PLANTS OF BITTER LAKE NATIONAL WILDLIFE REFUGE, CHAVES COUNTY, NEW MEXICO

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The three tracts of Bitter Lake National Wildlife Refuge are on the Pecos River, east and northeast of Roswell in southeastern New Mexico, near the western edge of the Great Plains. The Refuge encompasses about 9,920 hectares (24,520 acres). In addition to the river floodplain and the tributary Salt Creek valley, the Refuge includes uplands that rise 66 m above the river, to 1120 m elevation, in places with steep cliffs of Permian gypseous rock. Soils are derived either from these Permian strata or from river deposits; both sources are saline. Several sinkholes and a large playa contain highly salty water. The river, two streams, and several artificial lakes vary from nearly fresh to somewhat saline.

The North Tract includes the broad valley of Salt Creek, a major but ephemeral tributary of the Pecos from the west. North of the creek are the Red Bluffs of steep, raw gypseous rock, and at their foot are several sinkholes including the deep, steep-walled Inkpot. East of the Pecos in the North Tract are extensive grasslands with a small playa, surrounded by sands to the west and by low gravelly hills to the south and east. Most of the North Tract is designated as the Salt Creek Wilderness. Within the wilderness is Inkpot Research Natural Area. The Middle Tract has Bitter Lake, a large, natural but newly developed saline playa fed from the west by Bitter River. This stream and nearby sinkhole springs (notably Sago Spring) are centers of diverse animal and plant life. North of Bitter Lake is a plateau of thinly covered gypseous rock with many sinkholes, including Lake St. Francis. The Pecos floodplain is broad in the Middle Tract and is the site of several large artificial lakes managed for waterfowl and of extensive marshlands as well as grasslands and abandoned crop-fields. There are springs above (west of) the lakes. East of the Pecos are the north-south Comanche Bluffs of reddish, gypseous rock, through which cut several steep-walled canyons. Within the Middle Tract are the headquarters area, Bitter Lake Research Natural Area, and Lake St. Francis Research Natural Area. The smaller South Tract is within the river floodplain and is used mainly for raising grain crops for waterfowl.

The climate is warm, with mean temperature 14º C (58º F). Average precipitation is 250 mm (10 inches) measured at the Refuge, or 330 mm (13 in.) measured over a longer period near Roswell; most comes as rainfall from May through August. Sunshine averages 70% of the amount possible for the year.

Vegetation of the Refuge is adapted to the low and variable rainfall, great range of temperatures, high salinity, and gypseous substrates. Alkali sacaton (*Sporobolus airoides*) is the principal dominant of both bottomlands and uplands, in pure stands or mixed with a variety of grasses, forbs, and shrubs. Saltcedar (*Tamarix chinensis*) has invaded in recent decades and has changed the appearance of streambanks and other bottomlands, and is a factor in preventing re-establishment of native cottonwood bosque (but salinity, fire, and beavers have also been factors).

At the margins of lakes, river, and streams and in other wet areas grow bulrushes (*Scirpus* spp.), spikerushes (*Eleocharis* spp.), cattails (*Typha angustifolia*), Pecos sunflower (*Helianthus paradoxus*), coyote willow (*Salix exigua*), willow baccharis (*Baccharis salicina*), saltgrass (*Distichlis spicata*), and reeds (*Phragmites australis*) as well as the invasive saltcedar and a remnant of cottonwood (*Populus deltoides* var. *wislizenii*). Greenmolly (*Kochia scoparia*) is an invasive dominant. Stands of cordgrass (*Spartina pectinata*) dominate springs west of the artificial lakes.

Sinkhole pools are dominated by stoneworts (*Chara* spp.) and widgeon-grass (*Ruppia maritima*). Alkali flats are dominated by seepweeds (*Suaeda* spp.), sea lavender (*Limonium limbatum*), sea purslane (*Sesuvium verrucosum*), and iodine bush (*Allenrolfea occidentalis*), with grasses (saltgrass and alkali sacaton) and *Pseudoclappia arenaria* in less severe sites.

Sandy soils exist on the river floodplain and in a few upland areas. Dropseeds (*Sporobolus* spp.) and windmill grasses (*Chloris* spp.) dominate on sand, with the common forbs spectaclepod (*Dimorphocarpa wislizenii*), woolly dalea (*Dalea lanata*), western ragweed (*Ambrosia psilostachya*), annual buckwheat (*Eriogonum annuum*), Indian blanket (*Gaillardia pulchella*), Tahoka daisy (*Machaeranthera tanacetifolia*), and *Palafoxia sphacelata*. Mesquite (*Prosopis glandulosa*) hummocks occupy the deepest sands of the North Tract.

Non-sandy uplands are dominated by mixed grasses of which alkali sacaton, tobosa (*Hilaria mutica*), galleta (*Hilaria jamesii*), three-awns (*Aristida* spp.), gramas (*Bouteloua* spp.), false buffalo grass (*Munroa squarrosa*), and burro grass (*Scleropogon brevifolius*) are most common. Large areas may earlier have been dominated by black grama (*Bouteloua eriopoda*), which persists in patches. Common shrubs and half-shrubs are mesquite, four-wing saltbush (*Atriplex canescens*), perennial snakeweeds (*Gutierrezia* spp.), and jimmyweed (*Isocoma pluriflora*). *Calylophus* spp., blackfoot daisy (*Melampodium leucanthum*), and pepperweed (*Lepidium alyssoidesl*) are conspicuous forbs on uplands, with *Sartwellia flaveriae* abundant most years. Strongly gypseous sites have a specialized flora that includes gyp grass (*Sporobolus nealleyi*), gyp grama (*Bouteloua breviseta*), gyp bush (*Tiquilia hispidissima*), gyp ringstem (*Anulocaulis gypsogenus*), and *Nerisyrenia linearifolia.*

Of 381 taxa (375 species) that we have recorded from the Refuge, 28, or 7%, are not native to New Mexico. For comparison, 67 of 586, or 11%, of taxa that we recorded from Bosque del Apache National Wildlife Refuge in south-central New Mexico are introduced. In the sand shinnery, a vegetation type studied 60 km east of Bitter Lake Refuge, 5 of 169 (3%) of taxa are introduced; that area, the Mescalero Sands, lacks surface water and has less disturbed ground than do the Refuges (Peterson, unpublished data).

A 1937 vegetation map and flora of the Refuge (Campbell 1937) record about 200 species, many of them different from those that we have found. It is not easy to sort out real changes from the results of misidentifications. *Acacia constricta, Artemisia carruthii* (as *A. wrightii*), *Baccharis salicifolia* (as *B. glutinosa*), *B. sarothroides, Ceanothus greggii, Chrysothamnus viscidiflorus, Chilopsis linearis, Clematis drummondii, Eurotia lanata*, *Flourensia cernua, Frankenia jamesii, Hippuris vulgaris*, *Hymenoclea monogyna, Isocoma tenuisecta* (as *Haplopappus hartwegii*), *Koeberlinia spinosa*, *Prunus minutiflora*, and *Tetradymia canescens* were listed as prominent plants but we have not found them.

We studied the Refuge's flora from 1982 through 1986. Visits since 1986 have been brief but have led to additions to the Refuge flora, and there are surely more species to be found. The South Tract was added to the Refuge in 1988 and has not been surveyed carefully, but it is within the river floodplain and seems unlikely to offer additional species. In 1998 Gordon Warrick, Refuge biologist, invited Peterson to see *Cirsium wrightii*, growing to 2.5 m tall in two locations where we could not possibly have missed it in the 1980's; it has apparently arrived on its own in recent years. Nearly all taxa known for the Refuge are represented in a post-binder herbarium kept at Refuge headquarters; many are also in the New Mexico Natural History Institute herbarium at the Randall Davey Audubon Center in Santa Fe.

Although not used first in all instances, names used by Allred (2001) are included for all taxa in the following list. Names of cacti follow Weniger (1984).

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List of Vascular Plant Species

FERN ALLIES

Equisitaceae
Equisetum hyemale L. Banks of the Pecos. North and Middle Tracts.

GYMNOSPERMS

Ephedraceae
Ephedra torreyana S. Wats. Widespread in uplands.

ANGIOSPERMS

(Agavaceae: see Liliaceae)

Aizoaceae
Sesuvium verrucosum Raf. Common, sometimes dominant, on alkali flats.

Amaranthaceae
Amaranthus arenicola I. M. Johnston. Common on sand in the North Tract.
Amaranthus crassipes Schlecht. Occasional in mud-holes.
Amaranthus hybridus L. Common in abandoned crop-fields.
Amaranthus palmeri S. Wats. Occasional on disturbed ground.
Amaranthus retroflexus L. Occasional on disturbed ground.
Amaranthus wrightii S. Wats. Occasional on disturbed ground.
Tidestroemia lanuginosa (Nutt.) Standl. Widespread, especially on disturbed ground.

(Amaryllidaceae: see Liliaceae)

Anacardiaceae
Rhus microphylla Engelm. Rare in canyons of Comanche Bluffs (Middle Tract).
Rhus trilobata Nutt. Occasional in canyons and on bluffs.

Apiaceae (Umbelliferae of Refuge herbarium)
Ammoselinum popei Torr. & Gray Occasional on sand, playas, abandoned fields.
Berula erecta (Huds.) Cov. Rare; by canals of Middle Tract.
Eurytaenia texana Torr. & Gray. Rare (missing, most years) on sand, east side North Tract.

Apocynaceae
Apocynum cannabinum L. *sensu lato.* Common on riverbanks and wet areas.

Asclepiadaceae
Asclepias brachystephana Engelm. *ex* Torr. Occasional in grasslands.
Asclepias latifolia (Torr.) Raf. Occasional in lowland grassland and on disturbed ground.
Asclepias nyctaginifolia A. Gray. Uncommon in uplands.
Asclepias oenotheroides Cham. & Schlecht. Occasional in grasslands of North Tract.
Asclepias speciosa Torr. In one wet depression south of Bitter Lake.
Asclepias subverticillata (Gray) Vail. Common by roads and in wet areas.

Asteraceae (Compositae of Refuge herbarium)
Ambrosia acanthicarpa Hook. Occasional on roadsides, disturbed ground, and sand.
Ambrosia psilostachya DC. Widespread; common on sand.

Aphanostephus ramosissimus DC. Mainly on sand; also with alkali sacaton.
Artemisia bigelovii A. Gray. Occasional on cliffs and canyon walls.
Artemisia dracunculus L. Very localized; dominant in a few washes.
Artemisia filifolia Torr. Common on upland sands.
Artemisia ludoviciana Nutt. Occasional in canyons and on bluffs.
Aster ericoides L. [*Symphyotrichum ericoides* (L.) Nesom.] Occasional in moist areas.
Aster pauciflorus Nutt. [*Almutaster pauciflorus* (Nutt.) Löve & Löve. Marsh east of headquarters (Middle Tract).
Aster spinosus Benth. [*Chloracantha spinosa* (Benth.) Nesom.] Common on riverbanks and in wet areas. Spines almost lacking.
Aster subulatus Michx. incl. *A. exilis* Ell. [*Symphyotrichum subulatum* (Michx.) Nesom.] Occasional in wet areas, mostly near the Pecos.
Baccharis pteronioides DC. Uncommon on upland slopes.
Baccharis salicina Torr. & Gray. Abundant on riverbanks, moist areas, lowlands.
Baccharis wrightii A. Gray. Occasional in uplands, particularly near Red Bluffs (North Tract).
Bahia pedata A. Gray. Common in uplands.
Baileya multiradiata Harv. & Gray. Common, especially on sand.
Berlandiera lyrata Benth. Frequent in uplands, especially on gypseous sites.
Brickellia californica (Torr. & Gray) Gray. Rare in canyons of east side of Middle Tract.
Brickellia eupatorioides (L.) Shinners var. *chlorolepis* (Woot. & Standl.) B. Turner [*Kuhnia eupatorioides* L.]. Common in a few washes and uplands.
Brickellia grandiflora (Hook.) Nutt. Occasional in canyons.
Brickellia laciniata A. Gray. In a wash near northeast corner of Middle Tract.
Centaurea americana Nutt. Occasional in washes, depressions, and sand.
Chrysothamnus nauseosus (Pall. *ex* Pursh) Britt. [*Ericameria nauseosa* Nesom & Baird.] Noted in 1981 but no specimen taken; not found during our 1982-1986 study nor since. Also listed in 1937. Included tentatively.
Cirsium ochrocentrum A. Gray. Occasional, widespread.
Cirsium wrightii A. Gray. Two locations in 1998, one near and one south of headquarters (Middle Tract). To 2.5 m tall.
Conyza canadensis (L.) Cronquist. Widespread and common, especially in wet areas.
Conyza coulteri A. Gray. [*Laennecia coulteri* (Gray) Nesom.] Widespread, locally common.
[*Crepis ?runcinata* (James) Torr. & Gray. The record is Castetter 9470, at the Univerisity of New Mexico, a bare flowering scape collected in 1951. Not counted in flora.]
Dicranocarpus parviflorus A. Gray. Abundant 1 year in the past 20; usually rare in uplands.
Dyssodia acerosa DC. [*Thymophylla acerosa* (DC.) Strother.] Abundant on upland ridges and slopes.
Dyssodia aurea (Gray) A. Nels. [*Thymophylla aurea* (Gray) Greene.] Disturbed sites; rare.
Dyssodia pentachaeta (DC.) B. L. Robinson. [*Thymophylla pentachaeta* (DC.) Small.] Occasional in gravelly uplands.
Erigeron bellidiastrum Nutt. Occasional, mostly on sandy soils.
Erigeron divergens Torr. & Gray. Occasional, widespread.
Evax verna Raf. including *E. multicaulis* DC. Occasional in grassland.
Flaveria campestris J. R. Johnston. Occasional on disturbed ground.
Flaveria chloraefolia A. Gray. Common around Bitter River and Sago Spring (Middle Tract).
Gaillardia pinnatifida Torr. Common in uplands, especially on gypseous sites.
Gaillardia pulchella Foug. Common in some years on sand.

Grindelia nuda Alph. Wood var. *aphanactis* (Rydb.) Nesom. Occasional in grassland and on disturbed ground.
Gutierrezia microcephala (DC.) A. Gray. Common in grass-shrub steppe.
Gutierrezia sarothrae (Pursh) Britt. & Rusby. Common in uplands, especially gravelly soil.
Gutierrezia sphaerocephala A. Gray (or intermediates to *G. texana* (DC.) Torr. & Gray*).* Widespread; common in grassland.
[*Helenium microcephalum* DC. occurs a few meters north of North Tract.]
Helianthus annuus L. Common on sandy sites, to 2+ m tall.
Helianthus ciliaris DC. Common in depressions.
Helianthus paradoxus Heiser. Locally dominant in moist areas around river and lakes.
Helianthus petiolaris Nutt. Occasional in grasslands, sandy, and disturbed areas.
Heterotheca latifolia Buckl. Common and locally abundant on sand of river floodplain.
Hymenopappus flavescens A. Gray. Locally common on sand.
Hymenoxys linearifolia Hook. Widespread, especially with lowland alkali sacaton.
Hymenoxys odorata DC. Abundant some years on playas and mudflats, east North Tract.
Hymenoxys scaposa (DC.) Parker. [*Tetraneuris scaposa* (DC.) Grne.] Occasional in uplands, mostly in Red Bluffs area of North Tract.
Isocoma pluriflora (Torr. & Gray) Grne. Widespread, abundant, often codominant with alkali sacaton.
Iva dealbata A. Gray. Occasional in depressions on disturbed ground.
Lactuca serriola L. Occasional on disturbed ground and sand.
Leucelene ericoides (Torr.) Grne. [*Chaetopappa ericoides* (Torr.) Nesom.] Occasional in uplands.
Lygodesmia texana (Torr. & Gray) Grne. Rare in grasslands.
Machaeranthera pinnatifida (Hook.) Shinners *sensu lato.* Common throughout uplands.
Machaeranthera tanacetifolia (H.B.K.) Nees. Widespread, common, mostly on sand.
Machaeranthera viscida (Woot. & Standl.) Hartman. [*M. havardii* (Waterfall) Shinners.] Widespread, occasional.
Melampodium leucanthum Torr. &Gray. Common throughout uplands.
Palafoxia sphacelata (Nutt. *ex* Torr.) Cory. Common on sand.
Pectis angustifolia Torr. Widespread; abundant some years.
Perezia nana A. Gray. [*Acourtia nana* (Gray) Reveal & King.] Common in uplands.
Pseudoclappia arenaria Rydb. Common in moist areas; occasional in uplands.
Psilostrophe tagetina (Nutt.) Grne. Common in uplands, especially on sandy soils.
Ratibida columnifera (Nutt.) Woot. & Standl. Occasional in uplands.
Ratibida tagetes (James) Barnh. Occasional on disturbed ground.
Sartwellia flaveriae A. Gray. Occasional throughout gypseous uplands; abundant most years on disturbed sites of Middle Tract.
Senecio flaccidus Less. var. *douglasii* (DC.) B. Turner & T. Barkley. Occasional in grasslands.
Senecio flaccidus Less. var. *flaccidus.* Occasional in grasslands.
Senecio riddellii Torr. & Gray. Common in grasslands.
Sonchus asper (L.) Hill. Occasional on disturbed ground in moist areas.
Stephanomeria pauciflora (Torr.) A. Nels. Occasional in uplands.
Thelesperma megapotamicum (Spreng.) O. Ktze. Common in uplands.
Tragopogon dubius Scop. Occasional on lowland disturbed ground.
Verbesina encelioides (Cav.) Benth. & Hook. *ex* A. Gray var. *encelioides*. Often abundant

on disturbed ground.
Verbesina encelioides var. *exauriculata* Robins. & Greenm. Occasional, disturbed ground.
Verbesina nana (A. Gray) Robins. & Greenm. Occasional in uplands (dominant in small patches) including disturbed ground.
Xanthium strumarium L. Often abundant on moist sites, especially river sandbars.
Zinnia grandiflora Nutt. Occasional in uplands.

Boraginaceae
Cryptantha cinerea (Torr.) Cronq. var. *jamesii* (Torr.) Cronq. Occasional in uplands.
Cryptantha crassisepala (Torr. & Gray) Grne. Common in uplands.
Heliotropium convolvulaceum (Nutt.) Gray. Occasional on sand.
Heliotropium curassavicum L. Common on mudflats and other depressions.
Lappula redowskii (Hornem.) Grne. Widespread and common in uplands.
Lithospermum incisum Lehm. Occasional in uplands, including gypseous sites.
Tiquilia canescens (DC.) A. Richardson. Rare in north-center of North Tract.
Tiquilia hispidissima (Torr. & Gray) A. Richardson. A dominant on strongly gypseous sites.

Brassicaceae
Descurainia pinnata (Walt.) Britt. Widespread; common in lowland disturbed areas.
Dimorphocarpa wislizenii (Engelm.) Rollins. Common on sand; occasional in grassland.
Draba cuneifolia Nutt. *ex* Torr. & Gray. Abundant in uplands, especially on gravelly slopes.
Lepidium alyssoides A. Gray var. *angustifolium* (C. L. Hitchc.) Rollins. Widespread and abundant in uplands, especially in washes on gypseous sites.
Lepidium lasiocarpum Nutt. var. *wrightii* (Gray) C. L. Hitchcock. Occasional, disturbed sites.
Lesquerella fendleri (A. Gray) S. Wats. Common in uplands.
Lesquerella gordonii (A. Gray) S. Wats. Locally abundant in depressions and on sand.
Nerisyrenia linearifolia (S. Wats.) Grne. Common in gypseous uplands.
Rorippa sinuata (Nutt.) C. L. Hitchcock. Common in disturbed or wet lowlands.
Sisymbrium irio L. Occasional in disturbed areas.

Cactaceae
Echinocactus texensis Höpf. Occasional in grasslands, mostly in North Tract.
Echinocereus caespitosus Engelm. [*Echinocereus reichenbachii* (Terscheck) Haage.] Common near the Red Bluffs (North Tract).
Echinocereus triglochidiatus Engelm. *sensu lato.* A single multi-stemmed plant west of headquarters (Middle Tract), perhaps an old planting.
Mammillaria macromeris Engelm. [*Coryphantha macromeris* (Engelm.) Britt. & Rose.] Uncommon in North and Middle Tracts.
Opuntia imbricata (Haw.) DC. Occasional in uplands.
Opuntia leptocaulis DC. Occasional in uplands.
Opuntia phaeacantha Engelm. Occasional in uplands.
Opuntia davisii Engelm. [*Opuntia tunicata* (Lehm.) Link & Otto var. *davisii* (Engelm.) L. Benson.] One old plant, now dead, on sand of North Tract, east side.
Opuntia macrocentra Engelm. [*Opuntia violacea* Engelm. var. *macrocentra* (Engelm.) L. Benson.] Occasional in uplands.
Opuntia polyacantha Haw. Occasional in *Sporobolus airoides* grassland, North Tract.

(Caesalpinaceae: see Fabaceae.)

Chenopodiaceae

Allenrolfea occidentalis (S. Wats.) O. Ktze. Common (often dominant) in saline lowlands.
Atriplex argentea Nutt. Common in mud-holes and other moist sites.
Atriplex canescens (Pursh) Nutt. Common in both lowland and upland grasslands.
Atriplex prostrata Boucher ex DC. Occasional in lowlands of Middle Tract.
Bassia hyssopifolia (Pall.) O. Ktze. Common in moist sites.
Chenopodium albescens Small. Occasional in poorly drained areas.
Chenopodium album L. Uncommon on disturbed ground and poorly drained areas.
Chenopodium berlandieri Moq. Common on sand.
Cycloloma atriplicifolia (Spreng.) Coult. Common on sand.
Kochia scoparia (L.) Roth. Abundant, sometimes in pure stands on disturbed areas; to 2+ m tall in moist sites.
Salicornia bigelovii Torr. Common in moist, alkaline areas including Bitter Lake.
Salicornia utahensis Tidestr. Common in moist, alkaline areas including Bitter Lake.
Salsola tragus L. Abundant in some lowland disturbed areas.
Suaeda calceoliformis (Hook.) Moq. including *S. depressa* var. *erecta* S. Wats. Common in moist, alkaline areas, including the shore of Bitter Lake.
Suaeda mouquinii (Torr.) Greene incl. *S. torreyana* Wats. Common in moist, alkaline areas.

Commelinaceae

Commelina erecta L. Occasional on sand in floodplains and washes.

(Compositae: see Asteraceae)

Convolvulaceae

Convolvulus equitans Benth. Occasional in uplands.
Cressa truxillensis H.B.K. Occasional to locally dominant in lowlands.
Evolvulus nuttallianus Roem. & Schult. Uncommon, mostly on sand.

(Cruciferae: see Brassicaceae)

Cucurbitaceae

Apodanthera undulata A. Gray. One plant by road. Also on 1937 list.
Cucurbita foetidissima H.B.K. Occasional on sand and gravel.

Cuscutaceae

Cuscuta indecora Choisy. Occasional. Parasitic on *Helianthus*, *Gutierrezia*, other plants.
Cuscuta leptantha Engelm. Occasional. Parasitic on *Euphorbia* spp. and other plants.

Cyperaceae

Cyperus esculentus L. Common in moist areas near river.
Eleocharis palustris (L.) Roemer & Schultes. Common beside fresh waters.
Eleocharis rostellata (Torr.) Torr. Occasional beside fresh waters.
Fimbristylis spadicea (L.) Vahl. [*Fimbristylis puberula* (Michx.) Vahl var. *interior* (Britt.) Kral.] In marsh near headquarters (with *Cirsium wrightii*).
Scirpus americanus Pers. [*Schoenoplectus americanus* (Pers.) Volkart.] Emergent or near water; common.
Scirpus maritimus L. [*Schoenoplectus maritimus* (L.) K. Lye.] Occasional in wet areas of the Middle Tract.

Scirpus pungens Vahl. [*Schoenoplectus pungens* (Vahl) Palla.] Abundant in wet areas.

Eleagnaceae

Eleagnus angustifolia L. Occasional in moist areas, especially by river in North Tract.

Euphorbiaceae

Argythamnia humilis (Engelm. & Gray) Muell. Arg. var. *laevis* (Torr.) Shinners. [*Ditaxis laevis* (Torr.) Heller.] Rare in gypseous sites including dry sinkholes.
Croton dioicus Cav. Occasional in uplands.
Croton pottsii (Kl.) Muell. Arg. Locally common in uplands, especially degraded grasslands.
Croton texensis (Kl.) Muell. Arg. Especially common on arroyo sand.
Euphorbia albomarginata Torr. & Gray. [*Chamaesyce albomarginata* (T.& G.) Small.] Common on disturbed ground.
Euphorbia dentata Michx. Widespread and locally abundant in uplands.
Euphorbia fendleri Torr. & Gray var. *chaetocalyx* Boiss. [*Chamaesyce chaetocalyx* (Boiss.) Woot. & Standl.] Occasional in uplands.
Euphorbia fendleri Torr. & Gray var. *fendleri*. [*Chamaesyce fendleri* (T. & G.) Small.] Common in uplands.
Euphorbia lata Engelm. [*Chamaesyce lata* (Engelm.) Small.] Widespread, occasional.
Euphorbia micromera Boiss. *ex* Engelm. [*Chamaesyce micromera* (Engelm.) Woot. & Standl.] Occasional on sand.
Euphorbia missurica Raf. [*Chamaesyce missurica* (Raf.) Shinners.] Occasional in uplands, including sand.
Euphorbia serpens H.B.K. [*Chamaesyce serpens* (H.B.K.) Small.] Disturbed ground including long-abandoned crop-fields, North Tract.
Euphorbia serpyllifolia Pers. [*Chamaesyce serpyllifolia* (Pers.) Small.] Occasional in grass-lands and on arroyo sand.
Euphorbia serrula Engelm. [*Chamaesyce serrula* (Engelm.) Woot. & Standl.] Common in uplands.
Euphorbia spathulata Lam. Widespread, occasional, including strongly gypseous sites.
Euphorbia stictospora Engelm. [*Chamaesyce stictospora* (Engelm.) Small.] Occasional in uplands including strongly gypseous sites.

Fabaceae, including Caesalpinaceae and Mimosaceae (Leguminosae of Refuge herbarium)

Astragalus kentrophyta A. Gray. Occasional in uplands of NorthTract.
Astragalus lentiginosus Dougl. *ex* Hook. Occasional in lowland grasslands.
Astragalus mollisimus Torr. Occasional in grasslands.
Astragalus nuttallianus DC. Widespread, occasional.
Astragalus praelongus Sheldon. Occasional in Middle Tract, including roadsides.
Caesalpinia gilliesii (Hook.) Benth. A few plants escaped or persisting Middle Tract.
Caesalpinia jamesii (Torr. & Gray) Fisher. Occasional in uplands.
Cassia roemeriana Scheele. Scattered to abundant in grasslands and disturbed areas.
Dalea candida Willd. Occasional in lowland grasslands.
Dalea formosa Torr. Scattered in uplands, especially on cliffs.
Dalea jamesii (Torr.) Torr. & Gray. Occasional in uplands.
Dalea lanata Spreng. Common on sand.
Gleditisia triacanthos L. One grove, a male clone, persisting and spreading from cultivation; west of headquarters (Middle Tract). A single female tree in a dry sinkhole nearby.

Glycyrrhiza lepidota Nutt. *ex* Pursh. Common near water, especially on riverbank sand.
Hoffmannseggia glauca (Ortega) Eifert. Occasional in uplands.
Medicago sativa L. Occasional in South Tract, where escaped from cultivation.
Melilotus albus Medicus. Occasional in moist and disturbed areas.
Mimosa borealis A. Gray. A few groups in hills of North Tract.
Oxytropis lambertii Pursh. On Comanche Bluffs (east side of Middle Tract).
Prosopis glandulosa Torr. Widespread and often dominant. Shapes the ground in sandy hummock areas of North Tract.
Sophora nuttalliana B. L. Turner. Moist depressions on east side of North Tract.

Fumariaceae
Corydalis aurea Willd. Rare in canyons and on north-facing slopes.

Gentianaceae
Centaurium texense (Griseb.) Fern. Occasional on alkaline and gypseous sites.
Eustoma exaltatum (L.) Salisb. *ex* G. Don. Wet sites in the Middle Tract.

Geraniaceae
Erodium texanum A. Gray. Occasional in uplands.

(Gramineae: see Poaceae)

Hydrophyllaceae
Nama hispidum A. Gray. Occasional in uplands.
Phacelia integrifolia Torr. Widespread and abundant, especially on sand.
Phacelia popei Torr. & Gray, including *Phacelia depauperata* Woot. & Standl. Rare, Salt Creek Valley (North Tract).

Juncaceae
Juncus mexicanus Willd. Common in wet areas.
Juncus torreyi Cov. Occasional, especially on riverbanks.

Juncaginaceae
Triglochin maritima L. Occasional in wet sites of Middle Tract; abundant near Bitter River.

Krameriaceae
Krameria lanceolata Torr. Occasional on hills and bluffs, rare in grassland.

(Labiatae: see Lamiaceae)

Lamiaceae (Labiatae of Refuge herbarium)
Marrubium vulgare L. Uncommon on disturbed ground.
Monarda pectinata Nutt. Occasional with lowland alkali sacaton.
Salvia reflexa Hornem. Occasional in grassland and on disturbed ground.
Scutellaria drummondii Benth. Widespread, occasional.
Teucrium laciniatum Torr. Occasional in grasslands.

(Leguminosae: see Fabaceae)

Liliaceae
Allium perdulce Fraser. Widespread in uplands.
Asparagus officinalis L. Occasional in moist sites.
Yucca glauca Nutt. Common in uplands.

Zephyranthes longifolia Hemsl. Occasional (sprouting after heavy rains) in grasslands.

Linaceae

Linum aristatum Engelm. Occasional in upland grasslands.
Linum puberulum (Engelm.) Heller. Occasional in upland grasslands.
Linum rigidum Pursh. Occasional in grasslands.

Loasaceae

Cevallia sinuata Lag. Occasional in washes and on cliffs.
Mentzelia humilis (A. Gray) J. Darl. Occasional in uplands, especially on gypsum.
Mentzelia multiflora (Nutt.) A. Gray. Occasional in uplands and on disturbed ground.
Mentzelia strictissima (Woot. & Standl.) J. Darl. Occasional, widespread, often on sand.

Malvaceae

Malvella leprosa (Ortega) Krapovickas. On mudflats, especially eastern North Tract.
Sphaeralcea angustifolia (Cav.) G. Don. Common, mainly in canyons and on slopes.
Sphaeralcea coccinea (Nutt.) Rydb. Occasional in uplands.

Molluginaceae

Mollugo verticillata L. Rare, usually on disturbed or bare ground.

Moraceae

Morus alba L. A few trees, planted or escaped, in Unit 7 (Middle Tract).

Nyctaginaceae

Abronia fragrans Nutt. Occasional on sand.
Allionia choisya Standl. Occasional on sand.
Allionia incarnata L. Common in uplands on sand and on gypseous sites.
Anulocaulis gypsogenus Waterfall. Common on strongly gypseous sites.
Boerhaavia spicata Choisy including *B. torreyana* (Wats.) Standl. Common in uplands, especially canyons and sandy sites.
Mirabilis glabra (S. Wats.) Standl. [*Oxybaphus glaber* S. Wats.] Sandy soil, North Tract.
Mirabilis linearis (Pursh) Heimerl. [*Oxybaphus linearis* (Pursh) Robins.] Occasional in uplands. Both variety *linearis* and variety *decipiens*, if recognized, are present.
Selinocarpus diffusus A. Gray. A few plants in the North Tract.
Selinocarpus lanceolatus Woot. Occasional in gypseous uplands.

Oleaceae

Forestiera pubescens Nutt. var. *glabrifolia* Shinners. Occasional in moist sites.
Menodora scabra A. Gray. Rare in uplands.

Onagraceae

Calylophus hartwegii (Benth.) Raven. Occasional in grasslands.
Calylophus tubicula (Gray) Raven. Common in grasslands and on disturbed ground.
Gaura coccinea Pursh. Occasional in uplands.
Gaura parviflora Dougl. *ex* Hook. [*Gaura mollis* James.] Occasional on disturbed ground and on moist sites.
Gaura villosa Torr. Occasional on sand, east side of North Tract.
Oenothera albicaulis Pursh. Common on sand.
Oenothera caespitosa Nutt. Occasional on cliffs and disturbed ground and in grassland.

Orobanchaceae
Orobanche multiflora Nutt. Occasional, mostly on sandy and gypseous sites.

Papaveraceae
Argemone ?squarrosa Grne. Rare on sand, in disturbed sites, and on grassland.

Pedaliaceae
Proboscidea louisianica (Mill.) Thell. Occasional on sand.

Plantaginaceae
Plantago patagonica Jacq. Widespread; abundant some years in uplands.

Plumbaginaceae
Limonium limbatum Small. Abundant on alkali flats and moist sites.

Poaceae (Gramineae of Refuge herbarium)
Andropogon gerardii Vitman *sensu lato*. Rare amid mesquite hummocks, North Tract.
Aristida havardii Vasey. Occasional in uplands.
Aristida purpurea Nutt. var. *fendleriana* (Steud.) Vasey. Uplands.
Aristida purpurea Nutt. var. *longiseta* (Steud.) Vasey. Common in grasslands, roadsides.
Aristida purpurea Nutt. var. *purpurea*. Occasional in grasslands.
Aristida purpurea Nutt. var. *wrightii* (Nash) Allred. Uplands.
Bothriochloa barbinodis (Lag.) Herter. Occasional in washes and along roads.
Bothriochloa laguroides (DC.) Herter. Occasional in washes, on cliffs, and by roads.
Bothriochloa springfieldii (Gould) Parodi. Occasional in lowlands.
Bouteloua barbata Lag. Widespread, especially in disturbed sandy areas.
Bouteloua breviseta Vasey. Dominant (with *Sporobolus nealleyi*) on gypseous sites.
Bouteloua curtipendula (Michx.) Torr. Common in canyons and on north slopes.
Bouteloua eriopoda (Torr.) Torr. Common in uplands.
Bouteloua gracilis (H.B.K.) Lag. *ex* Steudel. Occasional in uplands.
Buchloë dactyloides (Nutt.) Engelm. Occasional in poorly drained upland sites.
Cenchrus incertus M. A. Curtis. Common on sand.
Chloris cucullata Bisch. Common on sand.
Chloris virgata Sw. Common on disturbed areas and on sand.
Cynodon dactylon (L.) Pers. Occasional on river floodplain.
Distichlis spicata (L.) Grne. Abundant on alkali flats and near water; occasional elsewhere.
Echinochloa muricata (Beauv.) Fern. Occasional on mudflats and disturbed sites. *E. crus-galli* (L.) Beauv. likely also present, but not distinguished.
Elymus canadensis L. Occasional near the Pecos and Salt Creek.
Elymus longifolius (Smith) Gould. Occasional in washes, canyons, uplands.
Elymus smithii (Rydb.) Gould. Occasional in lowlands.
Enneapogon desvauxii Beauv. Common in uplands, especially on gypseous sites.
Eragrostis barrelieri Daveau. Occasional in disturbed areas.
Eragrostis cilianensis (All.) Lut. *ex* Janchen. Occasional in disturbed and sandy areas.
Eragrostis curtipedicellata Buckl. Occasional in upland grasslands.
Eragrostis pectinacea (Michx.) Nees *ex* Steud. Occasional in uplands and disturbed areas.
Erioneuron pilosum (Buckl.) Nash. Occasional in uplands.
Erioneuron pulchellum (H.B.K.) Tateoka. [*Dasyochloa pulchella* (H.B.K.) Willd. *ex* Steudel.] Occasional in uplands, mostly shrub-dominated.

Hilaria jamesii (Torr.) Benth. [*Pleuraphis jamesii* Torr.] Common in upland grasslands.
Hilaria mutica (Buckl.) Benth. [*Pleuraphis mutica* Buckl.] Dominant in large patches, usually on poorly drained sites.
Hordeum jubatum L. Occasional on disturbed ground and by the river.
Leptochloa fascicularis (Lam.) A. Gray. Occasional by temporary ponds.
Muhlenbergia arenacea (Buckl.) A. S. Hitchc. Common in poorly drained areas.
Muhlenbergia arenicola Buckl. Occaional to locally dominant in uplands, including sand.
Muhlenbergia asperifolia (Nees & Mey. *ex* Trin.) Parodi. Common in wet areas.
Muhlenbergia porteri Scribn. *ex* Beal. Common in uplands, especially under shrubs
Muhlenbergia pungens Thurb. Rare in Salt Creek Wilderness, usually on sand.
Muhlenbergia torreyi (Kunth) A. S. Hitchc. *ex* Bush. Common in upland grasslands.
Munroa squarrosa (Nutt.) Torr. Common in uplands.
Panicum bulbosum H.B.K. In northeast corner of Middle Tract.
Panicum hallii Vasey. Occasional in sandy grasslands of east side of North Tract.
Panicum obtusum H.B.K. Widespread and common in poorly drained sites.
Panicum virgatum L. *sensu lato.* Occasional, mostly on sand. On dunes of North Tract measurements are *P. virgatum*'s but rhizomes suggest its dune ecotype, *P. havardii* Vasey (*P. virgatum* var. *macranthum* Vasey).
Paspalum distichum L. Occasional on playas and moist areas.
Phalaris caroliniana Walter. Occasional in Salt Creek bottom (North Tract).
Phragmites australis (Cav.) Trin. *ex* Steud. Forms pure stands to 3+ m tall in wet areas.
Polypogon monspeliensis (L.) Desf. Common on moist ground
Polypogon viridis (Gouan) Breistroffer. Occasional at water's edge.
Saccharum ravennae (L.) L. Invading along the Pecos, a large colony on east bank in northern North Tract and newer, smaller colonies in North and Middle Tracts. Well established when found by Gordon Warrick in 1999.. Only locality known for New Mexico.
Schedonnardus paniculatus (Nutt.) Trel. Occasional in grasslands and disturbed sites.
Scleropogon brevifolius Phil. Forms large, pure patches in uplands.
Setaria leucopila (Scribn. & Merr.) K. Schum. Widespread, common, especially in washes.
Setaria magna Griseb. Ditch-bank and marsh-edge east of Headquarters. First found in 1983 by Charles Oliver of NMSU. Only locality known for New Mexico.
Setaria ramiseta (Scribn.) Pilger. On sand east of the Pecos.
Sorghum bicolor (L.) Moench. Frequent escape from cultivation; does not persist.
Sorghum halepense (L.) Pers. Occasional in ditchbanks and moist areas.
Spartina pectinata Link. Forms several pure stands near springs of Middle Tract.
Sphenopholis obtusata (Michx.) Scribn. Occasional in moist areas, especially by river.
Sporobolus airoides (Torr.) Torr. The Refuge's major dominant in uplands and lowlands.
Sporobolus contractus A. S. Hitchc. Occasional in sandy areas.
Sporobolus cryptandrus (Torr.) A. Gray. Widespread and abundant, especially on sand.
Sporobolus flexuosus (Thurb. *ex* Vasey) Rydb. Widespread, occasional.
Sporobolus giganteus Nash. Occasional on sand.
Sporobolus nealleyi Vasey. Dominant (with *Bouteloua breviseta*) on gypseous sites.
Sporobolus texanus Vasey. Common in wet areas.
Sporobolus wrightii Munro *ex* Scribn. Occasional in depressions and moist areas.
Tridens albescens (Vasey) Woot. & Standl. Occasional in lowland grasslands.
Tridens muticus (Torr.) Nash. Occasional in hills of North Tract.
Vulpia octoflora (Walter) Rydb. Widespread in uplands; abundant some years.

Polemoniaceae
Eriastrum diffusum (A. Gray) Mason. Occasional in uplands.
Gilia laxiflora (Coult.) Osterh. [*Ipomopsis laxiflora* (Coult.) V. Grant.] Occasional on sand.
Gilia rigidula Benth. Occasional on cliffs, rocky or sandy sites, and roadways.

Polygalaceae
Polygala alba Nutt. Rare in grassland of North Tract.

Polygonaceae
Eriogonum abertianum Torr. *in* Emory. Common in uplands.
Eriogonum annuum Nutt. Abundant on sandy soils in some years.
Eriogonum jamesii Benth. Occasional on upland slopes and in grasslands.
Eriogonum rotundifolium Benth. Common on sandy, gravelly, or disturbed sites.
Rumex altissimus Wood. In Salt Creek bottomland (North Tract).
Rumex hymenosepalus Torr. Occasional in grasslands and sandy sites.

Portulacaceae
Portulaca oleracea L. Common in mudflats and disturbed sites.
Portulaca parvula A. Gray. Occasional in grasslands; locally abundant on gravel and sand.
Talinum angustissimum (A. Gray) Woot. & Standl. Occasional in grasslands.
Talinum aurantiacum Engelm. Rare in washes and grasslands.

Potamogetonaceae
Potamogeton pectinatus L. Rare except for detached fragments, in water.

Primulaceae
Samolus ebracteatus H.B.K. Occasional on wet sites near the Pecos and Bitter Lake.

Ranunculaceae
Delphinium wootonii Rydb. Occasional in upland grasslands in the North Tract.

Rhamnaceae
Condalia ericoides (A. Gray) M. C. Johnston. Several groups in Middle and North Tracts.
Condalia lycioides (A. Gray) Weberb. A few shrubs by Tour Loop overlook, Middle Tract.

Rubiaceae
Hedyotis humifusa A. Gray. [*Houstonia humifusa* (Gray) A. Gray.] Occasional in grasslands and in sandy sites.

Ruppiaceae
Ruppia maritima L. Abundant in sinkholes and springs, with *Chara* spp.

Salicaceae
Populus deltoides H. Marshall subsp. *wislizenii* (S. Wats.) Eckenwalder. Occasional by the river and in other moist sites. More have been planted in the last 20 years.
Salix exigua Nutt. Abundant by the river; occasional in other wet sites.
Salix ? amygdaloides Anderss. A few trees to 5 m tall near the Pecos in North Tract. Not found blooming. Could be *S. bonplandiana* H.B.K. Both species are on the 1937 list.
Salix nigra var. *vallicola* Dudley. Uncommon near river, east side of North Tract.

Sapindaceae
Sapindus saponaria L. var. *drummondii* (Hook. & Arn.) L. Benson. Two groups in north-eastern Middle Tract.

Saururaceae

Anemopsis californica (Nutt.) Hook. & Arn. In small patches by the river in North Tract.

Scrophulariaceae

Agalinus calycina Pennell. In marsh east of headquarters. Only known locality for NM.
Castilleja sessiliflora Pursh. Uncommon in uplands of Middle Tract.
Mauryandya antirrhinifolia Humb. & Bonpl. *ex* Willd. Occasional, mostly in canyons.
Penstemon fendleri Torr. & Gray. Uncommon in upland grasslands.

Solanaceae

Chamaesarcha conioides (Moric.) Britt. Common in uplands, especially disturbed ground.
Datura quercifolia H.B.K. Occasional on sand of washes and floodplains.
Datura inoxia Mill. Widespread, occasional.
Lycium berlandieri Dunal. Widespread; common in washes and canyons.
Lycium pallidum Miers. Occasional on upland ridges and slopes and in canyons.
Nicotiana trigonophylla Dunal. Common on gypsum of Comanche Bluffs (Middle Tract).
Physalis lobata Torr. Occasional on disturbed sites, rare in grassland.
Physalis virginiana Mill. Occasional in uplands, especially in dry sinkholes.
Solanum elaeagnifolium Cav. Widespread and common, mostly on disturbed ground.
Solanum rostratum Dunal. Occasional on mudflats and disturbed ground.

Tamaricaceae

Tamarix chinensis Loureiro including *Tamarix ramosissima* Ledeb. Widespread in lowlands, forming impenetrable stands near some waters.

Typhaceae

Typha angustifolia L. Common in shallow water.
[Other *Typha* species are probably also present.]

Ulmaceae

Celtis reticulata Torr. A few trees on gravelly hills of North Tract. Counted as native, but these may have spread from planted trees.
Ulmus pumila L. Widespread, occasional, some planted and some escaped.

Urticaceae

Parietaria hespera B. D. Hinton. Under *Tamarix* near Salt Creek (North Tract).

Verbenaceae

Tetraclea coulteri A. Gray. Occasional in uplands, especially cliffs and canyons.
Verbena bipinnatifida Nutt. [*Glandularia bipinnatifida* (Nutt.) Nutt.] Common on disturbed ground.
Verbena bracteata Lag. & Rodr. Occasional on disturbed sites.
Verbena menthaefolia Benth. Occasional in lowlands and arroyos and on roadsides.

Zygophyllaceae

Kallstroemia californica (S. Wats.) Vail. Widespread and common.
Kallstroemia grandiflora Torr. *ex* A. Gray. Rare in washes and canyons, Middle Tract.
Kallstroemia parviflora Norton. Uncommon in uplands.
Larrea tridentata (DC.) Cov. Common and locally dominant, mostly in dry, gravelly uplands.
Tribulus terrestris L. Occasional on disturbed ground.