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Ecological Systems of Texas' West Gulf Coastal Plain

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by

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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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FOREST AND WOODLAND

CES205.679 EAST-CENTRAL TEXAS PLAINS POST OAK SAVANNA AND WOODLAND

This system is primarily found within eastern Texas, lying in a broad band west of the Upper West Gulf Coastal Plain and Gulf Coast Prairies and Marshes ecoregions, ranging from Live Oak and Atascosa counties in the south and trending in a northeasterly band to the Red River along the Oklahoma-Texas border. It exhibits some floristic and physiognomic variation across this northeast-southwest gradient. Its range is roughly co-incident with (parts of) the "East Central Texas Plains" (Level III Ecoregion 33) of EPA (Griffith et al. 2004). It is distinguished from the surrounding prairie by the higher density of trees and diversity of woody species. The system differs from the floristically similar Crosstimbers Oak Forest and Woodland (CES205.682) in that it generally occurs on Tertiary (primarily Eocene) geologic formations on the East-Central Texas Plains, while the related Crosstimbers ecological system occupies Cretaceous and older formations of the interior plains (EPA Level III Ecoregion 29). Floristically, Post Oak Savanna (at least north of the Colorado River) contains species of more eastern affinities such as *Callicarpa americana*, *Sassafras albidum*, *Cornus florida*, *Vaccinium arboreum*, *Ulmus alata*, and particularly *Ilex vomitoria*, the latter species being absent from Crosstimbers Oak Forest and Woodland (CES205.682). Post Oak Savanna generally occurs on sandy or loamy soils, often underlain by a claypan subsoil. Rainfall ranges from about 120 cm in the northeastern part of the range to about 70 cm in the southwest, where it becomes increasingly erratic. Therefore moisture is often limiting during part of the growing season. The system was historically characterized as having significant areas of graminoid cover with species composition resembling that of nearby prairie systems, punctuated by short, stunted woodlands and forests dominated by *Quercus stellata* and *Quercus marilandica*. Other species, such as *Carya texana*, *Quercus incana* (on more xeric sites), *Quercus fusiformis*, *Ulmus alata*, *Juniperus virginiana*, and *Prosopis glandulosa*, can also be present. In some sites, particularly in the south, *Quercus fusiformis* may codominate the woodlands. Shrubs may attain significant cover in the understory, with species including *Ilex vomitoria* (often dominant), *Callicarpa americana*, *Vaccinium arboreum*, *Sideroxylon lanuginosum*, *Ilex decida*, *Toxicodendron radicans*, and *Symphoricarpos orbiculatus*. Where light penetration allows the development of an herbaceous understory or in areas with reduced woody canopy, the understory contains species typical of the surrounding prairies, in particular *Schizachyrium scoparium*, but also including *Andropogon gerardii*, *Bothriochloa laguroides* ssp. *torreyana*, *Paspalum plicatum* (to the south), *Sorghastrum nutans*, and *Sporobolus cryptandrus*. Drought, grazing, and fire are the primary natural processes that affect this system. Much of this system has been impacted by conversion to improved pasture or crop production. Overgrazing and fire suppression have led to increased woody cover on most extant occurrences and the invasion of some areas by problematic brush species such as *Juniperus virginiana* var. *virginiana* and *Prosopis glandulosa* in the southern part of the system's range. These factors have 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 Alfisols, generally associated with Tertiary (primarily Eocene) formations of the East Central Texas Plains (Level III Ecoregion 33) of EPA (Griffith et al. 2004). These soils range from shallow to moderately deep and are often underlain by claypan subsoils. Rainfall ranges from about 120 cm in the northeastern part of the range to about 70 cm in the southwest, where it becomes increasingly erratic.

CES203.280 WEST GULF COASTAL PLAIN MESIC HARDWOOD FOREST

This ecological system is found in limited upland areas (especially ravines and sideslopes) of the Gulf Coastal Plain west of the Mississippi River. These areas are topographically isolated from historically fire-prone, pine-dominated uplands in eastern Texas, western Louisiana, and southern Arkansas. Sites are often found along slopes above perennial streams in the region. These sites have moderate to high fertility and moisture retention. Soils can be quite variable, ranging from coarse to loamy in surface texture. Most are acidic in surface reactions and less commonly circumneutral. Vegetation indicators are mesic hardwoods such as *Fagus grandifolia*, *Quercus alba*, and *Ilex opaca*, although scattered, large-diameter pines (most often *Pinus taeda*) are also often present. Spring-blooming herbaceous species are typical in the understory of most examples. Sites are often found along slopes above perennial streams in the region. These sites have moderate to high fertility and moisture retention. Soils can be quite variable, ranging from coarse to loamy in surface texture. Most are acidic in surface reactions and less commonly circumneutral.

CES203.378 WEST GULF COASTAL PLAIN PINE-HARDWOOD FOREST

This West Gulf Coastal Plain ecological system consists of forests and woodlands dominated by *Pinus taeda* and/or *Pinus echinata* in combination with a host of dry to dry-mesic site hardwood species. This type was the historical matrix (dominant vegetation type) for large portions of the Upper West Gulf Coastal Plain (TNC ecoregion 40) where it replaced *Pinus palustris*-dominated vegetation. In this region of southern Arkansas, northwestern Louisiana, and parts of eastern Texas, this type was historically present on nearly all uplands in the region except on the most edaphically limited sites (droughty sands, calcareous clays, and shallow soil barrens/rock outcrops). Such sites are underlain by loamy to fine-textured soils of variable depths. These are upland sites on ridgetops and adjacent

sideslopes, with moderate fertility and moisture retention. This type was also present in more limited areas of the West Gulf Coastal Plain (TNC ecoregion 41), where it was confined more typically to sideslopes and other locations not dominated by *Pinus palustris*. In southern Arkansas, northwestern Louisiana, and parts of eastern Texas, this type was historically present on nearly all uplands in the region except on the most edaphically limited sites (droughty sands, calcareous clays, and shallow soil barrens/rock outcrops). Such sites are underlain by loamy to fine-textured soils of variable depths. These are upland sites on ridgetops and adjacent sideslopes, with moderate fertility and moisture retention.

CES203.056 WEST GULF COASTAL PLAIN SANDHILL OAK AND SHORTLEAF PINE FOREST AND WOODLAND

This ecological system occurs west of the Mississippi River primarily outside the natural range of longleaf pine and less commonly within. Like other sandhill systems of the Gulf and Atlantic coastal plains, this type is found on uplands underlain with deep, coarse sandy soils. These sites are typified by low fertility and moisture retention, which contribute to open tree canopies with usually <60% canopy closure. Sparse understory vegetation and abundant patches of bare soil are indicative of this system. Vegetation indicators are species tolerant of droughty sites, especially *Quercus incana* and *Quercus arkansana*, but also *Quercus marilandica* and *Quercus stellata*. *Pinus palustris* is absent (or perhaps at low frequency within its range); *Pinus echinata* is usually present. This system supports a large concentration of vascular plant endemics, near endemics, and a number of plant species with high fidelity to sandhills in the region. Elsewhere in the Atlantic and Gulf coastal plains, including most of the adjacent ecoregion (41), these site conditions are closely associated with longleaf pine. This system type is found on droughty uplands underlain with deep, coarse sandy soils. These sites are typified by low fertility and moisture retention. Fire is believed to have been a critical natural disturbance process which affected the vegetation structure and likely the species composition of communities in this system. A variety of fire-return intervals have been estimated for *Pinus echinata* vegetation. Garren (1943) proposed an 8- to 10-year return interval, Landers (1989) inferred a regime of 10 per century, and Martin and Smith (1993) estimated a 5- to 15-year interval, however, none of these estimates were specific to *Pinus echinata* on sandhills. Many such sites in the region lack well-developed and continuous fine fuels necessary to ignite and spread fires, possibly due to site infertility and droughtiness (R. Evans pers. obs., L. Smith pers. comm.).

CES203.891 WEST GULF COASTAL PLAIN STREAM TERRACE SANDYLAND LONGLEAF PINE WOODLAND

These *Pinus palustris* sandhills are dry woodlands or savannas found on excessively drained, xeric soils of alluvial origin in the West Gulf Coastal Plain (South Central Plains of EPA) of Texas and formerly Louisiana. They occur on areas of deep sand (ranging in texture from coarse to fine) which are present in quaternary alluvial deposits. The general habitat is on low terraces adjacent to stream floodplains, and adjacent communities may include baygalls and ponds. Precipitation rapidly dissipates via percolation due to the character of the soil. Soils include fine sands, such as fluvial terraces of Bienville-Alaga soils developed in the Deweyville Formation, and the Tonkawa fine sand, as well as other coarse sands. *Pinus palustris* historically dominated the vegetation of this region across nearly all uplands regardless of soil type or moisture, and longleaf pine forests were among the most valuable economic resources in the region at the turn of the century (Bray 1906). The importance of frequent fire has been well-documented for the perpetuation of this and related systems throughout the coastal plains. Stands are dominated by *Pinus palustris*, which often occurs in mixed stands with *Quercus incana*, *Pinus echinata*, and *Carya texana*. Some small isolated terraces (inclusions) may be dominated by oaks and hickories, with little or no *Pinus palustris*. The oaks generally become denser with fire exclusion, particularly on the small isolated areas. Mesophytic oak species are absent or extremely rare. This type, and other longleaf communities and systems of the West Gulf Coastal Plain, lie outside the range of *Aristida beyrichiana* (wiregrass). Other grasses (*Andropogon* spp., other *Aristida* spp., and *Schizachyrium* spp.) dominate understories which are rich in species diversity. Overall losses of longleaf pine in Texas have exceeded those of all other southern states (Outcalt 1997); less than 16,200 hectares of mostly second-growth stands remain (McWilliams and Lord 1988). Land-use practices continue to degrade remaining examples of longleaf pine communities (Bridges and Orzell 1989a). This system was formerly part of West Gulf Coastal Plain Upland Longleaf Pine Forest and Woodland (CES203.293) but has been separated out due to its distinctive environment. The herbaceous cover of subtypes 2 and 3 of Bridges and Orzell (1989a) is usually sparse, with considerable exposed sand and foliose lichen cover, and is characterized by numerous West Gulf Coastal Plain endemics (Bridges and Orzell 1989a). Two taxa (*Phlox nivalis* ssp. *texensis* and *Gaillardia aestivalis* var. *winkleri*) are nearly endemic to subtype 3 and occur primarily along Village Creek in Hardin County, Texas. *Carex tenax* and *Galium hispidulum* are nearly restricted to subtype 3 and are long-distance disjuncts from the East Gulf Coastal Plain (Bridges and Orzell 1989a). This upland ecological system occurs mainly in the Southern Loam Hills Subsection (232Fa) of Texas and formerly Louisiana, apparently ranging south into the Southwest Flatwoods Subsection (232Fb) (Hardin County, Texas). West Gulf Coastal Plain longleaf sandhills are distinctive from those in the East Gulf Coastal Plain because they occur beyond the ranges where wiregrass and sand post oak are dominant. This system usually occurs in deep, well-drained sandy soils on stream terraces, occurring above medium-sized perennial creeks that are typically clear and have sandy bottoms. These sites have very fine sands on ridgetops or slightly higher rises in the sandhill terraces. The flat areas with broad sandhills are slightly coarser and hold a little more water. A site for this system can have both fine and coarse sands. The landscape profile starts out with some bottomland hardwoods type with braided bald-cypress - tupelo, then a slight slope with a wide baygall edge against the sandhill. Sometimes there is a small ribbon of American beech slope forest just above the baygall, then going into the upland sandhill; sometimes it is just a baygall to sandhill transition (J. Singhurst pers. comm.). It

represents a distinctive subset of longleaf pine-dominated vegetation in the inner (landward) portions of the West Gulf Coastal Plain in eastern Texas (and Louisiana).

This system is best represented at the TNC Roy E. Larsen Sandyland Sanctuary. Some stream sites in Texas that include this system are Turkey Creek in Tyler County, Big Sandy Creek in Polk County, Cypress Creek in Hardin County, Village Creek (Hardin and Tyler counties), and Little Cow and Big Cow Creek in Newton County. Additional sites for this system include the Sand Hill Cemetery site, located near the junction of State Route 363 and Big Cow Creek: travel east 0.4 mile from this junction and then north about 2.7 miles to Sand Hill Cemetery. This site is a sparsely vegetated xeric sandhill (i.e., "Farkleberry Sandylands" as described by Geraldine Watson, Geyeta Ajilusgi, Dr. Paul Harcombe, and others) and is comprised of a longleaf pine - bluejack oak - farkleberry community. These deep xeric sands are fluvial terraces of Bienville-Alaga soils developed in the Deweyville Formation and deposited from nearby Big Cow Creek. These sites are sparsely vegetated with xerophytes (drought-resistant plants) and were infrequently visited by natural lightning-induced fires. Trees are usually stunted and/or crooked. These deep upland sands slope to the west of the Sand Hill Cemetery following a linear slope running north and south, adjacent to nearly level, frequently flooded loamy Iuka soils. A second site is found in Hardin County, Texas. The following is taken from an unpublished report "Preliminary Results of An Investigation of Fire-Dependent and Other Ecological Communities of Conservation Concern and Significant Species Occurrences on the Big Thicket National Preserve" (no date, no author given): Stand TCR98.3. (Figure 7) Hardin Co.: Big Thicket National Preserve, Turkey Creek Unit; E side of Turkey Creek, just N of its mouth at Village Creek, on rounded sandhill along Sandhill Trail from Interpretive Center, ca. 0.8-1.1 airmiles N to NNW of the jct. of F. M 420 and McNeely Lake Rd. Kountze North Quadrangle. Elevation: ca. 75 ft. Geology: Pleistocene fluvial terrace deposits (Shelby et al. 1968). Soils are mapped as Tonkawa fine sand; see sheet 70 in Deshotels (undated).

CES203.293 WEST GULF COASTAL PLAIN UPLAND LONGLEAF PINE FOREST AND WOODLAND

The common and unifying feature of this system is vegetation naturally dominated by *Pinus palustris*. This was formerly the most extensive system within its natural range in western Louisiana and eastern Texas. In most of the region, longleaf pine is (presently) a distinctive, but rarely dominant, element of existing vegetation (Harcombe et al. 1993). However, this tree historically dominated the vegetation across nearly all uplands regardless of soil type or moisture (excluding wetlands), and longleaf pine forests were among the most valuable economic resources in the region at the turn of the century (Bray 1906). Typical sites included sandhills on well-drained to excessively drained soils, but also more loamy and clayey upland soils. The importance of frequent fire has been well documented for the perpetuation of this system. Unlike comparable systems east of the Mississippi River, this type lies outside the range of *Aristida* spp. (wiregrasses), but most stands supported open grass-dominated understories rich in species diversity.

This system represents the presumed matrix vegetation type of the inner (landward) portions of the West Gulf Coastal Plain in Louisiana and eastern Texas within the range of longleaf pine. In Louisiana, these are mapped as the Upper Terrace and some smaller landward units (Snead and McCulloh 1984). The system is bounded on the outer (seaward) side by West Gulf Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.191) and on the inner (landward) side primarily by West Gulf Coastal Plain Pine-Hardwood Forest (CES203.378) and other hardwood or hardwood-pine systems.

STEPPE/SAVANNA

CES203.291 SOUTH-CENTRAL SALINE GLADE

This system occurs in portions of the Coastal Plain west of the Mississippi River on soils with high saline content, which in the most extreme examples are generally not conducive to woody plant growth. Thus, the vegetation forms a mosaic primarily consisting of open herbaceous or shrubby plant communities. This type is most common, and best documented in Arkansas and western Louisiana, but also occurs in eastern Texas. At least one high-ranked plant species, *Geocarpon minimum*, occurs in this system. In Arkansas, the forested examples of this system are called "Alkali Post Oak Flat," and the herbaceous examples are called "Alkali Wet Prairie" (Arkansas Multi-Agency Wetland Planning Team 2001). This system is found in isolated areas of the Upper West and West Gulf Coastal Plain ecoregions, and along the boundary of the Gulf Coast Prairies and Marshes.

This system occurs on soils with high saline content, which in the most extreme examples are generally not conducive to woody plant growth. The soils on which this system is found have high pH and high levels of sodium or magnesium salts in or near the surface layer. They typically have very poor drainage and a shallow hardpan. The combination of impeded drainage and unusual soil chemistry restricts the potential plant communities and provides habitat for certain rare species. The forested community apparently occurs on soils with deeper hardpans than the prairie communities. Most sites with alkali soils are believed to be former (Pleistocene) lakebeds (Arkansas Multi-Agency Wetland Planning Team 2001).

CES203.364 WEST GULF COASTAL PLAIN CATAHOULA BARRENS

This system is confined to the Catahoula geologic formation of eastern Texas and western Louisiana. It includes a vegetational mosaic ranging from herbaceous-dominated areas on shallow soil and exposed sandstone to deeper soils with open woodland vegetation. Woodlands include a post oak-dominated overstory grading into longleaf pine-dominated areas. Seasonal droughtiness, shallow soils, aluminum toxicity, and periodic fires are important factors that influence the composition and structure of this system. The western boundary of this system is unclear. The Catahoula Formation extends into the Crosstimbers region as well as the Pineywoods, but it is not clear whether these areas should be considered the same system.

The habitat of this system includes shallow soil and exposed sandstone, which tend to an herbaceous-dominated vegetation expression, as well as zones of deeper soils with open woodland vegetation.

CES203.277 WEST GULF COASTAL PLAIN WECHES GLADE

This small-patch system is endemic to outcrops of marine sediment and glauconitic clays of the Weches Formation in central eastern Texas, where it occurs primarily in San Augustine, Nacogdoches, and Sabine counties. These outcrops are exposed by natural erosion of hillside slopes. Soils are shallow, rocky and basic, factors which tend to inhibit growth of woody vegetation. Outcrops are seepy and saturated during winter and early spring but become hard and dry in the summer. Enormous seasonal variations in species dominance can occur, but a number of herbaceous species are characteristic of this system, including the narrowly endemic annuals *Lesquerella pallida* and *Leavenworthia aurea* var. *texana*. Characteristic species include *Sedum pulchellum*, *Clinopodium arkansanum*, and *Sporobolus vaginiflorus*. A scattered shrub layer, including *Cercis canadensis*, *Cornus drummondii*, *Juniperus virginiana*, and *Sideroxylon lanuginosum*, may be present on some sites.

This system is endemic to a localized region of eastern Texas, primarily in San Augustine, Nacogdoches, and Sabine counties. Soils are mapped as Trawick series (Mollic Hapludalfs).

The Weches Formation is a marine mudstone with abundant fossils of shallow-water organisms and contains appreciable arsenic, which becomes bioavailable due to weathering. The Eocene Claiborne Group of the Texas Gulf Coastal Plain contains alternating clay and quartzose sand units. The Weches Formation in the Nacogdoches area, a transgressive phase of the Claiborne Group, consists of about 20 m of fossiliferous green clay present as sand-sized aggregates ("greensand"), many of which are fecal pellets. The clay is Fe-rich and has been variously described as "mixed-layer montmorillonite" or as glauconite (Ledger and Judy 2003).

HERBACEOUS

CES205.897 EAST-CENTRAL TEXAS PLAINS XERIC SANDYLAND

This extremely xeric system of the east-central Texas Plains (EPA ecoregion 33; post oak savanna region) is found primarily on the Carrizo geologic formation, but also on other Eocene strata such as Queen City and Sparta. The combination of these very droughty soils with low levels of rainfall create extreme edaphic conditions and a locally unique environment which supports a number of endemic plant taxa. There are a number of endemics associated with this system. The vegetational component of this system includes open herbaceous-dominated sand "prairies" or "barrens" to open oak-dominated woodlands. A large number of narrowly distributed, endemic species are associated with this system, including *Abronia macrocarpa*, *Allium elmendorffii*, *Brazoria truncata* var. *pulcherrima* (= *Brazoria pulcherrima*), *Brazoria truncata* var. *truncata*, *Chaetopappa imberbis*, *Cryptantha texana*, *Dalea obovata*, *Galactia canescens*, *Hymenopappus carrizoanus*, *Lechea san-sabeana*, *Lesquerella grandiflora*, *Liatris elegans* var. *carizzana*, *Polanisia erosa* ssp. *breviglandulosa*, *Polygonella parksii*, *Prunus texana*, *Senecio ampullaceus*, *Sphaeralcea lindheimeri*, *Tephrosia lindheimeri*, and *Tetragonotheca repanda*.

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CES205.684 TEXAS BLACKLAND TALLGRASS PRAIRIE

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.

CES203.379 WEST GULF COASTAL PLAIN SOUTHERN CALCAREOUS PRAIRIE

This is one of two described calcareous prairie ecological systems which occur within the pine-dominated portions of the Coastal Plain west of the Mississippi River. This type is the more southerly ranging of the two [compare against West Gulf Coastal Plain Northern Calcareous Prairie (CES203.377)]. Examples include natural grassland vegetation and adjacent wooded vegetation in a relatively small natural region of Louisiana and Texas. Although most examples are typically upland, some include small stream bottoms or riparian areas that bisect the prairies. This system is found primarily within the historical range of *Pinus palustris*, or TNC Ecoregion 41, but it extends somewhat beyond this area to the north. In addition, examples occurring west to the eastern edge of the Post Oak Savanna region of eastern Texas are also included here. Plant communities in this system occur over relatively deep soils with circumneutral surface soil pH. These conditions are unusual in the local landscape which is predominantly one of acidic, generally forested soils. In most cases individual prairie openings are small and isolated from one another. Although they were

formerly more extensive prior to European settlement, they apparently were much smaller than examples of West Gulf Coastal Plain Northern Calcareous Prairie (CES203.377).

This system is best documented from the Fleming geologic formation, but is also known from the Cook Mountain Formation in Louisiana. Examples from the Jackson Group (in Louisiana) are also included here, as well as the Morse Clay Calcareous Prairie of northwestern Louisiana.

WOODY WETLAND

CES203.065 RED RIVER LARGE FLOODPLAIN FOREST

This floodplain forest system is specifically restricted to the main stem of the Red River in the West Gulf Coastal Plain and Upper West Gulf Coastal Plain of southwestern Arkansas, adjacent Texas, and Louisiana. Its range is conceptually coincident with the vast majority of Subsection 234Ai of Keys et al. (1995), excluding the portion of 234Ai within TNC Ecoregion 42 (Mississippi River Alluvial Plain). Its range is also coincident with Level IV Ecoregion 35g (Red River Bottomlands) of Omernik (EPA 2004). Several distinct plant communities can be recognized within this system that may be related to the array of different geomorphic features present within the floodplain. Some of the major geomorphic features associated with different community types within the system include natural levees, point bars, meander scrolls, oxbows, and sloughs. The vegetation generally includes forests dominated by bottomland hardwood species and other trees tolerant of flooding, including bald-cypress and water tupelo. Herbaceous and shrub vegetation may also be present in certain areas. This system is generally similar in concept to West Gulf Coastal Plain Large River Floodplain Forest (CES203.488) but is distinct both from it and from the floodplain forests of the Mississippi River Alluvial Plain primarily because of the difference in magnitude between the typical large rivers (such as the Trinity, Neches, and Sabine), on the one hand, and the Mississippi River on the other. In Arkansas (at least), this system is most closely affiliated with the "Billyhaw-Perry-Portland" Soil Association (MUID=AR033 in STATSGO).

This system is restricted to the main stem of the Red River in southwestern Arkansas (partly bordering Texas) and Louisiana in the West Gulf Coastal Plain and Upper West Gulf Coastal Plain of the United States. The portion of the Red River to the west (Keys et al. 231Em) is treated as part of West Gulf Coastal Plain Large River Floodplain Forest (CES203.488).

Some of the major geomorphic features associated with different community types within the system include natural levees, point bars, meander scrolls, oxbows, and sloughs (Sharitz and Mitsch 1993). The "flatwoods" of the upper terraces within the floodplain are a different system.

CES203.547 WEST GULF COASTAL PLAIN FLATWOODS POND

This system represents predominantly graminoid-dominated flatwoods ponds of the West Gulf Coastal Plain of eastern Texas and western Louisiana. These ponds are generally circular or elliptical, flat-bottomed depressions on flat terraces in the Outer Coastal Plain. The slowly permeable soils trap local runoff and precipitation resulting in higher water tables than surrounding areas. Water depth may be 3-5 feet in the winter and even deeper toward the center of some examples (Bridges 1988, Bridges and Orzell 1989a). Examples range from shallow to several meters in depth; the large and deeper examples may exhibit distinct vegetation zonation. Most examples have a layer of tall wetland grasses and sedges above a layer of semi-aquatic herbs. Many lack a significant woody layer due in part to periodic fires originating in the pine savanna matrix. However, scattered, often stunted *Nyssa biflora* and stems of *Cephalanthus occidentalis* may be present. The following species are characteristic of this type: *Eriocaulon compressum*, *Xyris fimbriata*, *Eleocharis equisetoides*, *Eleocharis quadrangulata*, as well as two additional species, *Carex verrucosa* and *Rhynchospora cephalantha*, which are more frequent in other pond types. Some other species frequently found in this type include *Eriocaulon compressum*, *Rhynchospora corniculata*, *Panicum hemitomon*, *Ludwigia sphaerocarpa*, *Xyris laxifolia* var. *iridifolia* (= *Xyris iridifolia*), and *Sagittaria graminea*. Other herbaceous species may include *Gratiola brevifolia*, *Hydrolea ovata*, *Proserpinaca pectinata*, *Pluchea rosea*, *Ludwigia pilosa*, *Bacopa caroliniana*, *Xyris* sp., and *Rhynchospora capitellata*.

This system tends to occur as inclusions within wetland pine savannas in depression ponds or ancient stream channels and sloughs. Local runoff and rainfall collect in these depressions with slowly permeable soils. Resulting water tables persist for long periods after rain, at higher levels than surrounding parts of the landscape. Water in this pond type is often 3-5 feet deep in winter, and even deeper areas (with floating aquatic vegetation) may occur in the center of some sites (Bridges 1988, Bridges and Orzell 1989a). They tend to occur as inclusions within wetland pine savannas, but may also be bordered by upland depression swamps. The depressions are typically closed, with no surface outlet. Water collects from local rainfall and runoff from small watersheds. There is typically no input from streamflow and little or no outflow (Bridges and Orzell 1989a).

CES203.488 WEST GULF COASTAL PLAIN LARGE RIVER FLOODPLAIN FOREST

This system represents a geographic subset of Kuchler's (1964) Southern Floodplain Forest found west of the Mississippi River. Examples may be found along large rivers of the West Gulf Coastal Plain and Upper West Gulf Coastal Plain, especially the Trinity, Neches, Sabine, and others. Several distinct plant communities can be recognized within this system that may be related to the array of different geomorphic features present within the floodplain. Some of the major geomorphic features associated with different

community types include natural levees, point bars, meander scrolls, oxbows, and sloughs. Vegetation generally includes forests dominated by bottomland hardwood species and other trees tolerant of flooding, including bald-cypress and water tupelo. However, herbaceous and shrub vegetation may be present in certain areas as well.

Some of the major geomorphic features associated with different community types within this system include natural levees, point bars, meander scrolls, oxbows, and sloughs (Sharitz and Mitsch 1993).

CES203.548 WEST GULF COASTAL PLAIN NONRIVERINE WET HARDWOOD FLATWOODS

This ecological system represents predominantly wet hardwood flatwoods of the West Gulf Coastal Plain of southern Arkansas, eastern Texas, and western Louisiana. Examples may be somewhat more common in the inland portions of the region but are also found in the Outer Coastal Plain as well. These areas are usually found on Pleistocene high terraces (EPA 35c) primarily associated with the Red and Mississippi rivers that are located above the current floodplain. Hydrology is controlled by local rainfall events and not overbank flooding. Soils are fine-textured, and hardpans may be present in the subsurface. The limited permeability of these soils contributes to perched water tables during fairly substantial portions of the year (when precipitation is greatest and evapotranspiration is lowest). Saturation occurs not from overbank flooding but typically whenever precipitation events occur. The local landscape is often a complex of ridges and swales, usually occurring in close proximity. There is vegetation variability related to soil texture and moisture and disturbance history. Most examples support hardwood forests or swamps, which are often heavily oak-dominated. Important species are tolerant of inundation. They include *Quercus michauxii*, *Quercus phellos*, *Quercus laurifolia*, and *Liquidambar styraciflua*, with sparse coverage of wetland herbs such as *Carex glaucescens*. Some swales support unusual pockets of *Fraxinus caroliniana* and *Crataegus* spp. Some examples can contain *Pinus taeda*. This system may grade upslope into West Gulf Coastal Plain Pine-Hardwood Flatwoods (CES203.278) and down into West Gulf Coastal Plain Flatwoods Pond (CES203.547). Apparently, this system occurs within the historic range of longleaf pine [see USFS ecomap attributions]. Within this range, more information is needed to identify the toposequence between longleaf pine-dominated flatwoods/savannas/uplands and hardwood/loblolly-dominated flatwoods. The distribution of this system in the South Central Plains Flatwoods and Southern Tertiary Uplands (EPA 35e and f) needs to be better defined. This system is found in the West Gulf Coastal Plain, Upper West Gulf Coastal Plain, and Mississippi River Alluvial Plain (P. Faulkner pers. comm.).

This system is found on the wettest inclusions of Pleistocene terraces in the West Gulf Coastal Plain of southern Arkansas, eastern Texas, and western Louisiana.

CES203.372 WEST GULF COASTAL PLAIN SEEPAGE SWAMP AND BAYGALL

This West Gulf Coastal Plain ecological system consists of forested wetlands (often densely wooded) in acidic, seepage influenced wetland habitats. These wetlands may occur in poorly developed upland drainages, toe-slopes, and small headwaters stream bottoms. These environments are prone to long duration standing water, and tend to occur on highly acidic, nutrient-poor soils. The vegetation is characterized by an overstory of *Magnolia virginiana*, *Nyssa sylvatica*, *Nyssa biflora*, and *Acer rubrum*, although there is some variation according to latitude. Understory vegetation throughout the region consistently supports the vine *Smilax laurifolia* and a dense abundance of ferns, such as *Osmunda cinnamomea*, *Osmunda regalis* var. *spectabilis*, and *Woodwardia areolata*. In most cases, these wetlands are embedded in uplands with deep sandy soils. When these communities are associated with streams, they tend to be low gradient, with narrow, often braided channels and diffuse drainage patterns. Due to excessive wetness, these habitats are normally protected from fire except those which occur during extreme droughty periods. The limited examples in Oklahoma are somewhat depauperate and lack some of the more southern and eastern taxa (e.g., *Magnolia virginiana*, *Nyssa biflora*).

This system occurs on saturated soils associated with springs and seepage flow at the headwaters and margins of topographically flat creek bottoms of low velocity in the West Gulf Coastal Plain. The creek channels themselves tend to be highly meandering, often with multiple channels and extremely shallow banks. Nixon et al. (1983a) measured stream depths of 0.3-0.6 m and widths of less than 1 meter in a study of this system. Examples are invariably embedded within deep sandy slopes and uplands, and may also occur in association with flatwoods drainages (Martin et al. 1990, Martin and Smith 1991, Smith 1996a). The deep, poorly drained, strongly acidic, loamy fine sand soils have a high organic matter content (Brooks et al. 1993). Van Kley (1999a) indicates that these habitats, sometimes mapped as the Betis soil series and Guyton soil complex, are notably low in calcium and magnesium. Soils of other examples may be mapped as Lovelady (Arenic Glossudalf), Rentzel (Arenic Plinthaquic Paleudult), Corrigan (Typic Albaqualf), Melhoms (Humaqueptic Psammaquent), and Osier (Typic Psammaquent). This system is known from the Pleistocene Terraces and Tertiary uplands in Louisiana, Texas, Arkansas and to a limited extent in Oklahoma. Geologic formations where this system occurs include: Bentley (Intermediate Pleistocene Terraces), Willis (High Pleistocene Terraces), Fleming (Miocene), Catahoula (Oligocene), Cockfield (Eocene), Sparta (Eocene), Carrizo (Eocene), Wilcox (Eocene), and possibly the Vicksburg (Oligocene) and other formations.

CES203.487 WEST GULF COASTAL PLAIN SMALL STREAM AND RIVER FOREST

This is a predominantly forested system of the West Gulf Coastal Plain associated with small rivers and creeks. In contrast to West Gulf Coastal Plain Large River Floodplain Forest (CES203.488), examples of this system have fewer major geomorphic floodplain features. Those features that are present tend to be smaller and more closely intermixed with one another, resulting in less obvious vegetational zonation. Bottomland hardwood tree species are typically important and diagnostic, although mesic hardwood species are also present in areas with less inundation, such as upper terraces and possibly second bottoms. As a whole, flooding occurs annually, but the water table usually is well below the soil surface throughout most of the growing season. Areas impacted by beaver impoundments are also included in this system. This system is associated with small rivers and creeks in the West Gulf Coastal Plain.

CES203.191 WEST GULF COASTAL PLAIN WET LONGLEAF PINE SAVANNA AND FLATWOODS

This system was the historical matrix vegetation of the outer portions of the West Gulf Coastal Plain in Louisiana and eastern Texas, occurring most frequently on relatively recent geologic formations within the range of longleaf pine. These areas are characterized by poorly drained upland soils with high water tables (Bridges and Orzell 1990). In natural condition, monospecific stands of *Pinus palustris* and species-rich herbaceous layers characterize this system. Widespread alterations following European settlement, including changes to natural fire regimes, have produced drastic changes to this system, and few large examples are extant. Examples appear to be somewhat more common in western Louisiana than eastern Texas. In Louisiana, two Natural Heritage communities (variants) of this system are recognized (Smith 1996b). These two variants are the longleaf pine flatwoods (which are mesic to dry-mesic [non-wetland] stands) and the true pine savannas which occupy poorly drained and seasonally saturated/flooded depressional areas and low flats. These two types form an interdigitated mosaic (Smith 1996b), which constitutes this system as here described and defined.

This system represents the presumed matrix vegetation of the outer (seaward) portions of the West Gulf Coastal Plain in Louisiana and eastern Texas, on relatively recent (Pleistocene) geologic formations within the range of longleaf pine. In Louisiana, these are mapped as the Intermediate Terrace and the upper Prairie Terrace (Snead and McCulloh 1984), and in Texas as the Lissie Formation and the upper Beaumont Formation (Sellards et al. 1932). The Intermediate Terrace of Snead and McCulloh (1984) includes terraces formerly designated as the Montgomery, Irene, and most of the Bentley. Within the range of longleaf pine, this system is bounded on the landward side by West Gulf Coastal Plain Upland Longleaf Pine Forest and Woodland (CES203.293).

HERBACEOUS WETLAND

CES203.194 WEST GULF COASTAL PLAIN HERBACEOUS SEEP AND BOG

This wet, fire-maintained, hillside seepage system occurs in the Gulf Coastal Plain west of the Mississippi River where it is documented in eastern Texas, western Louisiana, and adjacent areas of southern Arkansas. This oligotrophic wetland is maintained by seepage at the zone between an overlaying, permeable sandy layer and a lower layer of relatively impermeable material such as sandstone or clay. The vegetation of intact examples is dominated by a dense, species-rich graminoid-forb layer less than 1 m tall with continuous to nearly continuous cover, typically 80-90%. This type is intended to encompass the range of variation present in West Gulf Coastal Plain seepage bogs, although various authors have recognized a number of different subtypes. One of the most distinct variants that is included here for now is the "muck bog" of the Post Oak Savanna and Cross Timbers regions. It differs in a number of ways from most other examples of this system and may need to be recognized as a distinct ecological system. This system occurs in the Gulf Coastal Plain west of the Mississippi River where it is documented in eastern Texas, western Louisiana, and adjacent areas of southern Arkansas. There are rare examples of this (or a related system) found in the Post Oak Savanna and Crosstimbers regions of Texas.

This oligotrophic wetland is maintained by seepage at the zone between an overlaying, permeable sandy layer and a lower layer of relatively impermeable material such as sandstone or clay.

MIXED UPLAND AND WETLAND

CES203.278 WEST GULF COASTAL PLAIN PINE-HARDWOOD FLATWOODS

This ecological system represents predominantly mesic to dry flatwoods of limited areas of inland portions of the West Gulf Coastal Plain. These areas are usually found on Pleistocene high terraces that are located above current floodplains. Hydrology is controlled by local rainfall events and not overbank flooding. Soils are fine-textured, and hardpans may be present in the subsurface. The limited permeability of these soils contributes to shallowly perched water tables during portions of the year when precipitation is greatest and evapotranspiration is lowest. Soil moisture fluctuates widely throughout the growing season, from saturated to very dry, a condition sometimes referred to elsewhere as xerohydric. Saturation occurs not from overbank flooding but typically whenever precipitation events occur. Local topography is a complex of ridges and swales, often in close proximity to one another. Ridges tend to be much drier than swales, which may hold water for varying periods of time. Within both ridges and swales, there is vegetation variability relating to soil texture and moisture and disturbance history. The driest ridges support *Pinus taeda* and *Quercus stellata*; more mesic ridges have *Pinus taeda* with *Quercus alba* and species such as *Symplocos tinctoria* and *Viburnum dentatum*. Fire may have been an important natural process in some examples of this system (T. Foti pers. comm.). Embedded swales tend to support hardwood forests or swamps, often heavily oak-dominated with species tolerant of some inundation, such as *Quercus phellos* and *Quercus laurifolia*, with sparse coverage of wetland herbs such as *Carex glaucescens*. Some swales support unusual pockets of *Fraxinus caroliniana* and *Crataegus* spp. These latter vegetation types are linked to West Gulf Coastal Plain Nonriverine Wet Hardwood Flatwoods (CES203.548). In Arkansas (at least), this system is most closely affiliated with these Soil Associations: "Adaton-Felker-Gore" (MUID=AR035); "Wrightsville-Acadia-Louin" (MUID=AR036); "Amy-Pheba-Savannah" (MUID=038); "Amy-Pheba-Guyton" (MUID=AR040); "Smithdale-Savannah-Sacul" (MUID= AR041); "Sacul-Savannah-Sawyer" (MUID= AR042); "Calloway-Henry-Grenada" (MUID=AR044); "Wrightsville-Kolin-Gore" (MUID=AR063); "Bussy-Tillou-Guyton" (MUID=AR069). Apparently, this system occurs within the historic range of longleaf pine [see USFS ecomap attributions]. Within this range, more information is needed to identify the toposequence between longleaf pine-dominated flatwoods/savannas/uplands and hardwood/loblolly-dominated flatwoods. The distribution of this system in the South Central Plains Flatwoods and Southern Tertiary Uplands (EPA 35e and f) needs to be better defined.

Areas occupied by this system are usually found on nonriverine, Pleistocene high terraces. Soils are fine-textured and hardpans may be present in the subsurface. The limited permeability of these soils contributes to shallowly perched water tables during portions of the year when precipitation is greatest and evapotranspiration is lowest. Soil moisture fluctuates widely throughout the growing season, from saturated to very dry, a condition sometimes referred to elsewhere as xerohydric. Saturation occurs not from overbank flooding but typically whenever precipitation events occur. Local topography is a complex of ridges and swales, often in close proximity to one another. Ridges tend to be much drier than swales, which may hold water for varying periods of time.

B. Hoagland (pers. comm. 2006) indicates it is found in McCurtain County, OK. J. Singhurst (pers. comm. 2006): "The flatwood polygons in an arc heading northwest along the south side of the Red River west of Texarkana are all mounded flatwoods dominated by *Quercus stellata*, *Quercus falcata*, *Quercus marilandica*, *Vaccinium arboreum*, *Crataegus* spp., and a few scattered *Quercus alba*, *Carya alba*, and *Pinus* spp. Herbaceous flora includes *Chasmanthium laxum*, *Danthonia* spp., and *Carex* spp. Wetter sites have *Quercus phellos* and *Quercus nigra*. Between the mounds of dry flatwood sites, sometimes rather restricted grasses such as *Glyceria arkansana* are present in seasonal pond areas. In some places between the mounds, slight seepage does accumulate, with *Sphagnum*, *Rhynchospora* spp., *Aletris aurea*, *Polygala* spp., *Juncus* spp., etc. At the base of the mounds, sites can be mesic even though there is only a change from 1 to 2 meters in elevation, with plants such as *Polygonatum biflorum*, *Triosteum angustifolium*, *Erythronium albidum*, *Podophyllum peltatum*, *Trillium viridescens*, etc. A couple of other unusual species restricted to these sites in Texas includes *Pseudognaphalium canescens* (= *Gnaphalium wrightii*) and *Parthenium hispidum* (this later plant, I believe, is also a prairie species). [In relation to] SSURGO soils, [t]he soils for northeast Texas would be mapped as Wrightsville.... I am aware of sites in Cass, Fannin, Lamar, Red River, Bowie, Franklin, Titus, and Harrison counties (Harrison County is an extension of a few polygons you have in Caddo Parish, Louisiana). There are dry flatwoods in very northwestern Caddo Parish, Louisiana, near Vivian. There are some other dry flatwoods in Van Zandt and Henderson County west of Tyler, Texas. I am mostly familiar with the northeast Texas sites. But there should also be some in southeast Texas, so I will have to quiz a couple of folks about these areas you have through the Big Thicket area. I am assuming that Latimore Smith may be able to help me define dry flatwoods in this area of Texas. Most of this country is lower wet flatwoods and wet savannas. There are extensive areas of mounded soils that have dry flatwoods taxa on the mounds, but I would be curious how the Lower WGCP sites are defined/separated from the Upper WGCP sites. They are floristically different. Latimore will have a good handle on these types, and if I can see how he defines dry flatwoods or what areas he is defining for very southwestern Louisiana, I would be willing to assist here also."

We need both flatwoods types. Wet hardwood flatwoods do often occur within xero-hydric pine-oak flatwoods, but they also occur within bottomlands, uplands, and mesic hardwoods. The dominant species are not the same; actually there is little overlap. Structure is

different: forest vs. woodland. The fire regime is different: short interval, low intensity-low severity vs. medium to long interval, low intensity-high severity. The wet type is small to large patch; the dry pine-hardwood system is matrix (D. Zollner pers. comm. 2006).