Length of growing season is another climatic variable that affects cultivated crops and natural vegetation. Counties in the Red River valley have a longer growing season than those along the Kansas border. Some plants, such as buffalo currant, therefore, bloom a week earlier in Love County than in Grant County.

Geology and soils also play integral roles in determining the distribution of vegetation. For example, sugar maple trees can be found in the deeply eroded Permian sandstone canyons of Canadian and Caddo Counties, about 150 miles west of the Ozark Plateau and Ouachita Mountains where they are common. Limestone produces soils with high clay content that tend to be somewhat alkaline. Black dalea, Engelmann's pricklypear, shortlobe oak, and Ashe juniper are species that occur in regions where limestone and dolomite predominate, such as the Arbuckle Mountains and Slick Hills. Gypsum deposits in western Oklahoma support salt-tolerant plants, such as redberry juniper, gypsum phacelia, and woolly paper ower.

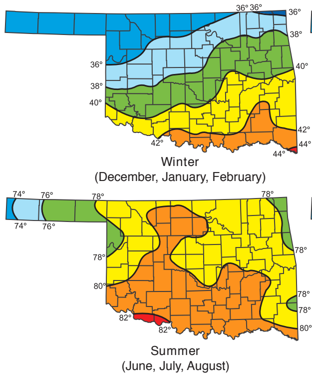
Distribution of vegetation is also in uenced by such disturbances as re and grazing by large animals. In the absence of re, grasslands are often replaced by forests and shrublands. Woodlands, which are characterized by scattered trees that are not in direct contact with one another, transform into closed-canopy forests in the absence of re. Eastern red cedar is one species that is very sensitive to re and

The vegetation types mappe
gated into three categories: gras
are areas where various grass sp
and shrubs may be present at pa
often are restricted to bottomla
are areas where trees and shrub
not in contact with one another
grass species predominate in th
predominate and their crowns i
favors the growth of shrubs and
tions.

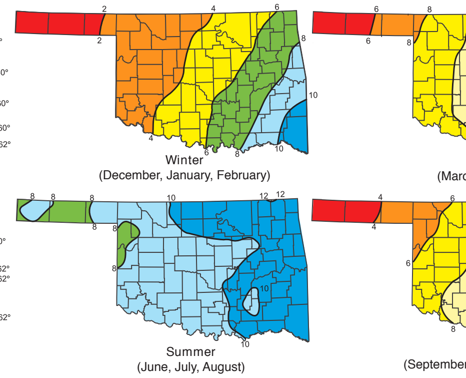
at Individual Station		
Kiamichi Fire Tower, Le Flore County	1957	84.47 in.
Smallest Reported Annual Total at Individual Station		
Regnier, Cimarron County	1956	6.53 in.
Greatest Reported Daily Precipitation at Individual Station		
Enid, Garfield County (October 11, 1973)		15.68 in.
Snowfall		
Greatest Reported Seasonal Snowfall Total for Individual Station		
Beaver, Beaver County (October 1911-March 1912)		87.3 in.
Greatest Reported Monthly Snowfall at Individual Station		
Buffalo, Harper County (February, 1971)		36.5 in.
Greatest Reported Daily Snowfall at Individual Station		
Buffalo, Harper County (February 21, 1971)		23.0 in.
Maximum Reported Snow Depth		
Buffalo, Harper County (February 22, 1971)		36.0 in.
Earliest Measurable Snowfall of Season		
Kenton, Cimarron County (September 17, 1971)		3.0 in.
Latest Measurable Snowfall of Season		
Billings, Noble County (May 6, 1954)		0.2 in.
Tornadoes		
Average Annual Number of Tornadoes (1950-2000)		54.1
Most Tornadoes in One Year	1999	146
Fewest Tornadoes in One Year	1988	17
Deadliest Tornado (Woodward, April 9, 1947)		107 deaths

[a]For the period of 1892-2000 unless otherwise noted.

[b]Compiled by the Oklahoma Climatological Survey from U.S. National Weather Service data.



(B) Mean seasonal temperatures.



(B) Mean seasonal precipitation.

CLIMATE OF OKLAHOMA

Howard L. Johnson, Oklahoma Climatological Survey

Temperature

Oklahoma is far enough north to experience weather systems that can bring rapid changes in temperature; but also far enough south so that episodes of Arctic air during the cold months are short-lived. Oklahoma is in the continental interior, which leads to hot summers. But its climate is modi ed suf ciently by warm, moist air from the Gulf of Mexico to produce relatively mild winters. (Table 6 gives statewide-averaged annual temperature.)

Mean annual temperatures increase from north to south (Fig. 26A). Oklahoma weather is dictated by four seasons, which are common to temperate latitudes (Fig. 26B). Oklahoma experiences distinctive cold (winter) and hot (summer) seasons. Transitional periods of spring and autumn separate the two extremes.

Winter weather is controlled by the polar jet stream, a continuous band of strong winds found 5 to 8 miles above the Earth. Outbreaks of cold surface air from the Arctic normally are associated with southerly migrations of the jet stream. Periods of mild winter weather occur when the jet stream stays well to the north. The jet stream plays an important role in developing new storm systems along fronts that mark the transition between cold and warm air masses.

Winter ends as cold fronts decrease in frequency, and encounter progressively warmer and more humid air masses in the spring. Approaching springtime cold fronts are frequently preceded by intense thunderstorms accompanied by a rapid drop in temperature.

In summer the jet stream normally ows far north of Oklahoma, and high pressure (an extension of the Bermuda High) builds over the southeastern United States. The air around the Bermuda High circulates clockwise with its center over the Atlantic Ocean, resulting in persistent southerly winds across Oklahoma. The size, location, and strength of circulating air determine if southerly winds deliver either warm, moist air from the Gulf of Mexico, or hot, dry air from the desert Southwest.

Autumn is usually gentle, with successive air masses becoming progressively cooler until winter is established. Cool spells in autumn are often separated by mild, dry periods known as Indian Summer that can last for several days or longer, providing Oklahoma with some of the year's most pleasant weather.

Precipitation

Proximity to the Rocky Mountains and Gulf of Mexico affects Oklahoma weather and climate. The Rocky Mountains form a barrier to prevailing westerly winds in the upper atmosphere, inducing a semi-permanent trough of low-pressure air at lower elevations to the east. This "lee trough" normally is located in eastern Colorado and western Kansas, extending south into the Oklahoma and Texas Panhandles. This trough intensi es the southerly surface winds that prevail across Oklahoma most of the year. Across Texas and Oklahoma, interaction between warm, moist air from the Gulf and outbreaks of cold air from the Arctic frequently forms new weather systems along the lee trough.

The weather systems grow in size and strength spawning violent thunderstorms over the southern plains, especially in the spring, providing much of Oklahoma's rainfall. Occasionally, the storms produce high winds, hail, and tornadoes.

Moisture arrives from the Gulf of Mexico, borne on southerly winds prevalent most of the year. The distance from the Gulf often is measured by the dryness of the air. The east and southeast are relatively moist, but western regions with higher elevations are dry, with warm days and cool nights.

Oklahoma's geographic diversity and size commonly create situations

where one area experiences drought
nual and seasonal variations in prec
precipitation across Oklahoma range
Curtain County) in the Ouachita Mo
marron County) in the Panhandle (
with thunderstorms lasting a few ho
do occur. Water from snow represent
tation (Fig. 27 A-B).

The wettest period is springtime
storm activity (Fig. 27B). Spring rai
often accompanies severe weather o
The highest statewide precipitation
tember. In September and October,
rains associated with remnants of h
the west coast of Mexico. Many one
Locally heavy rainfall occurs a
storm train," which happens when
same path. Such rainfalls can measu

Figure 28. Mean snowfall (in inches) recorded in Oklahoma (1971–2000): (A) Mean annual snowfall; (B) Mean monthly snowfall for December; (C) Mean monthly snowfall for January; (D) Mean monthly snowfall for February.

Winter Storms/Snowfall

Occasionally bitterly cold, Oklahoma's winter weather is not as consistent as the summer heat. Winter storms move through the State fairly quickly, leaving time for temperatures to moderate before the next storm arrives.

Figure 28A shows mean annual snowfalls. December and March snowfall patterns and amounts (Fig. 28B) are similar. January and February (Figs. 28C–D) are the snowiest months, in the mean. The greatest snowfall is in the Panhandle; the least is in the southeast (Fig. 28).

Growing Season

The dates between the last freeze (temperature less than 32°F) in spring and the rst freeze in fall (Figs. 29–30) de ne the growing season for fruits and vegetables. Home gardeners are sensitive to these dates. The average frost-free period ranges from 24 weeks in the western Panhandle to 33 weeks along the Red River in south-central Oklahoma. The two-month difference in the growing season affects the variation in cultivated and natural vegetation across Oklahoma. The average date of the last freeze is in the south in late March. The last frost in the western Panhandle is about a month later. Average dates for the rst freezes range from mid-October in the western Panhandle to early November in the south.

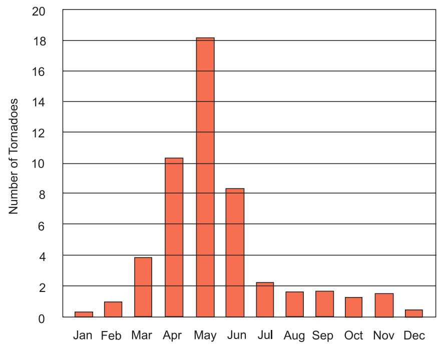


Figure 33. Average number of tornadoes reported in Oklahoma by month, 1950–1991 (modi ed from Johnson and Duchon, 1994, g. 4-14).

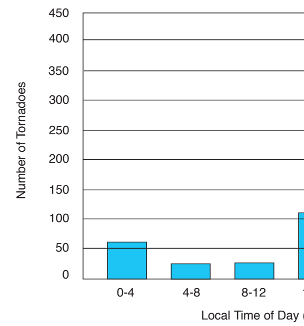


Figure 34. Number of F2 or greater tornad by time of day, 1950–1991 (modi ed from g. 4-15).

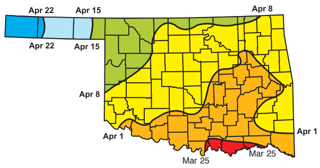


Figure 29. Mean annual date of the last freeze is in the spring in Oklahoma (1971–2000).

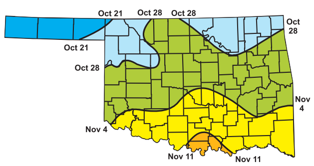


Figure 30. Mean annual date of the rst freeze is in autumn in Oklahoma (1971–2000).

Tornadoes

Tornadoes are violent columns of rotating air associated with very strong thunderstorms. Disastrous tornadic events—such as the tri-state (Texas/Oklahoma/Kansas) tornado outbreak of April 9, 1947 that killed 181 people (107 in Woodward); the Snyder tornado of May 10, 1905 that killed 97 people; and the May 3, 1999 tornadoes that affected Oklahoma and Kansas killing 49 people—have led to an enduring association between Oklahoma weather and tornadoes.

The highest frequency of tornadoes occurs in an area extending from Iowa to north-central Texas (Fig. 31) in a region (especially Oklahoma, Kansas, and north Texas) known as Tornado Alley. Most tornadoes, moving from southwest to northeast (but movement in any direction is possible) are small, leaving only a short path of destruction. Figure 32 shows tornado reports in each county from 1950 to 2000. Oklahoma, Kay, and Caddo Counties produced the most reports; Adair and Coal Counties have the fewest reports. An axis of maximum activity extends from Jackson County in the extreme southwest to Tulsa County in the northeast.

April through June is the most active period (Fig. 33), but tornadoes can occur in any month. May is the most active month, when 36% of Oklahoma's tornadoes occur; 22% occur in April; and 16% occur in June. Tornadoes can occur any hour of the day, but they are most frequent in late afternoon and evening (Fig. 34).

The F-scale (Table 7), designated for its creator, Professor Tetsuya Fujita, is used to classify tornadoes. The F-scale is based on tornado strength as determined from an analysis of the damage path. Damage from F0 and F1 events is not major, but F2 and F3 events cause extensive damage. Categories F4 and F5 denote violent tornadoes that leave wide paths of total destruction.

One of the most signi cant tornado outbreaks happened on May 3, 1999 in Oklahoma and Kansas, when more than 70 tornadoes occurred. The tornado causing the greatest damage (the greatest effect was on residential areas) was an F5 tornado that struck south Oklahoma City and nearby communities. That tornado produced a 38-mile-long path of destruction from near Chickasha to Midwest City. It destroyed over 2,750 homes and apartments and 8,000 other homes were damaged. There were 41 fatalities and about 800 injuries (FEMA, 1999). Advance warnings by the National Weather Service and continuous live coverage by Oklahoma City radio and television stations saved many lives.

Table 7. Fujita F-sca

F-Scale a	Severity	Estimated Win
F0		Weak Tornado
F1		Moderate Torn
F2		Signi cant Tor
F3		Severe Tornad
F4		Devastating To
F5		Incredible Torr

[a]The F-scale, designated for its inv does according to an analysis of th and F1 tornadoes do not cause ma commonly leave wide paths of tota