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# UNITED STATES DEPARTMENT OF AGRICULTURE
# NATURAL RESOURCES CONSERVATION SERVICE

## ECOLOGICAL SITE DESCRIPTION (New Format Report)

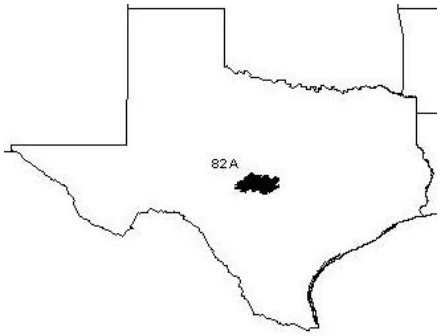
## ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Red Sandy Loam 25-32" PZ

Site ID: R082AY369TX

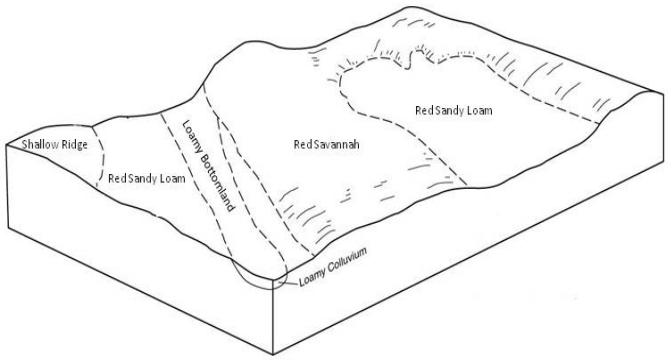
Major Land Resource Area: 082A-Texas Central Basin




## Physiographic Features

These soils associated with the Red Sandy Loam ecological site are on gently sloping to moderately sloping uplands. Slopes range from 1 to 8 percent. Elevation ranges from 850 to 2,200 feet.

Physiographic Image




Formed in material weathered from schist, sandstone and limestone on uplands

Landform: (1) Hill

(2) Plain

(3) Ridge

| | Minimum | Maximum |
|---|---|---|
| Elevation (feet): | 800 | 2250 |
| Slope (percent): | 1 | 8 |
| Water Table Depth (inches): | | |
| Flooding: | | |
| Frequency: | None | None |
| Duration: | None | None |
| Ponding: | | |
| Depth (inches): | | |
| Frequency: | None | None |
| Duration: | None | None |
| Runoff Class: | Negligible | Low |
| Aspect: | No Influence on this site | |

## Climatic Features

The climate for MLRA 82A is humid subtropical and is characterized by hot summers and relatively mild winters. The average first frost should occur around November 11 and the last freeze of the season should occur around March 21.

The average relative humidity in mid-afternoon is about 50 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible during the summer and 50 percent in winter. The prevailing wind direction is from the south.

Approximately two-thirds of annual rainfall occurs during the April to September period. Rainfall during this period generally falls as thunderstorms, and fairly large amount of rain may fall in localized areas for a short period of time.

| | Minimum | Maximum |
|---|---|---|
| Frost-free period (days): | 215 | 235 |
| Freeze-free period (days): | 265 | 276 |
| Mean annual precipitation (inches): | 25.0 | 32.0 |

Monthly precipitation (inches) and temperature (°F):

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Precip. Min. | 0.47 | 0.7 | 0.87 | 1.11 | 2.34 | 2.13 | 0.67 | 0.91 | 1.18 | 1.55 | 0.93 | 0.58 |
| Precip. Max. | 1.25 | 2.2 | 2.21 | 2.52 | 4.41 | 4.35 | 2.37 | 2.9 | 3.19 | 3.72 | 2.58 | 1.89 |
| Temp. Min. | 31.9 | 36.1 | 44.2 | 52.2 | 61.2 | 67.9 | 70.5 | 69.5 | 63.5 | 53.0 | 42.4 | 34.0 |
| Temp. Max. | 59.7 | 64.5 | 72.5 | 79.4 | 85.1 | 91.2 | 95.5 | 95.1 | 89.3 | 80.4 | 69.1 | 61.5 |

Climate Stations: (1) TX5272, Llano, Texas. Period of record 1971 - 2000
(2) TX5650, Mason, Texas. Period of record 1971 - 2000

## Influencing Water Features

None.

| Wetland Description: | System | Subsystem | Class |
|---|---|---|---|

## Representative Soil Features

Red Sandy Loam soil series consists of shallow, moderately deep, and very deep well drained, moderately permeable soils that formed in residuum from reddish colored sandstone. The soil formed in loamy reddish sediments of the Hickory Sandstone member of Upper Cambrian Age.

The site generally does not receive additional water from outside the site. There is little bare soil in this community, with plant basal cover, litter, and rock fragments comprising the ground cover. The site will have large rock fragments (cobbles, stones and boulders) on the soil surface, even in the reference state. Soils are fertile and hold moderately high amounts of soil moisture. This is a productive site with moderately high yields of good quality forage.

Associated soils for Red Sandy Loam ecological site include Hye, Oben, and Pontotoc.

Parent Materials:
Kind: Residuum
Origin: Sandstone

Surface Texture: (1)Stony Fine sandy loam
(2) Fine sandy loam
(3)Stony Sandy loam

Subsurface Texture Group: Loamy

| | Minimum | Maximum |
|---|---|---|
| Surface Fragments <=3" (% Cover): | 0 | 5 |
| Surface Fragments > 3" (% Cover): | 0 | 0 |
| Subsurface Fragments <=3" (% Volume): | 0 | 6 |
| Subsurface Fragments > 3" (% Volume): | 0 | 20 |

Drainage Class: Moderately well drained To Well drained
Permeability Class: Slow To Moderately slow

| | Minimum | Maximum |
|---|---|---|
| Depth (inches): | | |
| Electrical Conductivity (mmhos/cm): | 0 | 2 |
| Sodium Absorption Ratio: | 0 | 0 |
| Calcium Carbonate Equivalent (percent): | 0 | 0 |
| Soil Reaction (1:1 Water): | 6.1 | 7.3 |
| Soil Reaction (0.01M CaCl2): | | |
| Available Water Capacity (inches): | 1.0 | 5.0 |

# Plant Communities

## Ecological Dynamics of the Site

DEFINITIONS (From the National Range and Pasture Handbook (1997), unless otherwise noted.)

Community (plant community): An assemblage of plants occurring together at any point in time, while denoting no particular ecological status. A unit of vegetation.
Community pathway: A trajectory of system change between communities within a state (phases) triggered by management actions and/or natural mechanisms (Stringham et al. 2003).
Community phase: A vegetation community seral stage within a state (Stringham et al. 2003).
Decreaser: Plant species of the climax vegetation that will decrease in relative amount with continued heavy defoliation (grazing).
Deferment: Delay of livestock grazing in an area for an adequate period to provide for plant reproduction, establishment of new plants, or restoration of vigor of existing plants.
Historic climax plant community (HCPC): The plant community that was best adapted to the unique combination of factors associated with the ecological site. It was in a natural dynamic equilibrium with the historic biotic, abiotic, climatic factors on its ecological site in North America at the time of European immigration and settlement.
Increaser: The climax native species in a community of different plants that, under excessive continuous grazing by livestock, are not selected initially, and increase in abundance. If the heavy grazing continues, livestock will reduce the more palatable plants and shift to the increaser species causing them to decrease in abundance.
Introduced species: A species not a part of the original fauna or flora of the area in question.
Invader: Plants that are not a part of the original plant community that invade an area because of disturbance, or plant community deterioration, or both.
Native species: A species that is part of the original fauna or flora of the area in question.
Noxious species: A plant species that is undesirable because it conflicts, restricts, or otherwise causes problems under management objectives. Not to be confused with species declared noxious by laws concerned with plants that are weedy in cultivated crops and on range.
Noxious weed: An unwanted plant specified by Federal or State laws as being especially undesirable, troublesome, and difficult to control. It grows and spreads in places where it interferes with the growth and production of the desired crop.
Seral stages: The developmental stages of an ecological succession.
State: A recognizable, resistant and resilient complex of 2 components, the soil base and the vegetation structure. The vegetation and soil components are necessarily connected through integrated ecological processes that interact to

produce a sustained equilibrium that is expressed by a specific suite of vegetative communities (Stringham et al. 2003).
Threshold: Boundary in space and time between any and all states, or along irreversible transitions, such that one or more of the primary ecological processes has been irreversibly changed and must be actively restored before return to a previous state is possible (Stringham et al. 2003).
Transition: A trajectory of system change away from the current stable state that is triggered by natural events, management actions, or both. A transition is reversible when it occurs within a state, but is irreversible after a threshold has been breached (Stringham et al. 2003).

Plant Communities

Ecological Dynamics of the Site:
The Red Sandy Loam 25-35" PZ reference site is a fire-influenced Little Bluestem/Oak Savannah interspersed with perennial forbs and mixed shrubs. The site consists of two stable states: the Savannah State (1.0) and Shrubland State (2.0), each containing two communities.

The Texas Central Basin (MLRA 82A) is a unique geological region within Texas. It is composed largely of Pre-Cambrian granite, gneiss and schist (Bureau of Economic Geology 1981). Depending upon the parent material and topography, a great variety of soils have developed that vary from shallow, fissured, rocky outcrops with minimal soil development to relatively deep, well-developed soils with textures that vary from fine sandy loams to sands to gravelly clay loams to cobbly clay loams and stony clay loams (Goerdel 2000).

Precipitation patterns are highly variable. Long-term droughts, occurring three to four times per century, cause shifts in species composition by causing die-off of seedlings, less drought-tolerant species, and some woody species. Droughts also reduce biomass production and create open space that is colonized by opportunistic species when precipitation increases. Wet periods allow little bluestem, sideoats grama, and hardwoods to increase in dominance. The site also tends to have many opportunistic plants such as threeawns (Aristida spp.) and annuals that take advantage of the short flush of available water.

Climatic variation and topographic variability interact to influence vegetation responses to disturbances such as fire and grazing. The vegetation of the region developed under a humid, subtropical climate. Weather variation is great; precipitation is highly variable with seasonal, annual, and multi-year droughts (3-6 years) common as well as seasons and years with well above average precipitation; average conditions rarely exist. Typically the spring and fall are periods of highest precipitation while mid to late summer is usually a hot, droughty period. Winters are moderate with scattered precipitation sometimes in the form of short-lived snow and ice storms (Carr 1969, Bomar 1983).

The herbaceous savannah species adapted to fire and grazing disturbances by maintaining below-ground perennating tissues. Prior to European settlement, fires would likely have been frequent (approximately every 7-12 years) (Scifres and Hamilton 1993, Frost 1998) and burned any time of year as long as there were ample fuels, dry conditions, and an ignition source.

Fire was a major influence on vegetation structure and composition prior to settlement. Lightning and Native Americans were primary ignition sources, and the latter are considered to have increased the frequency and extent of fire as their populations increased. Fires occurred at all seasons but those that occurred during the hot, dry, late-summer season following fine fuel (grass) accumulation in the spring and early summer were perhaps the most intense and had the greatest influence on the character of the vegetation. Fires were frequent, and any area may have burned once within each 7-12 year interval (Scifres and Hamilton 1993, Frost 1998). Fire generally favors the herbaceous component of the community and hinders the establishment and growth of woody species under intense hot, dry conditions. Some individuals of trees (e.g. oak species) and resprouting shrubs (e.g. mesquite) were able to escape fires, and as they matured, they became fire-resistant components of the vegetation except for infrequent stand-replacing crown fires. These woody species became effectively uncoupled from the herbaceous and shrub layer even if the herbaceous species composition was substantially altered by grazing or other factors. If, however, the oaks were killed or removed it is very difficult for them to reestablish into mature single-stemmed trees due to the resprouting nature of the tree, particularly under current land use conditions. While fire had influenced these communities for millennia, as the land was settled with homesteads and crops were established, fires were purposely prevented or stopped. Most of the remaining rangeland was overgrazed, which reduced fuel loads and hence effectively fire-proofed the plant communities from the effect of fires. This was a primary factor in the increase of woody species within the Central Basin.

Remnant pristine plant communities are difficult to find to represent the HCPC of ecological sites across much of the Central Basin. While shrublands within MRLA 82 have traditionally been viewed as “degraded” relative to livestock production, it is important to recognize that they are not necessarily degraded from the ecological perspective of primary productivity, biomass accumulation, nutrient cycling, and biodiversity. The productivity of shrublands may be equal to or greater than that of the grassland they replaced. In addition, shrubs help modify soils and microclimate to increase levels of organic matter and nutrients in the upper soils horizons (Boutton et al. 2009, Boutton & Liao 2010). This nutrient enhancement by shrubs can offset grazing-induced losses of soil nutrients and contribute to enhance grass production when shrub cover is reduced. While shrub communities may have adverse impacts on grasses and grassland fauna, other plants and animals may benefit (Archer & Smeins 1991, Bestelmeyer et al. 2003). Thus, while ecosystem biodiversity certainly changes, it does not necessarily decrease with a shift from grass to woody dominance on these sites.

Soil and topographic variation interact with weather variation and land use to produce diverse plant communities across the Central Basin and on the Red Sandy Loam Site. Accounts of earlier explorers and settlers suggest the Central Basin was likely a mosaic of grassland, savannah, and woodlands (Foster 1917). In the historic climax plant community, midgrasses dominated the shortgrasses due to their ability to capture the sunlight and shade as well as being favored by the frequent fires. Plant communities vary from open grassland to savannah/parkland to shrubland/woodland to nearly closed canopy forest. The Historic Climax Community for most of the Central Basin and the Red Sandy Loam Ecological Site is defined as the historical (ca. 1800) fire-influenced grassland savannah that was widespread at the time of settlement but which did occur in a mosaic of shrublands, woodlands, and forests across much of the Central Basin (Smeins 1980, Weniger 1984). Almost all sites have a two or three-layered structure of over-story trees, mid-story shrubs and a ground layer of grasses and forbs.

Historical photographs suggest the nature of the vegetation structure depending on topography, soil properties, and time since the last major disturbances (such as drought or fire). However, the occurrence of extensive grasslands and grassland fauna (pronghorn, for example) is mentioned in numerous historical accounts.

Grasses that historically dominate Central Basin sites include little bluestem (Schizachyrium scoparium), sideoats grama (Bouteloua curtipendula), meadow dropseed (Sporobolus compositus), plains lovegrass (Eragrostis intermedia), plains bristlegrass (Setaria vulpiseta), Arizona cottontop (Digitaria californica), and sand dropseed (Sporobolus cryptandrus). Locally abundant tallgrasses include Indiangrass (Sorghastrum nutans) and switchgrass (Panicum virgatum). Shortgrasses that occur in the understory of mid- and tallgrasses or on shallow soils or disturbed areas include buffalograss (Bouteloua dactyloides), common curly-mesquite (Hilaria belangeri), hairy grama (Bouteloua hirsuta), and red grama (B. trifida) (Whitehouse 1933, Riskind and Diamond 1988). The composition and productivity of grassland communities would have varied with annual rainfall, soil depth, and the extent of argillic horizon development.

Historically, overstory species composition consisted of post oak (Quercus stellata), blackjack oak (Q. marilandica), live oak (Q. virginiana), honey mesquite (Prosopis glandulosa var. glandulosa), Texas hickory (Carya texana), elm species (Ulmus spp.) and others. The shrub layer was potentially diverse with saplings of the tree layer along with whitebrush (Aloysia gratissima), lotebush (Ziziphus obtusifolia), algerita (Mahonia trifoliata), Texas persimmon (Diospyros texana), prickly pear cactus (Opuntia spp.) and others.

With the exception of Ashe juniper, all native woody species found in the Central Basin readily resprout following fire. This trait has frustrated managers and played an important role in driving sites towards the Shrubland State. High numbers of fire sprouting shrubs make shrubland communities very resilient.

An important aspect of this site is the relationship of mature hardwood trees to each of the communities. Mature hardwoods are very resilient and remain constant whether surrounded by reference community grasslands, degraded grasslands, native-dominated shrublands, or invasive-dominated shrublands. Their presence or absence is not driven by grazing management and generally only slightly by prescribed fire. They remain relatively stable over a short management period (5-10 years) unless removed by mechanical or chemical means. Throughout this ecological site, mature oaks can occur in any of the communities if they were not historically removed. They are most likely to occur in mottes and remain relatively constant regardless of what is occurring in the rest of the community, particularly in the understory. Communities will have an absence of hardwoods if the hardwoods were harvested, burned, chained, or sprayed at some point. Once the hardwoods are removed, it is not easy to return to the Savannah State due to the difficulty, expense, and time involved.

Hardwoods were frequently removed from this site during the European settlement period due to their high value for construction and firewood. Additionally, many examples exist where hardwoods were removed as part of a broad scale brush removal program. This was done with chaining, herbicides, rootplowing, and other general means.

Oak mottes on this site formed under different conditions than currently found. This may be due to climate shift or increased competition from aggressive shrub species. However, while reestablishment is slow, there are many examples of second growth hardwood woodlands on this site. Hardwoods eventually reestablish when there is a lack of fire or tree clearing.

Infection of live oak by oak wilt (Ceratocystis fagacearum) has lead to the death of many individuals and mottes. An increase in tree density and the grafting of roots amongst individuals has facilitated spread of the pathogen, which is transmitted primarily through root connections (Appel 1995).

Ashe juniper (Juniperus ashei), which is very abundant on the surrounding limestone derived soils of the Edwards Plateau, is relatively uncommon in the Central Basin, but it is found scattered across the Central Basin as infrequent individuals or mottes. Observation indicates that it has been increasing in population and extent within the Central Basin during the past two decades (Walter and Wyatt 1982). Juniper has the ability to take over large tracts of land as near monocultures, known as “cedar breaks.”

Even reference sites show the influence of introduced species. King Ranch bluestem (Bothriochloa ischaemum) has become almost ubiquitous, occurring on sites where it has not been seeded. It tends to replace little bluestem and can function similarly in the community as far as structure, size and soil-holding capacity. However, unlike little bluestem, King Ranch bluestem acts like an

invader and moves to unoccupied areas.

The large ungulate fauna of the region prior to settlement consisted of bison (Bos bison), pronghorn antelope (Antilocarpa americana) and white-tailed deer (Odocoileus virginianus). Bison and pronghorn occasionally occurred in large numbers and may have intensively grazed the rangelands for short periods. However, they were largely migratory and free-roaming, so that when the forage became limited they moved on, often not to return for long periods. Their long-term impacts on the plant communities were considered to be relatively minor and may have had positive influences on production and diversity (Knapp et al. 1999, Fuhlendorf and Engle 2001).

While archeological evidence indicates that bison occurred in the region, there is also evidence of centuries of absence (Dillehay 1974). In addition, their numbers may have varied seasonally as herds migrated. When present, bison may have grazed certain areas heavily and then moved on. The infrequent but intense, short-duration grazing by these species suppressed woody species and invigorated herbaceous species (Eidson and Smeins 1999). After a burn, they would intensely graze the burn until no forages remained. Then, they moved off, probably not returning until the next fire cycle, which could have been five to ten years. This suggests heavy short-term grazing followed by long rest periods. Activities of other native herbivores (termites, cutter ants, soil nematodes, kangaroo rats) also influenced vegetation productivity and dynamics.

Currently, white-tailed deer are the primary native large herbivores. At settlement, large numbers of deer occurred, but as human populations increased (with unregulated harvest) their numbers declined substantially. Eventually laws and restrictions on deer harvest were put in place which assisted in recovery of the species. Females were not harvested for several decades following implementation of hunting laws, which helped create population booms. In addition, suppression of fire favored woody plants which provided additional browse and cover for the deer. Due to their impacts on livestock production, large predators (red wolves (Canis rufus), mountain lions (Felis concolor), black bears (Ursus americanus) and eventually coyotes (Canis latrins)) were reduced in numbers or eliminated (Schmidly 2002).

The screwworm (Cochilomyia hominivorax) was essentially eradicated by the mid-1960s, and while this was immensely helpful to the livestock industry, this removed a significant control on deer populations (Teer, Thomas & Walker 1965, Bushland 1985).

Recent increased management of the deer herd, because of their economic importance through lease hunting, has decreased deer populations with the objectives of improving individual deer quality and improving habitat. High fences, controlled harvest based on numbers, sex ratios, condition and monitoring of habitat quality have been effective in managing the deer herd on individual

properties. However, across the Central Basin excess numbers still exist which may lead to habitat degradation and significant die-offs during stress periods such as extended droughts.

The Central Basin is home to a variety of non-indigenous (exotic) ungulates, mostly introduced for hunting (Schmidly 2002). These animals are important sources of income to some landowners, but as with the white-tailed deer, their populations must be managed to prevent degradation of the habitat for themselves as well as for the diversity of native wildlife in the area. Many other species of medium and small sized mammals, birds, and insects can have significant influences on the plant communities in terms of pollination, herbivory, seed dispersal, and creation of local disturbance patches, all of which contribute to the plant species diversity.

Supplemental feeding of deer and exotics can also contribute to range degradation if it allows survival of excess numbers of animals.

Feral hogs have become well established within the Central Basin. Hogs use all of the ecological sites within MLRA 82. They cause considerable damage to soils and vegetation.

The faunal array of the Central Basin changed radically with the introduction of domestic species. Early on, wild mustangs released from early Spanish settlements roamed in large herds and had significant impacts on the vegetation. Later in the 19th century, cattle, sheep, goats, mules, and hogs were introduced. The pristine rangeland appeared to provide unlimited forage but as the ranges were fenced and overstocked they were degraded. Productivity of the rangeland began to decline, carrying capacity was reduced, and periodic die-offs of livestock occurred. Generally, the mid and taller grasses were replaced by short grasses and perennial grasses, and forbs were replaced by annuals. These changes not only reduced production but also in many instances caused permanent alteration of the ecological sites due to soil erosion, organic matter loss, compaction, moisture regime change, and other factors which altered many soil and hydrologic processes. This often precluded their recovery to pre-European conditions (Smith 1899, Smeins, Fuhlendorf and Taylor 1997). Not only did livestock overgraze the forage, they also contributed to seed dispersal of some woody plants, particularly honey mesquite, which exacerbated its increase on the rangelands.

Historical accounts prior to the 1800s also identify grazing by herds of wild horses, followed by heavy grazing by sheep and cattle as settlement progressed. Grazing on early ranches changed natural graze-rest cycles to continuous grazing and stocking rates exceeded the carrying capacity. By the early 1800s cattle, sheep, and goat numbers appear to have been quite high in the Central Basin, resulting in heavy, year-round grazing (Lehman 1969). Sheep numbers peaked at 10.8 million head in 1943, and stood at about 1.2 million in 2000. Goat numbers in Texas around 1900 were around 100,000. They peaked in 1965 at 4.6 million

and were 345,000 in 2000 (Texas Online). The Central Basin and Edwards Plateau region, because of its climate and diverse vegetation, was the mainstay of the Texas sheep and goat industry.

Today, beef cattle and horses are the primary grazers in the area. Goats used primarily for meat production are locally important and their numbers have increased. Sheep remain a minor but still important part of livestock grazing in the Central Basin. White-tailed deer, wild turkey, bobwhite quail, and doves are major commercial wildlife species, and hunting leases are a major source of income for many landowners. While the Central Basin ecological sites have changed in many ways since settlement, opportunities exist to produce products and provide income while conserving and sustaining the long-term stability and productivity of the area.

Homesteads and communities developed along with ranching, and many ecological sites within MLRA 82 were converted to cropland for wheat (Triticum spp.), oats (Avena spp.), forage, and peanuts (Arachis hypogaea), and other products needed for local consumption or for cash crops. This conversion effectively eliminated the native plant communities due to land clearing and the harvest of larger trees, used for building construction among other uses.

Over time, as many of the croplands became degraded, and along with the rangeland that had been overused, introduced forages were brought in to assist with soil and water conservation and to increase productivity. Coastal bermudagrass (Cynodon dactylon), Kleingrass (Panicum coloratum), Wilman lovegrass (Eragrostis superba) and King Ranch bluestem were widely planted on many acres of old cropland and in areas with deeper soils. The latter, while effective as a soil stabilizer, has become invasive in many areas where it is unwanted and is difficult to control.

In the 1940s, mechanical and herbicide treatments began to replace fire as a control of increasing density of woody plants on the rangeland. This activity was common practice for several decades until the 1980s, when these treatments became less cost effective. It was clear that brush management practices were treating symptoms rather than underlying problems in addition to their undesirable environmental and wildlife consequences. Sites cleared of brush regenerated rapidly and often formed thickets that were denser and of lower diversity than the original stands. This realization coupled with the fact that brush management treatments were typically expensive and short-lived, lead to the development of Integrated Brush Management Systems (Scifres et al. 1985). This approach takes a holistic, large-scale, long-term, socioeconomic, ecosystem-based approach to brush management and recognizes multiple-use options for rangeland resources including alternate classes of livestock, lease hunting, exotic game ranching, carbon credits and ecotourism.

Grazing and fire are two factors that critically influence the relative abundance of

grasses and woody plants through time. The resulting reduction in abundance of late seral grasses lead to a decline in soil organic matter, a reduction in fire frequency/intensity (due to lack of fine fuels), and a shift in dominance from midgrasses (little bluestem and sideoats grama) to shortgrasses (hooded windmillgrass (Chloris cucullata) and buffalograss) and forbs (Mexican sagewort (Artemisia ludoviciana ssp. mexicana) and croton (Croton spp.)). These changes would have favored woody plants, most of which are unpalatable to livestock, and enabled them to establish and maintain dominance.

Mesquite, whitebrush, juniper, lotebush, algerita, persimmon, prickly pear, and lime pricklyash (Zanthoxylum fagar) now dominate much of the Central Basin. These woody plants are not 'new arrivals' but rather, are native to the region and have increased in size and abundance within their historic ranges. Factors promoting their increase in abundance since European settlement are the subject of active debate. Such factors may involve an interactive combination of changes in climate, intensification of grazing, follow up brush management and reductions in fire frequency/intensity accompanied by increases in atmospheric CO2 concentrations and nitrogen deposition since the industrial revolution (Archer 1994).

Rangeland Health Reference Worksheets have been posted for this site on the Texas NRCS website (www.tx.nrcs.usda.gov) in Section II of the eFOTG under (F) Ecological Site Descriptions (ESD's).

State and Transition Model:
A State and Transition Model for the Red Sandy Loam Ecological Site (R082AY369TX) is depicted in Figure 1. Thorough descriptions of each state, transition, plant community, and pathway follow the model. Experts base this model on available experimental research, field observations, professional consensus, and interpretations. It is likely to change as knowledge increases.

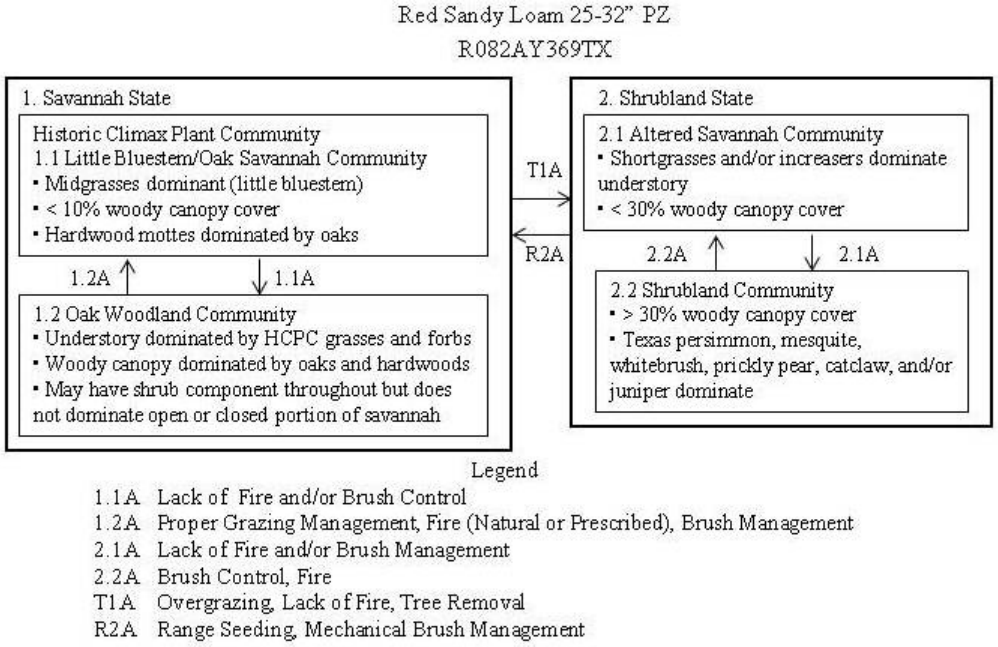
Plant communities will differ across the MLRA due to the naturally occurring variability in weather, soils, and aspect. The Historic Climax Plant Community (HCPC) is the reference state for this site. It is not necessarily the management goal but can be. Other vegetative states may be desired plant communities as long as the Range Health assessments are in the moderate and above category. The biological processes on this site are complex. Therefore, representative values are presented in a land management context. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

Both percent species composition by weight and percent canopy cover are used in this ESD. Most observers find it easier to visualize or estimate percent canopy for woody species (trees and shrubs). Canopy cover drives the transitions between

communities and states because of the influence of shade and interception of rainfall. Species composition by dry weight is used for describing the herbaceous community and the community as a whole. Woody species are included in species composition for the site. Calculating similarity index requires use of species composition by dry weight.

The following diagram suggests some pathways that the vegetation on this site might take. There may be other states not shown on the diagram. This information is intended to show what might happen in a given set of circumstances; it does not mean that this would happen the same way in every instance. Local professional guidance should always be sought before pursuing a treatment scenario.

**State and Transition Diagram**




Legend

1.1A Lack of Fire and/or Brush Control
1.2A Proper Grazing Management, Fire (Natural or Prescribed), Brush Management
2.1A Lack of Fire and/or Brush Management
2.2A Brush Control, Fire
T1A Overgrazing, Lack of Fire, Tree Removal
R2A Range Seeding, Mechanical Brush Management

**Savannah State - State 1**

There are two communities in the Savannah State: the Little Bluestem/Oak Savannah Community (1.1) and the Oak Woodland Community (1.2). The Little Bluestem/Oak Savannah Community occurred on this ecological site in a dynamically shifting mosaic over time with the Oak Woodland Community.

The majority of production occurs in late spring and early summer when temperatures and moisture are typically most suitable for growth. As conditions become warmer and drier, grasses become dormant and substantial litter accumulation occurs, making the site prone to fire. Recurrent fire (less than 10 years intervals) favors the dominant grasses and suppresses woody plants. In years without fire, leaf litter decomposes and adds organic matter to the soil, thus enhancing its fertility and water holding capacity. Prescribed grazing accelerates

the process. The dominant grasses are productive below ground and are deeply rooted. Extensive root systems bind the soil to minimize erosion while enabling the dominant grasses to access stored soil moisture.

Prior to settlement, Red Sandy Loam sites had a grassland savannah appearance with open areas dominated by mid grasses (little bluestem and sideoats grama) interspersed with scattered mottes of mature hardwoods (live oak and post oak) covering up to 10 percent of an area. Relatively frequent fires (7-12 year mean fire return interval) (Frost 1998) maintained the open areas by reducing shrub cover that was not yet to a fire resistant height. Mature hardwoods found in the mottes were long-lived and resistant to ground fires.

Fires were natural or man-caused. When fires were frequent on the savannah, most fires burned only the understory, leaving mottes of trees. Even with proper grazing and favorable climate conditions, lack of fire for 7-12 years will allow trees and shrubs to increase in canopy to reach the 20 percent level that indicates the shift to the Oak Woodland Community. This transition is not dependent on degradation of the herbaceous community, but on the lack of some form of brush control.

Shrub species increased within the grassland portion of the savannah and within the understory of the mottes following fire. Fine fuels were continuous and of sufficient quantity to allow fire to reduce brush and tree cover but not of sufficient quantity to create crown fires that would minimize single stemmed mature tree cover. The relationship of communities within the Savannah State was: 1) the savannah would be relatively open for a short period following a fire, 2) shrubs would begin to reestablish reducing the savannah appearance, 3) fire would return in 12 years or less, 4) fire would minimize young shrubs and trees without harming mature trees, 5) this would return the savannah appearance and shift species composition back to dominance by little bluestem and other grasses.

Occasionally a site would not burn for a period long enough for trees to grow to a fire resistant stage within the grassland portion of the savannah. As these trees matured, the fine fuel understory would decrease, reducing the ability of fires to grow large enough (and hot enough) to reduce single stemmed mature trees. This long-term lack of fire (25 - 50 years) would allow large trees to fill in open areas shifting the site to a woodland appearance. Once the site had dense tree cover, the site would be resistant to fires and a very resilient woodland community would develop.

In the absence of fire, woody canopy increased and the two communities in the Savannah State shifted between one another depending on the frequency and intensity of fire, grazing, and drought. The primary influence on the understory is grazing management and the primary influence on the overstory is fire. This allows the understory and overstory to react independently, i.e., trees can increase to the point where they dominate a site even if the understory component remains

vigorous and intact. Grazing management alone cannot maintain the site in the Little Bluestem/Oak Savannah Community (1.1).

It was rare that a dense woodland community would shift to a grassland or savannah community. In order to do so, something would have to cause widespread die-off of mature trees. This could occur due to disease or to a very hot fire that spread to the tree crowns and reducing canopy cover, events that typically only occur every 300 to 1,000 years. Following a severe fire, the site would have a grassland appearance for a few years as shrubs and trees resprouted or grew from seed.

Shrubs and trees comprise a portion of both plant communities in the Savannah State (1.0), hence woody propagules are present. The Savannah State always has potential for shrub dominance without fire. Mann (2004) discussed the importance of human induced fire as an important factor in maintaining open grasslands before European settlement.

The relationship between the two communities in the Savannah State can remain similar post-settlement. However, natural fires become less frequent and less widespread as human population density increases. “Cool,” slow-burning wildfires have become basically non-existent, because they are relatively easy to put out using modern firefighting equipment and techniques. Without fire, the reference savannah community becomes less resilient. Unless managers practice some method of brush control, shrub species will increase in the grassland portion of the savannah and in the understory of the oak mottes.

Brush control can play the role that natural fires played pre-settlement. However, it is difficult to manage in an ecological and economic matter on a small scale, as this site is rapidly repopulated by shrubs and trees without fire or brush management. Brush control may be prescribed fire, mechanical, chemical or biological control, or targeted grazing (generally by goats, although some instances exist in the Central Basin where exotic wildlife species or overpopulated white-tailed deer reduce woody cover). There are examples of this site being maintained as a savannah with introduced hay meadows and mottes of trees.

## Little Bluestem/Oak Savannah Community - Community Phase 1.1

1.1 Little bluestem/Oak Savannah (1)

1.1 Little bluestem/Oak Savannah Community (2)

The HCPC community is dominated by a diverse mix of warm season mid- and shortgrasses. Little bluestem makes up the majority of the grass component. Hardwood trees (live oak, post oak, blackjack oak, pecan and elm) contribute approximately 10 percent of species composition. These trees grow in mottes of mature trees. Forbs and cool-season grasses also make up a portion of the community, occurring primarily under the tree canopy within mottes.

The Little Bluestem/Oak Savannah Community (1.1) remains the presumed reference community. It is possible to have a reference community understory with a savannah appearance but the woody portion of the savannah is populated by low-growing shrubs and second growth non-native hardwoods.

Little bluestem, sideoats grama, meadow dropseed, vine mesquite, and sand dropseed dominate the herbaceous component of the site. Forbs commonly found on the site include Mexican sagewort, bundleflower, Engelmann’s daisy, western ragweed, orange zexmenia, and sensitive briar. Tree and shrub species found in the Little Bluestem/Oak Savannah Community include species of oaks, whitebrush, pricklypear, and honey mesquite. Tallgrasses (switchgrass and yellow

Indiangrass) are conspicuous in rocky outcrops but do not make up a significant portion of species composition. Sand lovegrass varies substantially in its composition on the red sandy loam site. Well managed examples of this site had up to 40 percent composition of sand lovegrass.

Shrubs continually increase in the open areas of the savannah and in the understory of the mottes. This pressure to move towards a woodland or shrubland community is further increased when aggressive, invasive shrubs become a part of the community.

Although large, land-clearing crown fires are relatively rare, similar impacts to the mature hardwoods occur when trees are cleared from the site by logging, chaining, or spraying. If a manager combines tree removal with proper grazing management and ongoing, maintenance level brush control, a woodland community could shift to a grassland community, mimicking the natural shift that occurred with large land clearing fires.

Maintaining the grassland-dominated savannah requires diligent brush control. There are examples where intensive targeted grazing with goats has maintained a grassland or savannah community on this site. The grassland and open savannah communities have proven to be difficult to manage on this site. This is due to the difficulty in combining effective brush management with grazing management that provides for grazing events of proper intensity and sufficient periods of deferment. Due to the difficulty of managing native species in the savannah community, many times this site was seeded with introduced grass species that are easier to manage.

**Community Phase Pathway 1.1A**
The driver for community shift 1.1A is lack of fire and/or brush control to maintain the woody component as mottes of mature oak and other hardwoods. Native woody species canopy will continue to increase without fire or brush control. Once it exceeds 20 percent, this indicates a shift to the Oak Woodland Community (1.2).

Because the woody species that dominate in the Oak Woodland Community (1.2) are native species that occur as part of the reference community, the shift to the Oak Woodland Community is a linear process with shrubs increasing soon after fire or brush control ceases. This is a continual process.

The Little Bluestem/Oak Savannah Community requires fire and/or brush control to maintain the savannah appearance with woody species cover below 10 percent. Regardless of the composition and vigor of the herbaceous component, this community will shift to the Oak Woodland Community without effective brush control. This shift can occur even with proper grazing management and if the herbaceous component remains vigorous. Brown and Archer (1999) concluded that even with a healthy and dense stand of grasses, woody species would

populate the site and eventually dominate the community.

## Little Bluestem/Oak Savannah Community Plant Species Composition:

| Grass/Grasslike | | | | | Annual Production in Pounds Per Acre | | Foliar Cover Percent | |
|---|---|---|---|---|---|---|---|---|
| Group | Group Name | Common Name | Symbol | Scientific Name | Low | High | Low | High |
| **1 -Warm-season midgrasses** | | | | | **1440** | **2150** | | |
| | | Grass, perennial | 2GP | | 0 | 50 | | |
| | | SIDEOATS GRAMA | BOCU | *Bouteloua curtipendula* | 300 | 900 | | |
| | | SILVER BEARDGRASS | BOLAT | *Bothriochloa laguroides ssp. torreyana* | 200 | 600 | | |
| | | ARIZONA COTTONTOP | DICA8 | *Digitaria californica* | 200 | 400 | | |
| | | PLAINS LOVEGRASS | ERIN | *Eragrostis intermedia* | 300 | 500 | | |
| | | VINE MESQUITE | PAOB | *Panicum obtusum* | 300 | 500 | | |
| | | LITTLE BLUESTEM | SCSC | *Schizachyrium scoparium* | 750 | 1500 | | |
| | | plains bristlegrass | SEVU2 | *Setaria vulpiseta* | 200 | 500 | | |
| | | composite dropseed | SPCO16 | *Sporobolus compositus* | 300 | 750 | | |
| | | SAND DROPSEED | SPCR | *Sporobolus cryptandrus* | 100 | 200 | | |
| **2 -Warm-season shortgrasses** | | | | | **240** | **350** | | |
| | | threeawn | ARIST | *Aristida* | 160 | 200 | | |
| | | BUFFALOGRASS | BODA2 | *Bouteloua dactyloides* | 160 | 200 | | |
| | | HAIRY GRAMA | BOHI2 | *Bouteloua hirsuta* | 160 | 200 | | |
| | | RED GRAMA | BOTR2 | *Bouteloua trifida* | 160 | 200 | | |
| | | HOODED WINDMILLGRASS | CHCU2 | *Chloris cucullata* | 175 | 300 | | |
| | | FALL WITCHGRASS | DICO6 | *Digitaria cognata* | 160 | 200 | | |
| | | CURLYMESQUITE | HIBE | *Hilaria belangeri* | 160 | 200 | | |
| | | HALLS PANICUM | PAHA | *Panicum hallii* | 160 | 200 | | |
| **3 -Cool-season grasses** | | | | | **70** | **100** | | |
| | | SCRIBNER'S PANICUM | DIOLS | *Dichanthelium oligosanthes var. scribnerianum* | 50 | 100 | | |
| | | CANADA WILDRYE | ELCA4 | *Elymus canadensis* | 50 | 100 | | |
| | | TEXAS WINTERGRASS | NALE3 | *Nassella leucotricha* | 50 | 100 | | |
| **4 -Grass-likes** | | | | | **50** | **70** | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | SEDGES | CAREX | *Carex* | 0 | 70 | | |
| **5 -Warm-season tallgrasses** | | | | **0** | **30** | | |
| | SAND BLUESTEM | ANHA | *Andropogon hallii* | 0 | 30 | | |
| | SWITCHGRASS | PAVI2 | *Panicum virgatum* | 0 | 30 | | |
| | INDIANGRASS | SONU2 | *Sorghastrum nutans* | 0 | 30 | | |

## Forb

| Group | Group Name | Common Name | Symbol | Scientific Name | Annual Production in Pounds Per Acre Low | Annual Production in Pounds Per Acre High | Foliar Cover Percent Low | Foliar Cover Percent High |
|---|---|---|---|---|---|---|---|---|
| **6 -Forbs** | | | | | **335** | **505** | | |
| | | Forb, perennial | 2FP | | 200 | 350 | | |
| | | WESTERN RAGWEED | AMPS | *Ambrosia psilostachya* | 200 | 350 | | |
| | | MEXICAN SAGEWORT | ARLUM2 | *Artemisia ludoviciana ssp. mexicana* | 200 | 350 | | |
| | | croton | CROTO | *Croton* | 200 | 350 | | |
| | | bundleflower | DESMA | *Desmanthus* | 200 | 350 | | |
| | | sensitive plant | MIMOS | *Mimosa* | 200 | 350 | | |
| | | KNOTWEED LEAFLOWER | PHPO3 | *Phyllanthus polygonoides* | 200 | 350 | | |
| | | AWNLESS BUSHSUNFLOWER | SICA7 | *Simsia calva* | 200 | 350 | | |
| | | ORANGE ZEXMANIA | WETE | *Wedelia texana* | 200 | 350 | | |

## Shrub/Vine

| Group | Group Name | Common Name | Symbol | Scientific Name | Annual Production in Pounds Per Acre Low | Annual Production in Pounds Per Acre High | Foliar Cover Percent Low | Foliar Cover Percent High |
|---|---|---|---|---|---|---|---|---|
| **7 -Shrubs** | | | | | **25** | **35** | | |
| | | WHITEBRUSH | ALGR2 | *Aloysia gratissima* | 25 | 35 | | |
| | | TEXAS PERSIMMON | DITE3 | *Diospyros texana* | 25 | 35 | | |
| | | TEXAS KIDNEYWOOD | EYTE | *Eysenhardtia texana* | 25 | 35 | | |
| | | AGARITO | MATR3 | *Mahonia trifoliolata* | 25 | 35 | | |
| | | pricklypear | OPUNT | *Opuntia* | 25 | 35 | | |
| | | mesquite | PROSO | *Prosopis* | 25 | 35 | | |
| | | WESTERN SOAPBERRY | SASAD | *Sapindus saponaria var. drummondii* | 25 | 35 | | |
| | | WOOLYBUCKET BUMELIA | SILAL3 | *Sideroxylon lanuginosum ssp.* | 25 | 35 | | |

| | | | | *lanuginosum* | | | | |
|---|---|---|---|---|---|---|---|---|
| **Tree** | | | | | **Annual Production in Pounds Per Acre** | | **Foliar Cover Percent** | |
| **Group** | **Group Name** | **Common Name** | **Symbol** | **Scientific Name** | **Low** | **High** | **Low** | **High** |
| **8 -Trees** | | | | | **240** | **360** | | |
| | | hickory | CARYA | *Carya* | 240 | 360 | | |
| | | BLACKJACK OAK | QUMA3 | *Quercus marilandica* | 100 | 250 | | |
| | | POST OAK | QUST | *Quercus stellata* | 240 | 360 | | |
| | | LIVE OAK | QUVI | *Quercus virginiana* | 240 | 360 | | |
| | | elm | ULMUS | *Ulmus* | 240 | 360 | | |

## Annual Production by Plant Type:

| | Annual Production (lbs/AC) | | |
|---|---|---|---|
| Plant Type | Low | Representative Value | High |
| Grass/Grasslike | 1800 | 2250 | 2700 |
| Forb | 335 | 420 | 505 |
| Shrub/Vine | 25 | 30 | 35 |
| Tree | 240 | 300 | 360 |
| Total: | 2400 | 3000 | 3600 |

## Structure and Cover:

Soil Surface Cover

| Cover Type | Minimum | Maximum | | Wood Type | Minimum | Maximum | Predominant Decomposition Class* |
|---|---|---|---|---|---|---|---|
| Basal Cover - Grass/ Grasslike | 10% | 15% | | Downed wood, fine-small (<0.40\" diameter; 1-hour fuels) | | | |
| Basal Cover - Forb | 1% | 2% | | Downed wood, fine-medium (0.40-0.99\" diameter; 10-hour fuels) | | | |
| Basal Cover - Shrub/ Vine | 1% | 2% | | Downed wood, fine-large (1.00-2.99\" diameter; 100-hour fuels) | | | |
| Basal Cover - Tree | 2% | 3% | | Downed wood, coarse-small (3.00-8.99\" diameter; 1000-hour fuels) | | | |
| Non-Vascular Plants | | | | Downed wood, coarse-large (>9.00\" diameter; 10000-hour fuels) | | | |
| Biological Crust | | | | Tree Snags** | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | (Hard***) | | | |
| Litter | 20% | 30% | | Tree Snags** (Soft***) | | | |
| Surface Fragments > 0.25" and <= 3" | 1% | 5% | | **Tree Snags** per Acre** | | | |
| Surface Fragments > 3" | 1% | 10% | | Hard Snags*** | | | |
| Bedrock | | | | Soft Snags*** | | | |
| Water | | | | | | | |
| Bare Ground | 0% | 5% | | | | | |

* Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.

** >4\" diameter at 4.5' above ground and >6' height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 1.0'above ground.

*** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.

Structure of Canopy Cover

| **Height Above Ground** | **Grasses/Grasslike** | | **Forbs** | | **Shrubs/Vines** | | **Trees** | |
|---|---|---|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | Minimum | Maximum | Minimum | Maximum |
| <=0.5 feet | 1% | 3% | 0% | 1% | % | % | | |
| > 0.5 - < 1 feet | 10% | 15% | 1% | 3% | 1% | 3% | | |
| > 1 - <= 2 feet | 40% | 55% | 3% | 5% | 5% | 8% | | |
| > 2 - < 4.5 feet | 8% | 15% | | | 3% | 5% | | |
| > 4.5 - <= 13 feet | | | | | | | | |
| > 13 - < 40 feet | | | | | | | 8% | 15% |
| < 40 - >= 80 feet | | | | | | | | |
| > 80 - < 120 feet | | | | | | | | |
| >= 120 feet | | | | | | | | |

**Plant Growth Curve:**

| | |
|---|---|
| Growth Curve Number: | TX4410 |
| Growth Curve Name: | Mid/Tallgrass Oak Savannah with <5% Woody Canopy |
| Growth Curve Description: | Mid and tallgrasses with oak savannah having less than 5% woody canopy cover. |

Percent Production by Month

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 3 | 5 | 13 | 23 | 15 | 4 | 5 | 15 | 7 | 5 | 3 |

**Oak Woodland Community - Community Phase 1.2**

1.2 Oak Woodland Community (1)

1.2 Oak Woodland Community (2)

The Oak Woodland Community is presumed to have historically covered a minority of this ecological site. Over time the oak/ mottes would expand while mature trees and shrubs increased in canopy cover responding to the fire/grazing/rest dynamics. The understory vegetation in the openings between trees would remain similar in composition to that of the Little Bluestem/Oak Savannah Community (1.1). However, as tree density increased, cool-season grasses and forbs would increase in species composition. Cool-season species increase as the distance to drainages decreases due to increased tree cover and shade near drainages.

Dominant species in the Oak Woodland Community are similar to those found in the Little Bluestem/Oak Savannah Community, but species composition shifts to dominance by trees and shrubs. There is also an increase in cool-season grasses and forbs. Texas wintergrass (Nassella leucotricha) and Canada wildrye (Elymus canadensis) increase in production. There also tends to be an increase in the amount of shrubs growing in the understory of the hardwoods and in the open areas of the savannah.

**Community Phase Pathway 1.2A**
Fire/brush control and proper grazing management drive community shift 1.2A.The shift from Oak Woodland Community (1.2) to Little Bluestem/Oak Savannah Community (1.1) is thought to have been infrequent historically, as large, crowning fires would be required to remove mature trees found in the Oak Woodland Community. Smaller repeated fires over long periods of time would result in some bark damage to older oaks and subsequent introduction of disease to the tree, resulting in hollow or dead trees.

The Oak Woodland Community can return to the Little Bluestem/Oak Savannah Community with fire and/or brush management combined with proper grazing management that provides sufficient critical growing season deferment in combination with proper grazing intensity. Favorable moisture conditions will facilitate or accelerate this transition.

## Annual Production by Plant Type:

| | Annual Production (lbs/AC) | | |
|---|---|---|---|
| Plant Type | Low | Representative Value | High |
| Grass/Grasslike | 600 | 750 | 900 |
| Forb | 360 | 450 | 540 |
| Shrub/Vine | 480 | 600 | 720 |
| Tree | 960 | 1200 | 1440 |
| Total: | 2400 | 3000 | 3600 |

## Plant Growth Curve:

Growth Curve Number: TX4411
Growth Curve Name: Midgrass Savannah with Woody Encroachment
Growth Curve Description: Midgrass Savannah with Woody Encroachment.

Percent Production by Month

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 3 | 5 | 13 | 22 | 15 | 5 | 3 | 15 | 7 | 5 | 4 |

**Transition - T1A**
The driver for Transition T1A is lack of brush management coupled with overgrazing.

Overgrazing, lack of fire, and/or improper brush management will result in the site crossing a threshold to the Shrubland State characterized by shortgrasses, unpalatable grasses and forbs, annual grasses and forbs, and shrubby species. Bare ground, erosion, and water flow patterns will increase, and forage production will decline. Without regular fire, woody species will increase in size, density, and canopy cover, reducing production from herbaceous species. Woody species composition may vary greatly depending largely on management.

Overgrazing causes a loss of dominant midgrasses and forbs from the savannah. This transition is indicated by a decrease of little bluestem and sideoats grama to less than 10 percent of species composition of the herbaceous community. Once these species are lost from the community or present only in trace amounts (typically with low vigor), grazing management alone cannot create a shift back to the reference community. At this point, a threshold has been crossed indicating a change in state.

Degradation of the herbaceous community combined with the aggressive nature of shrubs creates a loss in the savannah appearance of the site. The grassland portion is reduced and the trees exist in competition with aggressive shrubs. This competition limits the ability of trees to reproduce and increase. The aggressive nature of shrubs keeps the Savannah State (1.0) at high risk of transition to the Shrubland State (2.0). The possible exception would be the effective use of goats to target and suppress the shrubs. The trigger for this transition comes when shrubs reach reproductive capacity. Overgrazing, prolonged drought, no fire or brush management and a warming climate will provide a competitive advantage to shrubs.

Some of the increasing shrubs are introduced because their fruits and seeds are relished by wildlife that then spread seeds through droppings. If the management goal is to maintain the savannah state, managers need take action when canopy

cover is less than 10%.

**Shrubland State - State 2**

The Shrubland State is characterized by a shortgrass-dominated understory with scattered trees and shrubs. There are two communities in the Shrubland State (2.0): the Altered Savannah Community (2.1) and the Shrubland Community (2.2). The two communities in the Shrubland State interact in much the same manner as the two communities in the Savannah State but have degraded understory and (frequently) an overstory of shrubs rather than hardwoods. The Altered Savannah Community must be maintained with fire or brush control as it is under constant pressure by woody species to shift to the Shrubland Community.

The hardwoods that made up a portion of the plant community in the Savannah State (1.0) may or may not be present in the Shrubland State (2.0). The transition to the Shrubland State will not cause a decrease in the number of hardwoods. However, the Shrubland State often occurs on lands that have been cleared of brush and trees at some point in the past. Historically, trees were removed for lumber or firewood, and in some cases to clear the land for pasture or farming. Rootplowing had the same effect as tillage, converting the site to a grassland immediately following plowing but leaving the site subject to rapid invasion by fast-growing shrub species. This transition may respond like agricultural conversion and may have been accompanied by shifts in soil chemistry and structure. Rootplowing is likely to shift the community to the Shrubland Community (2.2). Once invasive woody species begin to establish, returning fully to the native community is difficult, but it is possible to return to a similar plant community.

The understory of the Shrubland State tends to be dominated by shortgrasses and lower-palatability forbs. The communities in the Shrubland State have a degraded herbaceous community when compared to the Savannah State. This is generally a result of long-term improper grazing management.

One factor that creates overgrazing on this site is the failure to reduce stocking rate as woody cover increases (loss of grazeable acres). Increased woody cover results in fewer grazeable acres and less forage being available. Unless stocking rates are reduced, the stocking pressure on the remaining forage increases, which increases the likelihood of palatable plants being overgrazed, losing vigor, and being grazed out of the community. At the same time, less palatable plants gain a comparative advantage and increase their representation in species composition.

**Altered Savannah Community - Community Phase 2.1**

2.1 Altered Savannah Community (1)

2.1 Altered Savannah Community (2)

2.1 Altered Savannah Comunity Photo 3

The Altered Savannah Community is characterized by woody canopy cover less than 30 percent. The Altered Savannah Community supports a lower diversity of uses than the Little Bluestem/Oak Savannah Community (1.1) it replaces. Native forbs occur at a low frequency, so that grazing management alone will not allow these species to reestablish as the dominant herbaceous species. Generally, the shrubs preclude establishment of remnant HCPC plants. Grazeable acreage is only 30 to 50 percent of the total area.

The Altered Savannah Community requires some form of brush control (fire, mechanical, chemical, or grazing) for maintenance. Without brush control it will shift to the Shrubland Community in a relatively short time (5-15 years). The open areas of the Altered Savannah Community will have shrubs sprout every year. As these plants mature, they will fill in the open areas. Once canopy cover of woody species reaches 30%, the site has shifted to the Shrubland Community.

Drought interacts with grazing to trigger midgrass to shortgrass transitions. Heavy continuous grazing will reduce plant cover, litter, and mulch. Bare ground will increase and expose the soil to erosion. Litter and mulch will move off-site as plant cover declines. Without brush control, woody canopy may increase until canopy cover approaches 50 percent.

Examples of the Altered Savannah Community within the Central Basin that have remained in this community have frequently been maintained with a combination of fire and goat grazing.

**Community Phase Pathway 2.1A**
Without brush control (including fire), the Altered Savannah Community (2.1) will shift to the Shrubland Community (2.2). Shrubs will continue to increase until they reach 30 percent canopy cover. Once shrubs have more than 30 percent canopy cover, management back to the Altered Savannah Community becomes more difficult due to the amount of energy required to remove dense brush.

**Annual Production by Plant Type:**

| | Annual Production (lbs/AC) | | |
|---|---|---|---|
| Plant Type | Low | Representative Value | High |
| Grass/Grasslike | 270 | 340 | 410 |
| Forb | 135 | 170 | 205 |
| Shrub/Vine | 545 | 680 | 815 |
| Tree | 410 | 510 | 610 |
| Total: | 1360 | 1700 | 2040 |

**Plant Growth Curve:**

Growth Curve Number: TX4412
Growth Curve Name: Shortgrass/Mixed-brush Community
Growth Curve Description: Shortgrass dominant with mixed-brush species.

Percent Production by Month

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 3 | 5 | 13 | 22 | 15 | 5 | 3 | 15 | 7 | 5 | 4 |

**Shrubland Community - Community Phase 2.2**

2.2 Shrubland Community (1)

2.2 Shrubland Community (2)

2.2 Shrubland Community Photo 3

The Shrubland Community (2.2) has over 30 percent woody plant canopy, dominated by hardwoods and shrubs. The community has lost its savannah appearance with shrubs beginning to fill the open grassland portion of the savannah. Shade from overstory is the driving factor. This community results from the lack of effective brush control. Production of the overstory canopy has increased by a similar amount to the decrease in herbaceous production. Unpalatable woody species have increased in size and density.

The Shrubland Community typically has multiple shrub species: Texas persimmon, mesquite, whitebrush, catclaw, prickly pear, and/or juniper.

Texas wintergrass, threeawns and annuals increase in the shade of the trees. Unpalatable invaders may occupy the interspaces between trees and shrubs. Plant vigor and productivity of grass species is reduced due to shade. Shade is a driving factor for the understory plant community. Without brush control, tree canopy will

continue to increase until canopy cover approaches 80 percent.

The Shrubland Community is a very resilient community and currently the most common community within on Red Sandy Loam sites. Unless managers practice effective, ongoing brush control this community will remain or reestablish. In the absence of fire and brush management, a highly stable and resilient Shrubland Community (2.2) develops as woody patches increase in abundance and coalesce with each other. Shrubs mix with oaks to create a canopy cover of greater than 25 per cent. Ground cover and herbaceous production beneath shrub canopies is minimal, but soil organic carbon and nitrogen levels are enhanced.

A sparsely vegetated community is not stable on this site. Shrubs and invasive grasses and forbs reestablish relatively quickly following disturbance. Because of the availability of invasives with low palatability, this site rarely stays barren. There are examples that are degraded but not yet dominated by brush but these examples tend to be quickly reinvaded by brush.

In this plant community, annual production is dominated by woody species. Browsing animals, such as goats and deer can find fair food value if browse plants have not been grazed excessively. Forage quantity and quality for cattle is low.

Intensive treatment is required to affect restoration back to the Savannah State (1.0). Prescribed burning may not be possible until woody cover is reduced by herbicides or mechanical treatments to the point that grasses (fine fuels) can establish. Brush treatment tends to be short-lived. Observation shows that even effective treatment will require constant maintenance to suppress brush reestablishment. Without maintenance, canopy cover may exceed 30 percent in 3 to 5 years.

**Community Phase Pathway 2.2A**
Extensive and selective brush management can reduce the woody component of the Shrubland Community (2.2) below the community shift level of 30 percent woody canopy cover. It may be difficult to shift back to the Altered Savannah Community (2.1) with fire alone due to the lack of fuel provided by the understory and height of the canopy cover. Fire can reduce seedlings of brush species if the seedling is younger than 2 years or the budding zone has not transitioned below the soil surface (Kramp et al 1999). Fire and/or brush management will be required to maintain woody canopy cover below the 25 percent level. The limitations with fire are amplified if the understory transitions to cool-season grasses.

If the herbaceous component has transitioned to shortgrasses and low forbs, proper grazing management (combined with favorable moisture conditions and adequate seed source) will be necessary to facilitate the shift of the understory component in the Shrubland Community (2.2) to the Altered Savannah Community (2.1).

## Annual Production by Plant Type:

| | Annual Production (lbs/AC) | | |
|---|---|---|---|
| Plant Type | Low | Representative Value | High |
| Grass/Grasslike | 500 | 625 | 750 |
| Forb | 200 | 250 | 300 |
| Shrub/Vine | 800 | 1000 | 1200 |
| Tree | 500 | 625 | 750 |
| Total: | 2000 | 2500 | 3000 |

## Structure and Cover:

Soil Surface Cover

| Cover Type | Minimum | Maximum | | Wood Type | Minimum | Maximum | Predominant Decomposition Class* |
|---|---|---|---|---|---|---|---|
| Basal Cover - Grass/ Grasslike | 5% | 10% | | Downed wood, fine-small (<0.40\" diameter; 1-hour fuels) | | | |
| Basal Cover - Forb | 3% | 5% | | Downed wood, fine-medium (0.40-0.99\" diameter; 10-hour fuels) | | | |
| Basal Cover - Shrub/ Vine | 2% | 3% | | Downed wood, fine-large (1.00-2.99\" diameter; 100-hour fuels) | | | |
| Basal Cover - Tree | 5% | 8% | | Downed wood, coarse-small (3.00-8.99\" diameter; 1000-hour fuels) | | | |
| Non-Vascular Plants | | | | Downed wood, coarse-large (>9.00\" diameter; 10000-hour fuels) | | | |
| Biological Crust | | | | Tree Snags** (Hard***) | | | |
| Litter | 40% | 50% | | Tree Snags** (Soft***) | | | |
| Surface Fragments > 0.25" and <= 3" | 1% | 5% | | **Tree Snags** per Acre** | | | |
| Surface Fragments > 3" | 1% | 10% | | Hard Snags*** | | | |
| Bedrock | | | | Soft Snags*** | | | |
| Water | | | | | | | |
| Bare Ground | 20% | 40% | | | | | |

* Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.

** >4\" diameter at 4.5' above ground and >6' height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 1.0'above ground.

*** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.

Structure of Canopy Cover

| Height Above Ground | Grasses/Grasslike | | Forbs | | Shrubs/Vines | | Trees | |
|---|---|---|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | Minimum | Maximum | Minimum | Maximum |
| <=0.5 feet | 1% | 3% | 1% | 3% | 3% | 5% | 0% | 1% |
| > 0.5 - < 1 feet | 3% | 5% | 2% | 4% | 5% | 8% | 1% | 2% |
| > 1 - <= 2 feet | 10% | 15% | 3% | 5% | 5% | 8% | 3% | 5% |
| > 2 - < 4.5 feet | 0% | 5% | | | | | 2% | 4% |
| > 4.5 - <= 13 feet | | | | | 3% | 5% | 20% | 40% |
| > 13 - < 40 feet | | | | | | | 15% | 25% |
| < 40 - >= 80 feet | | | | | | | | |
| > 80 - < 120 feet | | | | | | | | |
| >= 120 feet | | | | | | | | |

**Plant Growth Curve:**

Growth Curve Number: TX4413

Growth Curve Name: Shortgrass/Annuals Woodland Community

Growth Curve Description: Woodland community with shortgrasses and annuals.

Percent Production by Month

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 3 | 7 | 13 | 20 | 15 | 7 | 5 | 10 | 7 | 5 | 5 |

**Restoration Pathway - R2A**

R2A. Restoration Pathway to Savannah State

The driver for Restoration Pathway R2A is fire and/or brush control combined with natural restoration of the herbaceous community or active management of the herbaceous restoration process (range seeding). Restoration may require aggressive treatment of invader species.

Restoration of the Shrubland State to the Savannah State (R2A) requires substantial energy input. An integrated approach of biological, mechanical and chemical brush control in combination with prescribed fire, proper grazing, and favorable growing conditions is expensive, but is generally the most economical means of creating and maintaining the historic plant community. A long-term prescribed fire program may sufficiently reduce brush density to a level below the threshold of the Savannah State (1.0). However, the fire program will have to be aggressive because many of the woody species on this site are resprouters following fire and fuel loading is marginal. Establishment of native grasses is difficult and dependent upon natural seeding from remnant patches and seed banks. If remnant populations of midgrasses and desirable forbs are not present at sufficient levels, range planting will be necessary to restore a desirable herbaceous plant community.

Proper grazing management and stocking rates maintain the herbaceous layer in this state. With proper grazing management, midgrasses can regain dominance on the site and undesirable trends in soil organic matter, fertility, temperature, and erosion can be arrested and reversed. Regrowth of established woody plants will slow and it will become more difficult for new plants to establish. The extent to which the original Midgrass/Oak Savannah Community (1.1) can be re-established will depend on the extent to which soil physical and chemical properties were altered during retrogression (Heitschmidt and Stuth 1991).

## Ecological Site Interpretations

Animal Community:

The Red Sandy Loam site provides at least a portion of the habitat for many species of reptiles, birds, mammals, and insects. Game birds, songbirds, and birds of prey were indigenous or frequent users, and most are still plentiful. Quail and doves frequent this site depending upon the vegetative community. Small mammals that use the site include armadillos, opossum, raccoons, rodents, jackrabbits, cottontail rabbits, and skunks. Its use by deer is limited by browse and cover in climax condition. As ecological condition declines and woody plants increase and invade, it becomes more habitable for deer. Deer prefer many of the forbs and legumes that grow on the site.

Feral hogs (Sus scrofa) can be found on most Ecological Sites in Texas. Damage is caused by feral hogs each year including, crop damage by rutting up crops, destroyed fences, livestock watering areas, and predation on native wildlife, domestic livestock (small calves, goats, and sheep) and ground nesting birds. Feral hogs have no natural predators other than humans, thus allowing their population to grow to high numbers (Cearley 2009 & Mapston 2004). Feral hogs have naturalized to rangelands across the state.

Predators including bobcats, coyotes, foxes, and mountain lions can be found on the site.

The site is suitable for production of livestock, including cattle, sheep and goats. The site in HCPC was very suited to primary grass eaters such as cattle. As retrogression occurs and woody plants invade, the Oak Woodland (1.2) and Altered Savannah (2.1) plant communities becomes good habitat for sheep, goats, deer and other wildlife because of the desirable browse and cool-season grasses. Cattle, sheep and goats should be stocked in proportion to the available grass, forb and browse forage, keeping deer competition for forbs and browse in mind. Deer populations must also be kept within limits of the habitat sustainability even if the site is managed exclusively for deer. If the animal numbers are not kept in balance with herbage and browse production through prescribed grazing management and good wildlife population management, the Shrubland Community (2.2) will have little to offer as habitat except cover.

Plant Preference by Animal Kind:

This rating system provides general guidance as to animal forage preference for plant species. It also indicates possible competition between kinds of herbivores for various plants. Grazing preference changes from time to time, especially between seasons, and between animal kinds and classes. Grazing preference does not necessarily reflect the ecological status of the plant within the plant community. For wildlife, plant preferences for food, and plant suitability for cover are rated. Refer to habitat guides for a more complete description of a species habitat needs.

Legend: P=Preferred D=Desirable U=Undesirable N=Not Consumed T=Toxic X=Used, but not degree of utilization unknown
Preferred – Percentage of plant in animal diet is greater than it occurs on the land
Desirable – Percentage of plant in animal diet is similar to the percentage composition on the land
Undesirable – Percentage of plant in animal diet is less than it occurs on the land
Not Consumed – Plant would not be eaten under normal conditions. It is only consumed when other forages not available. This can also include plants that are unavailable during parts of the year.
Toxic – Rare occurrence in diet and, if consumed in any tangible amounts results in death or severe illness in animal (Hart, 2003). (Note: many plants can be good

forage but toxic at certain doses or at certain times of the year. Animals in poor condition are most susceptible.)

## Plant Preference by Animal Kind:

### Animal Kind: Cow/calf Cattle

| Common Name | Scientific Name | Plant Part | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WESTERN RAGWEED | *Ambrosia psilostachya* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| threeawn | *Aristida* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| LOUISIANA SAGEWORT | *Artemisia ludoviciana* | Leaves | U | U | D | D | D | D | D | D | D | D | U | U |
| aster | *Aster* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| CANE BLUESTEM | *Bothriochloa barbinodis* | Leaves | U | U | D | D | D | D | D | D | D | D | U | U |
| SIDEOATS GRAMA | *Bouteloua curtipendula* | Leaves | D | D | D | D | D | D | D | D | D | D | D | D |
| BUFFALOGRASS | *Bouteloua dactyloides* | Leaves | D | D | D | D | D | D | D | D | D | D | D | D |
| SILVER BLUESTEM | *Bothriochloa saccharoides* | Leaves | U | U | U | D | D | D | D | D | D | U | U | U |
| HALFSHRUB SUNDROP | *Calylophus serrulatus* | Leaves | U | U | D | D | D | D | U | U | U | U | U | U |
| EASTERN REDBUD | *Cercis canadensis* | Leaves | N | N | N | D | D | U | U | U | U | U | N | N |
| HACKBERRY SPP. | *Celtis* | Leaves | U | U | U | D | D | D | D | D | D | U | U | U |
| prairie clover | *Dalea* | Leaves | U | U | D | D | D | D | D | D | D | D | U | U |
| bundleflower | *Desmanthus* | Leaves | U | U | D | D | D | D | D | D | D | D | U | U |
| TICKCLOVER | *Desmodium* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| FALL WITCHGRASS | *Digitaria cognata* | Leaves | U | U | D | D | D | D | D | D | D | D | U | U |
| SCRIBNER'S PANICUM | *Dichanthelium oligosanthes var. scribnerianum* | Leaves | D | D | D | U | U | N | N | N | N | N | D | D |
| CANADA WILDRYE | *Elymus canadensis* | Leaves | P | P | P | D | D | U | U | U | U | U | P | P |
| Engelmann's daisy | *Engelmannia* | Leaves | P | P | P | D | D | D | U | U | U | D | D | P |
| jointfir | *Ephedra* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| PLAINS LOVEGRASS | *Eragrostis intermedia* | Leaves | U | U | D | D | D | D | D | D | D | D | U | U |
| TEXAS CUPGRASS | *Eriochloa sericea* | Leaves | D | D | P | P | P | D | D | D | D | D | D | D |
| ELBOWBUSH | *Forestiera pubescens* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| MAXIMILIAN SUNFLOWER | *Helianthus maximiliani* | Leaves | N | N | P | P | D | D | D | D | D | D | U | N |
| CURLYMESQUITE | *Hilaria belangeri* | Leaves | U | U | D | D | D | D | D | D | D | D | U | U |
| DOTTED GAYFEATHER | *Liatris punctata* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| AGARITO | *Mahonia trifoliolata* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| Nuttall's sensitive-briar | *Mimosa nuttallii* | Leaves | U | D | D | D | D | U | U | U | U | U | U | U |
| VINE MESQUITE | *Panicum obtusum* | Leaves | D | D | D | D | D | D | D | D | P | P | D | D |
| SWITCHGRASS | *Panicum virgatum* | Leaves | D | D | P | P | P | P | P | P | P | P | P | D |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KNOTWEED LEAFLOWER | *Phyllanthus polygonoides* | Leaves | U | U | U | U | U | U | U | U | U | U | U |
| SCURFPEA SP | *Psoralidium* | Leaves | U | U | U | U | U | U | U | U | U | U | U |
| Buckley oak | *Quercus buckleyi* | Leaves | U | U | U | U | U | U | U | U | U | U | U |
| BLACKJACK OAK | *Quercus marilandica* | Leaves | U | U | U | U | U | U | U | U | U | U | U |
| WHITE SHIN OAK | *Quercus sinuata var. breviloba* | Leaves | U | U | U | U | U | U | U | U | U | U | U |
| POST OAK | *Quercus stellata* | Leaves | U | U | U | U | U | U | U | U | U | U | U |
| LIVE OAK | *Quercus virginiana* | Leaves | U | U | U | U | U | U | U | U | U | U | U |
| prairie sumac | *Rhus lanceolata* | Leaves | U | U | U | U | U | U | U | U | U | U | U |
| SKUNKBUSH SUMAC | *Rhus trilobata* | Leaves | U | U | D | D | D | U | U | U | U | U | U |
| EVERGREEN SUMAC | *Rhus virens* | Leaves | U | U | U | U | U | U | U | U | U | U | U |
| snoutbean | *Rhynchosia* | Leaves | U | D | D | D | D | D | D | D | D | D | U |
| wild petunia | *Ruellia* | Leaves | N | N | N | N | N | N | N | N | N | N | N |
| LITTLE BLUESTEM | *Schizachyrium scoparium* | Leaves | D | D | P | P | P | P | P | D | D | D | D |
| AWNLESS BUSHSUNFLOWER | *Simsia calva* | Leaves | U | U | D | P | P | D | D | D | D | D | U |
| bully | *Sideroxylon* | Leaves | D | D | D | D | D | D | D | D | D | D | D |
| GREENBRIAR | *Smilax* | Leaves | U | U | U | D | D | U | U | U | U | U | U |
| INDIANGRASS | *Sorghastrum nutans* | Leaves | D | D | P | P | P | P | P | P | P | P | D |
| composite dropseed | *Sporobolus compositus* | Leaves | U | U | U | D | D | D | D | D | D | U | U |
| TALL DROPSEED | *Sporobolus compositus var. compositus* | Leaves | U | U | D | D | D | D | D | D | D | D | U |
| WILDBEAN | *Strophostyles* | Leaves | U | U | D | D | D | D | D | U | U | U | U |
| WHITE TRIDENS | *Tridens albescens* | Leaves | D | D | D | D | D | D | D | D | D | D | D |
| EASTERN GAMAGRASS | *Tripsacum dactyloides* | Leaves | D | D | P | P | P | P | P | P | P | P | D |
| PURPLETOP | *Tridens flavus* | Leaves | U | U | D | D | D | D | D | D | D | U | U |
| vetch | *Vicia* | Leaves | D | D | D | U | U | U | U | U | U | U | D |

## Animal Kind: White-tailed Deer

| Common Name | Scientific Name | Plant Part | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WESTERN RAGWEED | *Ambrosia psilostachya* | Leaves | N | N | N | D | D | U | U | U | U | U | N | N |
| BIG BLUESTEM | *Andropogon gerardii* | Entire plant | N | N | N | N | N | N | N | N | N | N | N | N |
| threeawn | *Aristida* | Entire plant | N | N | N | N | N | N | N | N | N | N | N | N |
| LOUISIANA SAGEWORT | *Artemisia ludoviciana* | Leaves | U | U | D | D | D | U | U | U | U | U | U | U |
| aster | *Aster* | Leaves | P | P | P | P | P | D | D | D | D | D | D | D |
| CANE BLUESTEM | *Bothriochloa barbinodis* | Entire plant | N | N | N | N | N | N | N | N | N | N | N | N |
| SIDEOATS GRAMA | *Bouteloua curtipendula* | Entire plant | N | N | N | U | U | U | U | U | U | U | N | N |
| BUFFALOGRASS | *Bouteloua dactyloides* | Entire plant | N | N | N | N | N | N | N | N | N | N | N | N |
| SILVER BLUESTEM | *Bothriochloa saccharoides* | Entire plant | N | N | N | N | N | N | N | N | N | N | N | N |
| HALFSHRUB SUNDROP | *Calylophus serrulatus* | Leaves | N | N | N | D | D | D | D | D | D | D | N | N |
| EASTERN | *Cercis canadensis* | Leaves | N | N | N | P | P | P | P | P | P | P | N | N |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REDBUD | | | | | | | | | | | | |
| HACKBERRY SPP. | *Celtis* | Leaves | N | N | N | P | P | P | P | P | P | N | N |
| prairie clover | *Dalea* | Leaves | N | N | N | D | D | D | D | D | D | N | N |
| bundleflower | *Desmanthus* | Leaves | N | N | N | P | P | P | P | P | P | N | N |
| TICKCLOVER | *Desmodium* | Leaves | N | N | N | P | P | P | P | P | P | N | N |
| FALL WITCHGRASS | *Digitaria cognata* | Entire plant | N | N | N | U | U | U | U | U | U | N | N |
| SCRIBNER'S PANICUM | *Dichanthelium oligosanthes var. scribnerianum* | Entire plant | U | U | U | U | N | N | N | N | N | U | U | U |
| BLACKSAMSON | *Echinacea angustifolia* | Leaves | N | N | N | P | P | P | P | P | P | N | N |
| CANADA WILDRYE | *Elymus canadensis* | Entire plant | U | U | U | U | N | N | N | N | N | U | U | U |
| Engelmann's daisy | *Engelmannia* | Leaves | P | P | P | P | D | D | N | N | N | P | P | P |
| jointfir | *Ephedra* | Leaves | P | P | P | P | P | P | P | P | P | P | P | P |
| PLAINS LOVEGRASS | *Eragrostis intermedia* | Entire plant | N | N | N | U | U | U | U | U | U | U | N | N |
| TEXAS CUPGRASS | *Eriochloa sericea* | Entire plant | N | N | N | U | U | U | U | U | U | U | N | N |

## Animal Kind: Goats Goats

| Common Name | Scientific Name | Plant Part | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Forb, annual | | Entire plant | P | P | P | P | P | P | P | P | P | P | P | P |
| WHITEBRUSH | *Aloysia gratissima* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| WESTERN RAGWEED | *Ambrosia psilostachya* | Leaves | U | U | D | D | D | D | D | D | D | D | D | U |
| BIG BLUESTEM | *Andropogon gerardii* | Leaves | U | U | D | D | D | D | D | D | D | D | D | U |
| threeawn | *Aristida* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| MEXICAN SAGEWORT | *Artemisia ludoviciana ssp. mexicana* | Leaves | U | U | D | D | D | D | D | D | D | D | D | U |
| PURPLE THREEAWN | *Aristida purpurea* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| SIDEOATS GRAMA | *Bouteloua curtipendula* | Leaves | U | U | D | D | D | D | D | D | D | D | D | U |
| BUFFALOGRASS | *Bouteloua dactyloides* | Leaves | U | U | D | D | D | D | D | D | D | D | D | U |
| HAIRY GRAMA | *Bouteloua hirsuta* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| SILVER BEARDGRASS | *Bothriochloa laguroides ssp. torreyana* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| SLENDER GRAMA | *Bouteloua repens* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| RED GRAMA | *Bouteloua trifida* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| PECAN | *Carya illinoinensis* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| SEDGES | *Carex* | Leaves | D | D | D | D | D | D | D | D | D | D | D | D |
| hickory | *Carya* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| HOODED WINDMILLGRASS | *Chloris cucullata* | Leaves | U | U | D | D | D | D | D | D | D | D | D | U |
| NASH WINDMILLGRASS | *Chloris ×subdolichostachya* | Leaves | U | U | D | D | D | D | D | U | U | U | U | U |
| snakewood | *Condalia* | Leaves | U | U | D | D | D | D | D | D | D | D | D | U |
| croton | *Croton* | Leaves | N | N | N | D | D | D | U | U | U | U | N | N |
| flatsedge | *Cyperus* | Leaves | D | D | D | D | D | D | D | D | D | D | D | D |
| prairie clover | *Dalea* | Leaves | N | N | P | P | P | P | P | P | P | P | N | N |
| bundleflower | *Desmanthus* | Leaves | N | N | P | P | P | P | P | P | P | P | N | N |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SCRIBNER'S PANICUM | *Dichanthelium oligosanthes var. scribnerianum* | Leaves | D | D | D | D | D | N | N | N | D | D | D | D |
| CANADA WILDRYE | *Elymus canadensis* | Leaves | D | D | D | D | N | N | N | N | D | D | D | D |
| TEXAS KIDNEYWOOD | *Eysenhardtia texana* | Leaves | P | P | P | P | P | P | P | P | P | P | P | P |
| CURLYMESQUITE | *Hilaria belangeri* | Leaves | U | U | D | D | D | D | D | D | D | D | D | U |
| GREEN SPRANGLETOP | *Leptochloa dubia* | Leaves | U | U | D | D | D | D | D | D | D | D | D | U |
| TEXAS WINTERGRASS | *Nassella leucotricha* | Leaves | D | D | D | U | U | N | N | N | N | D | D | D |
| pricklypear | *Opuntia* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| HALLS PANICUM | *Panicum hallii* | Leaves | U | U | D | D | N | N | N | N | N | N | N | U |
| VINE MESQUITE | *Panicum obtusum* | Leaves | U | U | D | D | D | D | D | D | D | D | D | U |
| FRINGELEAF PASPALUM | *Paspalum setaceum* | Leaves | U | U | D | D | D | U | U | U | U | U | U | U |
| mesquite | *Prosopis* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| BLACKJACK OAK | *Quercus marilandica* | Fruits/Seeds | N | N | D | D | D | D | U | U | P | P | P | N |
| BLACKJACK OAK | *Quercus marilandica* | Leaves | N | N | D | D | D | D | U | U | P | P | P | N |
| POST OAK | *Quercus stellata* | Fruits/Seeds | N | N | D | D | D | D | U | U | P | P | P | N |
| POST OAK | *Quercus stellata* | Leaves | N | N | D | D | D | D | U | U | P | P | P | N |
| LIVE OAK | *Quercus virginiana* | Fruits/Seeds | U | U | U | D | D | D | D | D | P | P | P | D |
| LIVE OAK | *Quercus virginiana* | Leaves | U | U | U | D | D | D | D | D | P | P | P | D |
| sumac | *Rhus* | Leaves | U | U | D | D | D | D | D | D | D | D | D | U |
| blackberry | *Rubus* | Leaves | U | U | D | D | D | D | D | D | D | D | D | U |
| WESTERN SOAPBERRY | *Sapindus saponaria var. drummondii* | Leaves | U | U | D | D | D | D | D | D | D | D | D | U |
| NEW MEXICO BLUESTEM | *Schizachyrium scoparium var. scoparium* | Leaves | U | U | D | D | D | D | D | D | D | D | D | U |
| plains bristlegrass | *Setaria vulpiseta* | Leaves | U | U | D | D | D | D | D | D | D | D | D | U |
| AWNLESS BUSHSUNFLOWER | *Simsia calva* | Leaves | N | N | P | P | P | P | P | P | P | P | N | N |
| WOOLYBUCKET BUMELIA | *Sideroxylon lanuginosum ssp. lanuginosum* | Leaves | P | P | P | P | P | P | P | P | P | P | P | P |
| composite dropseed | *Sporobolus compositus* | Leaves | U | U | D | D | D | D | D | D | D | D | D | U |
| SAND DROPSEED | *Sporobolus cryptandrus* | Leaves | U | U | D | D | D | D | U | U | U | U | U | U |
| PURPLETOP | *Tridens flavus* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| elm | *Ulmus* | Leaves | N | N | P | P | P | P | P | P | P | P | P | N |
| ORANGE ZEXMANIA | *Wedelia texana* | Leaves | D | D | D | D | D | D | D | D | D | D | D | D |

## Animal Kind: Rio Grande Turkey

| Common Name | Scientific Name | Plant Part | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WESTERN RAGWEED | *Ambrosia psilostachya* | Leaves | N | N | U | U | U | U | U | U | U | U | N | N |
| BIG BLUESTEM | *Andropogon gerardii* | Leaves | N | N | U | U | U | U | U | U | U | U | N | N |
| threeawn | *Aristida* | Leaves | N | N | U | U | U | U | U | U | U | U | N | N |
| LOUISIANA SAGEWORT | *Artemisia ludoviciana* | Leaves | U | U | U | U | U | U | U | U | U | U | U | U |
| aster | *Aster* | Leaves | D | D | D | D | U | U | U | U | U | U | U | U |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CANE BLUESTEM | *Bothriochloa barbinodis* | Leaves | N | N | U | U | U | U | U | U | U | N | N |
| SIDEOATS GRAMA | *Bouteloua curtipendula* | Fruits/Seeds | N | N | N | N | D | D | D | D | D | D | N |
| SIDEOATS GRAMA | *Bouteloua curtipendula* | Leaves | N | N | U | U | U | U | U | U | U | N | N |
| BUFFALOGRASS | *Bouteloua dactyloides* | Leaves | N | N | U | U | U | U | U | U | U | N | N |
| SILVER BLUESTEM | *Bothriochloa saccharoides* | Leaves | N | N | U | U | U | U | U | U | U | N | N |
| HALFSHRUB SUNDROP | *Calylophus serrulatus* | Leaves | N | N | U | U | U | U | U | U | U | N | N |
| EASTERN REDBUD | *Cercis canadensis* | Fruits/Seeds | N | N | N | D | D | D | D | D | U | U | U | U |
| HACKBERRY SPP. | *Celtis* | Fruits/Seeds | D | D | D | N | N | N | N | P | P | P | P | P |
| prairie clover | *Dalea* | Leaves | N | N | U | U | U | U | U | U | U | N | N |
| bundleflower | *Desmanthus* | Fruits/Seeds | N | N | N | N | P | P | P | P | P | P | N | N |
| bundleflower | *Desmanthus* | Leaves | N | N | U | U | U | U | U | U | U | N | N |
| TICKCLOVER | *Desmodium* | Fruits/Seeds | N | N | N | N | P | P | P | P | P | P | N | N |
| TICKCLOVER | *Desmodium* | Leaves | N | N | U | U | U | U | U | U | U | N | N |
| FALL WITCHGRASS | *Digitaria cognata* | Leaves | N | N | U | U | U | U | U | U | U | N | N |
| SCRIBNER'S PANICUM | *Dichanthelium oligosanthes var. scribnerianum* | Fruits/Seeds | N | N | N | D | D | D | N | N | N | N | N | N |
| composite dropseed | *Sporobolus compositus* | Leaves | N | N | U | U | U | U | U | U | U | N | N |
| TALL DROPSEED | *Sporobolus compositus var. compositus* | Leaves | N | N | U | U | U | U | U | U | U | N | N |
| WILDBEAN | *Strophostyles* | Fruits/Seeds | N | N | N | N | P | P | P | P | P | P | N | N |
| WILDBEAN | *Strophostyles* | Leaves | N | N | U | U | U | U | U | U | U | U | U |
| WHITE TRIDENS | *Tridens albescens* | Fruits/Seeds | N | N | N | N | D | D | D | D | D | D | N | N |
| WHITE TRIDENS | *Tridens albescens* | Leaves | N | N | U | U | U | U | U | U | U | N | N |
| EASTERN GAMAGRASS | *Tripsacum dactyloides* | Fruits/Seeds | N | N | N | N | N | D | D | D | D | D | D | D |
| EASTERN GAMAGRASS | *Tripsacum dactyloides* | Leaves | N | N | U | U | U | U | U | U | U | N | N |
| PURPLETOP | *Tridens flavus* | Leaves | N | N | U | U | U | U | U | U | U | N | N |
| vetch | *Vicia* | Fruits/Seeds | N | N | N | P | P | N | N | N | N | N | N | N |

Legend: P = Preferred D = Desirable U = Undesirable N = Not consumed E = Emergency T = Toxic X = Used, but degree of utilization unknown

## Hydrology Functions:

Red Sandy Loam sites tend to be well vegetated with high levels of canopy cover and low level of bare ground in all communities. Therefore, most examples are functioning hydrologically. Abusive management can create bare soils (particularly in the case of mismanaged brush control or abandoned farming). Bare soils are subject to erosion. Once the organic layer erodes in the A horizon, the soil functions less well hydrologically and the risk of further erosion increases.

Soils on this site are well-drained, making a large percentage of soil water available to plants. Water movement to underground layers is moderately high.

The Oak Woodland Community (1.2) tends to retain a highly functioning water cycle. As long as the understory remains intact, bare ground remains very low. Infiltration will be high and runoff low.

A shift to the Altered Savannah Community (2.1) may reduce canopy cover and increase bare ground. If bare ground stays low, the water cycle is expected to function similarly to the Little bluestem/Oak Savannah Community (1.1). If bare ground increases, infiltration will decrease and runoff will increase due to reduced ground cover, rainfall splash, soil capping, reduced organic matter, and poor structure. With a combination of a sparse ground cover and intensive rainfall, this site can contribute to an increased frequency and severity of flooding within a watershed.

Domination of the site by woody species may degrade the water cycle in the Shrubland Community (2.2). Interception of rainfall by tree canopies increases, which reduces the amount of rainfall reaching the surface and being available to understory plants. Increased stem flow, due to the funneling effect of the canopy, increases soil moisture at the base of trees, especially on mesquite. Evergreen species, such as live oak, create increased transpiration which provides less water for deep percolation. Increases in woody canopy create declines in grass cover, which creates similar causes impacts as those described for overgrazing above. Under the dense canopy of the shrubland, leaf litter builds up. This increases soil organic matter, builds structure, improves infiltration, and reduces surface erosion. These conditions improve the function of the water cycle compared to lower levels of canopy cover.

Recreational Uses:
Recreational uses include recreational hunting, hiking, camping, equestrian, and bird watching.

Wood Products:
Honey mesquite and some oak are used for firewood, charcoal, and other specialty wood products.

Other Products:
Jams and jellies are made from many fruit bearing species, such as algerita. Seeds are harvested from many HCPC plants for commercial sale. Many grasses and forbs are harvested by the dried-plant industry for sale in dried flower arrangements. Honeybees are utilized to harvest honey from many flowering plants, such as honey mesquite and whitebrush.

Other Information:

## Supporting Information

Associated Sites:

| Site Name | Site ID | Site Narrative |
|---|---|---|

Similar Sites:

| Site Name | Site ID | Site Narrative |
|---|---|---|
| Sandy Loam 25-32" PZ | R082AY373TX | The Sandy Loam site has fewer oaks and higher percentage of grasses than the Red Sandy Loam. The Sandy Loam soils are generally deeper than the Red Sandy Loam. |
| Red Savannah 25-32" PZ | R082AY568TX | Red Savannah exhibits similar vegetative communities and ecological dynamics; it tends to have occasional smaller oaks. The Red Savannah site contains lower pH soils than Red Sandy Loam sites. |

State Correlation:
This site has been correlated with the following states:
TX

Inventory Data References:
Information presented was derived from the site's previous Range Site Description, NRCS clipping data, literature, field observations, and personal contacts with range-trained personnel.

Reviewers:
Joe Franklin, ZRMS, NRCS, San Angelo, Texas
Justin Clary, RMS, NRCS, Temple, Texas
Mark Moseley, ESI Specialist, NRCS, Boerne, Texas
Kent Ferguson, StRMS, NRCS, Temple, Texas

Type Locality:

Relationship to Other Established Classifications:

Other References:
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Original Site Description Approval:

| Author | Date | Approval | Date |
|---|---|---|---|
| Unknown | 1/1/1972 | Unknown | 1/1/1972 |

Site Description Revision Approval:

| Author | Date | Approval | Date |
|---|---|---|---|
| Unknown | 7/3/1973 | Unknown | 7/3/1973 |

| | | | |
|---|---|---|---|
| Jack Alexander, Synergy Resource Solutions, Inc., Dr. Fred Smeins, Texas A&M University. | 4/8/2011 | Mark Moseley, ESI Specialist, NRCS, Texas | 4/8/2011 |
| Mark Moseley | 9/27/2011 | Homer Sanchez | 9/27/2011 |
| Mark Moseley | 9/27/2011 | Kent Ferguson | 10/3/2011 |

# Reference Sheet

**Author(s)/participant(s):** Synergy Resource Solutions, Belgrade, Montana

**Contact for lead author:** Zone Rangeland Management Specialist, NRCS, San Angelo, Texas

**Date:** 1/18/2011 **MLRA:** 082A **Ecological Site:** Red Sandy Loam 25-32" PZ R082AY369TX This *must* be verified based on soils and climate (see Ecological Site Description). Current plant community cannot be used to identify the ecological site.

**Composition (indicators 10 and 12) based on:** X Annual Production, Foliar Cover, Biomass

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**Indicators.** For each indicator, describe the potential for the site. Where possible, (1) use numbers, (2) include expected range of values for above- and below-average years for **each** community and natural distrurbance regimes within the reference state, when appropriate and (3) cite data. Continue descriptions on separate sheet.

1. **Number and extent of rills:**None.
2. **Presence of water flow patterns:**None, except following extremely high intensity storms when short flow patterns may appear.
3. **Number and height of erosional pedestals or terracettes:** None.
4. **Bare ground from Ecological Site Description or other studies (rock, litter, standing dead, lichen, moss, plant canopy are not bare ground):** 0 to 5 percent bare ground. Very small (<1 square foot) and non-connected.
5. **Number of gullies and erosion associated with gullies:** None.
6. **Extent of wind scoured, blowouts and/or depositional areas:** None.

7. **Amount of litter movement (describe size and distance expected to travel):** Very little litter movement under normal rainfall intensity. Litter is well distributed and stays in place beneath plant canopies.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil surface is very stable (average soil stability values of > 5).

9. **Soil surface structure and SOM content (include type and strength of structure, and A-horizon color and thickness):** 0-28 inches thick, fine sandy loam, sandy loam, reddish, weak fine and very fine subangular blocky structure. SOM 0-3%.

10. **Effect on plant community composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** High canopy, basal cover and density with small interspaces should make rainfall impact negligible. This site has well drained soils, deep with level to gently sloping (0 to 3 percent slopes) which produces negligible runoff and erosion.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None.

12. **Functional/Structural Groups (list in order of descending dominance by above-ground weight using symbols: >>, >, = to indicate much greater than, greater than, and equal to) with dominants and sub-dominants and "others" on separate lines:**
    Dominant: Warm-season midgrasses >>
    Sub-dominant: Warm-season shortgrasses >
    Other: Forbs > Cool-season grasses > Trees > Shrubs > Warm-season tallgrasses
    Additional: Forbs make up 15 percent of species composition, shrubs and trees compose up to 10 percent species composition.

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Grasses due to their growth habit will exhibit some mortality and decadence, though very slight. Little mortality evident on woody species.

14. **Average percent litter cover (20-30 %) and depth (0.5-2.0 inches):** Loose litter (tree leaf fall) may be up to 6 inches deep.

15. **Expected annual production (this is TOTAL above-ground production, not just forage production):** Representative value for production = 3000 lbs/ac.

16. **Potential invasive (including noxious) species (native and non-native). List Species which BOTH characterize degraded states and have the**

**potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicator, we are describing what in NOT expected in the reference state for the ecological site:** King Ranch bluestem, Wilmans lovegrass, mesquite, whitebrush, Ashe juniper, and cacti are the primary invaders.

17. **Perennial plant reproductive capability:** All species should be capable of reproducing except for periods of prolonged drought conditions, heavy natural herbivory, and fires.

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Reference Sheet Approval:

| Approval | Date |
|---|---|
| Mark Moseley, ESI Specialist, NRCS, Texas | 4/8/2011 |