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An Old-Growth Definition for Southwestern Subtropical Upland Forests

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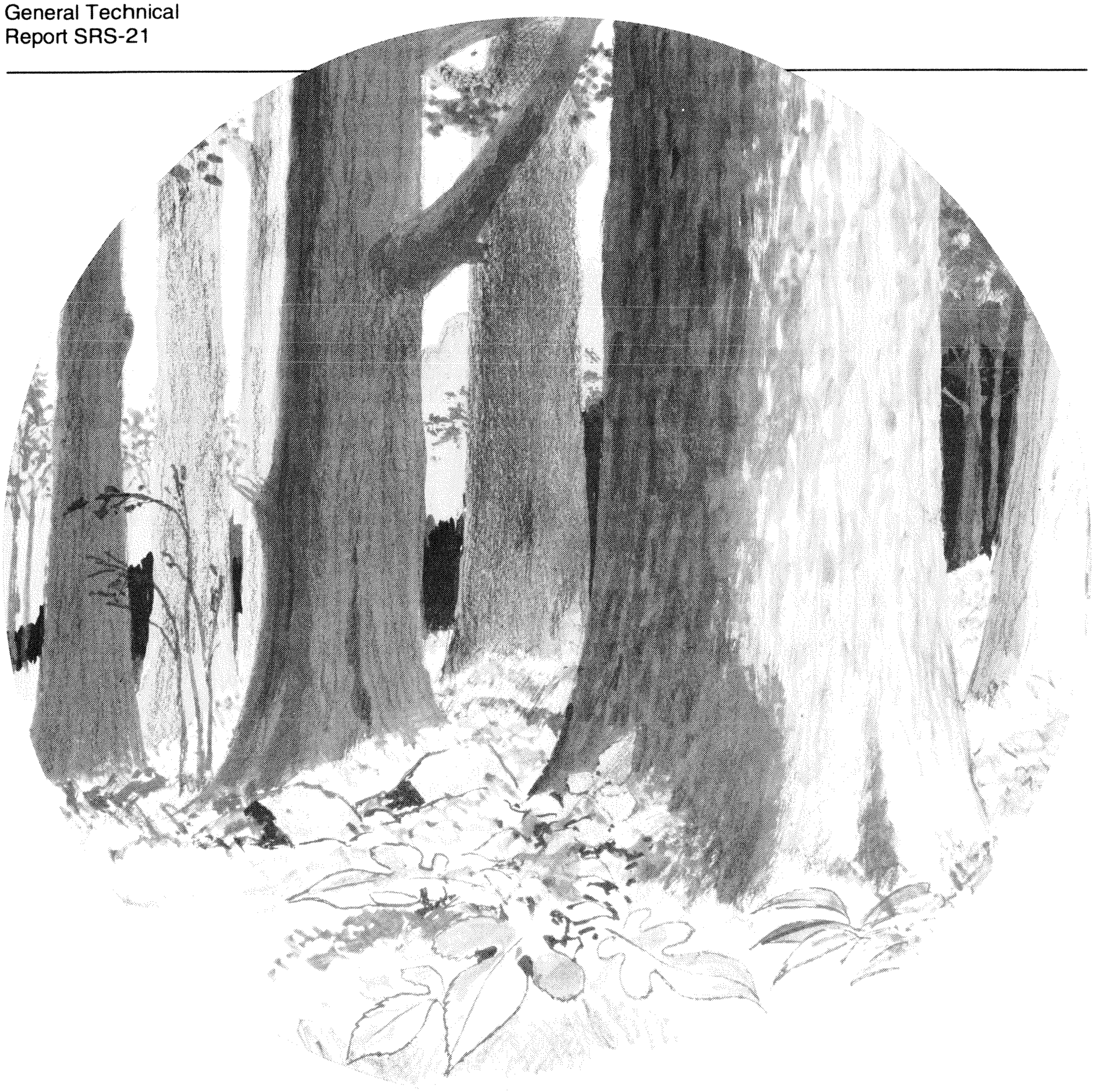

A Section of the Old-Growth Definition Series

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Preface

Old growth is widely acknowledged today as an essential part of managed forests, particularly on public lands. However, this concept is relatively new, evolving since the 1970's when a grassroots movement in the Pacific Northwest began in earnest to define old growth. In response to changes in public attitude, the U.S. Department of Agriculture, Forest Service, began reevaluating its policy regarding old-growth forests in the 1980's. Indeed, the ecological significance of old growth and its contribution to biodiversity were apparent. It was also evident that definitions were needed to adequately assess and manage the old-growth resource. However, definitions of old growth varied widely among scientists. To address this discrepancy and other old-growth issues, the National Old-Growth Task Group was formed in 1988. At the recommendation of this committee, old growth was officially recognized as a distinct resource by the Forest Service, greatly enhancing its status in forest management planning. The committee devised "The Generic Definition and Description of Old-Growth Forests" to serve as a basis for further work and to ensure uniformity among Forest Service Stations and Regions. Emphasis was placed on the quantification of old-growth attributes.

At the urging of the Chief of the Forest Service, all Forest Service Stations and Regions began developing old-growth definitions for specific forest types. Because the Southern and Eastern Regions share many forest communities (together they encompass the entire Eastern United States), their efforts were combined, and a cooperative agreement was established with The Nature Conservancy for technical support. The resulting project represents the first large-scale effort to define old growth for all forests in the Eastern United States. This project helped bring the old-growth issue to public attention in the East.

Definitions will first be developed for broad forest types and based mainly on published information and so must be viewed accordingly. Refinements will be made by the Forest Service as new information becomes available. This document represents 1 of 35 forest types for which old-growth definitions will be drafted.

In preparing individual old-growth definitions, authors followed National Old-Growth Task Group guidelines, which differ from the standard General Technical Report format in two ways—the abstract (missing in this report) and the literature citations (listed in Southern Journal of Applied Forestry style). Allowing for these deviations will ensure consistency across organizational and geographic boundaries.

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Introduction

Old-growth Southwestern subtropical upland forests, broad-leaved and mostly evergreen, are restricted to the Lower Rio Grande Valley of south Texas, primarily Cameron County, southern and western Hidalgo County, and extreme southern Willacy and Starr Counties. This forest type, although restricted to a small geographic area, was apparently once the prevailing upland vegetation of the lower valley. It occupied moist uplands and resaca (ox-bow) terraces over heavy-textured soils (mostly silty clay loam and silty clay Mollisols and Alfisols), which are now almost entirely in row-crop production. This evergreen low forest formed landscape mosaics with related floodplain hardwood forests dominated by deciduous species such as sugarberry (*Celtis laevigata* Willd.), [nomenclature follows Correll and Johnston (1970)], cedar elm (*Ulmus crassifolia* Nutt.) , and Berlandier ash (*Fraxinus berlandieri* A. DC.) (Clover 1937; Inglis 1964; Gonzalez-Medrano 1972; Bush and Van Auken 1984; Jahrsdoerfer and Leslie 1988; Wood and Wood 1988, 1989; Vora 1990[1]). A more restricted Texas palmetto (*Sabal mexicana* Mart.)-dominated forest once occupied the Rio Grande floodplain downstream from Brownsville but probably never extended far upstream (Clover 1937, Davis 1942, Williams and Allday-Bondy 1979).

The prevailing climate of the lower valley is warm with a frost-free period averaging more than 330 days. Although the area has suffered at least two severe freezes since December 1983, native species are typically not severely damaged or killed (Lonard and Judd 1985, 1991). Average precipitation ranges from 20 inches [50 centimeters (cm)] in the west to 30 inches (75 cm) in the east with no pronounced summer drought. However, high temperatures during the summer months cause water stress on upland sites during most years (Clover 1937). The Lower Rio Grande Valley is underlain mostly by Pleistocene and some Quaternary deposits (Wynd 1944). To the north, these deposits are overlain by eolian sands that support tall grasslands with live oak mottes (Johnston 1955, 1963; Diamond and Fulbright 1990), whereas, to the west and northwest, these deposits grade gradually into older, generally sandier deposits, higher and drier landscapes, and drier, cooler climates that support shrubland or deciduous thorn woodland vegetation (Huss 1959, McMahan and Inglis 1974, Drawe et al. 1978, O'Brien 1980, Archer et al. 1988, McLendon 1991[2]). Both to the north and to the west, rangeland is the dominant land use, whereas, the lower valley is dominated by cropland and urban development.

Texas ebony [*Pithecellobium flexicaule* (Benth.) Coult.] is always among the leading dominants of this forest type. Since few old-growth stands exist, and few or none have been quantitatively sampled, the status of secondary species is difficult to assess. Anacua [*Ehretia anacua* (Terán & Berland.) I.M. Johnst.] is probably most often the second most important overstory tree in high-quality stands. Old-growth shrub components include brasil (*Condalia hookeri* M.C. Johnst.), colima [*Zanthoxylum fagara* (L.) Sarg.], snake-eyes (*Phaulothamnus spinescens* Gray), and coma (*Bumelia celastrina* H.B.K.). These species may reach 16 feet [5 meters (m)] in height, which may represent the upper canopy on dry sites. Granjeno (*Celtis pallida* Torr.), sugarberry, cedar elm, and mesquite (*Prosopis glandulosa*) may be important but are also important in younger forests or mottes (woody vegetation clusters within an herb-dominated area).

Periodic flooding and fluctuations in the Rio Grande delta's water regime, along with catastrophic drought, were probably the dominant influences on this forest type (Clover 1937, Inglis 1964, Drawe et al. 1978). Fire may not have played an important role in shaping this mesic community.[3] The importance of smaller disturbances has not been

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[1] Neck, R.W.; Riskind, D.H. Undated. Biotic communities of southern Texas and northeastern Mexico—potential biotic communities and anthropogenic alterations. 42 p. Unpublished report. On file with: David D. Diamond, Director, Missouri Resource Assessment Partnership, Environmental Technology Center, 4200 New Haven Road, Columbia, MO 65201.

[2] Everitt, J.H.; Gonzalez, C.L.; Gerbermann, A.H. Undated. Botanical composition of eleven south Texas rangeland sites. 27 p. Unpublished report. On file with: David D. Diamond, Director, Missouri Resource Assessment Partnership, Environmental Technology Center, 4200 New Haven Road, Columbia, MO 65201.

[3] Hanselka, C.W.; White, L.D. Undated. Fire: history, effects, and use in the Tamaulipan Biotic Province. 17 p. Unpublished report. On file with: David D. Diamond, Director, Missouri Resource Assessment Partnership, Environmental Technology Center, 4200 New Haven Road, Columbia, MO 65201.

Table 1 (English units)—Standardized table of old-growth attributes for southwestern subtropical upland forests from Vora (1990) for six stands (0.247-acre plots) on Santa Ana National Wildlife Refuge (these are the only quantitative data on this forest type)

Quantitative attribute	Value		Notes
	Range	Mean	
Stand density (no./acre) —trees >2 in. d.b.h.	65–110	Not reported	Values by stand not reported; qualitative observations indicate some stands with much higher stem density
Stand basal area (ft^2/acre)	Not measured	--	Overstory canopy cover varied from 30 to 100 percent
Age of large trees (years)	Not measured	Not measured	
Number of 4-in. size classes —starting at 4 in. d.b.h.	Not reported	Not reported	Largest trees were 21 inches d.b.h., indicating some stands had as many as five
D.b.h. of largest trees (in.)			
—all species	21	Not reported	Values reported are maximum size across all six stands
Mesquite (*Prosopis glandulosa* Torr.)	14		
Texas ebony [*Pithecellobium flexicaule* (Benth.) Coult.]	21		
Standing snags	Not reported	Not reported	
Decadent trees	Not measured	Not measured	
Number of canopy layers	2	2	Shrub canopy measured from 40 to 85 percent; "shrubs" often reach to the upper canopy[a]
Percent canopy in gaps	Not measured	Not measured	Qualitative observation shows few gaps in mature stands[b]
Other features			
Canopy height (ft)	16–43	--	Cedar elm (*Ulmus crassifolia* Nutt.) was reported among the canopy dominants; important "shrubs" included Texas ebony, coma (*Bumelia celastrina* H.B.K.), guayacan [*Guaiacum angustifolium* (Engelm.) Gray], anacua [*Ehretia anacua* (Terán & Berland.) I.M. Johnst.], brasil (*Condalia hookeri* M.C. Johnst.), and colima [*Zanthoxylum fagara* (L.) Sarg.]

[a] See under text headings "Narrative of Old-Growth Conditions" and "Forest Dynamics and Ecosystem Function."
[b] See under text heading "Forest Dynamics and Ecosystem Function."

Table 1 (metric units)—Standardized table of old-growth attributes for southwestern subtropical upland forests from Vora (1990) for six stands (0.10-hectare plots) on Santa Ana National Wildlife Refuge (these are the only quantitative data on this forest type)

Quantitative attribute	Value: Range	Value: Mean	Notes
Stand density (no./ha) —trees >5 cm d.b.h.	160–380	Not reported	Values by stand not reported; qualitative observations indicate some stands with much higher stem density
Stand basal area (m^2/ha)	Not measured	--	Overstory canopy cover varied from 30 to 100 percent
Age of large trees (years)	Not measured	Not measured	
Number of 10-cm size classes —starting at 5 cm d.b.h.	Not reported	Not reported	Largest trees were 53 cm d.b.h., indicating some stands had as many as five
D.b.h. of largest trees (cm)			
—all species	53	Not reported	Values reported are maximum size across all six stands
Mesquite (*Prosopis glandulosa* Torr.)	36		
Texas ebony [*Pithecellobium flexicaule* (Benth.) Coult.]	53		
Standing snags (no./ha)	Not reported	Not reported	
Decadent trees	Not measured	Not measured	
Number of canopy layers	2	2	Shrub canopy measured from 40 to 85 percent; "shrubs" may reach to the upper canopy[a]
Percent canopy in gaps	Not measured	Not measured	Qualitative observation shows few gaps in mature stands[b]
Other features			
Canopy height (m)	5–13	--	Cedar elm (*Ulmus crassifolia* Nutt.) was reported among the canopy dominants; important "shrubs" included Texas ebony, coma (*Bumelia celastrina* H.B.K.), guayacan [*Guaiacum angustifolium* (Engelm.) Gray], anacua [*Ehretia anacua* (Terán & Berland.) I.M. Johnst.], brasil (*Condalia hookeri* M.C. Johnst.), and colima [*Zanthoxylum fagara* (L.) Sarg.]

[a] See under text headings "Narrative of Old-Growth Conditions" and "Forest Dynamics and Ecosystem Function."
[b] See under text heading Forest Dynamics and Ecosystem Function."

documented, although Archer et al. (1988) have shown the importance of the interaction of fire reduction and mesquite seed dispersal by domestic cattle. This interaction has triggered rapid change in the modern landscape from savannah to thorn woodland in related communities to the north. The processes that control succession on floodplains have been discussed by Bush and Van Auken (1986a, 1986b, 1987). Southwestern subtropical upland forests are easily distinguished from other forests in the southeast. They have broad-leaved, subtropical evergreens among the dominant species, and they occur only in south Texas (table 1).

Associated Society of American Foresters Cover Types:

None

Physiographic Provinces:

West-Gulf Coastal Plain

Narrative of Old-Growth Conditions

Diamond et al. (1987) and Diamond (1992) broke upland subtropical evergreen forests into two series for classification based on prevailing dominant species and differences in physiognomy: the Texas ebony—anacua series; and the Texas ebony—snake-eyes series. The former is described as a well-developed forest, whereas, the latter is a low forest grading into shrubland. These series represent a continuum of related communities that occupy uplands of the Lower Rio Grande Valley—the former on well-watered sites and the latter on drier sites. Both are listed by Diamond et al. (1987) as among the most endangered community types of Texas. The Texas Natural Heritage Program's Element Occurrence data base lists six examples of the Texas ebony—snake-eyes series; and eight occurrences of Texas ebony—anacua series in fair or better condition. Many of the observations made here and elsewhere are based on personal visits to these sites along with reviews of the literature.

Upland evergreen forests of the Rio Grande Valley grow on a range of sites: some only slightly better drained than floodplain hardwoods and others almost too dry to support a forest. Texas ebony appears to be the leading dominant on all the best sites.

Canopy height reaches to over 50 feet (15 m) on moist sites, with ebony reaching more than 24 inches (60 cm) in diameter at breast height (d.b.h.). Remnant ebony trees in residential sections of Brownsville and a few individuals in Santa Ana National Wildlife Refuge (NWR) are more than 30 inches (80 cm) d.b.h. On drier uplands, ebony trees still reach heights of more than 26 feet (8 m). Even on the driest sites that support this type, ebony can form a nearly monoculture canopy at about 13 feet (4 m). These low forests have flat, interlocking upper canopies and essentially no middle story or ground cover and are usually open enough to crawl or walk through, although stem density can make walking difficult. "Shrub" species may be present but often grow from single stems and reach the upper canopy at 13 to 16 feet (4 to 5 m). The edges of these low forests are sometimes nearly impossible to penetrate due to vigorous growth of shrubs between forests and cropland or roads. Taller, moister forests grow in mosaics with deciduous floodplain forests, as at Santa Ana NWR (Vora 1990). Although this type is mapped on about one-third of Santa Ana refuge (Vora 1990), I am not convinced that any undisturbed old-growth stands as large as an acre exist. Large Texas ebony and anacua trees are present but are often intermixed with early successional patches of sugarberry, cedar elm, soapberry (*Sapindus drummondii* Hook. & Arn.), and tepeguaje [*Leucaena pulverulenta* (Schlecht.) Benth.]. The existing patches are rather open, and various shrubs grow along the network of trails that interlace the refuge. The ecology of the shrub species is poorly known, but perhaps species such as brasil, snake-eyes, and Texas persimmon (*Diospyros texana* Scheele) would be represented in a true understory of old-growth forest on these moist sites. Certainly, species of the upper canopy would be represented in the understory. Unlike most retired cropland, old-growth examples of this forest type do not contain mesquite, huisache (*Acacia smallii* Isely), or sugarberry among the leading dominants.

Forest Dynamics and Ecosystem Function

Archer et al. (1988) described the conversion of open grassland to thorn woodland in communities to the north of the Lower Rio Grande Valley. Mesquite becomes established due to the reduction of fire and rapid dissemination of seeds by cattle. Other shrubs then become established under mesquite in a predictable sequence, and these mottes may grow together to form diverse thorn woodlands on some sites. Van Auken and Bush (Bush and Van Auken 1984, 1986a, 1986b, 1987; Van Auken and Bush 1985) have shown how differences in light and nutrient requirements may control secondary succession on floodplains of the San Antonio River. Huisache, an early successional species with higher light and lower nutrient requirements than sugarberry, would come first in the succession. Establishment processes and invasion of grassland described by Archer, and light/nutrient processes described by Van Auken and Bush, may both play a role in the forest dynamics of upland subtropical forests, but these processes have not been investigated in that type. Grazing by large ungulates was apparently not common in the valley before European settlement, as there are few or no records of bison in the area.

Revegetation of retired cropland is ongoing in the Lower Rio Grande Valley. More than 5,000 acres [2024 hectares (ha)] have been replanted, but only dubious records on planting methods and rates of "success" have been kept. In "natural" old fields, huisache, sugarberry, and cedar elm are common on wet sites, and mesquite is common on all sites; however, sugarberry and cedar elm are absent on dry sites. Granjeno is also a common, early successional species on almost all sites. Anacua grows in early successional stands, but Texas ebony is generally absent.

Unfortunately, little is known about processes in old-growth Texas ebony forests, nor about presettlement disturbances. Apparently, periodic flooding and severe drought were once controlling factors. These disturbances would certainly have caused patchiness in the presettlement landscape. The Rio Grande is now almost entirely "controlled" as it reaches the lower valley, and essentially all the fresh water in the river is allocated to human use before it gets to the Gulf of Mexico. Overflow in some areas that were once periodically flooded is now totally controlled. At the same time, some areas may be wetter than ever due to the collection of irrigation water in resacas. No record exists of the effects of the droughts of the 1930's and 1950's on the vegetation of the Rio Grande Valley. Workers who visited the area between 1937 and the 1960's did not note drought effects as they did in other areas of Texas and North America. Nor do standing dead trees provide residual evidence of the 1950's drought.

Gap-phase succession is not clearly apparent in old-growth upland forests of the Rio Grande Valley. There is often almost no mesquite in the interior of the oldest stands I have viewed. Texas ebony or a mixture of ebony and anacua generally form a nearly monoculture canopy; sometimes these species emerge slightly from a lower canopy of mixed shrubs and low trees. These stands have little or no understory, but the stems of species that reach near the canopy (16 to 26 feet or 5 to 8 m) may be so dense that walking is difficult. Paradoxically, the view is most often nearly clear under the canopy, since little green foliage grows below 15 feet (5 m). In other stands, a few individual mesquite trees along with Texas ebony emerge to about 26 feet (8 m) from a lower, mixed, small tree and shrub canopy (16 feet or 5 m). Since individual trees have small crowns that often interlock with other individuals in the canopy, light gaps formed by dead or dying canopy trees are inconspicuous and fill in quickly. In this situation, shade intolerant mesquite is nearly absent, and Texas ebony and anacua eventually dominate, especially in the least disturbed stands.

Many of the few remaining stands of this forest type are already in public ownership due to efforts of both the Federal (Lower Rio Grande Valley NWR) and State (Los Palomas State Wildlife Management Area) governments. Management of these tracts, however, may not always favor old-growth forests. The valley is a rapidly urbanizing area, in addition to being intensively developed for crop production. Reportedly, more than 500,000 visitors spent the winter in the valley, and more than 200,000 visited Santa Ana NWR, one of the better examples of this forest type. Thus, plans for park development, wildlife management, and visitor access often directly conflict with conservation. Conservation biologists have not systematically identified core ecological reserves nor made careful plans for expansion into restoration areas, even though thousands of acres of cropland in the Rio Grande Valley have been purchased for revegetation. Since as few as 15 fair or better-quality stands remain, according to the Texas Natural Heritage Program, and since most cover fewer than 20 acres (8 ha), such plans need to be developed and implemented soon in order to save this forest type from extinction.

Representative Old-Growth Stands

Consult Texas Natural Heritage Program data base for exact locations of these stands:

- Camp Perry, Boy Scouts of America, Cameron County
- Kelly Unit, Los Palomas State Wildlife Management Area, Hidalgo County
- Laguna Atascosa National Wildlife Refuge, Cameron and Willacy Counties
- Longoria Unit, Los Palomas State Wildlife Management Area, Cameron County
- Madero and Gabrielson Units, Lower Rio Grande Valley National Wildlife Refuge, Hidalgo County
- Methodist Camp, Hidalgo County
- Monte Meta Cemetery, Cameron County
- Santa Ana National Wildlife Refuge, Cameron County
- Resaca de la Palmas State Park, Cameron County
- Rio Grande-Bentson State Park, Hidalgo County

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Mainly evergreen, broad-leaved forests in the Southwestern United States are restricted to the Lower Rio Grande Valley of Texas. The soils and long growing season make this region valuable cropland, and thus almost all of the area once occupied by this forest type has been converted to row crops. Remaining old-growth forests are usually dominated by some combination of the broad-leaved evergreen Texas ebony and a host of other species. Few quantitative studies have described the composition of this forest type, and, likewise, little is known of the dynamics. Droughts, flooding regime, and fire were large-scale disturbance factors. Now, the Rio Grande is used extensively for irrigation, and flooding is controlled. Therefore, the presettlement water regime has been greatly altered, and vegetation of the remaining forest fragments is also adjusting to the new moisture regime. Some areas are wetter and some drier than in historical times. Many of the fragments that remain have already been incorporated into public ownership by the U.S. Fish and Wildlife Service or the Texas Parks and Wildlife Department.

Keywords: Anacua; evergreen, broad-leaved forests; old growth; Rio Grande Valley; Texas ebony.