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Quantifying Bee Diversity and Resource Use in the Appalachian Foothills near Marietta, Ohio

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Abstract: We surveyed bee richness, abundance, and diversity within Washington County, Ohio. Bees were collected at three sites within Washington County every two weeks from April to October 2013 using pan traps, vane traps, and hand collecting. A total of 2,753 bees were pinned and identified to genus, and when possible, species. A total of 35 genera of bees were collected representing over 130 species in five families. Of the species collected, 74 had fewer than 3 representatives. The most common genera were *Andrena*, *Lasioglossum*, and *Ceratina*. Of the bees collected, 81 individuals, the majority of which were either *Andrena erigeniae* (n=49) or *Andrena violae* (n=12), had visible pollen loads. *Andrena erigeniae* was found to collect pollen mainly from *Claytonia virginica*. *Andrena violae* collected pollen from a variety of spring ephemerals in addition to violets. Overall, this research provides a baseline understanding of the current bee populations in southeastern Ohio. More work is needed in a larger variety of habitats to better understand the bee diversity and richness across southeastern Ohio.

Introduction

Victorian-era collection and identification of organisms seems to have gone out of style. However, habitat surveys are imperative for understanding changes in biodiversity over time. Local changes in richness and/or species diversity can only be determined if there is a baseline for comparison. Worldwide, bees have been documented as in decline (Brown and Paxton, 2009). This includes decreases in both abundance and diversity and varies greatly depending on landscape changes (Burkle et al., 2013). As anthropogenic change continues, especially climate change, it is imperative to establish biodiversity baselines against which further surveys can be compared.

Washington county is 1,657 km^2 and includes the small town (population 15,000) of Marietta (39.4154° N, 81.4548° W). Marietta, Ohio, is rich in human history as the first capital of the Northwest Territory. However, the natural history of southeastern Ohio is sparse, especially involving bee species records. Therefore, this study set out to 1) determine the bee species richness and abundance in and around Marietta, Ohio, and 2) determine floral resource utilization of bees.

Materials and Methods

Sampling Sites. Three sites were chosen in Washington County: the Barbara A. Beiser Field Station, the Marietta College campus, and the Washington County Career Center. From east to west, the Barbara A. Beiser Field station is ≈12 kilometers from the Marietta College campus, which is ≈8 kilometers from the Washington County Career Center. The Barbara A. Beiser Field Station was formally established in 2008 and transferred to co-management by Marietta College and Friends of the Lower Muskingum. It is 77 acres of forest, old field, and streamfront, most of which is on a slope. Each site had three transects of ≈150 meters (Figure 1). The transects at the field station were in old field habitat bordered by forest edge. The transects at the Marietta College campus were on turf grass next to a stream overrun with invasive and ornamental plants. At the Washington County Career Center, one transect was on turf grass and the other two transects were old field habitat bordered by forest edge. The final transect at the Washington County Career Center was a clearing for an oil well surrounded by many acres of dense forest.

Bee Collection. Sampling consisted of bee bowls, hand-netting, and blue vane trapping. Bee bowls consisted of 96 ml soufflé (Solo®) cups painted either fluorescent yellow, fluorescent blue, or left white (Guerra Paints) as per the standardized guidelines of the Handy Bee Manual (Droege, 2012). Ninety bee bowls were set every five meters along each 150 meter transect. The bowls were half-filled with soap solution (0.5% blue Dawn® dish soap and distilled water mixture) and left out for 24 hours. Sampling for the bee bowls took place approximately every 2 weeks from April 2013 to mid-October 2013 on non-rainy days.

Hand-collection and netting occurred three times: April 29th, July 3rd, and August 2nd. Hand-collection or netting involved timed walks of 5 minutes along the transects to catch any observed bee within 5 meters of the transect. Blue vane traps (SpringStar™) were incorporated in an attempt to catch larger bees that escape from smaller traps (Stephan and Rao, 2005). The vane traps were used starting at the end of August until the first frost in October. Only one vane trap was set per transect and they were deployed for the same duration as the bee bowls. As with the bee bowls, these were half-filled with the soapy water solution.

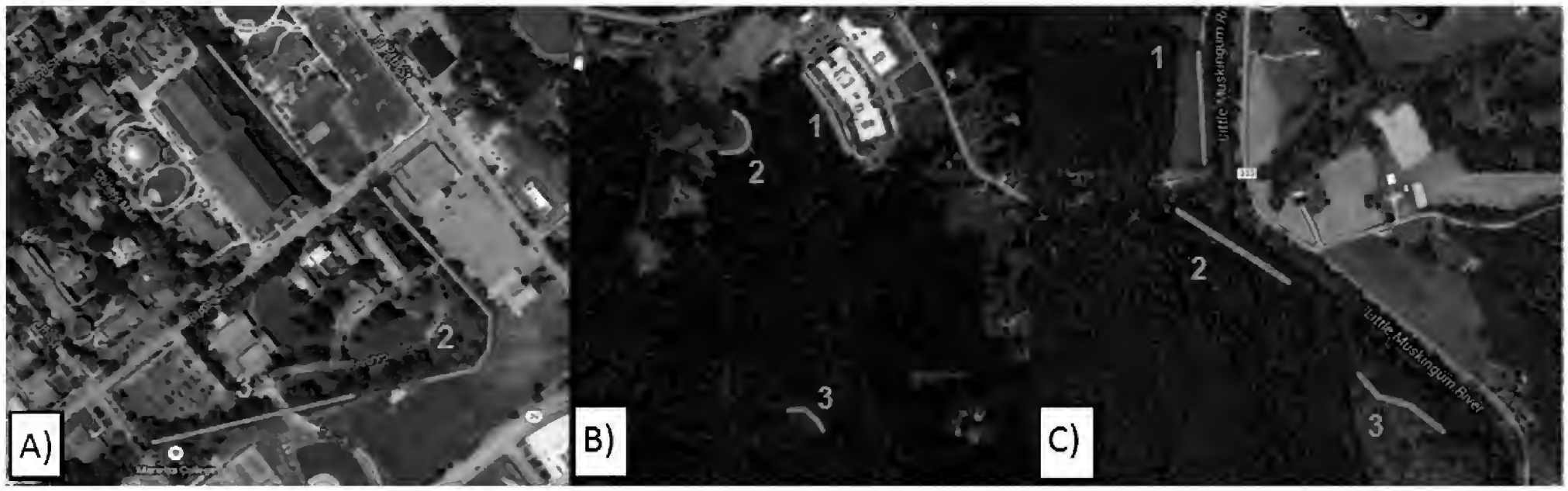

Figure 1. Sampling sites: A) the Marietta College campus; B) the Washington County Career Center; C) the Barbara A. Beiser Field Station.

Sample Preparation. Samples were stored in 70% ethanol. Bees were sorted from bycatch, washed, blown dry, and pinned as per recommendations from the Handy Bee Manual (Droege, 2012). Bees were identified to genus using Michener et al. (1994). Species identification was based largely on Discoverlife.org (Droege et al., 2013). Sam Droege (USGS Bee Inventory and Monitoring Lab) confirmed species-level identification of bees and identified all specimens in the genera *Lasioglossum* and *Nomada*.

In addition to calculated species richness, the Simpson's Diversity Index was used to calculate diversity (Simpson 1949). The modified Simpson's Diversity Equation is as follows:

$$D = 1 - (\sum (ni\ (ni - 1)) / N\ (N - 1))$$

Species accumulation curves for bee bowl samples were created in R (3.2.2) with package vegan (2.3-1). Samples were summed over the entire year and species complexes were removed from the analysis to get an estimate of species present. Simpson's Diversity Index provides information about the diversity and evenness of the samples and range from 0 to 1, where 0 is a 100% probability of getting two specimens of the same species from a sample and 1 is a 0% probability of randomly selecting two specimens of the same species from a sample (Simpson 1949).

Since most bees were collected in a soapy water solution, only bees with large, visible pollen loads were chosen for pollen analysis. Contamination from the collection method is possible; hence, only dominant pollen grains were identified to decrease the likelihood of identifying contaminants in the pollen masses. The pollen loads were gently scraped from the scopa with an insect pin and placed in labeled microcentrifuge tubes with 70% ethanol until they could be processed. Pollen slides were made using basic fuschin jelly to stain the grains (Kearns and Inouye, 1993) and then compared to a reference collection of pollen.

Results

Bees Collected. We collected 2,753 bees from the three locations sampled during 2013. A total of 28 bees were collected from vane traps, 147 were hand collected, and the remaining 2,578 were from bee bowls. Overall abundance was 995 at the Barbara A. Beiser Field Station, 760 at the Marietta College Campus, and 972 at the Washington County Career Center, with 26 bees collected elsewhere in Washington County. Five families of bees were collected: Apidae, Andrenidae, Colletidae, Halictidae, and Megachilidae. These pollinators belonged to 35 genera, and 130 species (Appendix 1). Of these 130 species, 74 had fewer than 3 representatives. The most common species were *Andrena erigeniae*, *A. violae*, *Calliopsis andreniformis*, *Apis mellifera*, *Ceratina calcarata*, *C. mikmaqi*, *C. strenua*, and *Lasioglossum versatum*. Eight species were state records (not previously reported) for Ohio: *A. macra*, *Hylaeus leptocephalus*, *Nomada annulata*, *N. luteola*, *Melecta pacifica*, *Stelis nitida*, *L. gotham*, and *L. subviridatum*. Only a small number of bees not native to the United States were found: *A. wilkella* (n=1), *Anthidium*

manicatum (n=5), *An. oblongatum* (n=41), *Apis mellifera* (n=146), *H. leptocephalus* (n=2), *Megachile rotundata* (n=35), *Osmia cornifrons* (n=3), and *O. taurus* (n=10). This study also found the first reported case of gynandromorphy (individual with both male and female body parts) in the bumble bee *Bombus bimaculatus* at the Barbara A. Beiser Field Station (Spring et al., 2015). This has only been reported in 113 bee species worldwide (Hinojosa-Diaz et al., 2012) with Michez et al. (2009) providing a comprehensive review of the condition. Very few of the bees were stylopized, with the authors only finding six specimens of *Andrena* with strepsipterans remaining in their abdomen (Spring et al., 2015).

Species diversity estimates. The calculated bee diversity (*D*) for all sites was as follows: the Washington County Career Center (0.929), the Barbara A. Beiser Field Station (0.875), and the Marietta College Campus (0.957).

A total of 2,434 specimens were used to create the species accumulation curves once species complexes were removed from the bee bowl data. Species accumulation curves were created for each site using chao, jackknife, and bootstrap (Table 1). The estimated species richness that could be collected via bee bowls is 172 (Chao), 172 (Jackknife1), 194 (Jackknife2), and 147 (Bootstrap) (Figure 2).

Table 1. Species Accumulation Curve for bee bowl collection.

Site	Sampled species richness	Chao	Chao SE	Jack1	Jack1 SE	Jack 2	Boot	n
Overall	126	172.22	17.11	172.22	18.91	194.97	147.24	9
BFS	52	82.25	14.75	74	16.93	83.0	62.22	3
MC	77	105.00	11.83	105	19.80	115.5	90.22	3
WCCC	77	93.90	7.46	103	19.87	111.0	89.67	3

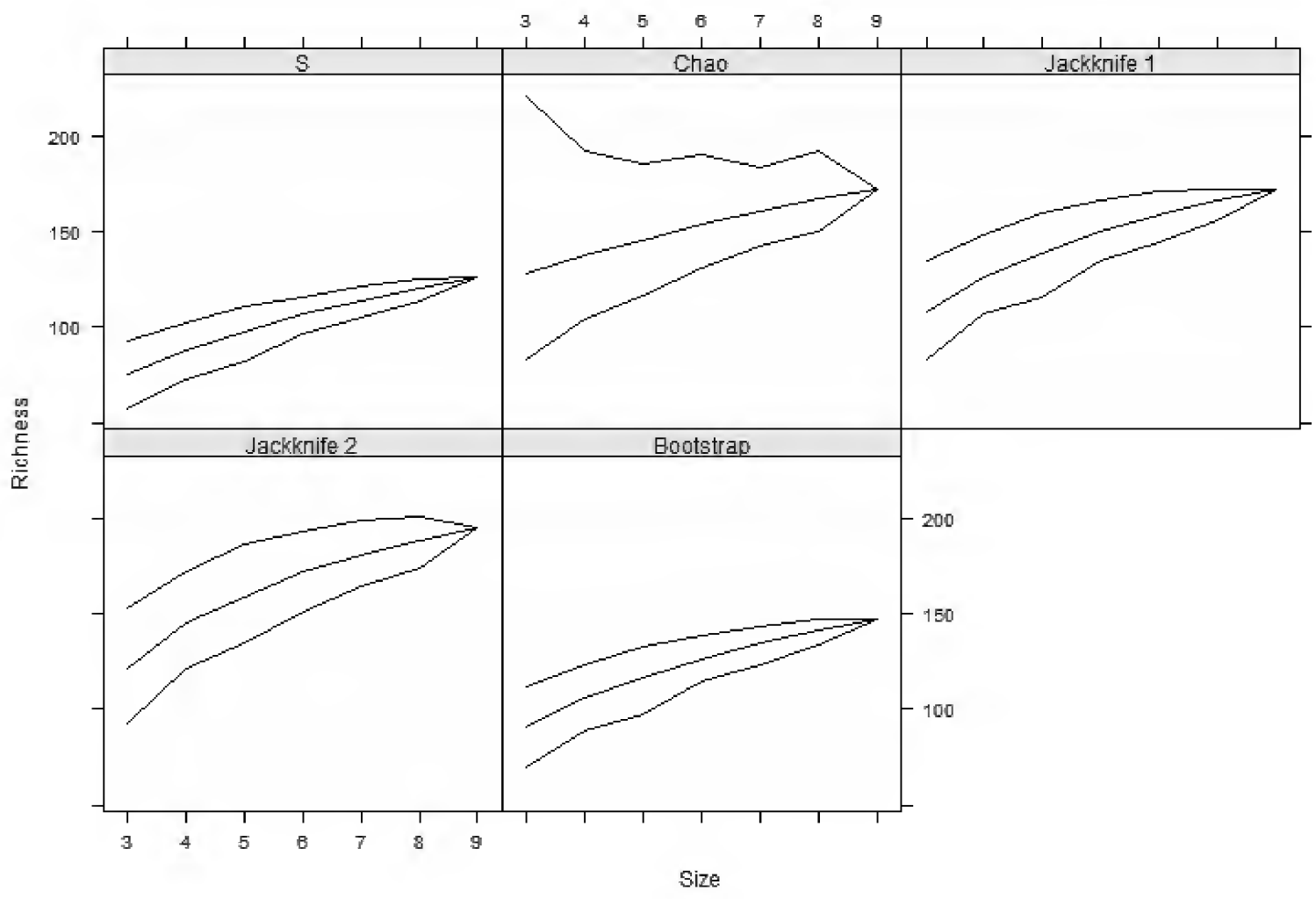

Figure 2. Species Accumulation Curve for bee bowl samples.

Pollen analysis. A total of 81 bees collected had visible pollen loads. Of these 81 bees, 66 were from the genus *Andrena*. Furthermore, a majority of these bees were from either *Andrena erigeniae* (n=50) or *Andrena violae* (n=12). *Andrena erigeniae* was found to collect mainly *Claytonia virginica*, a spring ephemeral common in Southeastern Ohio, but occasionally had other pollen in their loads including *Taraxacum officinale*, Caryophyllaceae, and Brassicaceae (Table 2). *Andrena violae* was found to have on average two dominant pollen types per load, but the types of pollen varied greatly by individual (Table 2).

Table 2. Pollen Loads

Bee Species	Average # of pollen types dominant per individual	Pollen Type
Andrena erigeniae (n=50)	1.24	*Claytonia virginica*, *Taraxacum officinale*, Caryophyllaceae, Brassicaceae
Andrena perplexa (n=3)	4	*Cornus* spp., *Viburnum* spp., *Carya* spp.
Andrena violae (n=12)	2.16	Rosaceae, Lamiaceae, Ranunculaceae, *Lonicera* spp., *Oxalis stricta*
Halictus ligatus (n=7)	1.71	*Taraxacum officinale*, Asteraceae

Discussion

There are only a few studies involving bees in Ohio, with most as part of ecological or agricultural studies and completed within the last decade (Arduser, 2010; Bernhardt et al., 2008; Cusser and Goodell, 2013; Iler and Goodell, 2014; Goodell et al., 2010; Pardee and Philpott, 2014; Phillips and Gardiner 2015). Of the studies in the nearby states, there is a tendency to focus on an agricultural crop, such as apple orchards (Gardner and Ascher, 2006, Russo et al., 2015), sunflowers (Todd et al., 2016), or blueberry (Tuell et al., 2009) among many others. Occasionally, nearby studies focus on specific habitat such as sand dunes (Grundel et al., 2011), powerline right-of-ways (Russell et al., 2005), or shale barrens (Kalhorn et al., 2003). Other states are working on bee diversity and richness estimates, but many states lack a defined species list (Tucker and Rehan, 2016).

There is a dearth of species diversity surveys in Ohio. It is a large state, rich in biodiversity (thanks to the variety of habitats), and is thus likely to host a wide diversity of bees. The most recently published bee diversity survey occurred in the northwestern portion of Ohio in the Oak Openings (Arduser, 2010). This study took place on a nature preserve known for its biodiversity and unique habitat (Arduser, 2010). A direct comparison of diversity between these two studies is challenging because Arduser (2010) used hand-netting as the main sampling method, whereas this study largely utilized bee bowls, which are known to attract a slightly different subset of pollinators. Moreover, this study took place throughout the entire flying season from end of frost to first frost in the fall. The sampling effort for Arduser (2010) was mainly when the author had a chance to be in northern Ohio over a period of 3 years. Despite this discrepancy in sampling methods, Arduser (2010) found 116 species among 486 individuals hand-collected from flowers.

However, other than Mitchell's early work on bees across the United States, which only shows estimated distributions (Mitchell, 1960; Mitchell, 1962), and the study in Northwestern Ohio by Arduser, bee diversity remains largely understudied in Ohio. This is the first published year-long survey of bee diversity in southeastern Ohio known to the authors. We found a total of 130 bee species, which is similar in number, but not composition, to other bee diversity studies (Arduser, 2010; Giles and Ascher, 2006; Grundel et al., 2011). We found a total of eight state records of bee species not previously reported in Ohio (Sam Droege, pers. comm). Of these records, one was a newly split species group (*L. gotham*) (Gibbs, 2011) or invasive (*H. leptocephalus*). Two records are of species not reported in many collections (*A. macra* and *L. subviridatum*); thus, they are rare in general. The remainder are parasites of other bees (*N. annulata, N. luteoloa, Melecta pacifica, and S. nitida*). This number of state records could be partly due to the habitat; the Appalachian foothills are still understudied for their bee diversity, and most research involving bees occurs in the central and northern region of the state.

Species diversity was calculated using the reciprocal Simpson's Diversity Index. With this equation, a larger value (between 0-1) on the Simpson's Diversity Index indicates a greater likelihood of randomly selecting two different species when selecting two specimens. A larger value can therefore be interpreted as a higher-diversity assemblage. All three sites had high index values (>0.85), which would imply diverse assemblages and good biodiversity of the overall area. Moreover, the species estimates for just bowl collection of the area range from 147-194 species, whereas we only collected a total of 126 species with bee bowls. This implies that subsequent years of sampling with bee bowls should still find more species. Importantly, this calculation did not take into account alternative sampling methods, which are known to collect a different subset of the biodiversity in bees. Thus, the authors recommend additional effort in Washington County focusing on vane traps and hand-collection to get a better idea of bee richness.

Pollen loads. Of the 2,753 bees collected, few had visible pollen loads remaining once they got back to the lab. This could be partly due to the pollen packing methods of different bee species. Some species mix pollen with nectar to get the mass to stay attached to the scopa, whereas others just brush the pollen onto their scopa. Of the bees collected with visible pollen loads, most were in the genus *Andrena*. *Andrena erigeniae* is often stated as a pollen specialist on *Claytonia virginica (*Reese and Barrows, 1980). All of our specimens were found to be collecting *C. virginica* pollen, though they did occasionally have large quantities of other pollens present.

Many articles, without referencing sources, state that *A. violae* only pollinates violets (Motton, 1986; Giles and Ascher, 2006). In our case, *A. violae* is found to collect pollen from a variety of sources, rarely having similar pollen loads. Older literature shows that *A. violae* is documented on many spring ephemerals in addition to violets (Robertson 1929; Mitchell 1960), which is more in line with our data.

Future Research

The authors recommend that the study be repeated in a few years with more hand-netting to collect more species. Increased hand-collection has the potential to find more species that are unlikely to visit bee bowls. Furthermore, collection at additional sites with a wider variety of habitats and floral resources is recommended to get a better idea of the diversity present in and around the historic area of Marietta, Ohio.

Acknowledgements

We would like to thank Sam Droege from the USGS Bee Inventory and Monitoring Lab for his help with confirmations of IDs and species identification of the *Lasioglossum* and *Nomada*. We would also like to thank Karen Goodell for access to her reference collection of Ohio bees in the spring of 2014. Thanks also go to the following undergraduates at Marietta College who assisted with the 3:00 a.m. set-up time for bee bowls and vane traps or hand-collecting during the day: Rachel Shoop, Anna Cooper, Tristine Toves, and Rachel Stahl. Furthermore, we would like to thank the Marietta College Investigative Studies program and the Biology and Environmental Science Department for funding this project, and the Investigative Studies Travel grant for funding travel to both the Association for Southeastern Biologists meeting and the International Conference for Pollinator Biology, Health, and Policy. Thanks for diversity index calculation and interpretation goes to Katherine Todd and Bryan Zake. A synoptic collection of this research is housed at the Museum of Biological Diversity at The Ohio State University.

Appendix 1. Species list and abundance of individuals.

Species	Total	BFS T1	BFS T2	BFS T3	BFS Total	MC T1	MC T2	MC T3	MC Total	WCCC T1	WCCC T2	WCCC T3	WCCC Total	Other Sites
Agapostemon virescens	29	1	1	0	2	5	4	10	19	5	3	0	8	0
Andrena barbara	1	0	0	0	0	1	0	0	1	0	0	0	0	0
Andrena barbilabris	1	0	0	0	0	1	0	0	1	0	0	0	0	0
Andrena bisalicis	1	1	0	0	1	0	0	0	0	0	0	0	0	0
Andrena bradleyi	1	0	0	0	0	0	0	1	1	0	0	0	0	0
Andrena brevipalpis	3	0	0	1	1	1	0	1	2	0	0	0	0	0
Andrena carlini	3	0	0	2	2	0	0	0	0	1	0	0	1	0

Species	Total	BFS T1	BFS T2	BFS T3	BFS Total	MC T1	MC T2	MC T3	MC Total	WCCC T1	WCCC T2	WCCC T3	WCCC Total	Other Sites
Andrena commoda	1	0	0	1	1	0	0	0	0	0	0	0	0	0
Andrena cressonii	1	0	0	0	0	0	0	0	0	0	0	1	1	0
Andrena cressonii cressonii	5	0	1	0	1	0	1	0	1	0	0	1	1	2
Andrena distans	3	1	0	0	1	0	1	1	2	0	0	0	0	0
Andrena erigeniae	323	42	94	96	232	10	16	21	47	6	10	28	44	0
Andrena gardineri	1	0	0	0	0	0	0	0	0	0	0	1	1	0
Andrena illini	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Andrena imitatrix	2	0	0	0	0	0	1	1	2	0	0	0	0	0
Andrena macra	3	0	0	0	0	0	0	0	0	0	1	2	3	0
Andrena miserabilis	2	0	0	0	0	1	1	0	2	0	0	0	0	0
Andrena nasonii	3	0	0	1	1	0	0	0	0	1	0	1	2	0
Andrena nubecula	1	0	0	0	0	0	0	0	0	0	1	0	1	0
Andrena perplexa	40	0	6	0	6	8	10	4	22	4	7	1	12	0
Andrena placata	2	0	1	0	1	0	0	0	0	0	1	0	1	0
Andrena pruni	2	0	2	0	2	0	0	0	0	0	0	0	0	0
Andrena robertsonii	2	0	0	0	0	0	0	1	1	0	1	0	1	0
Andrena sayi	2	0	2	0	2	0	0	0	0	0	0	0	0	0
Andrena simplex	1	1	0	0	1	0	0	0	0	0	0	0	0	0
Andrena sp.	4	0	0	0	0	0	0	0	0	0	1	3	4	0
Andrena vicina	3	0	0	0	0	1	1	1	3	0	0	0	0	0
Andrena violae	266	59	77	44	180	12	14	18	44	5	21	16	42	0
Andrena wheeleri	1	0	0	0	0	1	0	0	1	0	0	0	0	0

Species	Total	BFS T1	BFS T2	BFS T3	BFS Total	MC T1	MC T2	MC T3	MC Total	WCCC T1	WCCC T2	WCCC T3	WCCC Total	Other Sites
Andrena wilkella	1	0	1	0	1	0	0	0	0	0	0	0	0	0
Anthidiellum notatum notatum	1	0	0	0	0	0	0	0	0	0	0	1	1	0
Anthidium manicatum	6	0	0	0	0	2	0	1	3	0	2	0	2	1
Anthidium oblongatum	40	0	0	0	0	7	13	5	25	0	11	3	14	1
Anthophora terminalis	1	1	0	0	1	0	0	0	0	0	0	0	0	0
Apis mellifera	147	5	10	4	19	21	41	27	89	15	11	10	36	3
Augochlora pura	49	6	22	2	30	2	2	3	7	2	7	3	12	0
Augochlorella aurata	16	0	0	0	0	0	0	1	1	1	7	7	15	0
Augochloropsis metallica	7	0	1	0	1	1	1	1	3	1	1	1	3	0
Bombus auricomus	2	0	0	0	0	0	0	1	1	0	0	0	0	1
Bombus bimaculatus	15	6	1	0	7	2	1	2	5	0	1	1	2	1
Bombus griseocollis	4	0	0	0	0	0	4	0	4	0	0	0	0	0
Bombus impatiens	20	0	0	0	0	7	3	2	12	0	3	3	6	2
Bombus perplexus	3	1	0	0	1	0	1	1	2	0	0	0	0	0
Bombus vagans	2	0	0	0	0	1	1	0	2	0	0	0	0	0
Calliopsis andreniformis	95	2	2	0	4	0	3	3	6	0	16	69	85	0
Ceratina calcarata	169	7	64	15	86	38	5	5	48	11	5	19	35	0
Ceratina dupla	38	2	7	8	17	3	0	1	4	1	7	9	17	0
Ceratina mikmaqi	97	5	26	21	52	4	0	1	5	3	14	23	40	0
Ceratina sp.	5	0	3	0	3	1	0	0	1	0	0	1	1	0
Ceratina strenua	396	7	115	27	149	26	17	23	66	22	25	134	181	0
Chelostoma philadelphi	1	0	0	0	0	1	0	0	1	0	0	0	0	0

Species	Total	BFS T1	BFS T2	BFS T3	BFS Total	MC T1	MC T2	MC T3	MC Total	WCCC T1	WCCC T2	WCCC T3	WCCC Total	Other Sites
Coelioxys sayi	1	0	0	0	0	0	0	1	1	0	0	0	0	0
Coelioxys sayi/ octodenata	1	0	0	0	0	1	0	0	1	0	0	0	0	0
Colletes inaequalis	3	0	1	0	1	0	0	1	1	0	0	0	0	1
Colletes simulans	1	0	0	1	1	0	0	0	0	0	0	0	0	0
Eucera atriventris	15	3	0	1	4	2	1	3	6	2	0	3	5	0
Eucera dubitata	3	0	2	0	2	0	0	1	1	0	0	0	0	0
Eucera hamata	3	0	1	0	1	0	0	1	1	1	0	0	1	0
Eucera sp.	1	0	0	1	1	0	0	0	0	0	0	0	0	0
Halictus confusus	23	0	0	0	0	7	10	4	21	0	0	0	0	2
Halictus ligatus	76	2	7	1	10	11	3	6	20	8	15	23	46	0
Halictus rubicundus	9	1	2	0	3	1	1	0	2	2	2	0	4	0
Halictus sp.	2	0	0	0	0	2	0	0	2	0	0	0	0	0
Heriades leavitti/ variolosa	2	0	2	0	2	0	0	0	0	0	0	0	0	0
Holcopasites calliopsidis	2	0	0	0	0	0	0	0	0	0	0	2	2	0
Hoplitis pilosifrons	8	0	0	0	0	1	0	0	1	0	2	5	7	0
Hoplitis producta	22	4	3	4	11	6	0	2	8	0	2	1	3	0
Hoplitis spoliata	1	0	0	0	0	0	0	1	1	0	0	0	0	0
Hylaeus affinis/ modestus	27	3	5	2	10	4	2	1	7	0	6	4	10	0
Hylaeus hyalinatus	1	0	0	0	0	1	0	0	1	0	0	0	0	0
Hylaeus leptocephalus	2	0	0	0	0	2	0	0	2	0	0	0	0	0
Hylaeus mesillae	3	0	0	0	0	1	1	0	2	0	0	1	1	0
Hylaeus sp.	1	0	0	0	0	0	0	0	0	0	0	1	1	0

Species	Total	BFS T1	BFS T2	BFS T3	BFS Total	MC T1	MC T2	MC T3	MC Total	WCCC T1	WCCC T2	WCCC T3	WCCC Total	Other Sites
Lasioglossum admirandum	2	0	0	0	0	2	0	0	2	0	0	0	0	0
Lasioglossum bruneri	4	0	0	0	0	2	2	0	4	0	0	0	0	0
Lasioglossum cattallae	2	0	0	0	0	0	1	0	1	0	1	0	1	0
Lasioglossum coriaceum	6	0	0	0	0	2	0	1	3	0	0	3	3	0
Lasioglossum cressonii	5	2	0	1	3	0	0	0	0	0	1	1	2	0
Lasioglossum ephialtum	6	0	0	0	0	4	1	0	5	1	0	0	1	0
Lasioglossum foxii	1	0	0	0	0	1	0	0	1	0	0	0	0	0
Lasioglossum fuscipenne	2	0	1	0	1	0	0	0	0	1	0	0	1	0
Lasioglossum gotham	10	1	0	0	1	1	4	1	6	1	0	2	3	0
Lasioglossum hitchensi	52	1	5	1	7	10	11	10	31	3	5	6	14	0
Lasioglossum imitatum	21	0	1	0	1	9	6	5	20	0	0	0	0	0
Lasioglossum katherineae	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Lasioglossum obscurum	3	0	0	0	0	2	1	0	3	0	0	0	0	0
Lasioglossum para-admirandum	1	1	0	0	1	0	0	0	0	0	0	0	0	0
Lasioglossum quebecense	3	0	1	0	1	0	0	0	0	1	0	1	2	0
Lasioglossum sp.	76	3	9	2	14	20	6	7	33	5	11	9	25	4
Lasioglossum subviridatum	10	0	3	1	4	1	0	0	1	2	2	1	5	0
Lasioglossum tegulare	3	0	0	0	0	1	0	1	2	0	0	1	1	0
Lasioglossum truncatum	2	0	0	0	0	0	0	1	1	0	0	1	1	0
Lasioglossum versans	1	1	0	0	1	0	0	0	0	0	0	0	0	0
Lasioglossum versatum	202	4	34	12	50	8	9	1	18	34	49	51	134	0
Megachile brevis	2	0	0	0	0	0	0	0	0	0	1	1	2	0

Species	Total	BFS T1	BFS T2	BFS T3	BFS Total	MC T1	MC T2	MC T3	MC Total	WCCC T1	WCCC T2	WCCC T3	WCCC Total	Other Sites
Megachile campanulae	2	0	0	0	0	0	0	0	0	0	1	1	2	0
Megachile centuncularis	1	0	0	0	0	0	0	0	0	0	0	1	1	0
Megachile inimica sayi	1	0	0	1	1	0	0	0	0	0	0	0	0	0
Megachile mendica	6	0	0	0	0	0	2	2	4	1	1	0	2	0
Megachile montivaga	1	0	0	0	0	0	0	0	0	0	1	0	1	0
Megachile petulans	1	0	0	0	0	0	0	0	0	0	0	1	1	0
Megachile rotundata	37	0	0	0	0	13	15	5	33	1	0	2	3	1
Megachile sp.	2	0	0	0	0	0	0	0	0	1	1	0	2	0
Melecta pacifica	1	0	0	0	0	0	0	0	0	0	0	1	1	0
Melissodes bimaculatus	15	2	2	0	4	3	2	3	8	1	0	1	2	1
Melissodes coloradensis	1	0	1	0	1	0	0	0	0	0	0	0	0	0
Melissodes denticulata	13	2	6	0	8	0	0	0	0	1	3	1	5	0
Melissodes desponsa	7	0	1	1	2	0	1	0	1	1	2	1	4	0
Melissodes druriella	2	0	0	0	0	0	1	0	1	0	1	0	1	0
Melissodes sp.	2	0	0	2	2	0	0	0	0	0	0	0	0	0
Melitoma taurea	15	4	6	0	10	1	0	2	3	1	0	1	2	0
Nomada (Bidentate)	15	0	2	0	2	1	3	1	5	4	1	3	8	0
Nomada annulata	1	0	0	0	0	0	0	0	0	0	0	1	1	0
Nomada articulata	4	0	0	0	0	3	0	1	4	0	0	0	0	0
Nomada cressonii	1	0	0	0	0	1	0	0	1	0	0	0	0	0
Nomada denticulata	2	1	0	0	1	0	0	0	0	0	1	0	1	0
Nomada depressa	1	0	0	0	0	0	0	0	0	0	0	1	1	0
Nomada fervida	1	0	1	0	1	0	0	0	0	0	0	0	0	0

Species	Total	BFS T1	BFS T2	BFS T3	BFS Total	MC T1	MC T2	MC T3	MC Total	WCCC T1	WCCC T2	WCCC T3	WCCC Total	Other Sites
Nomada imbricata	18	0	2	0	2	0	2	0	2	3	4	7	14	0
Nomada luteola	1	0	0	0	0	0	0	0	0	1	0	0	1	0
Nomada luteoloides	4	0	0	0	0	0	1	0	1	1	0	2	3	0
Nomada parva	3	0	0	0	0	0	0	1	1	1	0	1	2	0
Nomada pygmaea	7	0	1	0	1	1	0	1	2	3	0	1	4	0
Nomada sp.	1	1	0	0	1	0	0	0	0	0	0	0	0	0
Osmia atriventris	7	0	0	0	0	2	1	1	4	0	2	1	3	0
Osmia bucephala	17	6	1	2	9	2	1	0	3	0	1	4	5	0
Osmia caerulescens/ cordata	5	0	0	0	0	2	0	0	2	2	0	1	3	0
Osmia collinsiae	3	0	0	0	0	0	0	0	0	2	0	1	3	0
Osmia cordata	18	0	0	1	1	10	1	2	13	2	1	1	4	0
Osmia cornifrons	3	0	0	0	0	0	0	1	1	1	0	1	2	0
Osmia distincta	4	0	0	0	0	0	0	1	1	1	2	0	3	0
Osmia georgica	15	2	2	2	6	3	1	0	4	2	0	3	5	0
Osmia inspergens	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Osmia pumila	9	0	2	1	3	0	0	0	0	1	2	3	6	0
Osmia sp.	21	1	1	0	2	7	0	1	8	5	3	3	11	0
Osmia subfasciata	1	0	0	0	0	0	0	0	0	0	0	1	1	0
Osmia taurus	12	1	0	1	2	0	1	2	3	3	0	2	5	2
Panurginus potentillae	3	0	0	0	0	0	0	0	0	0	0	3	3	0
Peponapis pruinosa	4	0	0	0	0	1	1	0	2	0	1	1	2	0
Ptilothrix bombiformis	11	0	0	0	0	2	4	2	8	1	1	1	3	0

Species	Total	BFS T1	BFS T2	BFS T3	BFS Total	MC T1	MC T2	MC T3	MC Total	WCCC T1	WCCC T2	WCCC T3	WCCC Total	Other Sites
Sphecodes coronus	1	0	0	0	0	0	0	0	0	0	0	1	1	0
Stelis lateralis	1	0	0	0	0	0	0	0	0	0	1	0	1	0
Stelis nitida	1	1	0	0	1	0	0	0	0	0	0	0	0	0
Triepeolus cressonii?	1	0	0	0	0	0	0	0	0	0	1	0	1	0
Xylocopa virginica	4	0	0	0	0	0	0	0	0	0	0	1	1	3
SUM	2753				995				760				972	26

Literature Cited

Arduser, M. 2010. Bees (Hymenoptera: Apoidea) of the Kitty Todd Preserve, Lucas County, Ohio. Great Lakes Entomologist 43: 45-68.

Bernhardt, C. E., Mitchell, R. J., and Michaels, H. E. 2008. Effects of population size and density on pollinator visitation, pollinator behavior, and pollen tube abundance in *Lupinus perennis*. International Journal of Plant Sciences 169: 944-953.

Brown, J. F., and Paxton, R. J. 2009. The conservation of bees: a global perspective. Apidologie 40: 410-416.

Burkle, L. A., Marlin, J. C., and Knight, T. M. 2013. Plant-pollinator interactions over 120 years: loss of species, co-occurrence, and function. Science 339: 1611-1615.

Cusser, S., and Goodell, K. 2013. Diversity and distribution of floral resources influence the restoration of plant-pollinator networks on a reclaimed strip mine. Restoration Ecology 21: 713-721.

Droege, S. 2012. The very handy manual: how to catch and identify bees and manage a collection. USGS Native Bee Inventory and Monitoring Lab.

Droege, S., Jean, R., and Orr, M. 2013. Discover Life ID nature guide (draft): bee genera of Eastern North America (Hymenoptera: Apoidea: Anthophila). Available from http://www.discoverlife.org/mp/20q?search=Apoidea

Iler, A. M., and Goodell, K. 2014. Relative floral density of an invasive plant affects pollinator foraging behavior on a native plant. Journal of Pollination Ecology 13: 173-183.

Gardner, K. E., and Ascher, J. S. 2006. Notes on the native bee pollinators in New York apple orchards. Journal of New York Entomological Society 114: 86-91.

Gibbs, J. 2011. Revision of the metallic *Lasioglossum* (*Dialictus*) of eastern North America (Hymenoptera: Halictidae: Halictini). Zootaxa 3073: 1-216.

Giles, V., and Ascher, J. S. 2006. A survey of the bees of the Black Rock Forest Preserve, New York. Journal of Hymenoptera Research 15: 208-231.

Goodell, K., McKinney, A. M., and Lin, C. H. 2010. Pollen limitation and local habitat-dependent pollinator interactions in the invasive shrub *Lonicera maackii*. International Journal of Plant Sciences 171: 63-72.

Grundel, R., Jean, R. P., Frohnapple, K. J., Gibbs, J., Glowacki, G. A., and Pavlovic, N. B. 2011. A survey of bees (Hymenoptera: Apoidea) of the Indiana Dunes and Northwest Indiana, USA. Journal of the Kansas Entomological Society 84: 105-138.

Hinojosa-Diaz, I. A., Gonzalez, V. H., Ayala, R., Merida, J., Sagot, P., and Engel, M. S. 2012. New orchid and leaf-cutter bee gynandromorphs, with an updated review (Hymenoptera: Apoidea). Zoosytematics and Evolution 88(2): 205–214.

Kalhorn, K. D., Barrows, E. M., and LaBerge, W. E. 2003. Bee (Hymenoptera: Apoidea: Apiformes) diversity in an Appalachian shale barrens. Journal of the Kansas Entomological Society 76: 455-468.

Kearns, C. A., and Inouye, D. W. 1993. Techniques for pollination biologists. University Press of Colorado, Boulder, CO. 583 pp.

Michener, C. D., McGinley, R. J., and Danforth, B. N. 1994. The bee genera of North and Central America (Hymenoptera: Apoidea). Smithsonian Institution Press, Washington. 304 p.

Michez, D., Rasmont, P., Terzo, M., and Vereecken, N. J. 2009. A synthesis of gynandromorphy among wild bees (Hymenoptera: Apoidea), with an annotated description of several new cases. Annales de la Société entomologique de

France (N.S.): International Journal of Entomology 45: 365-375.
Mitchell, T. B. 1960. Bees of the Eastern United States. Vol I. Technical bulletin. North Carolina Agricultural Experiment Station 141: 1-538.
Mitchell, T. B. 1962. Bees of the Eastern United States. Vol II. Technical bulletin. North Carolina Agricultural Experiment Station 152: 1-557.
Pardee, G. L., and Philpott, S. M. 2014. Native plants are the bee's knees: local and landscape predictors of bee richness and abundance in backyard gardens. Urban Ecosystems 17: 641-659.
Phillips, B. W., and Gardiner, M. M. 2015. Use of video surveillance to measure the influences of habitat management and landscape composition on pollinator visitation and pollen deposition in pumpkin (*Cucurbita pepo*) agroecosystems. PeerJ. 3:e1342.
Reese, C. S. L., and Barrows, E. M. 1980. Co-evolution of *Claytonia virginica* (Portulacaceae) and its main native pollinator, *Andrena erigeniae* (Andrenidae). Proceedings of the Entomological Society of Washington 82: 685-694.
Robertson, C. 1929. Flowers and insects. Science Press. Lancaster, PA.
Russell, K. N., Ikerd, I., and Droege S. 2005. The potential conservation value of unmowed powerline strips for native bees. Biological Conservation 124: 133-148.
Russo, L., Park, M., Gibbs, J., and Danforth, B. 2015. The challenge of accurately documenting bee species richness in agroecosystems: bee diversity in eastern apple orchards. Ecology and Evolution 5: 3531-3540.
Simpson, E. H. 1949. Measurement of diversity. Nature 163: 688.
Spring, M. R., Lustofin, K. S., and Gardiner, M. M. 2015. Occurrence of a gynandromophic *Bombus bimaculatus* (Hymenoptera: Apidae) in Southeastern Ohio. The Great Lakes Entomologist 48: 155-163.
Stephen, W. P., and Rao, S. 2005. Unscented color traps for non-*Apis* bees (Hymenoptera: Apiformes). Journal of the Kansas Entomological Society 78: 373-380.
Todd, K. J., Gardiner, M. M., and Lindquist, E. D. 2016. Mass flowering crops as a conservation resource for wild pollinators (Hymenoptera: Apoidea). Journal of Kansas Entomological Society 89(2): 158-167.
Tucker, E. M., and Rehan, S. 2016. Wild bee pollination networks in northern New England. Journal of Insect Conservation 20: 325-337.
Tuell, J. K., Ascher, J. S., and Isaacs, R. 2009. Wild bees (Hymenoptera: Apoidea: Anthophila) of the Michigan highbush blueberry agroecosystem. Annals of the Entomological Society of America. 102: 275-287.

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A Bilateral Gynandromorph Northern Cardinal from South Bass Island

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Abstract: We report on a Northern Cardinal from South Bass Island, in the western basin of Lake Erie, which showed male plumage characteristics on the right side and female plumage characteristics on the left side. This condition, termed bilateral gynandromorphism, is rare among wild birds, and there are few (<100) preserved specimens available for research. This bird had a slightly enlarged ovary on the left side and a small and probably non-functional testis on the right side. The plumage was fairly well demarcated between the two sides, but the female side was interspersed with red feathers and the male side was interspersed with brown. A recent study of gynandromorph domestic chickens provides a likely pathway for the origin and appearance of these Northern Cardinals. We suggest that a recent spate of records is probably due to increasing numbers of observant birdwatchers as well as the ubiquity of digital cameras.

Keywords: *Cardinalis cardinalis*, bilateral gynandromorph, plumage

Introduction

Gynandromorphy is a rarely encountered condition in which an organism displays a combination of male and female characteristics. This condition may be bilateral, with one half of the organism phenotypically male and the other half phenotypically female, often with a clear line separating the two sides. Individuals with this condition are known across multiple classes of Metazoans, and individuals with this condition have been documented in both captive fowl as well as wild birds (Kumerloeve 1954). Kumerloeve (1954) conducted a review of this condition and the mechanisms that may underlie it, and documented several dozen instances in wild birds. Patten (1993) updated this review, and several additional records have been published since then (e.g., DaCosta et al. 2007, Peer and Motz 2014). No formal systematic review of gynandromorphism records has been conducted, but there are certainly more than fifty published examples as of this writing. Wild birds with gynandromorphism have been documented in many taxonomic orders and families across Aves, though there are multiple reports of gynandromorphy in Eurasian Bullfinch (*Pyrrhula pyrrhula*) and Evening Grosbeak (*Coccothraustes vespertinus*), two members of the Fringillidae family. Published records are an underrepresentation of the prevalence of this condition, as any species without obvious size or plumage-related sex differences could only be documented through dissection by a knowledgeable museum specimen preparator.

In this article, we document a bilateral gynandromorph Northern Cardinal (*Cardinalis cardinalis*) from South Bass Island, Ottawa County, Ohio.

Specimen Data

Bartlett operates a banding station for several weeks every spring and fall on private property on the east end of South Bass Island, in the western basin of Lake Erie (Ottawa County, Ohio, USA: 41.66239°N, 82.79624°W). While banding on 01 May 2011, Bartlett and Jones encountered an unusual Northern Cardinal. The bird was initially identified as a female with an unusual molt pattern; Bartlett has encountered other female Northern Cardinals with excessive red presumably due to age and/or eccentric molt. Further examination demonstrated that the red coloration was primarily restricted to the right side of the bird, and there was a fairly sharp color demarcation down the middle of the bird's body. Jones made the decision to collect the bird, and the specimen was transferred to the ornithology research collection at the Cleveland Museum of Natural History.

Jones prepared the bird specimen (collector number AWJ 596, and cataloged as CMNH 74623). The bird weighed 43.1 g. There was a little molt on this bird, which is unusual for a Northern Cardinal in May (like most songbirds, they typically do not molt during the early part of the breeding season): several feathers on the right breast were being replaced, the left innermost tail

feather (R1) was being replaced and was about 80% grown, and the right innermost tail feather was missing. There was no cloacal protuberance nor brood patch, suggesting that this bird was unpaired. The wing chord of both wings was 91mm, which is within the size range of both male and female Northern Cardinals (Pyle 1997). During dissection, Jones found an ovary on the bird's left side that measured 8 × 5 mm, with the largest ovum 2 mm in diameter, and with a slightly enlarged oviduct. On the right side, an apparent testis was found, but it was small (for this time of year; 2 × 1 mm) and black in color, indicating that it may not have been functional.

The bird's plumage differs between the left and right sides most sharply on the ventral side, with a sharp demarcation on the breast, belly, and undertail coverts (Figure 1). The right side is red, though not nearly as bright red as a typical male, and interspersed with several partly or completely brown feathers. The left side is the same color of brown as a typical female, interspersed with a few red feathers. The head plumage is consistent with a female: dusky rather than solid black feathers surrounding the bill, brownish-gray feathers with a red crest, but with scattered red feathers on the face on the right side. The back is also consistent with a female, with brownish-gray feathers across the nape, mantle, scapulars, and uppertail coverts, but interspersed with some red feathers on the right side. The left tail feathers have dusky tips on the underside and dusky outer margins; the right tail feathers are almost entirely red.

Figure 1. Ventral view of a specimen (CMNH 74623) of a bilateral gynandromorph Northern Cardinal. The red plumage on the bird's right side is not as fully red as a typical male Northern Cardinal. The bird is not perfectly bilaterally symmetrical; there are female-like feathers on the male side, and male-like feathers on the female side.

Discussion

This Northern Cardinal specimen is the third record of gynandromorphy in this species in the peer-reviewed literature. Laskey (1954) banded one in central Tennessee. Like our report, it was male on the right side, but she noted that hers had brilliant red feathers rather than the dull red we observed. Her record was otherwise similar to ours, with a sharp demarcation line on the underside, and a female-like head. Peer and Motz (2014) observed a gynandromorph which was male on the left side. It had brilliant red feathers on the left side. Despite being observed throughout the breeding season, the bird did not pair with another bird. Playback experiments were conducted, and the bird changed its posture and awareness in response to the song of another Northern Cardinal, but did not sing. Other Northern Cardinals did not show any noticeable behavior such as aggression towards the gynandromorph.

We are also aware of several putative records of gynandromorph Northern Cardinals that have been circulated on various internet websites, with photographs. Some of these individuals appear to be gray rather than brown over part of the body, suggesting a pigment abnormality rather than gynandromorphism. However, we have also seen photographs of a bird from Virginia that closely resembles our bird (https://www.flickr.com/photos/birdsofvirginia/3370349942/). A newsletter article (Bohlen 2006) reported on two records from Illinois. One was accompanied by a series of photographs and indicated that the

bird was seen singing, was seen carrying nesting material, and was socially associating with a female. Overall, there have been perhaps six records of Northern Cardinal gynandromorphs, and five of these have been in the last two decades. We attribute this to an increase in the number of active birdwatchers, increasing access to digital cameras and cell phones to document these birds, and an improved ability to communicate these sightings through the Internet.

Including the present study, four of the five verifiable bilateral gynandromorph Northern Cardinals were male-plumaged on the right side. This is the typical condition for bilateral gynandromorphs in other birds as well; in birds, the females typically only develop an ovary on the left side (Kumerloeve 1954). However, some gynandromorphs have an ovary on the left and a testis on the right, yet the plumage sides are reversed from the gonads (e.g., DaCosta et al. 2007). Most of these Northern Cardinal records include scattered red feathers on the female side, and brown feathers on the male side. Plumage differences between the two sides are often imperfect in gynandromorphs, and this may be related to the mechanism causing the condition. The genetic basis underlying gynandromorphism is not completely understood. Graves (1996) reviewed variations on the symmetry of gynandromorphs and indicated that there may be multiple pathways to this condition. Zhao et al. (2010) examined three gynandromorphic domestic chickens (*Gallus gallus*) from a genetic and cellular perspective and demonstrated that those individuals were male-female chimaeras; some cells have ZW sex chromosomes typical of females, and other cells have ZZ sex chromosomes typical of males. Most of the cells on the male-plumaged side were ZZ, and most of the cells on the female-plumaged side were ZW. As a result of the incomplete sorting of male and female cells between the two sides, the chickens they studied had feathers on each side that corresponded to the opposite sex. This mechanism likely explains why the Northern Cardinals in this and other reports tend to have imperfect plumage symmetry. The gynandromorphs studied by Zhao et al. (2010) probably result from an error in oogenesis in the mother of the gynandromorph, resulting into two nuclei in the fertilized ovary. It is unclear if this explanation is universal to all gynandromorphs, and we encourage further collection and study of wild and domestic birds with this condition. We suggest that researchers should preserve extensive tissue samples, including freezing or formalin preserving of the entire body and sectioning the gonads to ascertain their functionality.

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Literature Cited

Bohlen, H. D. 2006. Illinois sightings of bilateral gynandromorphism in birds. The Living Museum 68:15-16.

DaCosta, J. M., Spellman, G. M., and Klicka, J. 2007. Bilateral gynandromorphy in a White-ruffed Manakin (*Corapipo altera*). The Wilson Journal of Ornithology 119:289-291.

Graves, G. R. 1996. Comments on a probable gynandromorphic Black-Throated Blue Warbler. Wilson Bulletin 108:178-180.

Kumerloeve, H. 1954. On gynandromorphism in birds. Emu 54:71-72.

Laskey, A. R. Bilateral gynandrism in a Cardinal and a Rufous-Sided Towhee. The Auk 86:760.

Patten, M. A. 1993. A probable bilateral gynandromorphic Black-Throated Blue Warbler. Wilson Bulletin 105:695-698.

Peer, B. D. and Motz, R. W. 2014. Observations of a bilateral gynandromorph Northern Cardinal (*Cardinalis cardinalis*). The Wilson Journal of Ornithology 126:778-781.

Pyle, P. 1997. Identification guide to North American birds: Part I. Slate Creek Press, Bolinas, California.

Zhao, D., McBride, D., Nandi, S., McQueen, H. A., McGrew, M. J., Hocking, P. M., Lewis, P. D., Sang, H. M., and Clinton. M. 2010. Somatic sex identity is cell autonomous in the chicken. Nature 464: 237-243.

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A Survey of the Turtles of Mentor Marsh, Lake County, Ohio

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Abstract: Turtle trapping records and observations from 1979–2016 were compiled to survey the turtles of Mentor Marsh, Lake County, Ohio. Six species of turtles were previously known to occur in Mentor Marsh prior to 2016. Two species of turtles known from the marsh since the 1930s, *Emydoidea blandingii* and *Clemmys gutatta*, were not observed or trapped. *Sternotherus odoratus* (Eastern Musk Turtle) was recorded for the first time from Mentor Marsh and is a new Grand River drainage system record.

Keywords: Mentor Marsh, salt intrusions, *Emydoidea blandingii*, *Clemmys gutatta*, *Sternotherus odoratus*

Introduction

Mentor Marsh is a large coastal wetland positioned at the mouth of the old Grand River at Lake Erie in Lake County, Ohio. It became a national natural landmark in 1966 and was dedicated as Ohio's first state nature preserve in 1971. Ownership of the marshlands is shared by the state of Ohio, the City of Mentor, the Cleveland Museum of Natural History, and by private land owners. The marsh occupies the old Grand River channel and its floodplain (Bolsenga and Herdendorf 1993) and includes nearly 868 acres (361 hectares; Fineran 2003) on the Lake Erie Plains (Brockman 2002; White 1980). The marsh is about 6.9 km (4.3 miles) long and approaches 0.8 km (0.5 miles) in width at the widest points and has a perimeter of approximately 20 km (12.5 miles). Two tributary streams flow into the marsh from the south: Marsh Creek enters into the western basin, and Black Brook enters into the eastern basin (Figure 1).

The Grand River formerly meandered northward over the lake plain of low relief to within 0.5 km of Lake Erie before turning westward paralleling the shoreline of the lake. It entered Lake Erie at what is now Mentor Harbor (also referred to as Mentor Marina/Mentor Lagoons). At some time following the formation of modern Lake Erie (approximately 4000 years BCE) and before 1796 when the marsh was first surveyed (Holley 1796; Pease 1796), an event occurred where the river breached through its north bank and connected with the lake at Fairport Harbor. Water flow to the west of the cut-off was diminished, and over time, a diverse mosaic of wetland communities became established in the relict Grand River channel while swamp forests developed upon its flood plain (Bolsenga and Herdendorf 1993).

Available riverine and wetland habitats have been conducive to support several species of turtles. Records and distribution maps of Conant (1951) and Zemko (1974) included four species of turtles for Mentor Marsh. The records included *Chelydra serpentina (*Snapping Turtle), *Chrysemys picta marginata* (Midland Painted Turtle), *Emydoidea blandingii* (Blanding's Turtle), and *Clemmys guttata* (Spotted Turtle). Two of these species are of particular interest: the Blanding's Turtle and the Spotted Turtle have been designated as threatened by the Ohio Department of Natural Resources Division of Wildlife (2016). The first records for these two species from Mentor Marsh include *Clemmys guttata*, collected on 11 July 1931 by Roger Conant and Cecil Murphy (American Museum of Natural History reptile number 120799, formerly Toledo Zoological Society number 541), and *Emydoidea blandingii*, collected on 11 July 1931 by Cecil Murphy (AMNH 120821, formerly TZS 542). Both of these specimens were collected on the "West end of Mentor Marsh." It remains unclear whether the "West end of Mentor Marsh" refers to the eastern portion of the western basin (Figure 1) or to the western portion nearer the mouth of Mentor Harbor. While at the edge of Mentor Marsh (presumably on this date), Conant in 1982 related his observations of seeing numerous yellow spots at the water's surface. Binoculars enabled them to identify the spots as yellow throats of Blanding's Turtle. Conant wrote, "We had never seen so many in one place." A second *Emydoidea blandingii* was collected on 16 June 1932 by Lawrence E. Hicks (Ohio State University Museum reptile number 877, formerly Hicks R420-1) at "Black Run Swamp." Black Run Swamp probably refers to the southeastern portion of the marsh, where Black Brook enters the marsh and becomes broadly

distributary, having no central channel (Isard 1966; Bernstein 1981; Whipple 1999). During the 1930s, the eastern part of the marsh was relatively open with cattails and nightshades, while buttonbush and alders formed dense stands of shrub growth. By 1951, the succession of swamp forest plant community had mostly replaced the open cattail-nightshade marsh community (Isard 1966; Whipple 1999).

In 1959, intrusion of salt (sodium chloride) from the salt dump of salt mining tailings very near Black Brook in the southeastern corner of Mentor Marsh greatly elevated the salt concentration in the marsh and caused a die-off of native vegetation in the marsh and swamp forests (Isard 1966, 1967; NOACA 1983). Salt has persisted in the system and continues to pollute the marsh and has led to the establishment, proliferation, and vegetative dominance of *Phragmites australis* (common reed grass). This perturbation of the marsh in concert with human development and resultant fires have altered the marsh landscape (Bernstein 1981; Fineran 2003; Isard 1967; Whipple 1999) to the point that it may no longer support Blanding's and/or Spotted Turtles. Purposes of the project were to survey the turtles of Mentor Marsh and, more specifically, to search for the continued presence of Blanding's and Spotted Turtles.

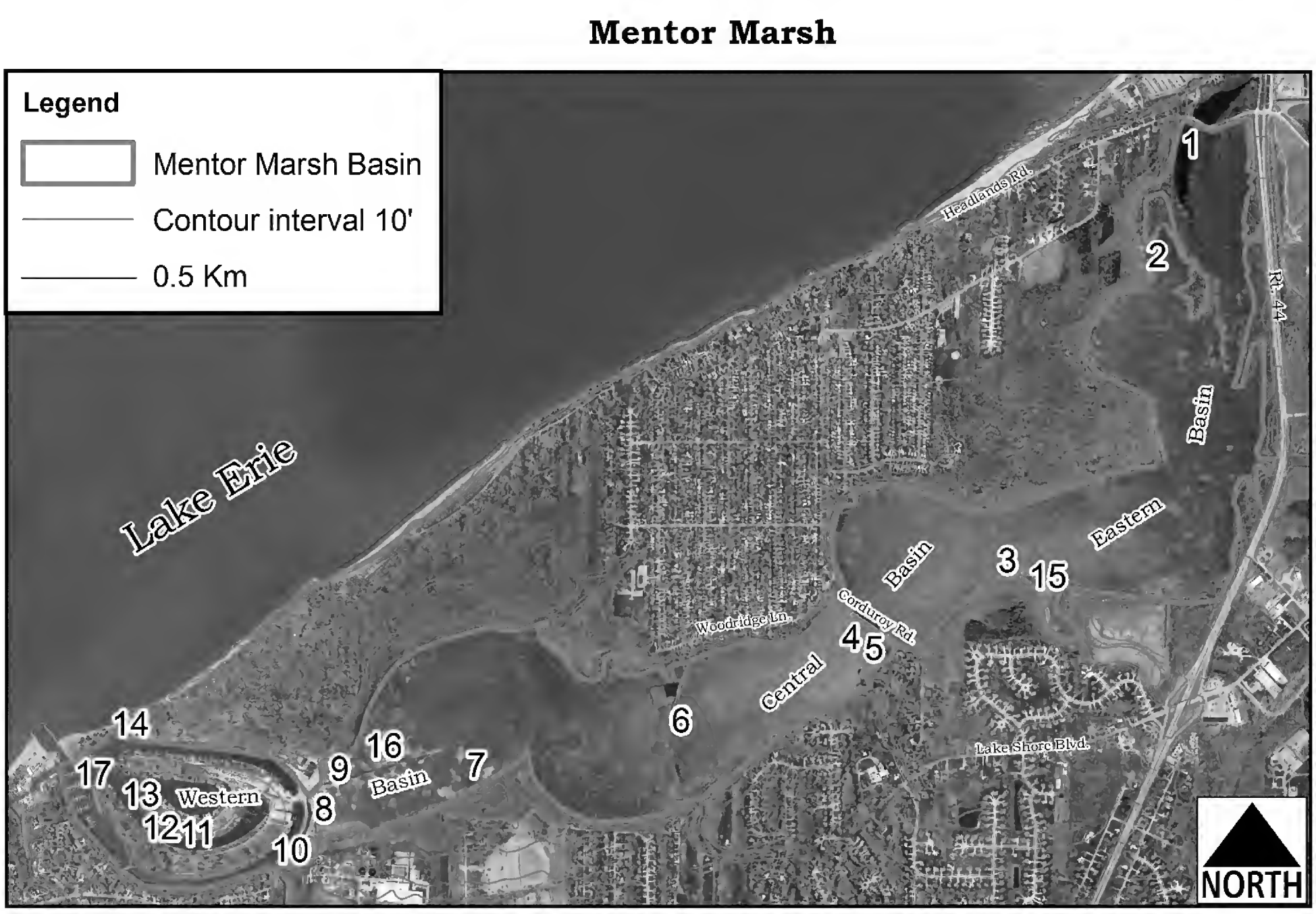

Figure 1. Map of the Mentor Marsh area showing the basin outline and site locations.

Methods

Recent surveys and records of visual observations of the turtles of Mentor Marsh have been ongoing since 1979, when one of us (TOM) began vertebrate surveys of fishes, amphibians, reptiles, and mammals of the marsh. Turtle captures were also recorded marsh-wide during seining operations and during the deployment of turtle traps and fyke nets while conducting a fish survey for the Northeast Ohio Areawide Coordinating Agency (NOACA) in 1981 and 1982 (Matson 1983). A survey specifically for turtles was conducted during the summer of 2016 and was focused on the Mentor Harbor, Marsh Creek, and Becker Pond areas (Figure 1; sites 7–14) on the western end of the marsh and on the Shipman Pond area (sites 1–2) at the eastern end. Figure 1 diagrammatically represents where sites in the marsh were located; names of those sites and their respective geographical coordinates are presented in Table 1. These two areas of the marsh were selected because they are

the areas approximating where earlier records of *Emydoidea blandingii* and *Clemmys guttata* occurred and where suitable habitat may still occur. The section south of Shipman Pond (Figure 1, site 2) was trapped for small mammals during 1979; one *Clemmys guttata* was captured in a pitfall trap on 25 July 1979 and was released at the site of capture (Matson, unpublished data). All specimens collected, salvaged, or photo-vouchered were deposited in the herpetology and ichthyology collections of the Cleveland Museum of Natural History.

Seines used in the surveys had lengths of 6, 12, and 25 feet with 3/16-inch mesh; all had depths of 4 feet. Fyke nets had 3-foot hoops and two 25-foot wings with one-inch mesh. Turtle traps had hoop diameters of 2.5, 3, and 4 feet, all with one-inch square mesh.

Scientific and common names used in this publication are those in Crother (2012).

Table 1. Site locations in Mentor Marsh where turtle traps were positioned or observations of turtles were recorded over the period 1979–2016. Site 15 is approximate for 1932 Black Brook site.

Site Number	Site Name	Latitude (N)	Longitude (W)
1	Shipman Pond	41°45'08"	81°17'31"
2	Shipman Pond SW	41°44'37"	81°17'47"
3	Kervin North	41°44'08"	81°18'08"
4	Corduroy Road	41°43;58"	81°18'35"
5	SW Corduroy Road	41°43'55"	81°18'30"
6	Wake Robin Trail	41°43'45"	81°19'05"
7	Becker Pond	41°43'34"	81°19'48"
8	Marsh Creek Bridge	41°43'28"	81°20'18"
9	Canal zone	41°43'27"	81°20'16"
10	Dock E East	41°43'24"	81°20'23"
11	Dock D/1	41°43'25"	81°20'40"
12	Dock D/2	41°43'27"	81°20'47"
13	Dock D/Tip	41°43'31"	81°20'50"
14	Dock A	41°43'41"	81°20'53"
15	Blackbrook Mouth[2]	41°44'	81°17'
16	Spetz site	41°43'37"	81°20'16"
17	Near mouth of Mentor Harbor	41°43'37"	81°20'59.1"

[2]available data do not pemit greater coordinate accuracy.

Results

During the 2016 trap survey, 74 trap-nights were accumulated (all turtle traps). From 1980–1982, 18 trap-nights using turtle hoop nets and fyke nets were deployed to capture both turtles and fish. Fyke nets were very effective in capturing turtles at some sites. For example, on 1 May 1982 two fyke nets placed at site 1, Shipman Pond, captured 12 *Chelydra serpentina* and 71 *Chrysemys picta marginata*.

Four species of turtles were trapped during 2016 (Table 2). *Trachemys scripta elegans* (Red-eared Slider) was first recorded for the marsh by James Spetz in May 2011 at a site in the western basin north of site 9 (CMNH 14202, James Spetz photo; Figure 1, site 16). We trapped five adult individuals and observed one juvenile in Mentor Harbor of the western basin (Table 2; 1 turtle vouchered, CMNH 14543). This species was also sighted at site 6 on 12 October 2016 (CMNH 14544; Nanette Patrick photo) and in the eastern basin at site 1 on 22 June 2016 (Owen Lockhart, pers. comm.).

Sternotherus odoratus (Eastern Musk Turtle; 1 individual) was recorded for the first time from Mentor Marsh on 15 July 2016 at site 10 (CMNH 14545); two additional musk turtles were trapped on 4 August, one each at sites 8 and 9.

Chelydra serpentina and *Chrysemys picta marginata* were widely distributed throughout the marsh (Figure 1 and Table 2).

The first documented record of *Graptemys geographica* (Eastern Map Turtle; 1 individual) in Mentor Marsh was captured in a fyke net at site 8 and released in August 1981 (Matson, unpublished data). On 1 July 2014, a specimen was trapped in Mentor Harbor (CMNH 14330; James Spetz photo). Map turtles were observed near the mouth of Mentor Harbor in 2015 near site 17 (CMNH 14530; Jake Kudna photo). No map turtles were trapped or observed during our 2016 survey.

There have been no additional records for *Emydoidea blandingii* since the 1930s or for *Clemmys guttata* since 1979.

Table 2. Species of turtles recorded from Mentor Marsh, Lake County, Ohio, and the sites at which they were detected. [2]indicates that the species is threatened within the state of Ohio (ODNR Division of Wildlife 2016).

Species Name / Site Numbers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Family Chelydridae																	
Chelydra serpentina Snapping Turtle	•			•	•	•	•	•		•	•	•	•	•			
Family Kinosternidae																	
Sternotherus odoratus Eastern Musk Turtle								•	•	•							
Family Emydidae																	
Chrysemys picta marginata Midland Painted Turtle	•	•		•	•		•	•	•	•				•			
Clemmys guttata[2] Spotted Turtle		•															
Emydoidea blandingii[2] Blanding's Turtle															•		•
Graptemys geographica Northern Map Turtle								•									
Trachemys scripta elegans Red-eared Slider	•									•	•			•		•	

Discussion

Chrysemys picta marginata and *Chelydra serpentina* are widespread and common throughout the marsh. They have also colonized several mitigation ponds that were constructed in 2000 and 2001 above the marsh basin on the north and south sides of the marsh. *Sternotherus odoratus* was successfully trapped only in the western basin. Other areas within the marsh appear to provide suitable habitat to support this species and more extensive trapping may reveal its presence. The occurrences of *Sternotherus* within Mentor Marsh are the first records for this species in the Grand River drainage system.

The occurrence of *Trachemys scripta elegans* in the western basin, along Wake Robin Trail in the central basin, and at Shipman Pond in the eastern basin was predictable. All three areas are frequented by people. The western basin marina is used extensively for recreation (sites 10–14), and the Marsh Creek and canal (sites 8–9) are used by canoeists and kayakers for outdoor education and recreation experiences. A boardwalk is available for public access at Wake Robin Trail (site 6), and Shipman Pond (site 1) is commonly used by fishermen and birdwatchers. These areas are closely proximate to roads whereby unwanted captive turtles could be released. Sliders have been released at numerous locales in northeastern Ohio; their populations and distribution are expanding, and it is probable that their numbers will increase in Mentor Marsh. These capture records are the first documented occurrences of *Trachemys* in the Grand River drainage system.

The addition of new turtle species to the herpetofauna of Mentor Marsh was anticipated. Since the marsh is the old Grand River channel and floodplain, the species of turtles inhabiting the current Grand River are indicators of the species predictably present in the marsh. The Eastern Spiny Softshell Turtle (*Apalone spinifera*) is common and widespread in the Grand River but has not yet been documented in Mentor Marsh.

Management practices now used in Mentor Marsh in attempts to reduce the standing crop and distribution of *Phragmites* and to restore native plant biodiversity may lead to population increases in all turtle species. If still surviving in the marsh, the Spotted Turtle may be the species that would benefit most from habitat restoration.

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Literature Cited

Bernstein, N.P. 1981. Vegetational history of Mentor Marsh. Ohio Journal of Science. 81(3): 105-108.

Brockman, C.S. 2002. Physiographic regions of Ohio. Ohio Department of Natural Resources, Division of Geological Survey. 2 p.

Conant, R. 1951. Reptiles of Ohio. The American Midland Naturalist. University of Notre Dame Press, Notre Dame, Indiana. 284 p.

Conant, R. 1982. Herpetology in Ohio: fifty years ago. Special Publication of the Toledo Herpetological Society. 64 p.

Crother, B.I. (ed.). 2012. Standard common and current scientific names for North American amphibians, turtles, reptiles, and crocodilians. Seventh Edition. Herpetological Circular 39: 1-92.

Fineran, S.A. 2003. Assessing spatial and temporal vegetative dynamics at Mentor Marsh, 1976–2000 A.D. Dissertation, The Ohio State University. 467 p.

Holley, J.M. 1796. J. Milton Holley's Diary: Cleaveland to Connecticut. Oct 1796. Western Reserve Historical Society. Cleveland, Ohio.

Isard, L.G. 1966. The Vegetation of Mentor Marsh, A Preliminary Survey. The Cleveland Museum of Natural History, Cleveland, Ohio.

Isard L.G. 1967. Biotic Survey of Mentor Marsh. The Cleveland Museum of Natural History, Cleveland, Ohio.

Matson, T.O. 1983. An inventory of the species of fish occurring in Mentor Marsh. *In* Mentor Marsh, Lake County, Ohio Historical data and current baseline conditions. Final report, Technical appendix A49. Northeast Ohio Areawide Coordinating Agency.

NOACA. 1983. Mentor Marsh, Lake County, Ohio Historical data and current baseline conditions. Final report, Technical appendix A49. Northeast Ohio Areawide Coordinating Agency.

ODNRDW. 2016. Ohio's listed species Wildlife that are considered to be endangered, threatened, species of concern, special interest, extirpated, or extinct in Ohio. Publication 5356.

Pease, S. 1796. Seth Pease Field Notes: 1796. Western Reserve Historical Society. Cleveland, Ohio.

Whipple, J.C. 1999. Geological and environmental assessment of Mentor Marsh. Master's Thesis. University of Akron. Akron, Ohio.

White, G.W. 1980. Glacial geology of Lake County, Ohio. Ohio Department of Natural Resources, Division of Geological Survey, Report of Investigations No. 117, Columbus, Ohio.

Zemko, R.G. 1974. The occurrence and distribution of turtles in Ohio. M.S. thesis, Miami University, Oxford, OH. 98 p.

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A List of the Vascular Plants of Bender Mountain Preserve (Including Adjacent Parts of the Delhi Township Property and Sisters' Hill)

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Abstract: Several species of non-native invasive plants, including Amur honeysuckle (*Lonicera maackii*), had become quite numerous at Bender Mountain Preserve in Hamilton County, which made it very difficult for native plants to compete. After the removal of Amur honeysuckle by Western Wildlife Corridor volunteers, there was a resurgence of native plants in the preserve. So far, 431 species of vascular plants have been identified, 73% of which are native to Hamilton County. This list is sure to grow over the next few years as the preserve continues to recover. It is hoped that this study will encourage land managers and park districts not to give up on their nature preserves: non-native, invasive plants can be controlled in natural areas and native plants can come back.

Key Words: Amur honeysuckle, native plants, Western Wildlife Corridor, Western Mesophytic Forest Region, Ohio River Valley

Introduction

Bender Mountain Nature Preserve (N 39.10°, W 084.67°) is a 22.3 ha preserve in southwest Hamilton County, Ohio, consisting of property owned by Delhi Township Parks and Recreation as well as land owned by the Western Wildlife Corridor. The preserve and some of the adjacent forested property owned by the Sisters of Charity are managed by the Western Wildlife Corridor, a land trust dedicated to preserving the environmental heritage of the Ohio River Valley. Native plants reappeared at Bender Mountain Preserve after non-native invasive plants were removed by volunteers. This paper outlines the geologic history of Bender Mountain Preserve, its subsequent vegetational changes over time, Western Wildlife Corridor's contribution to restoring the hillslope to its native state, and a list of plants that currently reside on the preserve.

The Bender Mountain Preserve site lies at the southern edge of Delhi Township in Hamilton County, Ohio, on a steep ridge overlooking the Ohio River to the south and Rapid Run Creek to the north. The valleys of the Ohio River and its tributaries in this portion of Hamilton County are exceptionally narrow here and have oversteepened slopes due to the rerouting of the Ohio River during the Illinoian Glaciation. Approximately 400,000 years BP, during the Pleistocene Epoch, glaciation dammed the Pleistocene Deepstage Ohio River at Cincinnati (Durrell 1961, 1977). The large lake that formed as a result of the damming found an outlet at a location known as Anderson Ferry, west of downtown Cincinnati and about two kilometers southeast of present-day Bender Mountain. As glacial lake water overflowed the lake's western terminus, it cut a new, narrow gorge in what is now the Ohio River valley. Tributary streams in the region where the river was rerouted also cut gorges as they dropped down to the level of the newly formed river. A small tributary of the Ohio River known as Rapid Run Creek flows in one of the newly formed gorges, and runs somewhat parallel to the Ohio River near Anderson Ferry. The ridge that formed between Rapid Run Creek and the Ohio River is Bender Mountain.

Bender Mountain Preserve lies within the Outer Bluegrass Ecoregion (Hedeen 2006). The clay-rich soils on the preserve are categorized as members of the Eden Series by the Hamilton County Soil Survey (Lerch et al. 1980). The mountain's ridge top is underlain by thin, stony silty-clay colluvial soil derived from the Ordovician Fairview Formation, whereas the lower part of the hillslope is underlain by thick clay colluvial soil derived from the underlying Kope Formation. Both formations consist of interbedded limestone and shale: the Fairview Formation is about 3:1 shale to limestone, and the Kope Formation is about 4:1 shale to limestone. The dominance of shale in the Kope Formation allows it to weather into soil at a relatively fast rate, thus producing a thick, heavy clay soil that is associated with landsliding wherever the Kope Formation crops out in Cincinnati. A factor of safety analysis of saturated soils underlying the Bender hillslope indicates a residual friction angle of 16° to 20°. This suggests that the hillslope cannot retain soil at angles steeper than 20°, but the ridge slopes at a higher angle than this, especially near its western terminus. The soils on the hillside are most likely held in place by the rocky nature of the colluvial soil, along

with irregularities in the bedrock surface angles. Moreover, roots of woody plants contribute significant strength to the colluvial soil and allow it to remain in place, unfortunately intermittently, since the hillslope is pocked with landslide troughs and scarps (Riestenberg 1994). In fact, a road that cut tangentially across the hillslope had to be closed down permanently during the 1970s after a particularly dramatic series of landlsides (Fleming and Johnson 1994).

The Bender Mountain area is a part of the Western Mesophytic Forest region, a region of diverse vegetation types (Braun 1950). The steep slopes, north and south aspects, and narrow valleys have created many different types of habitat, including dry, rocky ridge tops, warm, fertile, south-facing slopes, cool, fertile, north-facing slopes, alluvial benches, wetlands, and riparian zones.

Delhi Township records indicate that over the years, parts of the Bender Mountain area have been used for grazing cows, foraging hogs, growing grapes and other fruit, and selective logging (Duba and Brunsman 1976). In the early part of the twentieth century, plant ecologist E. Lucy Braun mapped the woody plants on a hillslope north of the Ohio River at Anderson Ferry, close to present-day Bender Mountain (Braun 1916). Most of the same woody species can be found at Bender Mountain Preserve today; however, woody species are now under siege from invasion by alien plants and other pests such as the Emerald Ash Borer (*Agrilus planipennis*) (Jester 2009).

Invasive alien plants began to appear in significant numbers in southwestern Ohio in the mid-twentieth century. For example, Braun noted in *The Woody Plants of Ohio* (Braun 1961) that Amur honeysuckle had by that time escaped from cultivation in Hamilton County and that it was becoming abundant in pastures and woodlands. By the year 2000, Amur honeysuckle covered most of Bender Mountain with a blanket of foliage that blocked the sun. Underneath this, other alien species such as garlic mustard (*Alliaria petiolata*) and winter creeper (*Euonymus fortunei*), which are more shade tolerant, were gaining a foothold. The result was an observable reduction in the number of native plants, especially forest-floor, herbaceous flowering plants. When Western Wildlife Corridor began managing Bender Mountain Preserve in 2004, volunteers began removing the invasives, allowing the native plant species to repopulate the preserve (Conover et al. 2016; Conover and Sisson 2016).

Methods

Several books (listed in the Literature Cited section) were used to identify species. *The Seventh Catalog of the Vascular Plants of Ohio* (Cooperrider et al. 2001) provided the initial basis for the nomenclature used in this list of plants. Plant taxonomy is in a state of flux, and some of the names in this list have been updated to reflect recent changes in taxonomy. Author names are provided with each species to avoid confusion as to which species is present. For the most current taxonomic information about families, genera, and plant names, refer to The Integrated Taxonomic Information System (www.itis.gov).

Most plants were identified in the field between 2013 and 2017. A few specimens were collected and deposited in herbaria at the University of Cincinnati and Miami University, Oxford, Ohio.

Results

Our vascular plant survey has so far identified 431 different species, of which 73% are native to Hamilton County. The list of species is sure to increase, since additional species are discovered in the preserve every year. The current list of species includes horsetails (*Equisetum* spp.), ferns, woody plants (shrubs, trees, and vines), rushes (*Juncus* spp.), sedges (*Cyperus* and *Carex*), grasses, and forbs. Plants such as blue-eyed Mary (*Collinsia verna*) grow in profusion on the gentle slope above Rapid Run creek; northern red oak (*Quercus rubra*), shagbark hickory (*Carya ovata*), great yellow wood sorrel (*Oxalis grandis*), early saxifrage (*Saxifraga virginiensis*), mullein-foxglove (*Dasistoma macrophylla*), American pennyroyal (*Hedeoma pulegioides*) and poverty oat grass (*Danthonia spicata*) prefer the upper slopes; and bulrushes (*Scirpus* spp.), jewelweeds (*Impatiens* spp.), scouring rushes (*Equisetum* spp.), and great blue lobelia (*Lobelia siphilitica*) prefer the wetter areas. From this study, it is clear that if Amur honeysuckle and other non-native invasive plants are removed from a natural area while propagules (seeds, roots, bulbs, and corms) of native plants are still viable, native vegetation can reclaim the area.

The vascular plant species found in the Preserve are listed in Table 1.

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Rick Gardner and Mike Vincent provided suggestions regarding the format of the species list. Rick Gardner also provided information regarding the native status of species on the list. Thanks are also due to Mike Vincent, curator of Miami University's herbarium, and Eric Tepe, curator of the University of Cincinnati's herbarium, for depositing specimens. Great appreciation is due to Western Wildlife Corridor for preserving Bender Mountain and for managing it properly. The removal of invasive plant species by Western Wildlife Corridor volunteers makes possible the continued survival of native plants and animals there.

Table 1. List of vascular plants currently found on Bender Mountain. (*) indicates probably not native to Hamilton County.

PTERIDOPHYTES	
Family Aspleniaceae, the Spleenwort Family	
Asplenium platyneuron (L.) Britton, Sterns. & Poggenb.	Ebony spleenwort
Family Dryopteridaceae, the Wood Fern Family	
Cystopteris protrusa (Weath.) Blasdell	Lowland fragile fern
Diplazium pycnocarpon (Sprengel) M. Broun Synonym: *Athyrium pycnocarpon* (Sprengel) Tidestrom	Narrow-leaved glade fern
Polystichum acrostichoides (Michx.) Schott	Christmas fern
Family Equisetaceae, the Horsetail Family	
Equisetum arvense L.	Field horsetail
Equisetum hyemale L.	Scouring-rush
GYMNOSPERMS	
Family Cupressaceae, the Cypress Family	
**Juniperus horizontalis* Moench	Creeping juniper
Juniperus virginiana L.	Eastern red cedar
ANGIOSPERMS – Dicotyledons	
Family Acanthaceae, the Acanthus Family	
Ruellia strepens L.	Smooth ruellia
Family Adoxaceae, the Moschatel Family	
Sambucus canadensis L.	Elderberry
Viburnum prunifolium L.	Blackhaw
Family Aceraceae, the Maple Family (now included in the Sapindaceae)	
Acer negundo L.	Boxelder
Acer nigrum Michx. Synonym: *Acer saccharum* L. var. *viride* (Schmidt) E. Murray; *Acer saccharum* L. ssp. *nigrum* (f. Michx.) Desmarais	Black maple
Acer saccharinum L.	Silver maple
Acer saccharum L.	Sugar maple
Family Amaranthaceae, the Amaranth Family	
**Achyranthes japonica* (Miq.) Nakai	Japanese chaff flower
Family Anacardiaceae, the Cashew Family	
Rhus glabra L.	Smooth sumac
Rhus typhina L. Synonym: *Rhus hirta* (L.) Sudw.	Staghorn sumac
Toxicodendron radicans (L.) Kuntze Synonym: *Rhus radicans* L.	Poison ivy
Family Annonaceae, the Custard-Apple Family	
Asimina triloba (L.) Dunal.	Paw paw
Family Apiaceae, the Carrot Family (Umbelliferae)	
Chaerophyllum procumbens (L.) Crantz	Spreading chervil
**Conium maculatum* L.	Poison hemlock
Cryptotaenia canadensis (L.) DC.	Honewort
**Daucus carota* L.	Wild carrot; Queen Anne's lace
Erigenia bulbosa (Michx.) Nutt.	Harbinger-of-spring
Osmorhiza claytonii (Michx.) C. B. Blake	Hairy sweet cicely
Osmorhiza longistylis (Torr.) DC.	Smooth sweet cicely
**Pastinaca sativa* L.	Wild parsnip
Sanicula canadensis L.	Canadian black snakeroot
Sanicula odorata (Raf.) K. M. Pryer & L. R. Phillippe	Clustered black snakeroot
**Torilis* sp. Adans.	Hedge parsley
Family Apocynaceae, The Dogbane Family	
Apocynum cannabinum L.	Indian hemp

**Vinca minor* L.	Periwinkle; myrtle
Family Aquifoliaceae, the Holly Family	
Ilex opaca Aiton	American holly
Family Araliaceae, the Ginseng Family	
**Hedera helix* L.	English ivy
Family Aristolochiaceae, the Birthwort Family	
Asarum canadense L.	Wild ginger
Family Asclepiadaceae, the Milkweed Family (now included in the Apocynaceae)	
Asclepias incarnata L.	Swamp milkweed
Asclepias syriaca L.	Common milkweed
Asclepias tuberosa L.	Butterfly weed
Cynanchum laeve (Michx.) Pers. Synonym: *Ampelamus albidus* (Nutt.) Britt.; *Gonolobus laevis* Michx.	Sand vine
Family Asteraceae, the Aster Family (Compositae)	
Achillea millefolium L.	Yarrow
Ageratina altissima (L.) R. M. King & H. Rob.	White snakeroot
Ambrosia artemisiifolia L.	Common ragweed
Ambrosia trifida L.	Giant ragweed
**Arctium minus* Schk.	Common burdock
**Artemisia annua* L.	Annual wormwood
**Artemisia vulgaris* L.	Mugwort
Bidens bipinnata L.	Spanish needles
Bidens cernua L.	Nodding bur-marigold
Bidens frondosa L.	Devil's beggar-ticks
**Carduus nutans* L.	Nodding thistle
**Cichorum intybus* L.	Chicory
**Cirsium arvense* (L.) Scop.	Canada thistle
Cirsium discolor (Muhl. ex Willd.) Sprengel	Field thistle
**Cirsium vulgare* (Savi) Ten.	Bull thistle
Eclipta prostrata (L.) L. Synonym: *Eclipta alba* (L.) Hassk.	Yerba-de-tajo
Erechtites hieraciifolia (L.) Raf. ex DC.	Pilewort
Erigeron annuus (L.) Pers.	Daisy fleabane
Erigeron canadensis L.	Horseweed
Erigeron philadelphicus L.	Philadelphia fleabane
Erigeron strigosus Muhl. ex Willd.	White-top
Eupatorium altissimum L.	Tall boneset
Eupatorium perfoliatum L.	Boneset
Eupatorium purpureum L.	Purple joe-pye weed
Eupatorium serotinum Michx.	Late-flowering thoroughwort
Euthamia graminifolia (L.) Nutt. Synonym: *Solidago graminifolia* (L.) Salisb.	Bushy goldenrod
Helianthus tuberosus L.	Jerusalem artichoke
Heliopsis helianthoides (L.) Sweet	Ox-eye sunflower
Lactuca canadensis L.	Wild lettuce
Lactuca floridana (L.) Gaertner	Wild blue lettuce
**Lactuca saligna* L.	Willow-leaf lettuce
**Lactuca serriola* L. var. *serriola*, var. *integrata* Gren. & Godr. Synonym: *Lactuca scariola* L.	Prickly lettuce
**Leucanthemum vulgare* Lam.	Ox-eye daisy
**Packera glabella* (Poir.) C. Jeffrey	Butterweed
Polymnia canadensis L.	Small-flowered leafcup
Prenanthes alba L.	White rattlesnake-root
Rudbeckia laciniata L.	Green-headed coneflower
Rudbeckia triloba L.	Brown-eyed Susan
**Senecio vulgaris* L.	Common groundsel
Silphium perfoliatum L.	Indian cup
Solidago altissima L.	Tall goldenrod
Solidago canadensis L.	Canada goldenrod
Solidago flexicaulis L.	Zigzag goldenrod
Solidago gigantea Aiton	Smooth goldenrod
Solidago nemoralis Aiton	Gray goldenrod
**Sonchus asper* (L.) Hill	Prickly sow-thistle

Symphyotrichum cordifolium (L.) Nesom	Heart-leaved aster
Symphyotrichum ericoides (L.) G.L. Nesom var. *ericoides*	White heath aster
Symphyotrichum lanceolatum (Willd.) Nesom ssp. *lanceolatum* var. *lanceolatum*	Eastern lined aster
Symphyotrichum lateriflorum (L.) A.& D. Löve var. *lateriflorum*	Calico aster
Symphyotrichum novae-angliae (L.) Nesom	New England aster
Symphyotrichum shortii (Lindl.) Nesom	Short's aster
**Taraxacum officinale* Weber ex F. H. Wigg.	Common dandelion
**Tussilago farfara* L.	Colt's-foot
Verbesina alternifolia (L.) Britt. Synonym: *Actinomeris alternifolia* (L.) DC.	Wingstem
Vernonia gigantea (Walter) Trel. Synonym: *Vernonia altissima* Nutt.	Tall ironweed
Xanthium strumarium L.	Common cocklebur
Family Balsaminaceae, the Touch-me-not Family	
Impatiens capensis Meerb.	Spotted jewelweed
Impatiens pallida Nutt.	Pale jewelweed
Family Berberidaceae, the Barberry Family	
Caulophyllum thalictroides (L.) Michx.	Blue cohosh
Jeffersonia diphylla (L.) Pers.	Twinleaf
Podophyllum peltatum L.	Mayapple
Family Betulaceae, the Birch Family	
Carpinus caroliniana Walter ssp. *virginiana* (Marshall) Furlow	Musclewood; ironwood
Ostrya virginiana (Miller) K. Koch	Eastern hop-hornbeam
Family Bignoniaceae, the Trumpet-creeper Family	
Campsis radicans (L.) Seemann	Trumpet-creeper
Family Boraginaceae, the Borage Family	
Hackelia virginiana (L.) I. M. Johnston	Beggar's-lice
Mertensia virginica (L.) Pers. ex Link	Virginia bluebells
Family Brassicaceae, the Mustard Family (Cruciferae)	
**Alliaria petiolata* (Bieb.) Cavara & Grande Synonym: *Alliaria officinalis* Andrz.	Garlic mustard
**Barbarea verna* (Mill.) Asch.	Early yellowrocket
**Barbarea vulgaris* R. Br.	Winter cress
Boechera laevigata (Muhl. ex Willd.) Al-Shehbaz	Smooth rockcress
**Brassica nigra* L.	Black mustard
**Capsella bursa-pastoris* (L.) Medikus	Shepherd's purse
Cardamine concatenata (Michx.) O. Schwarz Synonym: *Dentaria laciniata* Muhl.	Cut-leaved toothwort
Cardamine diphylla (Michx.) A. Wood Synonym: *Dentaria diphylla* Michx.	Twin-leaved toothwort
Cardamine douglasii Britton	Purple cress
**Cardamine hirsuta* L.	Hoary bitter cress
**Erophila verna* (L.) Chev.	Whitlow-grass
**Hesperis matronalis* L.	Dame's rocket
Iodanthus pinnatifidus (Michx.) Steudel	Purple rocket
**Lepidium campestre* (L.) R. Br.	Field pepper-weed
Lepidium virginicum L.	Poor-man's pepper
Rorippa palustris (L.) Besser.	Common yellow-cress
**Thlaspi arvense* L.	Field penny-cress
Family Caesalpiniaceae, the Caesalpinia Family (now in Fabaceae)	
Cercis canadensis L.	Redbud
Gleditsia triacanthos L.	Honey-locust
Gymnocladus dioica (L.) K. Koch.	Kentucky coffee-tree

Family Campanulaceae, the Bellflower Family	
Campanula americana L. Synonym: *Campanulastrum americanum* (L.) Small	Tall bellflower
Lobelia inflata L.	Indian tobacco
Lobelia siphilitica L.	Great blue lobelia
Triodanis perfoliata (L.) Nieuwl.	Venus' looking-glass
Family Cannabaceae, the Hemp Family	
Celtis occidentalis L.	Hackberry
Family Caprifoliaceae, the Honeysuckle Family	
**Lonicera japonica* Thunb.	Japanese honeysuckle
**Lonicera maackii* (Rupr.) Maxim.	Amur honeysuckle
Symphoricarpos orbiculatus Moench.	Coralberry
Family Caryophyllaceae, the Pink Family	
Paronychia canadensis (L.) Alph. Wood	Forked chickweed
**Saponaria officinalis* L.	Soapwort; Bouncing Bet
Stellaria corei Shinners	Kentucky chickweed
**Stellaria media* (L.) Vill.	Common chickweed
**Stellaria pallida* (Dumort) Pire	Lesser chickweed
Stellaria pubera Michx.	Star chickweed
Family Celastraceae, the Staff-Tree Family	
**Celastrus orbiculatus* Thunb.	Oriental bittersweet
**Euonymus alatus* (Thunb.) Siebold	Winged Euonymus
Euonymus atropurpureus Jacq.	Wahoo
**Euonymus fortunei* (Turcz.) Hand.-Mazz.	Wintercreeper
Family Chenopodiacaeae, the Goosefoot Family (now included in the Amaranthaceae)	
**Chenopodium album* L.	Lamb's quarters
Dysphania ambrosioides (L.) Mosyakin & Clemants	Mexican tea
Chenopodium standleyanum Aellen	Woodland goosefoot

Family Convolvulaceae, the Morning-Glory Family	
Calystegia sepium (L.) R. Br. Synonym: *Convolvulus sepium* L.	Hedge bindweed
**Ipomoea hederacea* Jacq.	Ivy-leaved morning-glory
Ipomoea lacunosa L.	Small-flowered morning-glory
Ipomoea pandurata (L.) G. F. W. Mey	Man-of-the-earth
Family Cornaceae, the Dogwood Family	
Cornus drummondii C. A. Meyer	Rough-leaved dogwood
Cornus florida L.	Flowering dogwood
Cornus racemosa Lam.	Gray dogwood
Family Cuscutaceae, the Dodder Family	
Cuscuta pentagona Engelm.	Five-angled dodder
Family Crassulaceae, the Stonecrop Family	
Sedum ternatum Michx.	Wild stonecrop
Family Dipsacaceae, the Teasel Family (now included in the Caprifoliaceae)	
**Dipsacus fullonum* L. Synonym: *Dipsacus sylvestris* Huds.	Common teasel
**Dipsacus laciniatus* L.	Cut-leaved teasel
**Dipsacus sativus* (L.) Honck.	Indian teasel
Family Ebenaceae, the Ebony Family	
Diospyros virginiana L.	Persimmon
Family Euphorbiaceae, the Spurge Family	
Acalypha deamii (Weath.) H.E. Ahles	Deam's three-seeded mercury
Acalypha rhomboidea Raf. Synonym: *Acalypha virginica* L. var. *rhomboidea* (Raf.) Cooperr.	Rhombic three-seeded mercury
Acalypha virginica L.	Virginia three-seeded mercury
Euphorbia commutata Engelm. ex A. Gray	Woodland spurge
Family Fabaceae, the Pea or Bean Family (Leguminosae)	
**Albizia julibrissin* Durazz.	Silk tree

Amphicarpaea bracteata (L.) Fernald	Hog-peanut
Desmanthus illinoensis (Michx.) MacMillan	Prairie mimosa
**Lotus corniculata* L.	Birdsfoot trefoil
**Medicago lupulina* L.	Black medick
**Melilotus albus* Medik.	White sweet-clover
**Melilotus officinalis* (L.) Pall.	Yellow sweet-clover
Robinia pseudoacacia L.	Black locust
* *Securigera varia* (L.) Lassen	Crown-vetch
**Trifolium hybridum* L.	Alsike clover
**Trifolium pratense* L.	Red clover
**Trifolium repens* L.	White clover
Family Fagaceae, the Beech Family	
Fagus grandifolia Ehrh.	American beech
Quercus alba L.	White oak
Quercus macrocarpa Michx.	Bur oak
Quercus muhlenbergii Engelm.	Chinquapin oak
Quercus rubra L. Synonym: *Quercus borealis* F. Michx.	Northern red oak
Quercus shumardii Buckley	Shumard oak
Quercus velutina Lam.	Black oak
Family Fumariaceae, the Fumitory Family (now included in the Papaveraceae)	
Corydalis flavula (Raf.) DC.	Yellow corydalis
Dicentra canadensis (Goldie) Walp.	Squirrel corn
Dicentra cucullaria (L.) Bernh.	Dutchman's-breeches
Family Geraniaceae, the Geranium Family	
Geranium carolinianum L.	Carolina crane's-bill
Geranium maculatum L.	Wild geranium
Family Hippocastanaceae, the Horse-Chestnut Family (now included in the Sapindaceae)	
Aesculus glabra Willd.	Ohio buckeye
Aesculus flava Aiton Synonym: *Aesculus octandra* Marshall.	Yellow buckeye
Family Hydrangeaceae, the Hydrangea Family	
Hydrangea arborescens L.	Wild hydrangea
**Philadelphus coronarius* L.	Mock-orange
Family Hydrophyllaceae, the Waterleaf Family (now included in the Boraginaceae)	
Hydrophyllum appendiculatum Michx.	Appendaged waterleaf
Hydrophyllum canadense L.	Maple-leaved waterleaf
Hydrophyllum macrophyllum Nutt.	Large-leaved waterleaf
Phacelia bipinnatifida Michx.	Fernleaf phacelia
Family Hypericaceae, the St. John's-Wort Family	
**Hypericum perforatum* L.	Common St. John's-wort
Hypericum punctatum Lam.	Spotted St. John's-wort
Family Juglandaceae, the Walnut Family	
Carya cordiformis (Wangenh.) K. Koch	Bitternut hickory
Carya laciniosa (Michx. f.) Loudon	Shellbark hickory
Carya ovata (Miller) K. Koch	Shagbark hickory
Juglans nigra L.	Black walnut
Family Lamiaceae, the Mint Family (Labiatae)	
Agastache nepetoides (L.) Ktze.	Yellow giant-hyssop
Blephilia hirsuta (Pursh) Benth.	Hairy woodmint
**Glechoma hederacea* L.	Ground ivy; gill-over-the-ground; creeping Charlie
Hedeoma pulegioides (L.) Pers.	American pennyroyal
**Lamium amplexicaule* L.	Henbit
**Lamium purpureum* L.	Purple dead-nettle
**Leonurus cardiaca* L.	Motherwort
Lycopus virginicus L.	Virginia water-horehound
Prunella vulgaris L.	Self-heal; heal-all
Salvia lyrata L.	Lyre-leaved sage
Scutellaria ovata Hill	Heart-leaved skullcap
Stachys nuttallii Benth. Synonym: *Stachys riddellii* House.; *Stachys cordata* Riddell.	Heart-leaved hedge-nettle
Stachys tenuifolia Willd.	Common hedge-nettle

Teucrium canadense L.	American germander; wood sage
Family Lauraceae, the Laurel Family	
Lindera benzoin (L.) Blume	Northern spicebush
Sassafras albidum (Nutt.) Nees.	Sassafras
Family Limnanthaceae, the Meadow-Foam Family	
Floerkea proserpinacoides Willd.	False mermaid
Family Lythraceae, the Loosestrife Family	
**Lythrum salicaria* L.	Purple loosestrife
Family Magnoliaceae, the Magnolia Family	
Liriodendron tulipifera L.	Tuliptree; yellow poplar
Family Malvaceae, the Mallow Family	
**Abutilon theophrasti* Medic.	Velvet-leaf
Hibiscus moscheutos L.	Crimsoneyed rosemallow
**Hibiscus syriacus* L.	Rose of Sharon
**Sida spinosa* L.	Prickly mallow
Family Menispermaceae, the Moonseed Family	
Menispermum canadense L.	Moonseed
Family Molluginaceae, the Carpet-Weed Family	
**Mollugo verticillata* L.	Carpet-weed
Family Montiaceae, the Links Family	
Claytonia virginica L.	Spring beauty
Family Moraceae, the Mulberry Family	
**Morus alba* L.	White mulberry
Morus rubra L.	Red mulberry
Family Oleaceae, the Olive Family	
Fraxinus americana L.	White ash
Fraxinus quadrangulata Michx.	Blue ash
**Ligustrum vulgare* L.	Common privet
Family Onagraceae, the Evening-Primrose Family	
Circaea lutetiana L. var. *canadensis* L.	Enchanter's nightshade
Epilobium coloratum Biehler	Purple-leaved willow-herb
Gaura biennis L.	Biennial gaura
Oenothera biennis L.	Common evening-primrose
Family Orobanchaceae, the Broomrape Family	
Dasistoma macrophylla (Nutt.) Raf. Synonym: *Seymaria macrophylla* Nutt.	Mullein-foxglove
Family Oxalidaceae, the Wood Sorrel Family	
Oxalis dillenii Jacq.	Southern yellow wood-sorrel
Oxalis grandis Small	Great yellow wood-sorrel
Oxalis purpurea L.	Purple wood-sorrel
Oxalis stricta L. Synonym: *Oxalis europaea* Jord.	Common yellow wood-sorrel
Family Papaveraceae, the Poppy Family	
Sanguinaria canadensis L.	Bloodroot
Stylophorum diphyllum (Michx.) Nutt. Synonym: *Chelidonium diphyllum* Michx.	Wood poppy; celandine poppy
Family Passifloraceae, the Passion-Vine Family	
Passiflora lutea L.	Yellow passion-flower
Family Penthoraceae, the Ditch-Stonecrop Family	
Penthorum sedoides L.	Ditch-stonecrop
Family Phrymaceae, the Lopseed Family	
Phryma leptostachya L.	American lopseed
Family Phytolaccaceae, the Pokeweed Family	
Phytolacca americana L.	Pokeweed
Family Plantaginaceae, the Plantain Family	
Collinsia verna Nutt.	Blue-eyed Mary
Leucospora multifida (Michx.) Nutt. Synonym: *Conobea multifida* (Michx.) Benth.	Narrowleaf paleseed
**Plantago lanceolata* L.	English plantain
**Plantago major* L.	Broad-leaved plantain
Plantago rugelii Decne.	Rugel's plantain
Veronica anagallis-aquatica L.	Water speedwell
Veronica peregrina L.	Purslane speedwell
Family Platanaceae, the Plane-Tree Family	
Platanus occidentalis L.	American sycamore

Family Polemoniaceae, the Phlox Family	
Phlox divaricata L.	Blue phlox
Polemonium reptans L.	Greek valerian
Family Polygonaceae, the Smartweed Family	
**Fallopia japonica* (Houtt.) Ronse Decr.	Japanese knotweed
Persicaria hydropiper (L.) Spach	Water-pepper
**Persicaria longiseta* (Bruijn) Kitag.	Long-bristled smartweed
**Persicaria maculosa* Gray	Lady's thumb
Persicaria punctata (Elliott) Small	Dotted smartweed
Persicaria virginiana (L.) Gaertn.	Jumpseed; Virginia knotweed
**Polygonum aviculare* L.	Prostrate knotweed
**Rumex crispus* L.	Curly dock
**Rumex obtusifolius* L.	Bitter dock
Family Portulacaceae, the Purslane Family	
Claytonia virginica L.	Spring beauty
Portulaca oleracea L.	Common purslane Note: There is archeological evidence indicating that this species is native.
Family Primulaceae, the Primrose Family	
**Anagallis arvensis* L.	Scarlet pimpernel
**Lysimachia nummularia* L.	Moneywort
Samolus parviflorus Raf. Synonym: *Samolus floribundus* Kunth	Water-pimpernel
Family Ranunculaceae, the Buttercup Family	
Anemone acutiloba (DC.) G. Lawson Synonym: *Hepatica acutiloba* DC.; *Hepatica nobilis* Schreb. var. *acuta* (Pursh) Steyerm.	Sharp-lobed hepatica
Anemone virginiana L.	Thimbleweed
Cimicifuga racemosa (L.) Nutt. Synonym: *Actaea racemosa* L.	Black cohosh
Delphinium tricorne Michx.	Dwarf larkspur
Isopyrum biternatum (Raf.) Torr. & A. Gray Synonym: *Enemion biternatum* Raf.	False rue-anemone
Ranunculus abortivus L.	Kidney-leaved crowfoot
**Ficaria verna* Huds.	Lesser celandine
Ranunculus hispidus Michx. var. *hispidus*; var. *caricetorum* (Greene) T. Duncan Synonym: *Ranunculus septentrionalis* Poiret	Hispid buttercup
Ranunculus micranthus Nutt.	Small-flowered crowfoot
Ranunculus recurvatus Poiret	Hooked crowfoot
Thalictrum dioicum L.	Early meadow-rue
Thalictrum thalictroides (L.) A. J. Eames & B. Bovin	Rue-anemone
Family Rosaceae, the Rose Family	
Crataegus mollis Scheele	Downy hawthorn
**Duchesnea indica* (Andrews) Teschem.	Indian strawberry
Geum canadense Jacq.	White avens
Geum vernum (Raf.) Torr. & A. Gray	Spring avens
**Malus pumila* Mill. Synonym: *Pyrus malus* L.	Cultivated apple
Prunus americana Marshall	Wild plum
**Prunus avium* L.	Sweet cherry
Prunus serotina Ehrh.	Wild black cherry
**Pyrus calleryana* Dcne.	Callery pear
**Rosa canina* L.	Dog rose
**Rosa multiflora* Thunb. Ex Murray	Multiflora rose
Rosa setigera Michx.	Prairie rose; climbing rose
Rubus allegheniensis T. C. Porter	Common blackberry
Rubus enslenii Tratt.	Enslen's blackberry
Rubus flagellaris Willd.	Northern dewberry
Rubus occidentalis L.	Black raspberry
Family Rubiaceae, the Madder Family	
Galium aparine L.	Cleavers
Galium circaezans Michx.	Wild licorice

Galium concinnum Torr. & A. Gray	Shining bedstraw
**Galium mollugo* L.	False baby's breath
Family Rutaceae, the Rue Family	
Ptelea trifoliata L.	Wafer-ash
Family Salicaceae, the Willow Family	
Populus deltoides Marshall	Cottonwood
Salix exigua Nutt. ssp. *interior* (Rowlee) Cronq. Synonym: *Salix interior* Rowlee.	Sandbar willow
Salix nigra Marshall	Black willow
Family Saxifragaceae, the Saxifrage Family	
Heuchera americana L.	Alum-root
Saxifraga virginiensis Michx.	Early saxifrage
Family Scrophulariaceae, the Figwort Family	
Scrophularia marilandica L.	Maryland figwort
**Verbascum blatteria* L.	Moth mullein
**Verbascum thapsus* L.	Common mullein
Family Simaroubaceae, the Quassia Family	
**Ailanthus altissima* (Miller) Swingle	Tree-of-heaven
Family Solanaceae, the Nightshade Family	
Physalis longifolia Nutt. var. *subglabrata* (Mackenz. & Bush) Cronq.	Smooth groundcherry
Solanum carolinense L.	Horse-nettle
Solanum dulcamara L.	Bittersweet nightshade
**Solanum lycopersicum* L.	Garden tomato
Solanum ptychanthum DC.	Black nightshade
Family Staphyleaceae, the Bladder-Nut Family	
Staphylea trifolia L.	Bladdernut
Family Tiliaceae, the Linden Family	
Tilia heterophylla Vent.	White basswood
Tilia americana L.	American linden
Family Ulmaceae, the Elm Family	
Ulmus americana L.	American elm
Ulmus rubra Muhl.	Slippery elm; red elm
Family Urticaceae, the Nettle Family	
Laportea canadensis (L.) Wedd.	Wood nettle
Pilea pumila (L.) A. Gray	Clearweed
Urtica dioica L. var. *procera* (Muhl. ex Willd.) Wedd. Synonym: *Urtica dioica* L. subsp. *gracilis* (Aiton) Selander	American stinging nettle
Family Verbenaceae, the Vervain Family	
Phyla lanceolata (Michx.) Greene Synonym: *Lippia lanceolata* Michx.	Fog-fruit
Verbena utricifolia L.	White vervain
Family Violaceae, the Violet Family	
Viola pubescens Ait.	Common yellow violet
Viola sororia Willd Synonym: *Viola papilonacea* Pursh	Common blue violet
Viola striata Aiton.	Striped violet
Family Vitaceae, the Grape Family	
Parthenocissus quinquefolia (L.) Planchon	Virginia creeper
Vitis vulpina L.	Frost grape
ANGIOSPERMS – Monocotyledons	
Family Asparagaceae, the Asparagus Family	
**Yucca filamentosa* L.	Adam's needle; yucca
Family Araceae, the Arum Family	
Arisaema dracontium (L.) Schott	Green dragon
Arisaema triphyllum (L.) Schott Synonym: *Arisaema atrorubens* (Aiton) Blume	Jack-in-the-pulpit
Family Commelinaceae, the Spiderwort Family	
**Commelina communis* L.	Asiatic day-flower
Tradescantia subaspera Ker Gawl.	Zigzag spiderwort
Tradescantia virginiana L.	Virginia spiderwort
Family Cyperaceae, the Sedge Family	
Carex aggregata Mackenzie Synonym: *Carex sparganioides* var. *aggregata* (Mack.) Gleason	Glomerate sedge

Carex albicans Willd. Synonym: *Carex artitecta* Mackenzie	Oak sedge
Carex albursina Sheldon	White bear sedge
Carex blanda Dewey	Common wood sedge
Carex brevior (Dewey) Mack.	Shortbeak sedge
Carex careyana Torr. ex Dewey	Carey's sedge
Carex cephalophora Muhl. ex Willd.	Oval-leaf sedge
Carex communis L.H. Bailey	Fibrousroot sedge
Carex frankii Kunth	Frank's sedge
Carex granularis Muhl. ex Willd.	Limestone meadow sedge
Carex grisea Wahlenb.	Inflated narrow-leaf sedge
Carex jamesii Schwein.	James' sedge
Carex pensylvanica Lam. var. *pensylvanica*	Pennsylvania sedge
Carex rosea Schkuhr ex Willd.	Rosy sedge
Carex sparganioides Muhl. ex Willd.	Bur-reed sedge
Carex spp.	Sedges
Carex tribuloides Wahlenb.	Blunt broom sedge
Carex vulpinoidea Michx.	Fox sedge
Cyperus esculentes L.	Yellow nut-grass
Cyperus strigosus L.	Straw-colored flatsedge
Scirpus atrovirens Willd.	Dark green bulrush
Scirpus pendulus Muhl. Synonym: *Scirpus lineatus* Michx.	Drooping bulrush
Family Dioscoreaceae, the Yam Family	
Dioscorea villosa L.	Wild yam
Family Iridaceae, the Iris Family	
Sisyrinchium angustifolium Miller	Common blue-eyed-grass
Family Juncaceae, the Rush Family	
Juncus dudleyi Wiegand Synonym: *Juncus tenuis* Willd. var. *dudleyi* (Wiegand) F. J. Hermann	Dudley's rush
Juncus effusus L. var. *solutus* Fern. & Wieg.	Common rush
Juncus spp.	Rushes
Juncus tenuis Willd.	Path rush
Juncus torreyi Coville	Torrey's rush
Family Liliaceae, the Lily Family	
Allium burdickii (Hanes) A. G. Jones Synonym: *Allium tricoccum* Aiton var. *burdickii* Hanes	Narrow-leaved ramp
Allium canadense L.	Wild garlic
Allium cernuum Roth	Nodding wild onion
Allium tricoccum Aiton	Red ramp
**Allium vineale* L.	Field garlic
Camassia scilloides (Raf.) Cory Synonym: *Cyanotris scilloides* Raf.	Wild hyacinth
Erythronium albidum Nutt.	White trout-lily
Erythronium americanum Ker Gawler	Yellow trout-lily
**Hemerocallis fulva* (L.) L.	Day-lily
Maianthemum racemosum (L.) Link Synonym: *Smilacina racemosa* (L.) Desf.	Solomon's plume; false Solomon's seal
**Ornithogalum umbellatum* L.	Star-of-Bethlehem
Polygonatum biflorum (Walter) Elliott	Solomon's seal
Polygonatum commutatum (Schult. & Schult. f.) A. Dietr Synonym: *Polygonatum biflorum* (Walter) Elliott var. *commutatum* (Schult. f.) Morong	Giant Solomon's seal
Trillium flexipes Raf Synonym: *Trillium gleasonii* Fern.	Drooping trillium
Trillium sessile L.	Sessile trillium
Uvularia grandiflora (Michx.) Salisb.	Large-flowered bellwort
Family Poaceae, the Grass Family (Graminae)	
**Agrostis gigantea* Roth Synonym: *Agrostis stolonifera* L. var. *major* (Gaudin) Farw.; *Agrostis alba* L., misapplied.	Redtop

Alopecurus carolinianus Walter	Meadow foxtail
Andropogon virginicus L.	Broomsedge
**Bromus inermis* Leyss.	Smooth brome
**Bromus japonicus* Thunb. ex Murray	Japanese brome
**Dactylis glomerata* L.	Orchard grass
Danthonia spicata (L.) P. Beauv. ex Roem. & Schult.	Poverty oat grass
**Digitaria ischaemum* (Schreb.) Muhl.	Smooth crab-grass
**Digitaria sanguinalis* (L.) Scop.	Large crab-grass
**Echinochloa crusgalli* (L.) P. Beauv. var. *crusgalli*	Barnyard grass
Echinochloa muricata (P. Beauv.) Fern.	Barnyard grass
Elymus hystrix L. Synonym: *Hystrix patula* Moench	Bottlebrush-grass
Elymus macgregorii R. Brooks & J.J.N. Campbell	Early wild rye
**Elymus repens* (L.) Gould	Quackgrass
Elymus riparius Wieg.	Streambank wild rye
Elymus villosus Muhl. ex Willd.	Downy wild rye
Elymus virginicus L. var. *virginicus*	Virginia wild rye
**Festuca arundinacea* Schreb.	Tall fescue
**Festuca pratensis* Hudson	Meadow fescue
Festuca subverticillata (Pers) E. Alexeev Synonym: *Festuca obtusa* Biehler	Nodding fescue
Glyceria striata (Lam.) A. Hitchc.	Fowl manna grass
Hordeum pusillum Nutt.	Little barley
Leersia virginica Willd.	White grass
**Microstegium vimineum* (Trin.) A. Camus.	Japanese stilt grass
Muhlenbergia schreberi J. F. Gmelin.	Nimblewill
Panicum dichotomiflorum Michx.	Fall panic grass
Panicum spp.	Panic grasses
**Phalaris arundanacea* L.	Reed canary grass
**Phleum pratense* L.	Timothy
**Phragmites australis* (Cav.) Trin. ex Steud.	Common reed
**Poa annua* L.	Annual blue grass
**Poa pratensis* L.	Kentucky blue grass
Poa sylvestris Gray	Woodland blue grass
**Setaria faberi* Herrm.	Giant foxtail grass
**Setaria glauca* (L.) Beauv.	Yellow foxtail grass
**Setaria viridis* (L.) Beauv.	Green foxtail grass
**Sorghum halepense* (L.) Pers.	Johnson grass
Sphenopholis nitida (Biehler) Scribn.	Shiny wedgescale
Sporobolus spp.	Sporobolus
Sporobolus vaginiflorus (Torr. ex A. Gray) A. Wood	Poverty-grass
Tridens flavus (L.) A. Hitchc. Synonym: *Triodia flava* (L.) Smyth	Grease grass
Family Smilaceae, the Catbrier Family	
Smilax herbacea L.	Carrion-flower
Smilax tamnoides L. Synonym: *Smilax hispida* Muhl. ex Torr.; *Smilax tamnoides* L. var. *hispida* (Muhl. ex Torr.) Fern.	Bristly greenbrier
Family Typhaceae, the Cattail Family	
Typha angustifolia L.	Narrowleaf cattail

Literature Cited

Braun, E.L. 1916. The physiographic ecology of the Cincinnati region, Ohio. Biological Survey, Volume II, No. 3, Bulletin No. 7. Ohio State University, Columbus, Ohio.

Braun, E L. 1950. Deciduous forests of eastern North America. Blackiston Co., Philadelphia, PA. 596 p.

Braun, E.L. 1961. The woody plants of Ohio. Ohio State University Press, Columbus, Ohio. 362 p.

Braun, E.L. 1967. The Monocotyledoneae [of Ohio]: cattails to orchids. The Ohio State University Press, Columbus, OH. 464 p.

Conover, D.G., D.R. Geiger, and T. Sisson. 2016. Dormant season foliar spraying slows the spread of winter creeper, English ivy, and lesser periwinkle in wooded natural areas (Ohio). Ecological Restoration 34(1): 19-21.

Conover, D.G., and T. Sisson. 2016. Resurgence of native plants after removal of Amur honeysuckle from Bender Mountain Preserve (Ohio). Ecological Restoration 34(3): 187-190.

Cooperrider, T.S. 1995. The Dicotyledonae of Ohio, part 2: Linaceae through Campanulaceae. The Ohio State Universisty Press, Columbus, Ohio. 656 p.

Cooperrider, T.S., A.W. Cusick, and J.T. Kartesz (eds.). 2001. Seventh catalog of the vascular plants of Ohio. Ohio State University Press, Columbus, Ohio. 195 p.

Duba, L., and S.S. Brunsman. 1976. The history of Delhi Township. Delhi Township American Revolution Bicentennial Commission, Cincinnati, OH.

Durrell, R.H. 1961. The Pleistocene geology of the Cincinnati area, field trip 3. Geological Society of America guidebook for field trips, p. 47-57.

Durrell, R.H. 1977. A recycled landscape. Cincinnati Museum of Natural History Quarterly 14(2): 8-15.

Fisher, T.R. 1988. The Dicotyledoneae of Ohio, part 3: Asteraceae. Ohio State University Press, Columbus, OH. 280 p.

Fleming, R., and A. M. Johnson. 1994. Landslides in colluvium: landslides of the Cincinnati area, Ohio. USGS Bulletin 2059-B.

Gleason, H.A., and A. Cronquist. 1991. Manual of vascular plants of northeastern United States and adjacent Canada, second edition. New York Botanical Garden, New York, NY. 910 p.

Hedeen, S. 2006. Natural history of the Cincinnati Area. Cincinnati Museum Center, Cincinnati, OH.

Jester, J. 2009. In the footsteps of E. Lucy Braun: the vegetation on a forested ridge in Western Cincinnati. Senior thesis, Mount St. Joseph University, Cincinnati, OH.

Lerch, N.K., D.D. LeMaster, and W.F. Hale. 1980. An inventory of Ohio soils, Hamilton County. Ohio Department of Natural Resources Progress, Division of Lands and Soils. 67 p.

Riestenberg, M.M. 1994. Landslides in colluvium: anchoring of thin colluvium by roots of sugar maple and white ash on hillslopes in Cincinnati. USGS Bulletin, 2059-E.

Weishaupt, C. 1971. Vascular plants of Ohio, third edition. Kendall/Hunt Publishing Company, Dubuque, IA. 293 p.