



## **Chapter 12: West Texas**

West Texas is the most diverse physiographic area of Texas, containing the greatest relief (from just over 1,000 feet to 8,751-foot Guadalupe Peak) and the most abrupt climatic gradients. Larger mountain ranges may receive more than 20 inches of rain annually, while lowland sites less than 30 miles distant receive less than 10 inches (Cottle 1931, Plumb 1988). Most of the region receives very little rainfall and potential evaporation greatly exceeds rainfall throughout the year (MacMahon 1988). Westernmost Texas (El Paso and Hudspeth counties) is most arid, with less than 8 inches of rainfall and -83 inches annual evaporation (Correll and Johnston 1970). West Texas is sparsely

populated (80 percent of the region's 900,000 residents live in one city, El Paso) and only one human activity, ranching, has greatly altered the landscape.

The term "Trans-Pecos" refers to the part of Texas west of the Pecos River, an unsatisfactory entity for ecological analysis as it excludes floristically similar semi-desert areas east of the Pecos. This thesis treats the Trans-Pecos with adjacent Loving, Winkler, Ward, and Crane counties as a single ecological region, with all parts receiving less than 15 inches of annual rainfall. Thus defined, the region also includes the Stockton Plateau, a limestone area geologically coterminous with the Edwards Plateau, but more arid (Bray 1905, Webster 1950).

The vegetation of West Texas is varied and diverse, due to climatic, topographic, and geologic heterogeneity and to migration of plant populations during prehistoric glaciation and melting periods. West Texas landscapes range from true deserts to shrublands, grasslands, woodlands and forests, as well as containing elements of the Rolling Plains, Edwards Plateau, and South Texas Plains flora (Powell 1996). Elevation correlates strongly with moisture and with occurrence of plant communities; however, communities are also influenced by slope and substrate (Gehlbach 1967). The relatively higher precipitation-evaporation ratios on north-facing slopes allow more mesic plant communities than on south or west-facing slopes at similar elevation (Cottle 1932). Vegetation on limestone surfaces may be more xerophytic than on igneous formations (e.g. in the Davis and Chisos mountains) at the same elevation (Warnock 1946, Gehlbach 1967). Concentrated moisture at the bases of cliffs and hills supports mesic vegetation (Warnock 1977). Drainages, washes, canyons, and basins where water is consistently available support distinct vegetation types.

The dominant vegetation on low, level plains of West Texas is a sparse shrub cover of creosotebush, tarbush, and other species. On slightly higher slopes and foothills, creosote mixes with desert shrubs, succulents and grasses, forming often diverse scrub communities. Abundant species may include lechuguilla, cacti, yuccas, gramas, mariola, ocotillo, and many other shrubs and grasses. Limestone slopes support distinct flora, while igneous slopes may

support grasslands of grammas, muhlys and other species. Mountain ranges exceeding 4,500 feet shelter areas of woodland, savannas, and lush grasslands. Isolation of vegetation on mountain ranges has resulted in the highest incidence of disjunct taxa in Texas. Higher, cooler, well-watered sites in the Guadalupe, Davis and Chisos ranges (6000-8750 feet) support isolated, relict examples of coniferous forest. The fossil record and studies of animal middens indicate that montane forest was widespread in west Texas prior to 8,000 years ago, and creosotebush and other xerophytic species were absent before 5,000 years ago (Wells 1977, Van Devender and Spaulding 1979).

Gypseous outcrops, quartz dunes, and saline wetlands support distinctive communities. In the Stockton Plateau, desert plants such as creosotebush, lechuguilla and sotols share dominance with South Texas and Edwards Plateau species such as acacias, junipers, and scrub oaks (Bray 1905, Powell 1998a).

"It seemed to me that there was enough grass growing in the Big Bend country to fatten every horse and cow in the United States," homesteader J. O. Langford recalled, speaking about the beginning of the twentieth century (Langford 1952, 20). By the mid-twentieth century, lush, low-elevation grasslands in the Big Bend had been replaced by desert scrub (Warnock 1970). While grazing intensity has lessened, dramatic degradation of rangelands resulted from the early period of overutilization (Grover and Musick 1990). Fire suppression and erosion or degradation of topsoil may also be important factors in the increase of desert scrub (Humphrey 1958, York and Dick-Peddie 1969).

## **Plant Communities of West Texas**

### **91. Saline or gypsic hardlands.**

Synonyms: Fleshy Tidestromia Sparsely Vegetated Alliance, New Mexico Saltbush Dwarf-shrubland Alliance (Weakley et al. 2000).

Description: "Badlands" formed by saline and gypseous clay deposits in the Big Bend country support only sparse vegetation of xerophytic and some gypsophilic

species. Saltbushes, alkali sacaton, ringstems, dog cholla, and sparse grass (e.g. false Rhodesgrass) may be present; following rain events, annuals such as fleshy tidestromia may be dominant (Weakley et al. 2000, Powell pers. comm.).

Status: Hardland areas cover more than 1,000 acres at low elevations in Big Bend National Park (Powell pers. comm.).

Suggested Priority for Further Protection of Community: Fairly Low

### **92. Mesquite-saltbush saline brush.**

Synonyms: Saline Bolson (Burgess and Northington 1979); Mesquite-Saltbush Series (Diamond 1993); Fourwing Saltbush-Creosotebush Shrub (McMahan et al. 1984); *Prosopis-Atriplex* Scrub (Henrickson and Johnston 1986); Fourwing Saltbush Shrubland Alliance (Weakley et al. 2000).

Description: Mesquite and fourwing saltbush form brush thickets on saline and alkaline subirrigated flats (e.g. around dry salt lakes) throughout West Texas and in the western South Texas Plains. This community is often mixed with stands of alkali sacaton where water is closer to the surface. Prickly pears, lotebush, Berlandier wolfberry, winged sesuvium, and other salt-tolerant species may be common (Diamond 1993, Powell 1994).

Status: This vegetation type is widespread and apparently not threatened, and occurs in Guadalupe Mountains National Park and other areas (Burgess and Northington 1979, Diamond 1993).

Suggested Priority for Further Protection of Community: Fairly Low

### **93. Hypersaline flats.**

Synonyms: Alkali Scrub (Henrickson and Johnston 1986); Pickleweed-Seepweed Series (Diamond 1993); Fourwing Saltbush Shrubland Alliance, in part; Iodine Bush Shrubland Alliance; Winged Sea-purslane Temporarily Flooded Sparsely Vegetated Alliance (Weakley et al. 2000).

Description: Extensive saline and alkaline flats occur in arid regions of the Trans-Pecos (e.g. Hudspeth and Culberson counties) around dry lake beds in

internally draining basins. Only halophytic plants can colonize these areas, which are typically unvegetated or sparsely covered with fourwing saltbush, pickleweed, seepweeds, winged sesuvium, saltgrass, and sacatons (Henrickson 1977, Burgess and Northington 1979).

Status: Though little protected or unprotected in conservation areas, this community is presently little threatened by human use or development.

Suggested Priority for Further Protection of Community: Medium

#### **94. Sacaton saline grasslands.**

Synonyms: Saline Bolson (Burgess and Northington 1979); Sacaton Grassland (Henrickson and Johnston 1986); Alkali Sacaton-Fourwing Saltbush Series (Diamond 1993); Alkali Sacaton Intermittently Flooded Herbaceous Alliance (Weakley et al. 2000).

Description: Stands of alkali sacaton occur in basins, saline flats, and along washes throughout most of western Texas, often in a mosaic with mesquite-saltbush shrublands. Big sacaton and other grasses, fourwing saltbush, James frankenia, jimmyweed, winged sesuvium, broomweeds, babywhite aster, and halophytic species such as seepweeds may occur (Bray 1906, Burgess and Northington 1979, Weakley et al. 2000).

Status: About 2,000 acres of this widespread grassland type are protected at Guadalupe Mountains National Park; smaller examples occur at other protected sites (Powell 1994). These communities are apparently secure in West Texas at present (Diamond 1993).

Suggested Priority for Further Protection of Community: Medium

#### **95. Saline or alkaline wetlands.**

Synonyms: Saltgrass-Olney Bulrush Series (Diamond 1993); Inland Saltgrass-(Foxtail Barley) Temporarily Flooded Herbaceous Alliance; Olney Threesquare Semipermanently Flooded Herbaceous Alliance (Weakley et al. 2000).

Description: Thin bands of halophytic vegetation occur along subsaline margins of streams and canals and in wet depressions in western Texas, including the Panhandle and Trans-Pecos. Moist saline soils may support stands of saltgrass, sacatons, seepweeds, and prairie cordgrass (Tharp 1939, Weakley et al. 2000). Saline soils around a few permanent desert springs and creeks support unique wetland associations of Olney bulrush, sedges, bordered sea-lavender, and the rare and restricted puzzle sunflower and clasping flaveria (Van Auken and Bush 1998).

Status: Always uncommon, these communities have become rarer as a result of water diversion and pumping of groundwater. Protected examples include the Nature Conservancy's Diamond Y Spring Preserve and Sandia Spring Preserve and saline sites at Balmorhea State Park, totalling roughly 200 acres (TPWD 1996, Karges pers. comm.).

Suggested Priority for Further Protection of Community: High

#### **96. Gypsum scrub and grasslands.**

Synonyms: Gypsum (Burgess and Northington 1979); Gypsophilous Scrub (Henrickson and Johnston 1986); Rough Tiquilia Series (Diamond 1993); Rough Tiquilia Dwarf-shrubland Alliance, Gyp Grama Sparsely Vegetated Alliance (Weakley et al. 2000)

Description: Gypsum habitats in the Trans-Pecos range from stable ridges and deposits to active dunes; all are generally dominated by gypsophilic grasses, shrubs, and forbs. Conspicuous plants on gypsum substrate include gyp grama, gypgrass, rough tiquilia, gyp mentzelia, moonpods, ringstems, range ratany, Torrey ephedra, gyp firewheel, gyp nama, and narrowleaf greggia; a number of endemic plants are common. Dunes, regardless of substrate, may be dominated by hoary rosemary-mint, sand bluestem, and occasional soaptree yucca and plains prickly pear (Waterfall 1946, Powell and Turner 1974, Morafka 1977, Burgess and Northington 1979, Worthington and Reid 1985, Powell pers. comm.).

Status: About 1,000 acres is protected in Guadalupe Mountains National Park and adjacent private Gypsum Dunes Preserve (Armstrong, Karges pers. comm.)  
Suggested Priority for Further Protection of Community: Medium

**97. Quartz sands.**

Synonyms: *Prosopis* Sand Dunes (Campbell 1929); Quartz Sand (Burgess and Northington 1979); Sand Dune Scrub (Henrickson and Johnston 1986); Mesquite-Sand Sage Series (Diamond 1993); Mesquite Shrubland Alliance, in part; Sand Bluestem Herbaceous Alliance; Sand Sage Shrubland Alliance, in part; Sandbar Willow Seasonally Flooded Woodland Alliance; Seep-willow-Rooseveltweed Seasonally Flooded Shrubland Alliance (Weakley et al. 2000).

Description: Fields of loose quartz sand dunes occur around dry lake beds, on the sand sheets of the Monahans area, and in the arid far-western Trans-Pecos. Dunes may also form where severe overgrazing has denuded vegetation in areas of deep sand. Partially stabilized dunes may support coppices of mesquite or sparse growth of yuccas, broom pea, fourwing saltbush, sand sage, sand prickly pear, hoary rosemary-mint, ipomopsis, grassland croton, sand-verbenas, bindweed heliotrope, sunflowers, sand-dune spurge, and other annuals and grasses such as giant dropseed, spike dropseed, mesa dropseed, sand bluestem, Havard panicum, big sandreed and common sandbur (Campbell 1929, Warnock 1974, Morafka 1977, Burgess and Northington 1979, Wright 1982, McMahan et al. 1984, Henrickson and Johnston 1986, TPWD 1989f, Worthington pers. comm.). Interdunal valleys over impermeable substrata (as with the Monahans Sand Sheet) may contain seasonal swales or ephemeral ponds supporting Indian ricegrass and other grasses, softstem bulrush, rushes, flatsedges, baccharis, mesquite, sandbar willow, marsh fleabane, abrojo and other weeds (TPWD 1989f). Further subdivision of silica dune communities is possibly appropriate (Powell pers. comm.).

Status: Excellent examples of dunes and interdunal swales are protected at Monahans Sandhills State Park (about 1,000 acres); Guadalupe Mountains

National Park also contains dune fields (Burgess and Northington 1979, TPWD 1989f, TPWD 1996).

Suggested Priority for Further Protection of Community: Fairly Low

**98. Havard shin oak low shrublands.**

Synonyms: Havard Shin Oak Brush (McMahan et al. 1984); Havard Oak Shrubland Alliance (Weakley et al. 2000).

Description: One of the most unusual plant communities in Texas is the very low (averaging 3 feet or less in height) brush or "shinnery" composed mostly of clones of rhizomatous Havard shin oak occurring on deep sands in Andrews, Ward, Winkler, and Crane counties as well as the southern High Plains and western Rolling Plains of Texas and Oklahoma. Plains yucca, black grama, bluestems, and dropseeds may be common; associated forbs in West Texas include grassland croton, spurges, sand-verbenas, and penstemons (Havard 1885, Muller 1951, Warnock 1974, TPWD 1989f, Best et al. 1993, Dhillion and Mills 1999, Weakley et al. 2000).

Status: This community is best protected at the Monahans Sandhills State Park, which contains roughly 2,800 acres of shinnery (TPWD 1989f).

Suggested Priority for Further Protection of Community: Medium

**99. Viscid acacia thickets.**

Synonyms: Huisache association (Denyes 1956); Huisache-Creosotebush association (Thompson 1953); Viscid Acacia Series (Diamond 1993); Trans-Pecos Wattle Shrubland Alliance (Weakley et al. 2000).

Description: Low hills and dry wash slopes throughout the Trans-Pecos support thickets of "whitethorn" acacias (viscid acacia, mesquit acacia, catclaw, and others). Mariola, mesquite, javelina bush, yuccas, prickly pears, fourwing saltbush, allthorn, other shrubs and sparse grasses may be present (Denyes 1956, Weakley et al. 2000). Possibly a disturbance type supplanting former low-

elevation grasslands, this community occurs in a mosaic with remnant grasslands or other scrub communities (Powell pers. comm.).

Status: This community type has become more widespread in West Texas perhaps as a result of overgrazing. It occurs extensively in protected areas, particularly in the Bofecillos Mountains of Big Bend Ranch State Park (Powell 1998a, Powell pers. comm.).

Suggested Priority for Further Protection of Community: Low

### **100. Creosotebush open shrub deserts.**

Synonyms: Mesquite-Creosote Bush association (Webster 1950); Creosote-Tarbrush association, Creosote-Tasajillo association (Denyes 1956); Shrub Desert (Whitson 1970); Creosotebush, Creosotebush-Tarbrush (Warnock and Kittams 1970); Creosote Flats (Burgess and Northington 1979); Creosotebush-Tarbrush Shrub (McMahan et al. 1984); *Larrea* Scrub (Henrickson and Johnston 1986); Creosotebush Series (Diamond 1993); Creosote Flats, Creosote-Grass, Lechuguilla-Tarbrush assemblages (Plumb 1988); Creosotebush Shrubland Alliance, Tarbrush Shrubland Alliance (Weakley et al. 2000).

Description: Large expanses of fairly level, arid, non-saline alluvial plains or bajadas throughout West Texas, usually below 3800 feet, are dominated by well-spaced creosotebush in pure stands or with tarbrush (which is often codominant, especially in the northern part of West Texas). Mariola, acacias, mesquite, javelina bush, prickly pears, tasajillo, Trecul yucca, tiquillas, stickseed, desert-holly, broomweeds, white ratany, and a few other species may be abundant. Spaces between shrubs may be bare or covered with sparse growth of grasses or forbs such as bush muhly, fluffgrass, burrograss, slim tridens and desert bailey (Tharp 1939, Warnock 1946, York 1949, Gehlbach 1967, Burgess and Northington 1979, Plumb 1988). Outwash drainages may support better growth of shrubs (e.g. fourwing saltbush, leatherstem, joint-fir, rough mortonia, tiquillas) (Williams 1969). This is probably the most widespread and dominant association

in West Texas, grading into more diverse vegetation on adjacent slopes and higher areas (Henrickson and Johnston 1986).

Status: Chihuahuan Desert communities are extensively protected in several large conservation areas in Texas. Creosotebush-dominated flats cover at least 200,000 acres of Big Bend National Park; that total does not include additional areas of transitional mixed scrub where creosote shares dominance with lechuguilla, yuccas, and grasses (Plumb 1988, Powell and Whitefield 1994). Creosotebush communities cover an estimated 20,000 acres of Black Gap WMA, more than 140,000 acres of Big Bend Ranch State Natural Area, some 16,000 acres of Guadalupe Mountains National Park, and at least 15,000 acres in smaller areas (Glass et al. 1974, TPWD 1996, Cooke pers. comm.).

Suggested Priority for Further Protection of Community: Low

#### **101. Mesquite thickets.**

Synonyms: Mesquite-Sumac-Condalia association (Webster 1950); Mesquite association (Denyes 1956); Mesquite-Giant Reed (Warnock and Kittams 1970); Creosotebush-Mesquite Shrub (McMahan et al. 1984); Mesquite Thicket (Plumb 1988); Honey Mesquite Temporarily Flooded Woodland Alliance (Weakley et al. 2000).

Description: Subirrigated soils of low salinity around streams, arroyos and basins (e.g. around the Pecos River and Rio Grande floodplains) support dense scrub of mesquite, acacias, and fourwing saltbush, perhaps indicative of relatively shallow water tables. Brush species (e.g. lotebush, creosotebush, knifeleaf condalia) and weedy forbs are often present. More saline sites may be dominated by alkali sacaton (Havard 1885, Morafka 1977, Plumb 1988). Along floodplains of the Rio Grande and other streams and adjacent arroyos, stands may form dense "bosques" (Palmer 1928, Wauer 1980).

Status: These communities are now common around watercourses and along the Rio Grande, but may have been less widespread prior to the twentieth century (Humphrey 1958). Exotic saltcedar is often dominant. Examples occur

in Big Bend National Park, Amistad National Recreation Area and other areas (Plumb 1988, TPWD 1996, Larson pers. comm.).

Suggested Priority for Further Protection of Community: Fairly Low

**102. Cottonwood-willow riparian woodlands.**

Synonyms: Riparian Woodland (Henrickson and Johnston 1986); Cottonwood Grove (Plumb 1988); Cottonwood-Willow Series (Diamond 1993, Dick-Peddie 1993); Fremont Cottonwood Temporarily Flooded Woodland Alliance, Goodding's Willow Temporarily Flooded Woodland Alliance (Weakley et al. 2000).

Description: Groves of Arizona cottonwood or Rio Grande cottonwood grow with Goodding willow and other willows near springs and tanks and along permanent streams in west Texas. Ashes, acacias, seep-willow, desert-willow, little walnut, whitebrush, arrow-weed, spiny aster, other forbs, and grasses may be common (Palmer 1928, Tinkham 1948, Wauer 1980, Plumb 1988, TPWD 1990I, Powell pers. comm.).

Status: Always limited in extent, riparian areas in the Trans-Pecos have been logged, cleared, and overgrazed, and many streams that supported them have run dry (Langford 1952). Bermudagrass, giant reed, tree-tobacco and other non-native species have become abundant along the Rio Grande (Wauer 1980). Fair to poor examples are protected at Big Bend Ranch and Davis Mountains State Parks, with small stands around springs and streams in Big Bend and Guadalupe Mountains National Parks, Ocotillo WMA, Fort Leaton and Davis Mountains State Parks. Protected sites total approximately 2,000 acres (TPWD 1996, Plumb 1988, Powell and Whitefield 1994).

Suggested Priority for Further Protection of Community: Fairly High

**103. Arroyo scrub.**

Synonyms: Apache-plume association (Denyes 1956); Sandy Arroyo Scrub (Henrickson and Johnston 1986); Desertwillow assemblage (Plumb 1988); Apache-plume Series (Diamond 1993); Sweet Desertwillow Intermittently

Flooded Shrubland Alliance, Apache-plume Intermittently Flooded Shrubland Alliance, Splitleaf Brickelbush Intermittently Flooded Shrubland Alliance, Seep-willow Intermittently Flooded Shrubland Alliance (Weakley et al. 2000)

Description: Margins of ephemeral watercourses (arroyos) and washes and sheet drainages in open plains and valleys of the Trans-Pecos may be lined by stands or stringers of shrubs, including desert-willow, Apache-plume, seep-willow, Roosevelt-weed, splitleaf brickellia, acacias, mesquite, allthorn, catclaw mimosa, daleas, granjeno, burrobrush, mariola, little walnut, sotols, guayacan, spiny greasebush, and netleaf hackberry, with species composition and vegetation stature influenced by the amount of moisture present. An array of forbs may be present (Denyes 1956, Warnock 1946, Hinckley 1947, Webster 1950, Diamond 1993, Powell and Whitefield 1994). Whitebrush, desert-willow, and splitleaf brickellia are dominant in drainages of the southwestern Edwards Plateau (Poole pers. comm.). This community often contains the tallest vegetation in low-elevation areas of the Chihuahuan Desert.

Status: This community type is widespread and probably secure at present (Diamond 1993). At least 14,000 acres are protected within Big Bend National Park, Franklin Mountains State Park, Sierra Diablo WMA, and other areas (Plumb 1988, TPWD 1996).

Suggested Priority for Further Protection of Community: Fairly Low

#### **104. Chihuahuan Desert scrub.**

Synonyms: Creosote-Ocotillo-Mesquite association, Creosote-Lechuguilla association, Sotol-Lechuguilla association (Denyes 1956); Chino Grama-Lechuguilla, Chino Grama-Candelilla (Warnock and Kittams 1970); Shrub Desert (Wauer 1971); Limestone Chihuahuan Desert (Burgess and Northington 1979); Yucca-Ocotillo Shrub, Creosotebush-Lechuguilla Shrub (McMahan et al. 1984); Lechuguilla-Sotol Series (Diamond 1993); Mixed Desert Scrub, Lechuguilla Scrub (Henrickson and Johnston 1986); Lechuguilla-Grass-Prickly Pear, Creosote-Lechuguilla, Lechuguilla-Grass-Candelilla, Lechuguilla-Grass-Hechtia

assemblages (Plumb 1988); Ocotillo Shrubland Alliance; Creosotebush Shrubland Alliance, in part; Smooth Sotol-(Lechuguilla, Skeletonleaf Goldeneye) Shrubland Alliance, in part (Weakley et al. 2000).

Description: Gravelly or rocky slopes, mesas, hills, and alluvial fans throughout west Texas, especially between 3500 and 5500 feet, often support a mosaic of desert scrub associations composed of succulents, low shrubs, and grasses. Lechuguilla is not always present but is often dominant, especially at lower elevations, and forms dense clonal stands. Chino grama may be codominant (especially in the southern Trans-Pecos); other grasses (e.g. blue threeawn, fluffgrass, black grama) may be abundant but are more often dominant on igneous substrates or at somewhat higher elevations. Other dominant species may include mariola, skeletonleaf goldeneye, yuccas, sotols, and ocotillo. Creosotebush may be codominant at lower elevations. Cacti are often abundant, including prickly pears, chollas, and members of *Echinocereus*, *Mammillaria*, *Neolloydia*, and other genera; many other cacti occur less frequently in various ranges and locales. Species preferring limestone habitats include cenizos, candelilla, Texas false-agave, leatherstem, joint-fir, guayule, and rough mortonia. Other abundant species may include acacias, range ratany, javelina bush, whitebrush, saltbushes, allthorn, plume tiquilia, feather dalea, fluffgrass, hairy tridens, threeawn, bush and curlyleaf muhly, shorthorn zexmenia, plains zinnia, broom snakeweed, hairyseed bahia, dogweeds, tatalencho, longstalk greenthread, and Chisos bluebonnet. Species of South Texas xeric communities such as cenizo and guayacan may be abundant in the southeastern Trans-Pecos. Annual forbs may be abundant after seasonal rains (Palmer 1928, Warnock 1946, York 1949, Wells 1965, Gehlbach 1967, Warnock 1970, Morafka 1977, Burgess and Northington 1979, Wauer 1980, McMahan et al. 1984, Aide and van Auken 1985, Plumb 1988, Powell 1994, Powell pers. comm.).

Status: This broadly defined community or group of communities is widespread and is the most extensively protected type of vegetation in Texas. Desert scrub dominated by lechuguilla, chino grama, sotols, creosotebush, skeletonleaf

goldeneye, and other species is the most abundant vegetation in Big Bend National Park, covering more than 300,000 acres of desert and regressed grasslands (Plumb 1988). Similar vegetation occupies 86,000 acres or more of Big Bend Ranch State Park, at least 50,000 acres of Black Gap WMA, and parts of Chinati Mountains State Natural Area and Franklin Mountains State Park (TPWD 1996; Yancey 1997; Cooke, McNamara pers. comm.). Grasses were probably much more dominant in many sites prior to grazing and related disturbance (Rogers 1964, Gehlbach 1981). Despite the high representation of this type in protected areas, endemic species and microhabitats should be further identified and prioritized.

Suggested Priority for Further Protection of Community: Fairly Low

**105. Alluvial short grasslands (tobosa flats).**

Synonyms: Tobosa-Burrograss association, others (Denyes 1956); Tobosa Grasslands (Henrickson and Johnston 1986); Tobosa Series (Diamond 1993, Dick-Peddie 1993); Tobosa Herbaceous Alliance, Tobosa Intermittently Flooded Herbaceous Alliance, Tobosa Shrub Herbaceous Alliance (Weakley et al. 2000).

Description: Intermountain depressions and internal basins (bolsons) with clay substrata may collect sufficient moisture to support grasslands of tobosa, which may be fairly pure or mixed with sacatons, buffalograss, gramas, burrograss (which colonizes disturbed sites), fluffgrass, bush muhly, or vine-mesquite. These communities are frequently invaded by mesquite, acacias, tarbush, fourwing saltbush, range ratany, weedy forbs, and succulents (Whitfield and Beutner 1938, Warnock 1946, Denyes 1956, Warnock 1977).

Status: Like other grassland types in West Texas, tobosa flats are threatened by encroachment of desert scrub species. Only small areas occur in conservation areas, perhaps totalling 500 acres (Plumb 1988, Armstrong pers. comm.).

Suggested Priority for Further Protection of Community: Medium

**106. Lower-elevation desert grasslands.**

Synonyms: Desert Grassland (Burgess and Northington 1979, Dick-Peddie 1993, Powell 1994); Tobosa-Black Grama Grassland (McMahan et al. 1984); Lechuguilla-Grass (Plumb 1988); Chino Grama Herbaceous Alliance, Black Grama Herbaceous Alliance, Hairy Grama-Blue Grama-Black Grama Shrub Herbaceous Alliance, Smooth Sotol-(Lechuguilla, Skeletonleaf Goldeneye) Shrubland Alliance, in part (Weakley et al. 2000).

Description: Grasslands occur at lower elevations in West Texas and were probably much more extensive prior to Anglo-American ranching. These grasslands are more extensive on igneous substrates, but can also occur on limestone. Black grama is often the dominant species on lower slopes of mountains below 4700 feet, including the Guadalupe, Quitman, Franklin, Delaware, Eagle, and Davis ranges, and in semidesert environments. Chino grama is often dominant on desert foothills and mesas between 1800-4500 ft in the Big Bend region and the Vieja, Quitman, Baylor and other mountain ranges (Warnock 1974, Powell 1994). Other associated grasses may include gramas, threeawns, fluffgrass, hairy tridens, bush muhly, and a number of others; scattered desert shrubs (e.g. acacias, mariola, sotols, prickly pears, yuccas, lechuguilla, skeletonleaf goldeneye, creosotebush, cacti, range ratany, feather dalea) are usually present. Abundant forbs may include woolly paperflower, hairyseed bahia, plains fleabane, desert bailey, and many others, with broom snakeweed in disturbed sites (Havard 1885, Whitfield and Beutner 1938, Gardner 1950, Denyes 1956, Gehlbach 1967, Whitson 1970, Warnock 1974, Warnock 1977, Burgess and Northington 1979, Powell 1994, Powell and Whitefield 1994, Wu et al. 1997, Powell pers. comm.).

Status: Though widespread, these grasslands have been invaded by desert shrubs and altered by soil compaction and overgrazing; large areas of former grassland are now dominated by lechuguilla, creosotebush, and other desert species (Cooke pers. comm.). Big Bend National Park retains somewhat intact chino grama grasslands, especially on the west slopes of the Chisos Mountains

(Powell pers. comm.). Franklin Mountains State Park and Sierra Diablo WMA contain good examples of black grama grassland (TPWD 1996, Yancey 1997).

Suggested Priority for Further Protection of Community: Medium

**107. *Yucca shrub savannas.***

Synonyms: *Yucca* Woodland, in part (Henrickson and Johnston 1986); *Yucca-Sotol-Grass* (Plumb 1988); Spanish Bayonet Series (Diamond 1993); Hairy Grama-Blue Grama-Black Grama Shrub Herbaceous Alliance, in part (Weakley et al. 2000).

Description: Stands of "arborescent" Faxon yucca and Thompson yucca grow on gravelly soils in desert scrub or grasslands above 3800 feet in the Dead Horse, Vieja, Eagle, Quitman, and other ranges (Simpson 1988). Associated species include gramas, threeawns, mariola, lechuguilla, sotols, cenizos, acacias, and mimosas (Rogers 1964; Cooke, Powell pers. comm.).

Status: Perhaps the best-known examples of this community are protected in Black Gap WMA and adjacent Big Bend National Park, covering some 25,000 acres (TPWD 1996, Plumb 1988).

Suggested Priority for Further Protection of Community: Fairly Low

**108. *Riparian shrublands.***

Synonyms: Walnut-Desert-willow association (Webster 1950); River-Walnut association (Denyes 1956); Persimmon-Walnut Association (Thompson 1953); Netleaf Hackberry-Little Walnut Series (Diamond 1993); Little Walnut Temporarily Flooded Shrubland Alliance (Weakley et al. 2000).

Description: Occasionally flooded streambeds and washes in low mountains, plateaus, and open canyons below 5200 feet may support tall deciduous shrubs or small trees such as little walnut, desert-willow, netleaf hackberry, and other species. Apache-plume, splitleaf brickellia, seep-willow, willows, granjeno, acacias, mesquite, ashes, whitebrush, agarito, scrub oaks, Mexican-buckeye, Texas persimmon, lotebush, and other shrubs associated with dry arroyos and

mesic talus slopes may be present depending on geographic location, with species composition influenced by moisture and substrate (Havard 1885, Hinckley 1947, Denyes 1956, Wauer 1971, Johnston et al. 1976, Plumb 1988).

Status: This community is widespread in drainages of the Trans-Pecos and western Edwards Plateau, with examples at Black Gap WMA, Big Bend and Guadalupe Mountains National Parks, Elephant Mountain WMA, and other sites (Plumb 1988, TPWD 1996, NPS 1998, Cooke pers. comm.).

Suggested Priority for Further Protection of Community: Fairly Low

**109. Lower-elevation juniper woodlands.**

Synonyms: Juniper-Ocotillo association; Sotol-Juniper-Lechuguilla association, Juniper-Sacahuiste association (Denyés 1956); Oneseed Juniper Series, in part (Diamond 1993); One-seed Juniper Woodland Alliance, in part; Redberry Juniper Woodland Alliance, in part (Weakley et al. 2000).

Description: Junipers coexist with desert scrub species on rocky lower slopes of several mountain ranges and in the Stockton Plateau and western Edwards Plateau. Redberry juniper is most abundant and widespread, but oneseed juniper occurs in the northeastern Trans-Pecos and rose-fruited juniper is the common species near Alpine (Powell 1998a). Junipers are usually scattered or clustered among grammas, blue threeawn, fluffgrass, muhlys, and other grasses; prickly pears, yuccas, lechuguilla, acacias, mimosas, mariola, and at higher elevations scrub oaks, sotol, sumacs, and sacahuista are often present. Forbs include hillside vervain, plains blackfoot daisy, daleas, and others (Webster 1950, Denyes 1956, Gehlbach 1967, Powell 1998b).

Status: Redberry juniper is spreading over lower elevations in the Guadalupe Mountains and other areas, possibly due to human alteration of rangeland (Glass et al. 1974, Armstrong pers. comm.). Juniper woodlands occur in fairly small areas at Big Bend Ranch State Park (Williams pers. comm.).

Suggested Priority for Further Protection of Community: Fairly Low

**110. Spring-fed streams and cienegas.**

Synonyms: Aquatic (Burgess and Northington 1979).

Description: Permanent springs (cienegas) and spring runs in the Trans-Pecos may support aquatic communities of spikesedges, sawgrass, caric-sedges, Torrey rush, western umbrella-sedge, brookweed, and water bentgrass, with prairie wedgrass and other grasses on stream banks (Butterwick and Strong 1976a, Johnston et al. 1976, Burgess and Northington 1979).

Status: Permanent creeks are now rare in West Texas; many have dried up during the last century. Most of the few remaining examples of these communities are threatened. Examples in protected areas include McKittrick Canyon in Guadalupe Mountains National Park and streams in Big Bend Ranch and Balmorhea State Parks. The Nature Conservancy holds a conservation easement on part of Independence Creek. These are among Texas' rarest and most threatened aquatic communities.

Suggested Priority for Further Protection of Community: High

**111. Limestone cliffs/outcrops.**

Synonyms: Mountain Outcrops (Burgess and Northington 1979).

Description: A number of forbs and shrubs, including some endemic species, grow only in rock crevices in limestone cliffs in the Trans-Pecos. Though the species composition of outcrop communities is highly variable and dependent on elevation, characteristic species of limestone cliffs may include true mountain-mahogany, rock-daisies, tufted rockmat, yellow rock-nettle, cliff fendlerbush, Mexican-buckeye, mock-oranges, namas, false-pennyroyals, salvias, needleleaf bluet, lip ferns, sotols, and many less common lithophilic shrubs and forbs, including numerous endemic species. Seeps in limestone areas of the Trans-Pecos, as elsewhere in western Texas, support maidenhair fern, columbines, and other species (Correll and Johnston 1970, Johnston et al. 1976, Burgess and Northington 1979, Powell and Whitefield 1994, Powell pers. comm.).

Status: These communities are local, but are often inaccessible; many sites are not greatly threatened at present. The Guadalupe Mountains National Park, Black Gap WMA, and other areas contain examples (Burgess and Northington 1979, Powell and Whitefield 1994).

Suggested Priority for Further Protection of Community: Medium

### **112. Igneous outcrops.**

Synonyms: Pericome Sparsely Vegetated Alliance (Weakley et al. 2000).

Description: Igneous rocks and talus are exposed in the Davis, Chinati, Chisos and other mountain ranges, sometimes covering extensive areas (Warnock 1977). Vegetation may be sparse and is primarily composed of "stray" species from adjacent communities and some forbs and shrubs adapted to rock outcrops and crevices, such as Mexican-buckeye, cliff fendlerbush, esperanza, and other species (TPWD 1990i, Powell pers. comm.).

Status: Protected examples occur in the Davis Mountains Preserve, Davis Mountains State Park, and Big Bend National Park, though many examples are not protected (Warnock 1977, TPWD 1990i).

Suggested Priority for Further Protection of Community: Medium

### **113. Mid-elevation mixed grasslands.**

Synonyms: Short-grass association, Short-grass-Yucca association, Short-grass-Cholla association, Short-grass-Sacahuiste association; Grama-Bluestem association (Denyes 1956); Grama-Sotol (Warnock and Kittams 1970); Sotol-Grass (Wauer 1971); Grama Grasslands (Henrickson and Johnston 1986); Sotol-Lechuguilla-Grass, Sotol-Nolina-Grass (Plumb 1988); Grama Grasslands (Dick-Peddie 1993); Plains grassland (Powell 1994); Blue Grama Herbaceous Alliance, in part; Hairy Grama Herbaceous Alliance, in part (Weakley et al. 2000).

Description: Lush stands of midgrasses and shortgrasses may occur in alluvial basins and on north-facing slopes at intermediate elevations (4000-5500 feet) in the Davis, Vieja, Chinati, and other mountain ranges (Warnock 1977). These

grasslands occur in mosaics with more xeric grasslands and shrub and succulent-dominated communities. Common species may include blue grama, hairy grama, sideoats grama, wolftail, cane bluestem, New Mexico little bluestem, silver bluestem, threeawns, plains lovegrass, sand muhly, and plains bristlegrass. Black grama, tanglehead, and other grasses may be dominant on adjacent slopes (Cottle 1932, Whitfield and Beutner 1938, Warnock 1946, Gardner 1950, Sikes and Smith 1975a, Tucker and Garner 1983, Plumb 1988, Hatch et al. 1990, TPWD 1990i, Powell 1994, Powell and Whitefield 1994, Powell pers. comm.). These grasslands may be relatively pure where not overgrazed or may include scattered yuccas, sacahuista, cane cholla, agaves, sotols, junipers, catclaw mimosa, and forbs (e.g. locoweeds, wild buckwheats, daleas, leatherweed croton where grazed); broomweeds and threadleaf groundsel may be abundant in disturbed rangelands (Cottle 1931, Warnock 1977, Plumb 1988, Powell 1994). More xeric sites may be dominated by sotols, lechuguilla, and desert shrubs, leading to the terms "grama-sotol" or "sotol-grassland" for these communities (Warnock and Kittams 1970, Plumb 1992).

Status: Grasslands were probably much more widespread in the Trans-Pecos prior to severe overgrazing a century ago (Havard 1885). However, much native rangeland at higher elevations in west Texas is intact, particularly around the Davis Mountains where many pastures on private ranches are relatively free of shrub vegetation (Warnock 1977). Most acreage is in private ownership, but there are examples in public conservation areas such as Davis Mountains State Park (TPWD 1990i). Residential subdivision around Fort Davis, Alpine and other towns is a new threat.

Suggested Priority for Further Protection of Community: Fairly High

#### **114. Canyon riparian woodlands.**

Synonyms: Riparian Woodland (Burgess and Northington 1979); Deciduous Woodland, in part (Wauer 1971); Canyon Scrub (Henrickson and Johnston 1986); Velvet Ash Series (Diamond 1993);

Description: Canyons at intermediate elevations support woodlands or scrub vegetation of velvet ash, netleaf hackberry, oaks, little walnut, Mexican-buckeye, granjeno, agarito, sumacs, acacias, esperanza, scarlet bouvardia, and other shrubs and grasses; species composition is influenced by substrate (Wauer 1971, Sikes and Smith 1973, Warnock 1977, Johnston et al, TPWD 1990i, Powell and Whitefield 1994). Bigtooth maple may occur in sheltered canyons (Hinckley 1947). As in all riparian communities, streambeds may support shrubs such as Apache-plume, splitleaf brickellia, and seep-willow (TPWD 1990i).

Status: This community is local, restricted to canyon bottoms. Examples include Fresno Canyon in Big Bend Ranch State Park and lower canyons in the Basin of Big Bend National Park. Protected acreage is probably less than 500 acres (Palmer 1928, TPWD 1990i, Yancey 1997, Alloway pers. comm.).

Suggested Priority for Further Protection of Community: High

#### **115. Montane shrub thickets.**

Synonyms: Bear grass-scrub oak postclimax (Whitfield and Beutner 1938); Chaparral (Whitson 1974); Mountain Shrub (Burgess and Northington 1979); Montane Chaparral (Henrickson and Johnston 1986); Oak Scrub (Plumb 1988); Scrub Oak-Mountain-Mahogany Series (Diamond 1993); Mohr Shin Oak Shrubland Alliance, Sandpaper Oak Shrubland Alliance, Turbinella Oak Shrubland Alliance, Coahuila Scrub Oak Alliance, Alderleaf Mountain-mahogany Shrubland Alliance, Gambel's Oak Shrubland Alliance (Weakley et al. 2000).

Description: "Chaparral" communities of sclerophyllous shrubs and stunted trees occur on limestone and igneous slopes, bluffs and ledges above 4500 ft, typically intermingled with grasslands or woodlands. Numerous oak species and hybrids may occur in these communities; Mohr shin oak, sandpaper oak, and Vasey shin oak are common especially on limestone, while gray oak and whiteleaf oak are common in the igneous Davis Mountains (Warnock 1946, Webster 1950, Powell pers. comm.). Other species include true mountain-mahogany, skunkbush and evergreen sumac, desert ceanothus, silk tassel, skeletonleaf goldeneye, Gregg

ash, catclaw mimosa, junipers, granjeno, Mexican-buckeye, agarito, bear-grass, agaves, lip ferns, and various forbs; lechuguilla may be common. Gramas, needlegrasses, muhlys, and bluestems may be dense, and mid-elevation grasslands are often adjacent (Wells 1965, Whitson 1970, Bunting 1978, Burgess and Northington 1979, Plumb 1988, Powell 1998a). Stunted thickets of sumacs, common hop-tree, Texas persimmon, mountain-mahogany, and scrub oaks also grow along rimrock escarpments and mesa tops (Hinckley 1947, Warnock 1977). Canyon walls and steep slopes at lower elevations may also support scrub oaks, junipers, sumacs, and other shrubs (Cottle 1932).

Status: This broadly defined type of vegetation is fairly extensive in mountains of west Texas, but further classification into subtypes is perhaps appropriate. Montane shrub communities occur in Guadalupe Mountains and Big Bend National Parks and Franklin Mountains and Hueco Tanks State Parks, among other areas; some 20,000 acres are protected (Glass et al. 1974, Plumb 1988, TPWD 1996, Powell 1998a).

Suggested Priority for Further Protection of Community: Low

#### **116. Juniper-oak-pinyon savannas.**

Synonyms: Pinyon-Oak-Juniper association, Pinyon-Juniper association, Oak-Juniper association (Denyes 1956); Pinyon-juniper-oak savanna/woodland, in part (Wauer 1971); Juniper-Pinyon Woodland (Henrickson and Johnston 1986); Alligator Juniper Woodland Alliance; Roseberry Juniper Woodland Alliance; Mexican Pinyon Woodland Alliance; Papershell Pinyon Woodland Alliance, in part (Weakley et al. 2000).

Description: Junipers, oaks, and pinyons may be scattered among grasslands at intermediate elevations (3500 to 5000 feet) on hilltops, ridges, and slopes of the lower mountain ranges of Texas. Examples occur in the Del Norte, Glass, Madera, Vieja, Chinati, and Diablo mountains and the Stockton Plateau; associated species and landscape position vary with substrate and local conditions. These savannas become closed woodlands on north and east-facing

slopes, in canyons, and at higher elevations. Species may include redberry, rose-fruited, or oneseed juniper; scrub oaks, gray oak, and Arizona white oak; and chaparral species (Denyes 1956, Warnock 1946, Whitson 1970, Warnock 1974, Powell 1998a, McLaran and McPherson 1999). Groves of Emory oak occur in relatively mesic places such as canyon bottoms, cliff bases, and igneous outcrops (Warnock 1977, TPWD 1990i). In the Davis and Chisos Mountains oaks, junipers and Mexican pinyon grow on slopes with rich stands of grammas, bluestems, bull muhly, threeawns, plains lovegrass, and scattered succulents or shrubs such as sotols, sacahuista, agaves, catclaw mimosa, sumacs, mountain-mahogany, and Gregg ash (Palmer 1929, Tharp 1939, Denyes 1956, Wauer 1971, Powell 1998a, Weakley et al. 2000).

Status: Examples are protected at Guadalupe Mountains National Park, Sierra Diablo WMA, Davis Mountains and other sites (Glass et al. 1974, TPWD 1996).

Suggested Priority for Further Protection of Community: Fairly Low

#### **117. Deciduous canyon forests.**

Synonyms: Riparian Woodland (Burgess and Northington 1979); Deciduous Woodland, in part (Wauer 1971); Bigtooth Maple-Oak Series (Diamond 1993); Bigtooth Maple Montane Forest Alliance, Xalapa Madrone-Bigtooth Maple-Oak Forest (Weakley et al. 2000).

Description: Mesic, sheltered canyons protected from rapid dehydration in Trans-Pecos mountain ranges may sustain relict forests containing bigtooth maple, chinquapin oak, western hophornbeam, and more generally distributed species such as gray oak, Gambel oak, Emory oak, alligator juniper, evergreen sumac, Texas madrone, bear-grass, Arizona grape, snowberries, grasses, sedges, and forbs. The most important example of southwestern riparian forest in Texas is at McKittrick Canyon in the Guadalupe Mountains National Park (Gehlbach 1981). Small patches occur in the Davis, Chisos, Glass, Vieja, and Diablo mountains (Tharp 1939, Warnock 1946, Sikes and Smith 1973, Burgess and Northington 1979, Powell 1998a).

Status: Though protected by remoteness from settlement and in some cases by public management, examples of this community are small, isolated, and few in number. Publicly owned sites include McKittrick Canyon (about 300 acres) and small patches in Big Bend National Park (Glass et al. 1974, Plumb 1988).

Suggested Priority for Further Protection of Community: High

**118. Montane oak-juniper-pinyon woodlands.**

Synonyms: Pinyon-juniper-oak savanna/woodland, in part (Wauer 1971); Gray Oak-Pinyon Pine-Alligator Juniper Parks/Woods (McMahan et al. 1984); Oak Woodlands (Henrickson and Johnston 1986); Mixed Oak, Pinyon-Oak-Juniper assemblages (Plumb 1988); Gray Oak-Oak Series, Emory Oak Series, Pinyon Pine-Oak Series (Diamond 1993); Mexican Pinyon-Chisos Red Oak Forest Alliance, Gray Oak Woodland Alliance, Emory Oak Woodland Alliance (Weakley et al. 2000).

Description: Mexican pinyon (southern Trans-Pecos) or pinyon (northern Trans-Pecos), various oaks, and junipers may form closed woodlands above 5500 feet in sheltered canyons, on north-facing slopes, and at cliff bases. Graves oak, gray oak, Emory oak, and several species of scrub oaks may be dominant, along with alligator, redberry, and weeping junipers. Other species include Texas madrone, sumacs, muhlys, New Mexico little bluestem, gramas, pinyon ricegrass, agaves, bear-grass, salvias, lip ferns, and other shrubs and wildflowers (Hinckley 1947, Gehlbach 1967, Warnock 1974, Plumb 1988).

Status: Though common in the southwestern United States, oak-pinyon-juniper woodlands and forests occur in Texas only in small areas of several Trans-Pecos mountain ranges (Hinckley 1947, Sikes and Smith 1973). The most extensive examples are in the Guadalupe, Davis, and Chisos mountains. Some 15,000 acres is protected in the Guadalupe Mountains and Big Bend National Parks and lands owned by the Nature Conservancy of Texas in the Davis Mountains (Plumb 1988, Armstrong pers. comm.).

Suggested Priority for Further Protection of Community: Medium

**119. Montane grass openings.**

Synonyms: Feathergrass-Grama association (Denyes 1956); Pinyon-juniper-oak savanna/ woodland, in part (Wauer 1971); Forest Meadow (Plumb 1988); Ponderosa Pine Series, in part (Diamond 1993); Arizona Fescue Herbaceous Alliance (Weakley et al. 2000).

Description: Openings and fire-created meadows within coniferous forests in the three highest mountain ranges of West Texas contain numerous grasses and forbs which are not found elsewhere in Texas. Dominant species differ among ranges, but may include needlegrasses, muhlys, Arizona fescue (primarily in higher parts of the Guadalupe Mountains), pinyon ricegrass, New Mexico little bluestem, bluegrasses, and gramas (Burgess and Northington 1979, Powell 1994, Armstrong pers. comm.).

Status: These communities are restricted to a few mountain ranges and are consequently vulnerable. Most examples are protected in conservation areas.

Suggested Priority for Further Protection of Community: Medium

**120. Montane conifer forests.**

Synonyms: Moist Woodland/Forest (Wauer 1971); Ponderosa Pine-Douglas-Fir Parks/Forest (McMahan et al. 1984); Pine Woodland (Henrickson and Johnston 1986); Ponderosa Pine Series, Douglas-Fir-Pine Series (Diamond 1993); Douglas-fir Forest Alliance, Ponderosa Pine Forest Alliance, Ponderosa Pine Woodland Alliance (Weakley et al. 2000).

Description: North-facing canyons and slopes above 5000 feet in the Guadalupe, Davis, and Chisos mountains support small patches of relict conifer forest. Conifer species present in the three ranges differ confusingly. Ponderosa pine and, at somewhat higher elevation, southwestern white pine occur in the Guadalupe and Davis mountains, with specimens exceeding 80 feet in height. Douglas-fir grows extensively in the Guadalupe Mountains and at Boot Canyon in the Chisos, but not in the Davis Mountains which contain apparently suitable habitat. Arizona pine and Arizona cypress are found only in the Chisos

Mountains. Small patches of quaking aspen grow on talus slopes in the three ranges (Plumb 1992, Powell 1998a). Other species of higher canyons and slopes include Gambel oak, gray oak, Graves oak, whiteleaf oak, and numerous other oaks (including endemic species), alligator juniper and other junipers, southwestern choke-cherry, pine dropseed, needlegrasses, pinyon ricegrass, bulb panicum, snowberries, bush rock-spire (on steep slopes and talus), grasses, sedges, salvias, penstemons, and many other wildflowers. Many species of forbs and grasses occur in Texas only in this community; numerous endemic plants grow in the three highest ranges (Tharp 1928, Palmer 1929, Hinckley 1944, Warnock 1977, Burgess and Northington 1979, Henrickson and Johnston 1986).

Status: The three occurrences of montane forest in West Texas are mostly preserved within Guadalupe Mountains and Big Bend national parks and on private lands in the Davis Mountains owned by the Nature Conservancy (Karges pers. comm.). However, geographic isolation and dependence on unique climatic conditions makes these forests vulnerable.

Suggested Priority for Further Protection of Community: Fairly High (Note: Most examples are currently protected)

Table 12. Conservation areas in West Texas, with types of vegetation occurring within each area.

Conservation Area	Vegetation Types Occurring in Area	Acreage of Area	Source
Amistad National Recreation Area (NPS)	55 (50%),56 (10%), 79 (10%),101 (3%), 104 (25%)	14,000 (land)	Larson pers. comm.
Balmorea State Park (TPWD)	94,95,101,102	46	TPWD 1996
Big Bend National Park and Rio Grande National Wild and Scenic River (NPS), Brushy Canyon Preserve (TNC), Black Gap State WMA (TPWD), and Christmas Mountains Ranch (GLO)	91 (1%),99 (1%),100 (33%),101 (1%),102 (<1%),103 (1%),104 (40%),105 (<1%),106 and 113 (11%),107 (6%),108 (<1%),111, 112,115 (<1%),116 (<1%),118 (<1%),119 and 120 (<1%)	810,763 (NPS), 9,825 (TNC), 106,915 (TPWD) and 9,269 (GLO)	Plumb 1988; Powell and Whitefield 1994; Cooke, Karges pers. comm.
Big Bend Ranch State Park (TPWD)	92 (<1%), 99 (2%),100 (50%),101,102 (2%), 103,104 (35%),106, 108,109,110,114,115	293,028	TPWD 1996, Yancey 1997, Alloway pers. comm.
Chandler Family Independence Creek Preserve (TNC and conservation easement)	104,109,110,115	1,358 (TNC) 701 (easement)	Karges pers. comm.
Chinati Mountains State Natural Area (TPWD)	100,103,104,106,108, 114,116,118	37,885	McNamara pers. comm.
Davis Mountains Preserve (TNC)	108 (2%),112,113 (20%),118 (25%),119 (>5%),120 (<50%)	18,127	Karges pers. comm.
Davis Mountains State Park (TPWD) and Fort Davis National Historic Site (NPS)	102 (<1%),108 (5%), 113 (35%),112,114, 116 (30%),118 (20%)	2,677 (TPWD) 460 (NPS)	TPWD 1996, 1990i
Diamond Y Spring Preserve (TNC)	93,94 (45%),95 (13%), 100,104,110	1,501	Karges pers. comm.
Elephant Mountain State Park and WMA (TPWD)	94 (5%), 99 (5%), 100 (35%),104 (4%),106 (15%),108 (5%),109 (15%),115 (15%)	23,147	TPWD 1996
Fort Leaton State Historical Park (TPWD)	100,101,102	18	TPWD 1996
Franklin Mountains State Park (TPWD)	100 (19%),103,104 (35%),106 (45%),115 (<1%)	23,863	TPWD 1996, Worthington pers. comm.

Guadalupe Mountains National Park (NPS) and Gypsum Dunes Preserve (TNC/Hudspeth Directive)	92 (2%),94 (5%),96 (2%),97,100 (22%), 103 (<1%),104 (25%), 106,108,109,110 (<1%),111 (1%),115 (25%),116,117 (<1%), 118 (5%),119 (1%?), 120 (11%)	86,400 (NPS) and 229 (TNC)	Glass et al. 1974; Armstrong, Karges pers. comm.
Hueco Tanks State Historical Park (TPWD)	100 (46%),106 (<1%), 115 (<1%)	860	TPWD 1996
Las Palomas State WMA, Ocotillo Unit (TPWD)	100 (70%),102 (28%)	2,082	TPWD 1996
Madera Canyon Preserve (TNC)	108 and 114 (25%), 112,113 and 118 (66%),117 (5%),120 (<1%)	2,240	Karges pers. comm.
Monahans Sandhills State Park (TPWD)	94 (<1%),97 (26%),98 (73%)	3,840	TPWD 1996
Sandia Springs Preserve (TNC)	92 (50%),95 (<5%), 100 and 104 (25%), 103 (5%),110	242	Karges pers. comm.
Seminole Canyon State Historical Park (TPWD)	56 (25%),57 16%),58 (38%),70,99 (6%),100 (5%),101 (6%),103 (1%)	2,173	Labus 1989, TPWD 1996
Sierra Diablo State WMA (TPWD)	103 (6%),104,106 (29%),111,114,116 (65%)	11,631	Sikes and Smith 1973, TPWD 1996
Total: 1,462,579 acres (6.2 percent of region)			
Abbreviations of Managing Entities: NPS=National Park Service TPWD=Texas Parks and Wildlife Dept.			
TNC=Nature Conservancy of Texas GLO=Texas General Land Office			