The Recent Spread of *Cyperus entrerianus* (Cyperaceae) in the Southeastern United States and its Invasive Potential in Bottomland Hardwood Forests

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Abstract - *Cyperus entrerianus*, a native of temperate South America, has become a tenacious weed in the southeastern United States. Herbarium and field studies revealed records of *C. entrerianus* from an additional 39 counties in the southeastern United States, increasing the number of counties where it is known by 118%. Vegetation sampling at two southeast Texas bottomland hardwood stands showed that *C. entrerianus* is capable of invading the understory of a mature forest with old-growth characteristics and that native herbaceous species richness and aerial cover are negatively correlated with increasing aerial cover of *C. entrerianus*. Life-history characteristics of *C. entrerianus* suggest it will continue to spread and could alter both herbaceous and woody plant dynamics in bottomland forests of the southeastern United States.

Introduction

Nonnative invasive species are estimated to cost the American public about $138 billion annually (Pimentel 2002). This cost includes the overall adverse effects and control measures for invasive species in agricultural, forest, urban, and natural areas. In addition to economic losses, non-indigenous species negatively affect native-plant community structure, diversity, and community dynamics (Westbrooks 1998, 2001; Woods 1993; Zimdahl 1995). The homogenization of native flora by introduced species can lead to modification of native habitats and local extinctions (Olden and Poff 2003), a classical example being the conversion of California grasslands from perennial-dominated to exotic annual-dominated ecosystems (Heady et al. 1992). Invasion of forest communities in the eastern United States by introduced plant species has been well documented (Barden 1987, Luken 2003, Nuzzo 1999, Rosen and Faden 2005), and, indeed, the invasion of intact climax or late successional forests followed by reduction in native-plant diversity (Woods 1993).

Cyperus entrerianus Böckeler (deeprooted sedge), a native of temperate South America, has become a tenacious weed in the southeastern United States (Carter 1990, Carter and Bryson 1996). Over the past decade, the authors have observed *C. entrerianus* in a variety of disturbed and native habitats, forming monotypic stands to the exclusion of native flora. Since its

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introduction prior to 1941, probably by separate events in Florida and Texas, *C. entrerianus* has dispersed rapidly (Bryson and Carter 1994, Carter 1990, Carter and Bryson 1996, Carter and Jones 1991). Voucher specimens from a total of 33 counties in Alabama, Florida, Georgia, Louisiana, Mississippi, and Texas were previously cited (Bryson and Carter 1994, Carter 1990, Carter and Bryson 1996, Carter and Jones 1991). Over the past decade, we have observed the continuous spread of *C. entrerianus*, and its adverse affect in agricultural areas and natural plant communities.

Field work throughout the southeastern United States over the past decade suggests that the dispersal of *Cyperus entrerianus* is being accelerated by human activities. Recently, we have observed the invasion of intact bottomland forests by *C. entrerianus* in southeastern Texas. We have found no published studies examining the response of native plant communities following invasion of *C. entrerianus*. The objectives of this research were to document additional spread of *C. entrerianus* and to determine its potential impact on a typical bottomland hardwood forest in southeastern Texas. We hypothesized that native herbaceous species richness and cover would be negatively correlated with the presence of *C. entrerianus*.

Materials and Methods

Study sites

In order to determine if *Cyperus entrerianus* could invade a bottomland forest with old growth canopy structure and understand which native species it might displace, we selected and compared two bottomland forest stands administered by the San Bernard National Wildlife Refuge. Both study sites are located in southwestern Brazoria County, TX, between 29º08'39.7" and 29º05'15.1"N latitude and 95º48'54.6" and 95º45'58.1"W longitude. The Dance Bayou Unit, a 263-ha old-growth bottomland forest stand, is not infested by *C. entrerianus*. The Bird Pond Unit is a 38-ha bottomland forest stand located 2 km north of the Dance Bayou Unit, similar in woody composition, but infested in the herbaceous layer with *C. entrerianus*. Soils at both sites are mapped as clayey textured, somewhat poorly drained, and very slowly permeable (Crenwelge et al. 1981). Topography at both sites comprises nearly level flats or pit and mound microtopography. Both sites are similar in their proximity to disturbed areas and activities that could facilitate invasion by *C. entrerianus*. Bird Pond has a history of understory disturbance and clearing for hunting, which might have promoted dispersal of *C. entrerianus* from an adjacent pipeline right-of-way. Both forest stands were acquired as stopover and staging habitat for Nearctic-Neotropical migrant land-birds. An additional conservation role of Bird Pond is to protect a large stand of *Leitneria floridana* A. Chapman (corkwood).

Vegetation sampling

Similar areas were selected at both sites and randomly sampled for woody and herbaceous vegetation in order to characterize a forested stand

invaded by *C. entrerianus* and to contrast it with an un-infested stand. At both sites, random points were placed within each sampling area. Once located in the field using a hand-held GPS, points were used to establish a corner for a 250-m^2 (10-m x 25-m) rectangular plot, with the long axis oriented in a north–south direction. Three 250-m^2 plots were permanently established at each stand (six plots total). Within each plot, all trees were sampled that possessed a diameter at breast height (DBH; about 1.4 m above the ground) ≥ 7.5 cm. Ten randomly placed 1-m x 1-m (1-m^2) quadrats within each of the 250-m^2 plots were sampled by estimating percentage of aerial cover (0–100%) of all herbaceous species (including woody vegetation < 0.5 m tall) for a total of thirty 1-m^2 quadrats at each stand (sixty total). All field work was conducted in early April 2004 and 2005.

Data analysis

Data obtained from the plots were used to calculate density and dominance (= basal area) for trees and frequency and dominance (= percent cover) for herbaceous vegetation. Importance values were obtained for each species in each plot by summing relative density and relative dominance for trees, and relative frequency and relative dominance for herbaceous vegetation. Native herbaceous species aerial cover and richness were arcsin transformed, and then their relationships with aerial cover of *Cyperus entrerianus* were examined using simple linear regression.

Results

Distribution

Intensive field surveys and review of herbarium specimens have led to discovery of populations of *Cyperus entrerianus* in an additional 39 counties in the southeastern United States, increasing the number of counties where it is known by 118% and documenting substantial range expansions both northward and southward in Florida, Mississippi, and Texas (Fig. 1, Appendix I). Although previously known only from disturbed sites, over the past decade, *C. entrerianus* has been increasingly observed in relatively undisturbed, natural habitats, including bottomland forests, riparian forests over deep sands, tall-grass prairies, and coastal grasslands dominated by *Spartina spartinae* (Trin.) Merr. ex A. S. Hitchc.

Vegetation sampling

Dominant and sub-dominant canopy species composition were similar for Bird Pond and Dance Bayou (Table 1). Based on importance value, both stands are dominated by *Ulmus crassifolia* Nutt. (cedar elm; Table 1). Bird Pond is sub-dominated exclusively by *Quercus virginiana* Mill. var. *virginiana* (live oak), whereas Dance Bayou is sub-dominated almost equally by *Celtis laevigata* Willd. var. *laevigata* (sugar hackberry), *Q. virginiana* var. *virginiana*, and *Q. nigra* L. (water oak; Table 1). Even though Dance Bayou had higher canopy-class species richness, Bird Pond

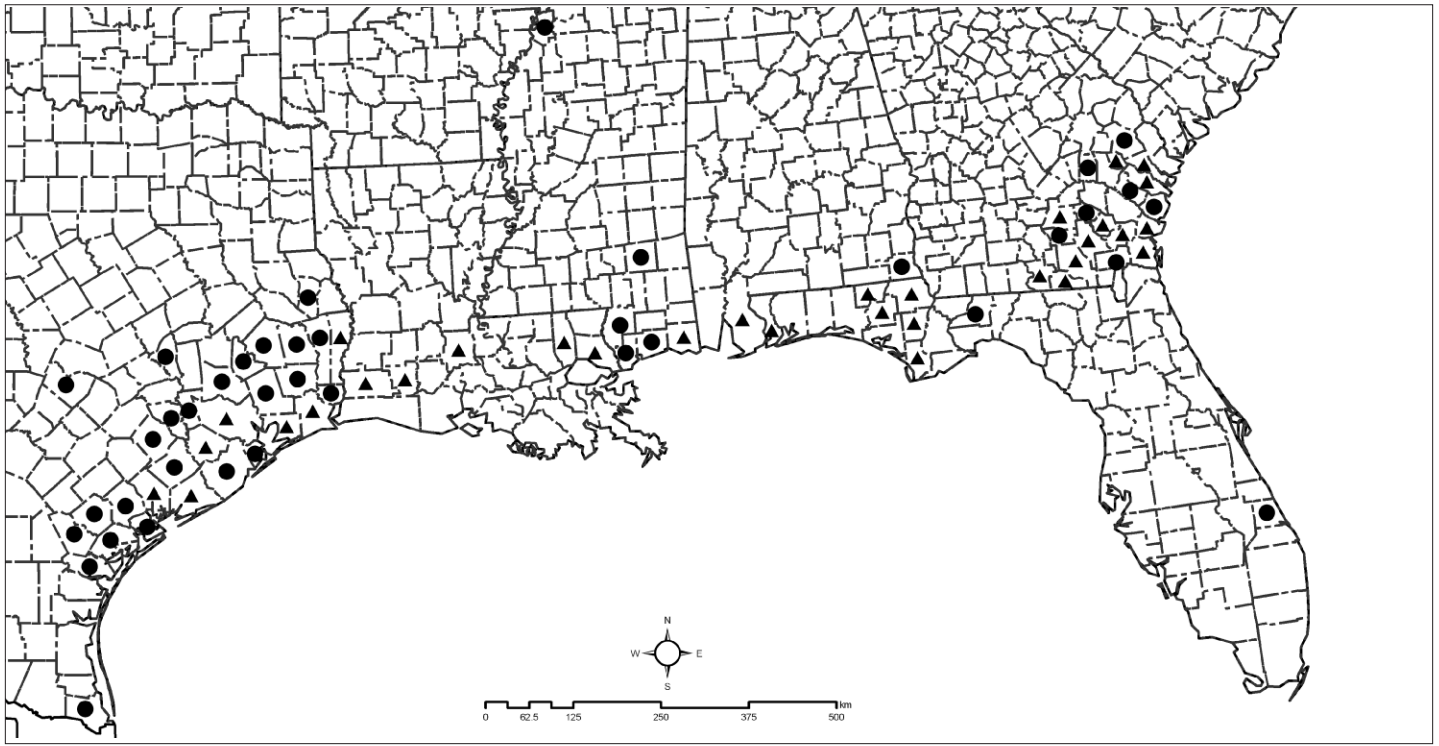

Figure 1. Distribution of *Cyperus entrerianus* in North America, North of Mexico. Specimens previously reported by Carter (1990), Carter and Jones (1991), Bryson and Carter (1994), and Carter and Bryson (1996) are indicated by solid triangles (▲) and records reported for the first time here by solid circles (●).

Table 1. Composition table for canopy size class (> 20 cm DBH) woody vegetation sampled at the Bird Pond Unit (infested with *Cyperus entrerianus*) and Dance Bayou Unit (no *C. entrerianus*), San Bernard National Wildlife Refuge. De = density (stems ha^{-1}), R.De. = relative density, Do = dominance (m^2 ha^{-1}), R.Do. = relative dominance, I.V. = importance value.

	Bird Pond					Dance Bayou				
	De	R.De.	Do	R.Do.	I.V.	De	R.De.	Do	R.Do.	I.V.
Ulmus crassifolia	173.3	65	13.1	26.1	91.1	120.0	50.0	10.2	31.1	81.1
Quercus virginiana	40.0	15	33.9	67.4	82.4	13.3	5.6	9.1	27.6	33.2
Celtis laevigata	26.7	10	2.0	3.9	13.9	40.0	16.7	3.8	11.6	28.3
Fraxinus pennsylvanica	13.3	5	0.8	1.7	6.7	-	-	-	-	-
Quercus nigra	13.3	5	0.5	0.9	5.9	26.7	11.1	4.1	12.5	23.6
Carya illinoiensis	-	-	-	-	-	13.3	5.6	2.4	7.4	13.0
Quercus shumardii	-	-	-	-	-	13.3	5.6	2.1	6.5	12.1
Acer negundo	-	-	-	-	-	13.3	5.6	1.1	3.4	9.0
Totals	266.6	100.0	50.3	100.0	200.0	240.0	100.0	32.8	100.0	200.0

Table 2. Composition table for herbaceous species with 100% occurrence sampled at the Bird Pond Unit (infested with *Cyperus entrerianus*) and Dance Bayou Unit (no *C. entrerianus*), San Bernard National Wildlife Refuge. %F = % frequency, R%F = relative % frequency, Do = dominance (% cover), R.Do. = relative dominance, I.V. = importance value.

	Bird Pond					Dance Bayou				
	%F	R%F	Do	R.Do.	I.V.	%F	R%F	Do	R.Do.	I.V.
Cyperus entrerianus	100	3.53	44.67	42.11	45.63	-	-	-	-	-
Sabal minor	100	3.53	21.33	20.11	23.64	100	2.4	8.92	4.56	6.96
Carex cherokeensis	100	3.53	17.08	16.10	19.63	100	2.4	43.33	22.17	24.57
Ulmus crassifolia	100	3.53	3.42	3.22	6.75	100	2.4	1.92	0.98	3.38
Carex flaccosperma	100	3.53	1.75	1.65	5.18	-	-	-	-	-
Viola sororia var. *sororia*	100	3.53	1.75	1.65	5.18	100	2.4	1.92	0.98	3.38
Quercus nigra	100	3.53	0.92	0.86	4.39	-	-	-	-	-
Carex leavenworthii	100	3.53	0.75	0.71	4.24	-	-	-	-	-
Fraxinus pennsylvanica	100	3.53	0.67	0.63	4.16	-	-	-	-	-
Carex caroliniana	100	3.53	0.67	0.63	4.16	-	-	-	-	-
Solidago canadensis	100	3.53	0.42	0.39	3.92	-	-	-	-	-
Toxicodendron radicans	100	3.53	0.42	0.39	3.92	100	2.4	17.42	8.91	11.31
Symphyotrichum racemosum	100	3.53	0.33	0.31	3.84	-	-	-	-	-
Tovara virginiana	-	-	-	-	-	100	2.4	23.33	11.94	14.34
Oplismenus hirtellus	-	-	-	-	-	100	2.4	15.67	8.01	10.41
Chasmanthium laxum	-	-	-			100	2.4	7.00	3.58	5.98
Campsis radicans	-	-	-	-	-	100	2.4	6.00	3.07	5.47
Parthenocissus quinquefolia	-	-	-	-	-	100	2.4	5.67	2.90	5.3
Sanicula canadensis	-	-	-	-	-	100	2.4	5.33	2.73	5.13
Carex blanda	-	-	-	-	-	100	2.4	3.67	1.88	4.28
Carex texensis	-	-	-	-	-	100	2.4	3.00	1.53	3.93
Myosotis macrosperma	-	-	-	-	-	100	2.4	2.58	1.32	3.72
Malvaviscus drummondii	-	-	-	-	-	100	2.4	2.50	1.28	3.68
Carex bulbostylis	-	-	-	-	-	100	2.4	2.17	1.11	3.51
Viola sororia	-	-	-	-	-	100	2.4	1.92	0.98	3.38
Spigelia texana	-	-	-	-	-	100	2.4	1.08	0.55	2.95
Galium aparine	-	-	-	-	-	100	2.4	1.00	0.51	2.91
Cyperus thyrsiflorus	-	-	-	-	-	100	2.4	0.75	0.38	2.78
Celtis laevigata	-	-	-	-	-	100	2.4	0.67	0.34	2.74
Berchemia scandens	-	-	-	-	-	100	2.4	0.67	0.34	2.74

had higher stem density (stems ha^{-1}) and dominance (m^2 ha^{-1}) indicating the canopy is structurally equivalent to the old-growth stand at Dance Bayou (Table 1). Based on importance value, the herbaceous layer at Bird Pond was dominated by *Cyperus entrerianus*, with sub-dominants of *Sabal minor* (dwarf palmetto) and *Carex cherokeensis* (cherokee sedge), while Dance Bayou is dominated by *C. cherokeensis* (Table 2). Species diversity, evenness, and richness were higher at Dance Bayou than Bird Pond (Table 3, Appendix II). At Bird Pond, native herbaceous species richness and aerial cover showed significant ($P < 0.05$) decline with increasing aerial cover of *Cyperus entrerianus* (Figs. 2, 3).

Discussion

Quantitative sampling of forest vegetation at the Bird Pond and Dance Bayou Units of the San Bernard National Wildlife Refuge demonstrated that

Table 3. Diversity indices for herbaceous vascular plants sampled at the Bird Pond unit (infested with *Cyperus entrerianus*) and Dance Bayou unit (no *C. entrerianus*), San Bernard National Wildlife Refuge.

Stand	H' = Diversity	J' = Evenness	Species richness
Bird Pond unit	3.3	0.86	49
Dance Bayou unit	3.7	0.89	65

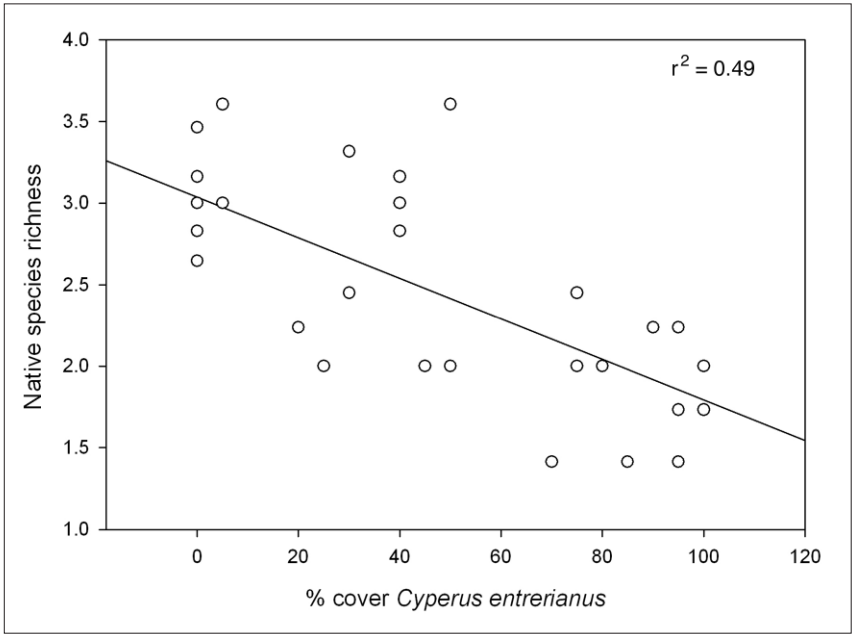

Figure 2. Linear least-squares regression line of native herbaceous species richness (arcsin transformed) vs. aerial % cover of *Cyperus entrerianus*. Points represent richness from single 1-m^2 quadrats.

Cyperus entrerianus became established under a canopy with old-growth attributes and that its presence was negatively correlated with native herbaceous species. *Cyperus entrerianus* may have less effect on more robust herbaceous species such as *Sabal minor* (dwarf palmetto) and *Carex cherokeensis* (cherokee sedge) than it does on species of smaller stature, or those with life history characteristics that would make them more sensitive to competition. The effect of *C. entrerianus* on seedlings of woody plants needs further study, although fewer woody species were sampled at Bird Pond (Appendix II) suggesting a negative effect. A comparison of species richness and diversity between the two study sites is not intended to suggest the reduced richness at Bird Pond is due entirely to invasion by an exotic species, since differences could be due to factors other than the occurrence of *C. entrerianus*. However, within each 250-m^2 plot at Bird Pond, cover and richness of herbaceous species was negatively correlated with cover of *C. entrerianus*. Our conclusions are based on a limited study at only two sites and our previous field observations. More research is needed to better understand the invasion of bottomland forests and other native habitats by *C. entrerianus*, and its effect on native vegetation.

Invasion of old-growth forests by exotic plants followed by depression of native species diversity is not well documented, but has been observed in North America (Woods 1993). The well-established ecological theory that

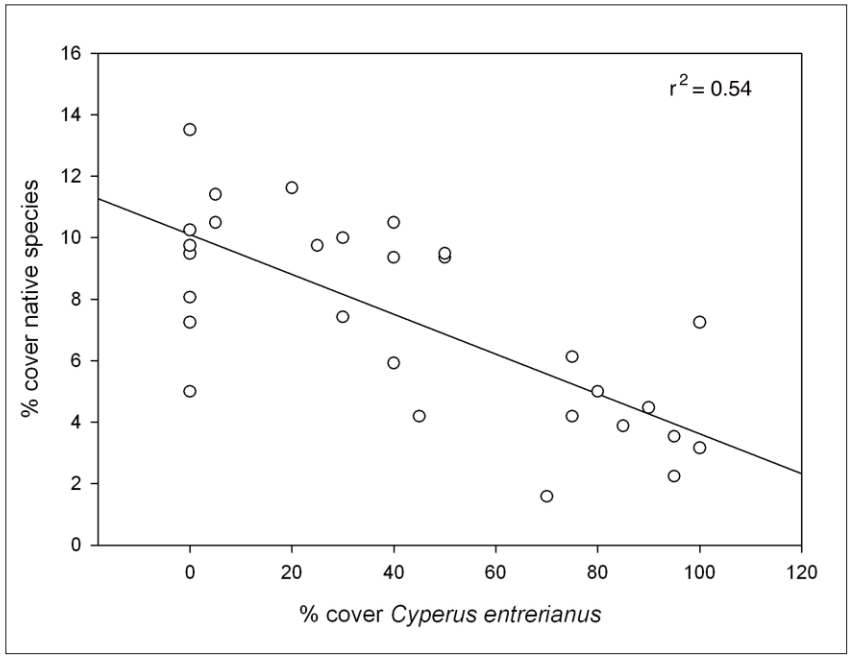

Figure 3. Linear least-squares regression line of native herbaceous species aerial % cover (arcsin transformed) vs. aerial % cover of *Cyperus entrerianus*. Points represent richness from single 1-m^2 quadrats.

productive, diverse habitats are resistant to exotic plant invasions has recently been challenged (Huston 2004). Our field observations of *Cyperus entrerianus* over the last decade indicate that its tiny seeds are readily dispersed, establishing new populations in a variety of habitats that increase in spatial extent and invade new areas. Life-history characteristics, including perennial habit, asexual reproduction, and high reproductive output (i.e., prolific seed production, high seed viability, and spring and fall flowering events) could give *C. entrerianus* a competitive advantage in a productive habitat such as bottomland hardwood forests. Results presented herein and observations of its life-history characteristics indicate *C. entrerianus* is a Type 8 colonizer. Type 8 colonizers are "quintessential invaders" with the following attributes: non-endemic, introduced via long-distance dispersal, and having a great impact on their new ecosystem (Davis and Thompson 2000). Its potential for competitive exclusion, apparent shade tolerance, and absence of native herbivores suggest that *C. entrerianus* could alter both herbaceous and woody plant dynamics in bottomland forests of the southeastern United States.

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Appendix I. Specimen citations for additional collections not reported by Carter (1990), Carter and Jones (1991), Bryson and Carter (1994), and Carter and Bryson (1996). Herbarium acronyms follow Holmgren et al. (1990).

ALABAMA. Houston Co.: sandy gravelly railroad switch area, just S of US 84, downtown Dothan, 14 Oct 1996, *Kral 86914* (VSC).

FLORIDA. Escambia Co.: Pensacola, roadside, 06 Aug 1941, *Brinker 413* (US). Leon Co.: small flood-control pond at E end of Municipal Drive, just W of Mabry and S of Pensacola Streets in Tallahassee, 15 Jun 2000, *Anderson 19354* (VSC). St. Lucie Co.: just W of Fort Pierce, along Hwy FL 70, ca 200 m E jct. Florida Turnpike and Hwy FL 70, 27°24.46'N 80°23.57'W, 22 Sep 1996, *Carter 13828* (VSC).

GEORGIA. Atkinson Co.: just W of Kirkland, ditch along N side Hwy. US 82, 31°18.560'N 082°54.851'W, 25 Aug 2005, *Carter 16109* (VSC). Bacon Co.: W side Alma, by Hwy GA 32, near N end Bacon County Airport, ditch along N side Hwy GA 32, locally common, 06 Aug 1998, *Carter 14173* (VSC). Bulloch Co.: S side Statesboro, W side Hwy. US 301, disturbed vacant lot, 32°24.763'N 081°48.239'W, 29 Oct 2005, *Carter and Kral 16257* (VSC). Charlton Co.: Homeland, jct. Bowery Lane and Guinn Place Drive, ruderal staging area for truck transport company, 30°51.143'N, 082°01.061'W, local, 22 Oct 2003, *Carter 15232* (VSC). Long Co.: Ludowici, S edge of town, open disturbed area adjacent to truck stop, SE Hwy US 84, locally common, UTM 17 428662E 3508333N, 23 Aug 2002, *Carter and Rosen 14736* (VSC).

McIntosh Co.: Eulonia, just W jct. hwys. US 17 and GA 99, 31°31.519'N 081°25.903'W, ditch and backslope by Hwy GA 99, 19 Sep 2003, *Carter 15087* (VSC). Toombs Co.: Parkers, 0.75 mi N jct. Hwys US 1 and GA 56, ditch by Paul Lockley Rd, SE jct. with Hwy US 1, local, 06 Aug 1998, *Carter 14150* (VSC).

MISSISSIPPI. Harrison Co.: Gulfport, ca. 0.5 mi. NE jct. Hwy I-10 and US 49, T7S R11W Sect 9 or 10, open disturbed area, vacant lot across from shopping strip mall, 08 Oct 2004, *Bryson 20389* (SWSL, VSC). Jones Co.: Laurel, SE quadrant intersection I-59 and Hwy US 84, 31°41.811'N 089°06.891'W, poorly drained area of truck stop, S Hwy US 84, locally common, 20 Sep 2004, *Carter 15800* (VSC). Pearl River Co.: ca. 3 mi. S Picayune, Nicholson Community, between Hwy US 11 and RR to W jct. of Hwy US 11 and MS 607, T6S R17W Sect. 38, open area, 10 Sep 2004, *Bryson 19789* (SWSL, VSC). Tunica Co.: ca. 0.6 mi. NE of Robinsville Community, SE jct. of Hwy US 61 and Grand Casino Parkway South, T3S R11W Sect. 18 NE/4 of NE/4 (34°50.195'N 090°16.639'W) E of Hwy US 61, Delta Region, 15 Aug 2004, *Bryson and Bryson 20319* (SWSL).

TEXAS. Austin Co.: N of I-10, 3.1 mi E of FM 1458, E of Sealy, between service road and interstate, N29º46'18.2" W96º03'30.4" (NAD83), 17 Sep 2004, *Rosen 3100* (VSC, SBSC). Bee Co.: overgrazed prairie S of TX Hwy. 202, about 8.3 miles W of its intersection with FM 2441, W of the town of Beeville, N28°23'17.3" W97° 33'02.5"), 12 Sep 2004, *Rosen and Carter 3093* (TEX, BRIT). Brazoria Co.: S corner of TX 35 and FR 2917, SW of Alvin., 09 Sep 1997, *Jones 13067* (SAT). Brazos Co.: N side of Briarcrest Dr., ca. halfway between TX 6 and Wildflower Drive in Bryan, 06 Jun 1997, *Jones 13047* (SAT). Calhoun Co.: Myrtle Foester-Whitmire Unit of the Aransas National Wildlife Refuge, about 1 mile SE of County Rd. 316 in the town of Indianola, N28º30'26.7" W96 º32'38.7", 02 Oct 2004, *Rosen et al. 3146* (BRIT, TEX, VSC). Cameron Co.: about 20 miles north of Brownsville, Paredes Line Road, 16 Jun 1941, *Runyon 2761* (TEX). Colorado Co.: median of Interstate Highway 10, about 1.5 miles W of CORD 217, between the towns of Schulenberg and Columbus, UTM 14 719802E 3286772N, 30 Jun 2004, *Rosen 2994* (VSC, SBSC). Galveston Co.: roadside FM 1266 at intersection with Hwy. 96, S of Gulf Airport., 15 Sep 2001, *Rosen 1645* (TAES). Goliad Co.: N roadside of TX Hwy. 239, about 13.2 mi W of its intersection with Hwy US 77, SE of the town of Goliad, N28 º 35' 23.8" W97 º 13' 37.1", 12 Sep 2004, *Rosen and Carter 3090* (TEX). Hardin Co.: N of FM 418 at Village Creek, between Kountze and Silsbee, frequent in deep, sandy soils of disturbed riparian forest remnant, N30º23'53.3" W94º15'52.6", 13 Jun 2005, *Rosen 3426* (TEX, VSC). Jasper Co.: East of State Highway 62, 5.1 miles N of its intersection with State Highway 12, 3.8 miles S of Farm Road 2246, S of the town of Buna, 13 Jun 2005, *Rosen 3425* (TEX, VSC). Liberty Co.: Trinity River NWR, adjacent to tributary of Picketts Bayou, NW of pipeline right-of-way, UTM 15 327219E 3311629N, 29 Aug 2002, *Rosen 2310* (SBSC). Montgomery Co.: Jones State Park, edge camping lake, sandy soil, 01 Jul 1982, *Kessler 6240* (TAES). Orange Co.: Adjacent to service road south of Interstate 10, 1.5 miles W of its intersection with State Highway 62, W of the town of Orange, 13 Jun 2005, *Rosen 3424* (TAES, TEX, VSC). Polk Co.: Big Thicket National Park (Big Thicket Unit), old well pad site along Horse Trail, south of Sun Flower Road, 18 Sep 2002, *Jones 14937* (SAT). Refugio Co.: Vidaurri Ranch, about 1.8 miles W of entrance to ranch, about 8 miles SW intersection Hwy US 77 and Hwy TX 239, 28 mi S Victoria, N28º25'38.6"W97º10'30.0", 12 Sep 2004, *Rosen and Carter 3083* (TEX, BRIT). San Augustine Co.: Angelina National Forest, 09 June 05, *Conway s.n.* (SFA). San Jacinto Co.: roadside ditch N of Hwy. 150, 1.4 miles W of its intersection with Hwy 59, W of Shepherd., 11 Sep 2003, *Rosen 2627* (VSC, SBSC). San Patricio.: S side Odem, parking area of truck stop E Hwy US 77, between Hwy US 77 and railroad, 27°56.577'N, 097°35.275'W, 13 Sep 2004, *Carter 15535* (VSC). Travis Co.: Austin; headwaters of Gaines Creek, about 400' NW intersection Brodie Ln. and US 290, 27 Nov 2004, *Turner s.n.* (VSC, TEX). Tyler Co.: On and W of US Hwy. 287, 7.7 miles S of its intersection with U. S. Hwy. 190 in the town of Woodville, 13 Jun 2005, *Rosen 3427* (TEX, VSC). Victoria Co.: S Victoria, RV Park, N Hwy US 59, ca. 6.5 mi NE jct. hwys. US 59 and TX 185, N28°49'27.0" W96°55'13.5", disturbed ground, *Carter and Rosen 15520* (VDB, VSC). Waller Co.: 0.1 mi S on Schlipf Road from its jct. with Morton Road., 24 Sep 1992, *Jones 9687* (VSC). Wharton Co.: Roadside of Highway 102, about 8 miles S of Eagle Lake, UTM 14 762260E 3263940N (NAD 83), 30 Jun 2004, *Rosen 2995* (VSC).

Appendix II. Species sampled in the herbaceous layer at Bird Pond and Dance Bayou. Species considered capable of reaching the shrub or canopy layer are indicated by an asterisk (*).

Species	Bird Pond	Dance Bayou
**Ampelopsis arborea* (L.) Köhne		x
Arisaema dracontium (L.) Schott		x
**Baccharis halimifolia* L.	x	
**Berchemia scandens* (Hill) K. Koch	x	x
Brunnichia ovata (Walter) Shinners		x
**Callicarpa americana* L.		x
Callitriche peploides Nutt.	x	
**Campsis radicans* (L.) B. Seemann ex E. Bureau	x	x
Carex basiantha Steud.		x
Carex blanda Dewey	x	x
Carex bulbostylis Mack.		x
Carex caroliniana Schwein.	x	
Carex cherokeensis Schwein.	x	x
Carex corrugata Fernald		x
Carex flaccosperma Dewey	x	x
Carex leavenworthii Dewey	x	x
Carex oxylepis Torr. & Hook. var. *oxylepis*		x
Carex texensis (Torr. ex L.H. Bailey) L.H. Bailey		x
**Celtis laevigata* Willd. var. *laevigata*		x
Chasmanthium laxum (L.) H. O. Yates var. *sessiliflorum* (Poiret) Wipff & S. D. Jones	x	x
**Cocculus carolinus* (L.) DC.		x
Conoclinium coelestinum (L.) DC.	x	
Cynosciadium digitatum DC.	x	
Cyperus entrerianus Böeck.	x	
Cyperus thyrsiflorus Jungh.		x
Cyperus virens Michx. var. *virens*	x	
Desmodium glabellum (Michx.) DC.	x	x
Dichondra carolinensis Michx.	x	x
Eleocharis acicularis (L.) Roem. & Schult. var. *acicularis*	x	
Eleocharis montana (Kunth) Roem. & Schult.	x	
Eleocharis wolfii (A. Gray) A. Gray ex Britton	x	
Elephantopus carolinianus Raeusch.		x
Elymus virginicus L. var. *virginicus*		x
Eupatorium serotinum Michx.		x
**Forestiera ligustrina* (Michx.) Poiret		x
**Fraxinus pennsylvanica* Marshall	x	x
Galium aparine L.	x	x
Galium tinctorium (L.) J. Scopoli	x	
Geum canadense Jacq. var. *camporum* (Rydb.) Fernald & Weath.		x
Hydrocotyle verticillata Thunb.	x	
Hygrophila lacustris (Cham. & Schltdl.) Nees	x	
Hypericum hypercoides (L.) Crantz	x	
**Ilex decidua* Walter		x
**Ilex vomitoria* Aiton	x	x
Juncus tenuis Willd. var. *tenuis*	x	

Species	Bird Pond	Dance Bayou
Leersia virginica Willd.	x	x
Malvaviscus drummondii Torr. & A. Gray		x
Matelea gonocarpos (Walter) Shinners		x
Melica mutica Walter		x
Micromeria brownei (Sw.) Benth. var. *pilosiuscula* A. Gray	x	
Muhlenbergia schreberi J.F. Gmel.		x
Myosotis macrosperma Engelm.	x	x
Oplismenus hirtellus (L.) P. Beauv. subsp. *setarius* (Lam.) Mez	x	x
Oxalis dillenii Jacq.	x	
Panicum commutatum Schult. var. *commutatum*	x	x
**Parthenocissus quinquefolia* (L.) Planch. var. *quinquefolia*	x	x
Passiflora lutea L.		x
Poa autumnalis Muhl. ex Elliott		x
Polygonum punctatum Elliot	x	
**Prunus caroliniana* Aiton		x
**Quercus nigra* L.	x	x
**Quercus shumardii* Buckley		x
Ranunculus hispidus Michx. var. *nitidus* (Chapm.) T. Duncan		x
Ranunculus pusillus Poiret	x	
Rubus argutus Link	x	x
Ruellia strepens L.		x
Sabal minor (Jacq.) Pers.	x	x
Sanicula canadensis L.	x	x
Sanicula odorata (Raf.) Pryer & Phillippe		x
Sapindus saponaria L. var. *drummondii* (Hook. & Arn.) L.D. Benson		x
Scleria oligantha Michx.		x
Sida rhombifolia L.	x	
Smallanthus uvedalia (L.) Mack. ex Small		x
**Smilax bona-nox* L.		x
**Smilax rotundifolia* L.	x	
**Smilax smallii* Morong		x
Solidago canadensis L. var. *scabra* (Muhl. ex Willd.) Torr. & A. Gray	x	
Spigelia texana (Torr. & A. Gray) A. DC.	x	x
Stellaria prostrata Baldwin ex Elliott		x
Symphoricarpos orbiculatus Moench		x
Symphyotrichum racemosum (Elliott) G. Nesom var. *subdumosum* (K. Wiegand) G. Nesom	x	
Teucrium canadense L. var. *canadense*	x	
Thelypteris kunthii (Desv.) C.V. Morton		x
Tovara virginiana (L.) Raf.		x
**Toxicodendron radicans* (L.) Kuntze	x	x
**Ulmus crassifolia* Nutt.	x	x
Urtica chamaedryoides Pursh		x
Verbesina virginica L. var. *virginica*		x
Viola sororia Willd. var. *sororia*	x	x