VASCULAR FLORA OF HACKBERRY FLAT, FREDERICK LAKE, AND SUTTLE CREEK, TILLMAN COUNTY, OKLAHOMA

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ABSTRACT

The objective of this study is to fill a floristic data gap for southwest Oklahoma. Based upon a review of the Atlas of the Flora of Oklahoma database, it was noted that Tillman County was floristically under-documented. This paper reports the results of an inventory of the vascular plants in Tillman County. A total of 371 taxa of vascular plants in 253 genera and 74 families were collected. The most species were collected from the families Asteraceae (65), Poaceae (67), and Fabaceae (25). There were 123 annual and 248 perennial species. Forty-one species of woody plants were present. Forty-two exotic species were collected representing 11% of the flora. A total of 266 previously unreported species were documented. Five species tracked by the Oklahoma Natural Heritage Inventory were located, none of which were Federally listed as threatened or endangered.

RESUMEN

El objetivo de este estudio es completar los datos florísticos del suroeste de Oklahoma. Basados en una revisión de la base de datos del Atlas of the Flora of Oklahoma se percibió que el Tillman County estaba subdocumentado florísticamente. En este artículo se publican los resultados de un inventario de las plantas vasculares en Tillman County. Se colectaron un total de 371 taxón de plantas vasculares de 253 géneros y 74 familias. La mayoría de las especies se colectaron de las familias Asteraceae (65), Poaceae (67), y Fabaceae (25). Había 123 especies anuales y 248 perennes. Estaban presentes cuarenta y una especies de plantas lenosas. Se colectaron cuarenta y dos especies exóticas que representan el 11% de la flora. Se documentaron un total de 266 especies no citadas previamente. Se localizaron cinco especies con seguimiento por el Oklahoma Natural Heritage Inventory, ninguna de las cuales estaba listada federalmente como amenazada o en peligro.

INTRODUCTION

North American botany has had a long tradition of floristic exploration and inventory (Ertter 2000a). Nevertheless, floristic inventories are of continued
value for research, conservation, and management purposes (Palmer et al. 1995). For example, it has been recently documented that new taxa are discovered and described at a rate of 60 per year (Ertter 2000a). Inventories are also crucial to biogeographic research by filling gaps in the geographic distribution of taxa at all levels. Floristic inventories play a role in plant species conservation, both in locating populations of rare and/or undescribed species and bringing their presence to the attention of conservation organizations (Radford et al. 1980; Stuessy & Sohmer 1996). The lack of accurate floristic data can jeopardize the long term persistence of sensitive species (Ertter 2000a). Finally, floristic inventories aid resource managers in locating populations of sensitive species and documenting the arrival of exotic and nuisance species (Barkley 2000). Ignorance of the presence of exotic species can be detrimental to sensitive species and/or exert adverse economic impacts (Ertter 2000b).

The objective of this study was to fill a gap in floristic data for southwest Oklahoma. Based on the Atlas of the Flora of Oklahoma database (AFO; Hoagland 2003), Tillman County is a floristically under-documented county. Prior to 1996, the year collecting began for this study, only 175 species were reported from Tillman County (Hoagland 2003). The first collection gathered in Tillman County was a specimen of Eryngium diffusum by G.W. Stevens on 17 October 1924. Peak years for plant collecting in Tillman County prior to this study were 1936 (30 specimens) and 1940 (45 specimens).

**Study Area**

Tillman County (Fig. 1) occupies 237,503 hectares and is located within the Subtropical Humid (Cf) climate zone (Trewartha 1968). Summers are warm (mean July temperature = 28.9°C) and humid, and winters are relatively short and mild (mean January temperature = 3.5°C). Mean annual precipitation is 78.7 cm., with periodic severe droughts (Oklahoma Climatological Survey 2003). Physiographically, the study area is located in the Osage Plains section of the Central Lowlands province (Hunt 1974) and within the Central Redbed Plains province of Oklahoma (Curtis & Ham 1979). The surface geology of Tillman County is predominately red sandstone and shale formed from shallow-marine and alluvial deposits of Permian age (Branson & Johnson 1979).

There are eight soil associations in Tillman County (Lamar & Rhodes 1974). The two predominant soil associations are the Tipton-Hardeman-Grandfield, which occurs on the floodplains of the Red and North Fork of the Red River and is nearly level, loamy, sandy soil with loamy subsoil, and the Ford-Tillman, which is a nearly level to gently sloping upland, loamy soil with loamy and clay subsoils. The Clairemont-Asa-Miller Association occupies bottomlands and is deep, nearly level soil which is loamy, clayey throughout (Lamar & Rhodes 1974).

The predominant potential natural vegetation in Tillman County (Duck & Fletcher 1943) includes the Mixedgrass Eroded Plains, which would occupy
138,565 hectares (58%) on loamy soil and shallow rocky soil, and 68,635 hectares (29%) of tallgrass prairie (Duck & Fletcher 1943). Sandsage grassland occupies 10,360 hectares (4%) and occurs on deep sand deposits along the North Fork of the Red River, Red River, and Otter Creek. Mesquite grassland occupies 4,403 hectares (2%). Bottomland forest occupies 15,540 hectares (6%).

METHODS

Collections were made at three locations: Hackberry Flat Wildlife Management Area (HF), and Lake Frederick (LF), a municipal reservoir, and Suttle Creek (SC) a Bureau of Land Management (BLM) holding along the Red River (Table 1). At each of these locations, collection sites were established for intensive floristic sampling. Sites were selected following a review of U.S. Geological Survey 1:24,000 topographic maps and field reconnaissance. The predominant vegetation association at these sites was classified according to Hoagland (2000). Collections were also made randomly throughout each location and the county. Collections at HF were made from April to October, 1996, and at LF and SC from April through October 2000, from March through October 2001. Vouchers for exotic species (defined as those species not native to North America) were made.
from naturalized populations only, thus excluding cultivated and ornamental plants. Specimens were processed at the Robert Bebb Herbarium of the University of Oklahoma (OKL) following standard procedures. Manuals used for specimen identification included Waterfall (1973), Great Plains Flora Association (1986), and Diggs et al (1999). Origin, either native or introduced, was determined using Taylor & Taylor (1991) and USDA-NRCS (2003). Nomenclature follows the United States Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS 2003). A voucher set was deposited at OKL. Sorensens’ Index of Similarity (Pielou 1984) was calculated for pairs of sites in order to determine similarity of floras.

RESULTS AND DISCUSSION

A total of 371 taxa of vascular plants in 74 families and 253 genera were collected in Tillman County. Among the angiosperms, 97 were monocots and 270 were dicots. In addition, one fern ally and one gymnosperm was recorded. The Asteraceae (65), Poaceae (67), and Fabaceae (25) had the greatest number of species. Genera with the greatest number of species were Dalea (6), Cyperus (5), Panicum (5) and Bromus (4). One hundred and twenty-three species were annuals and 248 were perennials. Forty-one species of woody plants were collected: 20 trees, 13 shrubs, and 8 woody vines.

Forty-two introduced species (11% of the flora) were collected in Tillman County. This is comparable to the number of exotics collected at the Chickasaw National Recreation, located in south-central Oklahoma, where 12% of the flora was composed of exotic species (Hoagland & Johnson 2001). The families with the greatest number of introduced species were Poaceae (17), Brassicaceae (5), and Asteraceae (4). Genera with the most exotic species were Bromus (4) and Echinochloa (3). Species tracked by the Oklahoma Natural Heritage Inventory (ONHI) were Abronia fragrans (G5, S2S3), Argythamnia humilis (G5,S2S3), Conctrhus echinatus(G5,S1), Escobarita vivipara (G5, S2S3), and Malvedia leprosa (G5, S1S2). Species are ranked according to level of imperilment at the state (S) and global (G) levels on a scale of 1–5; 1 representing a species that is imperiled and 5 one that is secure (Groves et al. 1995). No Federally listed threatened or endangered species were encountered.
Species richness was highest at LF (Table 2) and lowest at HF, which was by far the largest site (Table 3). The low species richness may be due to the fact that 97% of the land cover was classified as disturbed. Although LF was smaller in area than HF, which had the lowest species richness, there were more habitat types present. SC, which had the second lowest species richness, was 65% disturbed (Table 3). LF was only 10% disturbed. However, the number of annual species, which often indicates the degree of disturbance, was highest at LF, not HF.

Although all three sites were in close geographic proximity, Sorensen Indices were below 0.5 (Table 4). The highest similarity was scored for the comparison of HF and LF, which shared 53 species (Table 5). The high number of arenaaceous species at SC may account for the low similarity index values between that site and the other two. Interestingly, the highest similarity was between the largest sites.

The AFO database (Hoagland 2003) lists 175 species for Tillman County that were collected prior to 1996. Seventy species in the Atlas database were not collected in this study. There were eight families in the AFO database that were not collected in this study: Acanthaceae (Dyschoriste linearis and Justicia americana), Apocynaceae (Apocynum cannabinum), Cuscutaceae (Cuscuta cuspida), Dryopteridaceae (Woodsia obtusa), Fumariaceae (Corydalis aurea), Polemoniaceae (Pomopsis longiflora), and Pteridaceae (Pellaea atropurpurea).

Of the remaining species, 107 were reported both in AFO database and in this study. When that number is subtracted from the total of species in the checklist, this study contributed 266 species previously unreported from Tillman County. When the species unique to the AFO and this study are summed, along with the number of shared species, this gives a total of 441 species in Tillman County, a 40% increase in our previous knowledge.

Seven habitat types were found at the three primary collecting sites (Table 2). The actual number of habitat types at each site ranged from 3 to 6. A brief description of each habitat type follows.

**Sandbars and dunes (SB)**

Sandbars and dunes occurred only at the SC site. Vegetation on sandbars, which were in the Red River channel, was sparse, however Cyperus esculentus, Heliotropium curassavicum, and Tamarix chinensis were present. Sandunes, which occurred along the floodplain and terraces of the Red River, were vegetated by the Artemisia filifolia/Sporobolus cryptandrus-Schizachyrium scoparium shrubland association (Hoagland 2000). Associated species included Dalea villosa, Prunus angustifolia, Calylophus serrulatus, Eriogonum anuum, Sideroxylon lanuginosa, Rhus aromatic, Vitis acerifolia, and Zanthoxylum hirsutum. Tracked species found in this habitat type were Abronia fragrans and Cenchrus echinatus.
Table 2: Summary of floristic collections at three sites in Tillman County, Oklahoma. Format follows Palmer et al. (1995).

<table>
<thead>
<tr>
<th>Taxonomic group</th>
<th>Species</th>
<th>Native spp.</th>
<th>Introduced spp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hackberry Flat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coniferophyta</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Magnoliophyta</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnoliopsida</td>
<td>86</td>
<td>75</td>
<td>11</td>
</tr>
<tr>
<td>Liliopsida</td>
<td>35</td>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>121</td>
<td>100</td>
<td>21</td>
</tr>
<tr>
<td>Lake Frederick</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coniferophyta</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Magnoliophyta</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnoliopsida</td>
<td>144</td>
<td>130</td>
<td>14</td>
</tr>
<tr>
<td>Liliopsida</td>
<td>41</td>
<td>35</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>185</td>
<td>166</td>
<td>19</td>
</tr>
<tr>
<td>Suttle Creek</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coniferophyta</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Magnoliophyta</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnoliopsida</td>
<td>127</td>
<td>119</td>
<td>8</td>
</tr>
<tr>
<td>Liliopsida</td>
<td>54</td>
<td>45</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>182</td>
<td>165</td>
<td>17</td>
</tr>
</tbody>
</table>

Table 3: Habitat types mapped at the three primary collection sites in Tillman County, Oklahoma. Area = total area of the site, HT = number of habitat types at the site, SB = sandbars and dunes, AQ = aquatic, DA = Old fields and disturbed areas, PS = pasture, MG = mixedgrass prairie, MQ = mesquite shrubland, and BLF = bottomland forest. (HF = Hackberry Flat Wildlife Management Area, LF = Lake Frederick, SC = Suttle Creek). All values are reported in hectares.

<table>
<thead>
<tr>
<th>Site</th>
<th>Area</th>
<th>HT</th>
<th>SB</th>
<th>AQ</th>
<th>DA</th>
<th>PS</th>
<th>MG</th>
<th>MO</th>
<th>BLF</th>
</tr>
</thead>
<tbody>
<tr>
<td>HF</td>
<td>2,770</td>
<td>0</td>
<td>0</td>
<td>2,690</td>
<td>67</td>
<td>14</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LF</td>
<td>911</td>
<td>6</td>
<td>0</td>
<td>341</td>
<td>95</td>
<td>0</td>
<td>0</td>
<td>441</td>
<td>26</td>
</tr>
<tr>
<td>SC</td>
<td>161</td>
<td>5</td>
<td>17</td>
<td>9.6</td>
<td>105</td>
<td>0</td>
<td>0.1</td>
<td>0</td>
<td>28</td>
</tr>
</tbody>
</table>

Table 4: Sorensens' Index of Similarity values for three collection sites, Tillman County, Oklahoma (HF = Hackberry Flat Wildlife Management Area, LF = Lake Frederick, SC = Suttle Creek).

<table>
<thead>
<tr>
<th></th>
<th>Suttle Creek</th>
<th>Lake Frederick</th>
<th>Hackberry Flat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suttle Creek</td>
<td>1</td>
<td>0.347</td>
<td>0.275</td>
</tr>
<tr>
<td>Hackberry Flat</td>
<td>0.352</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
Table 5: An inter-site comparison of shared species in Tillman County, Oklahoma. Unique refers to species found only at the site listed. W/ = species shared with two sites.

<table>
<thead>
<tr>
<th>Site</th>
<th>Total</th>
<th>Unique</th>
<th>w/LF</th>
<th>w/HF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hackberry Flat</td>
<td>121</td>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lake Frederick</td>
<td>185</td>
<td>87</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Suttle Creek</td>
<td>182</td>
<td>88</td>
<td>63</td>
<td>41</td>
</tr>
</tbody>
</table>

Aquatic and wetland habitats (AQ)

Aquatic habitats were found at LF and SC. Aquatic environments at LF were composed of the 341 hectare Lake Frederick and its shoreline. Vegetated areas were on the upper reaches of the lake, where the Polygonum pensylvanicum–P. lapathifolium herbaceous association (Hoagland 2000) was common. Associated species included Eleocharis palustris, Juncus torreyi, Potamogeton pectinatus, Schoenoplectus pungens, and Xanthium strumarium.

Wetlands at SC were formed by seeps and springs that emerged at the base of sand dunes and flowed into Suttle Creek. The vegetation in the seeps and springs was best characterized as the Rorippa nasturtium-aquaticum herbaceous association (Hoagland 2000). Associated species included Eclipta prostrata, Hydrocotyle verticillata, Lobelia cardinalis, Ludwigia palustris, Myosurus minimus, and Ranunculus scleratus.

Along broader stretches of Suttle Creek, the Schoenoplectus americanus - Eleocharis spp. herbaceous association (Hoagland 2000) was predominant. Associated species included Amorpha fruticosa, Cephalanthus occidentalis, Distichlis spicata, E. palustris J. torreyi, Polypogon monspeliensis, Symphyotrichum subulatum and Typha domingensis.

Disturbed areas and old fields (DA)

Disturbed areas occurred at all three sites and was the predominant cover type at HF and SC. Disturbed area designations included mowed lawns, roadside, and other sites exhibiting signs of physical disruption. Common plants in disturbed areas included Bothriochloa ischaemum, Cynodon dactylon, Daucus pusillus, Melilotus officinalis, and Mollugo verticillata. Old-fields were characterized by Ambrosia trifida, Amaranthus rudis, Conioscolus texanus, Conyza canadensis, and Sorghum halepense. Malvella leprosa was the only species tracked by ONHI found in this habitat type.

Pasture (PS)

This habitat type occurred only at HF, where B. ischaemum had been planted on 67 ha in the northwest corner of the site. The pasture was essentially a monoculture of B. ischaemum with a few widely scattered individuals of Prosopis glandulosa.
Mixedgrass prairie (MG)
Mixedgrass prairie occurred at all three sample sites, but was most extensive at LF. *Bouteloua hirsuta* - *Bouteloua curtipendula* herbaceous association was common on coarse, shallow soils. Associated species included *Aristida purpurascens*, *Bouteloua rigidiseta*, *Crotonopsis elliptica*, *Leucelene asteroxides*, *Lithospermum tenellum*, *Opuntia phaeacantha*, *Schizachyrium scoparium*, and *Thelesperma filifolia* (Hoagland 2000, Crawford 2002). On loamy soils, the *Schizachyrium scoparium* - *Sorghastrum nutans* herbaceous association predominates. Common associates include *Andropogon gerardii*, *A. purpurascens*, *Bouteloua curtipendula*, *Panicum virgatum*, *Sporobolus cryptandrus*, and *Symphyotrichum ericoides*. *Argythamnia humilis* and *Esocharia vivipara* were found in this habitat type and also in mesquite shrubland.

Mesquite shrubland (MQ)
This habitat type, representing the *Prosopis glandulosa/Bouteloua* sp. shrubland association (Hoagland 2000), was found only at LF. Unlike *P. glandulosa* shrublands throughout Tillman County, the herbaceous vegetation at LF was predominantly native species (Crawford 2002). Dominant grasses included *Bouteloua curtipendula* and *Schizachyrium scoparium*. Associated species included *Aristida purpurascens*, *Bouteloua rigidiseta*, *Echinacea angustifolia*, *Erionurus pilosus*, *Eryngium leavenworthii*, *Opuntia phaeacantha*, *Sorghastrum nutans*, *Sporobolus cryptandrus*, *Symphyotrichum ericoides*, and *Thelesperma filifolia*.

Bottomland forest (BLF)
Bottomland forest occurred at LF and SC. Two vegetation types occurred in this category: *Fraxinus pennsylvanica* - *Ulmus americana* forest association and the *Populus deltoides/Salix (exigua, nigra)* forest association (Hoagland 2000). Associated species included *Ampelopsis cordata*, *Celtis laevigata*, *Teucrium canadense*, and *Toxicodendron radicans*.

ANOTATED CHECKLIST
Annotated species list for Tillman County, Oklahoma. The first entry is the collection number (the prefix BLM = Suttle Creek, a Bureau of Land Management holding on the Red River, HF = Hackberry Flat Wildlife Management Area, and PC = Lake Frederick). Specimens with the prefix M9 or the suffixes BWH or 98 represent specimens collected outside the three areas inventoried), followed by origin (N = native, I = introduced), life history (A = annual, Bi = biennial, P = perennial), and habitat (SB = sandbars and dunes, AQ = aquatic, DA = Old fields and disturbed areas, PS = pasture, MG = mixedgrass prairie, MQ = mesquite shrubland, and BLF = bottomland forest). Voucher specimens were deposited at the Robert Bebb Herbarium at the University of Oklahoma (OKL).
EQUISETOPHYTA

EQUISETACEAE
Equisetum laevigatum A. Braun; M9.134; N; P; AQ

CONIFEROPHYTA

CUPRESSACEAE
Juniperus virginiana L.; BLM0179, PC-138; N; P; DA, MG

MAGNOLIOPHYTA-LILIOPSIDA

AGAVACEAE
Yucca glauca Nutt.; BLM064; N; P; MG

ALISMATACEAE
Sagittaria latifolia Mackenzie & Bush; BLM0348; N; P; AQ

CYPERACEAE
Carex tetragona Scheele; BLM033, HF032; N; P; AQ
Carex perennis S.D. Jones; BLM045; N; P, AQ
Cyperus acuminatus Torr. & Hook. ex. Torr.; HF0158; N; P; DA
Cyperus squarrosum L.; 0119-90; N; A; AQ
Cyperus croceus Vahl; PC-168; N; A; DA
Cyperus esculentus L.; HF0151; I; P; DA
Cyperus odoratus L.; BLM0427; N; P; DA
Eleocharis montevidensis Kunth.; BLM031; N; P; AQ
Eleocharis palustris (L.) Roem. & Schult.; HF0019, PC-135; N; P; AQ
Fuirena simplex Vahl; BLM0357; N; P; AQ
Schoenoplectus americanus (Pers.) Volk ex Schinz & R. Keller; BLM067; N; P; AQ
Schoenoplectus pungens (Vahl) Pall. var. longispicatus (Britton) S.G. Sm.; PC-133; N; P; AQ
Schoenoplectus maritimus (L.) Lye; BLM0451; N; P; AQ

IRIDACEAE
Nemastylis geminiflora Nutt.; PC-2; N; P; DA, MG
Sisyrinchium angustifolium P.Mill.; HF065; N; P; DA, MG
Sisyrinchium chilense Hook.; PC-16; N; P; DA

JUNCACEAE
Juncus maritimus Rostk.; M9.132; N; P; AQ
Juncus torreyi Cov.; BLM0355, PC-132; N; P; AQ

LILIACEAE
Allium canadense L.; BLM0076; N; P; DA, MG
Cooperia drummondii Herbert; HF0141; N; P; MG

Erythronium abidum Nutt.; PC-232; N; P; BLF
Nothoscordum bivalve (L.) Britton; HF0166, PC-68; N; P; DA, MG, MQ

NAJADACEAE
Neja guadalupensis (Spreng.) Magnus; 2085-BWH; N; A; AQ

POACEAE
Aegilops cylindrica Host; HF051; I; A; AQ
Andropogon gerardii Vitman; BLM0435, PC-200; N; P; MG, MQ
Andropogon glomeratus (Walt.) B.S.P.; BLM0424; N; P; AQ, BLF
Aristida purpurascens Poir.; BLM0369; N; P; DA, MG
Anisida purpurea Nutt.; BLM0161, HF0104, PC-27; N; P; DA, MG

Bathochloa ischaemum (L.) Keng var. songarica (Rupr. ex Fisch. & C.A. Mey.) Celarier & Harlan; HF0139, PC-22; I; P; DA, PS
Bathochloa saccharoides (Sw.) Rydb.; HF047, PC-60; N; P; DA, MG, MQ
Bouteloua curtipendula (Michx.) Torr., BLM0363, HF0105, PC-172; N; P; MG, MQ
Bouteloua hirsuta Lag.; PC-173; N; P; MG, MQ
Bouteloua rigidiflora (Steud.) A. S. Hitchc.; BLM0180, HF060, PC-21; N; P; MG, MQ
Bromus catharticus Vahl; BLM046, HF036, PC-63; I; P; BLF, DA, MQ
Bromus commutatus Schrad.; PC-46; I; A; DA
Bromus japonicus Thunb. Ex Murr.; BLM0509, HF01; I; A; DA, MQ
Bromus secalinus L.; HF09; I; A; DA
Buchloë dactyloides (Nutt.) Engelm.; BLM051, HF02, PC-61; N; P; DA, MG, MQ
Cenchrus echinatus L.; BLM0322; N; A; SB
Chloris cuniculata Bischoff.; BLM0183; N; P; SB
Chloris verticillata Nutt.; HF0103; N; P; DA, MG, MQ
Cynodon dactylon (L.) Pers.; BLM0432, HF0100, PC-128; I; P; DA, PS
Digitaria sanguinalis (L.) Scop.; BLM0450; N; A; DA
Distichlis spicata (L.) Greene; BLM0312; N; P; AQ, SB
Echinocloa colona (L.) Link; BLM0434; I; A; AQ
Echinocloa crus-galli (L.) Beauv.; BLM0431; I; A; AQ
Echinocloa crus-pavonis (H.B.K.) Schult. var. macera (Wieg.) Gould; PC-194; I; A; AQ
Echinocloa muricata (Beauv.) Fern.; HF0101; N; A; AQ
Elymus canadensis L.; PC-114; N; P; BLF, MG, MQ
Elymus virginicus L.; BLM0147, HF0110; N, P; MG, MQ
Eragrostis cilianensis (All.) Vign. ex Janch.; BLM0328, HF0168; I; DA
Eragrostis hirsuta (Michx.) Nees; BLM0449; N; P; DA, MG, SB
Eragrostis hypnoides (Lam.) B.S.P.; HF078; N, A; AQ
Eragrostis sessilispiça Buckl.; PC-76; N, P; DA
Eriochloa contracta Hitchc.; HF0126; N, A; DA, MG
Eriaea sericea (Scheele) Munro ex Vasey; PC-71; N; DA, MG
Eriocneuron pilosum (Buckley) Nash; BLM028, PC-59; N, P; MG
Hordeum pusillum Nutt.; BLM044, HF042, PC-29; N; A, DA
Leersia oryzoides (L.) Sw.; BLM0430; N, P; AQ
Leptochloa fusca (L.) Kunth.; BLM0511, HF0135; N, A; DA
Leptochloa panicacea (Retz.) Ohwi ssp. brachiatia (Steud.) N. Snow; HF0152, PC-192; N, P; DA
Muhlenbergia asperifolia (Nees & Meyen ex Trin.) Parodi; BLM0437; N, P; AQ
Nassella leucotricha (Trin. & Rupr.) Poh; BLM0195, PC-4; N; P; MG
Neeragrostis repans (Michx.) PC-193; N; A, AQ
Panicum capillare L.; HF0124, PC-160; N, A; DA
Panicum hallii Vasey var. filipes (Scribn.) F.R. Waller; PC-169; N; P; MG
Panicum obtusum H.B.K.; HF077, PC-156; N, P; BLF, DA, MG
Panicum rigidulum Bosc. ex Nees; HF0122; N, P; MG
Panicum virgatum L.; BLM0488, PC-199; N; P; BLF, MG, MQ
Passcyprium smithii (Rydby.) A. Löve; BLM0486, PC-62; N, P; AQ, BLF
Pospomum distichum L.; HF0150; N, P; DA
Pospomum setaceum Michx.; BLM0487; N, P; AQ
Pennisetum glaucum (L.) R. Br.; BLM0429, HF0130; I, A; DA, PS
Phalaris canariensis L.; BLM0161; I; A; AQ
Phalaris caroliniana Walt.; HF033; N; A; AQ, MG
Poa annua L.; BLM047; I; A, DA
Poa arachnifera Torr.; BLM041; N; P; BLF
Polygonum monspeliensis (L.) Desf.; BLM0168; I; A, AQ, SB
Schedonardus paniculatus (Nutt.) Trel.; HF050; N, P; DA, MG
Setaria parviflora (Poiret.) Kerguelén; BLM0359; N; P; DA
Setaria viridis (L.) Beauv.; BLM0500; I; A, DA
Sorghastrum nutans (L.) Nash; BLM0433; N, P; MG
Sorghum halepense (L.) Pers.; BLM0484, HF041, PC-124; I, P; DA
Sporobolus airoides (Torr.) Torr.; HF079, PC-182; N; P, DA, SB
Sporobolus cryptandrus (Torr.) A. Gray; BLM0326; N, P; MG, SB
Sporobolus coromandelianus (Retz.) Kunth; PC-183; N, P; DA
Tridens albenscens (Vasey) Woot. & Standl.; BLM049, HF063, PC-3; N, P, MG
Triplasis purpurea (walt.) Chapman; BLM0436; N; A, SB
Vulpia octoflora (Walt.) Rydb.; BLM059; N, A; MQ

POTAMOGETONACEAE
Potamogeton nodosus Poir.; 2084-BWH; N, P; AQ

SMILACACEAE
Smilax bona-nox L.; BLM0446, PC-203; N, P; BLF
Smilax rotundifolia L., 071-98; N, P; BLF

TYPHACEAE
Typha domingensis Pers.; BLM0375, PC-134; N, P; AQ

ZANNICHELLIACEAE
Zannichellia palustris L.; BLM030; N, P; AQ

MAGNOLIOPSIDA

AMARANTHACEAE
Amaranthus palmeri S. Watts.; HF091; N, A, DA
Amaranthus rudis Sauer; BLM0438, HF115; N, A; DA

ANACARDIACEAE
Rhus tri lobata Nutt.; BLM0204; N, P, MG, MQ

APICEAE
Ammoselinum popei Torr. & A. Gray; HF067; N; A; DA
Chaeophyllum tainturieri Hook.; BLM048; N, A; DA, MG
Cyamoepus macrorhizus Buckl.; PC-221; N, P; MG
Daucus pusillus Michx.; BLM0154, HF053, PC-85; N; A, DA
Eryngium leavenworthii Torr. & A. Gray; PC-216; N; A; MG
Hydrocotyle verticillata Thunb.; BLM0502; N; P; AQ
Lomatium foenicuaceum (Nutt.) Coul. & Rose; PC-220; N, P; MG
Sanicula canadensis L.; BLM0499; N; BI, BLF

ASCLEPIADACEAE
Asclepias arenaria Torr.; BLM0492; N, P; MG
Asclepias asperula (Dcne.) Woods; HF054, PC-143; N; P, DA, MG
Asclepias viridiflora Raf.; PC-187; N; P, DA, MG, MQ
Asclepias viridis Walter; PC-53; N; P, MG
Funaria cyanochondes (Dcne.) Schltr.; BLM0345, PC-186; N; P, DA
Matelea biflora (Raf.) Woods; HF054, N; P, DA, MG

ASTERACEAE
Achillea millefolium L.; BLM042, HF022, PC-57; N; P, DA, MG
Ambrosia psilostachya DC.; BLM0352, HF0155, PC-176; N; P, DA, MG, MQ, SB
Ambrosia trifida L.; HF0149, N; A, DA
Amphiaclys dracunculoides (DC.) Nutt.; BLM0439, N; A, DA
Aphanoestephus ramosissimus DC.; BLM0201; N; A, SB
Antennaria filifolia Torr.; BLM0425; N; P, SB
Baccharis salicifolia Torr. & A. Gray; HF0107; N; P, BLF, DA, SB
Berlandiera texana DC.; M9,148; N; P, MG
Bidens frondosa L.; BLM0440; N; A; AQ
Centarea americana Nutt.; 2126-BWH, PC-70; N; A, DA, MG
Chloracantha spinosa (Benth.) Nesom; BLM0370; N; P, BLF
Chaetopappa ericoides (Torr.) Nesom; BLM0157, PC-10; N; P, MG
Cirsium ochrocentrum A. Gray; HF0108; N; P, DA, MG
Cirsium texanum Buckley; HF094, PC-54; N; P, MG
Cirsium undulatum (Nutt.) Spreng.; BLM0177, HF030; N; P, DA, MG
Conyza canadensis (L.) Cronq.; HF0114; N; A, DA
Coreopsis tinctoria Nutt.; HF040, PC-96; N; A, AQ, MG

Dracopis amplexicaulis (Vahl) Cass.; HF031, PC-84; N; A; AQ
Dysodiaopsis tagetoides (Torr. & A. Gray) Rydb.; PC-80; N; P, DA, MG
Echinacea angustifolia DC.; PC-93; N; P, MG, MQ
Epicota prostrata (L.) L.; HF164, BLM0453; N; A; AQ
Engelmannia peristenia (Raf.) Goodwin & Lawson; BLM0152, HF059, PC-171; N; P, MG, MQ
Erigeron strigosus Muell. ex Wild, HF018; PC-6; N; A; DA
Eupatorium serotinum Michx.; BLM0445; N; P, BLF, MG
Evax prolifera Nutt. ex DC.; PC-37; N; A; DA

Gaillardia pulchella Foug.; BLM0186; N; A, DA, MG, MQ
Gaillardia sauvis (A. Gray & Engelm.) Britton & Rusby; BLM075, HF028, PC-17; N; P, DA, MG, MQ
Grindelia nuda A.W. Wood; PC-178; N; P, DA, MG, MQ
Grindelia papposa Nesom & Suh; BLM00490; N; B; DA, MG, MQ
Grindelia squarrosa (Pursh) Dunal; HF0145; N; P, DA, MG, MQ

Helenium lanceolatum Nutt. var. texana (Scheele) Shinners; PC-215; N; P, DA, MG
Helenium microcephalum DC.; HF081, PC-164; N; A; AQ, BLF
Helianthus annuus L.; HF087, PC-101; N; A, DA
Helianthus petiolaris Nutt.; BLM0329; N; A, DA, SB
Heterotheca subaxillaris (Lam.) Britton & Rusby; HF0109; N; A, DA, MG
Heterotheca vilosa (Pursh) Shinners; PC-142; N; P, MG, SB
Hymenopappus flavescens Gray; BLM0188; N; B; MG
Hymenopappus scabieosus L'Hér.; M9,147; N; B; MG, MQ
Hymenopappus tenuifolius Pursh.; BLM0324, PC-14; N; B; MG
Hymenoxys odorata DC.; HF061; N; A, DA, MG
Lactuca canadensis (DC.) Spreng.; BLM0177, HF030; N; P, DA, MG
Lactuca ludoviciana (Nutt.) Riddell; HF095; N; B; DA
Liatis mucronata DC.; BLM0342; N; P, MG
Liatis punctata Hook.; HF0162, PC-212; N; P, MG
Lindeineria texana Gray & Engelm.; PC-15; N; A; MG, MQ
Machaeranthera pinnatifida (Hook.) Shinners; PC-179; N; P, MG
Machaeranthera pinnatifida (Hook.) Shinners ssp. pinnatifida var. pinnatifida; BLM0187, HF074; N; P; MG, MQ
Packera platensis (Nutt.) W.A. Weber & A. Löve; PC-13; N; P, BLF
Pleomea odorata (L.) Cass.; BLM0495; N; A; AQ, BLF
Pyrrhopappus grandiflorus (Nutt.) Nutt.; BLM043; N; P, DA
Ratibida columnifera (Nutt.) Wooton & Standl.; HF056, PC-88; N; P, DA, MG, MQ
Senecio vulgaris L.; PC-243; N; B; BLF
Solidago missouriensis Nutt.; BLM0353, PC-185; N; P, DA, MG, MQ
Acacia angustissimo (Torr. & A. Gray) Small; HF096; N; P; DA
Acacia serpens (Kunt.) Small; HF089; N; A; DA
Acacia misurica (Raf.) Shinners; BLM0377, PC-125; N; A; DA
Acacia nutans (Lag.) Small; PC-174; N; A; DA
Acacia prostrata (Aitnon) Small; PC-108; N; A; DA
Cnidoscolus texanus (Muell.-Arg.) Small; BLM0166; N; P; DA, SB
Croton capitatus Michx.; PC-152; N; A; DA, MG
Croton monanthygnus Michx.; PC-74; N; A; DA
Croton texensis (Klotzsch) Muell.-Arg.; BLM0428; N; A; DA, MG
Euphorbia dentata Michx.; PC-73; N; A; DA
Euphorbia marginata Pursh; BLM0347, HF0143, PC-35; N; A; DA, SB
Euphorbia spathulata Lam.; BLMO50, PC-26; N; A; DA
Phyllanthus polygonoides Nutt.ex Spreng., PC-98; N; P; MG
Stilligia sylvisica Garden ex L.; BLM0203; N; P; MG

FABACEAE

Acacia angustissimo (Mill.) Kuntze. var. hirta (Nutt.) B.L. Rob.; HF093, PC-141; N; P; MG, MQ
Amorpha fruticosa L.; BLM0151; N; P; AQ
Astragalus lindheimeri Engel. ex A. Gray, PC-32; N; A; MG, MQ
Astragalus platensis Nutt.; PC-28; N; P; MG, MQ
Chamaecrista fasciculata (Michx.) Greene; PC-204; N; A; MG, MQ
Dalea aurea Nutt. ex Pursh; PC-116; N; P; MG
Dalea candida Willd.; BLM0323, PC-122; N; P; MG, MQ
Dalea enneandra Nutt.; BLM0321, PC-115; N; P; MG
Dalea lanata Spreng.; BLM0306; N; P; SB
Dalea purpurea Vent.; PC-91; N; P; MG, MQ
Dalea villosa (Nutt.) Spreng.; BLM0305; N; P; SB
Desmanthus illinoensis (Michx.) MacM.; BLM0344, HF0111; N; P; DA
Gleditsia triacanthos L.; BLM073; N; P; BLF
Glycyrrhiza lepidota Pursh; BLM0310; N; P; SB
Hoffmannseggia glauca (Ort.) Eiffert; HF039, PC-147; N; P; DA
Indigofera miniata Ort. var. leptosepala; BLM0159, PC-206; N; P; SB
Medicago minima (L.) L.; PC-31; I; A; DA

Medicago orbicularis (L.) Bartal.; HF045; I; A; DA
Melilotus officinalis (L.) Lam.; BLM0485, HF027, PC-195; I; A; DA
Mimosa nuttallii (DC.) B.L. Turner; BLM0189, HF066, PC-90; N; P; MG, MQ
Neptunia latera Bentham.; PC-100; N; P; MG, MQ
Pediomelum cuspidatum (Pursh) Ryd.; PC-83; N; P; MG, MQ
Pediomelum linearifolium (Torr. & A. Gray) J. Grimes.; PC-95; N; P; MG, MQ
Prosopis glandulosa Torr.; BLM0176, HF068, PC-64; N; P; DA, MG, MQ
Vicia sativa L.; BLM053; I; A; DA

GENTIANACEAE

Eustoma exaltatum (L.) Salisb. ex G. Don; BLM0341, PC-202; N; A; AQ

GERANIACEAE

Erodium cicutarium (L.) L'Héroux ex Aiton; BLM063, PC-240; I; A; DA
Geranium carolinianum L.; 2087-BWH; HF049; N; A; DA

HYDROPHYLACEAE

Nama hispidum Gray; BLM0153; N; A; MG

KRAMERIACEAE

Krameria lanceolata Torr.; BLM0167, HF057, PC-81; N; P; MG, MQ

LAMIACEAE

Hedeoma reverchonii A. Gray; PC-126; N; P; MG, MQ
Lamium amplexicaule L.; BLM074, PC-239; I; A; BLF, DA
Monarda clinopodioides A. Gray; BLM0197, PC-69; N; A; DA, MG
Scutellaria drummondii Bentham; PC-105; N; A; MG
Scutellaria resinosoides A. Gray; PC-5; N; P; MG
Teucrium canadense L.; BLM0331, PC-129; N; P; BLF
Teucrium lucidum Benth.; BLM0149, HF055, PC-30, N; P; MG, MQ

LINACEAE

Linum perenne L.; BLM069; I; P; MG, MQ
Linum pratense (J.B.S. Norton) Small; PC-103; N; A; MG, MQ

LOASACEAE

Mentzelia nuda (Pursh) Torr. & A. Gray var. stricta (Osterhout) Harrington; BLM0325; N; P; SB
Mentzelia oligosperma Nutt. ex Sims.; PC-121; N; P; MG
LYTHRACEAE
Lythrum alatum Pursh.; HF04; N; P; AQ
Lythrum californicum Torr. & A. Gray; PC-130; N; P; AQ

MALVACEAE
Malvella leprosa (Ortega) Krapov.: HF03; N; P; DA
Sphaeralcea coccinea (Nutt.) Rydb.; PC-7; N; P; MG, MQ

MENISPERMACEAE
Cocculus carolinus (L.) DC.; BLM0309; N; P; DA

MOLLUGINACEAE
Mollugo verticillata L.; HF075; N; A; DA

MORACEAE
Maclura pomifera (Raf.) Schneid.; BLM0318; HFO69; N; P; BLF, DA
Morus alba L.; BLM0507; HF0117; I; P; DA

NYCTAGINACEAE
Abronia fragrans Nutt. ex Hook.; BLM057; N; P; SB
Mirabilis albida (Walt.) Heimerl; BLM0172; PC-162; N; P; SB
Mirabilis jalapa L.; HF0153; I; P; DA
Mirabilis linearis (Pursh) Heimerl; HF072; N; P; MG, MQ

OLEACEAE
Fraxinus pennsylvanica Marsh.; PC-150; N; P; BLF

ONAGRACEAE
Calylophus hartwegii (Benth.) Raven subsp. pubescens (A. Gray) Towner & Raven; PC-33; N; MG
Calylophus verrucatus (Nutt.) Raven; BLM0202; N; P; MG, SB
Gaura coccinea Nutt. ex Pursh.; BLM066; HF044; N; P; MG, SB
Gaura parviflora Doug. ex Lehm.; PC-191; HF025; N; A; DA
Gaura sinuata Nutt. ex Ser.; PC-158; N; P; MG, MQ
Ludwigia peploides (Kunth) Raven; 2089-BWH; N; P; AQ
Ludwigia repens J.R. Forst.; BLM0198; N; P; AQ
Oenothera grandis Britt.; BLM080, 062-97, PC-1; N; A; MG, SB
Oenothera rhombipetala Nutt. ex Torr. & A. Gray; BLM0378; N; Bi; DA, SB
Oenothera speciosa Nutt.; HF037; PC-34; N; P; DA, MG
Oenothera triflora Nutt.; M9.026; N; Bi, MG, MQ
Stenosiphon linifolius (Nutt. ex James) Heynh.; BLM0361, PC-89; N; P; DA, MG, MQ

OXALIDACEAE
Oxalis corniculata L.; PC-246; N; P; DA

PAPAVERACEAE
Argemone polyanthemos (Fedde) G.B. Ownbey; BLM0185; N; A; SB

PEDALIACEAE
Proboscidea louisianica (P. Mill.) Thell.; HF088; PC-211; N; A; DA

PLANTAGINACEAE
Plantago rhodopensima Decne.; BLM079; PC-25; N; A; DA, MG

POLYGLALACEAE
Polygala alba Nutt. BLM0148; PC-48; N; P; MG

POLYGONACEAE
Enagonon annuum Nutt.; BLM0354; N; A; SB
Enagonon longifolium Nutt.; PC-175; N; P; MG
Polygonum hydropiperoides Michx.; BLM0422; N; P; AQ
Polygonum lapathifolium L.; HF0148; N; A; AQ
Polygonum persicaria L.; HF024; N; A; AQ
Polygonum cernuum L.; HF0160; N; A; DA

RANUNCULACEAE
Rumex alismoides Wood; HF021; N; P; AQ, DA
Rumex crispus L.; HF05; I; P; AQ, DA, BLF

PORTULACACEAE
Portulaca oleracea L.; HF0137; N; A; DA

PRIMULACEAE
Androsace occidentalis Pursh.; PC-248; N; A; DA
Samolus ebracteatus Kunth; BLM0184; N; P; AQ
Samolus valerandi L.; BLM0503; N; P; AQ

RHAMNACEAE
Anemone berlandieri Pritz.; PC-23; N; P; MG
Anemone caroliniana Walt.; PC-227; N; P; DA, MG
Delphinium carolinianum Walt. ssp. virens (Nutt.) Brooks; PC-20; N; P; MG, MQ
Myosurus minimum L.; PC-234; N; A; AQ
Ranunculus sceleratus L.; BLM034; N; A; AQ

ROSACEAE
Crataegus viridis L.; M9.129; N; P; BLF
Prunus angustifolia Marshall; HF052, PC-139; N; P; DA, MG
Rubus trivialis Michx.; BLM037; N; P; BLF

RUBIACEAE
cephalanthus occidentalis L.; PC-119; N; P, AQ
Galium aparine L.; BLM039; N; A; BLF
Hedyotis nigricans (Lam.) Fosberg; BLM0191, PC-82; N; P, MG
Houstonia pusilla Schoenf.; PC-226; N; A; DA

RUTACEAE
Zanthoxylum hirsutum Buckl.; BLM0160; N; P; SB

SALICACEAE
Populus deltoides Marsh. ssp. monilifera (Ait.) Eckenw.; PC-19; N; P; BLF
Populus deltoides Bartr. ex Marsh; HF0128, PC-251; N; P; BLF
Salix exigua Nutt.; BLM0308, N; P, SB
Salix nigra Marsh; BLM0314, HF029, PC-120; N; P; AQ, BLF, SB

SAPINDACEAE
Cardiospermum halicacabum L.; BLM0339; N; A; BLF
Sapindus saponaria L. var. drummondi (Hook. & Arn.) L.D. Benson; HF026, PC-149; N; P, BLF, SB

SAPOTACEAE
Sideroxylon lanuginosum Michx.; BLM0173, PC-207; N; P, SB

SCROPHULARIACEAE
Lindernia dubia (L.) Pennell, M9.136; N; A; AQ
Penstemon cobei Nutt.; PC-51; N; P, MG
Veronica anagalis-aquatica L.; BLM052; N; P; AQ
Veronica peregrina L.; BLM081; N; A; DA

SIMARUROBACEAE
Allanthus altissima (P.Mill.) Swingle; 0489-98; l; P; DA

SOLANACEAE
Chamaesaracha coniodes Moric. ex Dunal; PC-58; N; P, DA
Physalis angulata L.; HF0123; N; A; DA
Physalis longifolia Nutt.; BLM0351, PC-97; N; P; DA
Physalis mollis Nutt. var. mollis; HF0133, PC-167; N; P, DA

Quincaia lobata (Torr.) Raf.; HF013, PC-52; N; P; DA
Solanum dimidiatum Raf.; BLM0153, PC-87; N; P; DA
Solanum elaeagnifolium Cav.; BLM0169, PC-50; N; P; MG
Solanum rostratum Dunal; BLM0493, HF092; N; A; DA

TAMARICACEAE
Tamarix chinensis Lour.; HF020, PC-198; I; P; AQ, SB

ULMACEAE
Celtis laevigata Willd. var. texana (Scheele) Sang.; HF080, PC-110; N; P; BLF, SB
Ulmus americana L.; BLM0337, PC-253; N; P; BLF

URTICACEAE
Parietaria pensylvanica Muhol. ex Willd.; BLM0170; N; A; BLF

VALERIANACEAE
Valerianella radiata (L.) Dufr.; BLM083; N; A; DA

VERBENACEAE
Phyla lanceolata (Michx.) Greene; BLM0199; N; P; AQ
Phyla nodiflora (L.) Greene; BLM0330, PC-127; N; P; AQ
Glandularia bipinnatifida (Nutt.) Nutt.; PC-12; N; A; DA
Verbena plicata Greene; BLM060; N; P; MG
Verbena scabra Vahl; BLM0423; N; P; MG

VIOLACEAE
Viola bicolor Pursh; PC-225; N; A; DA

VISCACEAE
Phoradendron tomentosum (DC.) Engel. ex A. Gray; BLM0164, PC-250; N; P; BLF

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