THE VASCULAR FLORA AND PLANT COMMUNITIES OF LAWTHER - DEER PARK PRAIRIE, HARRIS COUNTY, TEXAS, U.S.A.

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ABSTRACT

Field studies at the Lawther - Deer Park Prairie Preserve, an area of approximately 21 ha (51 acres) of the Gulf Coast Prairies and Marshes vegetation area, have resulted in a description of the vegetation associations and an annotated checklist of the vascular flora. Six plant community associations occur on the property: (1) the Upper Texas Coast Ingleside Sandy Wet Prairie; (2) Eastern Gamagrass - Switchgrass - Yellow Indiangrass Herbaceous Vegetation; (3) Gulf Cordgrass Herbaceous Vegetation; (4) Texas Gulf Coast Live Oak - Sugarberry Forest; (5) Little Bluestem - Slender Bluestem - Big Bluestem Herbaceous Vegetation, and (6) Natural Depressional Ponds. The checklist includes 407 species belonging to 247 genera and 86 families. Forty-six species are non-native. The best-represented families (with species number following) are Poaceae (84), Asteraceae (68), Cyperaceae (33), and Fabaceae (19). West Gulf Coastal Plain (eastern Texas and western Louisiana) endemics include *Helenium drummondii, Liatris acidota, Oenothera lindheimeri,* and *Rudbeckia texana*. One Texas endemic, *Chloris texensis,* a Species of Greater Conservation Need, is present. Other noteworthy species are *Andropogon capillipes, Digitaria texana,* and *Platanthera nivea*.

RESUMEN

Estudios de campo en Lawther - Deer Park Prairie Preserve, condado de Harris, Texas, un área de aproximadamente 21 ha (51 acres) del área de vegetación de la ecorregión Gulf Coast Prairies and Marshes de Texas (al oeste de la ecorregión Western Gulf Coast Plains que cubre hasta el oeste de Louisiana), han dado como resultado una descripción de las asociaciones de vegetación y una lista de verificación anotada de la flora vascular. Las siguientes asociaciones de la comunidad de plantas ocurren en la propiedad: 1) Upper Texas Coast Ingleside Sandy Wet Prairie; (2) Eastern gamagrass - Switchgrass - Yellow Indiangrass Herbaceous Vegetation; (3) Gulf Cordgrass Herbaceous Vegetation; (4) Texas Gulf Coast Live Oak - Sugarberry Forest; (5) Little Bluestem - Slender Bluestem - Big Bluestem Herbaceous Vegetation, y (6) estanques depresivos naturales. La lista de verificación incluye 407 especies que pertenecen a 247 géneros y 86 familias. Cuarenta y seis especies de esta lista no eran nativas. Las familias mejor representadas (con el siguiente número de especies) fueron Poaceae (84), Asteraceae (68), Cyperaceae (33) y Fabaceae (19). Las especies endémicas representantes de la ecorregión Western Gulf Coast Plains incluyen *Helenium drummondii, Oenothera lindheimeri, Liatris acidota* y *Rudbeckia texana*. Una especie endémica de Texas, *Chloris texensis,* que también es una Especie de Mayor Necesidad de Conservación estuvo presente. Otras especies notables fueron *Andropogon capillipes, Digitaria texana* y *Platanthera nivea*.

INTRODUCTION

The Gulf Prairies and Marshes (GPM) vegetation region of Texas occupies about 3,845,000 ha, the second smallest of the vegetation regions of the state, the smallest being the Post Oak Savannah with 3,440,000 ha (Gould 1960 converted and rounded from acres). The region also has the least amount of topographic variation, being nearly level and not exceeding 45.72 m in elevation (Gould 1960). However, GPM is botanically rich (MacRoberts & MacRoberts 2008; Singhurst et al. 2014b). It is also one of the least studied regions of the vegetation areas of the state (Singhurst et al. 2014b; Mink et al. 2016). This appears related to difficulty in accessing remaining tracts on private land and very few professional botanists in the field collecting specimens and

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compiling flora. The present paper is part of an effort to increase basic knowledge about the flora of the GPM while suitable study sites are intact. Our studies on the region have emphasized two objectives. First, document community composition of nonnative species and native species richness in selected GPM sites, and second, provide an index to compare plant communities between sites and quantify similarity in those plant communities. This area serves as a corridor for northern movement of non-natives plants originally established in the middle Texas coast. This, apparently, has always been happening, but it is now clear that many of the new arrivals find conditions more amenable to their survival and spread. Over the last several years we have reported new species records for Texas in this vegetation region (Singhurst et al. 2009), as well as a newly described species (Singhurst et al. 2011). We have noted that several non-natives have produced (or have been predicted to produce) detrimental effects. Included are Australian pine (*Casuarina equisetifolia,* Mink et al. 2016) and Brazilian pepper-tree (*Schinus terebinthifolius,* Lemke 1992; Billings 2010), both established and expanding in the mid-coast of Texas. For other new arrivals, the outcome of permanent establishment and expansion of non-native plants needs to be further investigated. See Mink et al. (2015) for further explanation of naturalization pathways. Our additional objective, where expressed by this manuscript, is another in a series of publications concerning the diversity and vegetational structure of the GPM. Similar studies have largely been limited to the northern portion of the GPM (Rosen 2007; Rosen 2010; Singhurst et al. 2014a; Singhurst et al. 2014b).

METHODS AND MATERIALS

The checklist is based upon specimens collected between 2012 and 2016 during ten field-sampling trips. Voucher specimens were verified at, and deposited in, the Baylor University Herbarium (BAYLU) and University of Texas Herbarium (TEX). General classification follows Correll and Johnston (1970) with corrections and revisions as needed from Hatch et al. (1990), Jones et al. (1997), Turner et al. (2003), and USDA, NRCS (2017).

DESCRIPTION OF STUDY SITE

Lawther - Deer Park Prairie (LDPP) is located 11 km west of Galveston Bay, within the city of Deer Park, which is in the industrial centered Houston metropolis (Fig. 1). It is bordered on three sides (East, North, and West) by residential subdivisions and on one side (South) by the Grandview Memorial Park Cemetery. Bayou Land Conservancy, in coordination with other prairie societies in the Houston area, led a successful effort to purchase the prairie. After purchase, the property was donated to the Native Prairies Association of Texas. Currently, Bayou Land Conservancy holds an easement on the property to protect it from development in perpetuity. This prairie is characterized by distinct plant community associations, wetland features, and soils similarity to prairies found in southwest Louisiana. Elevation varies from 7.5 m to 8.5 m. Climate of the region is humid subtropical (Bomar 1995) with warm summers and typically high relative humidity (80–90%). The average frost-free period is 273 days (Natural Fibers Information Center 1987) in Harris County, Texas. Mean annual precipitation averages 135 cm. Hurricanes have, over time, exerted a considerable influence on regional vegetation along the Texas coast and are relatively common with a 0.4 annual mean from 1850–2000 A.D. (Roth 2010). The main soil types are Bernard association characterized by nearly level to gently sloping loamy soils and Lake Charles association characterized by nearly level to gently sloping clay soils (Wheeler 1976). LDPP includes 18.15 ha coastal prairie, 2.6 ha freshwater ponds and 0.25 ha coastal woodlot (oak mottes).

STATISTICAL ANALYSIS

Community ecology statistics comparing species composition between LDPP and Candy Abshier Wildlife Management Area (CAWMA) and Warren & Jack Road Prairies (WJRP) were performed using Sørensen and Jaccard's indices of similarity. These comparisons are determined by presence/absence of species versus abundance or evenness. Thus, a single count of an individual plant species discriminates which species are communal and which are distinct. This measure of similarity for two sets of plant community data, with values from 0% to 100%, demonstrates and establishes those communities. The higher the percentage, the more

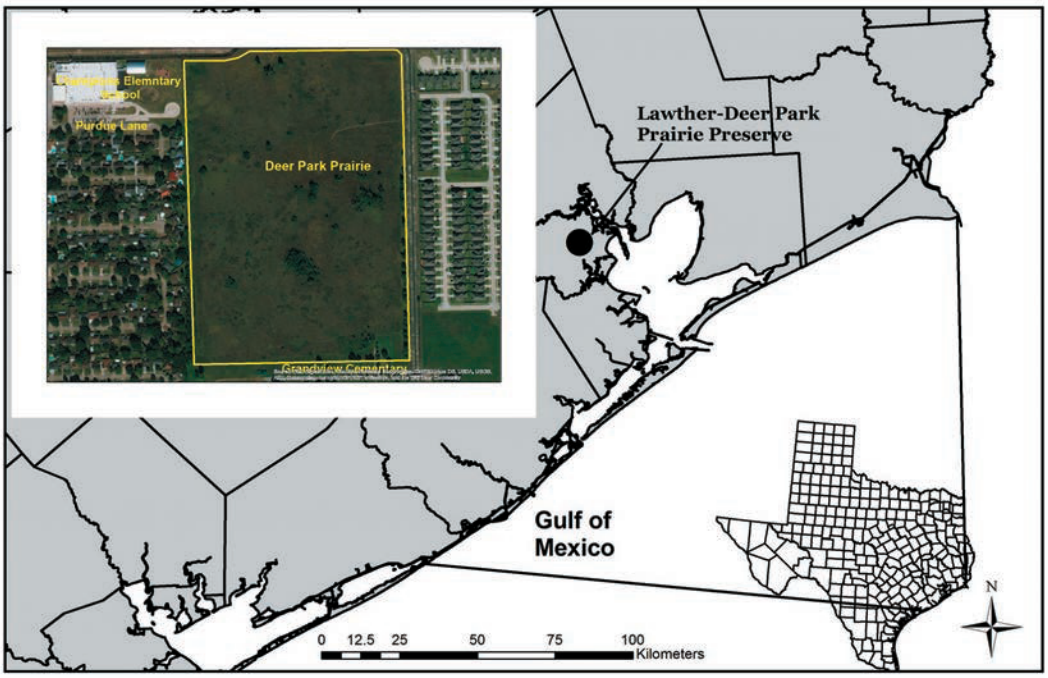

Fig. 1. Lawther - Deer Park Prairie Preserve, Harris County, Texas.

similar the two communities. Singhurst et al. (2010) offers detailed explanations of each statistic and its implementation.

FLORISTIC RESULTS

Vegetation frequently encountered across LDPP (Fig. 2) consists of *Schizachyrium scoparium* (little bluestem), *Schizachyrium tenerum* (slender bluestem), *Paspalum plicatulum* (brownseed paspalum), *Muhlenbergia capillaris* (gulf coast muhly), *Rhynchospora rariflora* (few flowered beaksedge), *Rhynchospora fascicularis* (fascicled beaksedge), *Scleria* spp. (nutrushes), *Spartina spartinae* (gulf cordgrass), and *Eleocharis montevidensis* (sand spikerush), with very limited amounts of *Quercus virginiana* (coastal live oak) and *Quercus nigra* (water oak). The presence of forbs is influenced by rainfall and includes *Arnoglossum ovatum* (ovateleaf cacalia), *Asclepias longifolia* (longleaf milkweed), *A. viridis* (green milkweed), *Baptisia bracteata* (longbract wild indigo), *Baptisia sphaerocarpa* (yellow wild indigo), *Drosera brevifolia* (dwarf sundew), *Eryngium yuccifolium* (rattlesnake master), *Eurybia hemispherica* (southern prairie aster), *Gaillardia aestivalis* (lanceleaf blanketflower), *Gaura lindheimeri* (Lindheimer's beeblossom), *Helenium flexuosum* (purplehead sneezeweed), *Helianthus angustifolius* (swamp sunflower), *Helianthus maximiliani* (Maximilian sunflower), *Liatris pycnostachya* (prairie blazing star), *Lobelia puberula* (downy lobelia), *Lythrum alatum* (winged lythrum), *Physostegia virginiana* ssp. *praemorsa* (obedient plant), *Pluchea foetida* (stinking camphorweed), *Polytaenia nuttallii* (Nuttall's prairie parsley), *Pycnanthemum tenuifolium* (narrowleaf mountainmint), *Rhexia mariana* (Maryland meadowbeauty), *Rudbeckia grandiflora* (rough coneflower), *R. hirta* (blackeyed Susan), *R. texana* (Texas coneflower), *Solidago sempervirens* (seaside goldenrod), *S. tortifolia* (twistleaf goldenrod), *Stenaria nigricans* (prairie bluets), and *Tephrosia onobrychoides* (multibloom hoarypea).

Four hundred seven species, representing 86 families and 247 genera were documented for LDPP (Appendix 1). Forty-six non-native species were found, comprising 11.7% of total taxa. Plant families with the

Fig. 2. Lawther - Deer Park Prairie Preserve with Little Bluestem - Gulf Coast Muhly - Slender Bluestem - Big Bluestem Herbaceous Vegetation (Photo by Don Verser, 3 June 2012). Texas coneflower (*Rudbeckia texana*) throughout and prairie blazing star (*Liatris pycnostachys*) in foreground.

largest number of species (followed by percentage makeup) were Poaceae (84, 20.6 %), Asteraceae (68, 16.7%), Cyperaceae (33, 8.1%), and Fabaceae (19, 4.8%). Several rare and regionally significant species were documented at LDPP. These included *Chloris texensis* (Texas windmill grass), *Helenium drummondii* (fringed sneezeweed), *Oenothera lindheimeri* (Lindheimer's beeblossum), *Liatris acidota* (sharp blazing star), and *Rudbeckia texana* (Texas coneflower).

The floral list was compared with those of recently published floral checklists of four coastal prairies. These were the flora of Candy Abshier Wildlife Management Area (Singhurst et al 2014b) in Chambers County; Nash Prairie (Rosen 2007) and Mowotony Prairie (Rosen 2010) in Brazoria County; and the Warren & Jack Road Prairies (Singhurst et al. 2014a) in Harris County. The comparisons (Table 1), show similar naturalness as represented by a low percentage of non-natives (11.7% or less) for all five prairie sites. LDPP had the highest percentage of non-natives, which appears consistent with the urban location (see Table 1). Notable is that four of the five prairies had more than 300 vascular plant species documented: Mowotony Prairie, with under 200 species present, had the lowest percentage (2%) of non-natives, indicating a superlative intactness (lack of disturbance). Remarkable is that the smallest prairie (LDPP with an area of 21 ha), was the most diverse prairie, by total number of species and species-area curves. Lawther - Deer Park Prairie also has the highest number of exotics, contributing to an exaggerated diversity value. Based on the indices of community similarity, both Sørensen's and Jaccard's statistic displayed a greater community similarity between LDPP and WJRP, although the values were minimally discrete from CAWMA (Table 2).

Table 1. Known vascular flora values of species richness for associated geographic area from published inventories in upper coastal prairies discriminated by native and non-native species composition in Texas, USA.

Upper Coastal Prairie Region	County	Total Species	Community Composition		Area (hectares)	Citation
			Native (%)	Non-Native (%)		
Candy Abshier WMA (TPWD)	Chambers	367	343 (93.5%)	24 (6.5%)	83 ha	Singhurst et al. 2014b
Lawther - Deer Park Prairie (NPAT)	Harris	407	346 (88.3%)	46 (11.7%)	21 ha	Singhurst et al. *this publication*
Mowotony Prairie (TNC)	Brazoria	199	195 (98.0%)	4 (2.0%)	42 ha	Rosen 2010
Nash Prairie (TNC)	Brazoria	311	289 (89.9%)	22 (7.1%)	120 ha	Rosen 2007
Warren & Jack Road Prairies (KPC)	Harris	378	354 (93.1%)	26 (6.9%)	321 ha	Singhurst et al. 2014a

Table 2. Statistical Community Indices of Similarity based on presence/absence of species composition between select upper coastal prairie sites and Lawther - Deer Park Prairie (LDPPP) in Texas, USA.

Plant Community	Total Species	Species in Common	Sørensen's	Jaccard's
Candy Abshier Prairie WMA (CAP)	358	191	0.49935	0.33275
Lawther - Deer Park Prairie (LDPPP)	407	-	-	-
Warren & Jack Road Prairies (WJRP)	356	199	0.52163	0.35284

In summary, all five of these prairies are extremely important to the conservation of the coastal flora and associated biota of the upper coast of Texas. This significance is based on a substantial perturbation by engineered, unnatural influences and current patchiness of extant relictual taxa and prairies throughout the Texas coastal bend.

PLANT COMMUNITY RESULTS

Based on dominant species, landscape position, and soil-water content, six (6) plant community associations were documented at LDPP. Lawther - Deer Park Prairie flora is herbaceous rich with 95% of the species being herbaceous annuals and perennials while only five percent of the flora consists of trees, shrubs, and woody vines. For organizational purposes, the plant community association descriptions are discussed by system categories (terrestrial and aquatic vegetation classes). Within each class, one or more associations may be present. The associations generally follow the name, a brief description of each, with emphasis on major characteristic species.

One association is a recently described plant community (see Singhurst et al. 2014b) within Nature Serve's classification scheme (NVCS 2017) (see first Natural Terrestrial Association in next section).

NATURAL TERRESTRIAL ASSOCIATIONS

1. Upper Texas Coast Ingleside Sandy Prairie (*Schizachyrium tenerum - Rhynchospora rariflora - Rhynchospora perplexa - Rhynchospora fascicularis - Scleria* spp. Herbaceous Vegetation)

This plant community, which encompasses about 5 ha, is an upland (lowland or similar) coastal prairie of the West Gulf Coastal Plain with extremely rich floral diversity. The area is dominated by *Schizachyrium tenerum, Rhynchospora rariflora, Rhynchospora perplexa, Rhynchospora fascicularis, Scleria ciliata, S. georgiana, S. triglomerata,* and *S. reticularis*. The community is developed on Lake Charles clay that is characterized by an abundance of pimple mounds. Assorted variability in micro-topography is typical, particularly with sandy to sandy loam soils within this prairie type. The most elevated mounds are very sandy and contain xeric sandhill flora found at the highpoint. The inter-mound swales vary in depth, retaining water from days to weeks after rain events, apparently caused by differential water holding capacity. In a few localized areas sandy ridges, in concert with a series of mounds, act as dry upland features with seasonal seepage migrating from the bases of

ridges and mounds to lower areas that are similar to seepage bogs or longleaf pine wetland savannas. These areas support such plants as *Aletris aurea, Rhynchospora pusilla,* and *Platanthera nivea.*

Other characteristic flora included *Andropogon capillipes, Anthaenantia rufa, Asclepias longifolia, Arnoglossum ovatum, Dichanthelium acuminatum, D. scoparium, Drosera brevifolia, Eleocharis tortilis, Eupatorium hyssopifolium, E. lancifolium, Helianthus angustifolia, Hypericum crux-andreae, Hyptis alata, Mitreola petiolata, Paspalum floridanum, Rhexia mariana, Scutellaria integrifolia,* and *Viola sagittata.*

2. Eastern gamagrass - Switchgrass - Yellow Indiangrass Herbaceous Vegetation (*Tripsacum dactyloides - Panicum virgatum - Sorghastrum nutans* Herbaceous Vegetation)

This tallgrass plant community of Coastal Prairies at LDPP is dominated by *Tripsacum dactyloides* and *Panicum virgatum* and encompasses about 1 ha. The community is developed on Bernard clay loam. Important associated flora includes *Andropogon gerardii, Carex microdonta, Paspalum floridanum, Schizachyrium scoparium, Sorghastrum nutans,* and *Sporobolus compositus.* Important forbs include *Asclepias viridiflora, Desmanthus illinoensis, Helianthus maximiliani, Rudbeckia hirta, Symphyotrichum ericoides,* and *Vernonia gigantea.* This community occurs on poorly drained or subirrigated soils and flat topography over Vertisols.

3. Little Bluestem - Gulf Coast Muhly - Slender Bluestem - Big Bluestem Herbaceous Vegetation (*Schizachyrium scoparium - Muhlenbergia capillaris - Schizachyrium tenerum - Andropogon gerardii* Herbaceous Vegetation)

This coastal prairie type occurs in the upper coast of Texas, encompasses about 11 ha on the LDPP, and is not well described. The Bernard association soils are thin layers of sand over clay, and the prairie type occurs on slightly higher elevational rises between pimple mounds. The dominant and characteristic species include *Schizachyrium scoparium* var. *scoparium, Muhlenbergia capillaris, S. tenerum,* and *Andropogon gerardii.* Other diagnostic flora includes *Arnoglossum ovatum, Asclepias obovata, A. verticillata, Buchnera americana, Castilleja indivisa, Dichanthelium acuminatum, Erigeron tenuis, Eryngium yuccifolium, Euphorbia corollata, Eurybia hemispherica, Helenium flexuosum, Helianthus maximiliani, Krameria lanceolata, Liatris pycnostachya, Penstemon laxiflorus, Polytaenia texana, Rhynchospora caduca, R. colorata, Rudbeckia grandiflora, R. texana, Scleria triglomerata,* and *Stenaria nigricans.*

4. Gulf Cordgrass Herbaceous Vegetation (*Spartina spartinae* Herbaceous Vegetation)

This plant community at LDPP occurs on upland flats just above normal tidal reach and encompasses about 1 ha on Bernard – Urban land complex soils. *Spartina spartinae* is typically a monodominant, but *Setaria parviflora* is common and *Spartina patens* may be locally codominant. Other characteristic species included *Andropogon glomeratus, Baccharis halimifolia, Cyperus* spp., and *Lythrum alatum.* Several small patches of saline hardpans (slick spots) are embedded within this plant community. These micro-habitats are sparsely vegetated with hyper-saline flora and include one Texas endemic, *Chloris texensis* (Poole et al. 2007). Additional saline flora includes *Distichlis spicata, Ipomoea sagittata, Iva frutescens, Solidago sempervirens,* and *Symphyotrichum subulatum.*

5. Texas Gulf Coast Live Oak - Sugarberry – Carolina Laurel Cherry Forest (*Quercus virginiana - Celtis laevigata / Prunus caroliniana* Forest)

This association (Diamond 1993) includes woodlands occurring along the upper Gulf Coast of Texas (Brazoria, Chambers, Galveston, Harris, and Jefferson counties, TX) on the Ingleside barrier-strandplain, a Pleistocene barrier ridge. This community at LDPP encompasses about 0.25 ha. The canopy is dominated by *Quercus virginiana.* The patchy understory contains *Celtis laevigata, Ilex vomitoria, Prunus caroliniana, Ulmus alata,* and *Zanthoxylum clava-herculis,* which may also reach into the canopy. A few other oak species occur sporadically in this coastal forest and include *Quercus marilandica* and *Q. nigra.* Several *Carex* spp. and *Allium canadense* are prominent in the seasonally damp shady understory during the spring and early summer.

NATURAL AQUATIC ASSOCIATIONS

Depressional Pond Types

6. Pond flora of LDPP encompasses about 2.6 ha and is variable due to differences in substrate and water depth. Pond flora is arranged in vegetation zones with the pond center dominated by emergent aquatic flora, then seasonal flooded flora in the next zone, and the outer zone edges with seasonally moist flora. The deeper portions of the ponds at LDPP have a water depth range of 15–61 cm (6–24 inches) and the flora is dominated by *Cyperus haspan, C. virens, Eleocharis montevidensis, Ipomoea sagittata, Juncus effusus, Polygonum hydropiperoides, Proserpinaca palustris, Rhynchospora corniculata, Saccharum giganteum, Thalia dealbata,* and *Typha domingensis*. Water depth values of less than 15 cm (6 inches) are areas dominated by *Hydrolea ovata, Juncus coriaceus, J. elliottii, J. megacephalus, J. repens, J. validus, Ludwigia linearis, L. leptocarpa, L. palustris, Panicum rigidulum,* and *Pluchea rosea*.

DISCUSSION

In a floristic comparison of LDPP to four upper coastal prairies in Texas (Table 1), it was surprising that LDPP had more native species than Candy Abshier Wildlife Management Area prairie despite a 75% reduction in area (21 ha versus 83 ha). Katy Prairie Conservancy's Warren & Jack Road Prairies is dramatically larger than LDPP (21 ha versus 321 ha) and yet has comparable native flora.

There may be several reasons why LDPP has high species richness for such a small tract of land. This could include past land use history, use as a hay meadow versus grazed rangeland, and intensity of haying. The flora at LDPP appears to tolerate a wide range of salinity from less saline habitats to more fresh water which may influence higher flora diversity in this prairie. Past and present land management most likely plays a role in the flora diversity of extant remnant prairies in Harris County. Consequently, SGCN (Species of Greatest Conservation Need) and conservation pursuits of various agencies support a present and continued need for study of the upper coastal prairies.

Coastal prairies (Smeins et al. 1991) are globally rare and often include rare species such as *Chloris texensis* which is found in LDPP. This species is ranked as G2S2 by NatureServe 2017 indicating that is imperiled and very vulnerable to extinction throughout its range. Lawther - Deer Park Prairie is an extremely important coastal prairie that contains a high diversity of flora, several regionally rare plants, and a Texas endemic. We highly encourage further flora inventories of the coastal prairies of Texas to continue monitoring and further understand and conserve the regional flora of these globally rare habitats.

APPENDIX 1

ANNOTATED CHECKLIST OF THE FLORA OF LAWTHER - DEER PARK PRAIRIE PRESERVE

The annotated checklist is divided into ferns and fern allies, gymnosperms, and angiosperms, the latter being subdivided into monocots and dicots. Families, genera, and species are arranged alphabetically beneath each heading. Nomenclature follows Kartesz (2017) and USDA, NRCS (2017). Modern family names as well as the latest generic names available are used throughout. An asterisk (*) denotes an introduced species.

FERNS AND FERN ALLIES

Ophioglossaceae
Ophioglossum crotalophoroides Walter, JRS 21856

GYMNOSPERMS

Pinaceae
Pinus taeda L., JRS 21413

ANGIOSPERMS
MONOCOTS

Agavaceae
Yucca louisianensis Trel., JRS 21186

Alismataceae
Sagittaria graminea Michx., JRS 21456
Sagittaria lancifolia L., JRS 21190

Alliaceae
Allium canadense L., JRS 21433
Allium drummondii Regel, JRS 21666
Nothoscordum bivalve (L.) Britton, JRS 21705

Amaryllidaceae
Hypoxis hirsuta (L.) Coville, JRS 21650

Asparagaceae
Asparagus setaceus (Kunth) Jessop, JRS 21824*

Commelinaceae
Commelina erecta L., JRS 21423
Tradescantia occidentalis (Britton) Smyth, JRS 21684

Cyperaceae
Carex cherokeensis Schwein., JRS 21451
Carex festucacea Schkuhr ex Willd., JRS 21441
Carex meadii Dewey, JRS 21429
Carex microdonta Torr. & Hook., JRS 21443
Carex triangularis Boeckeler, JRS 21439
Cyperus haspan L., JRS 21333
Cyperus strigosus L., JRS 21358
Cyperus virens Michx., JRS 21338, 21457
Eleocharis microcarpa Torr., JRS 21352
Eleocharis flavescens (Poir.) Urb., JRS 21742
Eleocharis montevidensis Kunth., JRS 21017
Eleocharis palustris (L.) Roem. & Schult., JRS 21748
Eleocharis parvula (Roem. & Schult.) Link ex Bluff, Nees & Schauer, JRS 21199
Eleocharis tortilis (Link) Schult., JRS 21437
Fimbristylis caroliniana (Lam.) Fernald, JRS 21430
Fimbristylis puberula (Michx.) Vahl, JRS 21755
Isolepis carinata Hook. & Arn. ex Torr., JRS 21670
Kyllinga odorata Vahl, JRS 21193
Rhynchospora caduca Elliott, JRS 21408
Rhynchospora colorata (L.) H. Pfeiffer, JRS 21389, 21435
Rhynchospora corniculata (Lam.) A. Gray, JRS 21434
Rhynchospora divergens Chapm. ex M.A. Curtis, JRS 21446
Rhynchospora fascicularis (Michx.) Vahl, JRS 21436
Rhynchospora glomerata (L.) Vahl, JRS 21440
Rhynchospora inexpansa (Michx.) Vahl, JRS 21438
Rhynchospora perplexa Britton, JRS 21305
Rhynchospora pusilla Chapm. ex M.A. Curtis, JRS 21442
Rhynchospora rariflora (Michx.) Elliott, JRS 21347
Rhynchospora recognita (Gale) Kral, JRS 21432
Scleria georgiana Core, JRS 21747
Scleria reticularis Michx., JRS 21757
Scleria triglomerata Muhl. ex Willd., JRS 21431
Scleria verticillata Muhl. ex Willd., JRS 21864

Iridaceae
Alophia drummondii (Graham) R.C. Fosteri, JRS 21809
Herbertia lahue (Molina) Goldblatt, JRS 21194
Sisyrinchium angustifolium Mill., JRS 21195
Sisyrinchium campestre E.P. Bicknell, JRS 21196
Sisyrinchium chilense Hook., JRS 21702
Sisyrinchium rosulatum E.P. Bicknell, JRS 21703

Juncaceae
Juncus coriaceus Mack., JRS 21769
Juncus diffusissimus Buckley, JRS 21741
Juncus effusus L., JRS 21758
Juncus elliottii Chapm., JRS 21723
Juncus marginatus Rostk., JRS 21459
Juncus megacephalus M.A. Curtis, JRS 21735
Juncus polycephalus Michx., JRS 21197
Juncus scirpoides Lam., JRS 21783
Juncus validus Coville, JRS 21724

Nartheciaceae
Aletris aurea Walter, JRS 21681

Orchidaceae
Platanthera nivea (Nutt.) Luer, JRS 21765
Spiranthes cernua (L.) Rich., JRS 21877
Spiranthes vernalis Engelm. & A. Gray, JRS 21815

Poaceae
Agrostis perennans (Walter) Tuck., JRS 21661
Aira elegans Willd. ex Kunth, JRS 21832*
Andropogon capillipes Nash, JRS 21400
Andropogon gerardii Vitman, JRS 21405
Andropogon glomeratus (Walter) Britton, Sterns & Poggenb., JRS 21365
Andropogon virginicus L. var. *virginicus*, JRS 21812
Andropogon ternarius Michx., JRS 21810
Anthenantia rufa (Nutt.) Schult., JRS 21313
Aristida lanosa Muhl. ex Elliott, JRS 21316
Aristida longespica Poir., JRS 21385
Aristida oligantha Michx., JRS 21380
Aristida purpurascens Poir., JRS 21384
Bothriochloa ischaemum (L.) Keng, JRS 21125*
Bothriochloa laguroides (DC.) Herter, JRS 21364, 21419
Bouteloua curtipendula (Michx.) Torr., JRS 21880
Bouteloua rigidiseta (Steud.) Hitchc., JRS 21454
Briza minor L., JRS 21716*
Bromus catharticus Vahl, JRS 21713*
Chasmanthium latifolium (Michx.) Yates, JRS 21200
Chloris canterai Arechav., JRS 21411*
Chloris × *subdolichostachya* Müll. Berol., JRS 21201
Chloris texensis Nash, JRS 21814
Chloris verticillata Nutt., JRS 21202
Coelorachis cylindrica (Michx.) Nash, JRS 21740
Cynodon dactylon (L.) Pers., JRS 21820*
Dactyloctenium aegyptium (L.) Willd., JRS 21774*
Dichanthelium aciculare (Desv. ex Poir.) Gould & C.A. Clark, JRS 21335
Dichanthelium acuminatum (Sw.) Gould & C.A. Clark, JRS 21347
Dichanthelium linearifolium (Scribn. ex Nash) Gould, JRS 21308, 21341, 21381
Dichanthelium oligosanthes (Schult.) Gould, JRS 21462
Dichanthelium scoparium (Lam.) Gould, JRS 21351
Dichanthelium sphaerocarpon (Elliott) Gould, JRS 21337
Digitaria texana Hitchc., JRS 21324
Distichlis spicata (L.) Greene, JRS 21025; 21323
Echinochloa crus-galli (L.) P. Beauv., JRS 21811*
Elionurus tripsacoides Humb. & Bonpl. ex Willd., JRS 21789
Eragrostis elliottii S. Watson, FH s.n.; JRS 21315
Eragrostis plana Nees, D.J. Rosen, Richard Carter, & Chris Reid 5763; JRS 21021, 21355*
Eragrostis pectinacea (Michx.) Nees ex Steud., JRS 21821
Eragrostis spectabilis (Pursh) Steud., JRS 21377
Koeleria macrantha (Ledeb.) Schult., JRS 21851
Leersia hexandra Sw., JRS 21020; 21344
Lolium perenne L., JRS 21852*
Muhlenbergia capillaris (Lam.) Trin., JRS 21370
Panicum brachyanthum Steud., JRS 21872
Panicum repens L., JRS 21782*
Panicum rigidulum Bosc ex Nees, JRS 21752
Panicum tenerum Bey. ex Trin., JRS 21728
Panicum verrucosum Muhl., JRS 21773
Panicum virgatum L., JRS 21410
Paspalum acuminatum Raddi, JRS 21327
Paspalum boscianum Flueggé, JRS 21767
Paspalum denticulatum Trin., JRS 21847
Paspalum dilatatum Poir., JRS 21422*
Paspalum floridanum Michx., JRS 21342
Paspalum langei (Fourn.) Nash, JRS 21312
Paspalum monostachyum Vasey, JRS 21799
Paspalum notatum Flueggé, JRS 21123*
Paspalum plicatulum Michx., JRS 21736

Paspalum praecox Walter, JRS 21378
Paspalum setaceum Michx, JRS 21376
Paspalum urvillei Steud., JRS 21738*
Phalaris caroliniana Walter, JRS 21655
Piptochaetium avenaceum (L.) Parodi, JRS 21654
Poa annua L., JRS 21858*
Saccharum giganteum (Walter) Pers., JRS 21873
Schizachyrium scoparium (Michx.) Nash, JRS 21726
Schizachyrium tenerum Nees, JRS 19312, 21164, 21379
Setaria parviflora (Poir.) Kerguélen, JRS 21368
Sorghastrum nutans (L.) Nash, JRS 21171
Sorghum halepense (L.) Pers., JRS 21402*
Spartina spartinae (Trin.) Merr. ex Hitchc., JRS 21731
Sporobolus compositus (Poir.) Merr., JRS 21837
Sporobolus indicus (L.) R. Br., JRS 21775*
Sporobolus junceus (P. Beauv.) Kunth, JRS 21722
Sporobolus pyramidatus (Lam.) Hitchc., JRS 21859
Sporobolus vaginiflorus (Torr. ex A. Gray) Alph. Wood, JRS 21787
Steinchisma hians (Elliott) Nash, JRS 21407
Stenotaphrum secundatum (Walter) Kuntze, JRS 21848*
Tridens flavus (L.) Hitchc., JRS 21841
Tridens strictus (Nutt.) Nash, JRS 21409
Tripsacum dactyloides (L.) L., JRS 21805
Urochloa texana (Buckley) R. Webster, JRS 21842
Vulpia octoflora (Walter) Rydb., JRS 21707

Smilacaceae
Smilax bona-nox L., JRS 21729

Typhaceae
Typha domingensis Pers., JRS 21766, 21344

DICOTYLEDONS

Acanthaceae
Justicia lanceolata (Chapm.) Small, JRS 21018
Ruellia humilis Nutt., JRS 21393

Aceraceae
Acer negundo L., JRS 21804
Acer rubrum L., JRS 21761

Adoxaceae
Sambucus nigra L., JRS 21754

Altingiaceae
Liquidambar styraciflua L., JRS 21744

Amaranthaceae
Alternanthera philoxeroides (Mart.) Griseb., JRS 21019, 21336*

Anacardiaceae
Toxicodendron radicans (L.) Kuntze, JRS 21792

Apiaceae
Ammoselinum butleri (Engelm. ex S. Watson) J.M. Coult. & Rose, JRS 21678
Centella erecta (L. f.) Fernald, JRS 21687
Cyclospermum leptophyllum (Pers.) Sprague ex Britton & P. Wilson, JRS 21688
Eryngium yuccifolium Michx., JRS 21785
Polytaenia texana (J.M. Coult. & Rose) Mathias & Constance, JRS 21695
Ptilimnium capillaceum (Michx.) Raf., JRS 21652
Torilis nodosa (L.) Gaertn., JRS 21714*

Apocynaceae
Asclepias longifolia Michx., JRS 21343
Asclepias obovata Elliott, JRS 21690
Asclepias verticillata L., JRS 21803
Asclepias viridiflora Raf., JRS 21771
Asclepias viridis Walter, JRS 21691
Cynanchum angustifolium Pers., JRS 21734

Aquifoliaceae
Ilex decidua Walter, JRS 21153
Ilex vomitoria Aiton, JRS 21354

Araliaceae
Hydrocotyle bonariensis Comm. ex Lam., JRS 21718

Asteraceae
Acmella oppositifolia (Lam.) R.K. Jansen var. *repens* (Walter) R.K. Jansen, JRS 21318
Ambrosia artemisiifolia L., JRS 21416
Ambrosia psilostachya DC., JRS 21806
Arnoglossum ovatum (Walter) H. Rob., JRS 21302, 21350
Baccharis halimifolia L., JRS 21417
Bidens pilosa L., JRS 21822*
Bidens aristosa (Michx.) Britton, JRS 21779
Bigelowia nuttallii L.C. Anderson, JRS 21826
Boltonia diffusa Elliott, JRS 21817
Calyptocarpus vialis Less., JRS 21425
Centaurea americana Nutt., JRS 21818
Chrysopsis pilosa Nutt., JRS 21833
Chrysopsis texana G.L. Nesom, JRS 21023, 21301
Cirsium horridulum Michx., JRS 21683
Cirsium texanum Buckley, JRS 21696
Conoclinium coelestinum (L.) DC., JRS 21415
Coreopsis lanceolata L., JRS 21676
Eclipta prostrata (L.) L., JRS 21831
Erigeron philadelphicus L., JRS 21710
Erigeron tenuis Torr. & A. Gray, JRS 21709
Eupatorium compositifolium Walter, JRS 21791
Eupatorium hyssopifolium L., JRS 21846
Eupatorium lancifolium (Torr. & A. Gray) Small, JRS 21307
Eupatorium serotinum Michx., JRS 21838
Eurybia hemispherica (Alexander) G.L. Nesom, JRS 21384
Euthamia gymnospermoides Greene, JRS 21406
Euthamia leptocephala (Torr. & A. Gray) Greene ex Porter & Britton, JRS 21845
Gaillardia aestivalis (Walter) H. Rock, JRS 21807
Gamochaeta purpurea (L.) Cabrera, JRS 21651
Helenium amarum (Raf.) H. Rock, JRS 21387
Helenium drummondii H. Rock, JRS 21849
Helenium flexuosum Raf., JRS 21672
Helianthus angustifolius L., JRS 21386
Helianthus maximiliani Schrad., 21394
Hypochaeris microcephala (Sch. Bip.) Cabrera, JRS 21450*
Iva angustifolia Nutt. ex DC., JRS 21314; 21383
Iva frutescens L., JRS 21749
Krigia caespitosa (Raf.) K.L. Chambers, JRS 21853
Liatris acidota Engelm. & A. Gray, JRS 21743
Liatris pycnostachya Michx., JRS 21816
Mikania scandens (L.) Willd., JRS 21753
Packera tampicana (DC.) C. Jeffrey, JRS 21862
Palafoxia rosea (Bush) Cory, JRS 21366
Pityopsis graminifolia (Michx.) Nutt., JRS 21329, 21418
Pluchea foetida (L.) DC., JRS 21808
Pluchea rosea Godfrey, JRS 21760
Pyrrhopappus carolinianus (Walter) DC., JRS 21834
Ratibida columnifera (Nutt.) Woot. & Standl., JRS 21346
Rudbeckia grandiflora (D. Don) J.F. Gmel. ex DC., JRS 21796
Rudbeckia hirta L., JRS 21756

Rudbeckia texana (Perdue) P. Cox & Urbatsch, JRS 21340
Senecio ampullaceus Hook., JRS 21663
Silphium gracile A. Gray, JRS 21770
Solidago altissima L., JRS 21367
Solidago odora Aiton, JRS 21863
Solidago sempervirens L., JRS 21404
Solidago speciosa Nutt., JRS 21330
Solidago tortifolia Elliott, JRS 21797
Sonchus asper (L.) Hill, JRS 21356*
Symphyotrichum patens var. *patens*, JRS 21827
Symphyotrichum divaricatum (Nutt.) G.L. Nesom, JRS 21762
Symphyotrichum ericoides (L.) G.L. Nesom, JRS 21784
Symphyotrichum lateriflorum (L.) Á. Löve & D. Löve, JRS 21719
Symphyotrichum pratense (Raf.) G.L. Nesom, JRS 21790
Symphyotrichum subulatum (Michx.) G.L. Nesom, JRS 21835
Vernonia gigantea (Walter) Trel., JRS 21839
Vernonia missurica Raf., JRS 21309
Xanthium strumarium L., JRS 21192

Boraginaceae
Lithospermum incisum Lehm., JRS 21879

Brassicaceae
Cardamine pensylvanica Muhl. ex Willd., JRS 21673

Campanulaceae
Lobelia appendiculata A. DC., JRS 21448
Lobelia puberula Michx., JRS 21388
Triodanis perfoliata (L.) Nieuwl., JRS 21674

Caprifoliaceae
Lonicera japonica Thunb., JRS 21733*

Caryophyllaceae
Sagina decumbens (Elliott) Torr. & A. Gray, JRS 21855
Stellaria media (L.) Vill., JRS 21708*

Celastraceae
Lepuropetalon spathulatum Elliott, JRS 21854

Convolvulaceae
Dichondra carolinensis Michx., JRS 21828
Evolvulus sericeus Sw., JRS 21685
Ipomoea hederacea Jacq., JRS 21427*
Ipomoea sagittata Poir., JRS 21392
Jacquemontia tamnifolia (L.) Griseb., JRS 21328

Cucurbitaceae
Melothria pendula L., JRS 21319

Droseraceae
Drosera brevifolia Pursh, JRS 21667

Ebenaceae
Diospyros virginiana L., JRS 21759

Elaeagnaceae
Elaeagnus angustifolia L., JRS 21361

Euphorbiaceae
Chamaesyce nutans (Lag.) Small, JRS 21322
Chamaesyce maculata (L.) Small, JRS 21750
Chamaesyce serpens (Kunth) Small, 21698
Croton capitatus Michx. var. *lindheimeri* (Engelm. & A. Gray) Müll. Arg., JRS 21686
Croton glandulosus L., JRS 21778
Croton monanthogynus Michx., JRS 21727
Euphorbia bicolor Engelm. & A. Gray, JRS 21412
Euphorbia corollata L., JRS 21326, 21375
Euphorbia maculata L., JRS 21750
Euphorbia nutans Lag., JRS 21322
Euphorbia serpens Kunth, JRS 21698
Euphorbia spathulata Lam., JRS 21649
Triadica sebifera (L.) Small, JRS 21369*

Fabaceae
Albizia julibrissin Durazz., JRS 21459*
Baptisia bracteata Muhl. ex Elliott, JRS 21461
Baptisia sphaerocarpa Nutt., JRS 21460
Chamaecrista fasciculata (Michx.) Greene, JRS 21725
Desmanthus illinoensis (Michx.) MacMill. ex B.L. Rob. & Fernald 21670
Desmodium ciliare (Muhl. ex Willd.) DC., JRS 21325
Galactia volubilis (L.) Britton, JRS 21840
Lathyrus pusillus Elliott, JRS 21682
Medicago polymorpha L., JRS 21711*
Melilotus officinalis (L.) Lam., JRS 21662*
Mimosa strigillosa Torr. & A Gray, JRS 21701
Neptunia lutea (Leavenworth) Benth., JRS 21700
Neptunia pubescens Benth., JRS 21699
Parkinsonia aculeata L., JRS 21357
Sesbania drummondii (Rydb.) Cory, JRS 21311, 21395
Strophostyles helvola (L.) Elliott, JRS 21844
Tephrosia onobrychoides Nutt., JRS 21334
Trifolium repens L., JRS 21850*
Vicia ludoviciana Nutt., JRS 21675

Fagaceae
Quercus marilandica Münchh., JRS 21362
Quercus nigra L., JRS 21772
Quercus virginiana Mill., JRS 21763

Gentianaceae
Centaurium pulchellum (Sw.) Druce, JRS 21444*
Sabatia campestris Nutt., JRS 21445

Geraniaceae
Geranium carolinianum L., JRS 21712

Haloragaceae
Proserpinaca palustris L., JRS 21801

Hydroleaceae
Hydrolea ovata Nutt. ex Choisy, JRS 21024

Hypericaceae
Hypericum crux-andreae (L.) Crantz, JRS 21398
Hypericum drummondii (Grev. & Hook.) Torr. & A. Gray, JRS 21802
Hypericum hypericoides (L.) Crantz, JRS 21374

Krameriaceae
Krameria lanceolata Torr., JRS 21658

Lamiaceae
Hedeoma hispida Pursh, JRS 21865
Hyptis alata (Raf.) Shinners, JRS 21396
Monarda punctata L., JRS 21732
Physostegia virginiana (L.) Benth. ssp. *praemorsa* (Shinners) Cantino, JRS 21421
Prunella vulgaris L., JRS 21715
Pycnanthemum tenuifolium Schrad., JRS 21793
Salvia azurea Michx. ex Lam., JRS 21397
Salvia coccinea P.J. Buchoz ex Etlinger, JRS 21823
Salvia lyrata L., JRS 21657
Scutellaria integrifolia L., JRS 21447
Scutellaria parvula Michx., JRS 21717
Stachys floridana Shuttlw. ex Benth., JRS 21704

Lauraceae
Cinnamomum camphora (L.) J. Presl, JRS 21768*

Lemnaceae
Lemna minuta Kunth, JRS 21198

Linaceae
Linum medium (Planch.) Britton, JRS 21655
Linum sulcatum Riddell, JRS 21866

Linderniaceae
Lindernia dubia (L.) Pennell, JRS 21737

Loganiaceae
Mitreola petiolata (J.F. Gmel.) Torr. & A. Gray, JRS 21320

Lythraceae
Lythrum alatum Pursh, JRS 21777

Magnoliaceae
Magnolia grandiflora L., JRS 21836*

Malvaceae
Callirhoe involucrata (Torr. & A. Gray) A. Gray, JRS 21453
Sida spinosa L., JRS 21321

Marantaceae
Thalia dealbata Fraser ex Roscoe, JRS 21016

Melastomataceae
Rhexia mariana L., JRS 21786

Meliaceae
Melia azedarach L., JRS 21359*

Moraceae
Morus rubra L., JRS 21878

Myriacaceae
Morella cerifera (L.) Small, JRS 21399

Oleaceae
Fraxinus pennsylvanica Marsh., JRS 21764
Ligustrum sinense Lour., JRS 21829*

Onagraceae
Gaura longiflora Spach, JRS 21015
Ludwigia alternifolia L., JRS 21819
Ludwigia glandulosa Walter, JRS 21798
Ludwigia leptocarpa (Nutt.) H. Hara, JRS 21300
Ludwigia linearis Walter, JRS 21310, 21401
Ludwigia palustris (L.) Elliott, JRS 21014
Oenothera laciniata Hill, JRS 21665
Oenothera lindheimeri Engelm. & A. Gray, JRS 21372
Oenothera speciosa Nutt., JRS 21669

Orobanchaceae
Buchnera americana L., JRS 21349
Castilleja indivisa Engelm., JRS 21721

Oxalidaceae
Oxalis rubra A. St.-Hil., JRS 21825
Oxalis dillenii Jacq., JRS 21680

Passifloraceae
Passiflora incarnata L., JRS 21331

Plantaginaceae
Plantago elongata Pursh, JRS 21857
Plantago virginica L., JRS 21867

Polemoniaceae
Phlox pilosa L., JRS 21452

Polygalaceae
Polygala incarnata L., JRS 21813
Polygala verticillata L., JRS 21656

Polygonaceae
Polygonum hydropiperoides Michx., JRS 21730
Rumex crispus L., JRS 21203
Rumex hastatulus Baldw., JRS 21860

Polypremaceae
Polypremum procumbens L., JRS 21306

Primulaceae
Anagallis arvensis L., JRS 21695*
Anagallis minima (L.) Krause, JRS 21660

Ranunculaceae
Anemone berlandieri Pritz., JRS 21874
Clematis crispa L., JRS 21739
Delphinium carolinianum Walter ssp. *vimineum* (D. Don) Warnock, JRS 21455
Ranunculus hispidus Michx. var. *nitidus* (Chapm.) T. Duncan, JRS 21694
Ranunculus pusillus Poir., JRS 21861

Rhamnaceae
Berchemia scandens (Hill) K. Koch, JRS 21795

Rosaceae
Eriobotrya japonica (Thunb.) Lindl., JRS 21360*
Pyracantha koidzumii (Hayata) Rehder, JRS 21390*
Pyrus calleryana Decne., JRS 21414*
Prunus persica (L.) Batsch, JRS 21876*
Rubus trivialis Michx., JRS 21428

Rubiaceae
Diodia teres Walter, JRS 21830
Diodia virginiana L., JRS 21668
Galium aparine L., JRS 21875
Galium tinctorium (L.) Scop., JRS 21693
Galium virgatum Nutt., JRS 21653
Houstonia micrantha (Shinners) Terrell, JRS 21677
Houstonia pusilla Schoepf, JRS 21869
Houstonia rosea (Raf.) Terrell, JRS 21868
Oldenlandia boscii (DC.) Chapm., JRS 21353
Sherardia arvensis L., JRS 21706*
Stenaria nigricans (Lam.) Terrell, JRS 21420

Rutaceae
Citris trifoliata L. JRS 21363*
Zanthoxylum clava-herculis L., JRS 21794

Salicaceae
Salix nigra Marsh., JRS 21720

Sapotaceae
Sideroxylon lanuginosum Michx., JRS 21800

Scrophulariaceae
Agalinis fasciculata (Elliott) Raf., JRS 21302
Agalinis heterophylla (Nutt.) Small ex Britton, JRS 21403
Agalinis oligophylla Pennell, JRS 21391
Agalinis tenuifolia (Vahl) Raf., JRS 21152
Mecardonia acuminata (Walter) Small, JRS 21781
Nuttallanthus canadensis (L.) D.A. Sutton, JRS 21648
Penstemon laxiflorus Pennell, JRS 21692
Veronica peregrina L., JRS 21870

Solanaceae
Physalis cinerascens (Dunal) Hitchc., JRS 21659
Solanum carolinense L., JRS 21659

Ulmaceae
Ulmus alata Michx., JRS 21788

Ulmus americana L., JRS 21776
Ulmus pumila L., JRS 21170*

Valerianaceae
Valerianella radiata (L.) Dufr., JRS 21679

Verbenaceae
Lantana camara L., JRS 21426
Phyla nodiflora (L.) Greene, JRS 21671
Verbena brasiliensis Vell., JRS 21745*
Verbena halei Small, JRS 21647
Verbena rigida Spreng., JRS 21449*
Verbena xutha Lehm., JRS 21780

Violaceae
Viola sagittata Aiton, JRS 21871

Vitaceae
Ampelopsis arborea (L.) Koehne, JRS 21424
Parthenocissus quinquefolia (L.) Planch., JRS 21751

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