

## Vascular Flora of a Riparian Site on the Canadian River, Cleveland County, Oklahoma

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This article reports the results of an inventory of the vascular plants from a riparian site in central Oklahoma. One hundred and sixty-three species of vascular plants in 131 genera and 45 families were collected. The most species were collected from the families Asteraceae (32) and Poaceae (26). Fifty-eight species were annuals, 97 perennials, and 8 biennials. Eight species of woody plants were present. Twenty-nine species, or 18% of the flora, were exotic to Oklahoma. No species listed as threatened or endangered by the U.S. Fish and Wildlife Service nor those tracked by the Oklahoma Natural Heritage Inventory were encountered.

### INTRODUCTION

Although North America has a long history of botanical inventory, exotic species are often under-represented in herbarium collections. Herbarium collections typically document the native flora of an area. Many botanists have historically shown little interest in collecting “weeds” or non-native species. Thus it is difficult to determine the arrival and establishment of exotic and invasive species (Cronk and Fuller, 2001). The same is true of highly disturbed areas which have historically been under-collected by botanists due to higher concentrations of non-native species (Plantly-Tabacchi et al., 1996). In recent years such habitats have become of interest, particularly in Europe, because they harbor a greater occurrence and abundance of exotic species (Ferreira and Moreira, 1995; Kowarik, 1995).

The objective of this study is to inventory the flora of a riparian area that has

been heavily impacted by natural and anthropogenic disturbances on the Canadian River. Natural disturbances consist of flooding and channel migration, which often destroy extant vegetation. Anthropogenic disturbances at the site include the abandoned City of Norman Municipal Landfill (NML) and sand and gravel removal for an adjacent asphalt plant. The NML now serves as a national test site for United States Geological Survey (USGS) studies of water pollution associated with landfills. The plant species list resulting from this project will serve as a baseline for USGS researchers and their cooperators working at the NML.

### STUDY AREA

The study area occupies 254 hectares on the Canadian River in Cleveland County, Oklahoma (35° 16'N, 95° 44'W). The site has been heavily disturbed by a variety of land uses (Figure), including the NML, which was

active from 1922 until 1985 (Curtis and Whitney, 2003). Active sand excavation occurs in the southern portion of the study area. In addition, the Canadian River is used for recreational purposes by the citizens of Norman. Past agricultural uses include hay fields and livestock grazing.

The dynamics of the Canadian River has also affected plant species composition. The Canadian River is a braided stream that often ceases to flow during summer months. Discharge on the Canadian River averages 310.16 m<sup>3</sup>/second (Tortorelli, 1999). A significant flood event in 1987 pushed the river channel approximately 500m south to the present location. Other major floods were recorded in 1941, 1948, and 1986 (Curtis and Whitney, 2003).

Climate of the study area is semi-arid continental. The hottest month is July, with an average temperature of 27.8°C, and the coldest is January, with an average temperature 2.4°C (Oklahoma Climate Survey 2006). The growing season is six months long (Bourlier et al., 1987). Topography at the site consists of gently rolling, southwest sloping plains. The soils are Quaternary alluvium on terrace deposits. Two soil types are present, the Gracemore silty clay loam and the Gracemore loamy fine sand and/or clay loams, both of the Gracemore-Gracemont Association (Bourlier et al., 1987). Both soils are frequently flooded, moderately alkaline, and calcareous. Underlying the alluvium is a low permeability unit of shale and mudstone (Eganhouse, et al., 1999).

## MATERIALS AND METHODS

Voucher specimens were collected from 1m<sup>2</sup> plots placed at 23m intervals along a transect and from random sites throughout the study area. Collections were made at two-week intervals from April through November 2005. Vouchers for species exotic 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 (1969) and Diggs et al. (1999). Origin, either native or introduced, was determined by using USDA-NRCS (2006). Nomenclature follows the US Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS, 2006). Voucher specimens were deposited at OKL.

## RESULT AND DISCUSSION

One hundred sixty-three species of vascular plants in 45 families, and 131 genera were collected (Appendix, Table). The Asteraceae (32), Poaceae (26), Fabaceae (11), and Cyperaceae (10), had the greatest number of species. Fifty-eight species of annuals, eight biennials, and 97 perennials were collected. Eight species of woody plants were collected, five of which were primarily represented by young saplings. No federally listed threatened or endangered species, or species tracked by the Oklahoma Natural Heritage Inventory, were encountered during this study. *Carduus nutans* (Asteraceae) and *Rhynchospora nivea* (Cyperaceae) were records for Cleveland County (Hoagland et al., 2006).

Twenty-nine species (18%) from 14 families were introduced. The family with the greatest number of introduced species was Poaceae (11). Sixteen of the introduced species were annuals or biennial and 13 were perennials. The percentage of exotic species at this site exceeds those reported in recent floristic studies in Oklahoma, which range from 9-13 percent of the flora (Hoagland and Johnson, 2001, 2004a, 2004b; Hoagland and Buthod, 2003, 2004; Hoagland and Wallick, 2003; Hoagland, et al., 2004; Hoagland, et al.,

2004). Given the small size of the flora, exotic species richness would be expected to have a disproportional effect. This is likely augmented by the disturbance history of the site.

Two habitat types predominated at the study site. Wetland and aquatic vegetation included the Canadian River channel and small ephemeral wetlands. Common species included *Amorpha fruticosa*, *Andropogon glomeratus*, *Eleocharis obtusa*, *Juncus torreyi*, *Salix exigua*, *S. nigra*, *Schoenoplectus americanus*, *Tamarix gallica*, and *Typha latifolia*. Disturbed areas and old-fields were sites heavily impacted by the human activities described above. These areas were generally represented by fewer species, many of which were introduced. Common species in this habitat included *Ambrosia trifida*, *Amphiachyris dracunculoides*, *Convolvulus arvensis*, *Cyperus esculentus*, *Bromus tectorum*, *Helianthus maximiliani*, *Torilis arvensis*, and *Verbesina encelioides*.

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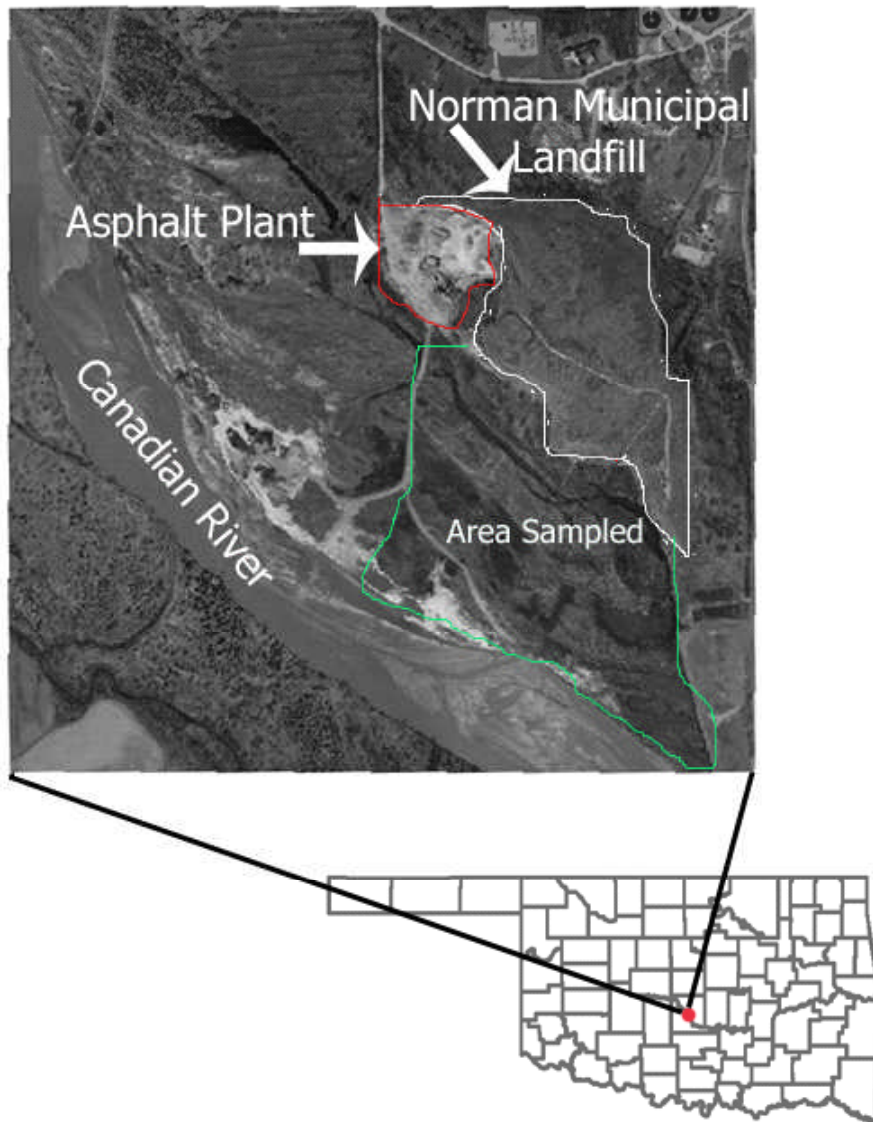
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**Table** Summary of floristic collections made in Cleveland County, Oklahoma.\*

Taxonomic group	Species	Native spp.	Exotic spp.
Equisetophyta	2	2	0
Coniferophyta	1	1	0
Magnoliophyta	160	131	29
Magnoliopsida	116	100	16
Liliopsida	44	31	13
Total	163	134	29

\* Table format follows Palmer et al. (1995).



**Figure** Location of Norman Landfill Site, Cleveland County, Oklahoma.

## APPENDIX

Annotated species list for a riparian site on the Canadian River in Cleveland County, Oklahoma. The first entry indicates life history (A = Annual, B = Biennial, P = Perennial), followed by habitat (WETL = wetland and aquatic vegetation, DAOF = disturbed areas and old-field vegetation), and collection number. Exotic species are denoted with an asterisk. Voucher specimens were deposited at the Robert Bebb Herbarium at the University of Oklahoma (OKL).

### Coniferophyta

#### Cupressaceae

*Juniperus virginiana* L. (eastern red cedar): P,  
DAOF, #152

### Equisetophyta

#### Equisetaceae

*Equisetum hyemale* L. var. *affine* (Engelm) A.A.  
Eat. (scouringrush horsetail): P, WETL, #15  
*Equisetum laevigatum* A. Braun (smooth  
horsetail): P, WETL, #16

### Magnoliophyta

#### Magnoliopsida

#### Anacardiaceae

*Rhus glabra* L. (smooth sumac): P, DAOF,  
#149  
*Toxicodendron radicans* (L.) Kuntze (poison ivy):  
P, DAOF, not collected#

#### Apiaceae

*Cicuta maculata* L. (spotted water hemlock): B,  
WETL, #150  
*Torilis arvensis* (Huds.) Link\* (hedge parsley):  
A, DAOF, #85

#### Asteraceae

*Achillea millefolium* L.\* (common yarrow): P,  
DAOF, #50  
*Ambrosia psilostachya* D.C. (western ragweed):  
P, DAOF, #86  
*Ambrosia trifida* L. (giant ragweed): A, DAOF,  
Lost#  
*Amphichyris dracunculoides* (DC.) Nutt. (prairie  
broomweed): A, DAOF, #131  
*Aphanostephus skirrhobasis* DC. (lazy daisy): A,  
DAOF, #51

*Carduus nutans* L.\* (nodding plumeless thistle):  
B, DAOF, #154  
*Chrysopsis pilosa* Nutt. (soft goldenaster): A,  
DAOF, #1  
*Conyza canadensis* (L.) Cronq. (horseweed): A,  
DAOF, #132  
*Coreopsis tinctoria* Nutt. (plains coreopsis): P,  
DAOF, #133  
*Croptilon divaricatum* (Nutt.) Raf. (slender  
scratchdaisy): A, DAOF, #134  
*Dracopis amplexicaulis* (Vahl) Cass. (clasping  
coneflower): A, DAOF, #158  
*Eclipta prostrata* (L.) L. (false daisy): P, WETL,  
#53  
*Erigeron annuus* (L.) Pers. (daisy fleabane): A,  
DAOF, #90  
*Erigeron philadelphicus* L. (Philadelphia  
fleabane): P, DAOF, #2  
*Eupatorium serotinum* Michx. (lateflowering  
thoroughwort): P, DAOF, #135  
*Euthamia gymnospermoides* Greene (Texas  
goldentop): P, WETL, #195  
*Helianthus hirsutus* Raf. (hairy sunflower): P,  
DAOF, #138  
*Helianthus maximiliani* Schrad. (Maximilian  
sunflower): P, DAOF, #139  
*Helianthus petiolaris* Nutt. (prairie sunflower):  
A, DAOF, #4  
*Heterotheca canescens* (DC.) Shinn. (hoary  
false goldenaster): P, DAOF, #116  
*Heterotheca subaxillaris* (Lam.) Britt. & Rusby  
(camphorweed): A, DAOF, #56  
*Iva annua* L. (annual marshelder): A, DAOF,  
#141  
*Lactuca canadensis* L. (Canada lettuce): B,  
DAOF, #5

*Pluchea odorata* L. Cass (purple camphorweed):  
P, DAOF, #91

*Rudbeckia hirta* L. (blackeyed susan): P, DAOF,  
#57

*Rudbeckia grandiflora* (D. Don) J.F. Gmel. Ex  
D.C. (blackeyed susan): P, DAOF, #142

*Solidago gigantea* Ait. (giant goldenrod): P,  
DAOF, #143

*Sonchus asper* (L.) Hill \*(spiny sowthistle): A,  
DAOF, #158

*Symphotrichum ericoides* (L.) Nesom var. *ericoides*  
(white heath aster): P, DAOF, #196

*Thelesperma filifolium* (Hook.) Gray var. *filifolium*  
(stiff greenthread): P, DAOF, #145

*Verbesina encelioides* (Cav.) Benth. & Hook. f. ex  
Gray (golden crownbeard): A, DAOF, #199

*Xanthium strumarium* L. (rough cocklebur): A,  
DAOF, #146

#### Amaranthaceae

*Amaranthus cruentus* L. (slim amaranth): A,  
DAOF, #44

#### Apiaceae

*Cicuta maculata* L. (spotted water hemlock): B,  
WETL, #117

*Conium maculatum* L.\* (poison hemlock): B,  
WETL, #45

*Torilis nodosa* (L.) Gaetrn.\* (knotted  
hedgearsley): A, DAOF, #148

#### Apocynaceae

*Apocynum cannabinum* L. (Indianhemp): P,  
WETL, #47

#### Asclepiadaceae

*Asclepias viridis* Walt. (green antelopehorn): P,  
DAOF, #49

*Asclepias arenaria* Torr. (sand milkweed): P,  
DAOF, #118

#### Bignoniaceae

*Campsis radicans* (L.) Seem. ex. Bureau  
(trumpet creeper): P, DAOF, #52

*Catalpa bignonioides* Walt. (southern catalpa): P,  
WETL/DAOF, #6

#### Boraginaceae

*Heliotropium convolvulaceum* (Nutt.) Gray (phlox  
heliotrope): A, DAOF, #119

#### Brassicaceae

*Lepidium virginicum* L. (Virginia pepperweed):  
A, WETL, #60

*Rorippa sessiliflora* (Nutt.) A.S. Hitchc. (stalkless  
yellowcress): A, DAOF/WETL, #7

*Rorippa palustris* (L.) Bess. (bog yellowcress): A,  
WETL, #120

#### Campanulaceae

*Triodanis perfoliata* (L.) Nieuwl. (clasping  
Venus' looking-glass): A, DAOF, #8

#### Caryophyllaceae

*Arenaria serpyllifolia* L.\* (thymeleaf sandwort):  
A, DAOF, #10

#### Chenopodiaceae

*Chenopodium ambrosioides* L.\* (Mexican tea): A,  
WETL, #9

#### Convolvulaceae

*Convolvulus arvensis* L.\* (field bindweed): P,  
DAOF, #11

#### Euphorbiaceae

*Chamaesyce missurica* (Raf.) Shinners (prairie  
sandmat): A, DAOF, #156

*Cnidioscolus texanus* (Muell.-Arg) Small (bull  
nettle): P, DAOF, #157

*Euphorbia marginata* Pursh (snow on the  
mountain): A, DAOF, #159

#### Fabaceae

*Amorpha fruticosa* L. (false indigo): P, WETL,  
# 95

*Chamaecrista fasciculata* (Michx) Greene var.  
*fasciculata*, (partridge pea): P, DAOF, #96

*Desmanthus illinoensis* (Michx.) MacM. ex. B.L.  
Robins & Fern. (Illinois bundleflower): P,  
DAOF, #97

*Desmodium ciliare* (Muhl ex Willd.) DC. (hairy  
small-leaf ticktrefoil): P, DAOF, #191



- Indigofera miniata* Ortega (coastal indigo): P,  
DAOF/WETL, #123  
*Lathyrus hirsutus* L.\* (Caley pea): A, DAOF, #  
66  
*Lespedeza stuevei* Nutt. (tall lespedeza): P,  
DAOF, #192  
*Medicago lupulina* L. (black medick): P, DAOF,  
#193  
*Melilotus officinalis* (L.) Lam. (yellow sweet  
clover): B, DAOF, #99  
*Strophostyles helvola* (L.) Elliott (trailing  
fuzzybean): A, WETL./DAOF, #160  
*Vicia villosa* Roth\* (winter vetch): B, DAOF,  
#162

#### Gentianaceae

- Eustoma exaltatum* (L.) Salisb. ex G. Don ssp.  
*russellianum* (Hook.) Kartesz  
(showy prairie gentian): P, DAOF, #144  
*Sabatia campestris* Nutt. (prairie rose): A,  
DAOF/WETL, #100

#### Lamiaceae

- Lamium amplexicaule* L.\* (henbit deadnettle):  
A, DAOF, #20  
*Lycopus americanus* Muhl. ex W. Bart.  
(American water horehound): P, WETL,  
#163  
*Teucrium canadense* L. (American germander): P,  
DAOF, #165

#### Lythraceae

- Ammannia coccinea* Rottb. (valley redstem): A,  
WETL, #87  
*Lythrum alatum* Pursh (winged lythrum): P,  
DAOF/WETL, #126  
*Rotala ramosior* (L.) Koehne (lowland rotala):  
A, WETL, #70

#### Malvaceae

- Callirhoe involucrata* (Torr. & Gray) Gray  
(purple poppymallow): P, DAOF, #22  
*Mirabilis nyctaginea* (Michx.) MacM. (heartleaf  
four o'clock): P, DAOF, #101

#### Onagraceae

- Gaura coccinea* Nutt. ex Pursh (scarlet  
beeblossom): P, DAOF, #23  
*Gaura mollis* James (velvetweed): P, DAOF,  
#24  
*Gaura villosa* Torr. (woolly beeblossom): P,  
DAOF/WETL, #127  
*Ludwigia peploides* (Kunth) Raven (floating  
primrose-willow): P, WETL, #193  
*Oenothera laciniata* Hill (cutleaf evening-  
primrose): A, DAOF, #37  
*Oenothera biennis* L. (common evening-  
primrose): B, DAOF/WETL, #84

#### Oxalidaceae

- Oxalis stricta* L. (common yellow oxalis): P,  
DAOF, #72

#### Papaveraceae

- Argemone polyanthemus* (Fedde) G.B. Ownbey  
(crested pricklypoppy): A, DAOF, #161

#### Plantaginaceae

- Plantago patagonica* Jacq. (woolly plantain): A,  
DAOF, #25

#### Polygonaceae

- Polygonum hydrophiloides* Michx. (swamp  
smartweed): P, WETL, #75  
*Polygonum lapathifolium* L. (curlytop knotweed):  
A, WETL, #194  
*Polygonum ramosissimum* Michx. (bushy  
knotweed): A, WETL, #102  
*Rumex crispus* L.\* (curly dock): P, WETL, #76

#### Primulaceae

- Samolus valerandi* L. ssp. *parviflorus* (Raf.) Hulten  
(seaside brookweed): P, WETL, #78

#### Ranunculaceae

- Clematis terniflora* DC.\* (sweet autumn  
virginsbower): P, DAOF, #79  
*Ranunculus sceleratus* L. var. *sceleratus* (cursed  
buttercup): P, WETL, #80

#### Rubiaceae

- Galium aparine* L. (stickywilly): A, DAOF,  
#129

*Sberardia arvensis* L.\* (blue fieldmadder): A,  
DAOF, #39

### Salicaceae

*Populus deltoides* Bart. ex Marsh. (eastern  
cottonwood): P, WETL, #175  
*Salix exigua* Nutt. (sandbar willow): P, WETL,  
#176  
*Salix nigra* Marsh (black willow): P, WETL,  
#177

### Scrophulariaceae

*Agalinis heterophylla* (Nutt.) Small ex. Britt.  
(prairie false foxglove): A, DAOF/WETL,  
#178  
*Agalinis aspera* (Dougl. ex. Benth.) Britt. (tall  
false foxglove): A, DAOF/WETL, #179  
*Castilleja indivisa* Engelm. (Indian paintbrush):  
A, DAOF, #111  
*Leucospora multifida* (Michx.) Nutt. (narrowleaf  
paleseed): A, DAOF, #88  
*Veronica anagallis-aquatica* L. (water speedwell):  
P, WETL, #40  
*Veronica peregrina* L. (neckweed): A, WETL,  
#180

### Solananceae

*Datura wrightii* Regel (sacred thorn-apple): P,  
DAOF, #182  
*Physalis angulata* L. (cutleaf ground cherry): A,  
WETL/DAOF, #183  
*Physalis heterophylla* Nees (clammy  
groundcherry): P, DAOF, #184  
*Solanum elaeagnifolium* Cav. (silverleaf  
nightshade): P, WETL, #185  
*Solanum physalifolium* Rusby (hoe nightshade):  
A, DAOF, #186  
*Solanum rostratum* Dunal (buffalobur  
nightshade): A, DAOF, #187

### Tamariaceae

*Tamarix gallica* L.\* (salt cedar): P,  
WETL/DAOF, #114

### Valerianaceae

*Valerianella radiata* (L.) Dufr. (beaked  
cornsalad): A, DAOF, #42

### Verbenaceae

*Phyla lanceolata* (Michx.) Greene (lanceleaf  
frogfruit): P, WETL, #83  
*Phyla nodiflora* (L.) Greene (turkey tangle  
frogfruit): P, WETL, #82  
*Verbena stricta* Vent. (hoary verbena): P,  
DAOF, #189

### Vitaceae

*Vitis cinerea* (Engelm.) Engelm ex. Millard  
(sweet grape): P, DAOF, #190

### Liliopsida

#### Commelinaceae

*Commelina virginica* L. (Virginia dayflower): P,  
DAOF, #151

#### Cyperaceae

*Carex festucacea* Schkuhr ex Willd. (fescue  
sedge): P, WETL, #62  
*Cyperus esculentus* L.\* (yellownutsedge): P,  
WETL, #12  
*Cyperus odoratus* L. (fragrant flatsedge): A,  
WETL, #153  
*Cyperus squarrosus* L. (bearded flatsedge): A,  
WETL, #54  
*Cyperus strigosus* L. (strawcolored flatsedge): P,  
WETL, #174  
*Eleocharis obtusa* (Willd.) J.A. Schultes (blunt  
spikerush): P, WETL, #13  
*Fuirena simplex* Vahl (western umbrella-sedge):  
P, WETL, #14  
*Schoenoplectus americanus* (Pers.) Volk. ex. Schinz  
& Keller (chairmaker's bulrush): P, WETL,  
#155  
*Schoenoplectus maritimus* (L.) Lye (cosmopolitan  
bulrush): P, WETL, #122  
*Rhynchospora nivea* Boeckl. (showy whitetop): P,  
WETL, #112

### Iridaceae

*Sisyrinchium angustifolium* P. Mill. (narrowleaf blue-eyed grass): P, DAOF, #18

### Juncaceae

- Juncus acuminatus* Michx. (tapertip rush): P, WETL, #67  
*Juncus biflorus* Ell. (bog rush): P, WETL, #195  
*Juncus marginatus* Rostk. (grassleaf rush): P, WETL, #124  
*Juncus torreyi* Coville (Torrey's rush): P, WETL, #19

### Lilaceae

*Ornithogalum umbellatum* L.\* (star of bethlehem): P, DAOF, #21

### Poaceae

- Andropogon ternarius* Michx. (splitbeard bluestem): P, DAOF, #170  
*Andropogon glomeratus* (Walt.) B.S.P. (bushy bluestem): P, WETL, #164  
*Aristida oligantha* Michx. (prairie threeawn) : A, DAOF, # 174  
*Bromus catharticus* Vahl\* (rescuegrass) : A, DAOF, # 89  
*Bromus japonicus* Thunb. ex Murr.\* (Japanese brome): A, DAOF, #26  
*Bromus tectorum* L.\* (cheatgrass): A, DAOF, #27  
*Cenchrus spinifex* Cav. (coastal sandbur): A, DAOF/WETL, #166  
*Cynodon dactylon* (L.) Pers.\* (Bermuda grass): P, DAOF, #105  
*Dichanthelium acuminatum* (Sw.) Gould & C.A. Clark var. *fasciculatum* (Torr.) Freckmann (western panicgrass): P, DAOF, #174  
*Digitaria cognata* (J.A. Schultes) Pilger (fall witchgrass): P, DAOF, #125

- Echinochloa crus-galli* (L.) Beauv.\* (barnyardgrass): A, DAOF/WETL, #28  
*Elymus canadensis* L. (Canada wildrye): P, DAOF, #168  
*Elymus virginicus* L. (Virginia wildrye): P, DAOF, #29  
*Festuca brevipila* Tracey\* (hard fescue): P, DAOF, #169  
*Hordeum pusillum* Nutt. (little barley): A, WETL/DAOF, #30  
*Koeleria macrantha* (Ledeb.) J.A. Schultes (prairie Junegrass): P, DAOF/ WETL, #31  
*Leptochloa fusca* (L.) Kunth ssp. *fascicularis* (Lam.) Snow (bearded sprangletop): P, DAOF/WETL, #32  
*Lolium perenne* L. ssp. *multiflorum* (Lam.) Husnot\* (Italian ryegrass): P, DAOF, #33  
*Panicum virgatum* L. (switchgrass): P, WETL/DAOF, #35  
*Phragmites australis* (Cav.) Trin. ex. Steudel\* (common reed): P, WETL, #171  
*Polypogon monspeliensis* (L.) Desf.\* (rabbitsfoot grass): A, WETL, #36  
*Saccharum ravennae* (L.) L.\* (Ravenna grass): P, WETL, #172  
*Schizachyrium scoparium* (Michx.) Nash var. *scoparium* (little bluestem): P, DAOF, #173  
*Setaria parviflora* (Poir.) Kerguelen (marsh bristlegrass): P, WETL, #109  
*Sorghum halepense* (L.) Pers.\* (Johnson grass): P, DAOF, #110  
*Sporobolus cryptandrus* (Torr.) Gray (sand dropseed): P, DAOF, #128

### Typhaceae

*Typha domingensis* Pers. (southern cattail): P, WETL, #188