

**INTERNATIONAL ECOLOGICAL  
CLASSIFICATION STANDARD:**

**TERRESTRIAL ECOLOGICAL CLASSIFICATIONS**

**Ecological Systems of Texas' Edwards Plateau**

08 October 2009

by

NatureServe

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This subset of the International Ecological Classification Standard covers terrestrial ecological systems attributed to the Texas. This classification has been developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications. Comments and suggestions regarding the contents of this subset should be directed to [Judy Teague <judy\_teague@natureserve.org>].



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NatureServe. 2009. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 08 October 2009.

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## FOREST AND WOODLAND

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### CES205.682 CROSTIMBERS OAK FOREST AND WOODLAND

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This system is primarily found within central Texas and Oklahoma, ranging north to southeastern Kansas, and east into eastern Oklahoma. It is distinct from the surrounding prairie by the higher density of tree species. The area consists of irregular plains with primarily sandy to loamy Ustalf soils that range from shallow to moderately deep. Rainfall can be moderate, but somewhat erratic, therefore moisture is often limiting during part of the growing season. Short, stunted *Quercus stellata* and *Quercus marilandica* characterize and dominate this system. Other species, such as *Carya texana*, *Carya cordiformis*, *Quercus prinoides*, *Ulmus crassifolia*, and *Quercus* spp., can also be present within their respective ranges. The understory often contains species typical of the surrounding prairies, in particular *Schizachyrium scoparium*. Shrubs such as *Rhus* spp. may also be present. Drought, grazing, and fire are the primary natural processes that affect this system. Overgrazing and conversion to agriculture, along with fire suppression, have led to the invasion of some areas by problematic brush species such as *Juniperus virginiana* and *Juniperus ashei* and *Prosopis glandulosa* farther south in Texas and Oklahoma. It has also led to decreases in native grass cover allowing for annual grasses and forbs to invade.

This system is located on irregular plains comprised of sandy to loamy Ustalf soils. These soils range from shallow to moderately deep. Rainfall can be moderate, but sporadic, leading to periods of limiting moisture.

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### CES303.656 EDWARDS PLATEAU DRY-MESIC SLOPE FOREST AND WOODLAND

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This system occurs on dry-mesic, middle slopes of the rolling uplands of the Edwards Plateau of Texas. The canopy is typically dominated by deciduous trees, including *Quercus buckleyi*, *Fraxinus texensis*, or *Ulmus crassifolia*. *Quercus fusiformis* and *Juniperus ashei* are often present but not dominant in this system. Canopy closure is variable, and this system can be expressed as forests and woodlands. This system occurs on dry-mesic, primarily north- and east-facing limestone slopes in the Edwards Plateau of Texas.

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### CES303.660 EDWARDS PLATEAU LIMESTONE SAVANNA AND WOODLAND

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This upland system occurs primarily on limestone soils in the Edwards Plateau and forms the matrix within this ecoregion. It can also occur on limestone in the shortgrass regions of Texas and north into Oklahoma in areas such as the Arbuckle Mountains. This system is typified by a mosaic of evergreen oak forests, woodlands and savannas over shallow soils of rolling uplands and upper slopes within the Edwards Plateau and Lampasas Cutplain. *Quercus fusiformis* or *Juniperus ashei* typically dominate the canopy of this system. Other species may include *Quercus buckleyi*, *Quercus laceyi*, *Quercus stellata*, *Ulmus crassifolia*, *Fraxinus texensis*, *Quercus sinuata*, *Quercus vaseyana*, and *Diospyros texana*. Physiographic expression of this system varies from dense mottes (patches of forest where canopy cover approaches 100%) interspersed with grasslands to open savannalike woodlands with scattered individual or small groups of trees. Understories can contain various shrubs and graminoids, including *Cercis canadensis* var. *texensis*, *Forestiera pubescens*, *Sideroxylon lanuginosum*, *Diospyros texana*, *Rhus trilobata*, *Bouteloua* spp., *Schizachyrium scoparium*, *Nassella leucotricha*, *Carex planostachys*, *Aristida purpurea*, *Aristida oligantha*, *Liatris mucronata*, *Stillingia texana*, *Symphotrichum ericoides*, *Hedyotis nigricans*, *Monarda citriodora*, and *Salvia texana*. Grasslands dominated by *Schizachyrium scoparium* occur in small patches within more closed woodlands and in larger patches between mottes or in open savannalike woodlands with scattered trees. Grasslands in this system tend to grade from shortgrass communities in the west to mixedgrass communities to the east. Substrate (limestone) determines the range of this system within given examples. Some disturbed areas of the western plateau are now dominated by mesquite woodland. Natural mesquite woodlands are believed to have occurred on the deeper soils of adjacent riparian systems. This system is primarily restricted to limestone soils of rolling uplands within the Cretaceous limestone formations of the Edwards Plateau and dissected Pennsylvanian limestone formations within Texas and north into Oklahoma. Soil moisture and topography influence this system.

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### CES303.038 EDWARDS PLATEAU MESIC CANYON

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This system is largely endemic to the Edwards Plateau ecoregion and occurs on canyon bottoms, mesic lower slopes and steep canyons, primarily in the Southern Balcones Escarpment, but also in the Eastern Balcones Escarpment. This system also includes cliff faces and lower slopes of boxed canyons occurring as narrow, sometimes long bands in areas often with seeps where moisture is consistently more available than on adjacent slopes. The tree canopy is generally closed. Common components include *Ulmus crassifolia*, *Juglans major*, *Quercus buckleyi*, *Quercus laceyi*, *Prunus serotina* var. *eximia* (becoming less common to the north), *Fraxinus texensis* (dominant in the northeastern plateau), *Quercus muehlenbergii*, and *Acer grandidentatum*. Canyon bottoms may have scattered *Quercus macrocarpa*. Substrate (limestone) and topographic position (north and east aspects and lower slopes) are the

dominant characteristics of this system. Small seepage areas are often dominated by *Adiantum capillus-veneris*, with *Thelypteris ovata* var. *lindheimeri* on nearby moist habitats. Other prominent species include *Buddleja racemosa*, *Ungnadia speciosa*, and *Toxicodendron radicans* ssp. *eximium*. Fire probably plays little role in the system, while grazing and browsing (by native as well as exotic ungulates) may play an important role in recruitment and understory composition. Adjacent, drier slopes are usually dominated by various *Quercus* species and *Juniperus ashei*. Largely endemic to the Edwards Plateau ecoregion and occurs on canyon bottoms, mesic lower slopes and steep canyons, primarily in the Southern Balcones Escarpment, but also in the Eastern Balcones Escarpment. This system occurs on mesic lower slopes, primarily with northern and eastern aspects and steep canyons over limestone in the Edwards Plateau region of Texas.

## SHRUBLAND

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### CES302.731 CHIHUAHUAN CREOSOTEBUSH DESERT SCRUB

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This ecological system is the common lower elevation desert scrub that occurs throughout much of the Chihuahuan Desert and has recently expanded into former desert grasslands in the northern portion of its range. Stands typically occur in flat to gently sloping desert basins and on alluvial plains, extending up into lower to mid positions of piedmont slopes (bajada). Substrates range from coarse-textured loams on gravelly plains to finer-textured silty and clayey soils in basins. Soils are alluvial, typically loamy and non-saline, and frequently calcareous as they are often derived from limestone, and to a lesser degree igneous rocks. The vegetation is characterized by a moderate to sparse shrub layer (<10% cover on extremely xeric sites) that is typically strongly dominated by *Larrea tridentata* with *Flourensia cernua* often present to codominant. A few scattered shrubs or succulents may also be present, such as *Agave lechuguilla*, *Parthenium incanum*, *Jatropha dioica*, *Koeberlinia spinosa*, *Lycium* spp., and *Yucca* spp. Additionally, *Flourensia cernua* will often strongly dominate in silty basins that are included in this ecological system. In general, shrub diversity is low as this ecological system lacks codominant thornscrub and other mixed desert scrub species that are common on the gravelly mid to upper piedmont slopes. However, shrub diversity and cover may increase locally where soils are deeper and along minor drainages with occasional *Atriplex canescens*, *Gutierrezia sarothrae*, or *Prosopis glandulosa*. Herbaceous cover is usually low and composed of grasses. Common species may include *Bouteloua eriopoda*, *Dasyochloa pulchella* (= *Erioneuron pulchellum*), *Muhlenbergia porteri*, *Pleuraphis mutica*, *Scleropogon brevifolius*, and *Sporobolus airoides*. Included in this ecological system are *Larrea tridentata*-dominated shrublands with a sparse understory that occur on gravelly to silty, upper basin floors and alluvial plains. A pebbly desert pavement may be present on the soil surface.

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### CES302.734 CHIHUAHUAN MIXED DESERT AND THORN SCRUB

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This ecological system is the widespread desert scrub that occurs on gravelly mid to upper bajadas, foothills and dissected gravelly alluvial fans in the Chihuahuan Desert and has recently expanded into former desert grasslands in the northern portion of its range. It generally occurs on mid to upper piedmonts above the desert plains Chihuahuan Creosotebush Desert Scrub (CES302.731) and extends up to the chaparral zone. Soils are typically well-drained, non-saline, gravelly loams often with a petrocalcic layer. Substrates are frequently derived from limestone although igneous rocks are common in some areas. Vegetation is characterized by the presence of *Larrea tridentata*, typically mixed with thornscrub or other desert scrub such as *Agave lechuguilla*, *Aloysia wrightii*, *Baccharis pteronioides*, *Dasyilirion leiophyllum*, *Flourensia cernua* (not bottomland), *Fouquieria splendens*, *Koeberlinia spinosa*, *Krameria erecta*, *Leucophyllum minus*, *Mimosa aculeaticarpa* var. *biuncifera*, *Mortonia scabrella* (= *Mortonia sempervirens* ssp. *scabrella*), *Opuntia engelmannii*, *Parthenium incanum*, *Prosopis glandulosa*, and *Rhus microphylla* (in drainages). Stands of *Acacia constricta*-, *Acacia neovernicosa*- or *Acacia greggii*-dominated thornscrub are included in this system, and limestone substrates appear important for at least these species. If present, *Prosopis glandulosa* has relatively low cover and does not dominate the shrub layer. This system also includes upper piedmont stands of desert scrub that are strongly dominated by *Larrea tridentata*. Grasses are common but generally have lower cover than shrubs. Common species may include *Bouteloua curtipendula*, *Bouteloua eriopoda*, *Bouteloua gracilis*, *Bouteloua hirsuta*, *Bouteloua ramosa*, *Dasyochloa pulchella*, and *Muhlenbergia porteri*. Also included in this ecological system are shrublands with a sparse understory of *Larrea tridentata* that occur on gravelly piedmont slopes that may extend down gravelly upper basins. A pebbly desert pavement may be present on the soil surface. This may indicate remnant erosional surfaces from the early Holocene that are thought to be some of the historic distribution of *Larrea tridentata* desert scrub in the Chihuahuan Desert. Historically, much of this desert scrub was thought to be a steppe characterized by perennial desert grasses (typically *Bouteloua eriopoda*) with an open creosotebush - mixed desert shrub layer.

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**CES302.738 CHIHUAHUAN SUCCULENT DESERT SCRUB**


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This ecological system is found in the Chihuahuan Desert on colluvial slopes, upper bajadas, sideslopes, ridges, canyons, hills and mesas. Sites are hot and dry, typically with southerly aspects. Gravel and rock are often abundant on the ground surface. The vegetation is characterized by the relatively high cover of succulent species such as *Agave lechuguilla*, *Euphorbia antisiphilitica*, *Fouquieria splendens*, *Ferocactus* spp., *Opuntia engelmannii*, *Opuntia imbricata*, *Opuntia spinosior*, *Yucca baccata*, and many others. Perennial grass cover is generally low. The abundance of succulents is diagnostic of this desert scrub system, but desert shrubs are usually present. Stands in rolling topography may form a mosaic with more mesic desert scrub or desert grassland ecological systems that would occur on less xeric northerly slopes. *Agave lechuguilla* is more abundant in stands in the southern part of the mapzone. This system does not include loamy plains desert grasslands or shrub-steppe with a strong cacti component such as cholla grasslands.

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**CES303.041 EDWARDS PLATEAU LIMESTONE SHRUBLAND**


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This ecological system occurs as a matrix on relatively thin-soiled surfaces of plateaus of the massive limestones such as the Edwards limestone. These short to tall shrublands are variable in density depending on the relative amount of, and depth to, bedrock. *Quercus sinuata* var. *breviloba* is an important component of this system, with some areas dominated by *Quercus fusiformis*. *Juniperus ashei* is often an important component of this system. In the west, *Pinus remota* may also contribute to a scattered emergent overstory. Other shrub species may include *Rhus virens*, *Rhus lanceolata*, *Cercis canadensis* var. *texensis*, *Forestiera pubescens*, *Forestiera reticulata*, *Fraxinus texensis*, *Ungnadia speciosa*, *Sophora secundiflora*, *Diospyros texana*, *Salvia ballotiflora*, *Mimosa borealis*, *Condalia hookeri*, *Rhus trilobata*, *Opuntia engelmannii*, and *Mahonia trifoliolata*. This system also includes *Quercus mohriana*- or *Quercus vaseyana*-dominated shrublands that are more common to the west, often sharing dominance with *Juniperus pinchotii*. Herbaceous cover may be patchy and is generally graminoid with species including *Schizachyrium scoparium*, *Bouteloua curtipendula*, *Bouteloua rigidisetata*, *Bouteloua trifida*, *Hilaria belangeri*, *Bothriochloa laguroides* ssp. *torreyana*, *Nassella leucotricha*, *Erioneuron pilosum*, *Aristida* spp., and others. Disturbances such as fire may be important processes maintaining this system. However, it appears to persist on thin-soiled sites. In the western portions of the Edwards Plateau, more xeric conditions lead to the slow succession of sites to woodlands, resulting in long-persisting shrublands. This system occurs on thin soils over limestone in the Edwards Plateau of Texas.

This system occurs in a steady state on thin-soiled xeric sites. Shrub cover can be 100% in patches, but overall cover may be 40-50%. Patches of dense shrubs may be interspersed with bare rock and grasslands over shallow soil. Farther west this system grades into other shallow-soiled shrubland systems.

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**CES301.986 TAMAULIPAN CALCAREOUS THORNSCRUB**


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This xeric thornscrub ecological system is restricted to limestone and calcareous sandstone hills and caliche substrates such as along the Bordas Scarp in southern Texas and northeastern Mexico. Soils are shallow, alkaline, strongly calcareous and underlain by bedrock or a caliche layer. It has a shorter, more open shrub canopy (usually less than 2 m) when compared to more typical thornscrub growing on more favorable sites. However, shrub cover is generally greater than 70% and often greater than 85%. Dominant species include *Leucophyllum frutescens*, *Acacia berlandieri*, and *Acacia farnesiana* with many other shrub species that may be locally dominant such as *Acacia rigidula*, *Amyris madrensis*, *Amyris texana*, *Castela erecta* ssp. *texana*, *Celtis pallida*, *Eysenhardtia texana*, *Helietta parvifolia*, *Koeberlinia spinosa*, *Parkinsonia texana* var. *macra*, *Sophora secundiflora*, or *Yucca* spp. The sparse to moderately dense herbaceous layer is dominated by perennial graminoids. This system is restricted to limestone and calcareous sandstone hills and caliche substrates such as along the Bordas Scarp in southern Texas and northeastern Mexico. Soils are shallow, alkaline, strongly calcareous and underlain by bedrock or a caliche layer.

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**CES303.671 WESTERN GREAT PLAINS SANDHILL STEPPE**


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This system is found mostly in south-central areas of the Western Great Plains Division ranging from southwestern Wyoming and southwestern Nebraska up into the Nebraska Sandhill region, south through eastern Colorado, and New Mexico to central Texas, although some examples may reach as far north as the Badlands of South Dakota. The climate is semi-arid to arid for much of the region in which this system occurs. This system is found on somewhat excessively to excessively well-drained, deep sandy soils that are often associated with dune systems and ancient floodplains. In some areas, this system may actually occur as a result of overgrazing in Western Great Plains Tallgrass Prairie (CES303.673) or Western Great Plains Sand Prairie (CES303.670). Typically, this system is characterized by a sparse to moderately dense woody layer dominated by *Artemisia filifolia*, but other characteristic species may be present, including *Amorpha canescens*, *Prosopis glandulosa* (southern stands), *Prunus angustifolia*, *Prunus pumila* var. *bessyei* (northern stands), *Rhus trilobata*, and *Yucca glauca*. Associated herbaceous species can vary with geography, amount and season of precipitation, disturbance, and soil texture. The herbaceous layer typically has a moderate to dense canopy but may include stands with sparse understory. Several mid- to tallgrass species characteristic of sand substrates are usually present to dominant, such

as *Andropogon hallii*, *Calamovilfa gigantea*, *Calamovilfa longifolia*, *Schizachyrium scoparium*, *Sporobolus cryptandrus*, *Sporobolus giganteus*, or *Hesperostipa comata*.

In the southern range of this system, *Quercus havardii* may also be present to dominant and represents one succession pathway that develops over time following a disturbance. *Quercus havardii* is able to resprout following a fire and thus may persist for long periods of time once established forming extensive clones. Edaphic and climatic factors are the most important dynamic processes for this type, with drought and extreme winds impacting this system significantly in some areas. Because *Quercus havardii* is able to resprout rapidly following fire, fire tends to cause structural changes in the vegetation, and compositional shifts are less significant in most cases. Overgrazing can lead to decreasing dominance of some of the grass species such as *Andropogon hallii*, *Calamovilfa gigantea*, and *Schizachyrium scoparium*. In the western extent of this system in the shortgrass prairie, more xeric mid- and shortgrass species such as *Hesperostipa comata*, *Sporobolus cryptandrus* and *Bouteloua gracilis* often dominate the herbaceous layer. This system is found primarily in semi-arid to arid areas of the Western Great Plains Division. It occurs on somewhat excessively to excessively well-drained and deep sandy soils. This system is often found associated with dune systems and/or ancient floodplains but may occur in soils derived from sandstone residuum.

## HERBACEOUS

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### CES303.659 CENTRAL MIXEDGRASS PRAIRIE

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This mixedgrass prairie system ranges from South Dakota into the Rolling Plains and the western Edwards Plateau of Texas. It is bordered by the shortgrass prairie on its western edge and the tallgrass prairie to the east. The loessal regions in west-central Kansas and central Nebraska, the Red Hills region of south-central Kansas and northern Oklahoma are all located within this system. Because of its proximity to other ecoregions, this system contains elements from both shortgrass and tallgrass prairies, which combine to form the mixedgrass prairie ecological system throughout its range. The distribution, species richness and productivity of plant species within the mixedgrass ecological system is controlled primarily by environmental conditions, in particular soil moisture and topography. Grazing and fire are important dynamic processes in this system. The relative dominance of the various grass and forb species within different associations in the system also can strongly depend on the degree of natural or human disturbance. This system can contain grass species such as *Bouteloua curtipendula*, *Schizachyrium scoparium*, *Andropogon gerardii*, *Hesperostipa comata*, *Sporobolus heterolepis*, and *Bouteloua gracilis*, although the majority of the associations within the region are dominated by *Pascopyrum smithii* or *Schizachyrium scoparium*. Numerous forb and sedge species (*Carex* spp.) can also occur within the mixedgrass system in the Western Great Plains. Although forbs do not always significantly contribute to the canopy, they can be very important. Some dominant forb species include *Ambrosia psilostachya*, *Echinacea angustifolia*, and *Lygodesmia juncea*. Oak species such as *Quercus macrocarpa* can occur also in areas protected from fire due to topographic position. This can cause an almost oak savanna situation in certain areas, although fire suppression may allow for a more closed canopy and expansion of bur oak beyond those sheltered areas. In those situations, further information will be needed to determine if those larger areas with a more closed canopy of bur oak should be considered part of Western Great Plains Dry Bur Oak Forest and Woodland (CES303.667). Likewise, within the mixedgrass system, small seeps may occur, especially during the wettest years. Although these are not considered a separate system, the suppression of fire within the region has enabled the invasion of both exotics and some shrub species such as *Juniperus virginiana* and also allowed for the establishment of *Pinus ponderosa* in some northern areas. This system is found primarily in the Central Mixed-grass Prairie (TNC Ecoregion 33); it becomes more restricted to mesic lowlands sites to the west and southwest in the shortgrass prairie region of Texas (S. Menard pers. comm. 2005). This is probably a reference to the Llano Estacado region rather than the Southern Shortgrass Prairie (TNC Ecoregion 28) (J. Teague pers. obs 2005). The Central Mixed-grass Prairie (TNC Ecoregion 33) should be extended south to include the Rolling Plains of Texas; being separated from the Southern Shortgrass Prairie (TNC Ecoregion 28) by the Caprock Escarpment (L. Elliott pers. comm. 2005).

Differences in topography and soil characteristics also occur across the range of this system. It is often characterized by rolling to extremely hilly landscapes with soils developed from loess, shale, limestone or sandstone parent material. Mollisol soils are most prevalent and range from silt loams and silty clay loams with sandy loams possible on the western edge of the range. The Red Hills region of Kansas and Oklahoma, which contains examples of this system, contains somewhat unique soil characteristics and has developed from a diversity of sources including red shale, red clay, sandy shale, siltstone, or sandstone. These soils have developed a characteristic reddish color from the primary material. These soils can consist of silt, loam, or clay and can have textures ranging from a fine sandy loam to a more clayey surface.

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### CES303.657 LLANO UPLIFT ACIDIC FOREST, WOODLAND AND GLADE

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This upland matrix system occurs primarily on coarse soils derived from the weathering of underlying granites in the Llano Uplift region of Texas. The underlying granitic substrate determines the range of this system. It is composed of a mosaic of vegetation types, including closed-canopy forests, open woodlands, savannas and sparsely vegetated rock outcrops. Common trees include *Quercus marilandica*, *Quercus fusiformis*, *Quercus stellata*, *Carya texana*, *Ulmus crassifolia*, and *Prosopis glandulosa*. Subcanopy species may include *Diospyros texana*, *Aloysia gratissima*, *Ungnadia speciosa*, *Ziziphus obtusifolia* var. *obtusifolia*, *Eysenhardtia texana*, *Aesculus glabra* var. *arguta*, *Opuntia engelmannii* var. *lindheimeri* (= *Opuntia lindheimeri*), *Yucca elata*, *Nolina texana*, and *Opuntia leptocaulis*. Grasslands may be dominated by *Schizachyrium scoparium*, *Sorghastrum nutans*, *Panicum virgatum*, *Bouteloua hirsuta*, *Bouteloua curtipendula*, *Nassella leucotricha*, *Bothriochloa laguroides*, and *Plantago wrightiana*. Granitic glades and barrens are sparsely vegetated by crustose and foliose lichens, several ferns and fern allies, and cacti. This system also includes small (up to 16 m in diameter) shallow depressions that hold rainwater and support wetland flora including the Texas endemic, *Isoetes lithophila*. This ecological system is defined to include a diversity of vegetation occurring on granitic outcrops and on soils that have developed over these outcrops in central Texas. In comparison to other areas of the U.S. where sparsely vegetated glades and barrens may be defined separately from the woodland surrounding them and/or the woodland separately from the forest (e.g., Southern Piedmont Granite Flatrock and Outcrop (CES202.329) just includes the sparsely vegetated barrens), these different vegetation types are included together here because they occur as an ecological complex or mosaic and they share floristic and geologic affinities that set them apart from the surrounding landscape. In the central mineral region of central Texas, granite glades and barrens are surrounded by areas of deeper soils derived from granite that support denser herbaceous or woody vegetation that includes many species found sparsely on



the glades. In the eastern U.S. xeric granite outcrops are generally separated from one another by large areas of mesic to dry-mesic forests, whereas the granitic outcrops in central Texas are separated from one another by areas of coarse soils derived from the underlying granite. In addition, the xeric nature of the granite outcrops in the eastern U.S. is a stark contrast to the other vegetation in this humid temperate environment. Whereas, west of the dry line, the moisture availability of the granite outcrops in central Texas is not as starkly contrasted with the surrounding landscape. This has been suggested as a reason why the granite glades of central Texas do not support the degree of endemism that is found on the granite outcrops of the eastern U.S. (Walters and Wyatt 1982). The relationship of this ecological system to the granite glades and woodlands occurring in Oklahoma (currently included in Crosstimbers Oak Forest and Woodland (CES205.682)) needs to be further explored.

Currently this system includes dry woodlands on shallow soil and mesic woodlands on deeper soil. The more mesic woodlands tend to support *Carya texana* which is generally absent in other areas on the plateau. Further investigation is needed to determine if the mesic and dry components should be classified as two separate systems.

This system is restricted to the Llano Uplift, also known as the central mineral region of Texas. Though named as an uplift because it is an intrusion of Precambrian metamorphic rocks and large granitic massifs, this area is generally lower in elevation than the surrounding Edwards Plateau (Walters and Wyatt 1982, Riskind and Diamond 1988). At a regional scale, it is a topographic bowl, though rock outcrops such as Enchanted Rock often produce dramatic increases in elevation at a local scale. Aside from these massif intrusions, topography is generally level to rolling. The substrate of granites, gneisses and schists determines the range of this system in central Texas. Elevation ranges from 251 to 686 m above sea level (825-2250 feet). Rainfall averages about 76 cm (30 inches), peaking in May or June and September. The central mineral region occupies approximately 1.5 million hectares in central Texas (Riskind and Diamond 1988). Mineralogy of the granitic material varies, with hornblende schist, graphite schist, quartz-feldspar gneiss and quartz-plagioclase-microcline rock common (Riskind and Diamond 1988). Soils are predominantly acidic.

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### **CES205.684 TEXAS BLACKLAND TALLGRASS PRAIRIE**

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This system is found primarily in the Blackland Prairie region of Texas but can range into southern Oklahoma. It is typified by the presence of dark alkaline Vertisol soils over calcareous parent material interspersed with patches of acidic, sandy loam Alfisols and Mollisols. Microtopography such as gilgai and mima mounds can occur and are important microhabitats that lead to a high degree of plant diversity in this system. *Schizachyrium scoparium* and *Sorghastrum nutans* are the most frequent species with *Andropogon gerardii* as a possible associate, especially on the patches of Mollisol soils. *Tripsacum dactyloides* and *Panicum virgatum* are common associates on the Vertisol soils, especially on the gilgai microtopography. Fire and grazing constitute the major natural dynamics influencing this system. Infrequent, but intense, fires prevent woody species from establishing. Fire suppression and over grazing have allowed woody species to invade, and heavy grazing has allowed species such as *Buchloe dactyloides* and *Bouteloua rigidisetata* to invade.

This system is restricted to the Blackland Prairie region, part of the Crosstimbers and Southern Tallgrass Prairie Ecoregion, in Texas and possibly adjacent southern Oklahoma.

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The Main Belt of the Blackland Prairie is divided into Vertisol, Alfisol and Mollisol regions. The Vertisol region is characterized by the presence of dark clay alkaline soils over limestone marl parent material, while the Eastern Marginal prairies are characterized by variously textured Alfisols over sandstone parent material. Alkaline clay and clay loam Mollisols are found on the Austin Chalk formation on fragmented Cretaceous limestone. Two outlier prairies, the Fayette (EPA 32b) and San Antonio Prairies (EPA 33c), are underlain by both Vertisols and Alfisols. Each variation in soil texture and pH supports its characteristic community.

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### **CES303.672 WESTERN GREAT PLAINS SHORTGRASS PRAIRIE**

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This system is found primarily in the western half of the Western Great Plains Division in the rainshadow of the Rocky Mountains and ranges from the Nebraska Panhandle south into Texas and New Mexico, although grazing-impacted examples may reach as far north as southern Canada where it grades into Northwestern Great Plains Mixedgrass Prairie (CES303.674). This system occurs primarily on flat to rolling uplands with loamy, ustic soils ranging from sandy to clayey. In much of its range, this system forms the matrix system with *Bouteloua gracilis* dominating this system. Associated graminoids may include *Aristida purpurea*, *Bouteloua curtipendula*, *Bouteloua hirsuta*, *Buchloe dactyloides*, *Hesperostipa comata*, *Koeleria macrantha* (= *Koeleria cristata*), *Pascopyrum smithii* (= *Agropyron smithii*), *Pleuraphis jamesii*, *Sporobolus airoides*, and *Sporobolus cryptandrus*. Although mid-height grass species may be present, especially on more mesic land positions and soils, they are secondary in importance to the sod-forming short grasses. Sandy soils have higher cover of *Hesperostipa comata*, *Sporobolus cryptandrus*, and *Yucca elata*. Scattered shrub and dwarf-

dwarf species such as *Artemisia filifolia*, *Artemisia frigida*, *Artemisia tridentata*, *Atriplex canescens*, *Eriogonum effusum*, *Gutierrezia sarothrae*, and *Lycium pallidum* may also be present. Also, because this system spans a wide range, there can be some differences in the relative dominance of some species from north to south and from east to west. Large-scale processes such as climate, fire and grazing influence this system. High variation in amount and timing of annual precipitation impacts the relative cover of cool- and warm-season herbaceous species.

In contrast to other prairie systems, fire is less important, especially in the western range of this system, because the often dry and xeric climate conditions can decrease the fuel load and thus the relative fire frequency within the system. However, historically, fires that did occur were often very expansive. Currently, fire suppression and more extensive grazing in the region have likely decreased the fire frequency even more, and it is unlikely that these processes could occur at a natural scale. A large part of the range for this system (especially in the east and near rivers) has been converted to agriculture. Areas of the central and western range have been impacted by the unsuccessful attempts to develop dryland cultivation during the Dust Bowl of the 1930s. The short grasses that dominate this system are extremely drought- and grazing-tolerant. These species evolved with drought and large herbivores and, because of their stature, are relatively resistant to overgrazing. This system in combination with the associated wetland systems represents one of the richest areas for mammals and birds. Endemic bird species to the shortgrass system may constitute one of the fastest declining bird populations. In Texas, this system occurs on the Llano Estacado and ranges to but does not include the Stockton Plateau.

This system is located on primarily flat to rolling uplands. Soils typically are loamy and ustic and range from sandy to clayey. Climate is continental with mean annual precipitation generally about 300 mm ranging to 500 mm to the south in Texas. Most of the annual precipitation occurs during the growing season as thunderstorms. Precipitation events are mostly <10 cm with occasional larger events.

## WOODY WETLAND

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### CES303.651 EDWARDS PLATEAU FLOODPLAIN

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This system occurs on floodplain terraces along perennial rivers and streams in central Texas. Canopy dominants may include *Ulmus crassifolia*, *Juniperus ashei*, *Celtis laevigata*, *Quercus fusiformis*, *Fraxinus texensis*, *Platanus occidentalis*, *Acer negundo*, *Juglans major*, *Quercus macrocarpa*, or *Carya illinoensis*. *Carya illinoensis* may be more likely to occur in deeper and better-developed alluvial soils. Apparent dominance of *Carya illinoensis* may also be an artifact of preferential harvesting of other species, leaving this species in greater abundance. Alluvial sedimentation processes dominate the formation and maintenance of this system. However, overgrazing and/or overbrowsing may influence recruitment of overstory species and composition of the understory and herbaceous layers. This system occurs along larger permanent rivers and streams throughout the Edwards Plateau of Texas and possibly adjacent ecoregions. It occurs from the Leon watershed in the Limestone Cutplain (EPA 29e) south to the edge of the Bacones Canyonlands (EPA 30c), west through the Edwards Plateau and north to the Pecan Bayou and Concho River watersheds in the lower Limestone Plains (EPA 27j) and lower Crosstimbers (EPA 29c) (EPA 2001). This system occurs on alluvial terraces along permanent rivers and streams in central Texas.

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### CES303.652 EDWARDS PLATEAU RIPARIAN

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This system occurs in various situations along small and intermittent streams of the Edwards Plateau, with drier representatives occurring in the western plateau and the Stockton Plateau, and moister representatives (such as communities dominated by *Juglans microcarpa* and *Brickellia laciniata*) in the eastern plateau. Representatives of this system typically occur in stream-scoured situations and vary in the openness of the habitat and physiognomy.

## HERBACEOUS WETLAND

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### CES303.654 EDWARDS PLATEAU UPLAND DEPRESSION

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This system includes shallow wetlands formed over limestone on the Edwards Plateau of Texas. Variable in size and duration of inundation, these wetlands are typically found on level uplands. Dominant vegetation includes both graminoids and forbs tolerant of wet periods but not necessarily wetland-dependent. Dominant species may include *Pleuraphis mutica*, *Buchloe dactyloides*, *Sedum pulchellum*, *Sedum nuttallianum*, *Sporobolus vaginiflorus*, *Chaetopappa bellidifolia*, *Paronychia* spp., and the alga *Nostoc commune*. Some larger occurrences of this wetland system are found in Crockett, Reagan, Schleicher, Irion and Sterling counties in the northwest Edwards Plateau (the Eldorado Plateau). Formation of these occurrences is apparently from solution of the underlying limestone.

**Comments:** The solution ponds of the Eldorado Plateau are superficially similar to the playa lakes of the Llano Estacado, but the underlying geology of the Edwards Plateau (Cretaceous limestone) occurrences is different from the Llano Estacado (Pliocene and late Tertiary) conglomerates and caliche of the Ogallala Formation and is mantled by a thick layer of wind-deposited Pleistocene sands and silty sands. Further field investigation is needed to better develop the association-level information for this system. This system occurs in shallow depressions over limestone in the Edwards Plateau of Texas.

## MIXED UPLAND AND WETLAND

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### CES302.746 CHIHUAHUAN-SONORAN DESERT BOTTOMLAND AND SWALE GRASSLAND

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This ecological system occurs in relatively small depressions or swales and along drainages throughout the northern and central Chihuahuan Desert and adjacent Sky Islands and Sonoran Desert, as well as limited areas of the southern Great Plains on broad mesas, plains and valley bottoms that receive runoff from adjacent areas. Occupying low topographic positions, these sites generally have deep, fine-textured soils that are neutral to slightly or moderately saline/alkaline. During summer rainfall events, ponding is common. Vegetation is typically dominated by *Sporobolus airoides*, *Sporobolus wrightii*, *Pleuraphis mutica* (tobosa swales), or other mesic graminoids such as *Pascopyrum smithii* or *Panicum obtusum*. With tobosa swales, sand-adapted species such as *Yucca elata* may grow at the swale's edge in the deep sandy alluvium that is deposited there from upland slopes. *Sporobolus airoides* and *Sporobolus wrightii* are more common in alkaline soils and along drainages. Other grass species may be present, but these mesic species are diagnostic. Scattered shrubs such as *Atriplex canescens*, *Prosopis glandulosa*, *Ericameria nauseosa*, *Fallugia paradoxa*, *Krascheninnikovia lanata*, or *Rhus microphylla* may be present. This bottomland/depressional wetland system can be similar to the upland Chihuahuan Loamy Plains Desert Grassland (CES302.061) but is restricted to moist depressions and intermittently flooded drainage terraces and adjacent flats. Alkali sacaton (*Sporobolus airoides*) is often associated with more alkaline (to gypsic), poorly drained areas and giant sacaton (*Sporobolus wrightii*) with less alkaline better drained areas. *Distichlis spicata*, *Allenrolfea occidentalis*, and *Suaeda* spp. are characteristic of more saline and alkaline sites.

This ecological system occurs in relatively small depressions or swales and along drainages on broad mesas, plains and valley bottoms that receive runoff from adjacent areas. These sites occupy low topographic positions and generally have deep, fine-textured soils that are neutral to slightly or moderately saline/alkaline.

## BARREN

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### CES303.655 EDWARDS PLATEAU CARBONATE GLADE AND BARRENS

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This system occurs on thin soils over massive hard-bedded limestone formations in the Edwards Plateau of Texas. This is a sparsely vegetated system, but species such as *Sedum* spp. can form bands of glades that alternate with areas of woodlands and forests. Some of the depressions hold moisture for longer periods than the surrounding landscape, providing for the establishment of a diversity of spring-blooming annuals. Some characteristic plants include *Lesquerella gordonii*, *Lesquerella ovalifolia*, *Schizachyrium scoparium*, *Sedum nuttallianum*, *Sporobolus vaginiflorus* (var. *ozarkanus* and var. *vaginiflorus*), and *Sedum pulchellum*.

These glades and barrens are found in xeric sites on limestone rock substrates.

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### CES303.653 EDWARDS PLATEAU CLIFF

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This system occurs on limestone cliff faces and lower slopes of boxed canyons of the Edwards Plateau. It usually occurs as narrow, sometimes long bands in areas where moisture is consistently more available than on adjacent slopes. Conspicuous components of occurrences of this system in seepage areas include *Adiantum capillus-veneris* along the seep and *Thelypteris ovata* var. *lindheimeri* on nearby moist habitats. Communities dominated by *Buddleja racemosa*, *Ungnadia speciosa*, and *Toxicodendron radicans* ssp. *eximium* occur on exposures of the Edwards Plateau Formation (or geologically similar formations) of the southern Edwards Plateau. Geology is clearly the controlling process of this system, along with moisture associated with the crevices in the underlying limestone bedrock. One factor controlling the composition of communities of this system is the amount of overstory shading the sites. This system occurs throughout the Edwards Plateau and west Texas. In the Lampasas Cutplain, this system is sparsely vegetated, and in the eastern plateau and Balcones Canyonlands, it is locally dominated by *Buddleja racemosa*, *Philadelphus* spp., *Styrax*, and *Perityle* spp. It is dominated in the western plateau by *Perityle* spp., *Penstemon baccharifolius*, and *Heterotheca* spp. and is associated with rivers and streams. The cliffs serve as refugia for palatable species.

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### CES303.725 LLANO ESTACADO CAPROCK ESCARPMENT AND BREAKS SHRUBLAND AND STEPPE

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This ecological system occurs on various surfaces that are sufficiently resistant to erosion to form breaks or escarpments along the eastern edge of the Llano Estacado in Texas. This includes sedimentary deposits such as sandstones, limestones, or shales, or less frequently, igneous formations such as basalt. It is sometimes associated with canyons or drainages, but not always. The system occupies slopes, but may continue over transitions to more level sites upslope and downslope. Soils are variable and this system can occur where there is little soil development. Rough Breaks Ecological Sites are characteristic of this system, but other sites such as Rocky Hill and Gravelly Ecological Sites may also be occupied by this system. The physiognomic character of occurrences ranges from sparsely vegetated to shrubland, to sparse woodland. Bare ground is often conspicuous, and herbaceous cover is usually dominated by mid- to shortgrasses such as *Aristida purpurea*, *Bouteloua curtipendula*, *Bouteloua gracilis*, *Bouteloua hirsuta*, and *Schizachyrium scoparium*. Forbs, including species such as *Artemisia ludoviciana*, *Calylophus* sp., *Chaetopappa ericoides*, *Krameria lanceolata*, and *Melampodium leucanthum*, may also be present. Shrub canopy may be dense, with some species reaching tree stature, and on some sites forming sparse woodland. Shrub and tree species include *Juniperus pinchotii*, *Juniperus ashei*, *Quercus mohriana*, *Rhus trilobata*, *Dalea formosa*, *Cercocarpus montanus*, *Prosopis glandulosa*, and *Gutierrezia sarothrae*.