Scio Township Natural Features Report and Management Plan

West Scio Preserve & Liberty Pond Nature Area

September 2021

Scio Township
827 N Zeeb Rd, Ann Arbor, MI 48103

Scio Township Natural Features Report

Scio Township, Ann Arbor, Michigan

Prepared by Anna Cone and James Johnson
September, 2021

Abstract

This document contains land history information for both West Scio Preserve and Liberty Pond Nature Area, local land-based knowledge, breeding bird survey and vegetative survey findings, and management objectives and actions. Management actions are broken down into short-term (0-3yrs), mid-term (3-5 yrs), and long-term (5-10yrs) goals.

Acknowledgements

Thank you to Hob Calhoun and Rita Clinthorne for their continued mentorship and support in the creation of this report. Thank you to Norm Roller for aiding in the methodology of the vegetative survey, Flip Jackson for sharing his localized bird knowledge, Elaine Brazin for sharing her land history knowledge, and Nat Siddall for sharing his localized vegetative knowledge.

We want to acknowledge the privilege of working and learning in the traditional homelands of the Anishinaabek. The *Ojibwe (Chippewa), Odawa (Ottawa)* and *Bodewadomi (Potawatomi)* people lived on and stewarded the land now known as the Great Lakes for hundreds of years before settlers created the colonial state which now allows us to live here and study/work in natural features management. These words are not enough, but may they serve as a reminder that we all, particularly those working in natural features management, must take actions to restore right relations and stand in solidarity with the Anishinaabek, the first people of this land.

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Executive Summary

The millage passed by the citizens of Scio Township in 2020 enabled the hiring of a team of two graduate students to serve as Natural Feature Management Interns at two Scio preserves for the summer of 2021. Over the course of 4 months, the intern team conducted public surveys, and performed a breeding bird survey and a vegetative survey on both West Scio Preserve and Liberty Pond Nature Area, garnering both formal and informal data to allow for the creation of a site-specific natural feature management plan for these two public green spaces in Scio Township.

West Scio Preserve, accessed from the end of Dino Drive, south of Jackson Road in Scio Township, is a 124-acre property made-up of Forested Wetland and Forested Upland. More specifically, Southern Hardwood Swamp and Dry-Mesic Southern Forest. Breeding bird surveys conducted at West Scio showed 56 species present, 21 confirmed breeding and 14 probable. As there is an intent to connect the two green-spaces with a pathway, the combined survey data are also valuable. In total, between Liberty Pond and West Scio, breeding bird surveys showed 67 species recorded. To illustrate the magnitude of these findings in just two green-spaces in Scio Township, Ann Arbor Parks has recorded 101 species using breeding bird surveys. Vegatative surveys at West Scio Preserve showed 21 species of tree, 29 pieces of saplings, shrubs, and climbing vines, and over 57 species in the herbaceous layer. Floristic Quality Assessment of these findings amounted to a total FQI of 30, with any quality between 1-19 ranking as low vegetative quality, and 20-35 as high vegetative quality.

Liberty Pond Nature Area, located off West Liberty road, is a 57-acre property covered in oldfield secondary succession plants due to the ecological disturbance caused by Ann Arbor Super Soils since the mid 1980s. Breeding bird surveys conducted at Liberty Pond showed 50 species present, 24 confirmed breeding and 7 probable. Vegetative Surveys showed 8 species of tree, over 33 species of saplings, shrubs, and climbing vines, and over 34 species in the herbaceous layer. Due to the ecological disturbance at West Liberty and the non-native species present, a Floristic Quality Assessment of the data amounted to a total FQI of 16, indicating low vegetative quality.

Survey boxes were placed at the entrance of West Scio Preserve and Liberty Pond with physical surveys and a QR code to a google survey. The surveys recorded data regarding how often visitors are engaging with the green space, how they learned about the space, when and how they engage, and their wishes for the property. Twenty-one responses were gathered, 10 from Liberty Pond, 4 from Marshall, 4 from West Scio, and 3 sans locations. The data from the limited number of surveys so far points towards people engaging with the green-spaces in Scio Township in a variety of ways, many discovering green-spaces by chance in passing by. Data is

continuing to be gathered on Saturdays at Scio Preserves events, and will hopefully shed more light on the ways in which visitors are engaging with green-spaces.

It is recommended that management at West Scio be focussed on protecting the outstanding natural features present. It is suggested that West Scio Preserve remain a preserve, and action be taken to protect certain natural features through invasive species removal and continued research.

It is recommended that management at Liberty Pond be focussed on maintaining it as an educational and community-enjoyed space. It is suggested that the invasive species at Liberty Pond be addressed through the angle of prairie restoration.

Introduction

This report is divided into four parts: The first part presents findings and recommendations for West Scio Park. The second part does the same for Liberty Pond Nature Area. The third part is Future Management. Lastly, the results of a survey are described that aimed to find out how users engaged with the park properties.

West Scio

Background

This section contains information on the location, geology, soils, hydrology, pre-settlement vegetation, post-settlement land use, and park land acquisition.

Location

West Scio Preserve is a 124-acre property accessed from the end of Dino Drive, south of Jackson Road in Scio Township.

Geology and Soils

West Scio Preserve is on glacial outwash sand and gravel and postglacial alluvium (W. R. Farrand, 1982). A full list of the soils present in West Scio Nature Preserve from a publication of the National Cooperative Soil Survey, collected between 1968-1973, can be found in Figure 1 (USDA Soil, 1977).

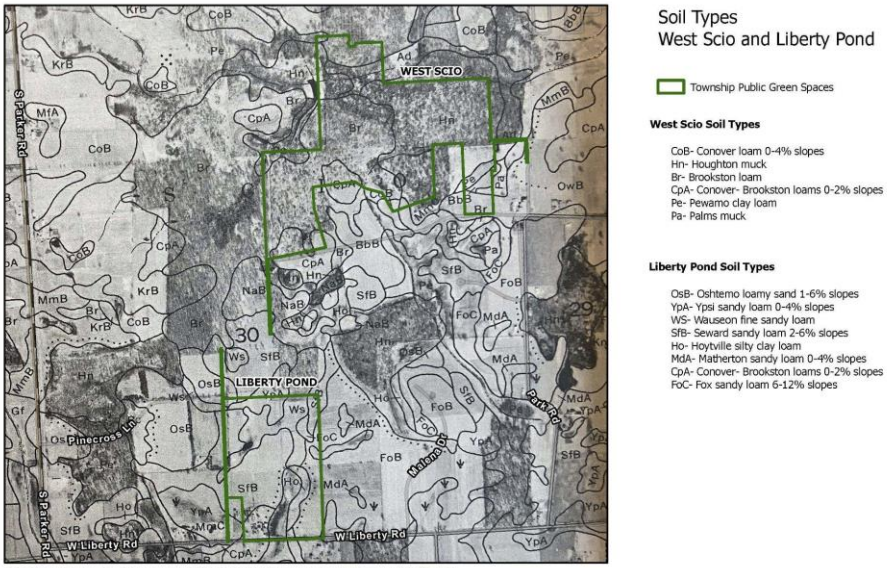


Figure 1. Property boundaries of West Scio Preserve and Liberty Pond Nature Area overlaid onto a map of soil types published by the National Cooperative Soil Survey.

The primary soil types at West Scio Nature Preserve are Brookston loam and Houghton muck. The brookston loam area shown in Figure 1 aligns with what presents as dry mesic southern forest today. The Houghton muck area aligns with what presents as southern hardwood swamp today.

Hydrology

There are currently roughly 180 contiguous acres of wetlands covering most of West Scio Preserve, as seen in Figure 2 (National Wetlands Inventory, 2020). A branch of Honey Creek crosses through the Eastern half of West Scio preserve from the northeast corner to the southern border of West Scio Preserve. The wetland habitat present at West Scio is Southern Hardwood Swamp.

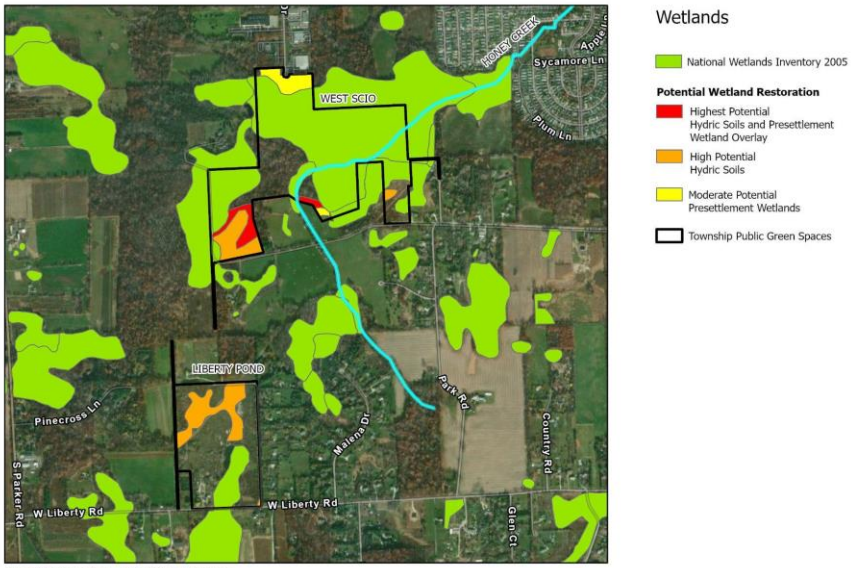


Figure 2. Property boundaries of West Scio Preserve and Liberty Pond Nature Area overlaid onto a map of wetlands and potential wetland restoration zones by the National Wetland Inventory.

Pre-settlement Vegetation

As shown in Figure 3, based on historical descriptions of the land and presettlement tree surveyor data from 1816-1856, West Scio Nature Preserve was primarily wet prairie and mixed hardwood swamp, with two smaller areas of black oak barren and mixed oak forest (Albert et al., 2008).

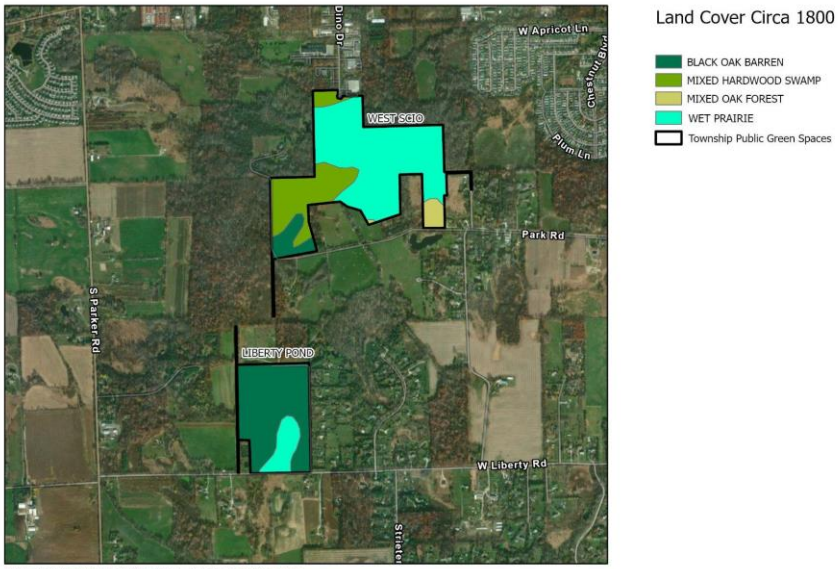


Figure 3. Property boundaries of West Scio Preserve and Liberty Pond Nature Area overlaid on a map of land cover circa 1800.

Oak barrens are a fire-dependent savanna type dominated by black and white oaks. The Anishinaabe, the First Nations people of Michigan, played an integral role in caring for the land. Native peoples living in or near Scio Township likely maintained the oak barrens through intentional fire.

According to the anthropological research of Wilbert Hinsdale, which is not comprehensive or fully representative of the life of native people in Michigan prior to, or during, settlement/colonization, a heavily used path and trade route passed through the southwest corner of West Scio preserve. The two trails that merged in order to create the path seen in

Figure 4 that passed through West Scio Preserve are the St. Joseph trail and Washtenaw trail.

Figure 4. Property boundaries of West Scio Preserve and Liberty Pond Nature Area overlaid on a map of Anishinaabe trade paths, burial mounds, and villages by Wilbert Hinsdale.

Post-settlement Land Use

Post European settlement, many wet prairies in Michigan, such as the one in West Scio Preserve circa 1800 shown in Figure 3, were converted into agricultural land, which is recorded to have occurred in West Scio Preserve (Smith, 2021).

Land History Interview with Sheldon Smith

Date: Sept 2, 2021
Interviewer: Anna Cone
Interviewee: Sheldon Smith

Sheldon Smith grew up walking the property that is now West Scio Nature Preserve, as his grandparents lived adjacent to the property. At around age 12 he was allowed to walk the land on his own, and he did. His exploration of the property ~60 years ago in conjunction with his

observations now as a property owner, gardener, and naturalist living adjacent to the preserve, provide for rich and meaningful land history data.

When Sheldon was exploring the property as a young boy scout ~60 years ago, the northeast Southern Hardwood Swamp, the location of the heron rookery, was drained and used as an open cow pasture. Sheldon estimates that the trees there now can't be older than 60/70 years.

Sheldon shared a general trend of increased biodiversity in the past 40 years. He noted increased vegetative, ornithological, and fish diversity on the property over this time period.

Sheldon notes that when he first bought the property, there were no signs of fish in the stream (Honey Creek). About 20 years ago he noticed cormorants, and a couple years later, "I saw little minnows when I was going down there… and a couple years later I saw a fish about this big that was the width of my finger...and then last year (2020) I saw a fish [with a head] about the size of my hand, and it looked like it was a muskie…" He has since noticed muskies swimming upstream toward the pond.

In terms of bird diversity, "it has just been steadily increasing over the 40 years." Sheldon states, "When I first moved in here... the diversity was not anywhere near where it is today. Until the past 2 years, I had not seen a warbler or heard a warbler out here. The wrens I have seen over the past 10 years. But I have seen more diversity in wrens the past couple of years."

He also notes increased tree falls, and that this summer (2021) is the wettest the swamp has been in the summer to his knowledge. He is familiar with the Southern Hardwood Swamp drying up in August and September, and then filling up again in October and November.

In terms of land management and wetland conservation, Sheldon recommends spot sampling runoff from Dino Drive and right after Scio Farms to assess water quality. In reference to the proposed Woodview Commons development North of West Scio Preserve, he recommends that stormwater retention areas be developed in preparation for at least 100 yr storms, if not 500 yr to control for flooding and inundation of the wetlands, which are already vulnerable to runoff. He also recommended lined retention ponds between the development and the property.

Park Land Acquisition

Over the last few years, Scio Township has been purchasing contiguous parcels of land to create West Scio Preserve, as shown in Figure 5. The 55 acre Jenkins Preserve was purchased first from Lee Jenkins. Just north is the Vander Haagen Preserve, which was purchased next from the Vander Haagen family at 30 acres. The Russel Preserve, Bennet Preserve, Graham Preserve, and Saalfeld Preserve were subsequently purchased from Regina Russel, Kathryn Bennett, Thomas and Catherine Graham, and Barb and Jerry Saalfeld. Scio Township was matched 50/50 by the Washtenaw County Natural Area Preservation Program for the cost of these parcels (Preserved Properties).

Figure 5. Parcel Map (MapWashtenaw)

Current Natural Features Status and Condition

The 124-acre property is made-up of Paulestrine- Class Forested Wetland and Forested Upland. More specifically, Southern Hardwood Swamp and Dry-Mesic Southern Forest, respectively (Kost, 2007). The landscape vacillates between walkable upland hickory and oak forest, and treacherous wetland inundated with standing water populated with Silver Maples and wetland herbaceous plants like skunk cabbage. In addition to the natural community types, there are two human-induced habitats, in-operation agricultural field, a Norway Spruce stand, as well as a vernal pool and a Great Blue Heron rookery (Cohen et al., 2020). Out -and-back foot paths that lead to the Vernal pool in the southwest corner can be found in the Dry-Mesic Southern Forest community type. There are currently no footpaths in the wetland.

Vegetation Status (Cover Types)

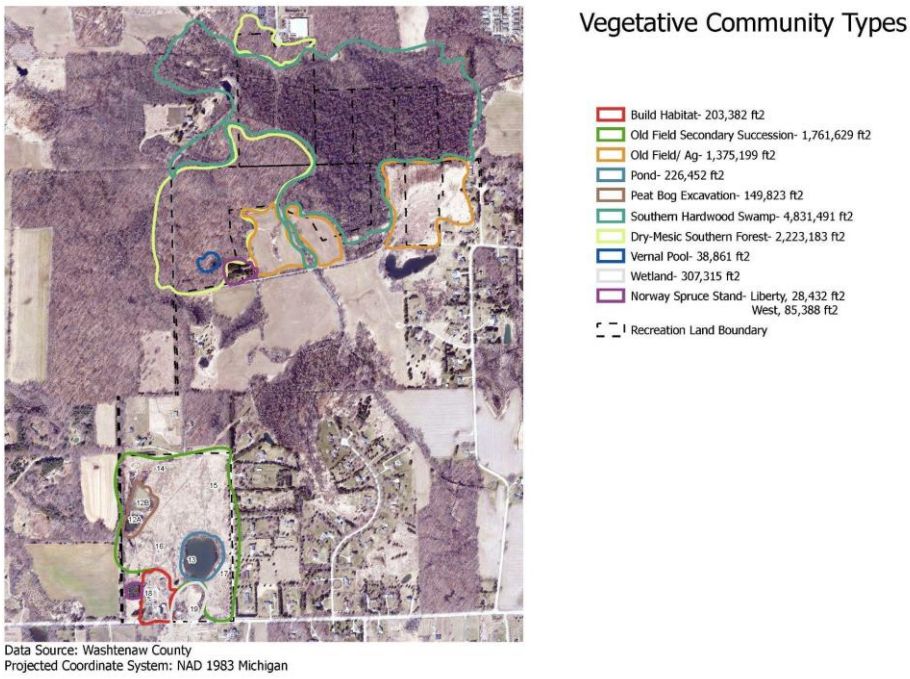


Figure 6. Property boundaries of West Scio Preserve and Liberty Pond Nature Area as well as color-coded representation of present vegetative community types.

Southern Hardwood Swamp

Southern Hardwood Swamps are dominated by lowland hardwoods, such as silver maple, red maple, green ash, and black ash. Southern Hardwood Swamps are sensitive to agricultural and residential upland development. They are ranked vulnerable (S3) by the Michigan Natural Features Inventory. This habitat type experiences seasonal fluctuations in water level, with standing water occurring throughout the winter and spring. Trees are shallowly rooted due to frequent inundation, which leads to fallen trees and unique microtopography, making space for a variety of herbaceous plants. This natural community type is known to be home to Great Blue Heron rookeries (Slaughter, 2009).

Management

Wetland conservation requires management of ground-water and run-off water quality, retention of coarse woody debri, management of adjacent uplands, and removal and monitoring of invasive species. With the goal of biodiversity conservation in mind, the best management practice is to keep large tracts of wetland unperturbed (Slaughter, 2009).

Dry-Mesic Southern Forest

Dry Mesic Southern Forests, also called oak-hickory forests, often occur on glacial outwash, the geology of West Scio Preserve. They are ranked as S3 by the Michigan Natural Features Inventory, uncommon in the state of Michigan, to reflect the community's vulnerability due to specific management needs (Lee, 2007).

Management

Dry-Mesic Southern Forests are fire-dependent and rely on frequent fires for oak tree regeneration and herbaceous diversity (Lee, 2007).

Vegetation Condition

At West Scio 21 species of trees, 29 species of shrub, vine, or sapling, and 57 different herbaceous species were identified during the vegetation survey. The most common tree species recorded was the American elm (*Ulmus americana*). The most common shrub, vine or sapling recorded was the green ash (*Fraxinus pennsylvanica*). In the herbaceous layer the most common species was false nettle (*Boehmeria cylindrica*). The plots positioned in the dry-mesic southern forest parts of the property had greater diversity of species than those in the southern hardwood swamp areas. In total only nine species recorded are considered introduced species. The most common ones were garlic mustard (*Alliaria petiolate*), common buckthorn (*Rhamnus cathartica*), and multiflora rose (*Rosa multiflora*).

None of the plants identified at West Scio are listed on the United States endangered species list. Nodding rattlesnake root (*Prenanthes crepidinea*) was identified on the property and is listed as threatened in the state of Michigan. Smooth carrion flower (*Smilax herbacea*) was also identified and is listed as a special concern in Michigan.

The floristic quality assessment (FQA) produced a coefficient of conservatism (C) for all plants and for just the natives, 3.4 and 3.8 respectively. These numbers indicate that a majority of the species recorded are not rare or specialists. A total floristic quality index (FQI) of 30 was calculated. This indicates that the vegetation condition on the property is of high quality.

Wildlife Habitat

At West Scio there were 56 unique species of bird seen or heard during the breeding bird survey. A total of 21 species were able to be confirmed as breeding on the property. The blue jay (*Cyanocitta cristata*), hairy woodpecker (*Leuconotopicus villosus*), and red-bellied woodpecker (*Melanerpes carolinus*) were all confirmed breeding in three separate units, the most in that category. Overall, the northern cardinal (*Cardinalis cardinalis*) was recorded in the greatest number of survey units.

None of the species recorded are listed on the United States endangered species list. The red-headed woodpecker (*Melanerpes erythrocephalus*) is listed as a special concern in the state of Michigan. The only non-native bird species observed was the European starling (*Sturnus vulgaris*).

Outstanding Features

Great Blue Heron Rookery

Near the northeast corner of West Scio Preserve there is an active Great Blue Heron rookery comprised of ~57 nests as of 5/24/21. Great Blue Herons are common permanent residents of Michigan, classified as a vulnerable population due to their specific colonial nesting behavior and the decline of available nesting sites (Cuthrell, 2004). According to local observation, this Heron rookery coalesced in 2019 (Smith, 2021). As seen in Figure 7, there is currently a proposed mixed-use development north of the rookery that comes within the recommended 300 meter (984.25 ft) buffer zone supported by the literature reviewed by both the Natural Resource Management Interns and Matt Iknken, Environmental Consulting & Technology, Inc. (ECT). Scio Township Parks, Preserves, and Pathways is currently in conversation with the Scio Township Board of Trustees and the developer of Woodview Commons, attempting to reach a conclusion that protects the Great Blue Heron rookery from disturbance.

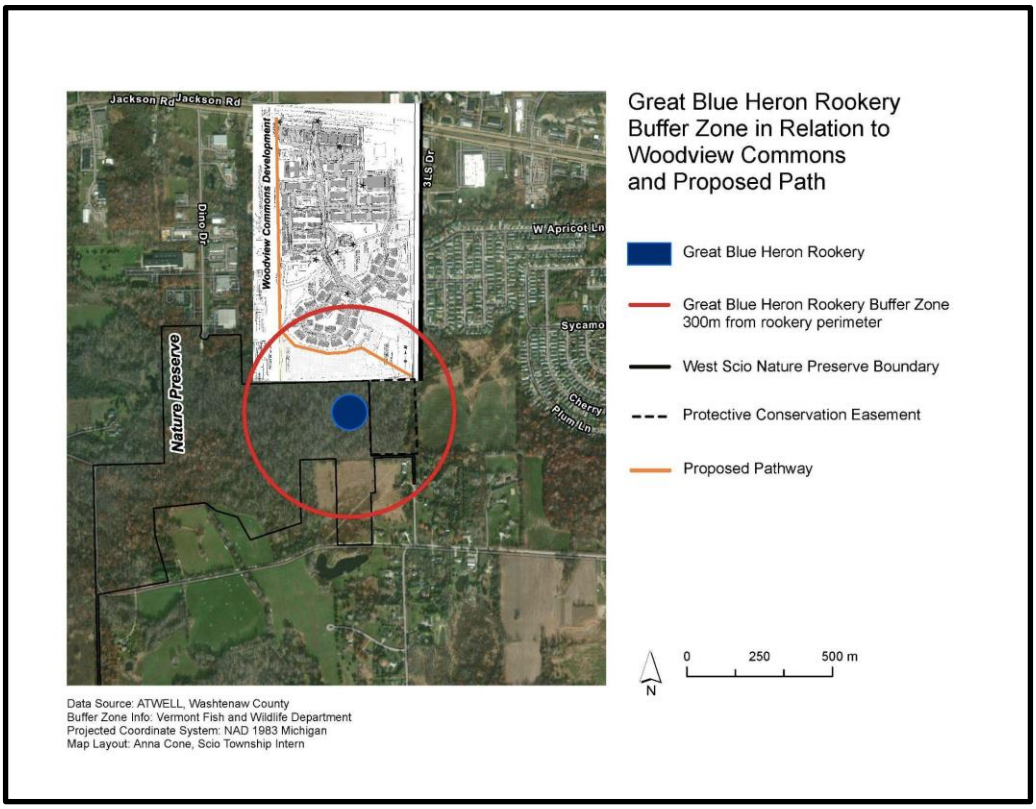


Figure 7. Property boundaries of West Scio Preserve and georeferenced image of proposed development plan, Woodview Commons, in relation to the Great Blue Heron Buffer Zone (300m).

Vernal Pool

As shown in Figure 6, in the southwest corner of West Scio Preserve, in the dry-mesic southern forest natural community type, lays a vernal pool, roughly 47.28 m (155.12 ft) in diameter at its largest. From June to August of 2021, the Natural Feature Management Interns observed marked fluctuation in the size of the pool after rains, with a general trend towards shrinking as the summer progressed, a common pattern for Michigan vernal pools (Thomas, 2010). Further research is needed to assess the health of the vernal pool at West Scio Preserve, and to determine further conservation and management needs moving forward.

Future Management

Park vs Preserve

"The primary intent of a park is to maintain open space and provide recreational opportunities…the primary goal of a preserve, however, is to protect the land's natural features" (Scio Township Master Plan, 2018, p.38). In lieu of the more sensitive features at West Scio Preserve, such as the Heron rookery, vernal pool, fire-dependent natural community, wetland, and FQI of 30 with only 9 out of 78 observed plant species being introduced, we maintain that it remains a preserve, and created a management plan accordingly.

Management Actions

Management at West Scio should be focussed on protecting the outstanding natural features present. This includes the natural features observed by citizen scientists and natural feature interns presented in this report, as well as the features yet to be documented through critical future research projects.

Short-term

<u>Parks and Recreation Advisory Board Sub-Committee</u>

A team of people dedicated to protecting the outstanding natural features present in Scio Township is needed to ensure that West Scio remains a diverse and beautiful green space. The preservation of these natural features depends on land management, and management depends on people. In order for this management plan to be successful, the green-spaces need a land management team. We propose that the Parks and Recreation Advisory Board form a sub-committee committed to the land management of Scio Township green-spaces.

<u>Heron Rookery</u>

The 300m buffer zone supported by the literature reviewed by both the Natural Resource Management Interns and Matt Iknken, Environmental Consulting & Technology, Inc. (ECT), should be respected in West Scio Nature Preserve, as habitat loss and disturbance are contributing factors to rookery abandonment.

Vernal Pool

Research is needed to better understand, classify, and protect the vernal pool in the southwest corner of West Scio Preserve. With better knowledge of the hydrology, water quality and species present, a management plan can be developed to protect this unique feature. Recommended buffer zones between roads and vernal pools are at least 100 m (330 ft) wide, with buffer zones up to 300 m (1,000 ft) for certain land development (Calhoun and deMaynadier 2008). Seeing as the vernal pool is bordered on the south and the west by Musolf Lane, we recommend that more research be done regarding disturbance during amphibian breeding period. Some recommendations for vernal pool management are providing loafing habitat for turtles and snakes, vegetating the littoral zone, and creating multiple vernal pools in one area for migrating individuals (Melvin, 2003).

Wetlands

Ecological monitoring of the hydrology of the wetlands in West Scio Nature Preserve should be a first priority. Understanding the hydrology will allow for more research in vegetation, amphibian and reptile populations (Melvin, 2003). Preserving the wetlands will involve management of noxious and invasive species present both in the southern hardwood swamp and the dry mesic southern forest. Introduced plants can provide a true threat to the health of wetlands as they pose a threat to the native species occupying the wetland. In West Scio Preserve, the introduced species recorded and in need of short-term management are garlic mustard (*Alliaria petiolate*), common buckthorn (*Rhamnus cathartica*), and multiflora rose (*Rosa multiflora*). While these three populations are present, they are primarily present in the dry-mesic southern forest. In the wetlands, there are small satellite infestations. In the wetland habitat, physical eradication of these satellite infestations is essential for the continued health of the native plants in West Scio Nature Preserve.

Dry-Mesic Southern Forest

Introduced plant management in the dry-mesic southern forest habitat may be best approached through physical eradication and controlled burns, as there is likely already a developed seed bank. Dry-Mesic Southern Forests are fire-dependent and rely on frequent fires for oak tree regeneration and herbaceous diversity (Lee, 2007). Regular controlled burns will not only provide for management of introduced and invasive species, but will also encourage the reintroduction of oak as a dominant canopy tree in the habitat type. Research shows that fires during the growing season (May) are most effective in removal of garlic mustard, while Fall fires might lead to larger populations (Landis et al.).

Mid-term

Paths

Both informal conversations and survey results suggested that folks engaging with West Scio Preserve and Liberty Pond would like to see more trails. Due to habitat type and an aim to protect natural features, we don't recommend increased pathways in West Scio Preserve. However, we recommend that the Township continue the development plans of the 2 mile trail running between West Scio Nature Preserve and Liberty Pond. With this connector-path we acknowledge the potential spread of invasive species from one property to another. Ideally the creation of this path is in tandem with the implementation of an invasive species management plan.

Long-term

Wetland Restoration

Based on soil type and wetland data from presettlement vegetation surveys, potential wetland restoration has been demarcated in certain areas of West Scio Preserve, as seen in Figure 2. The highest potential wetland restoration is located in the southwest corner of the preserve. A long-term management goal can be to restore the wetlands to provide increased runoff interception, as well as habitat for amphibians, reptiles, and wetland vegetation.

Heron Rookery

We recommend the purchase and preservation of land around the northeastern corner of West Scio Preserve in order to protect the great heron rookery. This recommendation is elaborated upon on page 28 of this report under the headline, Future Expansions.

Liberty Pond

Background

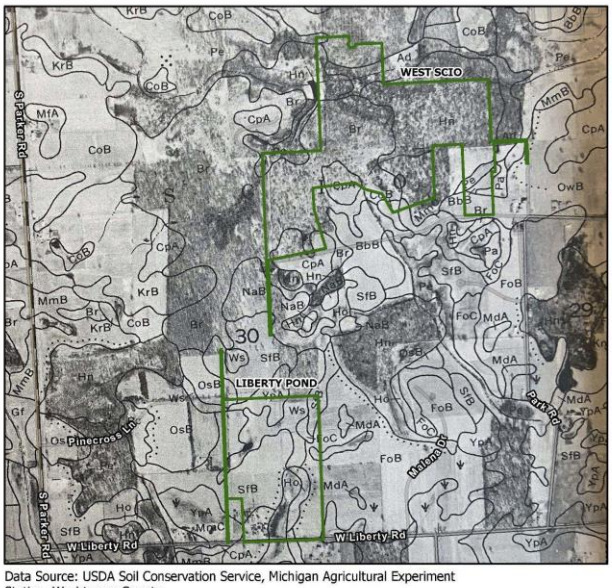
This section contains information on the location, geology, soils, hydrology, pre-settlement vegetation, and post-settlement land use.

Location

Liberty Pond Nature Area is a 57 acre property located off West Liberty road in Scio Township that opened in 2021.

Geology and Soils

Due to its close proximity to West Scio Preserve, Liberty Pond has the same geologic features. It exists on a glacial outwash sand and gravel and postglacial alluvium.



Data Source: USDA Soil Conservation Service, Michigan Agricultural Experiment Station, Washtenaw County
Projected Coordinate System: NAD 1983 Michigan

Soil Types
West Scio and Liberty Pond

Township Public Green Spaces

West Scio Soil Types

CoB- Conover loam 0-4% slopes
Hn- Houghton muck
Br- Brookston loam
CpA- Conover- Brookston loams 0-2% slopes
Pe- Pewamo clay loam
Pa- Palms muck

Liberty Pond Soil Types

OsB- Oshtemo loamy sand 1-6% slopes
YpA- Ypsi sandy loam 0-4% slopes
WS- Wauseon fine sandy loam
SfB- Seward sandy loam 2-6% slopes
Ho- Hoytville silty clay loam
MdA- Matherton sandy loam 0-4% slopes
CpA- Conover- Brookston loams 0-2% slopes
FoC- Fox sandy loam 6-12% slopes

Figure 8. Property boundaries of West Scio Preserve and Liberty Pond Nature Area overlaid onto a map of soil types published by the National Cooperative Soil Survey.

The primary soil types at Liberty Pond are Seward sandy loam, Wauseon fine sandy loam, and Hoytville silty clay loam. The Hoytville silty clay loam area in the map above aligns with what presents today as a large pond and wet meadow. The Wauseon fine sandy loam and Seward sandy loam areas present similarly today as old field secondary succession, as seen in figure 8.

Hydrology

According to the National Wetlands Study in 2005, Liberty Pond currently has an area of wetlands in the southern portion of the property, as seen in Figure 9. This area includes the largest pond and the wet meadow present on the property. The northern half of Liberty Pond has high potential hydric soil, soils which are inundated with water long enough during the growing season to develop anaerobic conditions.

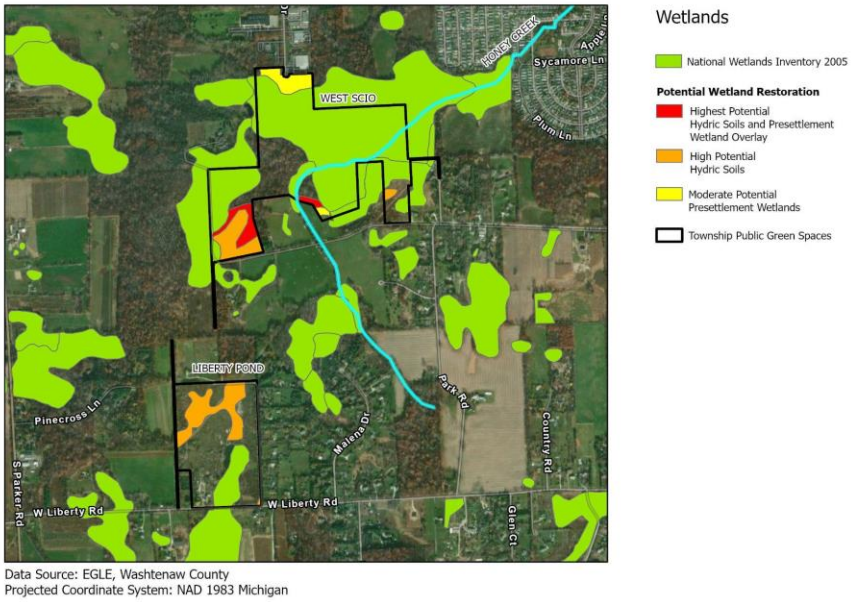


Figure 9. Property boundaries of West Scio Preserve and Liberty Pond Nature Area overlaid onto a map of wetlands and potential wetland restoration zones by the National Wetland Inventory.

Pre-settlement Vegetation

Based on descriptions of the land and presettlement tree surveyor data from 1816-1856, Liberty Pond Nature area was primarily black oak barren with a section of wet prairie (Albert et al., 2008). Oak barrens are a fire-dependent savanna type dominated by black and white oaks. The Anishinaabe, the First Nations people of Michigan, played an integral role in caring for the land. Native peoples living in or near Scio Township likely maintained the oak barrens through intentional fire.

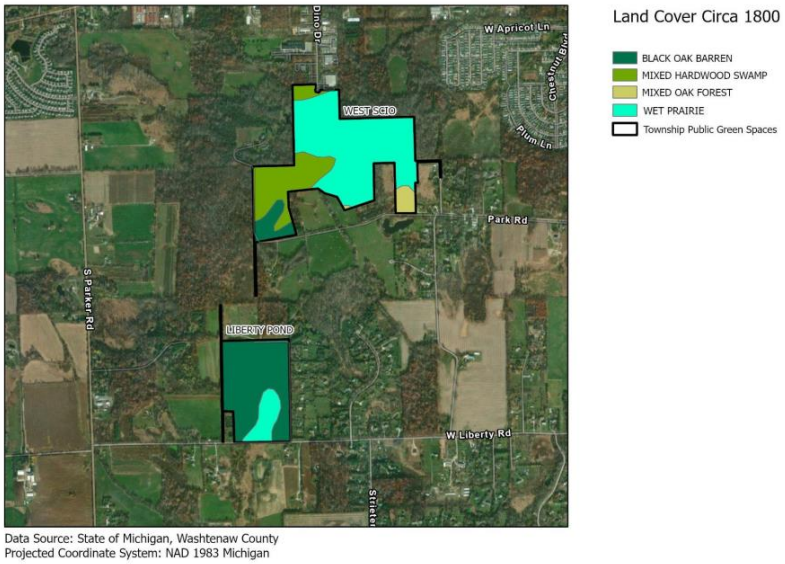


Figure 10. Property boundaries of West Scio Preserve and Liberty Pond Nature Area overlaid on a map of land cover circa 1800.

Post-settlement Land Use

After the opening of the Erie Canal in 1825, descendants of English pioneers settled on the East Coast and Ontario began arriving in Michigan. The parcel we know today as Liberty Pond was settled by the Thomas Smith family (Brazin, 2021; Hedberg). Thomas Smith died ca. 1851-1869, leaving his homestead to his three daughters, Sara E., Margaret Jane, and Mary Ann. In 1894, Fred Frey, Margaret's neighbors' son in law, became the owner of the parcel. Frey and his wife Jedel were from Germany, and participated in the German farming culture of Scio at the time. Their son, Adolph married to Minnie, is noted as the landowner in the 1910 census. The land then moved hands to their daughter, Ruth Emma Frey, who married Paul Rueben Wild.

Paul Wild had farm animals and an apple cider operation, and ran his farm with the help of many Scio Township German settlers. In 1976/77 the Wilds sold their farm to Ernest Bateson. Bateson formed Ann Arbor Super Soils, and removed roughly 50% of the top soil from Liberty Pond Nature Area and sold it as rich agricultural soil (Hedberg).This massive ecological disturbance made Liberty Pond Nature area what it is today, as shown in Figure 11.

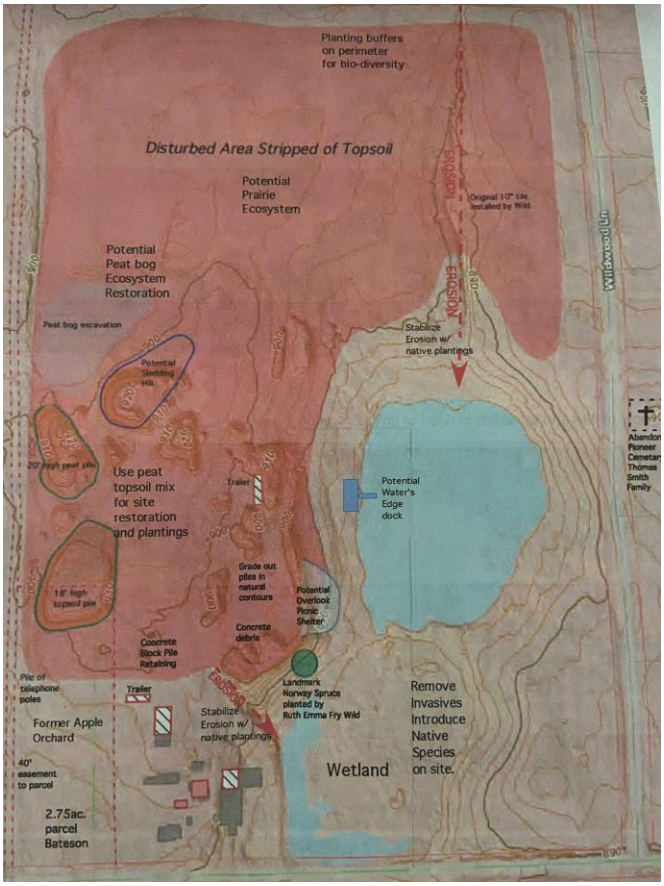


Figure 11. Liberty Pond property review by Scott C. Hedberg, Hedberg Associates, LLC

Land History Interview with Elaine Brazin

Date: Sept 6, 2021
Interviewer: Anna Cone
Interviewee: Elaine Brazin

Elaine Brazin is a neighbor to Liberty Pond, and an avid collector of land history knowledge. She became interested in the history of the land that is now Liberty Pond upon discovering an old cemetery belonging to the Smith family near her home. She found a gravestone in pieces that belonged to Ursula Nutty Richardson, likely the cousin of Thomas Smith, the original European settler of the land. Elaine's knowledge informed much of the above post-settlement land history section of the report.

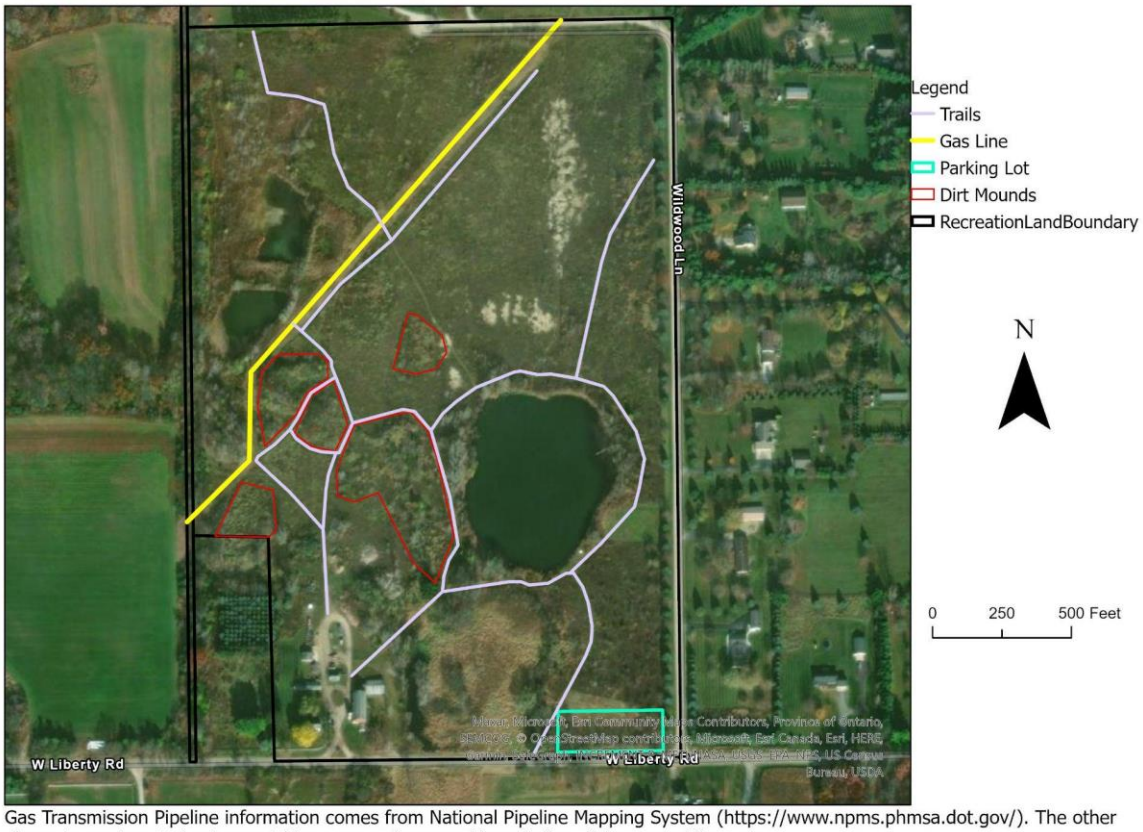
On top of having a detailed understanding of land ownership history and past residents of the space, Elaine also has place-based knowledge as a neighbor to Liberty Pond and a regular visitor with her dogs. Elaine informed me of John Swales and Judy Lobato, who "come out a couple times a year... and catalog butterflies." Their butterfly survey data collected with Marcy Breslow can be found in the appendix. Elaine also noted changes in the ponds overtime. The large human-dredged pond was stocked with bluegills by Paul Wild, and was named "Shannon Lake" by Mr. Bateson after his daughter. The pond near Liberty road "used to be a really clear blackwater pond, and now it's all green scum. You used to see 20-30 turtles sunning themselves on the logs. Now you don't see them anymore." Elaine also noted American Coots that nest in the marsh, and multiple pairs of Sandhill Cranes that "were [nesting] here every year for 25 years up until 2 years ago."

Elaine also noted succession occurring on the land, noting that "the cottonwoods weren't there 5 years ago, and the willows weren't there either. It was completely flat and bare."

Current Natural Features Status and Condition

Most of Liberty Pond is covered in oldfield secondary succession plants. Few tree species are present with cottonwoods and willows being dominant around the ponds. The property has three ponds on it with the largest located in the southeast covering roughly 6.2 acres. The ponds are surrounded by the thickest vegetation and most of the trees at Liberty Pond. Next to the largest pond is a wet meadow that is about 6.8 acres in size, containing many wetland plants such as cattails and nettles. To the west of the largest pond is a set of five topsoil mounds outlined in figure 12. These mounds contain the topsoil from the rest of the property and because of this contain a unique variety of species, many non-native. In the southwest part of the property there is a developed area. This area contains the house, barn, and out buildings from when the property was used as a farm. Running diagonally under the property from the northern side to the western side of the property is a buried gas transmission line that is also used as part of the trails. Most recently added to the property is a gravel parking lot. This is located in the southeastern corner of the property and provides enough parking for six cars and

a turn around for buses. Running from the parking lot, encircling the largest pond, and branching off to the northeastern corner, topsoil mounds, and the two other ponds is a walking trail.



Gas Transmission Pipeline information comes from National Pipeline Mapping System (https://www.npms.phmsa.dot.gov/). The other elements are inputted using aerial imagery and personal knowledge of the ground features.

Figure 12. Liberty Pond property features

Vegetation Status (Cover Types)

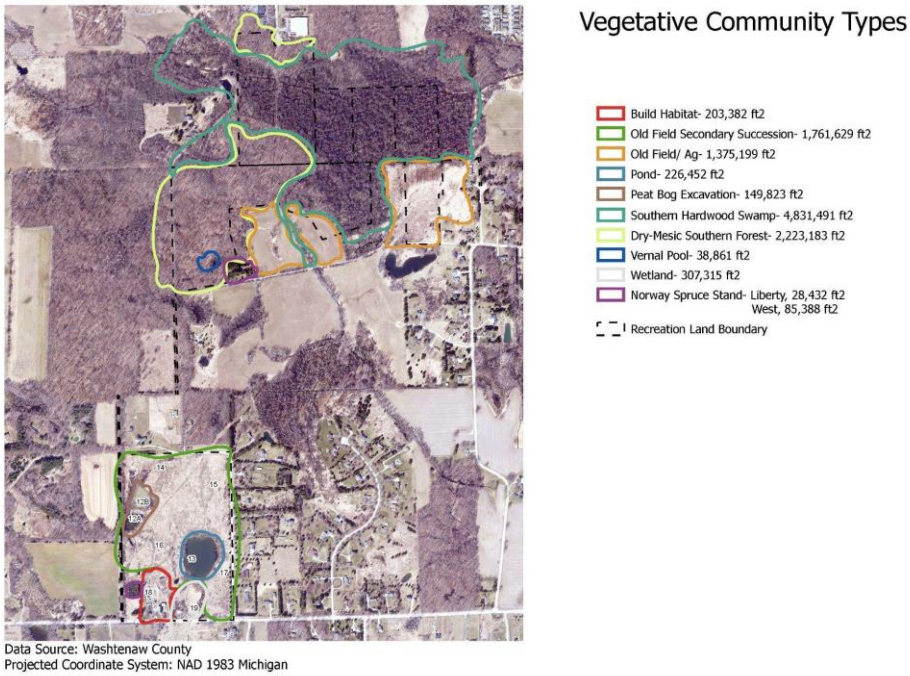


Figure 13. Property boundaries of West Scio Preserve and Liberty Pond Nature Area as well as color-coded representation of present vegetative community types.

The type of plant communities at Liberty Pond are challenging to categorize. This is in part due to the recent disturbance of the land and the large percentage of non-native species present. The best current classification would be an old field in secondary succession with floodplain forests around the ponds and a wetland, specifically southern wet meadow next to an area of developed land.

<u>Old Field Secondary Succession</u>

Secondary succession happens after a major event or disturbance has occurred to a natural area, altering its look and the flora and fauna that are present (Britannica, n.d.). On this property the disturbance was farming and then removal of the topsoil. Over time the plant community will recover and generally come back starting with pioneer species, intermediate species, and lastly a climax community will be established.

The vegetation survey done at Liberty Pond, provided a context for the type of plant communities present and what type of management strategy is appropriate. One option is to do no restoration and let nature take its course. Currently, it appears that the old field succession is in between the biennial and perennial phase and the shrub phase (Sargent, M.S. and Carter, K.S., 1999) From the data collected it is evident that non-native species are very abundant on this property. Almost 50% of the species recorded are considered non-native. With this many non-natives present, the succession of native species are hindered and species composition can be altered (Flory, S.L. and Clay, Keith, 2010; Kuebbing et al., 2014). By doing no restoration, the property is left to be overrun by non-natives which will eventually spread to neighboring properties.

In this section, the topsoil mounds are grouped into the management recommendations for the old field. Managing and restoring the old field at Liberty Pond to a prairie makes sense in the context of what is currently there. Prairie communities are dominated by big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), and Indian grass (*Sorghastrum nutans*) (Cohen et al., 2020). None of these grass species are specifically listed in the vegetation findings but the overall grass genus Poa is listed. Other species that are listed in the vegetation findings and are found in prairies include milkweed (*Asclepias spp.*), goldenrod (*Solidago spp.*), and sumacs (*Rhus spp.*) (Cohen et al., 2020). To maintain the openness of a prairie, frequent fires played an important role. Without them, the area is quickly colonized by shrubs and trees (Krost, M.A., 2010). Surprisingly ants, more so ant mounds, provide more evidence that this area is a good candidate for prairie restoration. While not captured in neither the bird nor the vegetation surveys done on the property, anecdotally there were a surprising number of ant mounds spread throughout the property. In relatively short periods of time, they can mix and aerate soils (Krost, M.A., 2010).

Prairies are important ecosystems that provide habitat for many species. Many songbirds such as sparrows and the eastern meadowlark and predatory birds such as owls and shrikes use open prairies for nesting or hunting (Krost, M.A., 2010; Michigan DNR, 2017). The eastern massasauga rattlesnake (*Sistrurus catenatus*), the only northern rattlesnake, also partially relies on prairies for habitat. Currently it is listed as federally threatened in the United States, in part due to declining habitat (US Fish and Wildlife, 2020). In Michigan, prairies have been severely reduced in the last 150 years because they were considered prime farming areas (Michigan DNR, 2017).

Floodplain Forests

Floodplain forests occupy low-lying areas and are subject to flooding throughout the year. The soil in these areas are generally nutrient rich. The vegetation along these areas are important to reducing water flow and sediment transportation. Woody debris from the floodplain also provides important habitat for many different aquatic species. Some of the common plant species include cottonwoods, ashes, willows, poison ivy, and virginia creeper (Cohen et al. 2020).

In the floodplain forests around the ponds, there is a decent number of native shrubs and trees such as willows (*Salix spp.*), silky dogwood (*Cornus amomum*), and riverbank grape (*Vitis riparia*). There are also native herbaceous plants like the allegheny monkey flower (*Mimulus ringens*), Canada bluejoint (*Calamagrostis canadensis*), and rough horsetail (*Equisetum hyemale*) found here. With this diversity of native species, removal of competing non-native species should help the ecosystem. The big problem species are tartarian honeysuckle (*Lonicera tatarica*), common buckthorn (*Rhamnus cathartica*), *Phragmites australis*, narrowleaf cattail (*Typha angustifolia*), and purple loosestrife (*Lythrum salicaria*).

Southern Wet Meadow

Southern wet meadows are open, groundwater-influenced wetlands. The open conditions on these sites are maintained by seasonal flooding, fires, or even beavers. Tussock sedge and bluejoint grass are generally the dominant species. Other common species include cattails, dogwoods, willows, and asters (Cohen et al. 2020).

In the southern wet meadow Canada bluejoint (*Calamagrostis canadensis*), spotted joe-pyeweed (*Eutrochium maculatum*), and false nettle (*Boehmeria cylindrical*) are all common native plants. There were two main non-native species present, narrowleaf cattail (*Typha angustifolia*) and *Phragmites australis*. Managing these two species will greatly reduce the competition felt by the native species in the area.

Vegetation Condition

At Liberty Pond in the quadrats there were eight species of trees recorded in the vegetation survey. Boxelder (*Acer negundo*) was the most common tree species recorded. In sampling the shrubs, vines, and saplings, seven species were found to be very common. They are tartarian honeysuckle (*Lonicera tatarica*), multiflora rose (*Rosa multiflora*), common buckthorn (*Rhamnus cathartica*), autumn olive (*Elaeagnus umbellate*), riverbank grape (*Vitis riparia*),

boxelder (*Acer negundo*), and callery pear (*Pyrus calleryana*). In the herbaceous layer, goldenrod (*Solidago spp.*) was the most common species.

In the belt transects at Liberty Pond, sandbar willow (*Salix exigua*) was the most common species in the trees, shrubs, and vine samplings. *Phragmites australis* was the most common species recorded in the herbaceous layer. In the southern wet meadow just three species, Canada bluejoint (*Calamagrostis canadensis*), narrowleaf cattail (*Typha angustifolia*), and spotted joe-pye weed (*Eutrochium maculatum*), dominated the area.

None of the species recorded at Liberty Pond are on the United States endangered species list or the Michigan natural inventories endangered species list. There were 40 species recorded that are considered non-native species.

The FQA for Liberty Pond produced a total mean C of 1.6 and a native total mean C of 3.1. This indicates that the non-native species are prevalent on the property. The total FQI for Liberty Pond is 14.8, indicating low vegetative quality.

Wildlife Habitat

At Liberty Pond 50 species of bird were seen or heard during the breeding bird survey. A total of 24 species were able to be confirmed as breeding on the property. The American robin (*Turdus migratorius*), northern cardinal (*Cardinalis cardinalis*), red-winged blackbird (*Agelaius phoeniceus*), and song sparrow (*Melospiza melodia*) were recorded in all 8 survey units at Liberty Pond.

None of the species at Liberty Pond are listed on the United States endangered species list. The trumpeter swan (*Cygnus buccinator*) is listed as threatened in the state of Michigan. The European starling (*Sturnus vulgaris*), house finch (*Haemorhous mexicanus*), and house sparrow (*Passer domesticus*) are all considered introduced species in Michigan. The house finch is unique because it is considered native in Mexico and the western United States.

Future Management

Outdoor Education

The proposed management plan for Liberty Pond takes into account the outdoor education currently taking place on the property with Ann Arbor school districts, as well as potential future outdoor education. Not only is Liberty Pond geographically suited for outdoor education with the open field plan, ponds, and wildlife, the site is also currently an incredible example of succession after ecological disturbance. With the implementation of the proposed management plan, the site could potentially be an equally exemplary case study in restoration. Through first person accounts of land history, the landscape take-over by invasive species at Liberty Pond has been well documented. In order to maintain Liberty Pond as an outdoor education facility, to keep the ponds, the explorable open landscape, and the wildlife present, management of invasive species is needed.

If restoration of the property happens in the future, this can be incorporated into the educational experience at Liberty Pond. Future students can be taught about invasive species and their impact on the environment and the methods with which they are controlled. The importance that fire plays in certain ecosystems can also be put on display here. Informing the public through educational signage or other means at Liberty Pond is important in keeping the local community informed and abreast of the progress. For some, they may have never received any form of ecological restoration education.

Citizen science is a great way to democratize science and promote equitable access to data. Many different kinds of citizen science have been used over the years with varying degrees of success(Sherbinin et al., 2021). For West Scio and Liberty Pond smartphone apps such as iNaturalist and eBird can easily be used by the public. These apps can help track changes in vegetation and bird trends over time.

Park vs Preserve

Liberty Pond Nature Area has a low FQI of 16, with 40 out of 89 observed plant species being non-native. Two options for this property include turning it into a Scio Township Park or using restoration to turn it into a native prairie. After informally speaking with people who visit Liberty Pond and reviewing the surveys, turning Liberty Pond into a park with paved pathways and picnic tables has been met with mixed feelings. With the data from the vegetation survey

and the proximity to West Scio, attempting to restore this property to a prairie is the recommended course of action. The goal should be to restore Liberty Pond by decreasing the abundance of non-native species and increasing the quality of habitat for native species. Below a strategy is put together, pulling from multiple restoration guidelines, that will help achieve this goal.

Management Actions

Short-term

Parks and Recreation Advisory Board Sub-Committee

A team of people dedicated to protecting the outstanding natural features present in Scio Township is needed to ensure that Liberty Pond moves in the direction of restored prairie. The mitigation of invasive species is dependent on land management, and management depends on people. In order for this management plan to be successful, the green-spaces need a land management team. We propose that the Parks and Recreation Advisory Board form a sub-committee committed to the land management of Scio Township green-spaces.

Paths

From an ecological perspective, it makes sense to protect an area around the largest pond, as it proved to be a popular nesting site on the property. The only change to the existing pathways we suggest is protecting the westward edge of the largest pond by removing the pathway from the edge of the pond. It is important to note that there are many stakeholders involved, such as neighbors who have been visiting the land for decades, neighbors who mow paths on the property, outdoor educators and their students, and groups of neighbor children. In order to make a well-informed recommendation for pathways at Liberty Pond, ideally stake-holders would be heard in the decision making process.

Old Field

The first step to take in restoring Liberty Pond to a prairie is site preparation. When a site has been heavily invaded by non-native grasses and other herbaceous plants, reestablishing a native seed bank is helpful to long-term success (Trowbridge et al., 2017). In the first couple of years, the field should be prepared for seeding. This can be done in a variety of ways. Tilling the field can kill the current generation of plants and prepare the soil for native plantings (Sargent, M.S. and Carter, K.S., 1999). A late spring or early summer prescribed burn of the whole field is another way to prepare the field. Roughly a month after the burn a treatment with herbicide

should be used to kill off regrowth. The following year, another prescribed burn and herbicide treatment should be used to kill off the plants that resprouted from the seed bank (Phillips-Mao et al. 2017; O'Connor, R., 2016). In mid to late fall of the first year, any large bushes, saplings, or trees in the old field should be treated using the cut-stump method (Woody Invasive of the Great Lakes Collaborative).

In the second year, at least two weeks after the herbicide application, seeding of the area can happen. Local seed suppliers should be contacted about native prairie seedling availability and planting timing. These can vary year to year depending on seed availability and weather timing. The area should be sown using a no-till drill or broadcast spreader. These methods will limit the amount of soil disturbance limiting non-natives from recolonizing (NRCS 2006; Phillips-Mao et al., 2017). Ideally this should take place over the full area of the old field.

Floodplain Forests and Southern Wet Meadow

Most of the invasive species in these areas can be controlled with herbicide foliar spray. Foliar spraying should be done either early spring or late fall. At these times most native plants are still dormant and accidental non-target spraying is reduced (Borland et al., 2009). For shrubs or trees that are past the sapling stage, cut stump treatment is the best option. This involves cutting the plant low to the ground and then applying herbicide to the stump (Borland et al., 2009). In the first year of treatment all large invasive shrubs and trees should be eliminated using the cut-stump treatment. Along with this all herbaceous plants and seedlings of the shrubs and trees should be treated with a foliar spray application.

Two invasive species on this property require special attention and may not ever be fully eradicated due to how aggressive of an invader they are. Narrow-leaved cattails (*Typha angustifolia*) can be hard to control and are not always necessary to control. In cases where it has altered the native flora and is a monoculture, steps can be taken to decrease its numbers (Bansal et al., 2019). Foliar herbicide has been found to be effective in the past, along with cutting and then flooding of the area (Borland et al., 2009). The other species that is hard to control is *Phragmites australis*. *Phragmites* can form dense monoculture stands and grow up to 20 feet tall, out competing all most other natives in the area (Michigan DNR, 2014). In stands of *Phragmites* that have become well established, like those at Liberty Pond, multiple methods are needed to control the population. In the first year of management herbicide should be applied in late summer or fall. In the following summer or fall, a prescribed burn of the area should take place. This will clear the area of the dead stems, providing a chance for native plants to recolonize and making it easier to spot treatment regrowth of *Phragmites* (Borland et al. 2009; Gettys et al., 2020; Michigan DNR, 2014).

Ponds

Due to limited time and resources, no detailed study was able to be completed of the ponds. To better understand what, if any, kind of management strategies should be implemented in the ponds a detailed study will need to be conducted.

Mid-term

Old Field

After the planting it is vitally important to keep weeds and non-native species under control until the native seeds can establish themselves. If there are large patches of non-native plants coming in, mowing these areas once they reach a height of 12 to 18 inches. This may need to be done multiple times a year (Phillips-Mao, 2017). Another option is spot treatment with herbicide. Different herbicides and treatment seasons can be used to mitigate damage done to native species (NRCS, 2006; O'Connor, R., 2006; Phillip-Mao, 2017;).

Three to five years after the initial planting the plant community should be well established and prescribed burns can take place (NRCS, 2006; Sargent, M.S. and Carter, K.S., 1999; Phillip-Mao, 2017). Before the prescribed burn a vegetation survey should take place to establish how well the site is doing after the planting and establish a baseline before the burnings. The survey should use the quadrats that were established during the current vegetation survey so comparisons can be made. The burning should not be done on the whole property at once. The property should be sectioned up and burned in alternating years. This provides a refuge for prairie animals to escape to during the burning and ensures that all the native prairie plants are not destroyed (Krost, M.A. 2010; NRCS, 2006; Phillip-Mao, 2017).

Floodplain Forest and Southern Wet Meadow

In the year following the first round of non-native control, another set of vegetation surveys on the transects should be conducted. These surveys will help in determining if the current treatment is effective at decreasing the number of non-natives. During this period, revegetation of natives to the treated area can boost long-term success (Kattenring and Adams, 2011). At the same time it is important to continue spot treating the areas for regrowth of non-native species from the seed bank (Borland et al., 2009; Gettys et al., 2020; Michigan DNR, 2014).

Long-term

Old Field

Every three to five years the different sections should be burned. The burning times should rotate between spring and fall burnings (Phillip-Mao, 2017). Periodic vegetation surveys should take place to ensure that the native prairie ecosystem is being supported by this schedule of burning.

Floodplain Forest and Southern Wet Meadow

To achieve long-term success in reducing the number of non-natives, continued spot treatment of regrowth will have to continue. This may not have to happen every year but the earlier that a possible invasion is detected the easier it is to remove (Borland et al., 2009). Continued vegetation sampling of the transects at Liberty Pond will help with identifying where the restoration work has succeeded and where additional work is needed.

Future Expansions

At both West Scio and Liberty Pond, expansion of the properties could be beneficial. At West Scio, expanding the property on the east side would be beneficial to protecting the heron rookery on site. As shown in Figure 14, parcels of land that would help with protecting the rookery have been colored in red and are considered a higher priority than the others. The parcels colored yellow are there to connect the two properties. This would create a larger nature area overall and would allow for longer trails to run between the two. The parcels colored green are expansions that could be beneficial to add to the property and act as barriers making it harder for invasive species to get in. These are only suggestions and no data was collected on the status of these parcels. In the future, a detailed study should be conducted on the properties before acquiring to ensure that they will benefit the overall area and not present a severe burden.

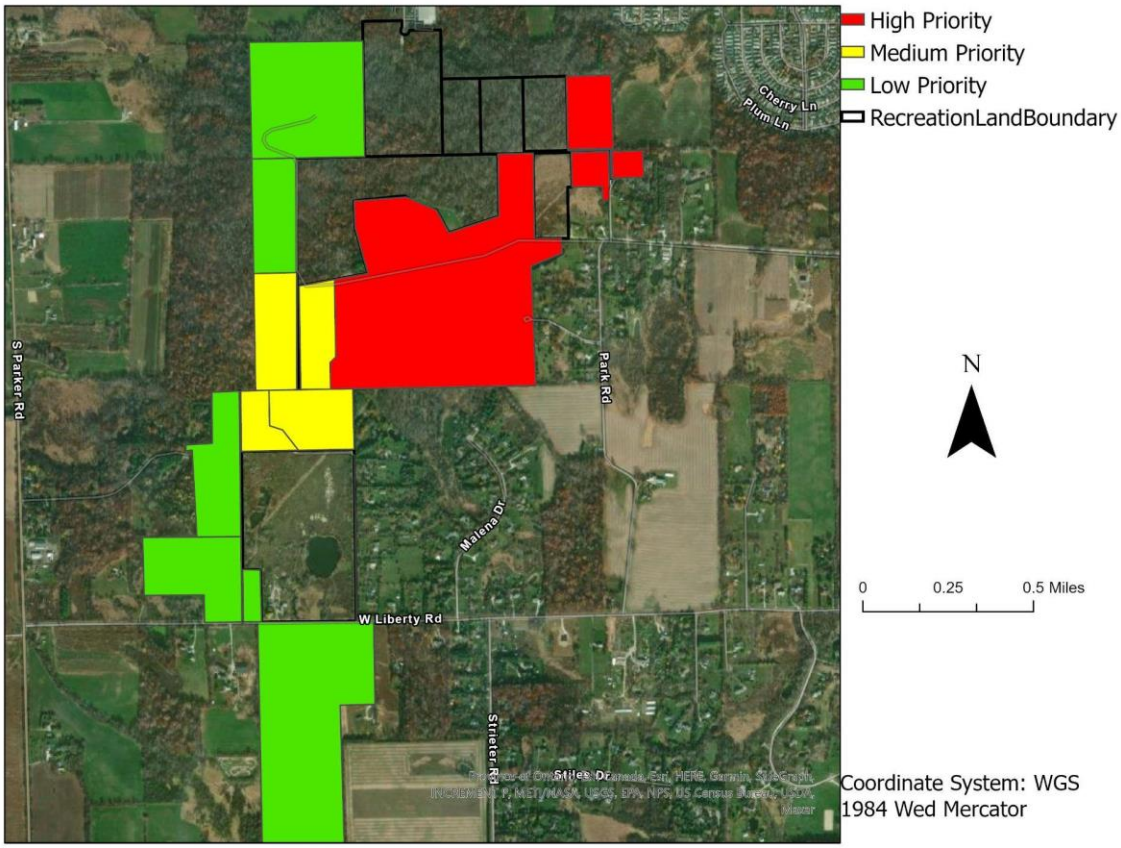
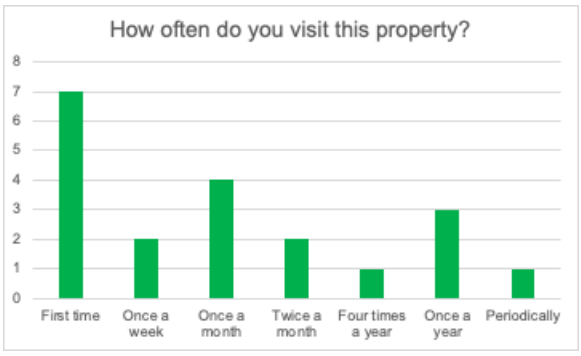


Figure 14. Property boundaries of West Scio Preserve and Liberty Pond Nature Area as well high, medium, and low priority expansion possibilities.

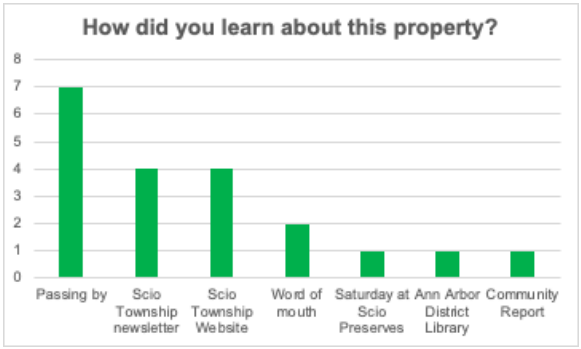
Public Surveys

Survey boxes were placed at the entrance of West Scio Preserve and Liberty Pond with physical surveys and a QR code to a google survey. The surveys recorded data regarding how often visitors are engaging with the green space, how they learned about it, when and how they engage, and their wishes for the property. The Scio Township Property Survey and results can be found in the appendix. Surveys were also handed out at the Saturdays at Scio Preserves event at Marshall Park. Twenty-one responses were gathered, 10 from Liberty Pond, 4 from Marshall, 4 from West Scio, and 3 sans locations. Based on the number of surveys collected, the data from the three green spaces has been analyzed together.

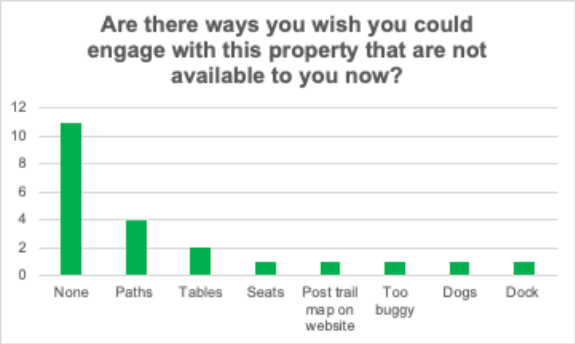
Summer is the most popular season for Scio Preserves, with Winter being the second most popular season.



Most survey respondents were visiting the green space for the first time.

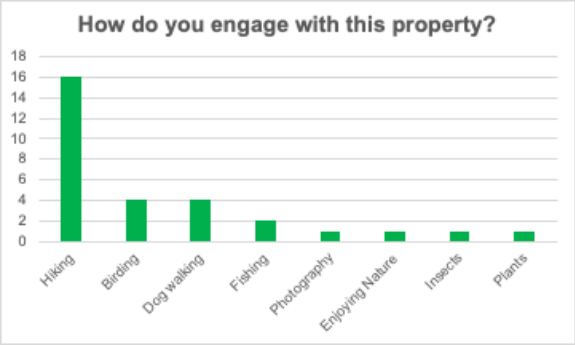


Most people enjoying the green spaces learned about them by passing by. The township newsletter and website are also helping people learn about green spaces.



Most people engaging with the preserve are content with their engagement. The next most popular request was for increased pathways, followed by tables and seats.

While most survey participants requested unpaved green spaces, it is important to note that accessibility was brought up in the responses of those who requested pavement and seats.



Most people engaging with green spaces are hiking, followed by birding and dog walking.

Appendices

The four research studies carried out as part of this project are described in detail here in the appendices: 1) the Scio Township property survey; 2) the butterfly survey, 3) the breeding bird survey; and, 4) the vegetation survey.

Scio Township Property Survey

This survey assesses the ways in which community members are engaging with publicly-owned green spaces. The results from this survey will inform future conservation and management plans. To learn more contact ScioParksandRec@ScioTownship.org. Thank you for your participation!

How often do you visit this property?

- About once a year
- About once a month
- About once a week
- Other: _____

During what season(s) do you/will you visit this property?

- Spring
- Summer
- Fall
- Winter

How did you learn about this property?

- Scio Township website
- Word of mouth
- Other: _____

How do you engage with this property?

- Birding
- Hiking
- Dog walking
- Fishing
- Other: _____

Are there ways you wish you could engage with this property that are not available to you now?

How would you like this property to look in the future? Any improvements you would like to see? Anything you would not like to see (e.g. benches, tables, paved pathways, xc ski paths, etc)?

Township of Scio, 827 North Zeeb Road, Ann Arbor, MI 48103
Ph. 734/369-9400 Website: Sciotownship.org

July 2021

Scio Township Property Survey Response Data

Timestamp	What property are you at currently?	How often do you visit this property?	During what season(s) do you/ will you visit this property?	How did you learn about this property?	How do you engage with this property?	Are there ways you wish you could engage with this property that are not available to you now?	How would you like this property to look in the future? Any improvements you would like to see? Anything you would not like to see? Eg. Benches, tables, paved pathways, xc ski paths, etc.
7/4/2021 9:32:34		About once a month	Spring, Summer, Fall, Winter	Scio towp newsletter	Hiking		Places to sit along the trail
7/5/2021 9:22:07		First time	Spring, Summer, Fall	Passing by	Hiking, Photography		Benches would be nice. Limited pavement to keep natural, but provide wheelchair accessibility.
7/23/2021 11:30:32	Liberty Pond (7970 West Liberty rd.)	About once a week	Spring, Summer	Walking by	Dog walking, Enjoying nature	A dock	A table would be nice
7/25/2021 15:49:37	Liberty Pond (7970 West Liberty rd.)	First time	Summer	Found it while out driving	Hiking	None	More paths
7/31/2021 15:34:53	Liberty Pond (7970 West Liberty rd.)	About once a year	Summer	Scio Township website	Birding, Hiking, Butterflies and dragonflies		Address some of the non-native invasive plants. E.g. phramites, reed canary grass, spotted knapweed.
8/1/2021 9:24:45	Liberty Pond (7970 West Liberty rd.)	About once a year	Summer	Scio Township website	Birding, Hiking, Butterflies and dragonflies		Address some of the non-native invasive plants. E.g. phramites, reed canary grass, spotted knapweed.
8/3/2021 14:28:02	Liberty Pond (7970 West Liberty rd.)	About once a month	Spring, Summer, Fall, Winter	Walked by	Hiking	No	A path around the whole pond
8/7/2021 10:47:54	Liberty Pond (7970 West Liberty rd.)	First time	Spring, Summer, Fall, Winter	Walking by and saw it!	Hiking	I'm so excited about it. It' s beautiful!	Paved path would be nice!
8/14/2021 19:27:13	Liberty Pond (7970 West Liberty rd.)	First time	Summer	Biked past	Dog walking, Fishing	Thank you for permitting dogs!	Maybe a playground
8/16/2021 15:59:30	Liberty Pond (7970 West Liberty rd.)	About once a month	Spring, Summer, Fall, Winter	Drive by	Dog walking	No	
8/30/2021 16:33:45	Liberty Pond (7970 West Liberty rd.)	About once a week	Spring, Summer, Fall, Winter	Word of mouth	Birding, Hiking, Fishing	Paths up hills, picnic tables	No paved pathways. Yes- keep it unpaved. We need a fishing dock?
8/24/2021 11:05:56	West Scio Nature Preserve (317 Dino dr.)	First time	Summer	Ann Arbor District Library	Hiking		less bugs fire hydrants
7/27/2021 11:22:59	West Scio Nature Preserve (317 Dino dr.)	About once a month	Spring, Summer, Fall, Winter	Word of mouth	Birding, Hiking, Botanical	No	Please keep as natural as possible. No dogs, no engineered paths.

Timestamp	What property are you at currently?	How often do you visit this property?	During what season(s) do you/ will you visit this property?	How did you learn about this property?	How do you engage with this property?	Are there ways you wish you could engage with this property that are not available to you now?	How would you like this property to look in the future? Any improvements you would like to see? Anything you would not like to see? Eg. Benches, tables, paved pathways, xc ski paths, etc.
7/3/2021 17:04:43	West Scio Nature Preserve	First visit today! I can see coming back when it's not quite so buggy, 3-6 times a year.	Spring, Summer, Fall, Winter	Summer 2021 Scio Community Report newsletter	Hiking	Regular places to sit down are important for accessibility. Solid high tree stumps or wide log sections are sufficient.	I would not pave the paths. Natural is nicer. I'm confused on dogs. It's named 'Preserve', which has always meant to dogs. The park is heavily forested with lots of undergrowth and lots of small animals. Frankly, people usually let their dogs run freely in such parks when they think they can get away with it. Dogs would cause real damage to this space. I hope they are barred and that it's enforced. We left our dogs at home and had a lovely, if buggy, walk. If you want to add picnic tables, I'd do it right at the entrance. The park is too pretty to disrupt like that. There are nice wide tall sections of tree trunk at a few locations that provide resting places for people with mobility challenges. I hope that is preserved. Many thanks to the U-M interns who are working on the park. We look forward to visiting again!
8/24/2021 11:07:47	West Scio Nature Preserve (317 Dino dr.)	2x/month	Spring, Summer, Fall	Township parks and rec	Birding, Hiking	too buggy	remove poison ivy on trail mow trails when grass high and weeds encroaching
8/24/2021 11:16:06	West Scio Nature Preserve (317 Dino dr.)	4x/year	Spring, Summer, Fall, Winter	Scio Township website	Hiking	POST THE TRAIL MAP ON THE WEBSITE!	
8/24/2021 10:56:35	Marshall	About once a year	Summer	Newsletter	Hiking	Hike a loop trail	loop trail

Timestamp	What property are you at currently?	How often do you visit this property?	During what season(s) do you/ will you visit this property?	How did you learn about this property?	How do you engage with this property?	Are there ways you wish you could engage with this property that are not available to you now?	How would you like this property to look in the future? Any improvements you would like to see? Anything you would not like to see? Eg. Benches, tables, paved pathways, xc ski paths, etc.
8/24/2021 10:58:30	Marshall	I would visit periodically	Spring, Summer, Fall, Winter	Saturdays @ Scio Preserves	Hiking	trails that do not interfere with trees and wildlife	unpaved trails- I would like to see a park w/ minimal human interference
8/24/2021 10:59:25	Marshall	just learned about it	Spring, Summer, Fall	Scio newsletter	Hiking		pathways- don't need to be paved
8/24/2021 11:00:19	Marshall	Today	Spring, Summer, Fall	Hob Calhoun (newsletter)	Hiking	Path for walking	benches, paved pathways

Initial Great Blue Heron Rookery Buffer Zone Map

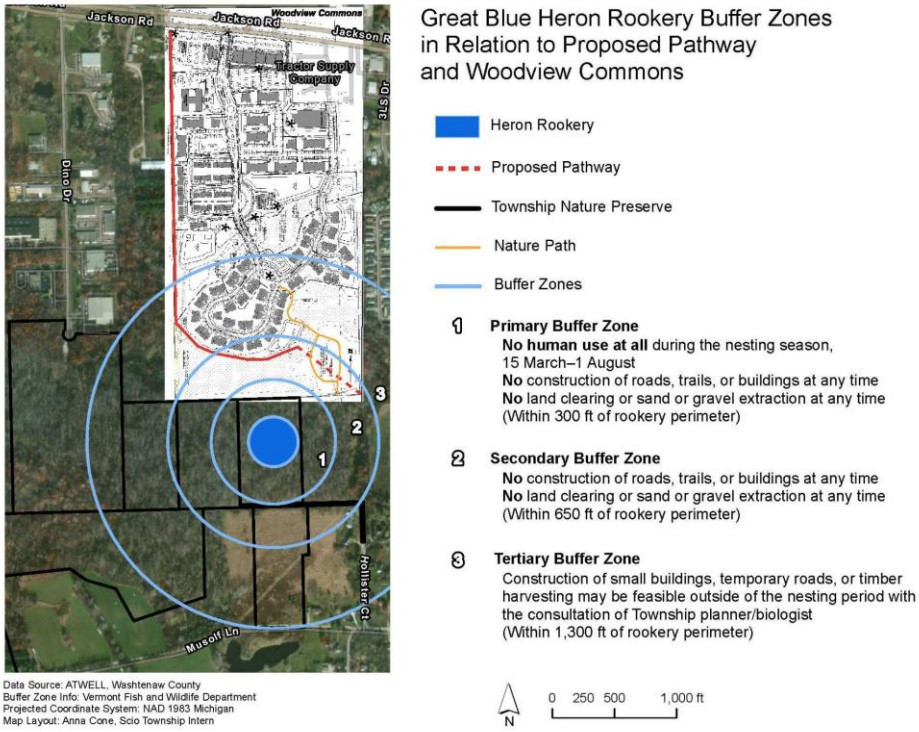


Figure 7B. Map used in initial discussions regarding Woodview commons and the heron rookery. Property boundaries of West Scio Preserve and georeferenced image of proposed development plan, Woodview Commons, in relation to the 3 Great Blue Heron Buffer Zones as detailed by the Vermont Fish & Wildlife Department (Agency of Natural Resources).

Butterfly Data

Surveys conducted by John Swales, Judith Lobato, Marcy Breslow

Sept 5, 2021

Species	Number
Cabbage white	49
Clouded Sulphur	170
Orange Sulphur	24
White Colias (white sulphur)	42
Eastern Tailed Blue	19
Monarch	7
Viceroy	5
Pearl Crescent	13
Red Admiral	1
Checkered skipper	2
Silver-spotted skipper	1
Wild Indigo Duskywing	25
Total individuals	358

September 21, 2021

Species	Number
Orange Sulphur	34
Clouded Sulphur	122
Cabbage White	43
Eastern Tailed Blue	36
Viceroy	2
Pearl Crescent	8

Wild Indigo Duskywing	45
Total Individuals	290

West Scio Studies

Breeding Bird Survey

Methods

Breeding bird inventories were conducted at both West Scio Nature Preserve and Liberty Pond Nature Area. The methods used in both locations were based on those used for compiling the Michigan Breeding Bird Atlas II (MMBA II) (Chartier et al. 2011). Slight changes to the methods were needed because of the smaller sampling area than that of the sampling area for the MMBA II.

Habitat Units

At West Scio, the area was divided into habitat units. An area was considered a separate habitat unit if most of the plant community was different from a neighboring unit, and it was larger than one acre in size. At West Scio this resulted in three distinct habitat units. These are southern hardwood swamp, dry-mesic southern forest, and open field. The hardwood swamp and dry-mesic southern forest required to be subdivided even further for ease of sampling. Units were created within each habitat type that were roughly the same size. The open fields were of appropriate size and did not need to be further subdivided. The units were then numbered starting with 1 at the most northern unit and then moving in a left to right fashion up to 11 (Figure 1). All the units are contained within the West Scio nature preserve boundary except for unit ten. This is an open field unit that was added to ensure that the edge habitat on that side of the preserve was being properly sampled and to capture any open field bird species that may be using the preserve for resources.

Survey Protocol

Morning bird surveys took place soon after sunrise in accordance with what is considered the most active time for most birds (Bird Searcher, n.d.). The surveys were completed between

May 18, 2021, and June 24, 2021. In each unit at least two surveys were completed at least one week apart from each other. This allowed for variation in the birds calling at the locations to be recorded. The time spent in each unit depended on the size of the unit and the activity of the birds. Thirty minutes to two hours were spent in each plot. When surveying if a bird was either seen or heard in a sample unit, the species (common names were used in the field), date, plot number, and a corresponding breeding code were recorded. The breeding codes used were the same used for the MMBA II and are recorded in table 1.

The breeding code is broken up into four categories; observed, possible, probable, and confirmed. Observed was used only when a bird was seen in an area, and it was either in a habitat that the bird is very unlikely to be breeding in or it is outside its normal breeding season. Possible is for when a bird is seen in suitable habitat during its breeding season or heard calling but no other indications toward breeding are shown. Probably is used when a bird is seen or heard in suitable habitat during its breeding season, and it is getting ready for breeding. These could include mating displays, territorial behavior, or visiting of possible nesting sites. Lastly, confirmed is used when there is direct evidence of a bird breeding in a location. This direct evidence could be nest building, carrying of food, distraction displays, or used nests. In each unit only the highest code was used for each bird species, i.e., confirmed > probable > possible > observed.

All the data was recorded in spreadsheets and each unit got its own table. Table 2 is an example of what the data sheets looked like. These individual tables were combined in a pivot table. A pivot table is helpful for analyzing large sets of data and can help with identifying useful information through its summarization of the data (Excel, n.d.).

Results

In total there were over 500 separate observations recorded at West Scio and Liberty Pond. There were 67 different species observed at the two properties. Out of the 67 species, 17 were unique to West Scio.

At West Scio there were 56 unique species of bird seen or heard. Table 3 is a pivot table that lists the species in alphabetical order by common name and includes the number of units that their breeding status was confirmed, probable, possible, or observed. Out of the 55 total species seen at West Scio preserve, 21 species were able to be confirmed as breeding. An additional 14 species were marked as probably breeding in the area. Over half of the total species seen or heard fall into the top two categories at West Scio preserve. The blue jay (*Cyanocitta cristata*), hairy woodpecker (*Leuconotopicus villosus*), and red-bellied woodpecker

(*Melanerpes carolinus*) were all confirmed breeding in three separate units, the most in that category. Overall, the northern cardinal (*Cardinalis cardinalis*) was recorded in the greatest number of survey units, all 11. This is easily seen in table 5 as all survey units have a 1 indicating there is a breeding code for that unit. The American robin (*Turdus migratorius*), blue jay (*Cyanocitta cristata*), eastern wood pewee (*Contopus virens*), and song sparrow (*Melospiza melodia*) were recorded in 10 of the 11 survey units. At West Scio, the great blue heron (*Ardea herodias*) was unique among all the species seen. A large rookery of over 50 nests were recorded in one of the survey units.

Endangered Species and Introduced Species

Out of the 56 species of birds recorded at West Scio, none are on the United States endangered species list. The yellow-billed cuckoo (*Coccyzus americanus*), technically shows up on the list but only the western subspecies is considered at risk (US Fish and Wildlife Service, n.d.). Michigan keeps its own list of endangered species specific to the state. The red-headed woodpecker (*Melanerpes erythrocephalus*) is listed as a special concern on this list (Michigan State University, n.d.-b). A species listed as a special concern is one that has a decent population size but is declining due to any number of reasons and could become threatened soon. Species listed as special concern do not have any additional protections afforded to them but their status should continue to be monitored in case of changes (Michigan State University, n.d.-a).

At West Scio there was only one species of bird observed that is considered non-native, the European starling (*Sturnus vulgaris*) (Jon L. Dunn et al., 2008). In North America there are an estimated over 200 million European starlings ranging all the way from Alaska to Mexico and coast to coast (Cornell Lab of Ornithology, n.d.-a). They are also known to take over nesting sites of cavity nesters. In a field study done by Purcell, Kathryn with the U.S. Forest Service, it was observed that European starlings avoid areas of tall, ungrazed/mowed grass. To prevent populations of European starlings in certain areas it is advised to leave taller grass and reduce their foraging areas (Purcell, Kathryn L. 2015).

Future research

This report is the first known breeding bird survey done at West Scio Preserve. As such, there are certain conclusions that cannot be drawn because of lack of prior data. We cannot know if any of the birds seen or heard are normal nesters on the properties or if they are new. We also cannot know if the number of observations made during this survey is high, average, or low. To

be able to answer these questions, future surveys should be done. Other surveys such as The North American Breeding Bird Survey and the Michigan breeding bird survey take place yearly and every 20 years respectively (U.S. Geological Survey, 2020, Chartier et al. 2011). Considering population dynamics, it would be best to do a survey every year or every other year to catch the change of the populations over time. As this is very hard to do and expensive, doing a breeding bird survey every 5 to 10 years should also catch the change of the populations. Incorporating citizen science into this process could help with this process as well. Ebird is a phone app that can be downloaded for free and used by the public to record sightings of birds.

In Michigan it is hard to find an exact count of the great blue heron rookeries that exist. Part of this is to protect the species. If a rookery location is not broadcasted, then it is harder for people to disturb it. Another reason appears to be lack of knowledge or research. In Washtenaw county in 1995, there were at least two known rookeries and this current one on the West Scio property would expand that to three (Michael A. Kielb et al., 1995). For this reason, continued monitoring and research of the great blue heron rookery at West Scio should be done to ensure protection of this natural resource. The monitoring of it should be performed yearly to ensure that there has been no mass abandonment of the site due to some disturbance.

Tables and Figures

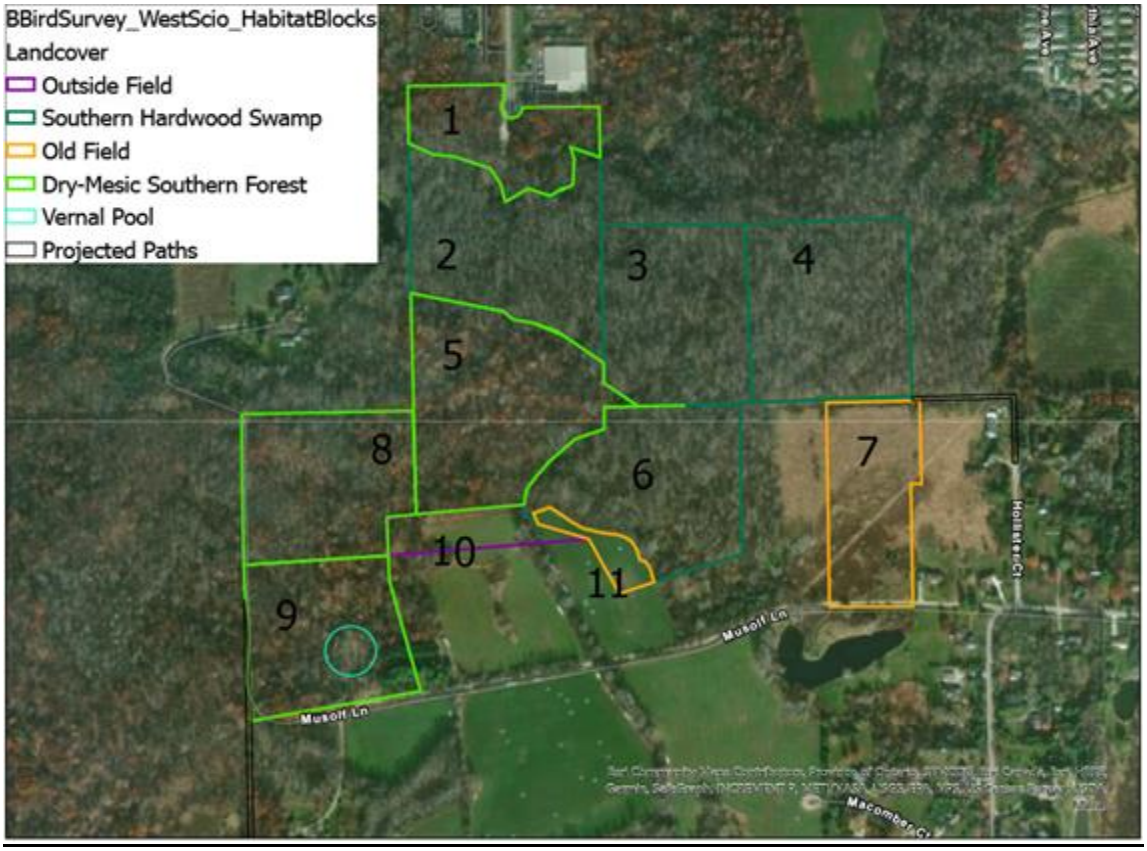


Figure 1: Map of the survey units used for the breeding bird survey at West Scio. There were a total of 11 units surveyed in three different types of stratum.

Breeding Codes	
Observed	
O	Species observed during its breeding season but no evidence of breeding in block. Individual birds in unlikely breeding habitat, flying over, or out of their normal breeding range without any indication of breeding.

Possible	
#	Species observed in suitable nesting habitat during its breeding season
X	Singing male present in suitable nesting habitat during its breeding season
Probable	
S	Singing male present at the same location on at least two dates at least seven days apart or multiple (five or more) singing males on the same date during the breeding season
P	Pair observed in suitable nesting habitat during breeding season
T	Territorial behavior (chasing individuals of the same species)
C	Courtship behavior or copulation
N	Visiting probable nest site
A	Agitated behavior or anxiety calls from adult
B	Nest building by wrens or excavation of holes by woodpeckers

Confirmed	
NB	Nest building by all except woodpeckers and wrens
PE	Physiological evidence of breeding or brooding based on bird in hand. Banders or biologists actually handling the birds are to use this code
DD	Distraction display or injury feigning
UN	Used nests or eggshells found. Caution: These must be carefully identified
FL	Recently fledged young (of altricial species) incapable of sustained flight, or downy young (of precocial species) restricted to the natal area by dependence on adults or limited mobility
ON	Occupied nest: Adults entering or leaving a nest site in circumstances indicating occupied nest (includes high nests or nest holes, the contents of which cannot be seen) or adult incubating or brooding
FY	Adults with food for young (carrying food) or feeding young. Use caution as some species will continue to feed young for a number of weeks after leaving the nest and may move some distance

FS	Adult carrying fecal sac
NE	Nest with eggs
NY	Nest with young seen or heard. Presence of a Brownheaded Cowbird egg or young is confirmation for both the cowbird and the host species

Table 1: Breeding codes used in MMBA II and used in the breeding bird survey at both West Scio nature preserve and Liberty Pond. The code is broken into four categories, observed, possible, probable, and confirmed (Chartier et al. 2011)

Location	west scio	Survey	m, n
		Observed	Possible
Date	Species	O	#
5/18/2021	nuthatch		
5/19/2021	Redeyed vireo		
5/21/2021	Redeyed vireo		
5/21/2021	Cardinal		
5/21/2021	Robin		1
5/21/2021	Bluejay		1
5/21/2021	Song sparrow		1
5/21/2021	Eastern wood pewee		1
5/21/2021	Blackbird		
5/21/2021	hummingbird		1
5/21/2021	European starling		2
5/21/2021	Crow		1
5/21/2021	flycatcher		
5/21/2021	Black-capped Chickadee		
5/21/2021	woodpecker		1
5/21/2021	Scarlet tanager		1
6/5/2021	pewee		
6/5/2021	Song sparrow		
6/5/2021	Redeyed vireo		
6/5/2021	Blackbird		5
6/5/2021	woodpecker		1
6/5/2021	Tufted titmouse		
6/5/2021	Bluejay		1
Unknown	cuckoo		2
6/24/2021	Wood thrush		

		Probable									Confirmed										
Date	Species	H	B	P	T	C	N	A	S	NB	PE	DD	UN	FL	ON	FY	FS	NE	NY	Comments
5/18/2021	nuthatch															*				
5/19/2021	Redeyed vireo				*															
5/21/2021	Redeyed vireo																			
5/21/2021	Cardinal																			
5/21/2021	Robin					*														
5/21/2021	Bluejay																			
5/21/2021	Song sparrow																			
5/21/2021	Eastern wood pewee																			
5/21/2021	Blackbird																			
5/21/2021	hummingbird																			got dive bar nest in the area?
5/21/2021	European starling																			
5/21/2021	Crow																			
5/21/2021	flycatcher																			
5/21/2021	Black-capped Chickadee																			
5/21/2021	woodpecker																			
5/21/2021	Scarlet tanager																			
6/5/2021	pewee																			
6/5/2021	Song sparrow							*												
6/5/2021	Redeyed vireo																			
6/5/2021	Blackbird																			
6/5/2021	woodpecker																			
6/5/2021	Tufted titmouse																			
6/5/2021	Bluejay																			
Unknown	cuckoo																			
6/24/2021	Wood thrush																			

*Table 2: This is an example of one of our sheets for recording data in the field. At the top the location lets us know if this is for West Scio or Liberty Pond. The survey represents how many morning (m) and night (n) surveys are done. The date and species columns correspond to the species of bird seen or heard and what the date was. In the field common names were used for simplicity. Next the breeding codes are listed out and what category they fall in, i.e. X falls in the possible category. To record a code for a species either a number was entered into the # column, this corresponds to the number seen or a * was entered into the appropriate category. Lastly a comment column was added to allow for anything that was not covered. The comment section was rarely used.*

West Scio Pivot Table of Breeding Codes

Count of Species	Column Labels				
Row Labels	Confirmed	Probable	Possible	Observed	Grand Total
American crow (Corvus brachyrhynchos)		1	6		7
American goldfinch (Spinus tristis)			2		2
American redstart (Setophaga ruticilla)			1		1
American robin (Turdus migratorius)	2	4	4		10
American tree sparrow (Spizelloides arborea)			1		1
Baltimore oriole (Icterus galbula)		3	3		6
Barred owl (Strix varia)			1		1
Black-billed cuckoo (Coccyzus erythropthalmus)	1				1
Black-capped chickadee (Poecile atricapillus)	2	1	4		7
Blue jay (Cyanocitta cristata)	3	4	3		10
Blue-gray gnatcatcher (Polioptila caerulea)	1	1			2
Brown creeper (Certhia americana)			2		2
Brown-headed cowbird (Molothrus ater)		2	2		4
Cedar waxwing (Bombycilla cedrorum)	1				1
Common grackle (Quiscalus quiscula)	1		6		7
Common yellowthroat (Geothlypis trichas)		1	1		2
Cooper's hawk (Accipiter cooperii)		1	1		2
Downy woodpecker (Dryobates pubescens)	2		3		5
Eastern bluebird (Sialia sialis)			1		1
Eastern kingbird (Tyrannus tyrannus)			1		1
Eastern phoebe (Sayornis phoebe)			3		3
Eastern screech owl (Megascops asio)			1		1
Eastern wood pewee (Contopus virens)	1	6	3		10
European starling (Sturnus vulgaris)			1		1
Gray catbird (Dumetella carolinensis)	1	2	2		5
Great Blue Heron (Ardea herodias)	1				1
Great crested flycatcher (Myiarchus crinitus)	1	3	4		8
Green heron (Butorides virescens)		1	1		2
Hairy woodpecker (Leuconotopicus villosus)	3		1		4
House wren (Troglodytes aedon)			2		2
Indigo bunting (Passerina cyanea)	1	2	3		6
Killdeer (Charadrius vociferus)			1		1
Mallard (Anas platyrhynchos)		1			1
Mourning dove (Zenaida macroura)		1	5		6
Northern cardinal (Cardinalis cardinalis)	1	5	5		11
Northern flicker (Colaptes auratus)		1	5		6
Ovenbird (Seiurus aurocapilla)			2		2
Pileated woodpecker (Dryocopus pileatus)			1		1
Red-bellied woodpecker (Melanerpes carolinus)	3	2	3		8
Red-eyed vireo (Vireo olivaceus)		4	2		6
Red-headed woodpecker (Melanerpes erythrocephalus)			1		1
Red-tailed hawk (Buteo jamaicensis)			1		1
Red-winged Blackbird (Agelaius phoeniceus)	2	5	2		9
Rose-breasted grosbeak (Pheucticus ludovicianus)		2			2
Ruby-throated hummingbird (Archilochus colubris)	1	1	2		4
Sandhill crane (Antigone canadensis)				1	1
Scarlet tanager (Piranga olivacea)		1	3		4
Sedge wren (Cistothorus stellaris)			1		1
Song sparrow (Melospiza melodia)	1	5	4		10
Tree swallow (Tachycineta bicolor)			1		1
Tufted titmouse (Baeolophus bicolor)		2	5		7
Turkey vulture (Cathartes aura)			2		2
White-breasted nuthatch (Sitta carolinensis)	1		2		3
Wild turkey (Meleagris gallopavo)	1	1	3		5
Wood thrush (Hylocichla mustelina)		2	6		8
Yellow-billed cuckoo (Coccyzus americanus)			2		2
Grand Total	**31**	**65**	**122**	**1**	**219**

Table 3: Pivot table of breeding codes for West Scio preserve. The first column is the species that was heard or seen and sorted in alphabetical order by common name. The next four columns indicate how many different units a species' breeding code fell into that category. The grand total column represents the total amount of units a species was either seen or heard in. For example, the American crow had one unit where its breeding code was probably breeding and seven units with possibly breeding. For a total of eight different units the American crow was seen at West Scio preserve.

West Scio Pivot Table of Survey Units

Count of Species	Column Labels											
Row Labels	1	2	3	4	5	6	7	8	9	10	11	Grand Total
American crow (Corvus brachyrhynchos)	1	1	1	1	1	1			1			7
American goldfinch (Spinus tristis)							1		1			2
American redstart (Setophaga ruticilla)		1										1
American robin (Turdus migratorius)	1	1	1	1	1	1	1	1	1		1	10
American tree sparrow (Spizelloides arborea)						1						1
Baltimore oriole (Icterus galbula)				1	1	1			1	1	1	6
Barred owl (Strix varia)									1			1
Black-billed cuckoo (Coccyzus erythropthalmus)									1			1
Black-capped chickadee (Poecile atricapillus)	1	1		1	1	1			1	1		7
Blue jay (Cyanocitta cristata)	1	1	1	1	1	1		1	1	1	1	10
Blue-gray gnatcatcher (Polioptila caerulea)						1			1			2
Brown creeper (Certhia americana)		1							1			2
Brown-headed cowbird (Molothrus ater)		1					1			1	1	4
Cedar waxwing (Bombycilla cedrorum)							1					1
Common grackle (Quiscalus quiscula)		1	1	1		1		1		1	1	7
Common yellowthroat (Geothlypis trichas)						1	1					2
Cooper's hawk (Accipiter cooperii)			1							1		2
Downy woodpecker (Dryobates pubescens)	1	1	1	1		1						5
Eastern bluebird (Sialia sialis)				1								1
Eastern kingbird (Tyrannus tyrannus)							1					1
Eastern phoebe (Sayornis phoebe)		1						1	1			3
Eastern screech owl (Megascops asio)								1				1
Eastern wood pewee (Contopus virens)	1	1	1	1	1	1	1	1	1	1		10
European starling (Sturnus vulgaris)	1											1
Gray catbird (Dumetella carolinensis)						1	1		1	1	1	5
Great Blue Heron (Ardea herodias)				1								1
Great crested flycatcher (Myiarchus crinitus)	1	1	1	1	1	1		1	1			8
Green heron (Butorides virescens)							1		1			2
Hairy woodpecker (Leuconotopicus villosus)		1	1		1				1			4
House wren (Troglodytes aedon)						1	1					2
Indigo bunting (Passerina cyanea)			1		1	1			1	1	1	6
Killdeer (Charadrius vociferus)			1									1
Mallard (Anas platyrhynchos)		1										1
Mourning dove (Zenaida macroura)			1		1		1	1	1	1		6
Northern cardinal (Cardinalis cardinalis)	1	1	1	1	1	1	1	1	1	1	1	11
Northern flicker (Colaptes auratus)		1	1		1	1		1	1			6
Ovenbird (Seiurus aurocapilla)							1				1	2
Pileated woodpecker (Dryocopus pileatus)									1			1
Red-bellied woodpecker (Melanerpes carolinus)	1	1	1	1	1	1		1	1			8
Red-eyed vireo (Vireo olivaceus)	1	1	1	1	1	1						6
Red-headed woodpecker (Melanerpes erythrocephalus)			1									1
Red-tailed hawk (Buteo jamaicensis)										1		1
Red-winged Blackbird (Agelaius phoeniceus)	1	1	1	1		1	1		1	1	1	9
Rose-breasted grosbeak (Pheucticus ludovicianus)					1	1						2
Ruby-throated hummingbird (Archilochus colubris)	1	1		1				1				4
Sandhill crane (Antigone canadensis)						1						1
Scarlet tanager (Piranga olivacea)	1				1			1	1			4
Sedge wren (Cistothorus stellaris)							1					1
Song sparrow (Melospiza melodia)	2	1	1	1		1	1	1		1	1	10
Tree swallow (Tachycineta bicolor)							1					1
Tufted titmouse (Baeolophus bicolor)	1	1	1	1	1	1			1			7
Turkey vulture (Cathartes aura)		1					1					2
White-breasted nuthatch (Sitta carolinensis)	1				1				1			3
Wild turkey (Meleagris gallopavo)		1	1	1	1		1					5
Wood thrush (Hylocichla mustelina)	1	1		1	1		1	1	1		1	8
Yellow-billed cuckoo (Coccyzus americanus)	1							1				2
Grand Total	**20**	**25**	**21**	**20**	**20**	**24**	**20**	**16**	**27**	**14**	**12**	**219**

Table 5: Pivot table of the survey units where a breeding code was entered for different species at West Scio preserve. The first column is the species alphabetical order based on common name. The column numbers (1-11) correspond to a survey unit. Within those columns, a 1 represents that a breeding code for that species was entered. For example, the American crow has a breeding code entered for survey units 1-6 and 9 for a total of 7 survey units. Out of the 11 survey units at West Scio, the American crow was seen or heard in 7 of them.

Vegetation Survey

Methods

The data collection for this report took place on two Scio Township properties, West Scio Preserve and Liberty Pond nature area. All the data presented was collected in July in 2021. Many of the methods used come from the United States Department of Agriculture's Forest Inventory and Analysis National Program (FIA) (US Department of Agriculture, 2021). To better answer the research questions and get the appropriate data, modifications were made, and unnecessary parts were left out.

Plot Setup

The FIA uses a plot system that contains four circular subplots and four microplots nested inside the four subplots to sample vegetation (Figure 1). An attempt to use this kind of setup was made but due to difficulty and length of time it took to setup, this design was abandoned for a simpler one. A quadrat system was used instead. Just like the FIA method, subplots were included inside the quadrat. The main quadrat was used to capture the tree diversity. Two sizes of subplots were used, one captured the saplings, shrubs, and climbing vines present and the other captured the herbaceous layer. The quadrat size necessary to capture the diversity of an area was unknown for this area. A sample plot was setup using a 50x50 foot, 100x100 foot, and 150x150 foot quadrat. First the tree species in the 50x50 foot plot were recorded. Next in the 100x100 foot plot any new species were noted and finally in the 150x150 foot plot, any tree species that did not show up in the first two plots were noted. When going from the 50x50 foot plot to the 100x100 foot plot there was almost a doubling of species present. When going from the 100x100 foot plot to the 150x150 foot plot, only one species of tree was added. Based on this it was decided that the 100x100 foot plot was the appropriate size to use for the area. A similar procedure was performed to determine the best subplot size for the sapling, shrub, and vine subplot and the herbaceous subplot. The best size was found to be a 10x10 foot subplot and 3x3 foot subplot respectively. To get a better understanding of the spatial difference inside the large 100x100 foot plot, three of each subplot was used (Figure 2).

When determining the locations where to put the plots, a grid and random number generator were used. In ArcGIS Pro version 2.8, the vegetation stratums were determined. There were three main vegetation stratums identified, southern hardwood swamp, dry-mesic southern forest, and open field (Figure 3). Over each stratum a grid with squares 100x100 feet was overlayed. A random number generator was then used to generate two numbers. The first number indicated how many spaces to move to the right and the second indicated how many spaces to move down. A similar strategy was employed for placing the 10x10 and the 3x3 foot squares inside the 100x100 foot square. To cover as much of the property in as little plots as possible, a plot was put roughly in every three acres. In the end there were six upland plots, five swamp plots, and one open field plot. On the right side of the map there is a large area with no vegetation plot. This was done to not disturb the great blue heron (*Ardea herodias*) rookery during breeding season that is present on the property.

Quadrat Data Collection

The vegetation plots were randomly placed using ArcGIS software. Before going out into the field, the GPS coordinates were obtained for the four corners of each 100x100 foot square. This made it faster to flag out the corners than rolling out a 100-foot tape every time. Within the 100x100 foot square, the trees were identified, the diameter at breast height (DBH) was measured, and the canopy position was noted. A plant was considered a tree if the main stem was larger than two inches at DBH. Dead standing woody material was also measured at DBH. It was considered dead standing material if it was at an angle greater than 45 degrees to the ground and there was no apart alive material left. The 10x10 foot squares and 3x3 foot squares were located based on the coordinates of their southwest corner. From there a tape measure was used to measure out the area. In the 10x10 foot square each species of sapling, shrub, and climbing vine were counted. In the 3x3 foot square each herbaceous species was counted, and the percent cover was recorded. For each species the lowest classification possible was strived for. In some cases, only genus level was able to be reached. In some cases, such as with the hawthorns (*Crataegus spp.*) there is not consensus in the scientific community on classification. In other cases, as with a lot of grasses (*Poa spp.*) the defining characteristics, seed heads or flowers, were not present.

Floristic Quality Assessment

Once all the data was collected a Floristic Quality Assessment (FQA) was conducted. FQAs are useful because it assigns a number to a species based on how much of a generalist or specialist species they are. This number is called the coefficient of conservatism (C value) and ranges from zero to ten. Zero are the species that can tolerate disturbed and degraded areas and non-

native species. Ten represents the specialist species that are often rare and require high-quality areas to grow in (WeConservePA, n.d.). It is important to remember when using an FQA that there are some limitations and criticisms. One of the criticisms include that the C value is assigned by botanists and subjectivity and bias can exist but is moderated as much as possible. Overreliance is another problem and as such FQAs should be used as a stand alone metric. FQAs also rely on a person's ability to identify a species. If a species is misidentified this will skew the C value (Spyreas, 2019). If used correctly FQAs are useful to land managers who are monitoring vegetation change over time or the effect of management strategies on the area (WeConservePA, n.d.). In this report we use the Universal FQA Calculator, an open-source tool that can pull C values from databases all over the country. In this case the Michigan FQA 2014 database was used.

Results

At West Scio Preserve, there were 21 different species of tree recorded. The American elm (*Ulmus americana*) was recorded the most with 181 different observations. The species with the least number of observations is the common apple (*Malus pumila*) with only one (Figure 4). The American elm is also recorded in the greatest number of plots, with plot 8 being the only where it was not recorded. Plot 5 contains the greatest number of unique species out of all the plots (Figure 5). Figure 6 provides a good comparison of upland plot and swamp plot species. It shows that the more upland plots have more diversity, while swamp plots mainly contain the American elm, silver maple (*Acer saccharinum*), red maple (*Acer rubrum*), and green ash.

In total there were twelve 100x100 foot plots with three 10x10 foot plots in each one, making a total of thirty-six 10x10 foot plots. In total there were 29 different species of saplings, shrubs, or climbing vines recorded. Out of 36 plots, green ash saplings were recorded in 25 of them (Figure 7). Green ash also had the highest stem count at 335 stems count. Silver maple, red maple, prickly ash (*Zanthoxylum americanum*), and common buckthorn (*Rhamnus cathartica*) all had stem counts over 100 (Table 1).

In each 100x100 foot plot there were also three 3x3 foot plots where the herbaceous vegetation layer was sampled. In total thirty-six 3x3 plots were sampled. There were a total of 57 different plants identified in the plots. False nettle (*Boehmeria cylindrica*) was observed in the most plots, 14 out of 36 and had a total stem count of 249. Out of the 57 plants identified, 21 of them occurred in only one plot. When looking at the total stem counts, goldenrod (*Solidago spp.*) had the highest even though it was only seen in six out of the 36 plots. For the grasses (*Poa spp.*) and sedges (*Juncus spp.*) observed, in some cases they occurred in large clumps. In these cases, a value of >100 was assigned to them (Table 2).

The FQA produced a total mean C of 3.4 for West Scio Preserve. If all non-native species were removed the total mean C would be 3.8. This indicates that most of the species are not rare or are specialists. The total Floristic Quality Index (FQI) is 30 (Table 3). The FQI indicates overall vegetative quality and a 30 falls into the category of high quality.

Endangered and Introduced Species

None of the 78 different species at West Scio are on the United States endangered species list (US Fish and Wildlife Service, n.d.). On the list of rare Michigan plants compiled by the Michigan Natural Inventories, nodding rattlesnake root (*Prenanthes crepidinea*) is listed as threatened and smooth carrion flower (*Smilax herbacea*) is listed as special concern (Michigan State University, n.d.). Currently there is little research on nodding rattlesnake root in Michigan. To conserve the species, it is advised to maintain its floodplain habitat and control any invasive species that may exist in the area (Michigan State University, n.d.-a). The smooth carrion flower is generally found in low forests, thickets, or wooded banks. To preserve this species, maintaining the forest canopy and the periodic flooding of the area is needed (Michigan State University, n.d.-b).

At West Scio there were nine species recorded that were introduced to the area. These species are garlic mustard (*Alliaria petiolate*), meadow foxtail (*Alopecurus pratensis*), avens (*Geum urbanum*), meadow hawkweed (*Hieracium caespitosum*), common apple (*Malus pumila*), common plantain (*Plantago major*), common buckthorn (*Rhamnus cathartica*), multiflora rose (*Rosa multiflora*), and common dandelion (*Taraxacum officinale*). The controlling and removing of introduced species generally involve three methods, biological, mechanical, and chemical (US Department of Agriculture, n.d.). Specific strategies to control introduced species will be discussed in more detail in the management actions of this document.

Future Research

The plots that were sampled during this survey were created with the intention of being permanent. In the future, if restoration or non-native species removal happens, then these plots can be used to get an idea on how the work is progressing. When compared to the data produced during this survey it can provide information on whether the removal of a species(es) is working or if restoration work is providing a better habitat for native species. A vegetation survey that focuses on just invasive species should also be performed. This kind of survey can provide better data on what non-native species are on the property and provide better management strategies to deal with them. A rare and endangered species inventory of the

property would be helpful when performing restoration work. As noted above there are already two species recorded at West Scio that are on the rare Michigan species list.

Tables and Figures

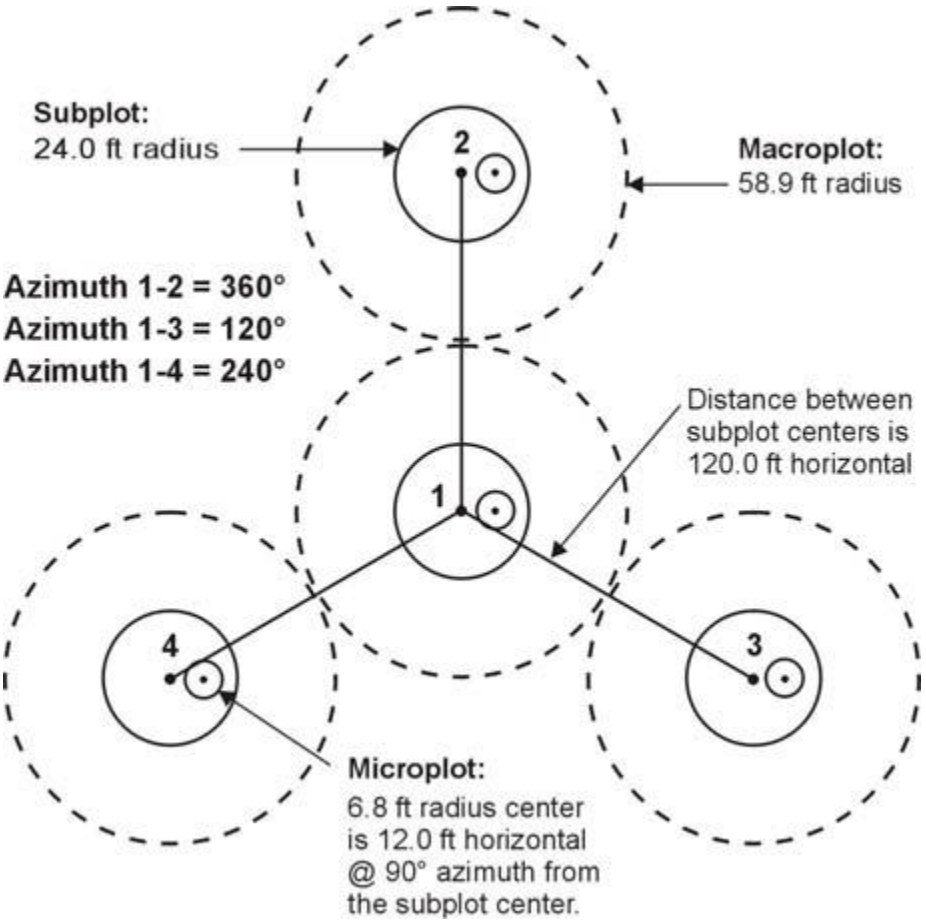


Figure 1: The FiA plot system uses four subplots inside a macroplot (the dotted lines). Inside the subplots exist four microplots. The subplots and the microplots are where vegetation sampling takes place.

Figure 2: An example of the plots used for collecting vegetation data at West Scio Preserve. The large red square is 100x100 feet and all the tree species were documented including their DBH. The blue squares are the 10x10 foot subplots where the species of saplings, shrubs, and climbing vines were documented. The green squares are the 3x3 foot subplots where the herbaceous plants were documented. The numbers were used for identifying which plot or subplot the data was being collected in. Each large plot (the red square) had a unique number.

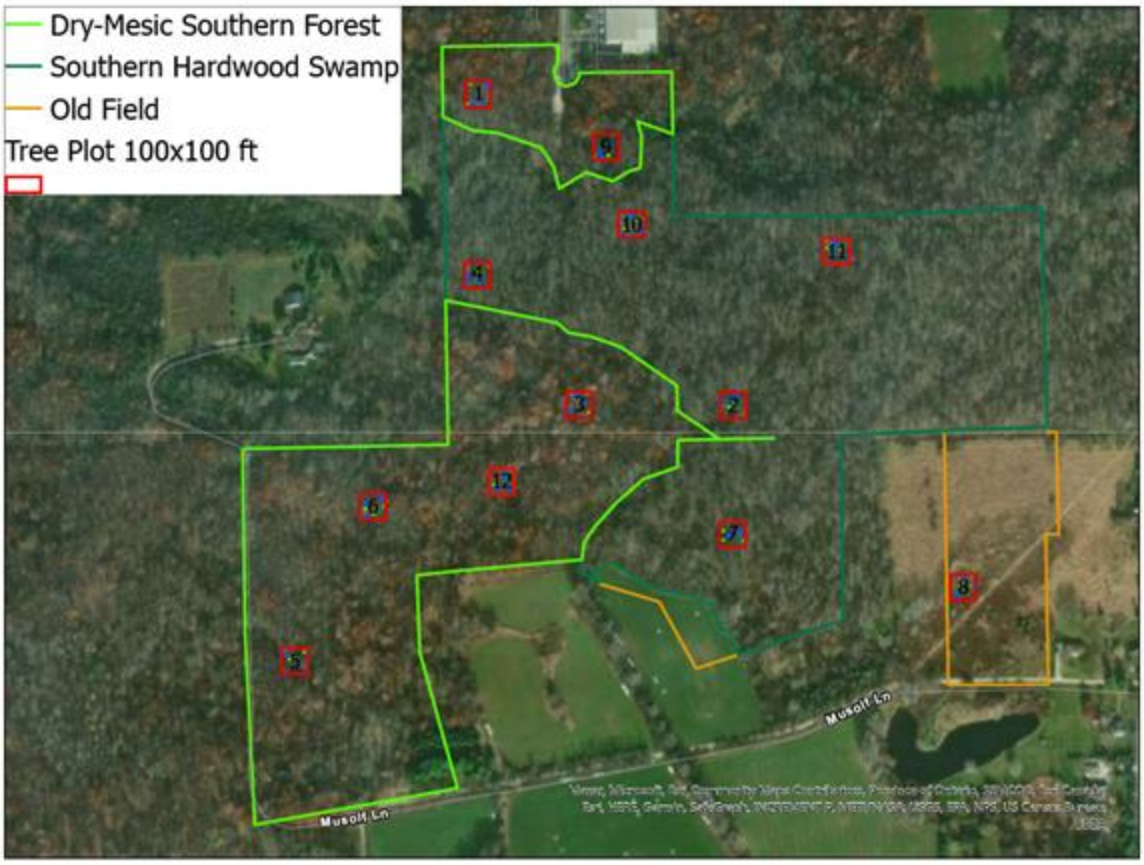


Figure 3: Map of the stratums and the vegetation plots at West Scio. There were 12 vegetation plots in total.

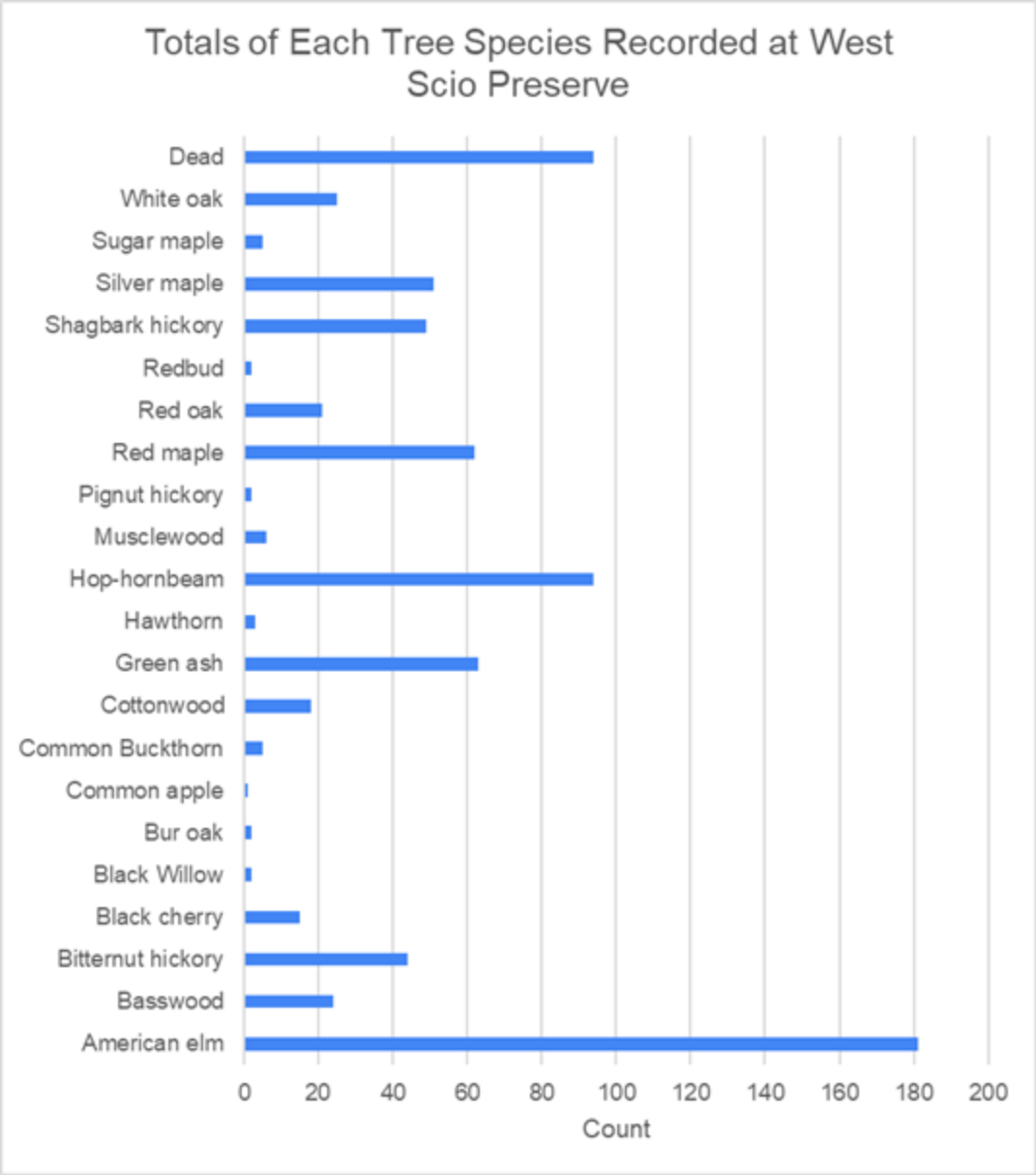


Figure 4: Graph of the count of each tree species recorded at West Scio Preserve. The American elm was recorded the most and the common apple was recorded the least.

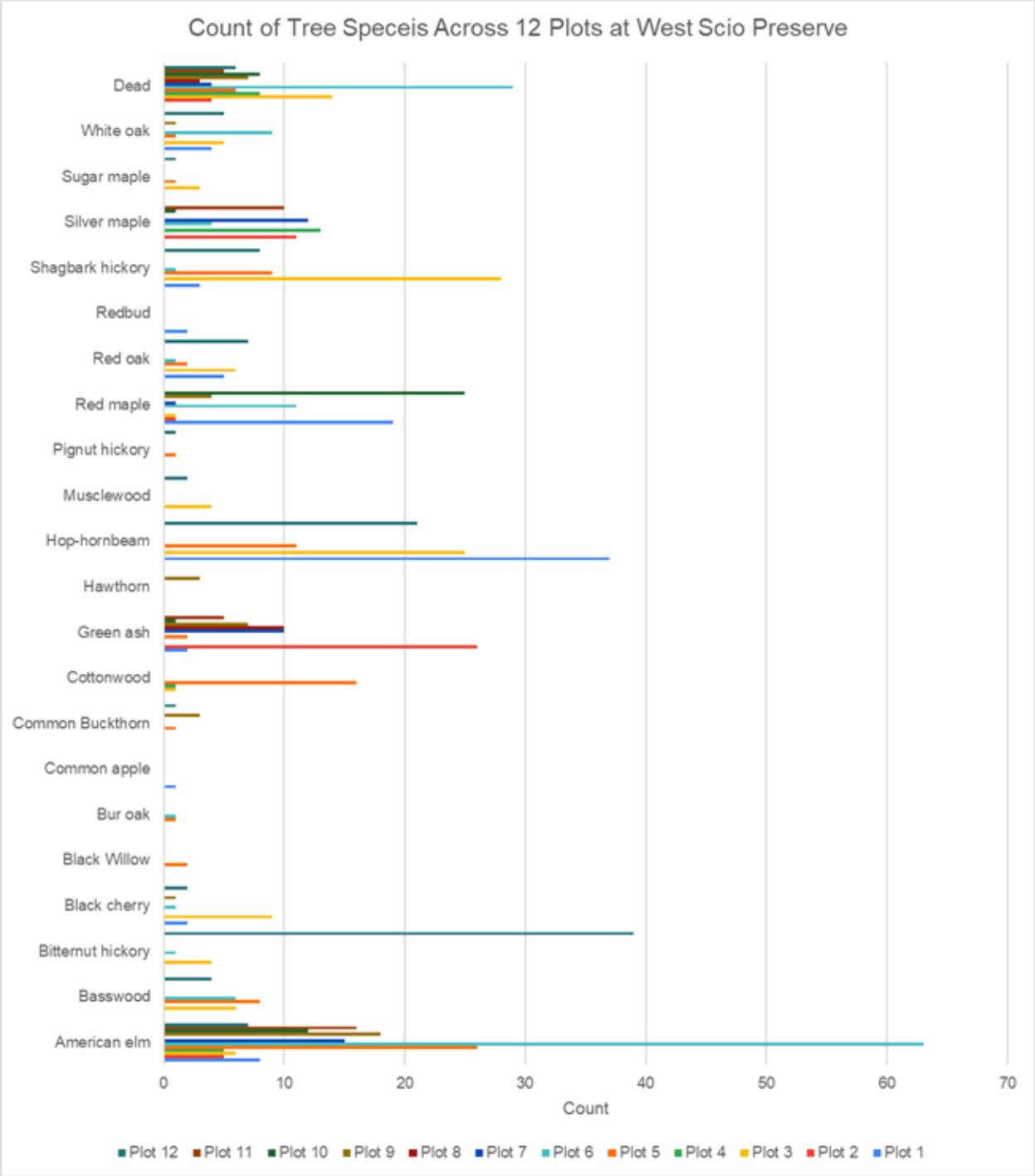


Figure 5: Graph of the number of each tree species seen in each plot. The American elm is recorded in every plot except plot 8.

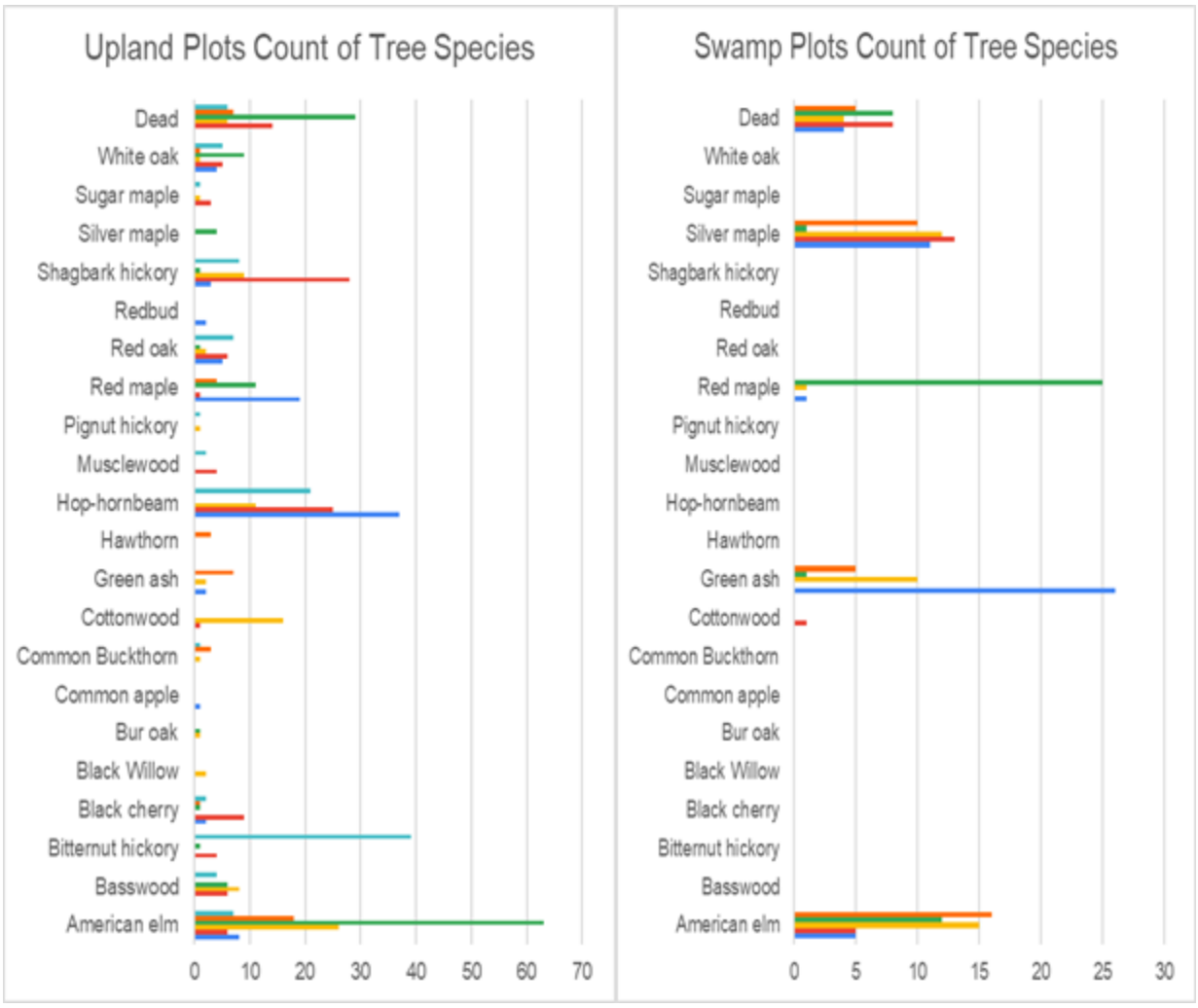


Figure 6: Two graphs comparing the species in the upland plots to that of the swamp plots. It is clear to see that the upland plots have a greater diversity of tree species present. The swamp plots have four species that make up almost all of the recorded observations.

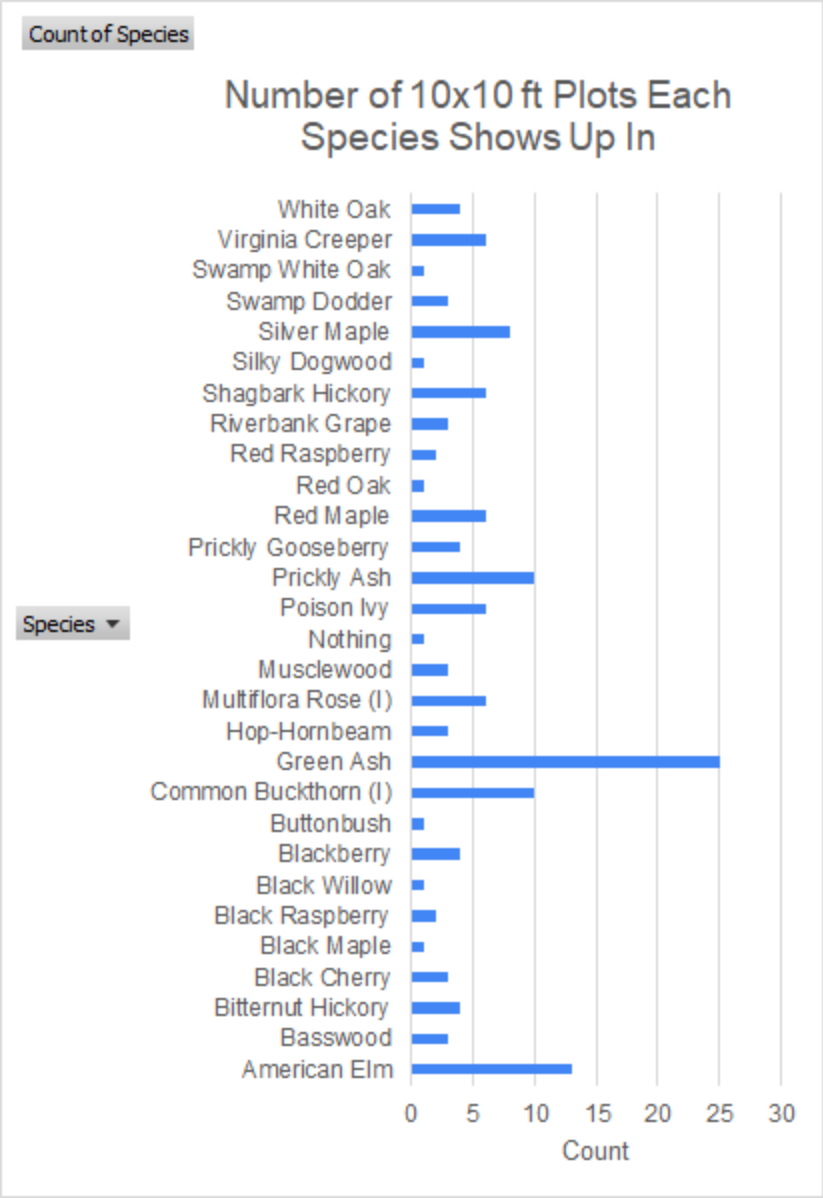


Figure 7: Graph of the frequency of each species that is recorded in the 10x10 foot plots. Green ash seedlings show up in the greatest number of plots with the American elm showing up in the second greatest number of plots.. An (I) indicates a species that is introduced in Michigan.

Species	Sum of Stem Count
Green Ash	335
Silver Maple	140
Common Buckthorn (I)	139
Prickly Ash	117
Red Maple	111
Multiflora Rose (I)	42
Prickly Gooseberry	38
American Elm	30
Musclewood	17
Black Cherry	16
Swamp Dodder	11
Shagbark Hickory	10
Blackberry	10
Virginia Creeper	8
Basswood	7
Bitternut Hickory	6
Poison Ivy	6
Riverbank Grape	4
White Oak	4
Hop-Hornbeam	3
Black Raspberry	2
Red Raspberry	2
Black Willow	1
Black Maple	1
Swamp White Oak	1
Silky Dogwood	1
Red Oak	1
Buttonbush	1
Nothing	
Grand Total	**1064**

Table 1: Pivot table containing the sums of the stem counts for each species in the 10x10 foot plots. Green ash was counted the most with silver maple, prickly ash, red maple, and common buckthorn having over 100 stem counts. An (I) indicates a species that is introduced in Michigan.

Species	Frequency
False Nettle	14
Poison Ivy	12
Wild Geranium	11
Enchanter's Nightshade	10
American Jumpseed	10
Aster Spp.	9
Geum Spp.	7
Jack In The Pulpit	7
Canada Bluejoint	6
Goldenrod	6
Virgina Creeper	5
Common Cinquefoil	5
Bedstraw	4
Dandelion (I)	4
Water Parsnip	4
Wood Avens (I)	4
Poa Spp.	4
Reed Canary Grass	3
Sedge Spp.	3
Juncus Spp.	3
Multiflora Rose (I)	2
Rattlesnake Root	2
Prairie Brome	2
Garlic Mustard (I)	2
Self-heal	2
Bur Merrigold	2
Daisy Fleabane	2
Hop Sedge	2
Prickly Gooseberry	2
Bottle Brush	2
Apiacea family	2
White Avens	2
Sensitive Fern	2
Black Raspberry	2
Broadleaf Enchanter's Nightshade	2
Broadleaf Plantain (I)	1
Smooth Carion Flower	1
Northern Bugleweed	1
Fragrant Bedstraw	1
Stinging Nettle	1
Poke Milkweed	1
False Solomon Seal	1
Canada Clearweed	1
Persicaria Spp.	1
Meadow Foxtail (I)	1
Spinulose Wood Fern	1
Meadow Hawkweed (I)	1
Upright Carrion Flower	1
Dogbane	1
Waldsteinia Spp.	1
Rough Horsetail	1
Intermediate Dogbane	1
Blue Cohosh	1
Blood Root	1
Mad Dog Skullcap	1
Jewleweed	1
Grand Total	**182**

Species	Total Stem Count
False Nettle	249
Poison Ivy	74
Wild Geranium	88
Enchanter's Nightshade	73
Aster Spp.	65
Jack In The Pulpit	20
Geum Spp.	38
Canada Bluejoint (>100)	273
Goldenrod	423
American Jumpseed	100
Virgina Creeper	133
Common Cinquefoil	28
Water Parsnip	8
Wood Avens (I)	14
Poa Spp.	>100 x 3
Dandelion (I)	10
Bedstraw	29
Reed Canary Grass	90
Sedge Spp.	82
Juncus Spp. (>100)	21
Garlic Mustard (I)	53
Bottle Brush	24
Self-heal	9
Daisy Fleabane	4
White Avens	16
Black Raspberry	3
Hop Sedge	2
Broadleaf Enchanter's Nightshade	8
Sensitive Fern	4
Prairie Brome	18
Apiacea family	8
Prickly Gooseberry	2
Rattlesnake Root	8
Bur Merrigold	10
Multiflora Rose (I)	4
Meadow Hawkweed (I)	1
Smooth Carion Flower	1
Broadleaf Plantain (I)	2
Dogbane	2
Stinging Nettle	4
Poke Milkweed	1
Blood Root	1
Intermediate Dogbane	18
Blue Cohosh	2
False Solomon Seal	1
Spinulose Wood Fern	1
Jewleweed	1
Upright Carrion Flower	1
Fragrant Bedstraw	10
Waldsteinia Spp.	3
Rough Horsetail	3
Northern Bugleweed	37
Canada Clearweed	6
Persicaria Spp.	3
Mad Dog Skullcap	1
Meadow Foxtail (I)	9

Table 2: The left table is a pivot table of frequency of the species recorded in the thirty-six 3x3 plots at West Scio Preserve. In total 57 different plants were identified. The right table shows the total stem count for each species. For some species such as Canada Bluejoint, there were too many stems to count because it is a grass. By putting >100, it indicates there were large patches of the species present in a plot. Poa spp. has >100 x 3 indicating there were three plots where it was very prevalent. An (I) indicates a species that is introduced in Michigan.

Conservatism-Based Metrics			Speceis Richness			Physiognomy Metrics			Duration Metrics	
Total Mean C	3.4		Total Species	78		Tree	22 (28.2%)		Annual	6 (7.7%)
Native Mean C	3.8		Native Species	69 (88.5%)		Shrub	8 (10.3%)		Perennial	75 (89.7%)
Total FQI	30		Non-native Species	9 (11.5%)		Vine	6 (7.7%)		Biennial	2 (2.6%)
Native FQI	31.6					Forb	33 (42.3%)			
Adjusted FQI	35.7					Grass	5 (6.4%)		Native Annual	6 (7.7%)
% C value 0	16.7		Species Wetness			Sedge	1 (1.3%)		Native Perennial	67 (79.5%)
% C value 1-3	32.1		Mean Wetness	0.4		Rush	0 (0%)		Native Biennial	1 (1.3%)
% C value 4-6	43.6		Native Mean Wetnes	0.1		Fern	3 (3.8%)			
% C value 7-10	7.7					Bryophyte	0 (0%)			
Native Tree Mean C	4.3									
Native Shrub Mean C	2.9									
Native Herbaceous Me	3.8									

Table 3: FQA metrics for West Scio Preserve. Total mean C and total FQI are the most informative metrics. The closer the mean C is to 10 the greater the number of rare or specialist species. An FQI of 31.9 indicates an area of overall high-quality vegetation.

Liberty Pond Studies

Breeding Bird Survey

Methods

On page 42 a more detailed description of the methods used in the breeding bird survey are provided. It includes where the methods came from, when the surveys took place, and the breeding code that was used. Here a short description of the sampling units at Liberty Pond is provided along with the results from there.

At Liberty Pond a similar system used to divide the habitat units at West Scio was used. At this location four habitat units were created, developed habitat, pond, marsh, and old field (Figure 1). The old field was the only habitat that needed to be subdivided to make the sampling of it easier. The ponds were unique habitat because it included the pond and the surrounding vegetation out up to 150 feet from the water.

Results

In total there were over 500 separate observations recorded at West Scio and Liberty Pond. There were 67 unique species observed at the two properties. Out of the 67 species, 12 were unique to Liberty Pond.

At Liberty Pond there were 50 unique species of bird seen or heard. Table 1 is a pivot table that lists these species in alphabetical order by common name and includes their breeding codes. There are a total of 24 species that were able to confirm as breeding at Liberty Pond. Additionally, 7 more unique species were recorded as probably breeding. Over 30 different species fall into the top two breeding categories at Liberty Pond. The red-winged blackbird (*Agelaius phoeniceus*) and the Baltimore oriole (*Icterus galbula*) were confirmed as breeding in the most survey units at 5 and 4 respectively. Based on table 2 the American robin, northern cardinal, red-winged blackbird, and song sparrow were recorded in all 8 survey units at Liberty Pond. The barn swallows (*Hirundo rustica*) at liberty pond were all seen nesting in the bottom of the old barn on the property. Over 20 nests were seen, and a detailed count was attempted but the location is hazardous, and it would cause too much of a disturbance to the birds.

Endangered Species and Introduced Species

There were 50 different species of bird recorded at Liberty Pond and none of them are on the United States endangered species list (US Fish and Wildlife Service, n.d.). On Michigan's endangered species list, the trumpeter swan (*Cygnus buccinator*) is listed as threatened (Michigan State University, n.d.-b). The status threatened is given to a species that is not endangered, i.e. close to extinction or extirpation, but could become endangered if current trends are not reversed. A species listed as threatened in Michigan is protected under the Endangered Species Act of the State of Michigan and the 1994 Michigan Natural Resources and Environmental Protection Act (Michigan State University, n.d.-a). The trumpeter swan seen at Liberty Pond was only seen circling over the biggest pond once and there was no indication of breeding on the property. . This could change in the future and the township should keep a lookout for a breeding pair in the future. If a pair is spotted, then it should be reported, and proper measures should be taken to ensure its safety.

At Liberty Pond, three species were recorded that are considered to be introduced to the area, the European starling, house finch (*Haemorhous mexicanus*), and house sparrow (*Passer domesticus*) (Jon L. Dunn et al., 2008). In North America there are an estimated over 200 million European starlings ranging all the way from Alaska to Mexico and coast to coast (Cornell Lab of

Ornithology, n.d.-a). They are also known to take over nesting sites of cavity nesters. In a field study done by Purcell, Kathryn with the U.S. Forest Service, it was observed that European starlings avoid areas of tall, ungrazed/mowed grass. To prevent populations of European starlings in certain areas it is advised to leave taller grass and reduce their foraging areas (Purcell, Kathryn L. 2015). The house finch is unique in this list of introduced species because of where it was introduced from. It is native to the western United States and Mexico but was introduced into the eastern United States (Cornell Lab of Ornithology, n.d.-b). This also means there is not much control of the species in the eastern part of the U.S. Since the species is native and is a migratory bird it falls under The Migratory Bird Treaty Act of 1918 and The Migratory Bird Treaty Reform Act of 2004 (U.S. Fish & Wildlife Service, 2020). The house sparrow was introduced into the United States from Europe. They nest in manmade structures and have even been seen evicting other cavity nesting birds (Cornell Lab of Ornithology, n.d.-c). Control measures include strategic placement of nesting boxes so that native birds are more likely to use them, plugging of nesting holes that are used by house sparrows, and active elimination of house sparrow birds and eggs (North American Bluebird Society, 2012).

Future research

This report is the first known breeding bird survey done at Liberty Pond Nature Area. As such, there are certain conclusions that cannot be drawn because of lack of prior data. We cannot know if any of the birds seen or heard are normal nesters on the properties or if they are new. We also cannot know if the number of observations made during this survey is high, average, or low. To be able to answer these questions, future surveys should be done. Other surveys such as The North American Breeding Bird Survey and the Michigan breeding bird survey take place yearly and every 20 years respectively (U.S. Geological Survey, 2020, Chartier et al. 2011). Considering population dynamics, it would be best to do a survey every year or every other year to catch the change of the populations over time. As this is very hard to do and expensive, doing a breeding bird survey every 5 to 10 years should also catch the change of the populations. Incorporating citizen science into this process could help with this process as well. Ebird is a phone app that can be downloaded for free and used by the public to record sightings of birds.

Figure 1: Map of the survey units used for the breeding bird survey at Liberty Pond. There were a total of 8 units. The numbering starts at 12 so as not to confuse units at West Scio and Liberty Pond. Units 12A and 12B were considered the same unit even though they are separate on the map.

Liberty Pond Pivot Table of Breeding Codes					
Count of Species	Column Labels				
Row Labels	Confirmed	Probable	Possible	Observed	Grand Total
American crow (Corvus brachyrhynchos)			1		1
American goldfinch (Spinus tristis)		4	3		7
American robin (Turdus migratorius)	2	4	2		8
American tree sparrow (Spizelloides arborea)			1		1
Baltimore oriole (Icterus galbula)	4	1	2		7
Barn swallow (Hirundo rustica)	1				1
Black-capped chickadee (Poecile atricapillus)	2		1		3
Blue jay (Cyanocitta cristata)			2		2
Brown-headed cowbird (Molothrus ater)	1		3		4
Cedar waxwing (Bombycilla cedrorum)	2		2		4
Chipping sparrow (Spizella passerina)	1				1
Common grackle (Quiscalus quiscula)	1		3		4
Common yellowthroat (Geothlypis trichas)	2	2	2		6
Downy woodpecker (Dryobates pubescens)	1				1
Eastern kingbird (Tyrannus tyrannus)	2	1			3
Eastern meadowlark (Sturnella magna)		1			1
Eastern phoebe (Sayornis phoebe)		2			2
Eastern wood pewee (Contopus virens)	1		3		4
European starling (Sturnus vulgaris)		2	1		3
Field sparrow (Spizella pusilla)	1				1
Gray catbird (Dumetella carolinensis)	1	4	2		7
Great Blue Heron (Ardea herodias)				3	3
Green heron (Butorides virescens)	1		3		4
Hairy woodpecker (Leuconotopicus villosus)			1		1
House finch (Haemorhous mexicanus)	1		2		3
House sparrow (Passer domesticus)	1				1
Indigo bunting (Passerina cyanea)		1			1
Killdeer (Charadrius vociferus)	2		2		4
Mallard (Anas platyrhynchos)			1		1
Mourning dove (Zenaida macroura)		1	2		3
Northern cardinal (Cardinalis cardinalis)	3	2	3		8
Orchard oriole (Icterus spurius)			1		1
Red-bellied woodpecker (Melanerpes carolinus)			1		1
Red-winged Blackbird (Agelaius phoeniceus)	5	1	2		8
Rose-breasted grosbeak (Pheucticus ludovicianus)			1		1
Ruby-throated hummingbird (Archilochus colubris)			3		3
Sandhill crane (Antigone canadensis)				3	3
Song sparrow (Melospiza melodia)	3	3	2		8
Swamp sparrow (Melospiza georgiana)			1		1
Tree swallow (Tachycineta bicolor)			3		3
Trumpeter swan (Cygnus buccinator)				1	1
Tufted titmouse (Baeolophus bicolor)		2			2
Turkey vulture (Cathartes aura)			2		2
Warbling vireo (Vireo gilvus)	1				1
White-breasted nuthatch (Sitta carolinensis)			1		1
Wild turkey (Meleagris gallopavo)			2		2
Wood duck (Aix sponsa)	1				1
Wood thrush (Hylocichla mustelina)			1		1
Yellow warbler (Setophaga petechia)	3	1	2		6
Yellow-billed cuckoo (Coccyzus americanus)			1		1
Grand Total	**43**	**32**	**65**	**7**	**147**

Table 1: Pivot table of breeding codes for Liberty Pond nature area. The first column is the species that was heard or seen and sorted in alphabetical order by common name. The next four columns indicate how many different units a species' breeding code fell into that category. The grand total column represents the total amount of units a species was either seen or heard in. For example, the American crow had one unit where its breeding code was probably breeding and seven units with possibly breeding. For a total of eight different units the American crow was seen at West Scio preserve.

Liberty Pond Pivot Table of Survey Units

Count of Species	Column Labels								
Row Labels	12	13	14	15	16	17	18	19	Grand Total
American crow (Corvus brachyrhynchos)			1						1
American goldfinch (Spinus tristis)	1	1	1	1	1	1	1		7
American robin (Turdus migratorius)	1	1	1	1	1	1	1	1	8
American tree sparrow (Spizelloides arborea)	1								1
Baltimore oriole (Icterus galbula)	1	1	1		1	1	1	1	7
Barn swallow (Hirundo rustica)							1		1
Black-capped chickadee (Poecile atricapillus)		1	1	1					3
Blue jay (Cyanocitta cristata)			1		1				2
Brown-headed cowbird (Molothrus ater)	1		1		1	1			4
Cedar waxwing (Bombycilla cedrorum)			1	1		1	1		4
Chipping sparrow (Spizella passerina)			1						1
Common grackle (Quiscalus quiscula)	1		1			1	1		4
Common yellowthroat (Geothlypis trichas)	1	1	1	1		1		1	6
Downy woodpecker (Dryobates pubescens)						1			1
Eastern kingbird (Tyrannus tyrannus)		1	1	1					3
Eastern meadowlark (Sturnella magna)				1					1
Eastern phoebe (Sayornis phoebe)	1			1					2
Eastern wood pewee (Contopus virens)	1	1	1		1				4
European starling (Sturnus vulgaris)			1			1	1		3
Field sparrow (Spizella pusilla)				1					1
Gray catbird (Dumetella carolinensis)	1	1	1	1	1	1	1		7
Great Blue Heron (Ardea herodias)				1	1			1	3
Green heron (Butorides virescens)	1	1					1	1	4
Hairy woodpecker (Leuconotopicus villosus)			1						1
House finch (Haemorhous mexicanus)					1	1	1		3
House sparrow (Passer domesticus)							1		1
Indigo bunting (Passerina cyanea)	1								1
Killdeer (Charadrius vociferus)	1			1	1		1		4
Mallard (Anas platyrhynchos)		1							1
Mourning dove (Zenaida macroura)			1			1	1		3
Northern cardinal (Cardinalis cardinalis)	1	1	1	1	1	1	1	1	8
Orchard oriole (Icterus spurius)			1						1
Red-bellied woodpecker (Melanerpes carolinus)						1			1
Red-winged Blackbird (Agelaius phoeniceus)	1	1	1	1	1	1	1	1	8
Rose-breasted grosbeak (Pheucticus ludovicianus)			1						1
Ruby-throated hummingbird (Archilochus colubris)	1			1				1	3
Sandhill crane (Antigone canadensis)	1			1				1	3
Song sparrow (Melospiza melodia)	1	1	1	1	1	1	1	1	8
Swamp sparrow (Melospiza georgiana)				1					1
Tree swallow (Tachycineta bicolor)		1	1	1					3
Trumpeter swan (Cygnus buccinator)		1							1
Tufted titmouse (Baeolophus bicolor)				1		1			2
Turkey vulture (Cathartes aura)				1			1		2
Warbling vireo (Vireo gilvus)		1							1
White-breasted nuthatch (Sitta carolinensis)							1		1
Wild turkey (Meleagris gallopavo)			1			1			2
Wood duck (Aix sponsa)	1								1
Wood thrush (Hylocichla mustelina)		1							1
Yellow warbler (Setophaga petechia)	1	1		1	1	1		1	6
Yellow-billed cuckoo (Coccyzus americanus)	1								1
Grand Total	**21**	**18**	**24**	**22**	**14**	**19**	**18**	**11**	**147**

Table 2: Pivot table of the survey units where a breeding code was entered for different species at Liberty Pond. The first column is the species alphabetical order based on common name. The column numbers (12-19) correspond to a survey unit. Within those columns, a 1 represents that a breeding code for that species was entered. For example, the American crow has a breeding code entered for survey unit 14. Out of the 8 survey units at Liberty Pond, the American crow was seen or heard in only 1 of them.

Vegetation Survey

Methods

A majority of the methods describing the vegetation survey is described on page 53. There information regarding where the methodology came from, how data was collected in quadrats, and the floristic quality assessment is discussed. In this section the plot setup at Liberty Pond and the transect setup and data collection are discussed.

Plot Setup

The way the plots were setup at Liberty Pond is very similar to that of West Scio. At West Scio, the area is dominated with trees and less understory plants. At Liberty Pond, most of the area is old field and has few trees and shrubs present. To account for this difference there were slight changes to the plots. The large 100x100 foot plot was kept but it was used for recording trees, shrubs, saplings, and climbing vines. This was done to get a better understanding of these species in this area. Subsequently, the 10x10 foot plot was removed. The 3x3 foot plot was kept for sampling the herbaceous layer (Figure 1).

The same grid and random number generator method mentioned above was used in placing the plots at Liberty Pond. There are five vegetation stratums present: open field, pond, marsh, topsoil mound, and developed area (Figure 2). Due to the way the vegetation is structured around the marsh and ponds, quadrats were not used in these stratums. The developed area was left out as well because most of it is monoculture grass and horticulture plants, as well as uncertainty surrounding its future as part of Liberty Pond. To capture as much of the variation in the vegetation present, a plot was put roughly every three acres in the open field and topsoil mound stratums. This resulted in five plots in the open fields and one in the topsoil mounds.

Transect Setup

At Liberty Pond the ponds and marsh vegetation are unique from the surrounding areas. The shape of these areas is not conducive to using quadrats. For this reason, a belt transect method like Grant et al. applied in their research was used but with some modifications to better fit our situation (2004). The vegetation areas around the ponds are variable in size, meaning it is impossible to set a defined length on the distance of the transect used. If a standard 100 foot transect was used for each location, part of the sampling would take place in the open field areas which are already sufficiently covered by the quadrat plots. To account for this a random spot at the edge of the ponds was chosen. From this spot the transect tape was rolled out until it reached the edge of the vegetation stratum, and the distance was recorded. If the tape was rolled out to the full 100-foot extent, then at three locations, 10 feet in from edge, 50 feet, and water's edge, along the transect the herbaceous vegetation was sampled. If the tape was not fully rolled out then only two locations were sampled, 10 feet in from edge and water's edge. To capture the trees, saplings, shrubs, and climbing vines present the length of the transect was walked and any that touched the tape or hung over it were recorded.

Results

At Liberty Pond there were six 100x100 foot plots sampled. Only three of the six 100x100 foot plots had trees measured in them. Eight different tree species were measured. Boxelder (*Acer negundo*) was recorded the most. Plot 6 had the greatest number of tree species at five species (Figure 3). The 100x100 foot plots were also used to record the stem counts of the saplings, shrubs, and climbing vines. None of the species recorded occurred in all six of the plots. Seven species; Tartarian honeysuckle (*Lonicera tatarica*), multiflora rose (*Rosa multiflora*), common buckthorn, autumn olive (*Elaeagnus umbellate*), riverbank grape (*Vitis riparia*), boxelder, and callery pear (*Pyrus calleryana*) are found in four of the plots (Table 1). The herbaceous plants were sampled in three 3x3 foot plots in each 100x100 foot plots. In eleven of the eighteen 3x3 plots goldenrod was identified. None of the species were seen in all eighteen of the plots. Poa spp. had over 600 stems recorded. There was not an exact count done because of how the grass can form large clumps making it too time consuming to get an exact count (Table 2).

At Liberty Pond seven belt transects were sampled. Six of the seven were done at random locations around the ponds. At those locations sandbar willow (*Salix exigua*) was the most common of the trees, shrubs, and climbing vines seen with a stem count of 47. Poa Spp. was the most common seen in the herbaceous layer with over 200 stems. At the species level, *Phragmites australis*, was the most common herbaceous plant recorded with a stem count of 111 (Table 3). The last transect was performed in the southern wet meadow at Liberty Pond. This transect was dominated by three species, Canada bluejoint (*Calamagrostis canadensis*),

narrowleaf cattail (*Typha angustifolia*), and spotted joe-pye weed (*Eutrochium maculatum*) (Table 4).

At Liberty Pond the total mean C is 1.6 and the total native mean C is 3.1. Here the non-native species play a large role in the reduction of the total mean C. Almost half the species, 47.1%, recorded at Liberty Pond are considered non-native. The total FQI for Liberty Pond is 14.8 (Table 5). This indicates that the overall vegetation quality is considered low.

Endangered and Introduced Species

At Liberty Pond, 85 unique plant species were recorded. None of the species are on either the United States endangered species list or the Michigan natural inventories endangered species list (Michigan State University, n.d.; US Fish and Wildlife Service, n.d.). Out of the 85 unique species recorded, 40 of them are non-native species. This large number of non-native species is most likely due to the history of the land. Much of the land was used for farming and at one point had disturbance to the topsoil layer. Management strategies to control the large number of non-native species is discussed later in the management actions section of this document.

Future Research

The quadrats and transects at Liberty Pond were put in with the intent of being permanent sampling points. In the future when restoration or non-native species removal work has been done, these plots can be resampled and compared to the findings in this report. This will help with knowing whether the restoration or the removal of non-native species is making an impact on the property. If there is to be removal of non-native species on this property, then it would be beneficial to have a vegetation survey done that focuses on just these plants. This can help provide more information to make better management decisions with. None of the species that were recorded in this current survey are on the rare Michigan species list. It would be beneficial to have a survey that looks to find any rare species on the property. Again this would be helpful to future management decisions on the property.

Tables and Figures

Figure 1: An example of the plots used for collecting vegetation used data at Liberty Pond. The orange square is the 100x100 foot plot where the trees, saplings, shrubs, and climbing vines were recorded. The green squares are the 3x3 foot plots where the herbaceous layer is sampled. The numbers on the 3x3 foot plots were used for identifying which subplot the data was being recorded in. Each orange 100x100 foot plot had a unique associated with it as well.

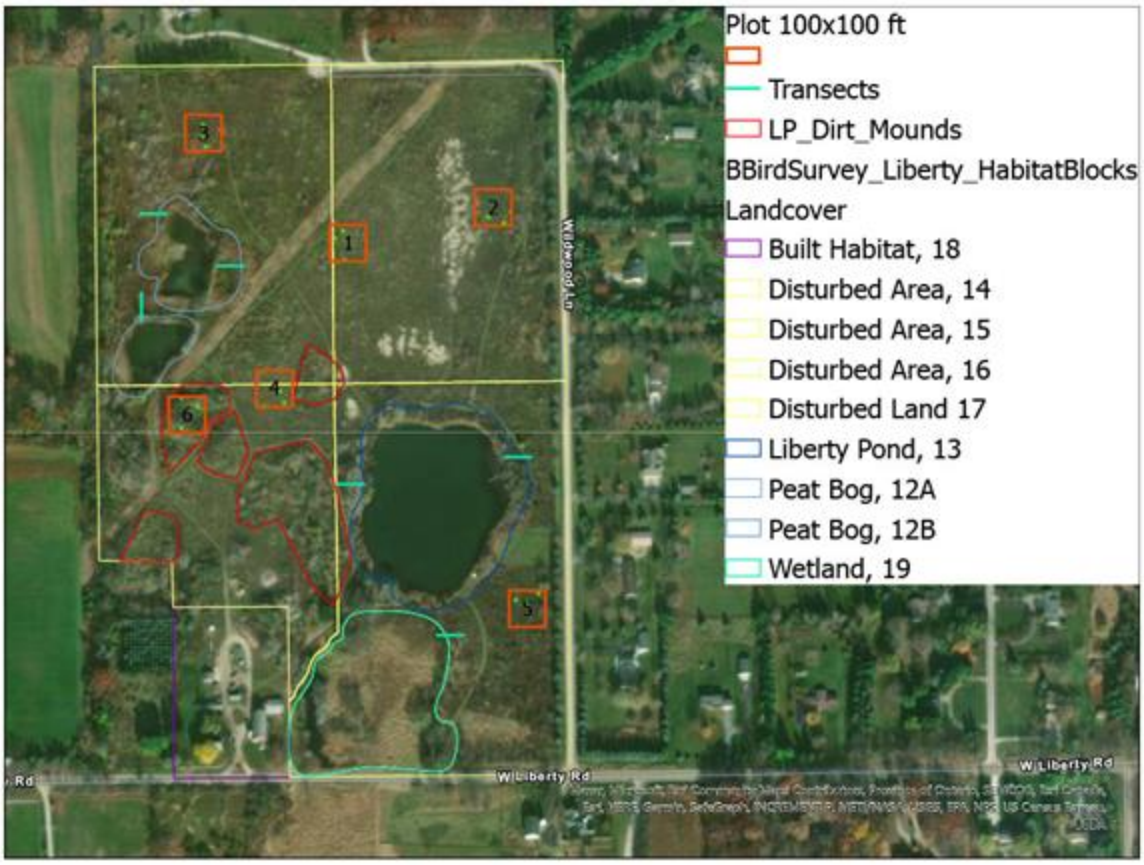


Figure 2: Map of the vegetation plots and transects at Liberty Pond and the different stratums present. There were six vegetation plots and six transects.

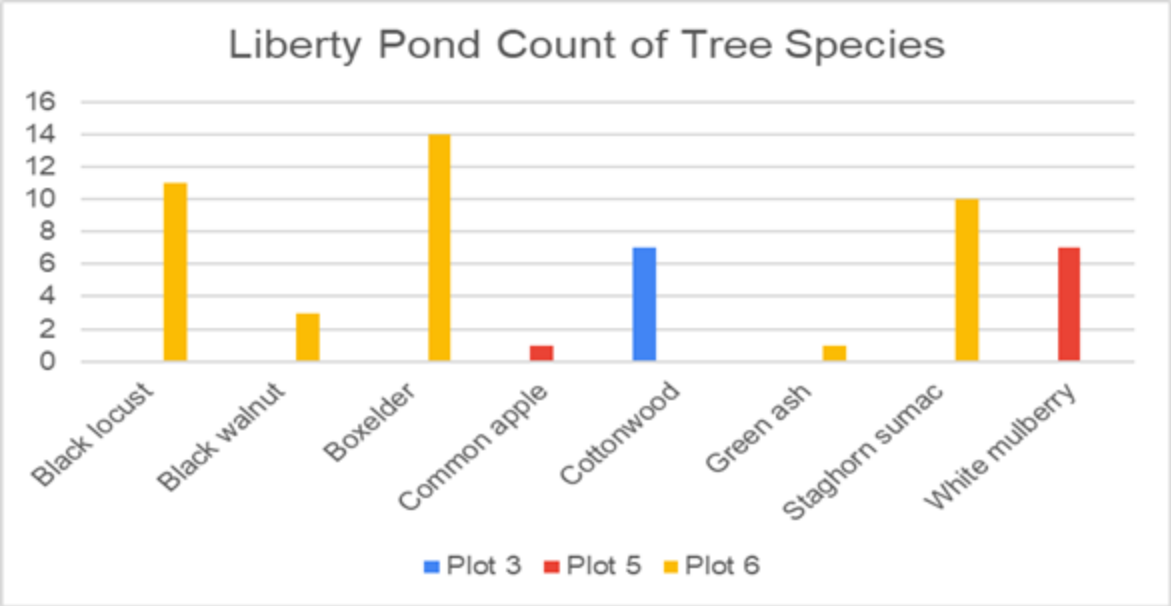


Figure 3: The count of each tree species seen in each 100x100 foot plot at Liberty Pond. Boxelder was recorded the most and plot 6 had the greatest number of tree species.

Count of Species	Colu						
Row Labels	1	2	3	4	5	6	Grand Total
Tartarian Honeysuckle (I)	1			1	1	1	4
Multiflora Rose (I)	1	1	1			1	4
Common Buckthorn (I)		1	1		1	1	4
Autumn Olive (I)		1	1		1	1	4
Riverbank Grape		1	1		1	1	4
Boxelder		1		1	1	1	4
Callery Pear (I)	1	1	1	1			4
Green Ash			1		1	1	3
Black Raspberry		1	1		1		3
Gray Dogwood		1	1		1		3
American Elm			1		1		2
Sandbar Willow		1	1				2
Black Locust (I)				1		1	2
Common Apple (I)		1		1			2
Cottonwood		1	1				2
White Mulberry (I)					1	1	2
Common Privet (I)					1		1
Rough Leaf Dogwood			1				1
Red Pine			1				1
Black Walnut					1		1
Stanghorn Sumac						1	1
Honey Locust	1						1
Red Maple			1				1
Japanese Knot Weed (I)						1	1
Basswood						1	1
Virgina Creeper						1	1
Eastern Red Cedar		1					1
Amur Honeysuckle (I)					1		1
Boxwood		1					1
Ninebark		1					1
Poison Ivy			1				1
Meadow Willow			1				1
Black Willow			1				1
Grand Total	**4**	**14**	**17**	**5**	**13**	**13**	**66**

Table 1: Pivot table of the frequency of each species of sapling, shrub, or climbing vine at Liberty Pond in the 100x100 foot plots. The numbers 1-6 across the top indicate which plot a species was seen in. None of the species are seen in all six plots. An (I) indicates a species that is introduced in Michigan.

Species	Frequency
Goldenrod	11
Poa Spp.	8
Common Teasel (I)	7
Purple Crown Vetch (I)	5
Oxeye Daisy (I)	4
Canadian Thistle (I)	4
Queen Anne's Lace (I)	4
Cut Leaf Teasel (I)	3
Narrowleaf Plantain (I)	3
Agrostis Spp.	3
Reed Canary Grass	2
Winged Loosestrife	2
Lesser Burdock (I)	2
Canada Bluejoint	2
Riverbank Grape	1
Red Clover (I)	1
Bebb's Sedge	1
Limestone Meadow Sedge	1
Black Medic (I)	1
Garlic Mustard (I)	1
Viola Spp	1
Love In A Mist (I)	1
Dandelion (I)	1
Meadow Foxtail (I)	1
Red Top (I)	1
Meadow Hawkweed (I)	1
Reticulated Seeded Spurge (I)	1
Virgina Creeper	1
Spotted Knapweed (I)	1
Field Bindweed (I)	1
Field Wormwood	1
Awl Fruited Sedge	1
Avens Spp.	1
Little Green Sedge	1
Grand Total	**80**

Species	Total Stem Count
Goldenrod	221
Poa Spp. (>100 x 6)	125
Common Teasel (I)	81
Purple Crown Vetch (I)	188
Oxeye Daisy (I)	40
Canadian Thistle (I)	77
Queen Anne's Lace (I)	19
Cut Leaf Teasel (I) (>100)	10
Narrowleaf Plantain (I)	6
Agrostis Spp.	>100 x 3
Reed Canary Grass	28
Winged Loosestrife	33
Lesser Burdock (I)	7
Canada Bluejoint (>100)	10
Riverbank Grape	1
Red Clover (I)	6
Bebb's Sedge	40
Limestone Meadow Sedge	4
Black Medic (I)	9
Garlic Mustard (I)	4
Viola Spp	5
Love In A Mist (I)	1
Dandelion (I)	1
Meadow Foxtail (I)	20
Red Top (I)	3
Meadow Hawkweed (I)	48
Reticulated Seeded Spurge (I)	2
Virgina Creeper	3
Spotted Knapweed (I)	7
Field Bindweed (I)	5
Field Wormwood	3
Awl Fruited Sedge	>100
Avens Spp.	25
Little Green Sedge	20

Table 2: Table on the left is a pivot table of the frequency of the species identified in the 3x3 plots at Liberty Pond. Goldenrod was identified in 11 out of the 18 plots. On the right is the total stem count of each species. For some of the species such as Poa Spp. large clumps existed within the plots that contained many stems. To indicate this, >100 was put in. Poa spp. has the highest stem count at over 600 stems. An (I) indicates a species that is introduced to Michigan.

Trees, Shrubs, and Climbing Vine Species	Total Stem Count
American Elm	1
Autumn Olive (I)	7
Bitternut Hickory	1
Black Raspberry	5
Black Willow	7
Box Elder	7
Common Buckthorn (I)	21
Cottonwood	16
Green Ash	5
Peachleaf Willow	14
Poison Ivy	2
Prickly Ash	6
Pussy Willow	2
Riverbank Grape	4
Sandbar Willow	47
Silky Dogwood	3
Smooth Sumac	10
Tartarian Honeysuckle (I)	13

Herbaceous Species	Total Stem Count
Allegheny Monkey Flower	5
American Bugleweed	2
Avens Spp.	2
Bedstraw	6
Bittersweet Nightshade (I)	1
Black Medic (I)	9
Blue Water Speedwell	1
Broadleaf Plantain (I)	1
Bur Marigold	1
Canada Bluejoint	59
Carex Spp.	110
Common Boneset	1
Dock Spp.	2
Enchanter's Nightshade	2
Field Sow Thistle (I)	1
Garlic Mustard (I)	1
Goldenrod	41
Jewelweed	34
Lesser Burdock (I)	1
Limestone Meadow Sedge	1
Narrowleaf Cattail (I)	32
Nodding Bulrush	50
Northern Bugleweed	18
Phragmites Australis (I)	111
Poa Spp. (>100 x 2)	75
Poison Ivy	31
Purple Crown Vech (I)	52
Purple Loosestrife (I)	104
Queen Anne's Lace (I)	8
Red Clover (I)	2
Riverbank Grape	5
Rough Horsetail	4
Swamp Milkweed	1
Timothy Grass (I)	>100
Virginia Creeper	7

Table 3: The left table is a total stem count of the trees, shrubs, and climbing vines recorded on the transects at Liberty Pond. The right table is the total stem count of the herbaceous species seen in the 3x3 plot used on the transects. The >100 indicates a species that had more than 100 stems in a certain area. An (I) indicates a species that is introduced to Michigan.

Species	Total Stem Count
Canada Bluejoint (>100 x2)	30
Narrowleaf Cattail (I)	7
Spotted Joe-pye Weed	14

Table 4: Species recorded at transect seven at Liberty Pond. This transect was in the marsh and was dominated by these three species.

Conservatism-Based Metrics			Species Richness			Physiognomy Metrics			Duration Metrics	
Total Mean C	1.7		Total Species	89		Tree	20 (22.5%)		Annual	6 (6.7%)
Native Mean C	3.1		Native Species	49 (55.1%)		Shrub	16 (18%)		Perennial	76 (85.4%)
Total FQI	16		Non-native Species	40 (44.9%)		Vine	5 (5.6%)		Biennial	7 (7.9%)
Native FQI	21.7					Forb	36 (40.4%)			
Adjusted FQI	23					Grass	6 (6.7%)		Native Annual:	3 (3.4%)
% C value 0	48.3		Speceis Wetness			Sedge	5 (5.6%)		Native Perennial:	45 (50.6%)
% C value 1-3	30.3		Mean Wetness	0.3		Rush	0 (0%)		Native Biennial:	1 (1.1%)
% C value 4-6	19.1		Native Mean Wetnes	-1.4		Fern	1 (1.1%)			
% C value 7-10	2.2					Bryophyte	0 (0%)			
Native Tree Mean C	3.5									
Native Shrub Mean C	2.2									
Native Herbaceous Me	3.3									

Table 5: Floristic quality assessment of the plants recorded at Liberty Pond. Total mean C and Total FQI are the two important values here.

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