

EVALUATING THE QUALITY OF A DISTURBED WETLAND IN SOUTHWESTERN INDIANA: A SURVEY OF NATIVE AND EXOTIC FLORA AT VECTREN CONSERVATION PARK

Jordan Lachowecki, Cris G. Hochwender*, Kristen Nolting, Abby Aldridge and Elizabeth Maurer: Department of Biology, University of Evansville, 1800 Lincoln Ave., Evansville, IN 47722

ABSTRACT. Wetland stability promotes ecosystem services such as water purification and maintenance of biodiversity. These ecosystem services have been disrupted by anthropogenic degradation of natural habitats resulting in decreased biodiversity and the spread of introduced species. In Indiana, more than 87% of wetlands have been destroyed or degraded; those wetlands that remain are threatened by invasive species. To assess the need for restoration at Vectren Conservation Park in Southwest Indiana, a survey of the floral species present, as well as a study of the relative abundance of native and exotic species, was performed. The site includes more than 1100 acres of wetland habitat, including riparian forest, recently planted trees, and abandoned agricultural land. We collected 144 species from 109 genera, with 31 of the species being non-native to Indiana. When including all native and non-native species, the floristic quality index (FQI) of the site was 23.5 and the mean coefficient of conservatism (C_{av}) was 2.0. The FQI and mean coefficient of conservatism (C_{av}) were relatively low compared to other sites found in Indiana, indicating few natural remnants remain at the site. Although highly degraded, the site is capable of supporting high quality native wetland species, which would result in the improvement of ecosystem services and buffer against more extensive establishment of non-native species.

Keywords: coefficient of conservatism, floristic quality index, invasive species, restoration, species diversity, wetlands

INTRODUCTION

Ecosystem stability contributes to processes such as water purification, flood control, ground water recharge, and even maintenance of biodiversity. Anthropogenic degradation and destruction of natural habitats negatively impacts ecosystem stability (Pearson 1972; Van Auken 2000), which in turn threatens biodiversity and creates opportunities for colonization by invasive species (Burke & Grime 1996). In the United States, more than 50% of wetlands (Nichols 1988; McCorvie & Lant 1993) and up to 99% of prairies (Samson & Knopf 1994; Samson *et al.* 2004) have been destroyed or degraded, resulting in imperilment of native species.

Because so little high quality native habitat remains in Indiana, restoration of degraded habitats must be a priority. Efforts aimed at restoring degraded habits have become more

widespread as awareness regarding the benefits of natural habitats has increased (Rood *et al.* 2003; Clark 2003). Restoration can reestablish ecosystem services in degraded habitats (Gratton & Denno 2006; Benayas *et al.* 2009), as well as enhance biodiversity. In turn, biodiversity can have a positive feedback on ecosystem function (Vernberg 1993; Lehman & Tilman 2000; Benayas *et al.* 2009). For example, diverse wetland plant communities purify water and provide flood control (Vernberg 1993; Benayas *et al.* 2009). Increasing diversity may also buffer against species invasions (Naeem *et al.* 2000; Kennedy *et al.* 2002, but see Foster *et al.* 2002; Eriksson *et al.* 2006).

After habitat destruction, biological invasions represent the second greatest threat to biodiversity (Vitousek *et al.* 1996; Knight & Reich 2005), so enhancing native diversity needs to be a priority when performing restoration ecology. Invasive species diminish biodiversity by outcompeting and excluding native species resulting in homogenization of habitats (Kaufman 1992). In some U.S. states, up to 47% of the flora is composed of exotic

* Corresponding author: ch81@evansville.edu, Department of Biology, University of Evansville, 1800 Lincoln Ave., Evansville, IN 47722, 812-488-2005, 812-488-1039 (fax)

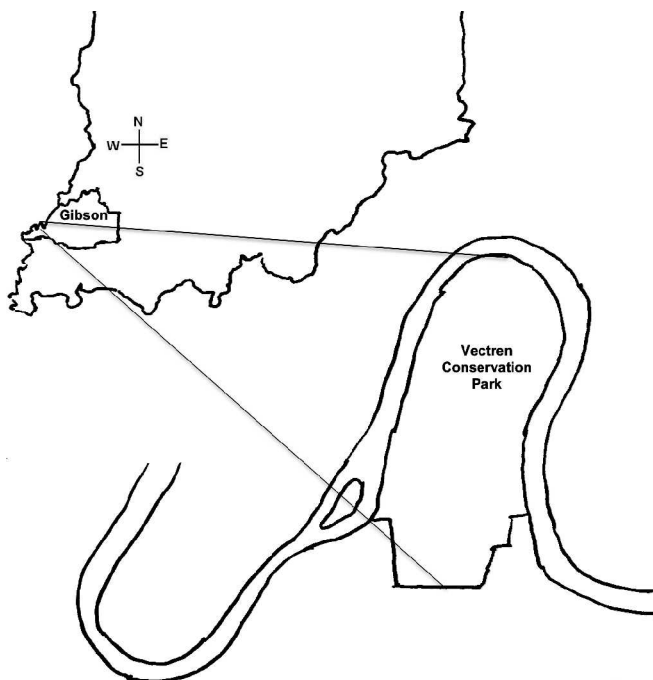


Figure 1.—Vectren Conservation Park in Gibson County, Indiana.

species. (Rejmanek & Randall 1994; Vitousek *et al.* 1997). In Indiana, invasive species pose a significant threat to the state's native flora (Weber & Gibson 2007), with approximately 39% of the 2800-plus species occurring in Indiana being categorized as non-native (Rothrock & Homoya 2005)

Special attention should be paid to biodiversity when restoring Indiana wetland habitat. First, wetlands are of particular interest when considering restoration because they support diverse habitats containing many rare species; in Indiana, wetlands lay claim to some of the highest levels of species diversity of any ecosystem type (Myers 1997). Second, more than 87% of Indiana's wetlands have been drained or destroyed (Dahl 1990; Miller & MacGowan 2004). Finally, wetland areas are especially susceptible to invasions; nearly 25% of the world's most invasive plants occur in wetlands (Zedler & Kercher 2004).

Vectren Conservation Park (VCP), a wetland next to the Wabash River in southern Indiana, may be a candidate for conservation or restoration. Comprised of abandoned agricultural fields and riparian forests, qualitative and

quantitative surveys of native and exotic flora are necessary to evaluate the quality of the habitat in order to make conservation and restoration decisions for the site. One measure of plant diversity, species richness (i.e., the number of species in an area), provides a means to evaluate ecosystem quality. Examination of native versus exotic plants provides a second assessment tool. In this study, we performed a qualitative survey of the property to identify the plant species at the site, as well as conducting a quantitative study to determine the relative abundance of native and exotic species at the site. In addition, to provide metrics of floristic and ecological quality comparable to other Indiana sites, a floristic quality index (FQI) and a coefficient of conservatism (C) were generated for the site.

METHODS

Study Site.—VCP is an 1118 acre property located in southwestern Indiana ($38^{\circ}17' N$, $87^{\circ}52' W$) (Fig. 1). Found 6.75 miles north-northeast of the town of Griffin in Posey County, the property is approximately 380 feet above sea level. In 2007, Vectren Corporation

provided the University of Evansville (UE) with a long-term lease to the property in order to provide a research site for undergraduate students and UE faculty. Surrounded on three sides by the Wabash River, VCP regularly floods, occasionally being entirely inundated with water. The soil composition of the site varies. (McWilliams 1989). The soils at the northern end of the property are characterized as frequently flooded silt loams, while the southern half of the property includes a wide range of frequently and occasionally flooded silt loams, silty clay loams, and fine sandy loams. The site consists of 157 acres of riparian forest, 454 acres of recently restored forest (see below for details), and 508 acres of meadow (Woodburn 2001). In addition, an operating agricultural field of 81 acres exists in the middle of the meadow. The remains of a levee erected by farmers follow the path of the river, and most of the mature riparian forest is bounded by the farmer's levee. The meadow resides in the interior of the site.

Based on U.S. census data, most of VCP was farmed from the early 1800's until 2001 when the Vectren Corporation purchased the property. In 2002, Vectren Corporation planted 454 acres with trees and shrubs, including five species of oak and three species of dogwood, as well as sycamore, black walnut, sweetgum, spicebush, and button bush (see Appendix 1 for a complete list of species planted and the number of each species planted). The trees and bushes were purchased from Vallonia State Nursery in Vallonia, Indiana. Of the trees planted by Vectren Corp., sweetgum, black walnut, and sycamore have had the most success establishing at the site. In addition to the 136,100 trees and shrubs that were planted, selected areas including roadway easements and the area surrounding the 81-acre agricultural field, were planted with warm and cool season grasses. Except for the 81-acre agricultural plot, the land has remained mostly unmodified by human activity after Vectren planted the trees, shrubs and grasses.

Plant Survey.—In 2007, we initiated a survey of the flora of VCP. On a semi-weekly basis from May to October in 2007 and 2009, trips were made to VCP to document the flora present, both in the meadow and the forest. The recently replanted forests were avoided in the surveys. During each visit to the site, surveyors collected, pressed, and later identified

any previously unidentified plant that was observed. The collected species were identified using a variety of identification keys and field guides (Deam 1940; Steyermark 1963; Gleason & Cronquist 1991; Holmgren 1998; Yatskievych 1999, 2006; Yatskievych 2000). The nomenclature from Gleason and Cronquist (1991) is reported for all species. The voucher specimens are being held at UE's herbarium.

Using plant information from the survey, each species was rated for level of wetland habitat preference, with categories including obligate and facultative wetland plants, as well as categories related to preference for upland habitat (U.S. Army Corps of Engineers 1996; see Appendix 2 for more details). The wetness scale proposed by Swink and Wilhelm (1994) was used to calculate a mean wetness value for VCP. In this scale, OBL = -5, FACW = -2.5, FAC = 0, FACU = 2.5, and UPL = 5; a site with a mean wetness below 0 is considered predominantly to have wetland plants.

In addition, each species was given a coefficient of conservatism (C-value) for Indiana (Rothrock 2004). C-values range from zero to 10, with lower values representing plants that are highly tolerant of disturbance and higher values representing plants that are usually restricted to high quality plant community remnants. Introduced plants are often not categorized for C-values, but they can be considered to have C-values of zero. A mean C-value (C_{av}) was calculated for the native species at the site. In addition, a C_{av} for the combined values of native species and introduced species was calculated (after attributing a C-value of zero to the introduced species). To provide a floristic quality index (FQI), the two C_{av} 's were multiplied by the square root of the number of plant species.

Plot Samples.—In addition to the qualitative survey, a study examining the relative abundance of native and exotic plants occurring in meadow and forest environments was conducted during the summer of 2007. Three 20×20 m plots were randomly selected both in the meadow and in the forest habitat. The plots were constructed at least 100 meters from any farmlands, tree plantings, or access roads to minimize the effects of adjacent small-scale habitats. Within each plot, 12 subplots (0.5×1.0 m) were randomly sampled. If the subplot chosen included a large tree (whether standing or fallen), the subplot was moved to

the next 0.5×1.0 m location directly to the left. In the forest, if a randomly selected subplot contained high concentrations of *Toxicodendron radicans* (poison ivy), the plot was moved to an area relatively free of this species. All forest plots were on the eastern edge of VCP. For all plots, ramet density was calculated by counting the number of stems of each plant species encountered in each subplot. Each species was identified as either native or non-native to the United States and to Indiana. Any species that could not be identified to species was identified to the lowest taxonomic level possible.

RESULTS

Plant Survey.—In total, 144 species from 109 genera within 54 families were collected from VCP (Appendix 2). Of the 144 species, 113 were native species and 31 were introduced species. Eight species were collected but identified only to genus because of a lack of morphological characteristics; these species were not classified as native or invasive. Seven additional species could not be identified to genus. Of those seven, one was a member of the Brassicaceae family, one was a member of the Poaceae family, and one was a member of the Apiaceae family. The final four species could not be attributed to a family because of a lack of identifying features.

Of the 113 native species at our site, twelve species (*Asclepias incarnata*, *Senecio glabellus*, *Rorippa palustris*, *Rorippa sessiliflora*, *Cephalanthus occidentalis*, *Hibiscus laevis*, *Salix nigra*, *Phyla lanceolata*, *Forestiera acuminata*, *Amorpha fruticosa*, *Saururus cernuus*, and *Mimulus alatus*) are almost always found in wetlands in our region. Overall, 42% of the species occur naturally at higher frequency in wetland habitat (FACW or OBL), and 36% are found equally as often in wetland habitats as in non-wetland habitats (FAC) (see Appendix 2 for notation). The remaining 22% of native species are more commonly associated with upland habitats (FACU or UPL). The non-native species were plants less commonly associated with wetlands; 57% of the non-native species that had a wetland designation are more commonly found in upland habitat (FACU or UPL). Using Swink and Wilhelm's wetness scale (1994), the plants at VCP had a mean wetness value of -0.37, suggesting that the site is only weakly associated with wetland plants.

Few species had both high coefficients of conservatism (C-values of six or greater) and high fidelity to wetland habitats. The exceptions included *Aristolochia tomentosa*, *Aster praealtus*, *Carex conjuncta*, *Celtis laevigata*, and *Forestiera acuminata* (see Appendix 2 for details). Of the 107 native species with C-values, 49.5% had C-values of 0–2, and 43.9% had C-values of 3–5. The mean C-value (C_{av}) for the native species was 2.5, and the C_{av} for all species (native and non-native species combined) was 2.0. The FQI for native species was 26.6, while the FQI for all species was 23.5.

Plot Samples.—The composition of the three forest plots and the three meadow plots differed greatly. In general, woody species were more abundant in the forest plots, while the meadow plots were dominated by herbaceous species. In total, 17 families and 21 genera were represented in the forest plots, while 14 families and 26 genera of plants occurred in the meadow plots. Four families (Apiaceae, Cyperaceae, Poaceae, and Urticaceae) characterized the forest plots, accounting for over 91% of the species collected. The families characterizing the meadow plots differed from those of the forest; three families (Asteraceae, Fabaceae, and Poaceae) accounted for over 88% of the species in the meadow. Of the 23 species collected in the forest plots, only one was introduced (although four species were unidentified). Of the 29 species collected in the meadow plots, eight species were introduced (although four species were identified only to genus, and thus not classified as native or introduced). In the meadow plots, invasive species accounted for the majority of the stems counted (59.8%) (Table 1A). Together, *Medicago lupulina* (black medic), *Melilotus officinalis* (yellow sweet clover), *Melilotus albus* (white sweet clover), and *Sorghum halepense* (Johnson grass) accounted for almost all of the introduced stems counted in the meadow plots (98.4%).

In Meadow Plot I, native species accounted for almost all of the stems (98.1%). The plot was characterized by *Aster praealtus* (56.8% of the stems) and *Elymus virginicus* (25.6%). The majority of stems in Plot II belonged to introduced species, with *Melilotus albus* and *Melilotus officinalis* accounting for over 51% of the stems. The native species in Plot II primarily consisted of *Aster praealtus* (14.5% of the stems) and *Solidago canadensis* (15.7%). Plot III was largely characterized by introduced

Table 1.—Species encountered in (A) meadow and (B) forest plots at Veetren Conservation Park. Family, origin (native or introduced), scientific and common name, and number of stems are given. A dash in the origin column indicates uncertain origin; these species were not included in abundance calculations.

A. Meadow							
Family	Origin	Scientific Name	Common Name	Plot I	Plot II	Plot III	Total
Aceraceae	Native	<i>Acer saccharinum</i>	Silver maple (sapling)	1	0	0	1
Anacardiaceae	Native	<i>Toxicodendron radicans</i>	Poison ivy	1	0	18	19
Apiaceae	Introduced	<i>Torilis arvensis</i>	Field hedge parsley	0	1	0	1
Asteraceae	Native	<i>Ambrosia artemisiifolia</i>	Common ragweed	0	1	16	17
Asteraceae	Native	<i>Ambrosia trifida</i>	Great ragweed	40	6	4	50
Asteraceae	Native	<i>Aster praealtus</i>	Veiny-line aster	870	328	87	1285
Asteraceae	—	<i>Aster</i> sp. 1	Unidentified long-leaf aster	145	3	1	149
Asteraceae	Native	<i>Conyza canadensis</i>	Horseweed	0	5	92	97
Asteraceae	Native	<i>Erigeron annuus</i>	Daisy fleabane	1	0	0	1
Asteraceae	Native	<i>Lactuca canadensis</i>	Wild lettuce	0	11	2	13
Asteraceae	Introduced	<i>Lactuca serriola</i>	Prickly lettuce	0	0	8	8
Asteraceae	Native	<i>Pyrrhopypus carolinianus</i>	False dandelion	0	1	0	1
Asteraceae	Native	<i>Solidago canadensis</i>	Common goldenrod	162	353	55	570
Asteraceae	Native	<i>Taraxacum officinale</i>	Common dandelion	11	41	85	137
Brassicaceae	Introduced	<i>Capsella bursa-pastoris</i>	Shepherd's purse	0	1	0	1
Convolvulaceae	Native	<i>Calyptegia sepium</i>	Hedge bindweed	1	1	2	4
Chenopodiaceae	—	<i>Chenopodium</i> sp.	Lamb's quarters	0	0	519	519
Fabaceae	Introduced	<i>Lespedeza cuneata</i>	Silky bushclover	0	48	0	48
Fabaceae	Introduced	<i>Medicago lupulina</i>	Black medic	1	0	3234	3235
Fabaceae	Introduced	<i>Melilotus albus and Melilotus officinalis</i>	Sweet clover	0	1159	70	1229
Fabaceae	Introduced	<i>Trifolium campestre</i>	Low hop clover	5	20	0	25
Onagraceae	Native	<i>Oenothera biennis</i>	Biennial evening primrose	1	40	466	507
Oxalidaceae	—	<i>Oxalis</i> sp.	Woodsorrel	1	0	0	1
Polygonaceae	Native	<i>Polygonum</i> sp.	Various smartweeds	0	0	8	8
Poaceae	Native	<i>Andropogon virginicus</i>	Broom sedge	22	0	0	22
Poaceae	Native	<i>Elymus virginicus</i>	Virginia wildrye	392	79	155	626
Poaceae	Introduced	<i>Sorghum halepense</i>	Johnson grass	23	156	274	453
Ulmaceae	Native	<i>Ulmus rubra and U. americana</i>	Elm (sapling)	0	4	0	4
Verbenaceae	Native	<i>Verbena urticifolia</i>	White vervain	1	0	3	4

Table 1.—Continued.

B. Forest							
Family	Origin	Scientific Name	Common Name	Plot I	Plot II	Plot III	Total
Anacardiaceae	Native	<i>Toxicodendron radicans</i>	Poison ivy	16	14	17	47
Apiaceae	Native	<i>Cryptotaenia canadensis</i>	Honewort	690	245	7	942
Asteraceae	Native	<i>Ambrosia trifida</i>	Great ragweed	2	0	0	2
Asteraceae	—	<i>Aster</i> sp. 2	Unidentified forest aster 1	42	0	36	78
Asteraceae	—	<i>Aster</i> sp. 3	Unidentified forest aster 2	27	3	0	30
Asteraceae	Native	<i>Solidago canadensis</i>	Common goldenrod	0	0	3	3
Bigoniaceae	Native	<i>Campis radicans</i>	Trumpet creeper	0	2	1	3
Convolvulaceae	Introduced	<i>Ipomea hederacea</i>	Ivy-leaved morning glory	2	0	0	2
Cyperaceae	Native	<i>Carex grayi</i>	Globe sedge	22	175	351	548
Menispermaceae	Native	<i>Menispermum canadense</i>	Common moonseed	0	0	1	1
Oleaceae	Native	<i>Fraxinus pennsylvanica</i>	Green ash	0	0	1	1
Phytolaccaceae	Native	<i>Phytolacca americana</i>	American pokeweed	26	0	0	26
Polygonaceae	Native	<i>Polygonum virginianum</i>	Jumpseed	1	5	0	6
Poaceae	Native	<i>Elymus virginicus</i>	Virginia wildrye	490	758	627	1875
Poaceae	Native	<i>Festuca subverticillata</i>	Nodding fescue	0	0	8	8
Smilacaceae	Native	<i>Smilax herbacea</i>	Smooth carrion-flower	1	1	1	3
Smilacaceae	—, but native	<i>Smilax</i> sp.	Unidentified smilax	3	13	0	16
Solanaceae	Native	<i>Solanum ptycanthum</i>	Eastern black nightshade	0	0	4	4
Ulmaceae	Native	<i>Celtis laevigata</i>	Sugarberry (sapling)	0	0	5	5
Urticaceae	Native	<i>Laportea canadensis</i>	Wood nettle	97	112	1	210
Urticaceae	Native	<i>Pilea pumila</i>	Clearweed	317	14	342	673
Violaceae	—	<i>Viola</i> sp.	Unidentified violet	3	12	4	19
Vitaceae	Native	<i>Parthenocissus quinquefolia</i>	Virginia creeper	38	44	59	141

species, with *Medicago lupulina* accounting for over 70% of the stems. *Oenothera biennis* (10.2% of the stems) was the only native species commonly found in Plot III. Some species were found throughout all three plots, while others were clustered in one or two of the three plots. For example, all but one specimen of *Medicago lupulina* was found in Plot III, while most of the *Melilotus* stems were found in Plot II. *Sorghum halepense* was the only introduced species commonly found throughout the three meadow plots. The native species commonly found in all three plots included *Aster praealtus*, *Solidago canadensis*, and *Elymus virginicus*.

In contrast to the meadow plots, native species represented almost all of the species present in the forest plots. In fact, only two introduced specimens were found across the three plots—two specimens of *Ipomea hederacea* (ivy-leaved morning glory) in forest Plot I (Table 1B). Five species (*Cryptotaenia canadensis* (honestwort), *Carex grayi* (globe sedge), *Elymus virginicus* (Virginia wildrye), *Laportea canadensis* (wood nettle), *Pilea pumila* (clearweed), and *Parthenocissus quinquefolia* (Virginia creeper)) accounted for more than 95% of the stems counted in the forest plots. The most common species in forest plots were fairly consistent across plots. Forest Plot I was represented by *Cryptotaenia canadensis* (40.5%), *Elymus virginicus* (28.8%), and *Pilea pumila* (18.6%). *Elymus virginicus* (55.3%), *Cryptotaenia canadensis* (17.9%), *Carex grayi* (12.8%) accounted for most of the stems found in forest Plot II. In Plot III, *Elymus virginicus* (43.9%), *Carex grayi* (24.6%), and *Pilea pumila* (23.9%) were the most common species.

DISCUSSION

Plant Survey.—The quality of habitat ($C_{av} = 2.5$, $FQI = 26.6$) at VCP is relatively low compared to other wetland sites in Indiana. For example, Bennett Wetland Complex (BWC) in Henry County has a C_{av} for native species of 3.8 (Ruch *et al.* 2009) and an FQI of 54.6. Turkey Run State Park in Parke County, Indiana also contains two habitats of higher quality. Two seep areas in the park are categorized as high quality habitats ($C_{av1} = 5.4$, $FQI_1 = 29.8$, $C_{av2} = 5.1$, $FQI_2 = 32.1$) (Rothrock & Homoya 2005). The C_{av} of VCP fails to fall within the suggested range of values for a natural habitat (>3.5), indicating that few natural remnants remain at this site. Although the site is degraded, it is still

capable of sustaining species that require a wetland habitat. This is evident by the presence of *Aristolochia tomentosa*, *Aster praealtus*, *Carex conjuncta*, *Forestiera acuminata*, and *Celtis laevigata*, which all have C-values equal to or greater than six and are commonly found in wetlands.

Plot Samples.—The proportion of non-native species in the meadow and forest plots differed greatly. The meadow has been used for agricultural purposes as recently as 2001, so the higher the abundance of invasive species was expected because disturbance promotes colonization by non-native species (Burke & Grime 1996). Although the invasive species accounted for over 50% of stems present in meadow plots, the presence of some non-native species (e.g., *Medicago lupulina* and *Melilotus spp.*) was localized, suggesting that concentrated efforts to control these non-natives may be successful.

In contrast, the widespread presence of Johnson grass, which was found in all plots, represents a pressing concern. Johnson grass produces large quantities of viable seed, while also spreading rhizomatously (Oyer *et al.* 1959). Furthermore, the formation of rhizomes as early as 50 days after seed planting causes the plants to become increasingly difficult to control because the entire rhizomatous system must be eradicated as opposed to simply destroying the aerial foliage. In addition, large quantities of herbicide are generally required to control Johnson grass (Frans *et al.* 1991), and some biotypes of Johnson grass have become resistant to certain herbicides (Smeda *et al.* 1997). For these reasons Johnson grass presents a major challenge in site restoration.

Restoration efforts have demonstrated that reestablishing biodiversity and ecosystem services can be effective. While VCP is a degraded site, restoring this environment could lead to improved ecosystem function, enhanced biodiversity, and reduced abundance of non-native plants (Vernberg 1993; Lehman & Tilman 2000; Benayas *et al.* 2009). Waterways, such as the Wabash River that borders VCP, expedite the spread of invasive species by acting as corridors for dispersal (Thebaud & Debussche 1991; Parendes & Jones 2000). So yearly floods currently wash in invasive seed banks and receding waters export invasive seed from the property's established invasive populations. In addition to restoring the ecosystem of VCP, establishment of a stable native wetland should

result in exportation of native seed instead of non-native seed. For example, a few recently discovered species (i.e., *Rudbeckia laciniata* and *Vernonia gigantea*) may have come from an attempted prairie planting in 2008, where floods swept the seeds far from the planting.

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APPENDIX 1:

Species planted by Vectren Corporation at Vectren Conservation Park in 2002.

Family	Scientific Name	Common Name	Inds. Planted
Caesalpiniaceae	<i>Cercis canadensis</i>	redbud	2300
Cornaceae	<i>Cornus amomum</i>	silky dogwood	2000
Cornaceae	<i>Cornus florida</i>	flowering dogwood	2300
Cornaceae	<i>Cornus racemosa</i>	gray dogwood	2300
Cornaceae	<i>Nyssa sylvatica</i>	black gum	7000
Fagaceae	<i>Quercus alba</i>	white oak	20900
Fagaceae	<i>Quercus imbricaria</i>	shingle oak	4600
Fagaceae	<i>Quercus macrocarpa</i>	bur oak	10000
Fagaceae	<i>Quercus michauxii</i>	swamp chestnut oak	4500
Fagaceae	<i>Quercus palustris</i>	pin oak	10000
Hamamelidaceae	<i>Liquidambar styraciflua</i>	sweetgum	20000
Juglandaceae	<i>Carya illinoensis</i>	pecan	10000
Juglandaceae	<i>Juglans nigra</i>	black walnut	10000
Lauraceae	<i>Lindera benzoin</i>	spicebush	2300
Oleaceae	<i>Fraxinus pennsylvanica</i>	green ash	10000
Plantanaceae	<i>Plantanus occidentalis</i>	sycamore	13000
Rosaceae	<i>Crataegus phaenopyrum</i>	Washington hawthorne	2300
Rosaceae	<i>Physocarpus opulifolius</i>	ninebark	700
Rubiaceae	<i>Cephalanthus occidentalis</i>	buttonbush	1900
		Total trees planted	136100

APPENDIX 2:

Species list of flora present at Vectren Conservation Park (arranged alphabetically by family). Each species report includes the following information: (1) scientific name based on Gleason and Cronquist (1991), (2) common name, (3) origin (native or introduced), (4) wetland indicator category (U.S. Army Corps of Engineers 1996), and (5) coefficient of conservatism (C-value) for Indiana (Rothrock 2004). For the wetland indicator categories, OBL represents obligate wetland plants (with plants almost always occurring in wetlands (>99%)), FACW represents facultative wetland plants (with plants usually occurring in wetlands (67%–99%)), FAC represents facultative plants (with plants being equally likely to occur in wetlands or non-wetlands (34%–66%)), FACU represents facultative upland plants (with plants usually occurring in non-wetlands (67%–99%)), and UPL represents Obligate Upland plants (with plants almost always occurring in non-wetlands in our region (>99%))(Reed 1996). NI represents plants with insufficient information available to determine indicator status. Signs (+/-) represent discrimination within categories, with a positive sign representing a greater frequency in that habitat and a negative sign representing a lower frequency). C-values range from zero to 10, with lower values representing plants that are highly tolerant of disturbance and higher values representing plants that are restricted to high quality plant community remnants. In addition to the species listed only to the level of genus, eight species were identified only at higher taxonomic levels; four specimens belonged to three families—Brassicaceae, Poaceae, and Asteraceae, and four were not placed to any family. Many introduced plants were neither categorized for wetland category nor for C-values. Still, introduced species are often given C-values of zero.

Acanthaceae (Acanthus Family)

Ruellia strepens L.: Wild petunia; native; FAC+; 4

Aceraceae (Maple Family)

Acer negundo L.: Boxelder; native; FACW-; 1

Acer saccharinum L.: Silver maple; native; FACW; 1

Amaranthaceae (Amaranth Family)

Amaranthus sp.

Apiaceae (Carrot Family)

Cryptotaenia canadensis (L.) DC.: Honewort; native; FAC; 3

Torilis arvensis (Huds.) Link: Field hedge-parsley; introduced, Europe

Apocynaceae (Dogbane Family)

Apocynum cannabinum L.: Indian hemp; native; FAC; 2

Araceae (Arum Family)

Arisaema dracontium (L.) Schott: Green dragon; native; FACW; 5

Aristolochiaceae (Birthwort Family)

Aristolochia tomentosa Sims: Pipe vine; native; FAC; 7

Asclepiadaceae (Milkweed Family)

Ampelamus albidus (Nutt.) Britton: Bluevine; native; - ; 1

Asclepias incarnata L.: Swamp milkweed; native; OBL; 4

Asclepias syriaca L.: Common milkweed; native; NI; 0

Asteraceae (Aster Family)

Achillea millefolium L.: Yarrow; native; FACU; 0

Ambrosia artemisiifolia L.: Common ragweed; native; FACU; 0

Ambrosia trifida L.: Giant ragweed; native; FAC+; 0

Aster praealtus Poir.: Veiny lined aster; native; FACW; 6

Aster pilosus Willd.: Heath aster; native; 0

Bidens comosa (A. Gray) Wiegand: Strawstem bur-marigold; native; - ; 1

Carduus nutans L.: Musk thistle; introduced, Europe

Conyza canadensis (L.) Cronquist: Horseweed; native; FAC-; 0

Erigeron annuus (L.) Pers.: Daisy fleabane; native; FAC-; 0

Erigeron philadelphicus L.: Philadelphia fleabane; native; FACW; 3

Eupatorium coelestinum L.: Mistflower; native; FACW; 2

Eupatorium serotinum Michx.: Late boneset; native; FAC+; 0

Iva annua L.: Rough marsh elder; native; FAC; 0

Lactuca serriola L.: Prickly lettuce; introduced, Europe; FAC; 0

Pyrrhophappus carolinianus (Walter) DC.: False dandelion; introduced; 2

Rudbeckia hirta L.: Black-eyed Susan; native; FACU; 2

Rudbeckia laciniata L.: Cutleaf coneflower; native; FACW; 3

Rudbeckia triloba L.: 3-lobed coneflower; native; FAC 3

Senecio glabellus Poir.: Butterweed; native; OBL; 0

Solidago canadensis L.: Common goldenrod; native; FACU; 0

Tragopogon dubius Scop.: Yellow salsify; introduced, Europe

Verbesina alternifolia (L.) Britton: Wingstem; native; FACW; 3

Vernonia gigantea (Walter) Trel.: Tall ironweed; native; FAC; 2

Bignoniaceae (Trumpet Creeper Family)

Campsis radicans (L.) Seem.: Trumpet creeper; native; FAC; 1

Catalpa speciosa Warder: Northern catalpa; native; FACU; 0

Brassicaceae (Mustard Family)

Capsella bursa-pastoris (L.) Medik.: Shepherd's purse; introduced, Europe; FAC-

Cardamine rhomboidea (Pers.) DC.: Springcress; native

- Lepidium virginicum* L.: Poor man's pepper; native; FACU-; 0
- Rorippa palustris* (L.) Besser: Common yellow cress; native; OBL; 2
- Rorippa sessiliflora* (Nutt.) Hitchc.: Southern yellow cress; native; OBL; 3
- Caesalpiniaceae (Caesalpinia Family)
- Cercis canadensis* L.: Redbud; native; FACU; 3
- Gleditsia triacanthos* L.: Honey-locust; native; FAC; 1
- Gymnocladus dioica* Lam.: Kentucky coffee-tree; native; 3
- Campanulaceae (Bellflower Family)
- Campanula americana* L.: Tall bellflower; native; FAC; 4
- Caprifoliaceae (Honeysuckle Family)
- Symphoricarpos* sp.
- Caryophyllaceae (Pink Family)
- Dianthus armeria* L.: Deptford pink; introduced, Europe; NI
- Chenopodiaceae (Goosefoot Family)
- Chenopodium* sp.
- Convolvulaceae (Morning-glory Family)
- Calystegia sepium* (L.) R. Br.: Hedge bindweed; native; FAC; 4
- Ipomoea hederacea* Jacq.: Ivy-leaved morning glory; introduced; FAC
- Ipomoea pandurata* (L.) G.Mey.: Wild potato; native; FACU; 3
- Cornaceae (Dogwood Family)
- Cornus drummondii* C. A. Mey.: Rough-leaved dogwood; native; FAC; 2
- Cucurbitaceae (Gourd Family)
- Sicyos angulatus* L.: Bur cucumber; native; FACW-; 3
- Cuscutaceae (Dodder Family)
- Cuscuta gronovii* Willd. Common dodder; native; 2
- Cyperaceae (Sedge Family)
- Carex conjuncta* Boott: Green-headed fox sedge; native; FACW; 6
- Carex cristatella* Britton: Crested sedge; native; FACW+; 3
- Carex digitalis* Willd.: Slender woodland sedge; native; UPL; 7
- Carex grayi* J. Carey: Globe sedge; native; FACW+; 5
- Carex muehlenbergii* Schkuhr ex Willd.: Muehlenberg's sedge; native; - ; 5
- Cyperus strigosus* L.: False nutsedge; native; FACW; 0
- Elaeagnaceae (Oleaster Family)
- Elaeagnus angustifolia* L.: Russian olive; introduced, native of Eurasia; FACU-
- Fabaceae (Pea Family)
- Amorpha fruticosa* L.: False indigo; native; OBL; 3
- Desmodium paniculatum* (L.) DC.: Panicked tick-clover; native; FACU; 2
- Lespedeza cuneata* (Dum. Cours.) G. Don: Silky bushclover; introduced, Asia; UPL
- Melilotus albus* Medik: White sweet clover; introduced, Asia;
- Melilotus officinalis* (L.) Pall.: Yellow sweet clover; introduced, Eurasia; FACU
- Trifolium campestre* Schreb.: Low hop clover; introduced, Eurasia and N. Africa
- Fagaceae (Beech Family)
- Quercus macrocarpa* Michx.: Bur oak; native; FAC-; 5
- Geraniaceae (Geranium Family)
- Geranium carolinianum* L.: Carolina crane's bill; native; - ; 2
- Juglandaceae (Walnut Family)
- Juglans cinerea* L.: Butternut; native; FACU+; 5
- Juglans nigra* L.: Black walnut; native; FACU; 2
- Lamiaceae (Mint Family)
- Lamium amplexicaule* L.: Henbit deadnettle; introduced, Eurasia and Africa
- Teucrium canadense* L.: American germander; native; FACW-; 3
- Liliaceae (Lily Family)
- Allium vineale* L.: Field garlic; introduced, native of Europe; FACU
- Malvaceae (Mallow Family)
- Hibiscus laevis* All.: Smooth rose mallow; native; OBL; 4
- Sida spinosa* L.: Prickly mallow; native; FACU
- Menispermaceae (Moonseed Family)
- Menispermum canadense* L.: Common moonseed; native; FAC; 3
- Mimosaceae (Mimosa Family)
- Desmanthus illinoensis* (Michx.) MacMill.: Bundleflower; native; FACU; 3
- Moraceae (Mulberry Family)
- Machura pomifera* (Raf.) Schneid: Osage orange; native; FACU
- Morus alba* L.: White mulberry; introduced, Asia; FAC
- Morus rubra* L.: Red mulberry; native; FAC-; 4
- Oleaceae (Olive Family)
- Forestiera acuminata* (Michx.) Poir.: Swamp privet; native; OBL; 8
- Fraxinus americana* L.: White ash; native; FACU; 4
- Fraxinus pennsylvanica* Marshall: Green ash; native; FACW; 1
- Onagraceae (Evening Primrose Family)
- Oenothera biennis* L.: Common evening primrose; native; FACU; 0
- Oenothera laciniata* Hill: Ragged evening primrose; native; FACU; 2
- Oenothera* sp.
- Oxalidaceae (Wood-sorrel Family)
- Oxalis dillinii* Jacq.: Southern yellow wood-sorrel; native; NI; 0
- Phytolaccaceae (Pokeweed Family)
- Phytolacca americana* L.: American pokeweed; native; FAC-; 0

Plantaginaceae (Plantain Family)

Plantago rugelii Decne.: American plantain; native; FAC; 0

Platanaceae (Plane-tree Family)

Platanus occidentalis L.: American sycamore; native; FACW; 3

Poaceae (Grass Family)

Agrostis gigantea Roth: Redtop; introduced, Europe; FACW

Andropogon virginicus L.: Broomsedge; native; FAC-; 1

Arundinaria gigantea (Walter) Muhl.: Giant cane; native; NI, 5

Bromus racemosus L.: Bald brome; introduced, Europe

Chasmanthium latifolium (Michx.) H.O. Yates: Wild oats; native; FAC; 4

Dactylis glomerata L. Orchard grass; introduced, Europe; FACU

Echinochloa crusgalli (L.) P.Beauv.: Barnyard grass; introduced, Eurasia; FACW

Elymus canadensis L.: Canada wildrye; native; FAC-; 5

Elymus virginicus L.: Virginia wildrye; native; FACW-; 3

Festuca pratensis Huds.: Meadow fescue; introduced, Europe; FACU-

Festuca subverticillata (Pers.) E.B. Alexeev: Nodding fescue; native; FACU+; 4

Hordeum jubatum L.: Foxtail barley; native; FAC+

Hordeum pusillum Nutt.: Little barley; introduced, N. America; FAC; 0

Koeleria pyramidata (Lam.) P. Beauv.: Junegrass; native; - ; 8

Lolium perenne L.: Perennial rye; introduced, Europe; FACU

Phleum pratense L.: Common timothy; introduced, Europe; FACU

Setaria viridis (L.) P. Beauv.: Green foxtail; introduced, Europe

Sorghum bicolor (L.) Moench: Sorghum; introduced, Africa; UPL

Sorghum halepense (L.) Pers.: Johnson grass; introduced, Europe and Africa; FACU

Polygonaceae (Smartweed Family)

Polygonum aviculare L.: Knotweed; native; FAC-

Polygonum cuspidatum Siebold & Zucc: Japanese knotweed; introduced; Japan; FACU

Polygonum erectum L.: Erect knotweed; native; FACU; 0

Polygonum pennsylvanicum L.: Pinkweed; native; FACW+; 0

Polygonum persicaria L.: Spotted lady's thumb; introduced, Europe; FACW

Polygonum virginianum L.: Jumpseed; native; FAC; 3

Rumex altissimus A. W. Wood: Pale dock; native; FACW-; 2

Rumex crispus L.: Curley dock; introduced, Europe; FAC+

Ranunculaceae (Buttercup Family)

Ranunculus micranthus Nutt.: Small-flowered crowfoot; native; FAC-; 4

Rosaceae (Rose Family)

Crataegus mollis (Torr. & Gray) Scheele: Downy hawthorn; native; FACW-; 2

Geum canadense Jacq.: White avens; native; FAC; 1

Potentilla norvegica L.: Rough cinquefoil; native; FAC; 0

Prunus sp.

Rubus sp.

Rubiaceae (Madder Family)

Cephalanthus occidentalis L.: Common button-bush; native; OBL; 5

Salicaceae (Willow Family)

Populus deltoides Marshall: Cottonwood; native; FAC+; 1

Salix exigua Nutt.: Sandbar willow; native; FACW+; 1

Salix nigra Marshall: Black willow; native; OBL; 3

Saururaceae (Lizard's tail Family)

Saururus cernuus L.: Lizard's tail; native; OBL; 4

Scrophulariaceae (Figwort Family)

Verbascum blattaria L.: Moth mullein; introduced, Eurasia; FACU-

Mimulus alatus Aiton: Sharpwing monkey-flower; native; OBL; 4

Smilacaceae (Catbriar Family)

Smilax herbacea L.: Smooth carrion flower; native; FAC; 4

Smilax sp.

Solanaceae (Nightshade Family)

Solanum carolinense L.: Horse-nettle; native; FACU-; 0

Ulmaceae (Elm Family)

Celtis laevigata L.: Southern hackberry; native; FACW; 7

Celtis occidentalis L.: Northern hackberry; native; FAC-; 3

Ulmus americana L.: American elm; native; FACW-; 3

Ulmus rubra Muhl.: Slippery elm; native; FAC; 3

Urticaceae (Nettle Family)

Laportea canadensis (L.) Wedd.: Canada nettle; native; FACW; 2

Pilea pumila (L.) A. Gray: Clearweed; native; FACW; 2

Urtica dioica L. Stinging nettle; native; FACW-; 1

Valerianaceae (Valerian Family)

Valerianella radiata (L.) Dufur.: Beaked cornsalad; native; FAC; 1

Verbenaceae (Vervain Family)

Verbena urticifolia L.: White vervain; native; FAC+; 3

Phyla lanceolata (Michx.) Greene: Fogfruit; native; OBL; 2

Violaceae

Viola sp.

Vitaceae (Grape Family)

- Parthenocissus quinquefolia* (L.) Planch.: Virginia creeper; native; FAC-; 2
Vitis aestivalis Michx.: Summer grape; native; FACU; 4
Vitis cinerea Engelm.: Sweet winter grape; native; FACW-; 4
Vitis riparia Michx.: Riverbank grape; native; FACW-; 1
Vitis vulpina L.: Winter grape; native; FACW-; 3

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