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Marsh Vegetation of the Margaret Guzy Pothole Wetlands Land and Water Reserve, Shelby County, Illinois

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ABSTRACT

The vascular flora of Margaret Guzy Pothole Wetlands Land and Water Reserve, 6 km west of Findley, Shelby County, Illinois, was studied during the growing seasons of 1998 through 2014. This preserve was established in 1994 from land donated by the Margaret Guzy Estate for the establishment of a wildlife sanctuary. This 64 ha (159 acres) preserve, located in the southwest corner of the Grand Prairie Section of the Illinois Grand Prairie Natural Division, is being restored to mesic prairie, marsh, and prairie potholes. A total of 156 vascular plant species were observed and collected from the site. More than 55 prairie species were encountered along with 54 exotic species. A survey of the marsh community recorded only eight species in plots with *Eleocharis palustris* having the highest Importance Value (I.V. of 83.0, 200 possible), followed by *Xanthium strumarium* (I.V. of 62.0), *Alisma subcordatum* (I.V. of 34.9), and *Bolboschoenus fluviatilis* (I.V. of 11.9). Studies of the marsh community in 1998, 2001, and 2004 by personnel from the Illinois Department of Natural Resources indicate wetter conditions with many weedy species, a few floating and submersed aquatic macrophytes, and extensive areas of bare ground.

INTRODUCTION

The tallgrass black soil prairie of the Grand Prairie Section of the Illinois Grand Prairie Natural Division was covered by the Woodfordian substage of the Wisconsin Episode of Pleistocene glaciation (Schwegman 1973). Mesic black soil prairie, marshes, and prairie potholes were dominant vegetation types within this poorly drained section, while forests and savannas were restricted to drainage systems and areas of rough topography associated with glacial moraines and river valleys (Schwegman 1973, Ebinger and McClain 1991).

Soon after settlement by European man the vast Illinois prairie was gone, having been converted to agriculture. Also lost were the marshes, prairie potholes, and the vast array of prairie animals and abundant waterfowl (Schwegman 1973, McClain and Ebinger 2000). This limitless prairie, the marshes, and the prairie potholes now occur as scattered, small degraded patches, along with a numerous attempts to recreate these communities in this part of Illinois (McClain 1997).

In 1994 the Margaret Guzy Estate gave 65 ha (159 acres) of farmland in Pickaway Township, Shelby County to the State of Illinois for the purpose of developing a wildlife sanctuary (NE1/4 S25 T13N R3E; 39.5450°N, 88.8127°W, elevation 205 m). This area, named the Margaret Guzy Pothole Wetlands Land and Water Reserve (Guzy Tract in this article), is being managed to establish an example of the pre-settlement vegetation originally found in this part of Illinois. Reconstruction started almost immediately and by 1997 there were 31 ha (77 acres) of prairie reconstruction and 8 ha (20 acres) of wetlands. Presently, the Guzy Tract contains 46 ha (113 acres) of mesic to wet-mesic prairie reconstruction, 18 ha (44 acres) of wetlands with six small prairie potholes scattered throughout the site, and one ha (1.5 acres) of buffer. The present study was undertaken to describe the composition and structure of the marsh vegetation, and prepare a vascular plant species list for the entire Guzy Tract.

DESCRIPTION OF THE STUDY SITE

The Guzy Tract is being managed to create breeding and foraging habitat for birds that utilize prairie, prairie pothole, and marsh habitats. As quantitative changes occur in plant species composition and the structure of the vegetation there should be a corresponding increase in the utilization of the site by these birds. These changes will require managing the vegetation to mimic pre-settlement condition, and to provide water levels in the marsh and potholes to optimize suitable habitat for wetland and grassland birds.

Both wetland and mesic prairie communities have been established on the Guzy Tract. The marsh was established along the southern part of the Guzy Tract at a slightly lower elevation with nearly level, poorly drained soil. This wetland is largely subject to natural processes since tiles were closed off and an extensive levee system was built. The levee gates (dozier valves) are set to allow the water to reach its maximum height just below the levee berm. No wetland species were planted, volunteer pioneer wetland species have reestablished naturally through seed bank deposits, wind, colonizing animals, and migratory waterfowl.

The wet-mesic to mesic tall grass prairie is mostly located on slightly higher nearly level ground. Starting in spring of 1994 a 15 ha (37 acre) section of the Guzy Tract was planted with a tallgrass prairie mixture of grasses and forbs, while in the spring of 1995 additional forbs were added to the original planting. In the springs of 1996 and 1997 an additional 8.1 ha (20 acre) areas were planted to prairie. The plantings continued, as seed became available, until the entire upland area was established to tallgrass prairie.

Management burns were conducted on the Guzy Tract from 1996 through 2000, and probably the entire area was burned each year. No burns were conducted from 2001 through 2008, except in 2007. One-third of the Guzy Tract was burned each year from 2009 through 2013 with the wetland being burned in the falls of 2010 and 2013,

and half of the prairie being burned in the springs of 2009, 2011, and 2012.

In 1995 six seasonally wet depressions were created throughout the prairie. These small wetlands are less than 0.3 ha in size and usually dry-out by the end of the summer. The potholes are an integral part of this complex community. Commonly referred to as "kettles" these depressions were originally the result of buried ice left behind by retreating glaciers (Miner and Miller 2010). Huge chunks of ice were commonly left under the extensive heaps of glacial drift. As these chunks of ice melted the glacial drift caved in around them, creating gently sloping depressions, some as large as a few kilometers in width. In pre-settlement times, prairie potholes were important breeding grounds for waterfowl (McClain and Ebinger 2000).

Two soils occur on the Guzy Tract, Drummer silty clay loam, and Flanagan silt loam (Gotsch 1996). The nearly level Drummer silty clay loam is poorly drained, high in organic content, slightly acid, subjected to ponding, and associated with wetlands. The Flanagan silt loam occurs on slightly higher ground now associated with the restored prairie. This nearly level, somewhat poorly drained, neutral soil is high in organic content and occurs on low ridges and knolls of loess-covered glacial till. In this part of Illinois annual precipitation averages 97.5 cm, with April having the highest rainfall (9.4 cm). Mean annual temperature is 11.8°C with July the hottest month (average of 24.6° C), the coldest January (-3.0° C). The average number of frost-free days is 171 (Midwestern Regional Climate Center 2012).

MATERIALS AND METHODS

The vascular flora of the prairie and marsh communities was examined periodically during the 2010 to 2013 growing seasons. Voucher specimens were collected for most species and deposited in the Stover-Ebinger Herbarium of Eastern Illinois University, Charleston (EIU). Nomenclature follows Mohlenbrock (2002), and the assignment of exotic species status was determined using Gleason and Cronquist (1991) and Mohlenbrock (2002). Searches were made for state endangered and threatened plant species (Illinois Endangered Species Protection Board 2011).

Quantitative sampling was conducted in late summer of 2013 using 1 m2 quadrats located at one-meter intervals along four randomly placed 25 m transects, two oriented E/W and two oriented N/S, within the central part of the marsh (n = 100). Even-number quadrats were placed to the right, odd-numbered to the left of each transect. Percent cover of each species was determined using the Daubenmire cover class system (Daubenmire 1959) as modified by Bailey and Poulton (1968): class 1 = 0-1%; class 2 = 1-5%; class 3 = 5-25%; class 4 = 25-50%; class 5 = 50-75%; class 6 = 75-95%; class 7 = 95-100%. From these data, frequency (%), mean cover (%), relative frequency, relative cover, and Importance Value (relative frequency + relative cover) were determined (Table 1).

Prior to the 2013 study three previous vegetation surveys had been completed on the wetlands of the Guzy Tract. These surveys were conducted by various members of the Illinois Department of Natural Resources (IDNR) and the Illinois Natural History Survey (INHS), and were completed in the early falls of 1998, 2001, and 2004. None of these surveys have been previously published, but we have sufficient data and notes on these surveys to incorporate the information into this paper (Tables 2, 3, & 4).

On 27 August 1998 the marsh area at the Guzy Tract was surveyed using quadrats 1m on a side located at one-meter intervals along three randomly placed 50 m transects oriented E/W in the marsh (n = 150). Even-number quadrats were placed

Table 1. Frequency (%), mean cover (% of total cover), relative frequency, relative cover, and importance value (I.V.) of ground layer species encountered in the 2013 survey at Margaret Guzy Pothole Wetlands Land and Water Reserve, Shelby County, Illinois. Tucker and Ebinger did the survey. (*exotic species)

Species	Freq. %	Mean Cover	Rel. Freq.	Rel. Cover	I.V.
Eleocharis palustris	100	54.33	29.0	54.0	83.0
Xanthium strumarium	99	33.56	28.7	33.3	62.0
Alisma subcordatum	89	9.16	25.8	9.1	34.9
Bolboschoenus fluviatalis	31	2.96	9.0	2.9	11.9
**Schoenoplectus mucronatus*	13	0.36	3.8	0.4	4.2
Leersia oryzoides	7	0.06	2.0	0.1	2.1
Eleocharis macrostachya	4	0.19	1.1	0.2	1.3
Cyperus esculentus	2	0.01	0.6	0.0	0.6
Totals		100.63	100.0	100.0	200.0
Average bare ground and litter		0.09			

Table 2. Frequency (%), mean cover (% of total cover), relative frequency, relative cover, and importance value (I.V.) of ground layer species encountered in the 1998 survey at Margaret Guzy Pothole Wetlands Land and Water Reserve, Shelby County, Illinois. Tucker and Ebinger did the survey. (*exotic species)

Species	Freq. %	Mean Cover	Rel. Freq.	Rel. Cover	I.V.
Ammannia coccinea	71	7.90	45.9	58.2	104.1
Potamogeton nodosus	5	1.42	3.0	10.5	13.5
Echinochloa crus-galli	4	1.14	2.6	8.4	11.0
Cyperus acuminatus	11	0.55	6.9	4.0	10.9
**Schoenoplectus mucronatus*	14	0.25	9.1	1.8	10.9
Eleocharis palustris	7	0.80	4.3	5.9	10.2
Ludwigia peploides	13	0.18	8.7	1.3	10.0
Lindernia dubia	9	0.26	5.7	1.9	7.6
Najas sp.	3	0.51	2.2	3.7	5.9
Xanthium strumarium	7	0.09	4.8	0.6	5.4
Bolboschoenus fluviatalis	3	0.13	2.2	1.0	3.2
Echinodorus berteroi	1	0.25	0.4	1.8	2.2
Cyperus esculentus	3	0.03	1.7	0.2	1.9
Schoenoplectus tabernaemontani	1	0.04	0.9	0.3	1.2
Amaranthus sp.	1	0.01	0.4	0.1	0.5
Ceratophyllum demersum	1	0.02	0.4	0.1	0.5
Panicum dichotomiflorum	1	0.02	0.4	0.1	0.5
Typha latifolia	1	0.01	0.4	0.1	0.5
Totals		13.61	100.0	100.0	200.0
Average bare ground and litter		83.17			

to the right, odd-numbered to the left of each transect. On 3 August 2001 a similar study was conducted using the same procedures and transects (n=150). On 4 August 2004 another study was undertaken using the same procedures but only two transects were surveyed (n=100).

RESULTS

We collected 156 vascular plant species from the Guzy Tract (Appendix I). Species present include 45 monocots in six families and 111 dicots in 34 families while no fern or fern-allies were recorded. Non-native (exotic) species accounted for 52 of the taxa encountered (33%), but only one occurred in the survey plots. Predominant plant families were Asteraceae (36 species), Poaceae (25), Cyperaceae (12), Brassicaceae (11), and Fabaceae (10). No state endangered or threatened species were observed.

At the time of the 2013 survey the marsh community contained no standing water. The soil was moist in some locations, but many areas were dry with occasional cracks. Only eight species were recorded in the plots, and almost no bare ground was observed. *Eleocharis palustris* dominated with the highest importance value (I.V.) of 83.0, and mean cover of 54.33, followed by the native and weedy *Xanthium strumarium* with an I.V. of 62.0 and a mean cover of 33.56. *Alisma subcordatum* (I.V. of 34.9) and *Bolboschoenus fluviatilis* (I.V. of 11.9), both common native wetland species, completed the top four, all having importance values exceeding 10 (Table 1). The exotic species *Schoenoplectus mucronatus* was present in low numbers as were the three remaining native wetland species. All species in plots were perennials except for the annual *Xanthium strumarium* and the mostly annual and exotic *Schoenoplectus mucronatus*.

Table 3. Frequency (%), mean cover (% of total cover), relative frequency, relative cover, and importance value (I.V.) of ground layer species encountered in the 2001 survey at Margaret Guzy Pothole Wetlands Land and Water Reserve, Shelby County, Illinois. Tucker and Ebinger did the survey. (*exotic species)

Species	Freq. %	Mean Cover	Rel. Freq.	Rel. Cover	I.V.
Echinodorus berteroi	80	44.28	38.2	61.7	99.9
Ammannia coccinea	17	4.66	8.3	6.5	14.8
Eleocharis ovata var. obtusa	13	4.07	6.4	5.7	12.1
Eleocharis palustris	15	3.07	7.0	4.3	11.3
Lindernia dubia	15	2.42	7.3	3.4	10.7
**Schoenoplectus mucronatus*	15	2.33	7.3	3.2	10.5
Eleocharis quadrangulata	8	3.96	3.8	5.5	9.3
Sagittaria latifolia	7	3.17	3.2	4.4	7.6
Potamogeton nodosus	11	1.19	5.1	1.7	6.8
Cyperus acuminatus	12	0.42	5.7	0.6	6.3
Echinochloa crus-galli	3	0.42	1.6	0.6	2.2
Alisma subcordatum	3	0.47	1.3	0.7	2.0
Leersia oryzoides	2	0.37	1.0	0.5	1.5
Bidens connata	3	0.06	1.3	0.1	1.4
Panicum virgatum	2	0.30	1.0	0.4	1.4
Schoenoplectus tabernaemontani	1	0.52	0.6	0.7	1.3
Xanthium strumarium	1	0.02	0.6	--	0.6
Conoclinium coelestinum	1	0.02	0.3	--	0.3
Totals		71.75	100.0	100.0	200.0
Average bare ground and litter		43.80			

Table 4. Frequency (%), mean cover (% of total cover), relative frequency, relative cover, and importance value (I.V.) of ground layer species encountered in the 2004 survey at Margaret Guzy Pothole Wetlands Land and Water Reserve, Shelby County, Illinois. Tucker and Ebinger did the survey. (*exotic species)

Species	Freq. %	Mean Cover	Rel. Freq.	Rel. Cover	I.V.
Alisma subcordatum	57	26.65	22.4	23.2	45.6
Echinodorus berteroi	48	29.25	18.8	25.5	44.3
Eleocharis ovata var. obtusa	41	21.23	16.0	18.5	34.5
Potamogeton nodosus	40	19.68	15.7	17.1	32.8
**Schoenoplectus mucronatus*	31	9.58	12.1	8.3	20.4
Phalaris arundinacea	13	3.53	5.1	3.1	8.2
Cyperus acuminatus	8	1.75	3.1	1.5	4.6
Xanthium strumarium	6	1.60	2.4	1.4	3.8
Bidens connata	5	0.50	2.0	0.4	2.4
Schoenoplectus tabernaemontani	2	1.00	0.8	0.9	1.7
Typha latifolia	1	0.15	0.4	0.1	0.5
Eleocharia palustris	1	0.03	0.4	--	0.4
Lindernia dubia	1	0.03	0.4	--	0.4
Polygonium sp.	1	0.03	0.4	--	0.4
Totals		115.01	100.0	100.0	200.0
Average bare ground and litter		39.99			

At the time of the 1998 and 2001 surveys standing water was common, about 33% of the plots being covered by up to 40 cm of water, the exposed soil being wet and mucky. The species present in plots indicate wetter conditions with a few weedy species, a few floating and submersed aquatic macrophytes, and extensive areas of bare ground, water, and litter. Eighteen species were recorded during each survey, about half being annual species, and nine being recorded in both the 1998 and 2001 surveys (Table 2 and 3). In the 1998 survey the annual *Ammannia coccinea* was the leading dominant with an I.V. of 104.1 and a mean cover of 7.90. The perennial aquatic macrophyte *Potamogeton nodosus* was second with an I.V. of 13.5 and a mean cover of 1.42, followed by five species with nearly identical importance values, all 10.0 or above (Table 2). In the 2001 survey the annual *Echinodorus berteroi* was the leading dominant (I.V. = 99.9, mean cover 44.28), followed by *Ammannia coccinea* with an I.V. = 14.8, and a mean cover 4.66. Five additional species exceeded an I.V. of 9.0 (Table 3). The remaining species were uncommon with six being recorded once in the 1998 survey and three in the 2001 survey (Tables 2 and 3).

At the time of the 2004 surveys there was no standing water but the soils were wet and mucky. Aquatic macrophytes were alive, lying on the soil surface. Fourteen species were recorded for the 2004 survey, eight annuals and six perennials (Table 4). The perennial *Alisma subcordatum* and an-

nual *Echinodorus berteroi* dominated with I.V.s of 45.6 and 44.3, and mean covers of 26.65 and 29.25, respectively. The remaining species with importance values of 10 or above included *Eleocharis ovata*, *Potamogeton nodosus*, and the exotic *Schoenoplectus mucronatus*.

DISCUSSION

The Guzy Tract wetland was created when old tiles were closed off and levee gates installed. In years with average to above average precipitation, as summer progressed, the marsh dries and the water was mostly gone by mid August to early September. As fall and winter continue the marsh usually starts to fill with water from fall, winter, and early spring precipitation and the process starts over. During these years, the water will be 50-60 cm deep by late spring while locations without water, especially where clay soil is present, will be wet and mucky through September. In drought years, however, the wetland dries earlier, often by early to mid summer. In the drought year of 2012 the marsh was almost dry in May and completely dry from June through August (Tucker et al. 2012).

Over the 16 years of this study (1998 to 2013) there have been many changes in the composition of the marsh community vegetation. Some changes are related to water levels and drought; while others represent successional change and the increase in seed sources and variety as more waterfowl use the marsh. Overall, there has been a decrease in the number of plant species from 1998 (Table 2) to 2013 (Table 1), as well as a decrease in the number of annual species observed, eight annual species found in 1998 and two present in the 2013 survey. Reduction in annual species density is common as reconstructions ages. These changes are probably due to the drought of 2012 that extended to August of 2013 when the marsh was completely dry at the time of the survey. During the earlier surveys (1998 through 2004) successional and weedy species were common on open, bare soil. These annuals, such as *Ammannia coccinea*, *Cyperus acuminatus*, *Echinochloa crus-galli*, *Lindernia dubia*, *Xanthium strumarium*, *Amaranthus* sp., and *Panicum dichotomiflorum* would be expected on recently exposed soils like those in the early years after construction of the marsh.

The aquatic macrophytes present in the 1998 to 2004 surveys are undoubtedly present in the seed bank and will reappear when standing water is present. These aquatics (*Ceratophyllum demersum*, *Najas* sp., and *Potamogeton nodosus*) are common species of many aquatic habitats in Illinois (Vogel and Ebinger 1979, Dolbeare and Ebinger 1974). The *Najas* encountered was probably *N. guadalupensis* (Spreng.) Magnus, a common species associated with ponds throughout most of central Illinois. No voucher specimen is available to verify this determination.

The dominance of perennial species in the 2013 survey should be expected as the marsh community undergoes successional changes (Table 1). Except for *Eleocharis macrostachya*, these perennial species were present in low number in the 1998, 2001, and 2004 surveys (Table 2, 3, and 4). Since the earlier surveys *E. palustris* and *Alisma subcordatum* have become dominants along with the annual *Xanthium strumarium*, these species accounting for about 90% of the I. V. of the marsh in the 2013 survey. *Eleocharis macrostachya* could be a recent introduction, probably transported by waterfowl. *Bolboschoenus fluviatilis*, in contrast, was scarce in the 1998 survey, but in 2013 formed scattered colonies to 4 m across. The exotic bulrush, *Schoenoplectus mucronatus*, was scattered and in small clumps of one to a few individuals. This species is now well established and will undoubtedly persist on the site.

Some of the species encountered in the earlier survey were not found during the 2013 study, and since vouchers are not available we did not include them in the species list (Appendix I). These include *Bidens connata* Muhl., *Ceratophyllum demersum* L., *Conoclinium coelestinum* (L.) DC., *Lindernia dubia* (L.) Pennell, *Ludwigia peploides* (HBK) Raven, *Najas guadalupensis*, *Phalaris arundinacea* L., *Potamogeton nodosus* Poir., *Sagittaria latifolia* Willd., and *Typha latifolia* L. Also, a colony of water lotus, *Nelumbo lutea* (Willd.) Pers., was reported from the site at the time of the 2001 survey but has not been found since. It may be extirpated from the site but probably persists in the seed bank. This population was photographed and a copy has been deposited in the herbarium (EIU).

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APPENDIX I. Vascular plant species encountered at the Margaret Guzy Pothole Wetlands Land and Water Reserve, Shelby County, Illinois are listed alphabetical by family under major plant groups. Collecting numbers are preceded by the initial of the collectors name (E = John E. Ebinger, M = Paul B. Marcum, T = Gordon C. Tucker). Specimens are deposited in the Stover-Ebinger Herbarium (EIU), Eastern Illinois University, Charleston, Illinois. Exotic species are marked with an asterisk.

DICOTS

Anacardiaceae
Toxicodendron radicans (L.) Kuntze, E33278
Apiaceae
**Conium maculatum* L., E33394
**Daucus carota* L., E33034
Eryngium yuccifolium Michx., E33084
**Pastinaca sativa* L., E33033
Apocynaceae
Apocynum cannabinum L., E32897
Asclepiadaceae
Asclepias incarnata L., E33085
Asclepias syriaca L., E33035
Asteraceae
Ambrosia artemisiifolia L., E33109
Ambrosia trifida L., E33110
**Anthemis cotula* L., E32898
**Arctium minus* Sckh., E33108
Aster novae-angliae L., E33470
Aster pilosus Willd., E33279
Bidens comosa (A. Gray) Wieg., E33111
Bidens polylepis Blake, E33112
**Cichorium intybus* L., E33038
Cirsium discolor (Nuhl.) Spreng., E33113
**Cirsium vulgare* (Savi) Tenore, E33468
Conyza canadensis (L.) Cronq., E33114
Coreopsis palmata Nutt., E33036
Echinacea pallida (Nutt.) Nutt., E32900
Erigeron annuus (L.) Pers., E32899
Eupatorium serotinum Michx., E33115
**Helianthus annuus* L., E33116
Helianthus grosseserratus Martens, E33117
Helianthus mollis Lam., E33118
*Heliopsis helianthoide*s (L.) Sweet, E33119
**Lactuca serriola* L., E33087
Oligoneuron rigidum (L.) Small, E33280
Parthenium integrifolium L., E33040
Ratibita pinnata (Vent.) Barnh., E33039
Rudbeckia hirta L., E33037
Senecio glabellus Poir., E32775
Silphium intergrifolium Michx., E33088
Silphium laciniatum L., E33120
Silphium terebinthinaceum Jacq., E33281
Solidago altissima L., E33283
Solidago canadensis L., E33282
**Sonchus aspera* (L.) Hill, E33041
**Taraxacum officinale* Weber, E33289
**Tragopogon pratensis* L., E33042
Vernonia fasciculata Michx., E33469
Xanthium strumarium L.:T16182
Boraginaceae
Myosotis verna Nutt., E32780
Brassicaceae
**Barbarea vulgaris* R. Br., E33290
**Brassica nigra* (L.) Koch, E33395
**Capsella bursa-pastoris* (L.) Medic, E33293
Cardamine pensylvanica Willd., E33291
Cardamine parviflora L., E32773
Descurainia pinnata (Walt.) Britt., E33294
**Eriophila verna* (L.) Cav.:T15939
**Erysimum repandum* L., E33295
Lepidium virginicum L., E32782
Sibara virginica L., E33292
**Thlaspi arvense* L., E32777
Caesalpiniaceae
Chamaecrista fasciculata (Michx.) Greene, E33089
Gleditsia triacanthos L., E33473
Caryophyllaceae
**Cerastium glomeratum* Thuill., E32778
**Stellaria media* (L.) Cyrillo, E33296
Chenopodiaceae
**Chenopodium album* L., E33284
Convovulaceae
Calystegia sepium (L.) R. Br., E33043
Euphorbiaceae
Chamaesyce maculata (L.) Small, E33285
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