



Protecting the Woods and the Gardens

Natural Areas Management Plan for Matthaei Botanical Gardens, Nichols Arboretum, Horner- McLaughlin Woods, and Mud Lake Bog

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Muskrat swimming in Fleming Creek (Photo credit Alexis Heinz)

Abstract

The purpose of a Natural Areas Land Management Plan for the Matthaei Botanical Gardens and Nichols Arboretum is to create a forward-focused systematic document that covers the most essential topics for land management. The ecological history of southeast Michigan led to a suite of natural communities located at Matthaei Botanical Gardens and Horner-McLaughlin Woods. Each community type supports a different network of wildlife and plant species. Depending on the location, the site may also encourage human interaction. As one example, volunteer stewardship is a practice integral to the successful management of natural areas. For these reasons, this Master's project examined both the natural and social environment. Using collected information, Team Botanical developed a natural areas management plan to guide future management actions. The plan first describes the properties through site characteristics, historical events, and current observations. Then the plan recommends management techniques such as species surveys, target plant communities, prescribed fire, and potential collaborative species introductions along a feasible timeline. The key goal is to establish a process such that those working in natural areas have a tool to develop additional land management plans.

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Introduction

The natural areas of Matthaei-Nichols serve a unique purpose in Washtenaw County. Affiliated with the University of Michigan, they are a resource for both the University population as well as residents in and around the city of Ann Arbor. Specifically, their natural areas are important for multiple reasons. They offer individuals the opportunity to explore nature in a managed and safe setting. These experiences bring people respite from busy urban life. In addition, people have the opportunity to learn while in natural areas. Species identification, management practices, and social skills are some of the benefits received from natural area experiences.

For these natural areas to persist and flourish, they need regular care and maintenance. Therefore, this goal of this project is to produce a management plan to guide future management decisions and actions. The human population and the Earth are in a paramount time period where environmental action is incipient to preserve – and in some cases restore – quality natural areas.

While technology yields many novel opportunities for modern-day culture, nature experiences balance this lifestyle. Fresh air, connection with one's senses, and healthy and functioning plant and animal communities are important to quality of life. Specifying recommendations for the management of Matthaei-Nichols natural areas ensures these positive rewards are available for present and future generations.

Oak openings area in Nichols Arboretum (Photo credit Alexis Heinz)



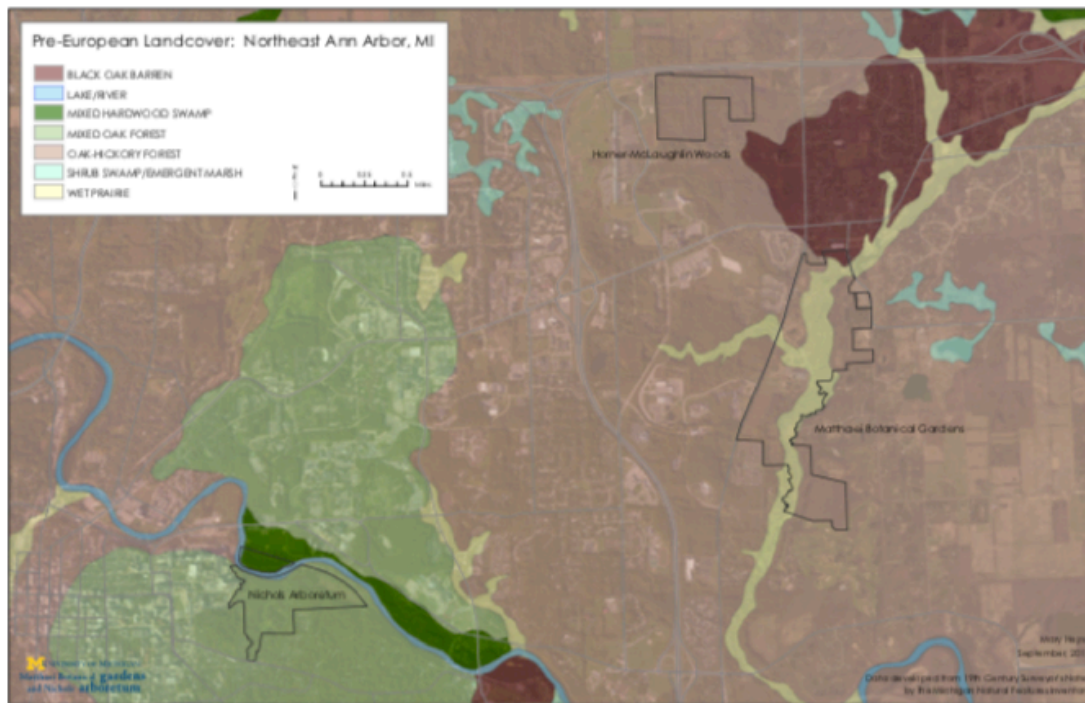


Our Mission

Promoting environmental enjoyment, stewardship and sustainability through education, research and interaction with the natural world.

Our Vision

We will be the center for rich and diverse nature-based experiences for the University of Michigan and its surrounding communities. We will provide exceptionally beautiful gardens and natural areas for enjoyment. We will train a new generation of environmental leaders in sustainability, conservation and ecological restoration and engage research that deepens our understanding of plants, ecology, and the role of nature in our lives.



Map of Pre-European land cover (Mary Hejna)

Brief History

In 1817 the University of Michigan first considered including areas of “useful literary and scientific institutions.” Then, in 1854 the proposition arose to include a botanical gardens on main campus. A serious search for a University botanical garden near to central campus commenced in 1906, and the property now known as Nichols Arboretum was established as the University’s botanical garden in 1907. In 1914 the construction of a new botanical garden began on Iroquois in Ann Arbor. The Botanical Gardens relocated to Dixboro Road in 1957 where the Matthaei family donated 200 acres with funds to purchase the adjacent Matteson Farm.

The map above shows the historical use of each of the properties dating back to pre-European settlement. These properties have been subjected to a variety of changes such as agriculture, land mining, and other forms of land development through the years of evolving ownership. However, many natural characteristics and plant communities have survived the changing land uses and are noted in the current state of the properties.

General Description



Group walking in Nichols Arboretum (Photo credit, Alexis Heinz)

Currently, Matthaei-Nichols manages four separate properties totaling 828 acres. The locations at Matthaei Botanical Gardens are a 350-acre hub of ecological diversity on the outskirts of the city of Ann Arbor, Michigan. While acting as a recreational center for residents of the city and surrounding areas, the Gardens also serve as the support setting for a wide range of botanical and wildlife species. Nichols Arboretum is well known as a resource for the University of Michigan students. At 128-acres, this designed feature contains a myriad of garden types and tree species. Another property, Horner-McLaughlin Woods, is 90 acres. In a more remote location, this property supports upland forest, wetlands, and a host of wildlife. Lastly, Mud Lake Bog at 260-acres is the least accessible property yet still houses a wide variety of unique plant types.

Although 16 natural plant communities occur across the four Matthaei Botanical Gardens and Nichols Arboretum properties, this management plan focuses on the ten natural communities located at Matthaei Botanical Gardens and Horner-McLaughlin Woods. Rather than address all four properties, this plan focuses on the most ecologically diverse and simple sites. To explain, understanding Matthaei Botanical Gardens facilitates the creation of a land management plan that is translatable to other diverse sites as well as smaller locations. In tandem, comprehending Horner-McLaughlin Woods allows the observation of key features of a smaller and less complex location. Through simultaneously considering broad and focused perspectives, the adaptable results are intended to be a model for the other two properties, Nichols Arboretum and Mud Lake Bog. This information complements the land management plan written by Jeff Plakke as a thesis on Nichols Arboretum. Beyond these four properties, the methods and perspectives revealed in this plan are potential examples of management recommendations for the natural areas of other properties.

Project Process

The research methods used to prepare this document include a literature review in the form of an evaluation of existing management plans, field observations, an examination of existing data, focus group meetings, and understanding the way the property currently operates.

In any major project, practitioners need to follow structural components that create the methods and procedures of the project. For this management plan, creating a flow of information meant illustrating important stages of interest from short-term and long-term perspectives. To achieve this goal, Team Botanical consisted of four students and two advisors,

with Matthaei-Nichols as the client. Working as a team allows for the combination of various expertises and the consolidation into one document of this more complex collection of perspectives.

This management plan required planning, organization, and implementation. Meeting as a team, planning and facilitating focus group sessions, evaluating field conditions and data, and preparing documentation resulted in this product. A management plan should be adaptable and changeable to account for the ever-evolving nature of the world. Therefore, this plan is designed as a flexible tool to manage natural areas.



Prairie flowers at Nichols Arboretum (Photo credit Alexis Heinz)

Literature Review

The literature review for this project included multiple topics. To start, Team Botanical examined a multitude of existing management plans and explored documents related to the history of the botanical gardens. Relevant topics included management guidelines, natural areas stewardship, invasive species, species conservation (birds, plants, animals, amphibians, and insects), climate change, natural communities and habitats, water quality, and urban environments.

Historical documents showed the value of Fleming Creek as one of the higher quality waterways within the Huron River watershed (SPH, 1972).

Concerning stewardship, the social and ecological environments are relevant aspects for understanding the complete network (Romolini et al., 2016). Because of the affiliation with the University, student involvement emerged as an important component to campus sustainability (Krasny et al., 2014). In regards to volunteer participation as related to restoration activities, most groups received support from project partners. Those volunteer groups linked to specific areas had higher long-term success and dedication (Peters et al., 2015). Volunteers are often motivated by experiencing a sense of belonging, taking care of the environment, and expanding their individual learning (Bramston et al., 2010). Further, data collection through citizen science can bolster research efforts (Chandler et al., 2016).

The management guidelines we reviewed stressed the need for identifying a timeline and keeping extensive records as well as setting clear goals and explaining recommendations with maps and photos (Sargent et al., 2001). Examples of these guidelines can be found in the references section, however some notable ones that influenced our management plan include the Kalamazoo Nature Center Report (Kalamazoo, MI), Beckwith Preserve Management Plan (Stockbridge, MI), and the Forest Stewardship Plan (Lansing, MI).

A specific topic of concern for this management plan was invasive species management. We read research

papers on control methods for invasive species and several weeds control methods handbooks. We focused on the most common invasive herbaceous plants in Ann Arbor like Garlic Mustard (Vaughn et al., 1999), Purple Loosestrife (Linda M. Wilson, Mark Schwarzlaender, Bernd Blossey, Carol Bell Randall, 2004), and shrubs and trees like Exotic Buckthorn (Heidorn R. 2007). These readings offered recommendation of combined practices on both severely disturbed sites and in natural communities of high quality (Heidorn R. 2007). They suggested specific circumstances where practices like hand-pulling, cutting, and mowing suffice, and other situations when chemical control may be helpful.

In addition literature was gathered on the health and community services of water quality (KalCounty, 2009), national climate assessment data for the Midwest (Hall, 2012), as well as climate monitoring (Walsh, 2014), in order to determine impacts to natural areas based on these implications.

Ecological Importance

Much of the background information we focused on about natural communities emerged from the Michigan Natural Features Inventory and the botanical survey of the Matthaei-Nichols properties conducted in 2012. Of particular interest for preservation are some select natural communities and species. Oak Openings are a critically imperiled natural community at the global and state level (Kost et al., 2007). In addition to some already existing Oak Openings habitats, Matthaei Botanical Gardens has the potential to restore some other degraded areas, including formerly mined areas, to this rare plant community type. In particular, Matthaei-Nichols aims to preserve and restore a suite of natural communities. Mesic Southern Forest, Southern Hardwood Swamp (Slaughter, 2009), Prairie Fen, Floodplain Forests (DeCecco et al., ND), Southern

Wet Meadows, Inundated Shrub Swamp, and Dry-Mesic Southern Forest are among the other existing natural communities that would benefit from restoration efforts.

A wide variety of plant and wildlife species reside or have the potential to do so on these properties. Keystone species include *Castor canadensis* (Beaver) (no longer present), *Myotis sodalis* (Indiana Bat) (possibly here, but not recently identified), *Quercus spp.* (Oaks), and *Sistrurus catenatus* (Eastern Massasauga Rattlesnake). Documented rare plants include *Agrimonia rostellata* (Woodland Agrimony), *Jeffersonia diphylla* (Twinleaf), *Gentianella quinquefolia* (Stiff Gentian), *Sanguisorba canadensis* (American Burnet), and *Valeriana edulis* (Tobacco Root).

As a botanical garden and arboretum, Matthaei-Nichols is in an exceptional position to support a collection of rare species. Further, as a university botanical garden, they have a stated goal to offer locations for ecological study and research. With the diversity of habitats, connections to the University of Michigan, and a large support network, they have the ability to enhance their community and environment with high quality natural areas.

Stewardship & Site Stewards

For these ecologically valuable populations to thrive, humans need to participate in their care. In *A Sand County Almanac*, stewardship is “dealing with man’s relation to land and to the animals and plants which grow upon it” (Leopold, 1949). This means that being a steward for the environment is practicing responsible use and protection of natural areas by utilizing sustainable practices. Stewardship is one of the most important components to natural areas management because of the way stewardship represents the link between individuals and the natural environment.



Myotis sodalis (Indiana Bat) (Animal Diversity Web)



Agrimonia rostellata (Woodland Agrimony) (Photo credit Alexis Heinz)

Settings

Physical Setting

Matthaei-Nichols manages four natural areas. These are Matthaei Botanical Gardens, Nichols Arboretum, Horner-McLaughlin Woods, and Mud Lake Bog. In addition to the natural areas found at these sites, Matthaei-Nichols also support a mixture of garden spaces and ornamental plant collections. In contrast, Horner-McLaughlin Woods and Mud Lake Bog have been prioritized for their natural qualities, which facilitate studies and research. This document focuses on Matthaei Botanical Gardens and Horner-McLaughlin Woods.

Horner-McLaughlin Woods

A historical view of Horner-McLaughlin Woods reveals the site is comprised of three different tracts of land. The Horner tract is the least disturbed area of native forest and was the chief reason the land was protected in the first place. The Pelton tract has experienced some disturbance but still maintains a mostly natural character. The McLaughlin tract was previously farmed and is now successional fields populated with species predominantly responsive to disturbances.

In Horner-McLaughlin Woods, *Quercus spp.* (Oaks) and *Carya spp.* (Hickory) are the dominant tree species. Existing Hickory trees tend to be *Carya ovata* (Shagbark Hickory). Historically, these dominant trees benefited from periodic fires. Observational surveys suggest much of the midsize saplings at Horner-McLaughlin Woods are *Acer spp.* (Maple) and *Fraxinus spp.* (Ash). Data on sapling and seed counts identify *Acer rubrum* (Red Maple)



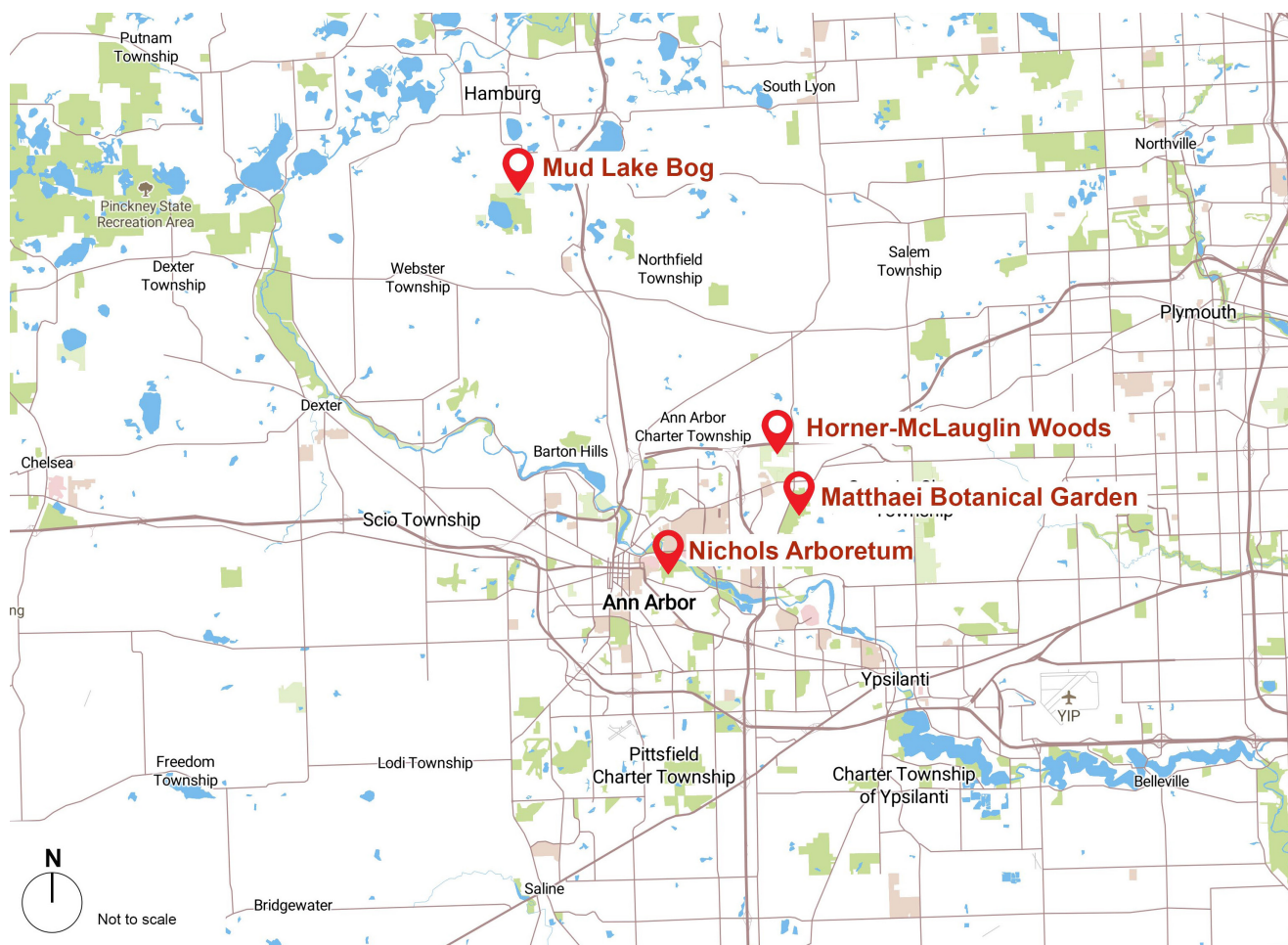
Meadow near Horner-McLaughlin Woods (Photo credit Alexis Heinz)

and *Acer saccharum* (Sugar Maple) as most common likely due to the lack of fire. Observed herbaceous plants include *Aquilegia spp.* (Columbine), *Arisaema triphyllum* (Jack-in-the-Pulpit), *Dentaria laciniata* (Cutleaf Toothwort), *Erythronium americanum* (Trout Lily), *Geranium maculatum* (Geranium), *Maianthemum racemosum* (False Solomon's Seal), *Podophyllum peltatum* (May Apple), *Sanguinaria canadensis* (Bloodroot) (a potential indicator species), and *Trillium spp.* (Trillium) (another potential indicator species). In the Inundated Shrub Swamps (Buttonbush Depression), *Quercus alba* (White Oak) is also present, likely due to the proximity to Oak-Hickory Forests. The open meadow portion supports *Quercus spp.* (Oak) as well as *Juglans nigra* 'Black Walnut'. Although filled with many invasive shrubs, *Cornus spp.* (Dogwood) are also present.

Matthaei Botanical Gardens

Matthaei Botanical Gardens has multiple natural areas. One of the highest quality areas, Radrick

Forest is located on part of the Defiance Moraine and contains *Quercus alba* (White Oak) and *Quercus rubra* (Northern Red Oak) as dominants with abundant *Carya spp.* (Hickory) and *Acer spp.* (Maple). The moraine transitions to a prairie fen along Fleming Creek, and the lower elevation area near the fen contains *Populus grandidentata* (Bigtooth Aspen) and *Acer nigrum* (Black Maple). In open areas, *Juniperus virginiana* (Red Cedar) and *Quercus alba* (White Oak) grow in areas once mined for sand and gravel. *Tilia americana* (Basswood) resides in both lower and upper elevations. Near the golf course, *Acer rubrum* (Red Maple) fills the midstory. Along the perimeter of Radrick Forest, invasive shrubs like *Lonicera tatarica* (Tartarian Honeysuckle) and *L. maackii* (Maack's Honeysuckle) take up about 25% of the understory. These shrubs are also found along the meadow edges growing with *Fraxinus americana* (White Ash) saplings. *Muhlenbergia schreberi* (Nimblewill) grows along the center of the access trail. *Ostrya virginiana*



Map of Matthaei-Nichols' four natural areas properties, [Source]

(Ironwood) and *Carpinus caroliniana* (Musclewood) are also scattered throughout. *Rubus spp.*, *Cornus spp.* (Dogwood), *Viburnum spp.* (Arrowwood), and *Carex spp.* (Sedge) occur in patches in various locations in the understory.

Other properties owned and managed by Matthaei-Nichols include Nichols Arboretum and Mud Lake Bog. Both are shown on the map below but are not detailed in this study.

Surrounding area

Surrounding the Matthaei-Nichols properties are predominantly roads, housing communities, and development. University staff, with the help of numerous volunteers, manages the land that has been designated as natural areas. The properties include remnant natural areas and areas previously used for farming and mining activities, with many invasive plant species that have naturalized. The properties

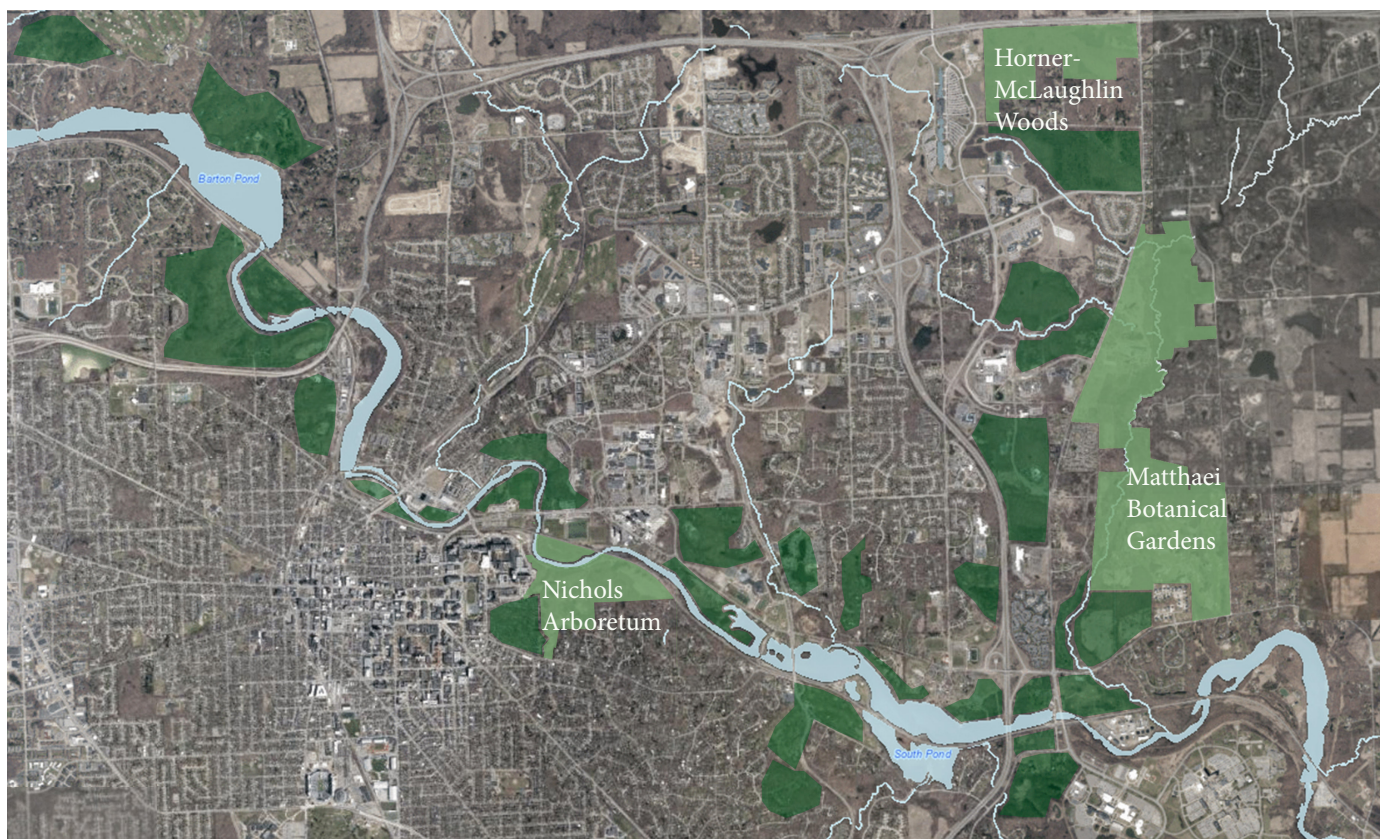
serve as corridors for many wildlife species, including high populations of deer. Movement of both wildlife and humans across the properties continues to aid in the spread of new invasive plants and animals, requiring regular vigilance. Access to these areas promotes human visitation, animal habitat connections, and invasive species introductions due to traveling vehicles and other means of dispersal.

Adjacent properties

Considering Matthaei Botanical Gardens and Horner-McLaughlin Woods, their proximity to other nearby natural areas is also important. In addition to an immediate adjacency to the Raymond F. Goodrich Preserve, Horner-McLaughlin Woods connects to the Marshall Nature Area through the county-owned Tom Freeman Preserve. Another nearby property is also relevant to the future management planning of these sites. Cherry Hill Nature Preserve is a high quality area east of the botanical gardens



Horner-McLaughlin Woods in autumn (Photo credit Alexis Heinz)



Map of surrounding natural areas (Washtenaw County)

established by the Superior Township Chapter of the Southeast Michigan Land Conservancy. Home to Oak, Hickory, and a suite of bird species, people appreciate this location as a way to spend time with family, walk their pets, and/or view nature through binoculars. These properties have the potential to support human and environmental concerns alike.

The properties are part of a larger connected network of natural areas located throughout and around the city of Ann Arbor. The Arboretum is close to Mitchell Field, Fuller Park, Furstenberg Nature Area, Ruthven Nature Area, and Gallup Park. Taken together, these properties form a healthy ecological corridor along the Huron River. Following the river corridor to the northeast, one happens upon Argo Nature Area, Bandemer Park, Bluffs Nature Area, Kuebler-Langford Nature Area, Bird Hills Nature Area, and Barton Nature Area. All of these properties, including one-quarter of the Arboretum, are owned and managed by the city, suggesting the importance of considering future management plans in tandem with the city. Several of these areas struggle with

invasive species, so a concerted effort would likely be more effective. Timing management strategies among connected properties could also potentially bolster their success.

Access - Public use “classification” – open, limited access, or closed (include why)

The properties discussed in this management plan are all open to the public for use and recreation. Each property supports diverse plant populations (as shown in Appendix 12) that are sensitive to human disturbance as well as location less suited to safe human access. These areas include those with steep slopes or thick brush, as well as areas that could be harmed from increased foot traffic such as wetland areas. The fen areas at Matthaei Botanical Gardens are a good example of sensitive areas containing peat soils and fragile plants that warrant protection from foot traffic.

Social Setting

Social Environment

When considering the future of Matthaei’s properties, the social environment is also a valuable factor to consider. Comprised of various stakeholders, the social environment for these properties includes residents, members, students, and nearby business owners. Romolini’s (2016) framework suggests stewardship actions and ecological objectives are more effectively met when the social environment is considered as well. For this reason, a portion of this project sought input through the use of focus groups. The overarching goal was to ask respondents about their views of stewardship and participating in volunteer stewardship activities. Specifically, the focus groups aimed to identify reasons encouraging participation and barriers inhibiting involvement.

Stakeholders included individuals connected to the Matthaei-Nichols properties through either physical or social connections. Those within physical proximity of Matthaei Botanical Gardens and Horner-McLaughlin Woods included residents of the Fleming Creek Subdivision, Laurel Gardens, and Matthaei Farms as well as those living near Dixboro and Cherry Hill Roads. Additional stakeholders comprised individuals connected to the properties through other avenues. Student groups, past Matthaei-Nichols volunteers, and Matthaei-Nichols members formulated the social community.

Focus Groups Summary

In the attempts to identify ways to increase volunteer involvement at Matthaei Botanical Gardens as well as gauge neighbors’ perspectives on natural areas stewardship, we ran three focus groups comprised of members of Matthaei Botanical Gardens, neighbors of these properties, academics associated with the University of Michigan, and students. (We also ran a practice focus group containing employees of



Matthaei-Nichols). Our standardized questions are attached in the appendix. We asked questions that would not only invoke the participants' thoughts towards our goals mentioned above, but also unveil their feelings towards stewardship as well as natural areas themselves. In addition to collecting these thoughts and feelings, we also prompted the participants to give us feedback on two outreach products we were creating: a bookmark and brochure (both extending information regarding stewardship of Matthaei-Nichols natural areas).

The responses were varied but focused around central themes. First, all participants shared fun stories of themselves enjoying natural areas and engaging with these areas. The importance of these places to the participants was clear, and they wanted to continue to have access to natural areas. Second, as we centered the conversation around stewardship, many participants identified weed removal and trash collecting as the first acts of stewardship of which they felt were important. We encouraged a broader definition of stewardship for our participants

through our discussion of bookmarks and brochure on stewardship activities; therefore, they seemed to have learned from us as we were learning from them. Third, maintaining the naturalness of the natural areas was important to many participants. They stated that they use these properties to connect with nature and feel that too many signs or people negatively impact their experience in these areas. Lastly, we received mixed reviews on the incorporation of a brochure to spread knowledge of stewardship, and many believed the bookmark to be a more feasible option for this goal. Though, some did recognize that the brochure and bookmark can serve the same purpose, while targeting different audiences.

Overall, continuing engagement with the neighbors of Matthaei Botanical Gardens is vital as well as continuing to offer the robust volunteer program (echoed thoroughly by many different focus group participants) and long-term volunteer program recommendations will be addressed later in this management plan.



Ecology/Natural Features

Geology and Ecoregions

Geology is the foundation to all landscapes, and at the Matthaei-Nichols properties this is no exception. Through years of weathering soil takes on the characteristics of erosional deposits left by glaciation. Since the Wisconsin glaciation period 10,000 years ago, deposition has created a combination of outwash and till developing the topographic variations seen throughout the landscape, such as valleys, moraines, rolling hills, wetlands, lakes, and tributary connections within the Huron River Watershed (Reid, 1962).

Bedrock and unconsolidated glacial deposits are two ways to describe the rock types of Washtenaw County. Bedrock is sedimentary rock roughly 4,000-7,000 feet thick underlying the glacial material common to this area's landscape. The four properties

are populated with glacial deposits of lakebeds, outwash plains, deltas, and moraines. Existing as a mixture of gravel, sand, silt, and clay, glacial deposits in the landscape have a range in depth from 50 feet to 450 feet (Sommers, 1984). The figure below shows the variability in permeability for the region based on the dominance of sand in soil (Michigan.gov). About 80% of the county's annual precipitation runs off into streams and other bodies of water, with 20% infiltrating into the groundwater. This is critical for property waterways such as Fleming Creek and the Huron River.

What is an Ecoregion

The flora, fauna, and ecosystems within a specific geographical area characterize an Ecoregion. Ecoregions can be divided into bioregions, ecozones, and biogeographic regions. These regions go

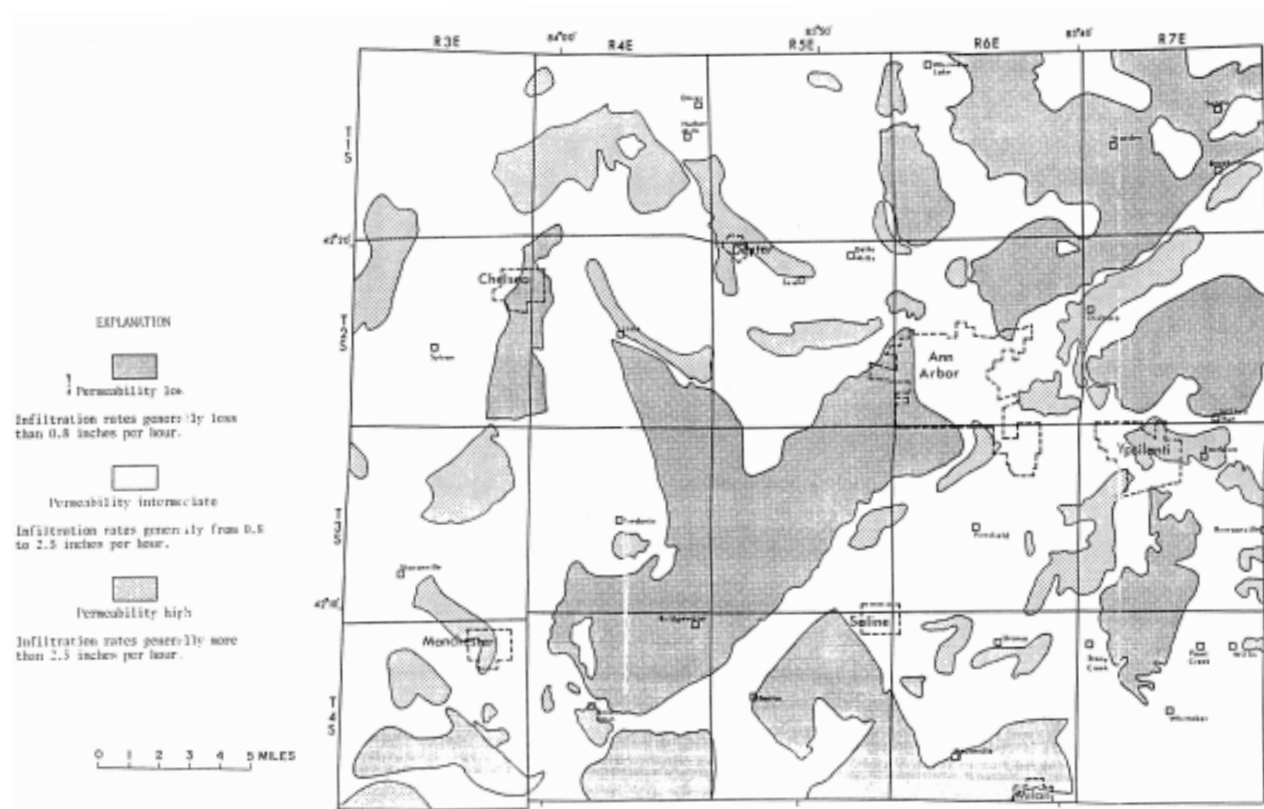


Figure of the permeability of soils in Washtenaw County) Overlay with property locations. (Michigan.gov)

beyond political divisions such as countries, states, and counties because natural areas do not stop at these boundary lines. Considering the spatial and temporal scales of species residing in these areas is important.

Ecoregion Levels

The Ecoregion system in North America has four levels (Omernik, 2014). North America is divided into fifteen broad Level I ecological regions. Fifty Level II ecological regions provide a more detailed description of the ecological areas within the Level I regions. Further, 182 Level III ecoregions are smaller ecological areas nested within Level II regions. While the finest-scale units are Level IV ecoregions, they identify 967 ecoregions across the United States.

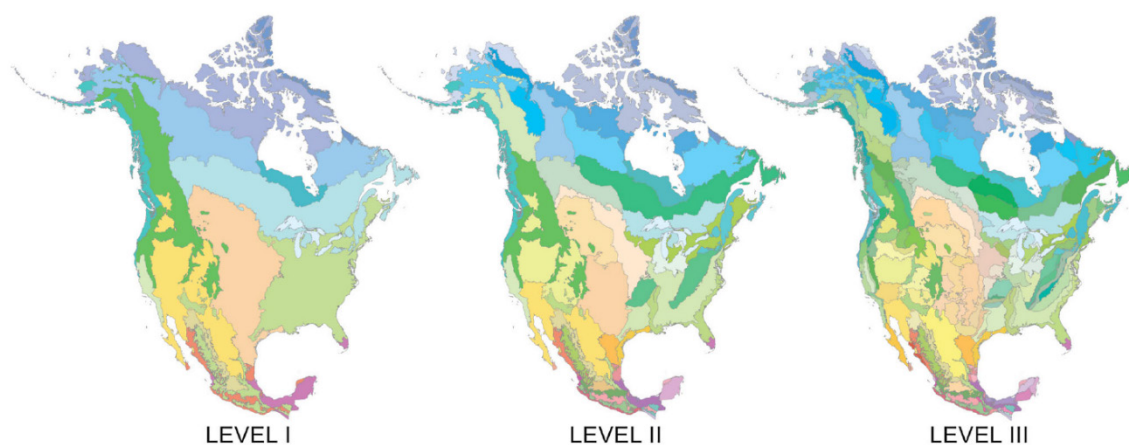
According to the work done by Albert (1995) on the regional landscape ecosystems of Michigan, section VI that is Southern Lower Michigan, is categorized as a region with a moderate climate and fertile lacustrine soils. The area consists of loamy end and ground moraines populated by Oak-Hickory, Beech-Sugar Maple, and Deciduous Swamp forests.

Fig. 1. Level I, II, and III ecological regions of North America. The names and identification numbers of these ecoregions are given in CEC 1997 and 2006.

These maps and others of all four levels of ecoregions of the United State are available at www.epa.gov/wed/pages/ecoregions.htm.

Ecoregion as Management Objectives

Ann Arbor resides within Ecoregion 55, Eastern Corn Belt Plains, which is primarily a rolling till plain with local end moraines. This landscape has loamier and better-drained soils than the Huron/Erie Lake Plain, which is to the east of Eastern Corn Belt Plains. Ecoregion 55a, Clayey High-Lime Till Plains, extends out from Indiana and Ohio into Michigan. Featuring rolling ground moraines, fine-textured silt, and deep, clay loam soils, the historic forest vegetation of Clayey High-Lime Till Plains consisted of Oak-Hickory on well-drained soils and Beech-Sugar Maple on clay soils. Most of what was once closed canopy forest has been cleared and part of the wetlands have been drained for agriculture. Wetter soils also supported Red Maple, American Elm, White Ash, and American Basswood. Today, small areas of cutover woodland occur on steeper slopes and the landscape is almost entirely devoted to corn, soybeans, oats, wheat, and hay. In Clayey High-Lime Till Plains the major water quality problems on rivers and tributaries originate from nutrient loading, high sediment inputs, and agricultural chemicals.



Figures of the Level I, II, and III ecological regions of North America. The names and identification numbers of these ecoregions are given in CEC 1997 and 2006. These maps and others of all four levels of ecoregions of the United State are available at www.epa.gov/wed/pages/ecoregions.htm.

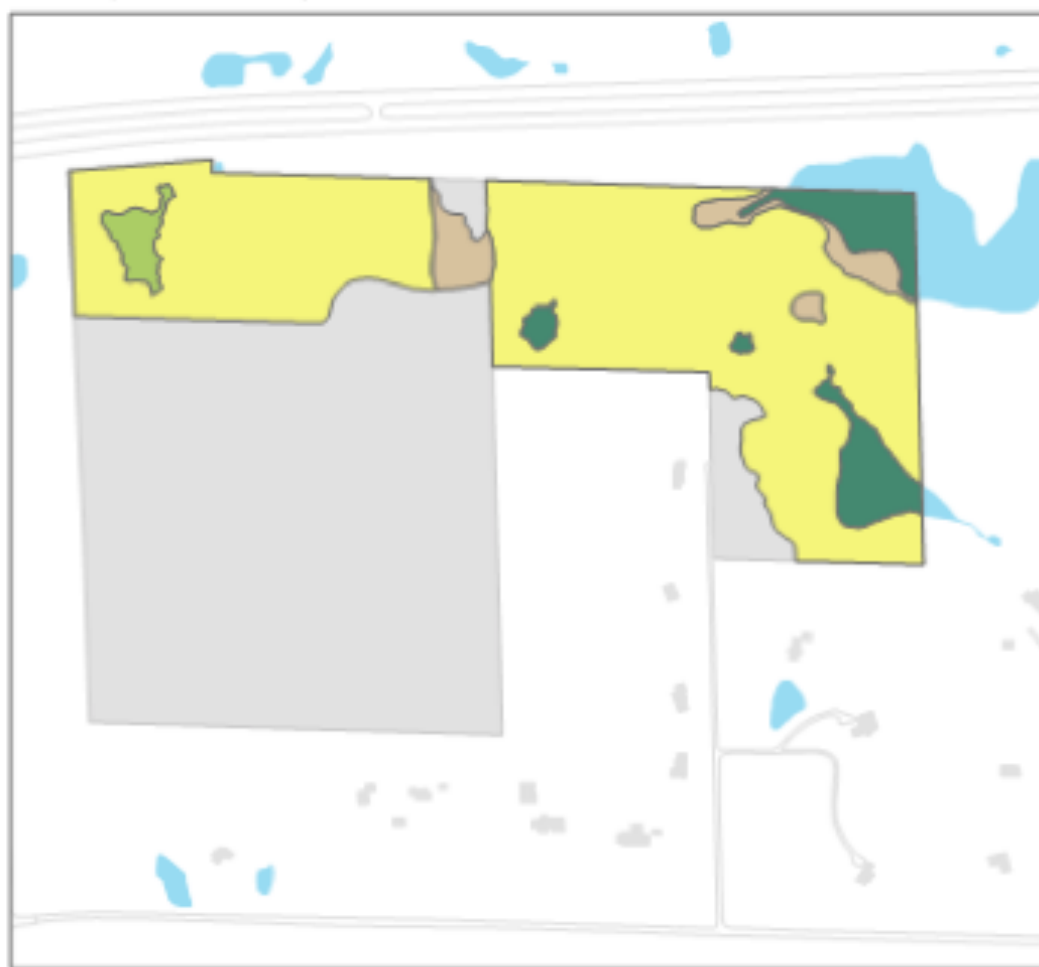
Natural Communities

Natural communities occurring on Horner-McLaughlin Woods are predominantly Dry-Mesic Southern Forest (Oak-Hickory), Inundated Shrub Swamp (Buttonbush Depression), Mesic Southern Forest (Beech-Sugar Maple), Southern Hardwood Swamp (Red Maple-Silver Maple-Elm-Ash), and

Wetlands (Walters et al, 2012). In addition, the northwest portion of the property connects to an open savanna-like habitat containing *Juglans nigra* (Black Walnut) as the dominant tree species. Throughout the woods, small vernal pools also occur.

NATURAL COMMUNITIES OF HORNER-MC Laughlin WOODS

Plant communities classified according to the natural community descriptions established by the Michigan Natural Features Inventory (Kost et al, 2007, Natural Communities of Michigan: Classification and Description, Report Number 2007-21; <http://mni.lanr.msu.edu/>)



- Dry-Mesic Southern Forest (39.2 acres)
- Inundated Shrub Swamp (5.5 acres)
- Mesic Southern Forest (2.6 acres)
- Southern Hardwood Swamp (1.0 acre)
- Wetland/Water

Mary Hejno
1/8/13

UNIVERSITY OF MICHIGAN
Matthaei Botanical Gardens
and Nichols Arboretum

According to the 2012 report (Walters et al.), Matthaei Botanical Gardens support seven distinct natural communities, including Dry-Mesic Southern Forest (Oak-Hickory), Emergent Marsh, Floodplain Forest (Rich Tamarack Swamp), Prairie Fen, Southern Shrub-Carr, and Southern Wet Meadow. Oak Openings also occur on site. In addition to

these specific natural communities, some hybrid communities exist in this periurban setting (i.e., those that have been constructed by humans to follow an ecological trajectory towards a more natural community). These include conifer plantation, orchard, constructed wetland, demonstration prairie, old fields, ponds, and nut groves.



Natural Communities

The majority of the following information stems from the natural community descriptions elucidated on the Michigan Natural Features Inventory webpage. The subsequent tables detailing the meaning behind conservation status codes are from the NatureServe Global Conservation Status Ranks. Global levels begin with G, while state levels being with S.

1) Oak Openings

Oak Openings are critically imperiled at the global (G1) and state (S1) level. With between 10 and 60% canopy dominated by oaks, they may or may not contain shrubs (Cohen, 2004). They occur on dry-mesic fertile loams of even to rolling topography with low to moderate soil holding capacity. “Oak openings have been nearly extirpated from Michigan; only one small example remains,” (Kost et al., 2007). Historically, they were most likely to

Rank	Definition
GX	Presumed Extinct (species) — Not located despite intensive searches and virtually no likelihood of rediscovery. Eliminated (ecological communities) —Eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species.
GH	Possibly Extinct (species) — Missing; known from only historical occurrences but still some hope of rediscovery. Presumed Eliminated — (Historic, ecological communities)-Presumed eliminated throughout its range, with no or virtually no likelihood that it will be rediscovered, but with the potential for restoration, for example, American Chestnut (Forest).
G1	Critically Imperiled —At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
G2	Imperiled —At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
G3	Vulnerable —At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
G4	Apparently Secure —Uncommon but not rare; some cause for long-term concern due to declines or other factors.
G5	Secure —Common; widespread and abundant.

Table of global and state natural community stability levels.



Nichols Arboretum Oak Openings (Photo credit Alexis Heinz)

reside on the west side of substantial firebreaks like rivers. As a fire-dependent community, the plant groupings and soil communities depended on frequent, low-intensity fires in spring through fall to uphold open landscapes. In fact, present grasses and forbs encourage this disturbance regime with their flammable litter. Together with drought and windthrow, ant mounds are another soil forming factor for Oak Openings.

Oak Openings are typically dominated by *Quercus alba* (White Oak), with *Q. macrocarpa* (Bur Oak) and *Q. muehlenbergii* (Chinquapin Oak) sometimes occurring as co-dominants (Kost et al., 2007). Other present tree species include *Carya glabra* (Pignut Hickory), *C. ovata* (Shagbark Hickory), *Q. rubra* (Northern Red Oak), and *Q. velutina* (Black Oak). Varying with different levels of fire frequency, shrubs covered 0 to 50% of the landscape. Fire-tolerant shrubs include *Amorpha canescens* (Leadplant), *Ceanothus americanus* (New Jersey Tea), and *Corylus americana* (American Hazelnut), while shrubs in fire-protected thickets were *Cornus foemina* (Gray Dogwood), *Prunus americana* (Wild Plum), and *Rhus glabra* (Smooth Sumac). Oak Openings uniquely contain both prairie plant species in open areas and forested plant species in shady areas. The continuous herbaceous layer contains grasses,

including *Andropogon gerardii* (Big Bluestem), *Schizachyrium scoparium* (Little Bluestem), and *Sorghastrum nutans* (Indian Grass). Common forbs include *Amphicarpaea bracteata* (Hog Peanut), *Anemone cylindrical* (Thimbleweed), *Asclepias purpurascens* (Purple Milkweed), *A. tuberosa* (Butterfly-weed), *Brickellia eupatorioides* (False Boneset), *Coreopsis palmata* (Prairie coreopsis), *Desmodium canadense* (Showy Tick-trefoil), *Eupatorium sessilifolium* (Upland Boneset), *Erigeron strigosus* (Daisy Fleabane), *Euphorbia corollata* (Flowering Spurge), *Galium boreale* (Northern Bedstraw), *Gentiana alba* (White Gentian), *Lathyrus venosus* (Veiny Pea), *Lespedeza capitata* and *L. hirta* (Bush Clovers), *Monarda fistulosa* (Wild-bergamot), *Pycnanthemum virginianum* (Virginia Mountain Mint), *Rudbeckia hirta* (Black-eyed Susan), *Silene stellata* (Starry Champion), *Solidago juncea* (Early Goldenrod), *Symphyotrichum laeve* (Smooth Aster), *S. pilosum* (Frost Aster), *Taenidia integerrima* (Yellow Pimpernel), *Triosteum perfoliatum* (Feverwort), *Veronicastrum virginicum* (Culver's Root), and *Zizia aurea* (Golden Alexanders). Intermingled with this plant community, animal species range from extensive arthropod populations to grassland birds and small mammals. The list of rare plant and animal species inhabiting Oak Openings is substantial (Appendices).

2) Mesic Southern Forest

Mesic Southern Forest (Beech-Sugar Maple) resides often on loam soils with subtle topography (Kost et al., 2007). The current global status is uncertain to imperiled (G2, G3), while the state status is vulnerable (S3). Frequently occurring small gaps encourage the growth of shade-tolerant species. They tend to display high levels of soil fertility as well as well-drained soils with substantial water-holding capacity. With *Fagus grandifolia* (American Beech) and *Acer saccharum* (Sugar Maple) serving as the dominant canopy trees, *Carya cordiformis* (Bitternut Hickory), *Fraxinus americana* (White Ash), *Liriodendron tulipifera* (Tuliptree), *Quercus alba* (White Oak), *Quercus rubra* (Northern Red Oak), and *Tilia americana* (Basswood) are also found. *Ostrya virginiana* (Ironwood) and *Ulmus americana* (American Elm) are common subcanopy trees, while common shrubs comprise *Asimina triloba* (Pawpaw), *Carpinus caroliniana* (Musclewood), *Cornus alternifolia* (Alternate-leaved Dogwood), *Cornus florida* (Flowering Dogwood), *Dirca palustris* (Leatherwood), *Hamamelis virginiana* (Witch-hazel), *Lindera benzoin* (Spicebush), *Lonicera canadensis* (American Fly Honeysuckle), *Ribes cynosbati* (Prickly Gooseberry) (an indicator species), *Sambucus racemosa* (Red Elderberry), and *Viburnum acerifolium* (Maple-leaved Arrowwood). The community hosts a wide variety of wildflowers including *Actaea pachypoda* (Doll's Eyes), *Erythronium albidum* (White Trout Lily), *E. americanum* (Yellow Trout Lily), *Hepatica acutiloba* (Sharp-lobed Hepatica), and *Uvularia grandiflora* (Large-flowered Bellwort). Various cavity-nesting and migratory birds find habitat in Mesic Southern Forest. In addition, the vernal pools support reptile and amphibian populations. Dozens of rare plants and animals live in these communities.

3) Floodplain Forest

Floodplain Forest in Matthaei Botanical Gardens sits on a wet Sloan silt loam along the majority of Fleming Creek and on Houghton muck soil west

of Willow pond. This community is vulnerable at both the global (G3) and state (S3) level. Located at low elevations adjacent to rivers and streams of third order or larger, they experience a flooding cycle with deposition and erosion. These dynamics create diverse landforms. Soils of the Floodplain Forest tend to be coarsest close to the waterway, with increasing amounts of fine sediment as distance increases. The soils have high nutrient content and soil moisture levels.

Dominant trees species are *Acer saccharinum* (Silver Maple), *Fraxinus pennsylvanica* (Green Ash), and (historically prior to Dutch Elm disease) *Ulmus americana* (American Elm). Additional tree and shrub species are exceedingly diverse and depend on the distance from the waterway. Some uncommon shrubs are *Staphylea trifolia* (Bladdernut), *Viburnum lentago* (Nannyberry), and *Zanthoxylum americanum* (Prickly-ash). Floodplains Forests contain a wide variety of ground flora: *Arisaema dracontium* (Green Dragon), *Asarum canadense* (Wild Ginger), *Boehmeria cylindrica* (False Nettle), *Impatiens capensis* (Jewelweed), *Iris virginica* (Southern Blue Flag), *Laportea canadensis* (Wood Nettle), *Lysimachia ciliata* (Fringed Loosestrife), *Maianthemum stellatum* (Starry False Solomon's Seal), *Matteuccia struthiopteris* (Ostrich Fern), *Onoclea sensibilis* (Sensitive Fern), *Osmunda regalis* (Royal Fern), *Packera aurea* (Golden Ragwort), *Pilea pumila* (Clearweed), *Ranunculus hispidus* (Swamp Buttercup), *Rubus pubescens* (Dwarf Raspberry), *Saururus cernuus* (Lizard's Tail), *Smilax ecirrata* (Carrion Flower), *Solidago gigantea* (Late Goldenrod), *Symplocarpus foetidus* (Skunk Cabbage), *Thalictrum dasycarpum* (Purple Meadow Rue), *Thelypteris noveboracensis* (New York Fern), and *Urtica dioica* (Stinging Nettle). Common grasses and sedges include *Calamagrostis canadensis* (Bluejoint Grass), *Carex spp.* (Sedges) like *Carex grayi* (Gray's Sedge) and *Carex muskingumensis* (Muskingum Sedge), *Cinna arundinacea* (Wood Reedgrass), *Elymus virginicus* (Virginia Wild Rye), *Glyceria striata* (Fowl Manna Grass), and *Leersia oryzoides* (Cut Grass). The Floodplain Forest supports both common and rare birds, reptiles, and amphibians (Appendix D). The federal and state endangered *Myotis sodalis* (Indiana Bat) can reside in these areas as well.

4) Prairie Fen

Prairie Fen occurs on a Houghton muck soil at Matthaei Botanical Garden. With a vulnerable status at the global (G3) and state (S3) level, these are unique communities on the property. This wetland natural community supports mostly sedges, grasses, and graminoids on alkaline organic soils (Kost et al., 2007). The alkaline groundwater runs through the organic soils and feeds the fen through seeps and perennial springs. Depending on the groundwater level, organic matter, disturbance regime, and water chemistry, different vegetation zones occur. Based on the botanical surveys conducted by Walters et al. (2012), the vegetation zones apparently most relevant to Matthaei Botanical Gardens are sedge meadow, marl flats, and a wooded fen zone. Sedges, grasses, forbs, ferns, and low shrubs dominate sedge meadows, while marl flats are more thinly vegetated with *Sphagnum spp.* (Sphagnum Mosses), sedges, forbs, rushes, carnivorous plants, and orchids. The wooded fen zone contains species like *Betula alleghaniensis* (Yellow Birch), *Betula pumila* (Bog Birch), *Cornus sericea* (Red-osier Dogwood), and *Viburnum lentago* (Nannyberry). Concerning animals, of interest are large ant mounds (0.5' tall by 3' wide) found in the sedge meadow zone. The Prairie Fen supports a significantly longer list of species which can be explored on the Michigan Natural Features Inventory website.

5) Southern Hardwood Swamp

Frequently neighboring Mesic Southern Forest, Southern Hardwood Swamp (Red Maple-Silver Maple-Elm-Ash) is another natural community type found at Horner-McLaughlin Woods. With a global rank of G3 and a state rank of S3, the community is vulnerable at both levels. The community occurs on shallow depressions and remote stream drainages (Kost et al., 2007). Persistent water levels are the result of a subterranean clay layer. Loamy soils tend to rest above this clay layer, sometimes with a layer of mulch on top. Standing water happens in the winter and spring with seasonal fluctuation. These water dynamics contribute to shallow tree roots and frequent blowdowns, which leads to pit and mound topography. The varied microtopography leads to high plant diversity. Shrubs, sedges, and grasses are prevalent. Specific plant species depend on if the soils are more mineral with substantial water fluctuations or organic with stable water levels.

Southern Hardwood Swamps are dominated by *Acer saccharinum* (Silver Maple), *Acer rubrum* (Red Maple), *Celtis occidentalis* (Hackberry), *Fraxinus pennsylvanica* (Green Ash), and *Fraxinus nigra* (Black Ash). Additional tree species include *Acer saccharum* (Sugar Maple), *Fraxinus americana* (White Ash), *Liriodendron tulipifera* (Tuliptree), *Platanus occidentalis* (Sycamore), *Populus deltoides* (Cottonwood), *P. tremuloides* (Quaking Aspen), *Quercus bicolor* (Swamp White Oak), *Q. palustris* (Pin Oak), *Q. macrocarpa* (Bur Oak), *Q. rubra* (Northern Red Oak), *Tilia americana* (Basswood), and *Ulmus americana* (American Elm). The shrub layer contains *Cephalanthus occidentalis* (Buttonbush), *Ilex verticillata* (Winterberry), *Lindera benzoin* (Spicebush), and *Sambucus canadensis* (Elderberry). Southern Hardwood Swamp also supports additional plant and animal species detailed on the website for the Michigan Natural Features Inventory.

6) Dry-Mesic Southern Forest

Providing some detail on the natural communities, the Dry-Mesic Southern Forest (Oak-Hickory) is a fire-dependent ecosystem occurring on a variety of soil types (Kost et al., 2007). This community is apparently secure at the global level (G4), while vulnerable at the state level (S3). In addition to fire, windthrow and periodic insect occurrences contribute to the natural disturbance regime, allowing the regrowth of oak saplings. In general, these communities have predominantly *Quercus alba* (White Oak), with some *Quercus velutina* (Black Oak) and *Quercus rubra* (Northern Red Oak). *Carya spp.* (Hickory) also reside in Dry-Mesic Southern Forests. Other tree species include *Acer rubrum* (Red Maple), *Fraxinus Americana* (White Ash), *Prunus serotina* (Black Cherry), *Quercus ellipsoidalis* (Hill's Oak), *Sassafras albidum* (Sassafras), and *Tilia americana* (Basswood). Likely shrubs are *Amelanchier spp.* (Serviceberry), *Hamamelis virginiana* (Witch-hazel), and *Prunus virginiana* (Choke Cherry). Of note in the subcanopy is the indicator species *Cornus florida* (Flowering Dogwood). Some herbaceous plants include *Actaea pachypoda* (Doll's Eyes), *Amphicarpaea bracteata* (Hog Peanut), *Arisaema triphyllum* (Jack-in-the-Pulpit) (indicator species), *Brachyelytrum erectum* (Bearded Shorthusk), *Bromus pubescens* (Hairy Woodland Brome), *Carex albursina* (White Bear Sedge), *C. rosea* (Rosy Sedge), *Circaea canadensis* (Enchanter's Nightshade), *Corallorhiza maculata* (Spotted Coral-root), *Galium triflorum* (Fragrant Bedstraw), *Hylodesmum glutinosum* (Pointed-leaf Tick-trefoil), *H. nudiflorum* (Naked-flower Tick-trefoil), *Sanicula marilandica* (Black Snakeroot), *Smilax hispida* (Bristly Greenbrier), *Uvularia grandiflora* (Large-flowered Bellwort), and *Viola*

pubescens (Downy Yellow Violet). This natural community occurs at Matthaei Botanical Gardens on Fox sandy loams and Boyer sandy loams and at Horner-McLaughlin Woods on Miami Loam.

7) Inundated Shrub Swamp

Inundated Shrub Swamp (Buttonbush Depression) is another natural community occurring at Horner-McLaughlin Woods. Vulnerable at the state level (S3), this community is apparently secure at the global level (G4). This area has poor drainage and displays dominance by *Cephalanthus occidentalis* (Buttonbush) (Kost et al., 2007). The inundated soils result from the existence of shallow muck over a type of clay substrate. These communities often occur as the result of nearby shrubs progressing into open wetlands or Open Emergent Marsh. The disturbance regime involves periodic flood events that prevent the ingrowth of larger trees species. Beaver activity may also stifle tree growth in these locations. Periods of drought may lead to succession to swamp forest. Other possible shrub species include *Aronia melanocarpa* (Black Chokeberry), *Cornus amomum* (Silky Dogwood), *Ilex verticillata* (Winterberry), *Rosa palustris* (Swamp Rose), *Rubus hispida* (Swamp Dewberry), and *Salix spp.* (Willow). Some of the herbaceous plant species include *Asclepias incarnata* (Swamp Milkweed), *Carex spp.* (Sedges) (including *Carex crinita* which is a potential indicator species), *Iris virginica* (Southern Blue Flag), *Lysimachia thyrsiflora* (Tufted Loosestrife), *Maianthemum canadense* (Canada Mayflower), *Onoclea sensibilis* (Sensitive Fern), *Osmunda cinnamomea* (Cinnamon Fern), *Scutellaria lateriflora* (Mad-dog Skullcap), *Sium suave* (Water Parsnip), *Symplocarpus foetidus* (Skunk Cabbage), and *Trientalis borealis* (Starflower).



Inundated Shrub Swamp (Photo credit Alexis Heinz)

8) Southern Wet Meadow

Southern Wet Meadow occurs on a Houghton muck with slope between 0 and 6% at Matthaei Botanical Gardens. The global ranking is inexact as apparently secure (G4?), while in the state of Michigan, the ranking is vulnerable (S3). Located frequently along the margins of waterways, the soils are neutral to alkaline and organic (Kost et al., 2007). Although water levels may vary across seasons, they “remain at or near the soil’s surface throughout the year,” (Kost et al., 2007). *Carex stricta* (Tussock Sedge) forms unique mound structures upon which other species grow. As a fire-dependent community, periodic burning helps encourage the native seed bank by opening microsites and discouraging shrub and tree growth.

In addition to *Carex stricta*, other sedge species include *C. aquatilis*, *C. bebbii*, *C. comosa*, *C. hystericina*, *C. lacustris*, *C. lasiocarpa*, *C. pellita*, *C. prairea*, *C. retrorsa*, *C. sartwellii*, *C. stipata*, and *C. vulpinoidea*. Grasses present include *Calamagrostis canadensis* (Bluejoint Grass) as the dominant species as well as *Bromus ciliatus* (Fringed Brome), *Glyceria striata* (Fowl Manna Grass), *Muhlenbergia glomerata* (Marsh Wild Timothy), *M. Mexicana* (Leafy Satin Grass), and *Poa palustris* (Fowl Meadow Grass). The list of forbs and ferns is also extensive: *Asclepias incarnata* (Swamp Milkweed), *Campanula aparinoides* (Marsh Bellflower), *Cicuta bulbifera* (Water Hemlock), *Cirsium muticum* (Swamp Thistle), *Eupatorium perfoliatum* (Common Boneset), *Eutrochium maculatum* (Joe-Pye-Weed), *Galium asprellum* (Rough Bedstraw), *Lathyrus palustris* (Marsh Pea), *Lycopus uniflorus* (Northern Bugle Weed), *Lysimachia thyrsiflora* (Tufted Loosestrife), *Onoclea sensibilis* (Sensitive Fern), *Pilea pumila* (Clearweed), *Persicaria amphibian* (Water Smartweed), *Pycnanthemum virginianum* (Virginia Mountain Mint), *Rumex orbiculatus* (Great Water Dock), *Sagittaria latifolia* (Common Arrowhead), *Scutellaria galericulata* (Common Skullcap), *Solidago canadensis* (Canada Goldenrod), *S. gigantea* (Late Goldenrod), *S. patula* (Swamp Goldenrod), *Symphotrichum firmum* (Smooth Swamp Aster), *S. puniceum* (Swamp Aster), *Thalictrum dasycarpum* (Purple Meadow Rue),

Thelypteris palustris (Marsh Fern), and *Triadenum fraseri* (Marsh St. John’s-wort).

This collection of plant species provides habitat for a variety of animal species. *Castor canadensis* (Beaver) are important to the ecosystem because their dam building activities support the open wetland state. *Ondatra zibethicus* (Muskrat) is also a part of the community, building lodges which are used by *Branta canadensis* (Canadian Goose). Kost et al. (2007) also mentions *Grus canadensis* (Sandhill Cranes) and *Cistothorus palustris* (Marsh Wrens) as nesting birds who inhabit Southern Wet Meadows.

9) Emergent Marsh

Emergent Marsh takes place on a Houghton Muck with a slope between 0 and 6% at Matthaei Botanical Garden. Globally, this natural community is unrankable (GU). At the state level, Emergent Marsh is S4, apparently secure. Characterized by emergent forbs, grass-like plants, and floating-leaved herbs, these groupings tend to reside along the edges of water bodies and waterways (Kost et al, 2007). They have varied soil substrates as well as pH. Periods of flooding, muskrat feeding, and beaver activity contribute to aquatic plant species, while times of low water levels and occasional fires promote seed germination and establishment. Common plant species include *Alisma spp.* (Water Plantains), *Carex spp.* (Sedges), *Eleocharis spp.* (Spike-rushes), *Glyceria spp.* (Manna Grass), *Leersia oryzoides* (Cut Grass), *Persicaria spp.* (Smartweeds), *Pontederia cordata* (Pickerel Weed), *Sagittaria spp.* (Common Arrowhead), *Schoenoplectus spp.* (Bulrushes), *Sparganium spp.* (Bur-reeds), *Spirodela polyrhiza* (Great Duckweed), *Typha spp.* (Cat-tails), *Wolffia spp.* (Water-meals), and *Zizania aquatica* (Wild-rice). The grasses and sedges tend to reside along the borders with floating plants in areas of deeper water. Common mammals include *Ondatra zibethicus* (Muskrat) and *Castor canadensis* (Beaver). Other animals inhabiting this natural community are fish, amphibians, reptiles, and birds. See Appendices for a list of rare plants and animals.

10) Southern Shrub-Carr

Southern Shrub-Carr resides on a Houghton muck soil with 0-6% slope on the northernmost portions of the Matthaei Botanical Gardens property and on a wet Sloan silt loam closer to Fleming Creek. On the global level, Southern Shrub-Carr is unrankable (GU), while on the state level rating is apparently secure (S4). Located predominantly on poorly drained organic soils with varying water levels, this natural community serves as an intermediate successional stage between open and forested wetlands (Kost et al., 2007). The areas are often thin strips along waterways. Wetland drainage paired with fire suppression leads to the migration of shrub species into the resulting open wetland locations. Southern Shrub-Carr results. Flooding due to beaver activity initially restrains shrub migration by maintaining water levels in wetlands. However, after shrub establishment, beaver activity supports Southern Shrub-Carr by discouraging overstory tree species. Extensive, long-term flooding can cause this habitat to return to open wetland. Conversely, over time, lack of fire and flooding can help transition Southern Shrub-Carr into a forested community.

Plant species occurring in the Southern Shrub-Carr vary by vegetation layer of 1) shrubs, 2) shrubs, sedges, and tall herbaceous plants, or 3) smaller herbaceous plants. The shrub layer includes species like *Aronia prunifolia* (Black Chokeberry), *Cornus amomum* (Silky Dogwood), *Cornus foemina* (Gray Dogwood), *Cornus sericea* (Red-osier Dogwood), *Corylus americana* (American Hazelnut), *Ilex verticillata* (Winterberry), *Rosa palustris* (Swamp Rose), *Salix* spp. (Willows), *Sambucus canadensis* (Elderberry), *Toxicodendron vernix* (Poison Sumac), *Vaccinium corymbosum* (Smooth Highbush Blueberry), and *Viburnum lentago* (Nannyberry). The second layer contains additional woody species like *Betula pumila* (Bog Birch), *Dasiphora fruticosa* (Shrubby Cinquefoil), *Ribes hirtellum* (Swamp Gooseberry), *Rubus* spp. (Raspberries), and *Spiraea alba*

(Meadowsweet) plus herbaceous plants like *Alisma subcordatum* (Water Plantain), *Asclepias incarnata* (Swamp Milkweed), *Calamagrostis canadensis* (Swamp Milkweed), *Carex* spp. (Sedges), *Cicuta maculata* (Water Hemlock), *Equisetum fluviatile* (Water Horsetail), *Erigeron philadelphicus* (Marsh Fleabane), *Eupatorium perfoliatum* (Common Boneset), *Glyceria canadensis* (Rattlesnake Grass), *Schoenoplectus tabernaemontani* (Softstem Bulrush), *Scirpus pendulus* (Bulrush), *Solidago canadensis* (Canada Goldenrod), and *Thelypteris palustris* (Marsh Fern). The third layer of smaller plants when present often contains *Campanula aparinoides* (Marsh Bellflower), *Galium* spp. (Bedstraws), *Lycopus uniflorus* (Northern Bugle Weed), *Maianthemum canadense* (Canada Mayflower), and *Pilea pumila* (Clearweed). The extensive amount of shrubs encourages a diverse ornithological community. Similar to the Prairie Fen, large ant mounds are also likely.

The 2012 report on the natural communities of Matthaei Botanical Gardens and Nichols Arboretum properties also includes Wetlands and Open Water as categories.

Keystone and indicator species

Keystone species are integral components of ecological communities. They often provide the structure or resources needed to ensure the success of other species. In Matthaei Botanical Gardens and Horner-McLaughlin Woods, several keystone species exist or have the potential to occur because of the abundance of suitable habitat. Potential species include *Castor canadensis* (Beaver) and *Myotis sodalis* (Indiana Bat), while already existing species include *Quercus spp.* (Oaks) and *Sistrurus catenatus* (Eastern Massasauga Rattlesnake). Historically, *Canis lupis* (Wolf) was likely a keystone predator in Oak Openings.

Indicator species reveal information about a habitat because of their sensitivity to environmental changes. Concerning indicator species, in Oak Openings, only one plant *Aster pilosus* (Frost Aster) qualified as an indicator species in a study surveying

prairies and savannas (Chapman & Brewer, 2008). An unpublished study examining Radrick Forest identified *Ribes cynosbati* (Prickly Gooseberry), *Cornus florida* (Flowering Dogwood), and *Arisaema atrorubens* (Jack-in-the-Pulpit) as indicator species (Mascaro, ND). For wetland communities, various invertebrate indicator species can reveal information about the water quality.

Another study used a suite of indicator plant species to examine the impact of deer populations on vegetation and natural communities in Manchester, Michigan in Washtenaw County (Courteau, 2015). These plants included the following: 1) Spring forest flora – *Euonymus obovata* (Spreading Strawberry-bush), *Phlox divaricate* (Wild Blue Phlox), *Sanguinaria canadensis* (Bloodroot), and *Trillium grandiflorum* (Trillium); 2) Fall forest wildflowers – *Helianthus divaricatus* (Woodland Sunflower),



Castor canadensis (Beaver) (Photo credit National Geographic)



Bloodroot (Photo credit Roane Grown)

Solidago caesia (Bluestem Goldenrod), and *Symphotrichum cordifolium* (Heart-leaved Aster); 3) Grassland wildflowers *Cirsium muticum* (Swamp Thistle), *Lactuca canadensis* (Wild Lettuce), *Solidago rigida* (Stiff Goldenrod), and *Symphotrichum laeve* (Smooth Aster). To add to this list, Penskar et al. 2003 identified 27 potential indicator plant species. Cross-referencing these lists to the botanical surveys from 2011 would yield a condensed list of potential indicator species for these properties.

According to a 2012 report (Walters, et al.) on the flora of Horner-McLaughlin Woods, the plant populations are comprised of 85 to 96% native species. MBG has slightly lower levels ranging from 72 to 98% native species. Mud Lake Bog has higher levels of native species overall, although the range is still wide when including all natural communities (i.e., 74% to 98% native species). Not surprisingly due to its more urban location, Nichols Arboretum has between 63 and 84% native species. Botanists identified rare plants at three of these locations during the 2011-2012 surveys. These rare plants include *Agrimonia*

rostellata (Woodland Agrimony) and *Jeffersonia diphylla* (Twinleaf) at Horner-McLaughlin Woods. Matthaei Botanical Gardens also provides habitat for *Gentianella quinquefolia* (Stiff Gentian), *Sanguisorba canadensis* (American Burnet), and *Valeriana edulis* (Tobacco Root). Populations of *Panax quinquefolius* (Ginseng) and *Hydrastis canadensis* (Goldenseal) are also preserved on these properties.

The Radrick Fen located on Matthaei Botanical Gardens properties displays high levels of bird activity. Continuing south into the higher elevations of Radrick Forest, some bird species of note include Golden-Crowned Kinglet, Fox Sparrow, and Hermit Thrush. The lower elevation Radrick Fen in this location supports diverse plant species include *Betula pumila* (Bog Birch). Horner-McLaughlin Woods supports raptors, possibly a Cooper's Hawk, as well as migratory birds including the Red-Breasted Nuthatch.



Red-Breasted Nuthatch (Photo credit Norm Dougan, Audubon Society)

Management

Intent

The intent of this management plan is to allow those working on Matthaei Botanical Gardens, Nichols Arboretum, Horner-McLaughlin Woods, and Mud Lake Bog, or any other natural areas property, to have a roadmap for the management of natural areas. Understanding the details of these individual properties allows stewards to protect and restore these natural areas.

Long-term objectives supporting this intent involve the plant and animal communities, the abiotic environment, and the social context. After considering these topics, some specific key goals guide the following management recommendations.

Key Goals

Ecological Health: Improve the quality of the habitats adjacent to the river in order to protect the waterway (Durfee, 2010a). Monitor the forest and encourage it to open up over time through appropriate management actions. Promote native species (Durfee, 2010b). Maintain high ecological quality for educational and restorative purposes. Enhance the value of the properties as natural areas for residents and visitors to appreciate, where appropriate. In some cases, limit the amount of human interaction within sensitive natural communities.

Stewardship: Include more local student groups and residents to simultaneously benefit volunteers as well as Matthaei-Nichols personnel and organizational objectives. Coordinate more frequent workdays. Consider employing site stewards, volunteers who would adopt a particular part of the property and oversee workdays (Durfee, 2010a). Michigan Botanical Club currently does this for Horner-McLaughlin Woods.

Social Environment: Educate the public on natural area stewardship activities like prescribed burning and private yard management, including information about invasive species trying to be controlled. Offer information about Eastern Massasauga Rattlesnakes to Matthaei Botanical Gardens neighbors. Build partnership with local organizations for developing resources (Durfee, 2010c). Coordinate efforts and management strategies with nearby stakeholders.

Infrastructure: Plan pathways in such a way as to minimize impacts to sensitive areas, while allowing for access in designated areas for maximum appreciation and learning. For some parts of these properties such as fens, restricted access might be necessary. Connect the trail system (Durfee, 2010a, 2010c).

Monitoring: Bolster the University's goal to act as a resource for research and education. Consistently update species lists and changes in natural communities, as well as records on amphibians, reptiles, mammals, and birds. Record data on additional elements like soil and water. Uphold records of natural areas management activities such as invasive shrub removal and prescribed burns. Maintain a GIS open portal and GIS online map.

Invasive species: Maintain awareness of active invasive species out of state and around the areas to promote early detection through continual monitoring. Identify new invasive species and remove before infestations develop. Reduce populations of Garlic Mustard at Horner-McLaughlin Woods and Matthaei Botanical Garden.

Prioritized Actions, 2-3 Years

Organizational

- Designate rare species and areas of higher diversity for protection.
- Install boot scrubs at all trail entrances.
- Monitor and manage populations of Garlic Mustard, Buckthorn, Honeysuckle, and Deer.
- Retain snags and woody debris. Add woody debris to waterways to encourage a wider flow path.
- Border paths with minimum 5” diameter logs to encourage appropriate trail behavior. Blaze trees to mark trails for safe use in winter.
- Identify emergency routes.
- Recruit trained focus group facilitators to gain support from a more inclusive sampling of the stakeholder population.
- Distribute newly designed deliverables to welcome additional volunteers.

Matthaei Botanical Gardens

- Surveying and monitoring including observations from volunteers and visitors and an efficient way for the information to reach Matthaei-Nichols.
- Perform actions linked to natural communities identified as higher priority.
 - o Oak Openings – Including two (possibly three if the Radrick Farms property is acquired) new locations, perform selecting cutting and girdling of undesirable species. Gradually restore the canopy to 10-40% Oak. Employ prescribed fire. Plant and encourage the growth of desirable species.
 - o Floodplain Forest – Explore beaver reintroduction to improve the hydrology and widen the floodplain. Reduce trails throughout the floodplain. Manually remove undesirable species. Avoid herbicide use due to the proximity to the waterway.

- o Prairie Fen – Protect the groundwater supply with regulation of nearby areas. Perform prescribed burning in small patches to allow arthropod refuge. Cut, girdle, and bag to remove undesirable species. Avoid herbicide use to protect the groundwater.

- o Dry-Mesic Southern Forest (MBG) – Manage hydrology to benefit the Southern Hardwood Swamp. Use fire cautiously. Limit habitat fragmentation through removal of undesirable species.

- Hiking/biking trail by Ravine Court
- Acquire the meadow owned by Radrick Farms
- Rebuild the bridges related to Radrick Forest
- Construct boardwalks to preserve sensitive wetland areas

Horner-McLaughlin Woods

- Perform actions linked to natural communities identified as higher priority
 - o Southern Hardwood Swamp – Maintain upland communities to protect the hydrology and water quality. Monitor water levels and disturbance events.
 - o Dry-Mesic Southern Forest – Evaluate the consequences of prescribed burning in the Goodrich Preserve to decide if burning would be an advantageous action for Horner-McLaughlin Woods. This action would likely benefit the Dry-Mesic Southern Forest landscape and encourage *Carya* spp. Hickory and *Quercus* spp. Oak regeneration. However, Mesic Southern Forest (Beech-Sugar Maple) is a less common natural community type, especially at this location, and is not dependent on fire disturbances.
 - o Mesic Southern Forest (HMW) – Manage with deer exclosures to encourage seedling regrowth. Remove invasives through cutting and girdling. Use herbicides sparingly to preserve water quality linked to the Southern Hardwood Swamp.

3-10 Years

Organizational

- Define a challenge gradation for trails
- Establishing a seed bank to provide a resource (add this to volunteering section)
- Deer culling / nuisance permits including bowhunting
- Work with the city of Ann Arbor to remove invasives along transit routes
- Achieve 50% reduction in invasive species populations
- More funding for student interns. Consider recruiting more student diversity concerning topics such as trail design.
- Have a dedicated natural area investor for each property.
- Have established volunteer groups for each property.
- Develop stronger relationships with individuals within the watershed to promote healthy water management practices.
- Establish sensitive construction practices for surrounding properties to reduce disturbance.
- Work with municipalities to enact stricter land use regulations on neighboring properties.

Priority Survey Targets

<i>Sanguinaria canadensis</i>	Bloodroot
<i>Trillium spp.</i>	Trillium
<i>Ribes cynosbati</i>	Prickly Gooseberry
<i>Cornus florida</i>	Flowering Dogwood
<i>Carex crinita</i>	Sedge
<i>Arisaema triphyllum</i>	Jack-in-the-Pulpit
<i>Aster pilosus</i>	Frost Aste
<i>Euonymus obovata</i>	Spreading Strawberry-bush
<i>Phlox divaricata</i>	Wild Blue Phlox
<i>Helianthus divaricatus</i>	Woodland Sunflower
<i>Solidago caesia</i>	Bluestem Goldenrod
<i>Symphyotrichum cordifolium</i>	Heart-leaved Aster
<i>Cirsium muticum</i>	Swamp Thistle
<i>Lactuca Canadensis</i>	Wild Lettuce
<i>Solidago rigida</i>	Stiff Goldenrod
<i>Symphyotrichum laeve</i>	Smooth Aster

Table of indicator species.

Long-term objectives

Due to their differing levels of plant diversity and ecological history, management techniques are more uniquely tailored to each habitat type. Botanical surveys from 2012 provide a starting point concerning present plant species at the four properties. Comparing this information to rare species lists for natural communities helps inform management decisions. In addition to future botanical surveys, surveys for other species would confer benefits. Amphibian and reptile surveys are helpful due to their sensitive nature as indicator species. Bird surveys function as a measure of environmental health. Mammal surveys offer structure to the community and include keystone species.

Beyond these wildlife concerns, the abiotic environment is also important. Soil health and water quality are key components of a healthy ecosystem. Future monitoring of both would inform managers of the quality of the environment and where to focus restoration efforts.

Another integral piece of the environment is the social context. Surveying the opinions of residents and natural area stewards offers information to guide management actions. Specifically related to stewardship, this data contributes to more effective monitoring, evaluation, and funding plans. Infrastructure, often in the form of trails, requires regular maintenance as well as an overarching future plan. Lastly, by working with University students and volunteers at a larger scale, the Matthaei Botanical Gardens and Nichols Arboretum has the potential to create a successful stewardship community.

Prothonotary Warbler (Photo credit Audubon Society)



	OO	PF	FF	MSF	SHS*
<i>Ambystoma texanum</i> Smallmouth Salamander				*	*
<i>Clonophis kirtlandii</i> Kirtland's Snake	*	*	*		*
<i>Emydoidea blandingii</i> Blanding's Turtle		*	*	*	*
<i>Anguispira kochi</i> Banded Globe			*		
<i>Discus patulus</i> Domed Disc			*		
<i>Pomatiopsis cincinnatiensis</i>			*		
<i>Buteo lineatus</i> Red-shouldered Hawk			*	*	*
<i>Protonotaria citrea</i> Prothonotary Warbler			*	*	*
<i>Haliaeetus leucocephalus</i> Bald Eagle					*
<i>Pandion haliaetus</i> Osprey					*
<i>Acronita falcula</i> Corylus Dagger Moth					*
<i>Battus philenor</i> Pipevine Swallowtail (DMSF)					
<i>Microtus pinetorum</i> Woodland Vole				*	
<i>Myotis sodalis</i> Indiana Bat			*		*
<i>Carex davisii</i> Davis's Sedge			*		
<i>Carex trichocarpa</i> Hairy-fruited Sedge			*		
<i>Camassia scilloides</i> Wild Hyacinth	*				
<i>Corydalis flavula</i> Yellow Fumewort	*		*		
<i>Euphorbia commutata</i> Tinted Spurge	*			*	
<i>Lactuca floridana</i> Woodland Lettuce	*				
<i>Chelone oblique</i> Purple Turtlehead			*		
<i>Euonymus atropurpureus</i> Wahoo			*		
<i>Galearis spectabilis</i> Showy Orchid			*	*	*
<i>Hybanthus concolor</i> Green Violet			*	*	*
<i>Justicia americana</i> Water Willow			*		
<i>Lithospermum latifolium</i> Broad-leaved Puccoon			*		
<i>Morus rubra</i> Red Mulberry			*		
<i>Polemonium reptans</i> Jacob's Ladder		*	*		
<i>Silphium perfoliatum</i> Cup Plant			*		
<i>Trillium sessile</i> Toadshade				*	
<i>Viburnum prunifolium</i> Black Haw DMSF			*	*	*
<i>Dryopteris celsa</i> Small Log Fern			*		*

Table of prioritized survey targets based on rare status. Locations refer to the five more sensitive natural communities, OO (Oak Opening), PF (Prairie Fen), FF (Floodplain Forest), MSF (Mesic Southern Forest), SHS (Southern Hardwood Swamp).

Stewardship

Volunteers

One way to mitigate operating costs is to enlist the support of volunteers. Yet the biggest setbacks keeping individuals from contributing their help are time and transportation. Through focus groups conducted to evaluate why individuals chose to practice natural areas stewardship, these were the two setbacks mentioned in each group. Many people volunteer their time in ways that are separate from group activities, which can include taking care of their own properties or visiting Matthaei-Nichols locations and pulling Garlic Mustard due to their own desire. Yet increasing volunteer participation and help requires empowering participants through allowing them to find an activity they enjoy. These types of actions could include letting them become a site steward in charge of a specific natural area or encouraging them to work at their own pace. Facilitating a positive experience hopefully increases their willingness to continuously contribute.

Matthaei-Nichols has the ability to address people's time constraints through shorter work sessions offered at various times. Incorporating activities in concert with the agendas of other organizations would allow participants to achieve multiple goals simultaneously. Addressing transportation is something that can be facilitated for natural area sites by working with the surrounding cities and neighborhoods to create various transportation means. These can include

adding a new bus route that goes near or directly in front of a natural areas entrance as well as working with rideshare companies to provide discounts for people using their services going to and from sites. Creating these kinds of options would improve volunteer efforts by taking away the limitation of lack of transportation. Additionally, students showed the same type of hesitation in regards to volunteering. A bus route from main campus to Matthaei Botanical Gardens will create more opportunities to attract student volunteers.

Ways to get long-term volunteers established

Several strategies could be taken to establish a long-term volunteering program with higher capacity, some of which are already implemented.

- Host monthly volunteer orientations, offering additional training for some activities.
- Advertise the stewardship program and publicly recognize volunteer efforts. Publish the upcoming workdays events on the Matthaei-Nichols website, monthly newspaper, and the Nextdoor App to reach a larger audience and recruit more volunteer help. Send out stewardship workdays reminders one week ahead of the event.
- Start the Volunteer Leaders program (Glenn R. Palmgren, 2017). Identify and invest in volunteers who are experienced in stewardship activities and are interested in taking the leadership. Train the stewardship leaders to independently lead volunteer workdays.
- Maintain consistent meeting times and locations.
- Explain to the volunteers the way in which stewardship activities align with the overall management of the property.
- Provide clear responsibility descriptions and create a sense of ownership over work accomplished.
- Provide quality tools and equipment.
- Maintain organized volunteer registration, a recording system, and name tags.
- Consider a group photograph at the end of each stewardship activities.
- Offer snacks/souvenirs/holiday gifts and other

MANAGEMENT TOPICS



Volunteers in Maithaei-Nichols

options.

- Establish a process for collecting and managing feedback and monitoring reports from visitors and volunteers.

In order to recruit volunteers from a broader audience, Team Botanical created three outreach deliverables. While the brochure contains more informational content, the bookmarks can be distributed at lectures or placed in bookstores and libraries.

- Brochure

Gardens and Arboretum, Horner-Woods brochure with map, linking people to gardens and county volunteer opportunities.

- Bookmark Geared towards students
- Bookmark Geared towards members

Both include comments about health benefits; “Healthy Nature”; “Naturecise”

Management Topics

Restoration

Seeding and Planting

Records for new and old plantings are documented to ensure knowledge of existing locations of species and their impacts to the surrounding locations. This is important to know when applying herbicide or administering other forms of invasive removal in order to preserve native planting habitats. Seeding dispersal is a method used to establish a new seed bank of native species that may have been lost to disturbances in the area. Keeping record of when and how much seed is used will help reduce costs and unnecessarily repeated work in areas. Records are also important when considering geologic history and the resulting influence on depositional layers, soil types, rock types, as well as sediment and mineral distribution.

Re-introduction of native species

For the five natural communities at Horner-McLaughlin Woods and the seven at Matthaei Botanical Gardens, the Michigan Natural Features Inventory list of rare plants should be compared to

existing botanical surveys. Based on this comparison, target species can be identified. These would then be selectively planted in locations corresponding to the appropriate natural community type.

Based on species lists from the Michigan Natural Features Inventory, the ten natural communities found at Horner-McLaughlin Woods and Matthaei Botanical Gardens have the potential to support many additional rare plant and animal species. These detailed lists are contained in Appendix D_Rare Species. Comparing these lists to a spreadsheet of currently surveyed species (birds, insects, plants, and animals) resulted in a tabular outcome identifying surveys for future introduction and/or monitoring (Appendix F). Based on the potential locations of these species, habitat recommendations also emerged. A note of caution: the authors do not understand the way these species interact with other inhabitants of these natural communities. Before introducing any new species, it would be helpful to first evaluate possible interactions with existing species. Beyond this cautionary note, practitioners would be wise to search for records of species at the University of Michigan herbarium in an effort to identify species that previously inhabited these areas.

Integrated Pest Management

According to Cornell University’s website on Integrated Pest Management, IPM involves “sustainable ways to manage pests and helps people to use methods that minimize environmental, health, and economic risks.” In general, IPM focuses on incorporating a range of options for addressing pest problems. These include organic, cultural, biological, mechanical, and chemical techniques often based on existing evidence. Pests include bacteria, fungi, viruses, weeds, and wildlife. Essentially, this practice focuses on using variety to have a less predictable offensive approach.

For example, instead of routinely applying an herbicide at the same time every month, IPM relies on developmental cues and information such as growing degree-days to better target application timing to insect population peaks. In this way, management actions are more effective. For Matthaei Botanical Gardens and Nichols Arboretum, this would entail using environmental cues to make management

What you might not know about Stewardship

Stewardship definition: Utilizing approaches such as conservation and sustainability, part of a steward's endeavor is to protect the natural environment.

Ways it is helpful: Saves endangered species, protects native plants and animals, removes invasive threats, and maintains positively acting ecosystems.

What activities are included: Invasive plant removal, prescribed burns, seed collection, native species planting, and activism.

What you can do:

- Spend more time in natural area
- Volunteer to Arboretum & Botanical Garden
- Plant native species in your own garden
- Control invasive species in your own yard
- Buy locally

We welcome volunteers to get involved in every season at Matthaei-Nichols. New volunteer orientations are offered every month, with additional training required for some assignments.

More volunteer chances:

<https://mbgna.umich.edu/volunteer/>

Delightful art events:

<https://mbgna.umich.edu/events/>

About us

We are one organization with several locations at the University of Michigan. Our mission is to promote environmental enjoyment, stewardship, and sustainability through education, research, and interaction with the natural world.



General Info: (734) 647-7600

Matthaei Botanical Gardens
Daily 10 am - 8 pm
Wednesdays until 8 pm
Free admission
1800 N. Dixboro Rd.
Ann Arbor, MI 48105

Nichols Arboretum
Open 7 days a week, sunrise to sunset
Free admission
1610 Washington Hts.
Ann Arbor, MI 48104



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Natural Area Stewardship

Public Engagement and Management within Matthaei Botanical Gardens, Nichols Arboretum, Horner-McLaughlin Woods, and Mud Lake Bog



MATTHAEI BOTANICAL GARDENS
AND NICHOLS ARBORETUM
UNIVERSITY OF MICHIGAN

Prescribed Burning

Definition: Using controlled fires to create space for native species regeneration either by disturbance to the seed bank or removal of invasive species.

Why: Some species require fire to germinate and produce new growth, while other species are so pervasive a successful way to discourage growth is to use fire.

What Plants: Woodlands species, Prairie species

Where: Matthaei Botanical Gardens Natural Area and Nichols Arboretum Natural Area

Native Plant Establishment

Definition: Seed collection and native species planting are two ways to re-establish native plants in an ecosystem.

Why: Reintroducing many native species that could have been removed due to erosion or agriculture is important for restoration.

What Plants: Prairie and woodland wildflowers, sedges, grass, shrubs and trees

Where: Matthaei Botanical Gardens Natural Area, Nichols Arboretum Natural Area, Horner Woods, Mud Lake Bog

Restoring Ecological Integrity

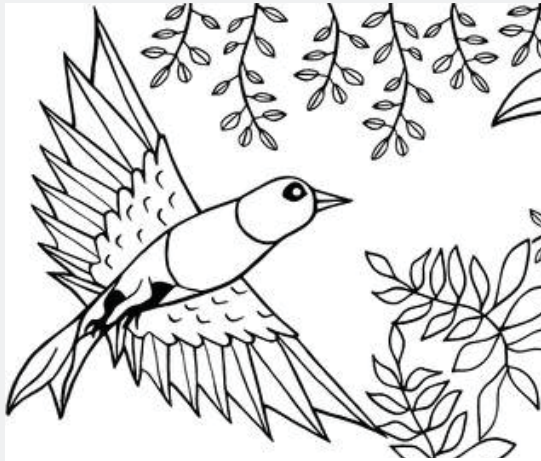
Definition: Transforming a disturbed ecosystem into a native landscape by removing invasive species and planting desirable species.

Why: Removing invasive species allows enough space and nutrient for native species.

What Plants: Buckthorn, Garlic Mustard, Honeysuckle

Where: Matthaei Botanical Gardens Natural Area and Nichols Arboretum Natural Area





LET'S
TAKE CARE

of

NATURAL
AREAS



What You Can Do

- Establish native plants
- Remove invasive plants
- Volunteer at the Botanical Garden, Arboretum, or with other natural areas groups
- Plant native and manage invasive species where you live
- Buy locally
- Pick up litter
- Whatever other creative, unique, fun, or innovative ideas you dream up!

Why This is Important

- Healthy natural areas translates into a healthier environment for both people and wildlife.
- Plus, you receive benefits:
 - Belong to a group
 - Learn something new

Learn About Us

We are one organization with several locations,

- 1) Matthaei Botanical Gardens
- 2) Nichols Arboretum
- 3) Horner-McLaughlin Woods
- 4) Mud Lake Bog

Our mission is to promote environmental enjoyment, stewardship, and sustainability through education, research, and interaction with the natural world.

General Info: (734) 647-7600

Check out our website for more information:
<https://mbgna.umich.edu/>
or scan the QR code with the camera app on your phone >



MATTHAEI BOTANICAL GARDENS
AND NICHOLS ARBORETUM
UNIVERSITY OF MICHIGAN

Natural Areas Stewardship



Stewardship is accepting ownership for taking care of natural areas.



Four Properties

- 1) Matthaei Botanical Gardens
- 2) Nichols Arboretum
- 3) Horner-McLaughlin Woods
- 4) Mud Lake Bog

Types of Activities

- 1) Restoring Ecological Integrity
- 2) Native Plant Establishment
- 3) Prescribed Burning

What You Can Do

- Spend time in natural areas
- Volunteer at the Botanical Garden, Arboretum, or with other natural areas groups
- Plant native species and manage invasive species where you live
- Attend lectures about natural areas to learn about other ways to contribute

Benefits

- A sense of belonging
- Taking care of the environment
- Learning something new



Be a part of restoring natural communities like Oak Openings.

<https://mbgna.umich.edu/volunteer/>

Visit the website above or scan this QR code



decisions. Specifically, this implies scheduling a spring burn to take place after the migration of a particular bird species or the emergence of a targeted weed species rather than during a set week of a chosen month. Successful IPM stems from wiser decisions founded on an understanding of ecological life cycles. Matthaei-Nichols currently follows a program of IPM for their gardens, greenhouses, and natural areas, keeping herbicide and pesticide use to a minimum. Incorporating the aforementioned IPM practices would further strengthen Matthaei-Nichols' management practices.

Mitigation of problem species

The abundance and spread of problem species have increased along with knowledge of their detrimental effects on native ecosystems. Ways to approach the mitigation of these species might include the prevention, control, or eradication of these unwanted species (Hoffman, 1997). This can be done with many different approaches, such as prescribed burns, pulling, cutting and spraying (removing the specimen), hacking and spraying (leaving the specimen), biological defenses, and fencing.

Prevention and control are the most reasonable and cost effective approach taken when addressing problem species. Understanding what is happening in surrounding states, being in communication with both nearby natural areas and communities involved with pest mitigation, or being aware of changes in your own properties are ways to stay vigilant of the introduction of unwanted species (Arlidge, 2018). Eradication is very costly and time consuming because it requires physical work to create alterations in the landscape, especially if a pest has become naturalized.

Roadways play a significant role in the introduction of problem species by facilitating dispersal. Some problem species cannot be removed by the above approaches due to their ability to grow and expand rapidly into particular ecosystems. For example, where Honeysuckle, Buckthorn, and other aggressive problem species are prevalent, resulting alterations to the ecosystem may push the area into a successional period.

Several of the reasons why a species becomes problematic include not having natural predators, producing more rapidly than its native counterparts, or being adaptable to different climates or habitats. This leads to changes in native biodiversity and ecosystem characteristics. Therefore, to create a plan to mitigate these occurrences, first understanding the causes leading to problem species introductions is valuable. This is especially important to do when distinguishing between intentional and unintentional introductions of new species. Approaches to be taken include prevention, detection, response, containment, eradication, and control (Unity College, 2017). Each of these approaches might be implemented through observing surrounding locations, planning for problem species before they reach the property, and isolating singular occurrences in order to eradicate the introduction and control the situation.



Alliaria petiolata (Garlic Mustard) from the Michigan Nature Guy's blog

Invasive Species Overview

Invasive species are a recurring and serious problems for natural areas, and if left unchecked and unreported, they can create long-lasting negative outcomes for native species. Many invasive species are pioneer species that do well in disturbed areas. In some ways, problems with invasive species are a consequence of current infrastructure practices. Altering construction techniques to be less disruptive to the existing plant community is one way to prevent invasive species spread.

Herbicide use is an important treatment used to mitigate the effects of invasive species. Application of these chemicals has a potentially harmful impact on both humans and nature. For this reason, accurate and thorough records in land management are warranted. Thus, it is standard practice for Matthaei-Nichols staff to record all instances of herbicide and pesticide applications in a publicly available log.

Invasive species and treatments

Trees, shrubs and vines:

Buckthorn, Honeysuckle, Privet, Norway Maple, Oriental Bittersweet, etc.

Treatment:

Cutting and treating stumps, girdling, brush hogging, chemical spray, prescribed burning.

Herbaceous plants:

Garlic Mustard, Dame's Rocket, Purple Loosestrife, etc.

Treatment:

Hand pulling, chemical spray, mechanical (mowing, brush hogging), biological (beetles on Purple Loosestrife), cultural (prescribed fire). Need to consider appropriate timing and combination of different methods.

Other considerations

1. Provide an educational public lecture.
2. Consider the effect of climate change and potential invasives from other warmer states.
3. Understand toxic plants.
4. Observe and document individual species and infestation through maps and photographs, if possible, but consider time and labor to manage data and overall goals of control.
5. Monitor the number of invasive species, the size of the infestation, and the number of native species to determine success of invasive species management.
6. Organize stewardship activities to manage for invasive species.



Rhamnus cathartica (Common Buckthorn) flowers, leaves, and fruit , from the Michigan Nature Guy's blog

7. Update the following example format for the invasive species inventory every 2 years for Matthaei Botanical Gardens and Nichols Arboretum and every 6 years for Horner-McLaughlin Woods and Mud Lake Bog.

TITLE: INVASIVE SPECIES INVENTORY –
#PROPERTY NAME - #TIME OF INVESTIGATION

INVASIVE SPECIES LIST: TREES, SHRUBS, VINES,
HERBACEOUS (IN SCIENTIFIC NAME)

SCIENTIFIC NAME, COMMON NAME, FAMILY
NAME, INVASIVE SPECIES DESCRIPTION:
LOCATION IN THE PROPERTY, CHARACTERISTICS,
CONTROL, PAST MANAGEMENT IN THE PROPERTY,
INVENTORY METHOD(BY OBSERVATION OR
PHOTO MONITOR.....), SOURCES

Prescribed Burns

Prescription burning is the process of intentionally setting a fire for the purposes of management and restoration. Many natural areas were burned seasonally or annually based on weather conditions before settlement of the land, therefore, the process is used to maintain and return areas to their pre-disturbance status (Peterson, 2001). Stewards know the way these processes occurred from historical records and documents derived from written reports, thus highlighting the importance of natural areas recordkeeping. The information for prescribed burns at Matthaei-Nichols can be found in the appendices. Records are kept of all prescribed burns performed on the properties. Many areas that receive this treatment are on a three-year cycle to allow for regeneration and adaption of native species.



Prescribed Burn, Michigan Nature Association - WordPress.com

Prescribed burning is not the most appropriate method for some forest areas of Southeast Michigan, such as maple forests that are fire intolerant, because they did not receive such frequent fires historically and are not evolved to handle this disturbance (Lorimer, 1984). However, practice has shown prescribed burning is beneficial to the landscape by both reducing invasive species populations and allowing the seed bank to reestablish native species that have been lost through years of ecosystem change (Brose, 2013).

Those areas described as Dry-Mesic Southern Forest (Oak-Hickory) are fire-dependent. “Frequent fires maintain semi-open conditions, promoting oak regeneration, and ground and shrub layer density,” (Kost et al., 2007). Some of the Dry-Mesic Southern Forest on site may be the result of suppressing fire in Oak Openings. Identifying some locations to restore to Oak Openings could occur with increased prescribed fire and the removal of some problematic shrubs such as *Lonicera spp.* (Honeysuckle) and *Elaeagnus umbellata* (Autumn Olive).

Based on unpublished data on saplings counts and seed traps collected since 2008 by researchers with the Ibanez lab at the University of Michigan, Horner-McLaughlin Woods has a large amount of *Acer rubrum* (Red Maple) (241 total seedlings) and *Acer saccharum* (Sugar Maple) (117 total seedlings) regrowth. In most years, fewer than ten total seedlings of any species are visible, while in two years, 2009 and 2014, 209 and 127 total seedlings emerged, respectively. Although existing as the dominant overstory species, few individuals

of *Carya spp.* (Hickory) or *Quercus spp.* (Oak) were observed. This is likely due to the lack of fire across the landscape because these two species need fire to discourage competing species. Additional species observed include, *Prunus spp.* (Cherries), *Liriodendron tulipifera* (Tuliptree), *Ostrya virginiana* (Ironwood), *Ulmus americana* (American Elm), *Amelanchier arborea* (Serviceberry), *Carya glabra* (Pignut Hickory), *Catalpa speciosa* (Northern Catalpa), *Ulmus spp.* (Elms), *Carya cordiformis* (Bitternut Hickory), *Fraxinus americana* (White Ash), *Prunus serotina* (Black Cherry), and *Quercus velutina* (Black Oak). The only observed invasive species seedlings were *Elaeagnus umbellata* (Autumn-olive). Implications of this information are addressed in the management section concerning Dry-Mesic Southern Forest and Southern Mesic Forests at Horner-McLaughlin Woods.

Emergent Marshes neighboring other fire-dependent communities would benefit from well-planned prescribed burns to promote the expression of species from the seed bank and to encourage seedling establishment. Similarly, Prairie Fens are adapted to fire. Prescribed burning of these areas would bolster nutrient cycling, community structure, and expression and maintenance of the seed bank. Some species living in Prairie Fens, such as arthropod communities, are sensitive to fire. For this reason, substantial portions of the fens should be demarcated as unburned during each fire season. A similar wetland community, Southern Wet Meadow also benefits from periodic burning, which enhances the native community through the encouragement of the seed bank.

Recommendations

The majority of the following recommendations concerning Matthaei Botanical Gardens and Horner McLaughlin Woods reference the following updated natural community maps of the two properties.

NATURAL COMMUNITIES OF HORNER-MC Laughlin WOODS

Plant communities classified according to the natural community descriptions established by the Michigan Natural Features Inventory (Kost et al. 2007, Natural Communities of Michigan: Classification and Description, Report Number 2007-21; <http://mnfi.anr.msu.edu/>)



- Dry-Mesic Southern Forest* (39.2 acres)
- Inundated Shrub Swamp* (5.5 acres)
- Mesic Southern Forest* (2.6 acres)
- Southern Hardwood Swamp* (1.0 acre)
- Wetland / Water*

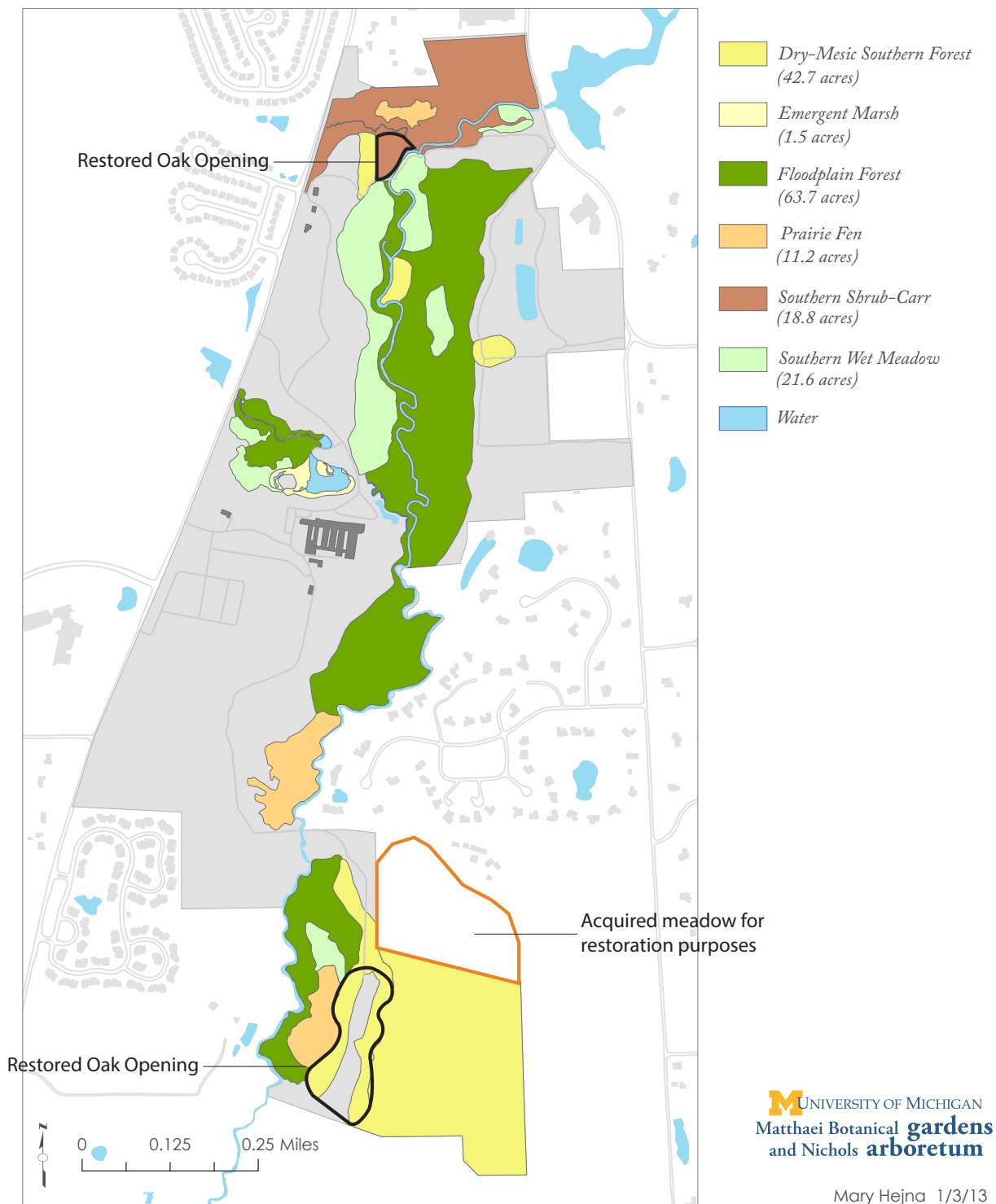


Mary Hejna
1/8/13

M UNIVERSITY OF MICHIGAN
Matthaei Botanical **gardens**
and Nichols **arboretum**

NATURAL COMMUNITIES OF THE MATTHAEI BOTANICAL GARDENS

Plant communities classified according to the natural community descriptions established by the Michigan Natural Features Inventory (Kost et al. 2007, Natural Communities of Michigan: Classification and Description, Report Number 2007-21; <http://mnfi.anr.msu.edu/>)



Protecting Unique Habitats and Rare Species

Wetlands

The Floodplain Forest has the potential to support 56 rare surveyed species, 28 of which currently reside in Washtenaw County. This is 39% of the 142 total surveyed rare species. For this reason, management actions for this natural community type are of higher significance. In particular, the Floodplain Forest can support ten different rare *Carex* spp. Sedge species.

In addition to species diversity, Floodplain Forests house a suite of unique habitats because of the variety of landforms. Depending on inundation frequency, soil type, and distance from the waterways, many microhabitats occur on floodplains. In addition to supporting species as a breeding and foraging area, they also bolster the river corridor. “Riparian corridors may harbor twice the number of species,” as that which resides in adjacent upland locations (Kost et al., 2007). Because of their complexity, floodplains require more integrated management techniques that also take into consideration upstream and upland conservation. Due to their function as a travel corridor, they are also more susceptible to invasive species. As a consequence, monitoring is especially important for these communities. “Preemptive measures to minimize the impacts of invasive species include maintaining mature floodplain forest, minimizing and eliminating trails and roads through floodplains, and buffering riparian areas with mature, continuous uplands,” (Kost et al., 2007). These goals require further efforts due to the loss of some key species like *Ulmus americana* (American Elm) and *Fraxinus* spp. (Ash).

A more vulnerable natural community, Floodplain Forests require significant area next to the adjacent waterway to allow for stream meander. Coarse woody debris plays a role by reconfiguring stream pathways. Vegetation in floodplains and soil bacteria in inundated soils reduce nutrient levels entering waterways. For this reason, protecting floodplains helps ensure water quality. In some locations, practitioners can restore eroded streambanks by

allowing the waterway a wider floodplain area. A recommended design technique would be to route the path along Fleming Creek in such a way that it only periodically is immediately adjacent to the water. Planned rerouting should also occur as the creek meanders. As Matthaei-Nichols has already constructed some new boardwalks to account for this, designing the boardwalks in an aesthetically pleasing manner along a curving route would elicit a positive response from visitors. Another concern at Horner-McLaughlin Woods is the status of the ephemeral streambanks. In some locations, erosive characteristics exist suggesting an examination of the site’s hydrology with possible re-routing or alternative flow pathway creation. Although a contentious topic, reintroducing beaver to the landscape would benefit the hydrology of the site and encourage a wider floodplain. Collaboration with local municipalities would likely meet initial resistance, so a broad understanding of possible implications and ways to overcome obstacles would strengthen the recommendation.

Prairie Fens have a vulnerable status globally and at the Michigan state level. As a wetland habitat, they are more susceptible to invasive species, so monitoring and long-term management techniques are essential. If shrub species migrate into the Prairie Fen area, Southern Shrub-Carr may result. If this occurs, multiple management routes exist. Southern Shrub-Carr, although a common habitat, can be retained for the benefits of stormwater holding capacity and bird habitat. If the open wetland is the desired habitat, the use of prescribed fire in addition to cutting and bagging shrub stumps would preserve the Prairie Fen landscape. However, if a forested landscape is preferred, the intermediate successional stage of Southern Shrub-Carr may be encouraged and further allowed to progress into less common forested swamp systems. To reiterate, both Prairie Fen and Floodplain Forest have vulnerable global and state level rankings.

Another unique habitat welcoming preservation is the Southern Wet Meadow. These communities



Southern Wet Meadow
(Photo credit Mike Kost)

have specialized hydrologic and soil conditions, so restoring degraded Southern Wet Meadows is more challenging than protecting those that exist. Ways to safeguard this natural community involve managing upland sites to ensure the quality of incoming water and employing prescribed fire. Mowing, only in the winter when the ground is frozen or in autumn when the meadow is dry, is a possible alternative to burning.

Inundated Shrub Swamps (Buttonbush Depression) are also relatively unique. They have a vulnerable status in the state of Michigan and provide habitat diversity within Horner-McLaughlin Woods. A minimum of 0.5-m as a water level is needed for these areas to prosper. These levels could be monitored as part of this management plan. Further, an examination of the differences between these microhabitats could produce a greater understanding of the conditions leading to their development such as the construction of the freeway. In some locations, the drainage routes appear eroded.

Although in a secure position in Michigan, Emergent Marshes have soils and water sensitive to external influences. Restriction of neighboring activities like lawn maintenance would be wise to protect both of these habitats. Eutrophication fosters invasive aquatic species, so regulation of nearby lands would bolster habitat health. Further, drainage ditches can interfere with normal groundwater flow, so filling in some drainage ditches to restore hydrology should also occur.

Protecting Unique Habitats and Rare Species

Terrestrial

Due to their rarity and critically imperiled status at both the global and state levels, preservation of Oak Openings is of paramount concern. Surveying for patches with restoration potential is the first step in re-establishing these communities. Prescribed fire and removing undesirable tree and shrub species should precede the re-introduction of subcanopy species. Oak Openings tend to exhibit between 10 and 60% canopy cover. Gradual restoration should occur in a stepwise fashion over a number of years to incrementally open areas to native species.

Historically, upland Oak Openings resided next to Prairie Fens. On the Matthaei Botanical Gardens property, the southernmost Prairie Fen abuts upland Dry-Mesic Southern Forest. The section located immediately adjacent to the Prairie Fen would be a prime location for restoration to an Oak Opening. Based on field observations, this area supports high bird diversity. Enhancing the habitat variety with the addition of an Oak Opening in this location would further support animal populations. A second location where an Oak Opening could occur is to the north of the Southern Wet Meadow that runs on the west side of Fleming Creek. Following the creek north from this area of wet meadow, one encounters Southern Shrub-Carr on the west bank and then Dry-Mesic Southern Forest further west. Situated on the west bank of the creek, this segment of Southern Shrub-Carr has the potential for transition to Oak Opening. A third area for an Oak Opening is the open meadow north of Radrick Forest currently owned by Radrick Farms. The previously displayed map of potential property expansions details these locations.

Jeffersonia diphylla (Twinleaf) is located near the unofficial Wood Lane entrance into Horner-McLaughlin Woods. Due to the proximity of this population to the trail and some invasive species, Matthaei-Nichols is presently discussing a relocation

of the trail. Expedient action towards rerouting the trail would be beneficial to these plant communities.

Because rare plant species exist at all four properties, signs suggesting appropriate behavior would help protect these plants. For example, reminders to stay on the path and to take only pictures would encourage visitors to appreciate the unique flora while ensuring their longevity. Clearly marked trails in terrestrial communities similarly preserve habitat quality whether through blazes on trees or logs bordering the path. Another benefit of using downed trees to border paths is that they offer small mammals protective ways to transit near areas receiving frequent visits from humans.

Another natural community type, Mesic Southern Forests have an uncertain and possibly imperiled global status, while at the state level they are vulnerable. For this reason, management efforts to expand this community, where appropriate soil types exist, would be wise. The amended map of Horner-McLaughlin Woods displays locations for these expanded communities. In the Mesic Southern Forest, downed trees in the form of coarse woody debris as well as large-diameter snags are essential components of healthy forest structure. Adding dead trees to the landscape can facilitate the development of old-growth mesic forest, which would be advantageous for the relatively young Mesic Southern Forests in Michigan, (Kost et al., 2007).

Tentative schedule and priority of implementation

Sample Schedule for Management

Management Type	Spring	Summer	Fall	Winter
Re-introduction of native species	X		X	
Integrated pest management		X		X
Mitigation of problem species		X		X
Indicating exclusive areas	X			
Protecting unique habitats and rare species	X	X	X	X
Water quality and wetland habitat improvement	X			
Prescribed Burns*	X	X	X	

*Prescribed burn schedule should be assessed for each specific habitat's fire season and continued to be monitored closely.

Monitoring schedule (include different seasons - 9 or 15 month interval)

The above monitoring schedule is a hypothetical rendition of what monitoring activities can be done for each season yearly.

Prescribe burn schedule

Prescribed burning is a useful tool when implemented for invasive species management, however is limited by site conditions and seasonal patterns. Burning should occur through seasonal variations with yearly changes in location so to not destroy an ecosystem.

Access

Human

Although humans often appreciate the natural environment, in some situations, less access is advisable. A gradient of access would be an appropriate approach. To explain, some highly managed areas like the designed gardens at Matthaei Botanical Gardens are geared towards increased visitor populations. Due to their proximity to the gardens and the wayfinding signage contained in the natural areas along Fleming Creek, these locations also beckon human activity.

In contrast, locations like Radrick Forest and Horner-McLaughlin Woods are not as readily entered. A reasonable management decision, therefore, is to manage these locations with wildlife and plant species preservation in mind rather than recreation. Permitted forms of recreation in these areas would include activities such as hiking, bird watching, botanizing, etc., which are less intrusive to the existing natural communities. Designating these areas as “research natural areas” would elicit cautious behavior from visitors. Signs clearly displayed at trail entrances should describe appropriate behavior in words and images. In addition, trail edges should

be maintained with approximately 5” diameter logs to clearly delineate the paths. To still promote an independent experience, trails with choices as well as wider sections to permit temporary sitting or resting would offer variety. Further, some areas requiring substantial restoration efforts may need human exclusion for a period of time.

Other animal

In addition to live sightings, motion-activated camera traps at Horner-McLaughlin Woods installed in Fall 2018 document the existence of a deer population. Deer-fencing and hunting permits are two ways future management should take advantage of the high deer populations. Matthaei-Gardens should receive nuisance permits for hunters to safely reduce deer numbers. As home to a high number of wildflowers, a specific area identified as a wildflower preserve should be fenced to completely exclude deer. Deer management is also important in the forested areas at Matthaei Botanical Gardens. To encourage conservation and to restore fragmented parcels in areas like Southern Mesic Forest and Floodplain Forest, deer exclosures around delicate forbs and tree saplings would be beneficial.



Deer in Horner-McLaughlin Woods (Photo credit time-lapse/motion-activated camera setup to Rachael Kluba and Alexis Heinz)

Improvement/Infrastructure

Below is a list of guidelines and recommendations regarding trail management and human influence mitigation based on literary research using other natural areas' management plans (indexed in our references), focus group results, conversations with Matthaei-Nichols as well as site observations.

Human Influences

1. Designate Research Natural Areas that set higher standards concerning visitor behavior in and near the properties.
2. Emergency personnel should be communicated with on which trails to use in the different natural areas to access downed hikers. And evacuating options should be explored at each site to produce the quickest evacuation of hurt visitors, while impacting ecosystems the least.
3. Given that these properties are associated with the University, professors and students should have access to them for educational purposes and studies. Taking many people onto these properties at once can cause damage due to excessive trampling (especially in Radrick Fen). Therefore, large groups approved to visit these sites should be advised to spread out or break into smaller groups.
4. Designated picnic areas do not seem feasible to include in Horner-McLaughlin Woods, Mud Lake Bog, or Radrick Forest, but these areas should be monitored to reduce litter. Where feasible, post signage to promote carry in-carry out waste policies. In other cases, include a small waste bin at the entrance of natural areas if signs are present at these entrances to be checked twice a week.
5. Establish a gradient of access, identifying challenging natural areas at one side of the spectrum in comparison to safer and more accessible locations.
6. Recreation activities include: hiking, dog walking,

wildlife watching, picnicking, hunting, camping, cross-country skiing, and nature walks.

7. Given that dogs are only permitted on the paved hiking/biking trail, ecosystems surrounding this trail should be extensively monitored for negative impacts associated with dog presence and dog waste.

8. Mountain biking vastly increases erosion, so trails near the biking trail should be monitored at a greater rate due to bikers being tempted to veer off the paved trail and onto these nearby dirt/gravel trails. Educational staff, caretakers, and trained volunteer docents should lead interpretive guided walks, to encourage visitation (especially those of younger ages) to the natural areas.

9. Hunting is generally a low impact activity, when in accordance with the United States Fish and Wildlife Service and Michigan Department of Natural Resources, and should be explored as a potential option to maintain healthy deer populations.

1. Deer hunting is very controversial in Ann Arbor, so close monitoring of this activity is important as well as the expansion of education regarding the negative effects of too great of a deer population.
2. Controlling the deer population can aid in invasive species management, specifically Garlic Mustard, and encourage native vegetation.
3. Explore the possibility of bow hunting as a historic form of recreation or more aggressive culls while not including firearms on these properties.

Trails

A. Recommendations

1. Design trails to establish secure drainage and minimize erosion using coarse woody debris (CWD), rocks, etc. Employ engineering or environmental planning students to design trails and student interns to construct trails.
2. Establish signage for all marked trails.
 1. Graduated challenges for trails should be explored.
 2. Trails associated with garden areas (compared to natural areas) should remain relatively flat with a sturdy surface.
 3. Distant trails should be rustic and provide more of a challenge to hikers as well as those with adequate wheelchairs.
3. Explore the possibility of additional entrances to each site and the re-establishment of the entrance near Cherry Hill on Gale Road.
 1. New entrances should be fashioned with signage welcoming visitors, establishing rules, and offering pamphlets with trail maps. (Indicated by the red box on the map of the Matthaei Botanical Gardens.)
 2. Utilizing the entrance on Gale Road can allow for more parking for guests in addition to increased visitation.

B. Guidelines

1. Construct Americans with Disabilities Act (ADA) compliant trails and boardwalks where feasible.
2. Position trails to avoid visitors wandering into undesired areas and signage should be indicated where these undesired areas are.
3. Construct trails to minimize impacts on wildlife.
4. Ensure elimination of dangerous snags and hazardous trees over trails, especially within burned areas.

Surrounding Properties

1. Encourage appropriate municipalities to construct noise blocking features alongside the highway to protect Horner-McLaughlin Woods from excess road noise.
2. Establish a regulatory buffer surrounding the properties' natural areas in which to maintain more protective land use regulations.

Expansion Potential

The first expansion (indicated by the blue box on the map of the Matthaei Botanical Gardens) for consideration is that of the hiking/biking trail at Matthaei Botanical Garden. This trail should extend to run alongside the service road and up to Ravine Court. The Gardens should work with Ann Arbor Township on this project to build a crossing at Ravine Court to allow access to the township. This is all contingent on the University's approval, so effort should be made to educate the University on the benefits of such an extension.

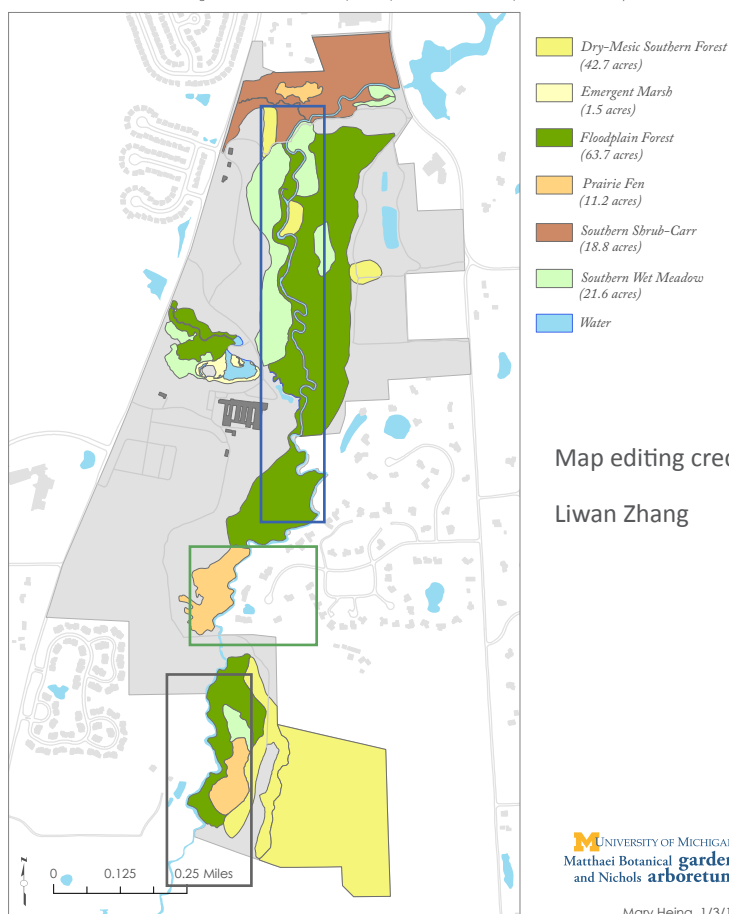
Secondly, bridges associated with Radrick Forest and Radrick Fen should be repaired to allow for trail connections and user access (indicated by the green box). One prime example is the bridge on the southern portion of this property. Currently under repair, completion of this bridge permits an extension

heading south from the trail pavilion to meet up with the service drive leading to Radrick Forest. This trail would follow Fleming Creek and be positioned outside of the deer fence, then joining the existing loop trail through the forest. Matthaei-Nichols would also be wise to acquire the open meadow tract of land north of Radrick Forest currently owned by Radrick Farms. This location has the potential for restoration to Oak Openings and would enhance the habitat diversity of the Gardens.

Thirdly, funds – currently requested in the annual budget – should be secured to rebuild the boardwalk over the manmade wetland/Parker Brook (indicated by the gray box). This allows visitation to Radrick Fen. Associated with this bridge is a similar bridge to the north, across Fleming Creek that should also undergo repair to be pedestrian-friendly.

NATURAL COMMUNITIES OF THE MATTHAEI BOTANICAL GARDENS

Plant communities classified according to the natural community descriptions established by the Michigan Natural Features Inventory (Kost et al. 2007, Natural Communities of Michigan: Classification and Description, Report Number 2007-21; <http://mrfi.ani.msu.edu/>)

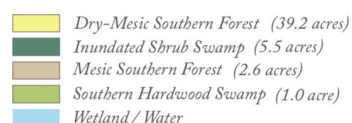
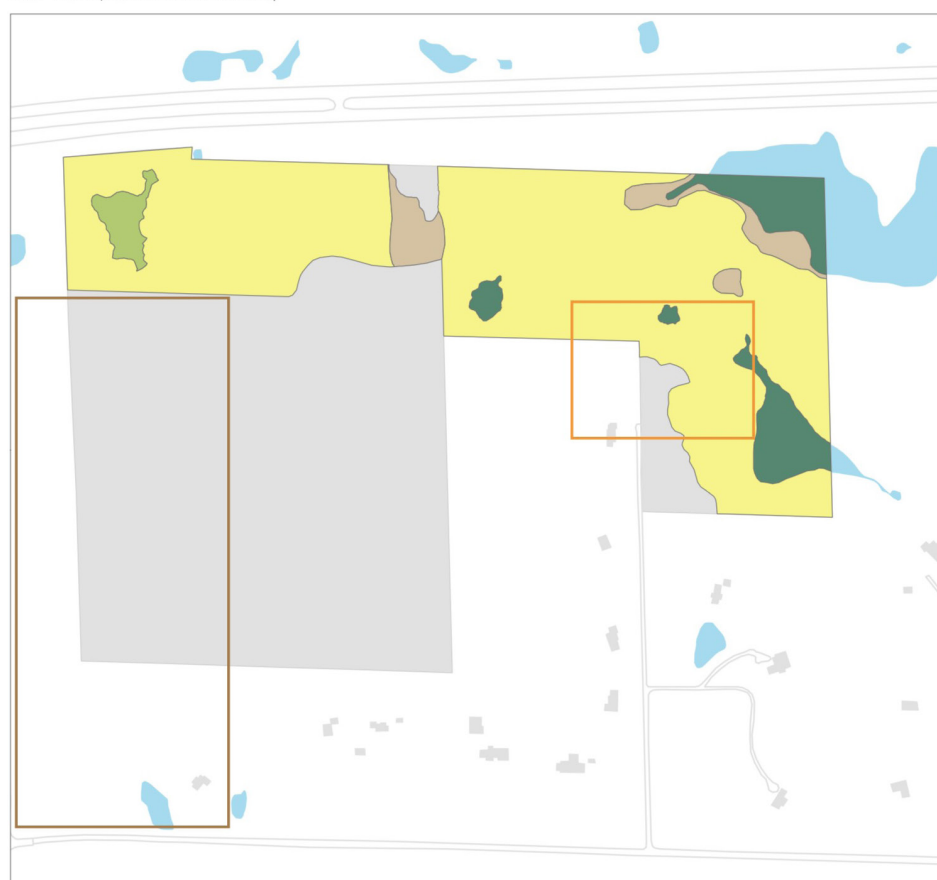


Concerning Horner-McLaughlin Woods, the mowed loop should be extended through the McLaughlin Tract (indicated by the brown box on the map of the Horner-McLaughlin Woods) to connect with the access trail of the Tom Freeman Preserve. In addition, the county natural areas program is exploring the option to purchase a portion of land extending from the boundary of the Goodrich Preserve/ Horner-McLaughlin Woods that would establish a connection to Marshall Park, south of Ford Road. This could allow visitors of the Park to extend their activities and venture into the natural areas.

In addition, research should be conducted on the feasibility of a trail rerouting the entrance trail at Wood Drive (indicated by the orange box on the map of the Horner-McLaughlin Woods) that goes through the Pelton Tract to be directed away from property lines and also diverted away from sensitive populations of wildflowers. Since this entrance is intended only for University personnel and Wood Drive residents, clearly posted signs related to the trail and parking would promote appropriate behavior.

NATURAL COMMUNITIES OF HORNER-MCCLAUGHLIN WOODS

Plant communities classified according to the natural community descriptions established by the Michigan Natural Features Inventory (Kost et al. 2007, Natural Communities of Michigan: Classification and Description, Report Number 2007-21; <http://mnfi.anr.msu.edu/>)



Mary Hejna
1/8/13

UNIVERSITY OF MICHIGAN
Matthaei Botanical gardens
and Nichols arboretum

Research

Future efforts

The intent of this project is to create something for anyone to use and for many years to come, either as a tool to develop an updated management plan, or as a reference when evaluating other natural area sites. In addition, this management plan recommends collaboration with University classes and programs to establish new ways of collecting data and exploring stewardship, such as drone fly-overs and weekly field labs. This collaboration is also meant to connect to students not already associated with work in natural areas by giving them a reason to find interest in MBGNA through engaging activities and lasting impressions.

Research overview

Natural areas create a rich opportunity for research and education to occur by allowing individuals to explore science and art in a non-classroom setting. Many projects have been conducted through the Matthaei-Nichols properties over the years providing experiences for students, staff, volunteers, and guests. These efforts range from aquaponics, population genetics, and solar dehydrator testing, to land plant phylogeny. Formally designating their natural areas as “research natural areas” similar to the USFS and Bureau of Land Management would establish the highest value on research and teaching with public access as a secondary goal. (<https://mbgna.umich.edu/education/faculty-student-research/>)

Understanding the social environment is another possible research avenue. One focus group participant stated experience managing multi-million dollar budgets for marketing with a large company. This individual suggested allotting adequate resources and personnel in order to conduct official focus groups. Due to limited resources, the focus groups conducted for this study were not as representative

as they could have been ideally. Future efforts should more persistently follow-up with stakeholders to establish thorough connections, especially with nearby residents.

Monitoring and Recordkeeping

In all areas of Matthaei Botanical Gardens and Nichols Arboretum as well as Horner-McLaughlin Woods and Mud Lake Bog, records exist for prescribed burn timing and location, (i.e. the yearly cycle of each site and the date of the next expected burn). Additional information details locations of invasive species and the methods used for removal, especially for the application of herbicides and pesticides. Planting histories and seeding dispersals are also recorded to document an accurate historical dataset for the inclusion of plants in each natural area. This is also kept in records meant for creating GIS maps and other tools so that stewards can locate a species more readily. Recording and collecting field information is part of a joint project with the Biostation, The School for Environment and Sustainability (SEAS), and the E.S. George Reserve to have a working effort of keeping spatial records of management.

Although not specifically documented, monitoring of water quality at Horner-McLaughlin Woods is advisable. Field observations resulted in the detection of a natural gas odor in winter 2018 near one of the waterways. Depending on if this location serves as drainage for surface flow or is fed by subsurface water, different management actions would develop. If the water is fed by subsurface water, possible sources of groundwater contamination need further examination. If the water is sourced from overland flow, upstream contaminant sources need

consideration and alteration. In either case, regular water monitoring would help maintain a healthy community. Based on information from local water authorities like the Huron River Watershed Council, detection levels of invertebrate communities can indicate water quality.

Photo-monitoring

Photo-monitoring is a relatively non-intrusive yet informative way to collect data on the species residing in natural communities. Overall, using

cameras that collect images on a time-lapse as well as motion-activated mode works best. Depending on the targeted species, different collection techniques may be employed. As sensitive indicator species, amphibians may be more useful to monitor than other species. Because of their stature and movement, time-lapse images set to every 15- to 30-seconds improve the likelihood of quality results (Gould et al., 2012). At this setting, batteries need changing daily. Stratifying the landscape to identify prime breeding locations enhances the success of data collection. Birds and small mammals are also well documented from photo-monitoring. In particular, images of small mammals are compelling as a marketing tool.



Citizen Photo Monitoring ,Land Conservancy of West Michigan



Ambystoma texanum (Smallmouth Salamander)
(Photo credit biokids UMich)



Clonophis kirtlandii (Kirtland's Snake) (Photo credit Michigan Natural Features Inventory)

Survey Species

Current data includes deer surveys, eBird and iNaturalist information as well as extensive plant surveys. Additional research could cover topics such as amphibians, reptiles, snails, birds, mammals (e.g. bats), and arthropods (e.g. native bees).

Rare Amphibians

Amphibians are often useful as indicator species because of their sensitivity to environmental conditions as well as their need for both aquatic and terrestrial habitats (Landscape Stewardship Plan, 2017). *Ambystoma texanum* (Smallmouth Salamander) is present in Washtenaw County. Surveying for this species in the Inundated Shrub Swamp, Mesic Southern Forest, and Southern Hardwood Swamp at Horner-McLaughlin Woods as well as the Floodplain Forest and Southern Wet Meadow at Matthaei Botanical Gardens has strong potential for indicator purposes. Although not present in Washtenaw County, *Ambystoma opacum* (Marbled Salamander), should also be surveyed for.

Rare Reptiles

Two reptile species currently in Washtenaw County are *Clonophis kirtlandii* (Kirtland's Snake) (Southern Hardwood Swamp at Horner-McLaughlin Woods; Floodplain Forest, Prairie Fen, Southern Wet Meadow, and Oak Opening at Matthaei Botanical Garden) and *Emydoidea blandingii* (Blanding's Turtle) (all communities at Horner-McLaughlin Woods; Emergent Marsh, Floodplain Forest, Prairie Fen, and Southern Wet Meadow at Matthaei Botanical Gardens). *Emydoidea blandingii* (Blanding's Turtle) already exhibits a small population at Matthaei Botanical Garden. Individuals have looked for *Clonophis kirtlandii* (Kirtland's Snake) at Matthaei Botanical Gardens previously, but none have been found. Of the three potentially surveyed reptile species, one species, *Nerodia erythrogaster neglecta* (Copperbelly Water Snake), currently not in Washtenaw County has the potential to be based on habitat requirements. Copperbelly Water Snake could live in all four natural communities at Horner-

McLaughlin Woods and half of those at Matthaei Botanical Gardens (Dry-Mesic Southern Forest, Floodplain Forest, and Southern Wet Meadow). For this reason, surveying for Copperbelly Water Snake would likely have higher success rates than Kirtland's Snake.

Rare Snails

Four species of rare snails have been documented in Washtenaw County. *Mesomphix cupreus* (Copper Button) has the potential to reside in the Dry-Mesic Southern Forest at Horner-McLaughlin Woods. *Anguispira kochi* (Banded Globe), *Discus patulus* (Domed Disc), and *Pomatiopsis cincinnatiensis* could live in the Floodplain Forest at Matthaei Botanical Garden.

Rare Birds

Bird surveys are used as a measure of environmental health in the European Union (Snall et al., 2011). Four species of rare birds occur in Washtenaw County. *Buteo lineatus* (Red-shouldered Hawk) and *Protonotaria citrea* (Prothonotary Warbler) have the potential to reside in the Mesic Southern Forest and Southern Hardwood Swamp at Horner-McLaughlin Woods plus the Floodplain Forest at Matthaei Botanical Garden. *Haliaeetus leucocephalus* (Bald Eagle) and *Pandion haliaetus* (Osprey) could occupy the Southern Hardwood Swamp at Horner-McLaughlin Woods. This natural community only covers 1-acre. Expanding the habitat would encourage these species.

Rare Mammals

Two rare mammal species have been documented in Washtenaw County, *Microtus pinetorum* (Woodland Vole) and *Myotis sodalis* (Indiana Bat). The prior has potential to reside in the Mesic Southern Forest at Horner-McLaughlin Woods, while the latter could live at the same property in the Southern Hardwood Swamp or at Matthaei Botanical Gardens in the Floodplain Forest.



Mesomphix cupreus (Copper Button) (Photo credit Carnegie Museum of Natural History)

Myotis sodalis (Indiana Bat) (Photo credit Animal Diversity Web)



Microtus pinetorum (Woodland Vole) (Photo credit biokids UMich)





Corydalis flavula (Pale Crested Lark) (Photo credit Missouri Plants)

Euphorbia commutata (Tinted Spurge)
(Photo credit wildflower.org and inaturalist.org)



Rare Plants

A wide variety of rare plant species (59) have the potential to exist in Washtenaw County, with 19 already doing so. This detailed list is in the table titled Appendix D_Rare Species in the column labeled Flowering Plants. Eleven species of surveyed Sedges *Carex* spp. are of concern. Only two, *Carex seorsa* (Weak Stellate Sedge) and *Carex lupuliformis* (False Hop Sedge) could exist in the Southern Hardwood Swamp at Horner-McLaughlin Woods. On this property in the Mesic-Southern Forest, *Carex oligocarpa* (Eastern Few-fruited Sedge) could also be an inhabitant. The aforementioned *C. lupuliformis* (False Hop Sedge) and *C. oligocarpa* (Eastern Few-fruited Sedge) also have the potential to live in the Floodplain Forest at Matthaei Botanical Gardens where the remaining eight Sedge species could reside. Two of these, *Carex davisii* (Davis’s Sedge) and *Carex trichocarpa* (Hairy-fruited Sedge) already exist in Washtenaw County. [See the Unique Habitats section for further discussion concerning the Southern Hardwood Swamp and Floodplain Forest.]

Although currently not found in Washtenaw County, several additional plant species from the surveyed rare species list beckon interest based on different qualities. *Lysimachia hybrida* (Swamp Candles) (Southern Hardwood Swamp) and *Mimulus alatus* (Winged Monkey Flower) (Emergent Marsh, Southern Wet Meadow) are visually attractive species that have the ability to form colonies from rhizomatous growth. *Mertensia virginica* (Virginia Bluebells) (Floodplain Forest) is an early-flowering wildflower. *Scutellaria nervosa* and *S. ovata* (Floodplain Forest) have medicinal value on top of an appealing flower.

Oak Openings currently have a global imperiled status, so rare species with the potential to inhabit this type of natural community invite special attention. *Camassia scilloides* (Wild Hyacinth) (Oak Opening, Floodplain Forest) has aesthetic appeal due to its role as a spring bulb. *Corydalis flavula* (Yellow Fumewort) (Floodplain Forest, Oak Opening) has aesthetically attractive flowers, foliage, and seed pods. *Euphorbia*

commutata (Tinted Spurge) (Mesic Southern Forest, Oak Opening) has unique foliage. *Lactuca floridana* (Woodland Lettuce) (Oak Opening), although considered a somewhat weedy annual/biennial, still has potential as a foliage plant.

The following species already exist in Washtenaw County. *Chelone oblique* (Purple Turtlehead) (Floodplain Forest) has aesthetic appeal. *Euonymus atropurpureus* Wahoo (Floodplain Forest) is unique as a shrub species. *Galearis spectabilis* (Showy Orchid) (Mesic Southern Forest, Southern Hardwood Forest, Floodplain Forest) has interest as an orchid. *Hybanthus concolor* (Green Violet) (Mesic Southern Forest, Southern Hardwood Forest, Floodplain Forest) is an indicator of high quality woodland and a seed food source. *Justicia americana* (Water Willow) (Emergent Marsh, Floodplain Forest) attracts pollinators and feeds muskrats. *Lithospermum latifolium* (Broad-leaved Puccoon) (Floodplain Forest) has coarse-veined foliage and hairy stems that appear silver. *Morus rubra* (Red Mulberry) (Floodplain Forest) provides fruit for birds on dioecious plants. *Polemonium reptans* (Jacob's Ladder) (Floodplain Forest, Prairie Fen) welcomes pollinators, and the reaching form provides structural understory for small mammals. *Silphium perfoliatum* (Cup Plant) (Floodplain Forest) collects water in the leaf axils, is useful for pollinators, and has a strong presence due to its large form. *Trillium sessile* (Toadshade) (Mesic Southern Forest, Floodplain Forest) is an aesthetically attractive early wildflower. *Viburnum prunifolium* (Black Haw) (Dry-Mesic Southern Forest, Mesic Southern Forest, Southern Hardwood Swamp, Floodplain Forest) has persistent berries edible to birds and wildlife.

Aside from these possible introductions, one surveyed fern species, *Dryopteris celsa* (Small Log Fern), has the potential to exist in Washtenaw County in the Southern Hardwood Swamp at Horner-McLaughlin Woods or the Floodplain Forest at Matthaei Botanical Gardens.



Silphium perfoliatum (Cup Plant) (Photo credit Go Botany - New England Wildflower Society)



Trillium sessile (Toadshade)
(Photo credit Ballyrobert Gardens)



Justicia americana (Water Willow)
(Photo credit illinoiswildflowers.info)

Reports on Stewardship Activities

Work day report summaries

The Stewardship Activities Record should be completed after each stewardship activity. It should include the following information:

- Location
- Start and end time
- Weather condition
- Manager/Leader
- Volunteer name and contact info
- Tasks
- Tools and supplies
- After work survey

After each activity, the report should be submitted to the staff in digital format.

Reports on items under “III. Management Issues”

Monitoring should be conducted regularly on the natural areas, either by volunteers or visitors. Visitors and volunteers can report their monitoring in paper or digital format.

Objects to be monitored including:

1. Rare species
2. Wildlife
3. Infrastructure, including trails, signs, parking, fence, gate, bridges, boardwalks, and observation platforms, etc.
4. Invasive species
5. Human impacts

Future/Adjusted plans and estimated dates

Flexible stewardship activities

- Monitoring (Flexible, Various locations)

Volunteers will be asked to monitor and take pictures of infrastructure condition, species change, and any human impact of a location, designated according to the volunteer’s preference. The time of the photo-monitoring is flexible.

- Photography (Flexible, Various locations)

Photography volunteers capture high resolution images of people, plants, and events for use in the publications, website, marketing materials, and special projects.

- Restoration, Trails, and Trees (Weekdays, AM/PM, Arboretum and Gardens)

This activity allows volunteers to conduct litter picking, hand weeding, and invasive species removal on the natural areas and trails according to the volunteer’s preference and convenience.

Weekly

- Native Plant Gardens and Seeds (Various locations, AM and PM)

This event should be scheduled both on weekdays and weekends to meet the availability of different groups of people. Weekday events will allow student groups to participate during classes with the leadership of caretaker(s).

Monthly

- Eco-restoration Workdays (2nd Saturdays at the Arboretum and 3rd Saturdays at the Gardens)

This event can be held more frequently and in smaller groups. Ideally, options on weekdays should be offered.

Annually

- Prescribed Burn Crew (Fall and Spring, weekday afternoon, Arboretum and Gardens)

For several natural communities with fire sensitive plants, prescribed burning will occur less frequently.

Funding

Members provide critical support for Matthaei-Nichols, with roughly one-third of the financial support acquired through gifts and donations, and the remaining two-thirds from the University. Combined with the University support, Donor gifts allow the Gardens and Arboretum to continue their mission by providing free, open, and beautiful places, Gardens collections, and internships, and research opportunities.

Initial Budget Needs

Salary, expendable supplies, capital equipment

1. Implementation/restoration
2. Improvements and/or infrastructure
3. Volunteer help

Matthaei Botanical Gardens 2018 Natural Areas Stewardship Budget

Salary (1 FTE)	45,000.00			
Benefits	22,500			
Summer Interns (3 X \$8,000)	24,000			
Equipment and Supplies	5,000			
*Indirect costs (10%)	9,650			
Volunteer hours \$24.14/hours	17,380.80	24 ecoworkdays X 10 volunteers per workday X 3 hours X \$24.14/hour		
Grand total approximate annual cost/value	123,530.80			
<i>* Indirect costs include UM facilities, vehicles, tools, fuel and other staff support that is not an exclusive expense for Natural Areas Management</i>				
% Time spent on each property				
Property	Matthaei	Arboretum	Horner-McLaughlin	Mud Lake Bog
Percent Time	45%	40%	10%	5%
Annual Grand Total \$	123,530.80	123,530.80	123,530.80	123,530.80
Annual Property Total \$	55,588.86	49,412.32	12,353.08	6,176.54

Conclusion

Many of the recommendations offered in this plan fall along a spectrum of actions. At one end of the axis are conservation and preservation actions. These concern activities to encourage desirable species populations. Closer to the other side are actions related to management, often dealing with invasive species. Invasive species, ecologically, are pioneer species. They respond to a disturbance. Rather than continuing to mitigate the symptoms of the problem, efforts would more wisely succeed if they focused on the source of the problem.

Current practices that change the landscape are often relatively disruptive. Decreasing the amount of disturbance and performing construction in a sustainable and sensitive manner would limit the amount of disturbance. A consequence would be a reduction in invasive species populations as well. This sort of solution requires collaboration from universities, community members, and municipalities.

In either case, natural areas are a positive resource for both human and wild communities. Through intelligent management choices and sensible action, these properties will continue to experience protection and support.

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Appendices

Floristic Quality Index:

Matthaei Botanical Gardens and Nichols Arboretum Natural Areas

Summary of FQI Data by Site

Compiled by Bev Walters, 2011-2012

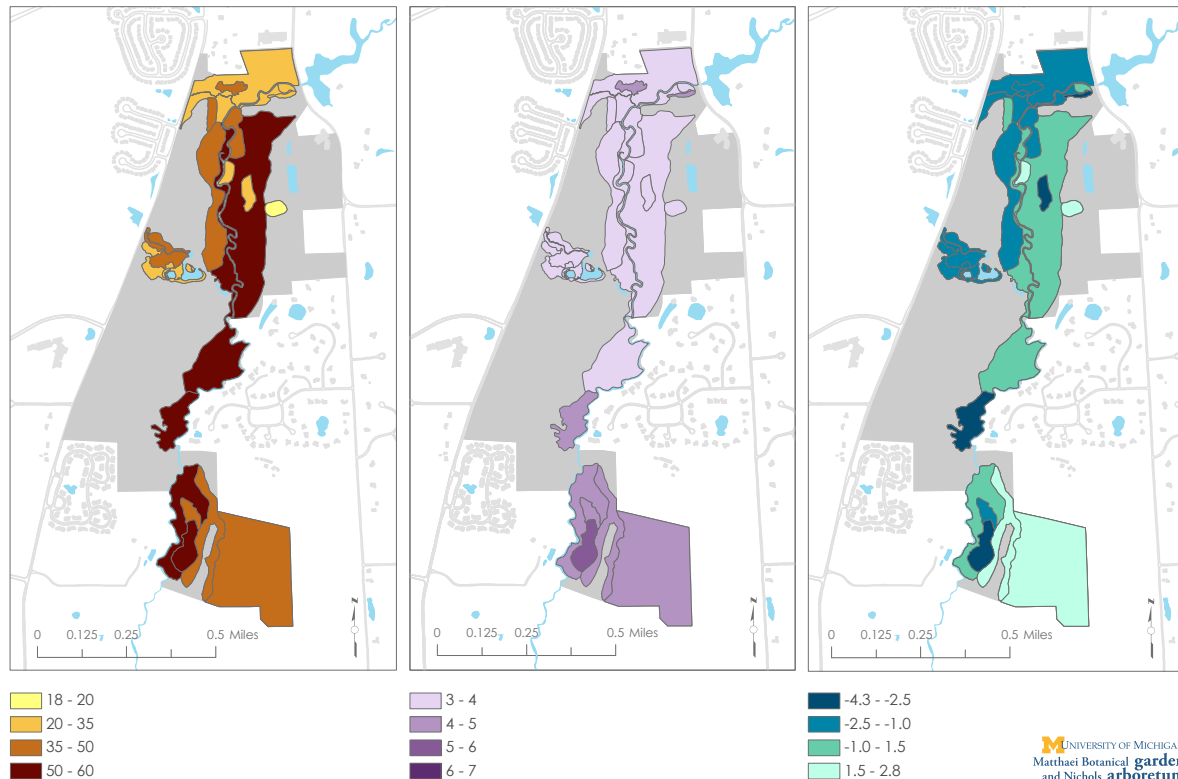
	TOTAL SPECIES	NATIVE FQI	FQI W/Adventives	% NATIVE	NATIVE MEAN C	NATIVE MEAN W
Horner-McLaughlin Woods	346	69.92	64.67	85.5	4.06	0.1
Matthaei Botanical Gardens	596	105.27	95.65	82.6	4.75	-0.4
Mud Lake Bog	420	91.06	85.93	89.0	4.71	-1.4
Nichols Arboretum	477	82.81	73.03	77.8	4.30	0.8

Matthaei Botanical Gardens: Floristic Quality Assessment Excluding Adventive Species

Floristic Quality Index

Mean Coefficient of Conservatism

Mean Coefficient of Wetness



Matthaei Botanical Gardens and Nichols Arboretum Natural Areas

Summary of FQI Data by Plant Community

Compiled by Bev Walters, 2011-2012

	TOTAL SPECIES	NATIVE FQI	FQI W/Adventives	% NATIVE	NATIVE MEAN C	NATIVE MEAN W
Bog						
MLB - Bog North	71	50.20	49.49	97.2	6.04	-4.3
MLB - Bog South	76	47.64	46.69	96.1	5.58	-3.9
Dry-mesic Prairie						
NA - Alex Dow Field - Prairie	155	35.18	28.67	66.5	3.47	2.4
NA - North Floodplain Prairie Remnant	58	19.23	15.36	63.8	3.16	2.5
Dry-mesic Southern Forest						
HM - Oak Woodlands	177	50.46	46.45	84.7	4.12	1.7
MBG - Clements-Osgood Woods - Oak Opening	60	26.99	24.14	80.0	3.90	1.6
MBG - Kirk Woods	145	39.82	36.37	83.4	3.62	0.8
MBG - Radrick Forest	98	41.84	39.19	87.8	4.51	2.8
MBG - Radrick Forest West	134	46.52	43.28	86.6	4.32	2.6
MBG - Sanford Woods	38	18.76	16.38	76.3	3.48	2.1
MLB - Big Oak Island	100	36.69	35.00	91.0	3.85	1.3
MLB - Horseshoe Island	76	30.61	27.64	81.6	3.89	0.9
MLB - Juniper Hill	61	24.43	21.89	80.3	3.49	1.4
MLB - Little Oak Island	47	22.14	19.11	74.5	3.74	1.9
MLB - North Island	62	26.19	23.75	82.3	3.67	1.7
MLB - Oak Woods SE	74	25.47	22.55	78.4	3.34	2.0
MLB - Oak-Hickory North	137	38.33	34.35	80.3	3.65	1.4
NA - East Oak Woodlands	194	54.75	48.46	78.4	4.44	1.9
NA - Forest Hills Woods	54	22.29	17.69	63.0	3.82	2.1
NA - Heathdale	153	47.00	41.80	79.1	4.27	1.7
NA - Maple Glen	37	22.84	20.22	78.4	4.24	2.6
NA - West Oak Woodlands	155	47.95	42.89	80.0	4.31	1.3
Emergent Marsh						
MBG - Willow Pond Marsh	76	25.47	22.25	76.3	3.34	-2.0
Floodplain Forest						
MBG - Clements-Osgood Woods	219	52.00	46.22	79.0	3.95	-0.8
MBG - Parker Brook Floodplain	129	38.33	34.25	79.8	3.78	-2.0
MBG - Radrick Floodplain Forest	173	51.26	48.05	87.9	4.16	-0.7
NA - Forested Wetland	163	49.06	43.47	78.5	4.34	0.5
NA - South Floodplain Woods	160	45.96	42.06	83.8	3.97	0.0
Hardwood-conifer Swamp						
MLB - Hardwood-Conifer Swamp	40	31.71	31.31	97.5	5.08	-2.5

	TOTAL SPECIES	NATIVE FQI	FQI W/Adventives	% NATIVE	NATIVE MEAN C	NATIVE MEAN W
Inundated Shrub Swamp						
HM - Central Wetland	55	29.26	28.72	96.4	4.02	-2.9
HM - North Wetland	61	32.83	32.01	95.1	4.31	-4.2
HM - South Wetland	79	32.99	31.28	89.9	3.92	-3.1
HM - Southwest Wetland	48	26.08	24.97	91.7	3.93	-0.8
Mesic Southern Forest						
HM - Mesic Forest East	103	42.22	41.19	95.1	4.27	0.1
HM - Mesic Forest West	80	30.38	28.62	88.8	3.61	0.4
MLB - Swamp White Oak Woods	91	29.82	27.26	83.5	3.42	0.4
Oak Openings						
NA - Alex Dow Field - Savanna	121	36.68	31.64	74.4	3.87	2.6
Poor Conifer Swamp						
MLB - Black Spruce Bog	23	29.00	28.36	95.7	6.18	-2.1
Prairie Fen						
MBG - Cummings Fen	109	44.60	41.86	88.1	4.55	-2.2
MBG - Radrick Fen	125	59.48	58.76	97.6	5.39	-3.0
MBG - Radrick North Wetland	146	50.34	47.50	89.0	4.42	-2.6
MLB - Prairie Fen	110	44.21	43.19	95.5	4.31	-2.2
Rich Tamarack Swamp						
MLB - Tamarack Swamp	94	50.60	49.51	95.7	5.33	-3.6
Savanna						
NA - Magnolia Glade	82	32.62	29.04	79.3	4.05	2.8
Southern Hardwood Swamp						
HM - Northwest Wetland	52	25.84	24.82	92.3	3.73	-2.5
MLB - Hardwood Swamp	126	48.82	47.84	96.0	4.44	-2.8
Southern Shrub-carr						
MBG - Kirk-Cummings-Sinclair Complex	100	32.87	29.40	80.0	3.68	-1.3
MLB - Shrub-carr	51	32.81	32.49	98.0	4.64	-3.0
Southern Wet Meadow						
MBG - Clements-Osgood Woods - Tamarack Swa	129	41.19	38.21	86.0	3.91	-2.2
MBG - Clements-Osgood Woods - Wet Meadow A	75	30.30	28.64	89.3	3.70	-3.0
MBG - Clements-Osgood Woods - Wet Meadow B	127	41.47	38.42	85.8	3.97	-1.9
MBG - Parker Brook Wet Meadow	62	28.28	25.40	80.6	4.00	-2.1
MBG - Radrick Wet Meadow	90	38.68	36.47	88.9	4.33	-2.2
MBG - Sinclair Meadow North	73	22.66	19.31	72.6	3.11	-0.5
MBG - Sinclair Meadow South	62	32.12	29.97	87.1	4.37	-3.8
MLB - Wet Meadow	133	49.71	48.38	94.7	4.43	-3.2
NA - North Floodplain Swale	110	34.91	31.75	82.7	3.66	-3.1

LAND COVER TYPES OF THE MATTHAEI BOTANICAL GARDENS



Mary Hujala: January 2013

LAND COVER TYPES OF HORNER-MCLAUGHLIN WOODS



UNIVERSITY OF MICHIGAN
Manitowish Botanical gardens
and Nichols arboretum
Mary Hejira | January 2013

- Coniferous Forest (0.8 acres)
- Forested Wetland (0.6 acres)
- Herbaceous Forest (41.1 acres)
- Scrubland (52.7 acres)
- Wetlands outside property
- Wetland Scrub (5.4 acres)



Matthaei Botanical Gardens: Areas of Soil Disturbance

Property Boundary Soil Disturbance

UNIVERSITY OF MICHIGAN
Matthaei Botanical Gardens
and Nichols Arboretum
May 2016

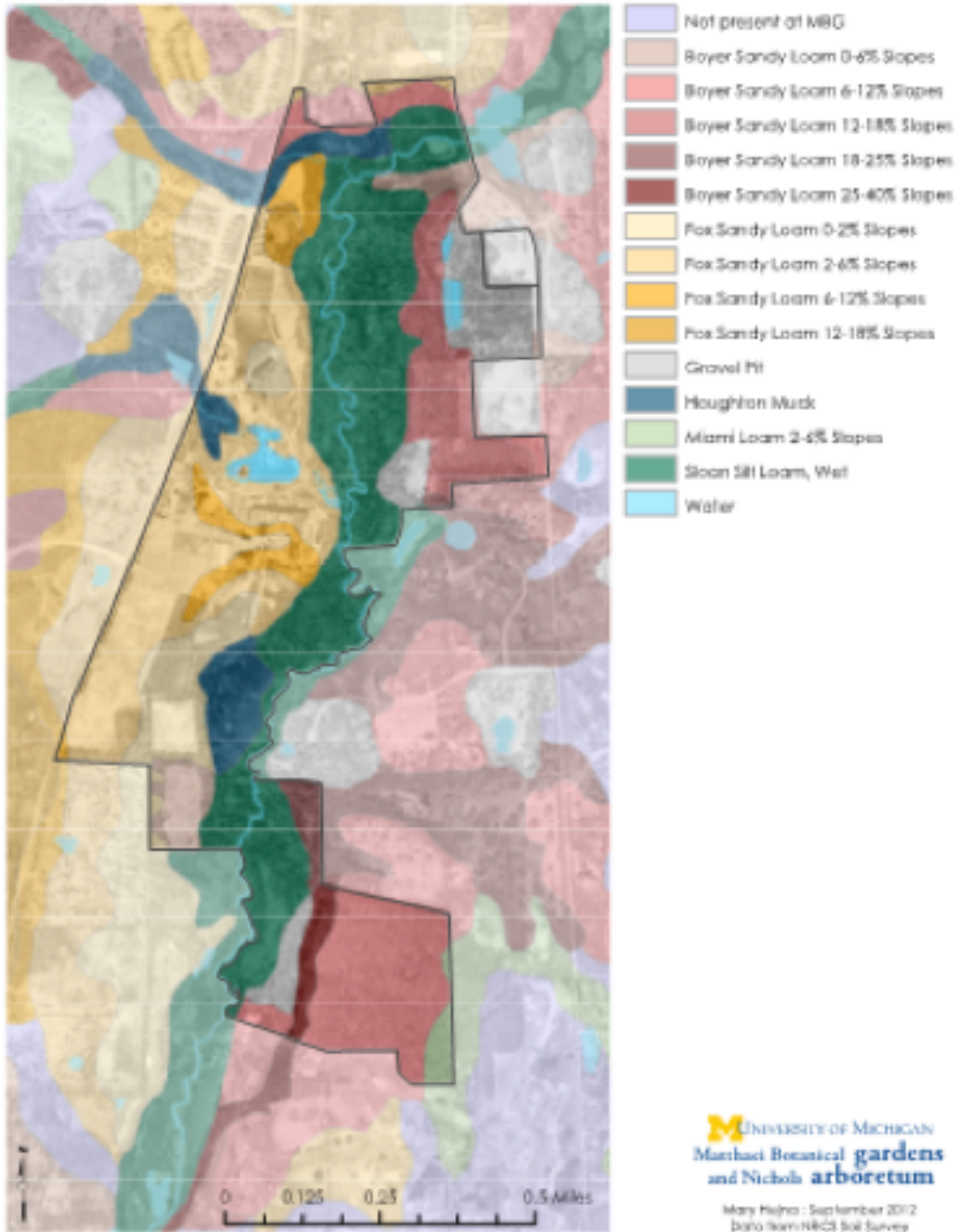


Horner-McLaughlin Woods: Areas of Soil Disturbance

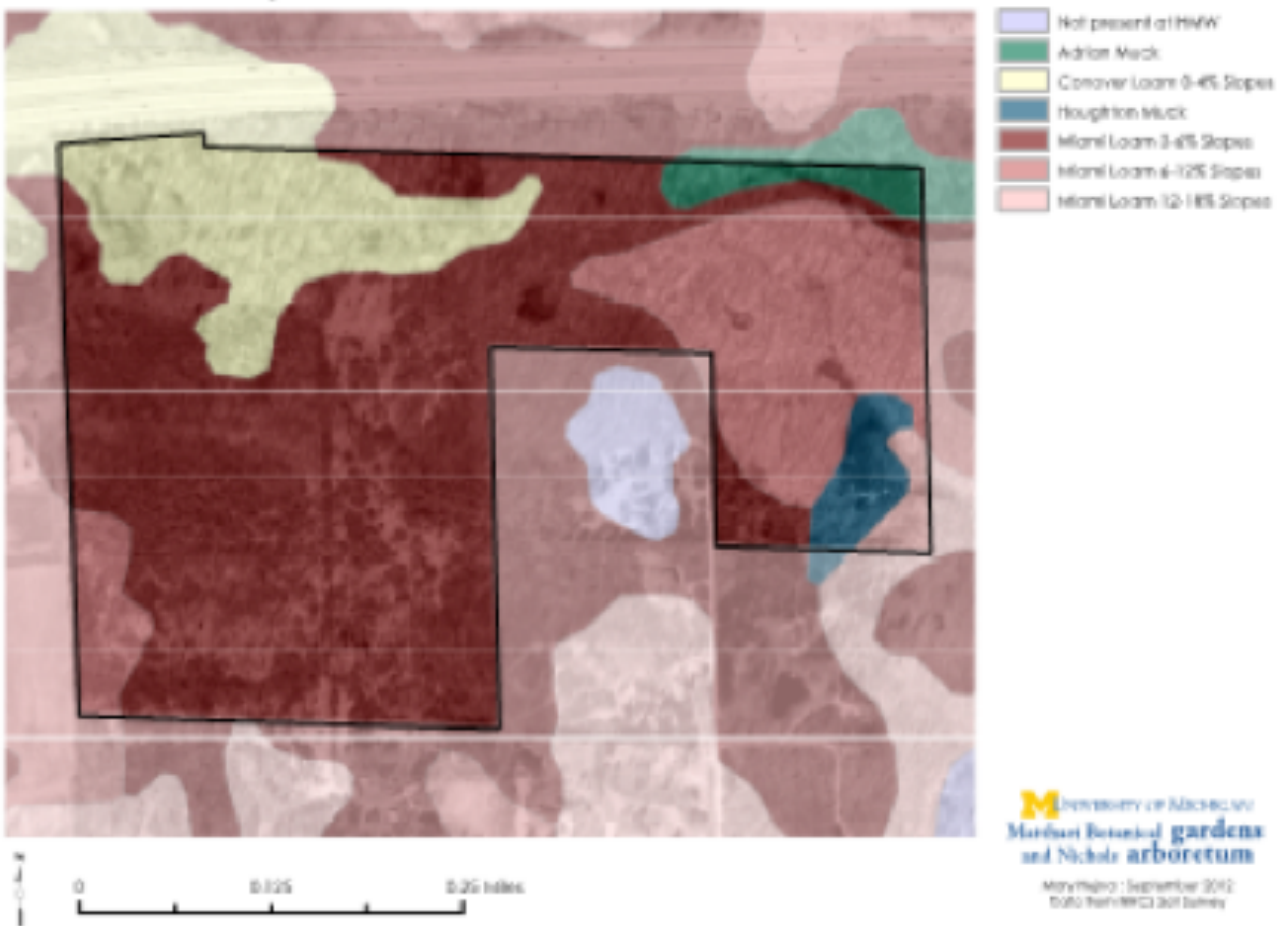
Property Boundary Soil Disturbance

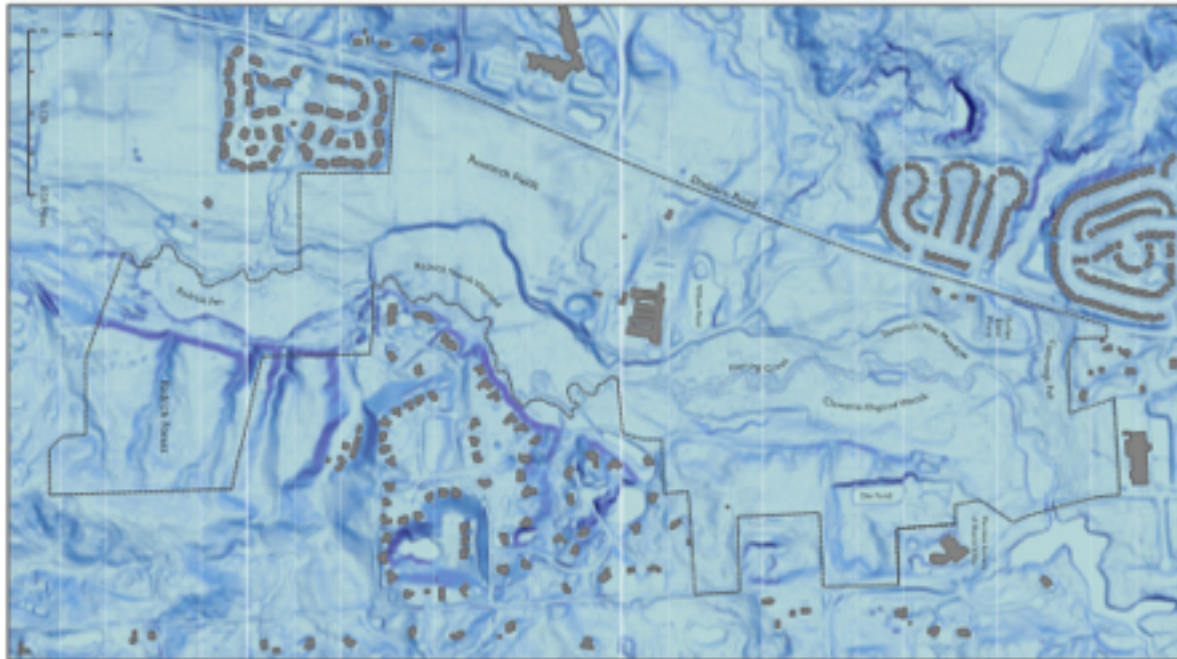
UNIVERSITY OF MICHIGAN
Matthaei Botanical Gardens
and Nichols Arboretum
May 2016

Matthaei Botanical Gardens: Soil Types



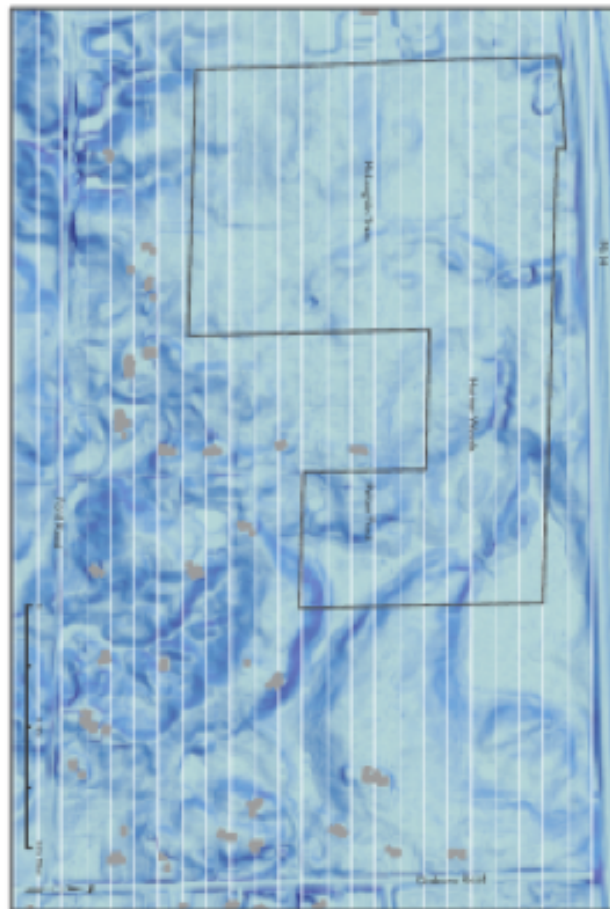
Horner-McLaughlin Woods: Soil Types





Terrain of the Matthaei Botanical Gardens

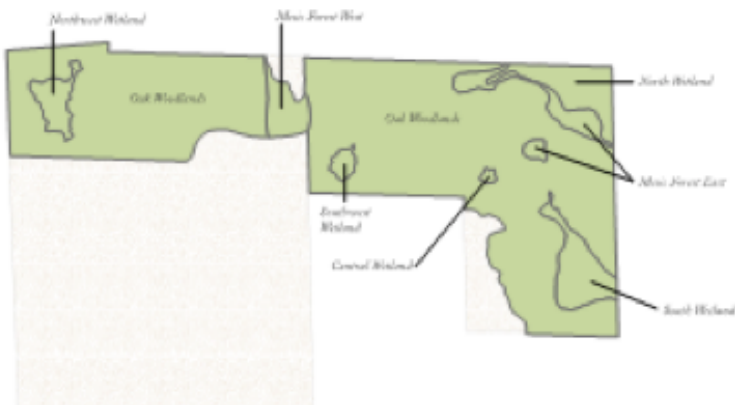
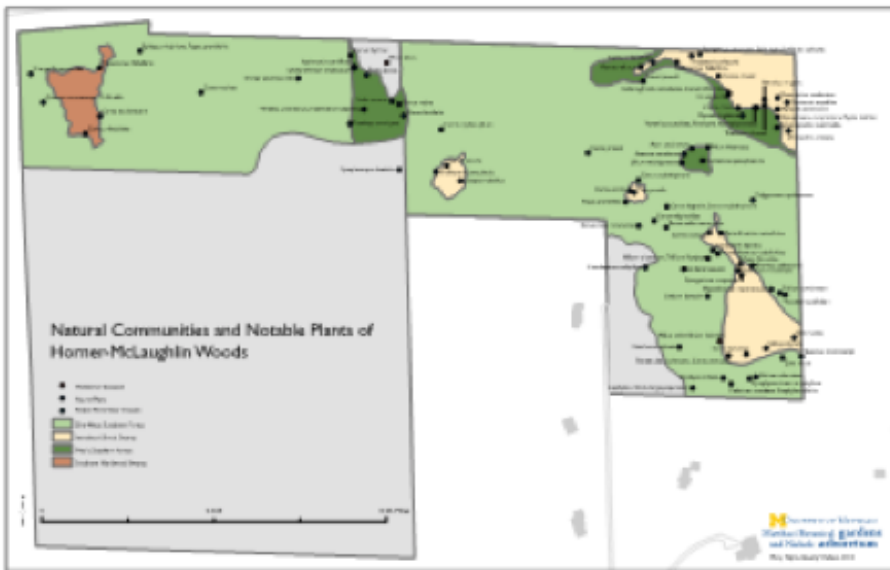
Hillshade (80% transparency) overlaid on slope analysis (blue gradient) | Play Home | February 2013



Terrain of Horner-McLaughlin Woods

Hillshade (80% transparency) overlaid on slope analysis (blue gradient) | Play Home | February 2013





Horner-McLaughlin Woods and the Goodrich Preserve

Trails University Property Boundary

0 4.125 8.25 Miles



Invasive Species Inventory - Nichols Arboretum

Summer 2005

Revised 2018 (Draft)

This invasive species inventory works as a part of the management files for MBGNA, aims to better track and profile the invasive species change in the property. The inventory is done by _____, using _____ method, and will be update every __ years.

In the same collection:

Invasive Species Inventory – Matthaei Botanical Garden;

Invasive Species Inventory – Horner-McLaughlin Woods;

Invasive Species Inventory - Nichols Arboretum

Summer 2005

Revised 2018 (Draft)

INVASIVE SPECIES LIST

Trees

Amur Cork Tree; *Phellodendron amurense*

Amur Maple; *Acer ginnala*

Black Alder; *Alnus glutinosa*

*Black Locust; *Robinia pseudoacacia*

Castor Aralia; *Kalopanax septemlobus*

European White Poplar; *Populus alba*

Japanese Angelica Tree; *Aralia elata*

Japanese Tree Lilac; *Syringa reticulata*

Katsura Tree; *Ceridiphyllum japonicum*

Norway Maple; *Acer platanoides*

Siberian elm; *Ulmus pumila*

Tree of Heaven; *Ailanthus altissima*

*Red Bud; *Cercis canadensis*

White Mulberry; *Morus alba*

*Yellow Buckeye; *Aesculus flava*

*Yellow-wood; *Rladrastis kentuckea*

Sweet Cherry; *Prunus avium*

Shrubs

Common Buckthorn; *Rhamnus cathartica* *

Glossy Buckthorn; *Rhamnus frangula*

Bush Honeysuckle; *Lonicera* spp *

Common Privet; *Ligustrum vulgare*

Winged Wahoo; *Euonymus alatus*

Spindle tree; *Euonymus europaea*

Japanese Barberry; *Berberis thunbergii*

Autumn Olive; *Elaeagnus umbellata*

Jet bead; *Rhodotypos scandens*

Multiflora rose; *Rosa multiflora*

Vines

Bittersweet Nightshade; *Solanum dulcamara*

Climbing Euonymus; *Euonymus fortunei*

English Ivy; *Hedera helix* L.

Japanese Honeysuckle; *Lonicera japonica*

Oriental Bittersweet; *Celastrus orbiculatus*

Pachysandra; *Pachysandra terminalis*

Common Periwinkle; *Vinca minor* L.

Field Bindweed; *Convolvulus arvensis*

Five-leaf Akebia; *Akebia quinata*

Invasive Species Inventory - Nichols Arboretum

Summer 2005

Revised 2018 (Draft)

Herbaceous Plants

Bull Thistle; *Cirsium vulgare*

Butter-and-eggs; *Linaria vulgaris*

Canada Thistle; *Cirsium arvense*

Celandine; *Chelidonium majus* (Biennial/Dicot)

Common Burdock; *Arctium minus* (Biennial/Dicot)

Creeping Bellflower; *Campanula rapunculoides*

Creeping Charlie; *Glechoma hederacea*

Creeping Jenny / moneywort; *Lysimachia nummularia*

Crown-vetch; *Coronilla varia*

Curly Dock; *Rumex crispus* L.

Dame's Rocket; *Hesperis matronalis* * (Biennial, Perennial/Dicot)

Garlic Mustard; *Alliaria petiolata* *(Annual, Biennial/Dicot)

Avens; *Geum urbanum* (Perennial/Dicot)

Japanese Knotweed, Mexican Bamboo; *Polygonum cuspidatum* (Perennial/Dicot)

European Lilly of the Valley; *Convallaria majalis* (Perennial, Monocot)

Common St. John's-wort; *Hypericum perforatum*

Motherwort; *Leonurus cardiaca*

Mock Strawberry; *Duchesnea indica*

Narrow leaf bitter cress; *Cardamine impatiens* (Annual, Biennial/Dicot)

Orchard Grass; *Dactylis glomerata*

Purple Loosestrife; *Lythrum salicaria*

Quack Grass; *Elytiglia repens*

Queen Anne's Lace; *Daucus carota*

Reed Canary Grass; *Phalaris arundinacea*

Spotted Knapweed; *Centaurea maculosa* (Biennial, Perennial/Dicot - Forb)

White Sweet Clover; *Melilotus alba*

Yellow Sweet Clover; *Melilotus officinalis*

Rare Species Lists

Dry-Mesic Southern Forest

Rare Plants

1. *Agrimonia rostellata* (beaked agrimony, state special concern)
2. *Arabis missouriensis* var. *deamii* (Missouri rock-cress, state special concern)
3. *Aristolochia serpentaria* (Virginia snakeroot, state threatened)
4. *Baptisia leucophaea* (cream wild indigo, state endangered)
5. *Castanea dentata* (American chestnut, state endangered)
6. *Dennstaedtia punctilobula* (hay-scented fern, state threatened)
7. *Eupatorium sessilifolium* (upland boneset, state threatened)
8. *Geum virginianum* (pale avens, state special concern)
9. *Houstonia caerulea* (bluets, state special concern)
10. *Linum virginianum* (Virginia flax, state threatened)
11. *Liparis liliifolia* (purple twayblade, state special concern)
12. *Quercus shumardii* (Shumard's oak, state special concern)
13. *Scutellaria elliptica* (hairy skullcap, state special concern)
14. *Silene stellata* (starry campion, state threatened)
15. *Silene virginica* (fire pink, state threatened)
16. *Triphora trianthophora* (three-birds orchid, state threatened)
17. *Viburnum prunifolium* (black haw, state special concern)

Rare Animals

1. *Accipiter cooperii* (Cooper's hawk, state special concern)
2. *Ambystoma opacum* (marbled salamander, state threatened)
3. *Anguispira kochi* (banded globe, state special concern)
4. *Battus philenor* (pipevine swallowtail, state special concern)
5. *Buteo lineatus* (red-shouldered hawk, state threatened)
6. *Catocala dulciola* (quiet underwing, state special concern)
7. *Catocala robinsoni* (Robinson's underwing, state special concern)
8. *Dendroica cerulea* (cerulean warbler, state special concern)
9. *Elaphe o. obsoleta* (black rat snake, state special concern)
10. *Emydoidea blandingii* (Blanding's turtle, state special concern)
11. *Erynnis baptisiae* (wild indigo duskywing, state special concern)
12. *Fixsenia favonius ontario* (northern hairstreak, state special concern)
13. *Mesomphix cupreus* (copper button, state special concern)
14. *Microtus pinetorum* (woodland vole, state special concern)
15. *Neoconocephalus retusus* (conehead grasshopper, state special concern)
16. *Nerodia erythrogaster neglecta* (copperbelly water snake, federal threatened and state endangered)
17. *Nicrophorus americanus* (American burying beetle, federal/state endangered)
18. *Oecanthus pini* (pinetree cricket, federal/state endangered)
19. *Papaipema cerina* (golden borer, state special concern)
20. *Pygarctia spraguei* (Sprague's pygarctia, state special concern)
21. *Sistrurus c. catenatus* (eastern massasauga, federal candidate species and state special concern)
22. *Terrapene c. carolina* (eastern box turtle, state special concern)
23. *Vallonia albula* (land snail, state special concern)
24. *Wilsonia citrina* (hooded warbler, state special concern)
25. *Xolotrema denotata* (velvet wedge, state special concern)

Inundated Shrub Swamp

Rare Plants

1. *Wolffia papulifera* (water-meal, state threatened)

Rare Animals

1. *Acris crepitans blanchardi* (Blanchard's cricket frog, state special concern)
2. *Ambystoma texanum* (smallmouth salamander, state endangered)
3. *Clemmys guttata* (spotted turtle, state threatened)

4. *Emydoidea blandingii* (Blanding's turtle, state special concern)
5. *Heteropacha rileyana* (Riley's lappet moth, state special concern)
6. *Heterocampa subrotata* (small heterocampa, state special concern)
7. *Nerodia erythrogaster neglecta* (copperbelly water snake, federal threatened and state endangered)
8. *Nycticorax nycticorax* (black-crowned night-heron, state special concern)
9. *Papaipema speciosissima* (regal fern borer, state special concern)
10. *Terrapene c. carolina* (eastern box turtle, state special concern)
11. *Williamsonia fletcheri* (ebony boghaunter, state special concern)

Mesic Southern Forest

Rare Plants

1. *Adlumia fungosa* (climbing fumitory, state special concern)
2. *Aristolochia serpentaria* (Virginia snakeroot, state threatened)
3. *Carex oligocarpa* (eastern few-fruited sedge, state threatened)
4. *Carex platyphylla* (broad-leaved sedge, state threatened)
5. *Castanea dentata* (American chestnut, state endangered)
6. *Dentaria maxima* (large toothwort, state threatened)
7. *Euphorbia commutata* (tinted spurge, state threatened)
8. *Galearis spectabilis* (showy orchis, state threatened)
9. *Gentianella quinquefolia* (stiff gentian, state threatened)
10. *Hybanthus concolor* (green violet, state special concern)
11. *Hydrastis canadensis* (goldenseal, state threatened)
12. *Jeffersonia diphylla* (twinleaf, state special concern)
13. *Liparis liliifolia* (purple twayblade, state special concern)
14. *Ophioglossum vulgatum* (southeastern adder's tongue, state threatened)
15. *Panax quinquefolius* (ginseng, state threatened)
16. *Polymnia uvedalia* (large-flowered buttercup, state threatened)
17. *Ruellia strepens* (smooth ruellia, state threatened)
18. *Scutellaria elliptica* (hairy skullcap, state special concern)
19. *Scutellaria ovata* (heart-leaved skullcap, state threatened)
20. *Smilax herbacea* (smooth carrion-flower, state special concern)
21. *Tipularia discolor* (crane-fly orchid, state threatened)
22. *Trillium recurvatum* (prairie trillium, state threatened)
23. *Trillium sessile* (sessile trillium, state threatened)
24. *Triphora trianthophora* (three-birds orchid, state threatened)
25. *Viburnum prunifolium* (black haw, state special concern)
26. *Vitis vulpina* (frost grape, state threatened).

Rare Animals

1. *Accipiter cooperii* (Cooper's hawk, state special concern)
2. *Accipiter gentilis* (northern goshawk, state special concern)
3. *Ambystoma opacum* (marbled salamander, state threatened)
4. *Ambystoma texanum* (small-mouthed salamander, state endangered)
5. *Buteo lineatus* (red-shouldered hawk, state threatened)
6. *Dendroica cerulea* (cerulean warbler, state special concern)
7. *Dryobius sexnotatus* (six-banded longhorn beetle, state special concern)
8. *Elaphe o. obsoleta* (black rat snake, state special concern)
9. *Emydoidea blandingii* (Blanding's turtle, state special concern)
10. *Microtus pinetorum* (woodland vole, state special concern)
11. *Nerodia erythrogaster neglecta* (copperbelly water snake, federal threatened and state endangered)
12. *Nicrophorus americanus* (American burying beetle, federal/state endangered)
13. *Protonotaria citrea* (prothonotary warbler, state special concern)
14. *Seiurus motacilla* (Louisiana waterthrush, state special concern)
15. *Terrapene c. carolina* (eastern box turtle, state special concern)
16. *Wilsonia citrina* (hooded warbler, state special concern)

Southern Hardwood Swamp

Rare Plants

1. *Betula murrayana* (Murray birch, state special concern)
2. *Carex lupuliformis* (false hop sedge, state threatened)
3. *Carex seorsa* (sedge, state threatened)
4. *Carex straminea* (straw sedge, state endangered)
5. *Cuscuta glomerata* (rope dodder, state special concern)
6. *Cuscuta polygonorum* (knotweed dodder, state special concern)
7. *Dryopteris celsa* (log fern, state threatened)
8. *Eupatorium fistulosum* (hollow-stemmed joe-pye-weed, state threatened)
9. *Fraxinus profunda* (pumpkin ash, state threatened)
10. *Galearis spectabilis* (showy orchis, state threatened)
11. *Hybanthus concolor* (green violet, state special concern)
12. *Hydrastis canadensis* (goldenseal, state threatened)
13. *Isotria medeoloides* (smaller whorled pogonia, state endangered)
14. *Isotria verticillata* (whorled pogonia, state threatened)
15. *Lysimachia hybrida* (swamp candles, state special concern)
16. *Panax quinquefolius* (ginseng, state threatened)
17. *Panicum microcarpon* (small-fruited panic grass, state special concern)
18. *Plantago cordata* (heart-leaved plantain, state endangered)
19. *Poa paludigena* (bog bluegrass, state threatened)
20. *Polymnia uvedalia* (large-flowered leafcup, state threatened)
21. *Populus heterophylla* (swamp or black cottonwood, state endangered)
22. *Rudbeckia subtomentosa* (sweet coneflower, presumed extirpated from Michigan)
23. *Trillium undulatum* (painted trillium, state endangered)
24. *Valerianella umbilicata* (corn-salad, state threatened)
25. *Viburnum prunifolium* (black haw, state special concern)
26. *Woodwardia areolata* (netted chain-fern, presumed extirpated from Michigan)

Rare Animals

1. *Accipiter cooperii* (Cooper's hawk, state special concern)
2. *Acronicta falcula* (corylus dagger moth, state special concern)
3. *Ambystoma opacum* (marbled salamander, state threatened)
4. *Ambystoma texanum* (smallmouth salamander, state endangered)
5. *Basilodes pepita* (gold moth, state special concern)
6. *Buteo lineatus* (red-shouldered hawk, state threatened)
7. *Catocala illecta* (Magdalen underwing, state special concern)
8. *Clemmys guttata* (spotted turtle, state threatened)
9. *Clonophis kirtlandii* (Kirtland's snake, state endangered)
10. *Emydoidea blandingii* (Blanding's turtle, state special concern)
11. *Euphyes dukesi* (Dukes' skipper, state threatened)
12. *Gomphus quadricolor* (rapids clubtail, state special concern)
13. *Haliaeetus leucocephalus* (bald eagle, state threatened)
14. *Heterocampa subrotata* (small heterocampa, state special concern)
15. *Heteropacha rileyana* (Riley's lappet moth, state special concern)
16. *Incisalia henrici* (Henry's elfin, state special concern)
17. *Myotis sodalis* (Indiana bat, federal/state endangered)
18. *Nerodia erythrogaster neglecta* (copperbelly water snake, federal threatened and state endangered)
19. *Nycticorax nycticorax* (black-crowned night-heron, state special concern)
20. *Pandion haliaetus* (osprey, state threatened)
21. *Papaipema cerina* (golden borer, state special concern)
22. *Papaipema speciosissima* (regal fern borer, state special concern)
23. *Protonotaria citrea* (prothonotary warbler, state special concern)
24. *Seiurus motacilla* (Louisiana waterthrush, state special concern)
25. *Sistrurus c. catenatus* (eastern massasauga, federal candidate species and state special concern)
26. *Terrapene c. carolina* (eastern box turtle, state special concern)

Emergent Marsh

Rare Plants

1. *Armoracia lacustris* (lakecress, state threatened)
2. *Beckmannia syzigachne* (slough grass, state threatened)
3. *Calamagrostis stricta* (narrow-leaved reedgrass, state threatened)
4. *Callitriche hermaphroditica* (autumnal water-starwort, state special concern)
5. *Callitriche heterophylla* (large water-starwort, state threatened)
6. *Cyperus acuminatus* (nut-grass, presumed extirpated from Michigan)
7. *Cyperus flavescens* (yellow nut-grass, state special concern)
8. *Eleocharis caribaea* (spike-rush, state threatened)
9. *Eleocharis equisetoides* (horsetail spike-rush, state special concern)
10. *Glyceria acutiflora* (manna grass, presumed extirpated from Michigan)
11. *Gratiola aurea* (hedge-hyssop, state threatened)
12. *Hibiscus laevis* (smooth rose-mallow, state special concern)
13. *Hibiscus moscheutos* (rose mallow, state special concern)
14. *Justicia americana* (water-willow, state threatened)
15. *Juncus militaris* (bayonet rush, state threatened)
16. *Lemna valdiviana* (pale duckweed, presumed extirpated from Michigan)
17. *Littorella uniflora* (American shore-grass, state special concern)
18. *Mimulus alatus* (wing-stemmed monkey-flower, presumed extirpated from Michigan)
19. *Myriophyllum alterniflorum* (alternate-leaved water-milfoil, state special concern)
20. *Myriophyllum farwellii* (Farwell's water-milfoil, state threatened)
21. *Nelumbo lutea* (American lotus, state threatened)
22. *Nuphar pumila* (small yellow pond-lily, state endangered)
23. *Nymphaea tetragona* ssp. *leibergii* (pygmy water-lily, state endangered)
24. *Potamogeton confervoides* (alga pondweed, state special concern)
25. *Potamogeton hillii* (Hill's pondweed, state threatened)
26. *Ranunculus ambigens* (spearwort, state threatened)
27. *Ranunculus macounii* (Macoun's buttercup, state threatened)
28. *Sabatia angularis* (rose pink, state threatened)
29. *Sagittaria montevidensis* (arrowhead, state threatened)
30. *Zizania aquatica* var. *aquatica* (wild-rice, state threatened)

Rare Animals

1. *Botaurus lentiginosus* (American bittern, state special concern)
2. *Chlidonias niger* (black tern, state special concern)
3. *Emydoidea blandingii* (Blanding's turtle, state special concern)
4. *Ixobrychus exilis* (least bittern, state threatened)
5. *Rallus elegans* (king rail, state endangered)
6. *Sterna forsteri* (Forster's tern, state special concern)

Floodplain Forest

Rare Plants

1. *Arabis perstellata* (rock cress, state threatened)
2. *Aristolochia serpentaria* (Virginia snakeroot, state threatened)
3. *Aster furcatus* (forked aster, state threatened)
4. *Camassia scilloides* (wild-hyacinth, state threatened)
5. *Carex assiniboensis* (Assiniboia sedge, state threatened)
6. *Carex conjuncta* (sedge, state threatened)
7. *Carex crus-corvi* (raven's-foot sedge, state threatened)
8. *Carex davisii* (Davis' sedge, state threatened)
9. *Carex decomposita* (log sedge, state threatened)
10. *Carex frankii* (Frank's sedge, state special concern)
11. *Carex haydenii* (Hayden's sedge, presumed extirpated from Michigan)
12. *Carex lupuliformis* (false hop sedge, state threatened)

13. *Carex oligocarpa* (eastern few-fruited sedge, state threatened)
14. *Carex squarrosa* (sedge, state special concern)
15. *Carex trichocarpa* (hairy-fruited sedge, state special concern)
16. *Carex typhina* (cat-tail sedge, state threatened)
17. *Chasmanthium latifolium* (wild oats, state threatened)
18. *Chelone obliqua* (purple turtlehead, state endangered)
19. *Corydalis flavula* (yellow fumewort, state threatened)
20. *Dasistoma macrophylla* (mullein foxglove, state threatened)
21. *Dentaria maxima* (large toothwort, state threatened)
22. *Diarrhena americana* (beak grass, state threatened)
23. *Dryopteris celsa* (log fern, state threatened)
24. *Euonymus atropurpurea* (burning bush or wahoo, state special concern)
25. *Fraxinus profunda* (pumpkin ash, state threatened)
26. *Galearis spectabilis* (showy orchis, state threatened)
27. *Gentianella quinquefolia* (stiff gentian, state threatened)
28. *Gymnocladus dioicus* (Kentucky coffee-tree, state special concern)
29. *Hybanthus concolor* (green violet, state special concern)
30. *Hydrastis canadensis* (goldenseal, state threatened)
31. *Jeffersonia diphylla* (twinleaf, state special concern)
32. *Justicia americana* (water-willow, state threatened)
33. *Lithospermum latifolium* (broad-leaved puccoon, state special concern)
34. *Lycopus virginicus* (Virginia water horehound, state threatened)
35. *Mertensia virginica* (Virginia bluebells, state threatened)
36. *Mikania scandens* (climbing hempweed, presumed extirpated from Michigan)
37. *Monarda didyma* (Oswego tea, presumed extirpated from Michigan)
38. *Morus rubra* (red mulberry, state threatened)
39. *Panax quinquefolius* (ginseng, state threatened)
40. *Plantago cordata* (heart-leaved plantain, state endangered)
41. *Poa paludigena* (bog bluegrass, state threatened)
42. *Polemonium reptans* (Jacob's ladder, state threatened)
43. *Pycnanthemum pilosum* (hairy mountain mint, state threatened)
44. *Rudbeckia subtomentosa* (sweet coneflower, presumed extirpated from Michigan)
45. *Ruellia strepens* (smooth ruellia, state threatened)
46. *Scutellaria nervosa* (skullcap, state threatened)
47. *Scutellaria ovata* (heart-leaved skullcap, state threatened)
48. *Silphium perfoliatum* (cup-plant, state threatened)
49. *Thalictrum venulosum* var. *confine* (veiny meadow-rue, state special concern)
50. *Trillium nivale* (snow trillium, state threatened)
51. *Trillium recurvatum* (prairie trillium, state threatened)
52. *Trillium sessile* (toadshade, state threatened)
53. *Valerianella chenopodiifolia* (goosefoot corn-salad, state threatened)
54. *Valerianella umbilicata* (corn-salad, state threatened)
55. *Viburnum prunifolium* (black haw, state threatened)
56. *Wisteria frutescens* (wisteria, state threatened)

Rare Animals

1. *Accipiter cooperii* (Cooper's hawk, state special concern)
2. *Ambystoma opacum* (marbled salamander, state threatened)
3. *Ambystoma texanum* (small-mouthed salamander, state endangered)
4. *Buteo lineatus* (red-shouldered hawk, state threatened)
5. *Clonophis kirtlandii* (Kirtland's snake, state endangered)
6. *Dendroica cerulea* (cerulean warbler, state special concern)
7. *Dendroica dominica* (yellow-throated warbler, state threatened)
8. *Elaphe o. obsoleta* (black rat snake, state special concern)
9. *Emydoidea blandingii* (Blanding's turtle, state special concern)
10. *Glyptemys insculpta* (wood turtle, state special concern)
11. *Myotis sodalis* (Indiana bat, federal/state endangered)

12. *Nerodia erythrogaster neglecta* (copperbelly water snake, federal threatened and state endangered)
13. *Protonotaria citrea* (prothonotary warbler, state special concern)
14. *Seiurus motacilla* (Louisiana waterthrush, state special concern)
15. *Sistrurus c. catenatus* (eastern massasauga, federal candidate species and state special concern)
16. *Tachopteryx thoreyi* (grey petaltail, state special concern)
17. *Terrapene c. carolina* (eastern box turtle, state special concern)
18. *Wilsonia citrina* (hooded warbler, state special concern)

Rare Aquatic Animals

1. *Acipenser fulvescens* (lake sturgeon, state threatened)
2. *Alasmidonta marginata* (elktoe, state special concern)
3. *Ammocrypta pellucida* (eastern sand darter, state threatened)
4. *Anguispira kochi* (banded globe, state special concern)
5. *Cyclonaias tuberculata* (purple wartyback, state special concern)
6. *Discus patulus* (domed disc, state special concern)
7. *Epioblasma torulosa rangiana* (northern riffleshell, state endangered)
8. *Epioblasma triquetra* (snuffbox, state endangered)
9. *Lampsilis fasciola* (wavy-rayed lampmussel, state threatened)
10. *Lepisosteus oculatus* (spotted gar, state special concern)
11. *Moxostoma carinatum* (river redhorse, state threatened)
12. *Noturus stigmosus* (northern madtorn, state endangered)
13. *Obovaria olivaria* (hickorynut, state special concern)
14. *Obovaria subrotunda* (round hickorynut, state endangered)
15. *Opsopoeodus emiliae* (pugnose minnow, state endangered)
16. *Percina copelandi* (channel darter, state endangered)
17. *Percina shumardi* (river darter, state endangered)
18. *Pleurobema clava* (northern clubshell, state endangered)
19. *Pleurobema coccineum* (round pigtoe, state special concern)
20. *Pomatiopsis cincinnatiensis* (brown walker, state special concern)
21. *Simpsonaias ambigua* (salamander mussel, state endangered)
22. *Toxolasma lividus* (purple lilliput, state endangered)
23. *Venustaconcha ellipsiformis* (ellipse, state special concern)
24. *Villosa fabalis* (rayed bean, state endangered)
25. *Villosa iris* (rainbow, state special concern)

Prairie Fen

Rare Plants

1. *Asclepias purpurascens* (purple milkweed, state special concern)
2. *Aster praealtus* (willow aster, state special concern)
3. *Berula erecta* (cut-leaved water-parsnip, state threatened)
4. *Cacalia plantaginea* (prairie Indian-plantain, state special concern)
5. *Calamagrostis stricta* (narrow-leaved reedgrass, state threatened)
6. *Carex richardsonii* (Richardson's sedge, state threatened)
7. *Cypripedium candidum* (white lady's-slipper, state threatened)
8. *Dodecatheon meadia* (shooting-star, state endangered)
9. *Drosera anglica* (English sundew, state threatened)
10. *Eryngium yuccifolium* (rattlesnake-master, state threatened)
11. *Filipendula rubra* (queen-of-the-prairie, state threatened)
12. *Helianthus hirsutus* (whiskered sunflower, state special concern)
13. *Muhlenbergia richardsonis* (mat muhly, state threatened)
14. *Phlox maculata* (wild sweet william, state threatened)
15. *Polemonium reptans* (Jacob's ladder, state threatened)
16. *Pycnanthemum muticum* (broad-leaved mountain mint, state threatened)
17. *Sanguisorba canadensis* (Canadian burnet, state threatened)
18. *Sporobolus heterolepis* (prairie dropseed, state special concern)
19. *Valeriana edulis* var. *ciliata* (edible valerian, state threatened)

Rare Animals

1. *Acris crepitans blanchardi* (Blanchard's cricket frog, state special concern)
2. *Calephelis muticum* (swamp metalmark, state special concern)
3. *Clemmys guttata* (spotted turtle, state threatened)
4. *Clonophis kirtlandii* (Kirtland's snake, state endangered)
5. *Dorydiella kansana* (leafhopper, state special concern)
6. *Emydoidea blandingii* (Blanding's turtle, state special concern)
7. *Flexamia huroni* (Huron River leafhopper, state special concern)
8. *Lepyronia angulifera* (angular spittlebug, state special concern)
9. *Neonympha m. mitchellii* (Mitchell's satyr, federal/state endangered)
10. *Oarisma poweshiek* (Poweshiek skipper, state threatened)
11. *Oecanthus laricis* (tamarack tree cricket, state special concern)
12. *Papaipema beeriana* (blazing star borer, state special concern)
13. *Papaipema sciata* (Culver's root borer, state special concern)
14. *Papaipema silphii* (silphium borer moth, state threatened)
15. *Papaipema speciosissima* (regal fern borer, state special concern)
16. *Prosapia ignipectus* (red-legged spittlebug, state special concern)
17. *Sistrurus c. catenatus* (eastern massasauga, federal candidate species and state threatened)
18. *Terrapene c. carolina* (eastern box turtle, state special concern)

Southern Shrub-Carr

Rare Plants

1. *Hypericum sphaerocarpum* (round-fruited St. John's-wort, state threatened)
2. *Lygodium palmatum* (climbing fern, state endangered)
3. *Pycnanthemum muticum* (broad-leaved mountain mint, state threatened)

Rare Animals

1. *Acris crepitans blanchardi* (Blanchard's cricket frog, state special concern)
2. *Catocala illecta* (magdalen underwing, state special concern)
3. *Clemmys guttata* (spotted turtle, state threatened)
4. *Erynnis p. persius* (Persius duskywing, state threatened)
5. *Gomphus quadricolor* (rapids clubtail, state special concern)
6. *Hemileuca maia* (barrens buckmoth, state special concern)
7. *Lanius ludovicianus migrans* (migrant loggerhead shrike, state endangered)
8. *Neonympha m. mitchellii* (Mitchell's satyr, federal/state endangered)
9. *Nycticorax nycticorax* (black-crowned night-heron, state special concern)
10. *Papaipema speciosissima* (regal fern borer, state special concern)
11. *Sistrurus c. catenatus* (eastern massasauga, federal candidate species and state special concern)
12. *Terrapene c. carolina* (eastern box turtle, state special concern)
13. *Williamsonia fletcheri* (ebony boghaunter, state special concern)

Southern Wet Meadow

Rare Plants

1. *Gentianella quinquefolia* (stiff gentian, state threatened)
2. *Mimulus alatus* (wing-stemmed monkey flower, presumed extirpated from Michigan)
3. *Pycnanthemum muticum* (broad-leaved mountain mint, state threatened)

Rare Animals

1. *Acris crepitans blanchardi* (Blanchard's cricket frog, state special concern)
2. *Ambystoma texanum* (smallmouth salamander, state endangered)
3. *Asio flammeus* (short-eared owl, state endangered)
4. *Botaurus lentiginosus* (American bittern, state special concern)
5. *Calephelis mutica* (swamp metalmark, state special concern)
6. *Circus cyaneus* (northern harrier, state threatened)
7. *Cistothorus palustris* (marsh wren, state special concern)
8. *Clonophis kirtlandii* (Kirtland's snake, state endangered)

9. *Emydoidea blandingii* (Blanding's turtle, state special concern)
10. *Euphyes dukesi* (Dukes' skipper, state threatened)
11. *Meropleon ambifusca* (Newman's brocade, state special concern)
12. *Neoconocephalus lyrists* (bog conehead, state special concern)
13. *Neoconocephalus retusus* (conehead grasshopper, state special concern)
14. *Neonympha m. mitchellii* (Mitchell's satyr, federal/state threatened)
15. *Nerodia erythrogaster neglecta* (copperbelly water snake, federal threatened and state endangered)
16. *Oarisma poweshiek* (Poweshiek skipperling, state threatened)
17. *Orchelimum concinnum* (red-faced meadow katydid, state special concern)
18. *Orchelimum delicatum* (delicate meadow katydid, state special concern)
19. *Papaipema cerina* (golden borer, state special concern)
20. *Papaipema maritima* (maritime sunflower borer, state special concern)
21. *Papaipema speciosissima* (regal fern borer, state special concern)
22. *Paroxya hoosieri* (Hoosier locust, state special concern)
23. *Phalaropus tricolor* (Wilson's phalarope, state special concern)
24. *Rallus elegans* (king rail, state endangered)
25. *Sistrurus c. catenatus* (eastern massasauga, federal candidate species and state special concern)
26. *Spartiniphaga inops* (spartina moth, state special concern)
27. *Speyeria idalia* (regal fritillary, state endangered)

Oak Openings

Rare Plants

1. *Amorpha canescens* (leadplant, state special concern)
2. *Asclepias purpurascens* (purple milkweed, state special concern)
3. *Aster sericeus* (western silvery aster, state threatened)
4. *Baptisia lactea* (white false indigo, state special concern)
5. *Baptisia leucophaea* (cream wild indigo, state endangered)
6. *Bouteloua curtipendula* (side-oats grama grass, state threatened)
7. *Camassia scilloides* (wild-hyacinth, state threatened)
8. *Corydalis flavula* (yellow fumewort, state threatened)
9. *Dennstaedtia punctilobula* (hay-scented fern, state threatened)
10. *Eryngium yuccifolium* (rattlesnake-master, state threatened)
11. *Eupatorium sessilifolium* (upland boneset, state threatened)
12. *Euphorbia commutata* (tinted spurge, state threatened)
13. *Gentiana flavida* (white gentian, state endangered)
14. *Gentiana puberulenta* (downy gentian, state endangered)
15. *Geum triflorum* (prairie-smoke, state threatened)
16. *Helianthus microcephalus* (small wood sunflower, presumed extirpated from Michigan)
17. *Helianthus mollis* (downy sunflower, state threatened)
18. *Hieracium paniculatum* (panicked hawkweed, state special concern)
19. *Houstonia caerulea* (bluets, state special concern)
20. *Kuhnia eupatorioides* (false boneset, state special concern)
21. *Lactuca floridana* (woodland lettuce, state threatened)
22. *Lechea minor* (least pinweed, state special concern)
23. *Lechea stricta* (erect pinweed, state special concern)
24. *Linum sulcatum* (furrowed flax, state special concern)
25. *Onosmodium molle* (marbleweed, presumed extirpated from Michigan)
26. *Oxalis violacea* (violet wood-sorrel, state threatened)
27. *Panicum leibergii* (Leiberg's panic-grass, state threatened)
28. *Polytaenia nuttallii* (prairie-parsley, presumed extirpated from Michigan)
29. *Ranunculus rhomboideus* (prairie buttercup, state threatened)
30. *Rudbeckia subtomentosa* (sweet coneflower, presumed extirpated from Michigan)
31. *Ruellia humilis* (hairy ruellia, state threatened)
32. *Scutellaria elliptica* (hairy skullcap, state special concern)
33. *Silene stellata* (starry campion, state threatened)

34. *Sisyrinchium strictum* (blue-eyed-grass, state special concern)
35. *Sporobolus clandestinus* (dropseed, state special concern)
36. *Tomanthera auriculata* (eared false foxglove, presumed extirpated from Michigan)
37. *Trichostema dichotomum* (bastard pennyroyal, state threatened)

Rare Animals

1. *Accipiter cooperii* (Cooper's hawk, state special concern)
2. *Ammodramus henslowii* (Henslow's sparrow, state threatened)
3. *Ammodramus savannarum* (grasshopper sparrow, state special concern)
4. *Atrytonopsis hianna* (dusted skipper, state threatened)
5. *Catocala amestris* (three-staff underwing, state endangered)
6. *Clonophis kirtlandii* (Kirtland's snake, state endangered)
7. *Cryptotis parva* (least shrew, state threatened)
8. *Dendroica discolor* (prairie warbler, state endangered)
9. *Elaphe o. obsoleta* (black rat snake, state special concern)
10. *Erynnis p. persius* (Persius duskywing, state threatened)
11. *Hesperia ottoe* (ottoe skipper, state threatened)
12. *Incisalia henrici* (Henry's elfin, state special concern)
13. *Incisalia irus* (frosted elfin, state threatened)
14. *Lanius ludovicianus migrans* (migrant loggerhead shrike, state endangered)
15. *Lepyronia gibbosa* (Great Plains spittlebug, state threatened)
16. *Lycaeides melissa samuelis* (Karner blue butterfly, federal endangered and state threatened)
17. *Microtus ochrogaster* (prairie vole, state endangered)
18. *Myotis sodalis* (Indiana bat, federal/state endangered)
19. *Neoconocephalus ensiger* (conehead grasshopper, state special concern)
20. *Nicrophorus americanus* (American burying water beetle, state endangered)
21. *Oecanthus pini* (pinetree cricket, state special concern)
22. *Orphulella p. pelidna* (barrens locust, state special concern)
23. *Papaipema beeriana* (Blazing star borer, state special concern)
24. *Papaipema sciata* (Culver's root borer, state special concern)
25. *Prosapia ignipectus* (red-legged spittlebug, state special concern)
26. *Pygarctia spraguei* (Sprague's pygarctia, state special concern)
27. *Pyrgus centaureae wyandot* (grizzled skipper, state special concern)
28. *Schinia indiana* (phlox moth, state endangered)
29. *Schinia lucens* (leadplant flower moth, state endangered)
30. *Scudderia fasciata* (pine katydid, state special concern)
31. *Sistrurus c. catenatus* (eastern massasauga, federal candidate species and state special concern)
32. *Spartiniphaga inops* (spartina moth, state special concern)
33. *Speyeria idalia* (regal fritillary, state endangered)
34. *Terrapene c. carolina* (eastern box turtle, state special concern)
35. *Tympanuchus phasianellus* (sharp-tailed grouse, state special concern)
36. *Tyto alba* (barn owl, state endangered)

Scientific Name	Common Name	Taxonomic Group	In The County Y/N
<u>Ambystoma opacum</u>	<u>Marbled salamander</u>	Amphibians	N
<u>Ambystoma texanum</u>	<u>Smallmouth salamander</u>	Amphibians	Y
<u>Accipiter gentilis</u>	<u>Northern goshawk</u>	Birds	N
<u>Buteo lineatus</u>	<u>Red-shouldered hawk</u>	Birds	Y
<u>Haliaeetus leucocephalus</u>	<u>Bald eagle</u>	Birds	Y
<u>Pandion haliaetus</u>	<u>Osprey</u>	Birds	N/Y
<u>Parkesia motacilla</u>	<u>Louisiana waterthrush</u>	Birds	Y
<u>Protonotaria citrea</u>	<u>Prothonotary warbler</u>	Birds	Y
<u>Setophaga cerulea</u>	<u>Cerulean warbler</u>	Birds	Y
<u>Setophaga citrina</u>	<u>Hooded warbler</u>	Birds	Y
<u>Setophaga dominica</u>	<u>Yellow-throated warbler</u>	Birds	N
<u>Dryopteris celsa</u>	<u>Small log fern</u>	Ferns and Fern Allies	N
<u>Astragalus canadensis</u>	<u>Canadian milk vetch</u>	Flowering Plants	Y
<u>Berula erecta</u>	<u>Cut-leaved water parsnip</u>	Flowering Plants	N
<u>Boechera dentata</u>	<u>Rock cress</u>	Flowering Plants	N
<u>Camassia scilloides</u>	<u>Wild hyacinth</u>	Flowering Plants	N
<u>Cardamine maxima</u>	<u>Large toothwort</u>	Flowering Plants	N
<u>Carex assiniboinensis</u>	<u>Assiniboia sedge</u>	Flowering Plants	N
<u>Carex conjuncta</u>	<u>Sedge</u>	Flowering Plants	N
<u>Carex crus-corvi</u>	<u>Raven's-foot sedge</u>	Flowering Plants	N
<u>Carex davisii</u>	<u>Davis's sedge</u>	Flowering Plants	Y
<u>Carex decomposita</u>	<u>Log sedge</u>	Flowering Plants	N
<u>Carex haydenii</u>	<u>Hayden's sedge</u>	Flowering Plants	N
<u>Carex lupuliformis</u>	<u>False hop sedge</u>	Flowering Plants	Y
<u>Carex oligocarpa</u>	<u>Eastern few-fruited sedge</u>	Flowering Plants	N
<u>Carex seorsa</u>	<u>Sedge</u>	Flowering Plants	Y
<u>Carex squarrosa</u>	<u>Sedge</u>	Flowering Plants	Y
<u>Carex trichocarpa</u>	<u>Hairy-fruited sedge</u>	Flowering Plants	Y
<u>Carex typhina</u>	<u>Cattail sedge</u>	Flowering Plants	N
<u>Chasmanthium latifolium</u>	<u>Wild oats</u>	Flowering Plants	N
<u>Chelone obliqua</u>	<u>Purple turtlehead</u>	Flowering Plants	Y
<u>Clematis occidentalis</u>	<u>Purple clematis</u>	Flowering Plants	N
<u>Collinsia verna</u>	<u>Blue-eyed Mary</u>	Flowering Plants	N
<u>Corydalis flavula</u>	<u>Yellow fumewort</u>	Flowering Plants	N
<u>Dasistoma macrophylla</u>	<u>Mullein-foxtail</u>	Flowering Plants	N
<u>Diarrhena obovata</u>	<u>Beak grass</u>	Flowering Plants	N
<u>Endodeca serpentaria</u>	<u>Virginia snakeroot</u>	Flowering Plants	Y
<u>Euonymus atropurpureus</u>	<u>Wahoo</u>	Flowering Plants	Y
<u>Euphorbia commutata</u>	<u>Tinted spurge</u>	Flowering Plants	N
<u>Eurybia furcata</u>	<u>Forked aster</u>	Flowering Plants	N
<u>Fraxinus profunda</u>	<u>Pumpkin ash</u>	Flowering Plants	N
<u>Galearis spectabilis</u>	<u>Showy orchis</u>	Flowering Plants	Y
<u>Gentianella quinquefolia</u>	<u>Stiff gentian</u>	Flowering Plants	Y
<u>Hybanthus concolor</u>	<u>Green violet</u>	Flowering Plants	Y
<u>Hydrastis canadensis</u>	<u>Goldenseal</u>	Flowering Plants	Y
<u>Jeffersonia diphylla</u>	<u>Twinleaf</u>	Flowering Plants	Y
<u>Justicia americana</u>	<u>Water willow</u>	Flowering Plants	Y
<u>Lactuca floridana</u>	<u>Woodland lettuce</u>	Flowering Plants	N
<u>Lithospermum latifolium</u>	<u>Broad-leaved puccoon</u>	Flowering Plants	Y

Table of Potential Survey Species

<u>Lycopus virginicus</u>	<u>Virginia water-horehound</u>	Flowering Plants	N
<u>Lysimachia hybrida</u>	<u>Swamp candles</u>	Flowering Plants	N
<u>Mertensia virginica</u>	<u>Virginia bluebells</u>	Flowering Plants	N
<u>Mikania scandens</u>	<u>Mikania</u>	Flowering Plants	N
<u>Mimulus alatus</u>	<u>Winged monkey flower</u>	Flowering Plants	N
<u>Morus rubra</u>	<u>Red mulberry</u>	Flowering Plants	Y
<u>Neottia auriculata</u>	<u>Auricled twayblade</u>	Flowering Plants	N
<u>Panax quinquefolius</u>	<u>Ginseng</u>	Flowering Plants	Y
<u>Plantago cordata</u>	<u>Heart-leaved plantain</u>	Flowering Plants	N
<u>Polemonium reptans</u>	<u>Jacob's ladder</u>	Flowering Plants	Y
<u>Prenanthes crepidinea</u>	<u>Nodding rattlesnake-root</u>	Flowering Plants	N
<u>Quercus shumardii</u>	<u>Shumard's oak</u>	Flowering Plants	N
<u>Ruellia strepens</u>	<u>Smooth ruellia</u>	Flowering Plants	N
<u>Scutellaria nervosa</u>	<u>Skullcap</u>	Flowering Plants	N
<u>Scutellaria ovata</u>	<u>Forest skullcap</u>	Flowering Plants	N
<u>Silphium perfoliatum</u>	<u>Cup plant</u>	Flowering Plants	Y
<u>Trillium nivale</u>	<u>Snow trillium</u>	Flowering Plants	N
<u>Trillium recurvatum</u>	<u>Prairie trillium</u>	Flowering Plants	N
<u>Trillium sessile</u>	<u>Toadshade</u>	Flowering Plants	Y
<u>Valerianella chenopodiifolia</u>	<u>Goosefoot corn salad</u>	Flowering Plants	N
<u>Valerianella umblicata</u>	<u>Corn salad</u>	Flowering Plants	N
<u>Viburnum prunifolium</u>	<u>Black haw</u>	Flowering Plants	Y
<u>Vitis vulpina</u>	<u>Frost grape</u>	Flowering Plants	N
<u>Wisteria frutescens</u>	<u>Wisteria</u>	Flowering Plants	N
<u>Acronicta falcula</u>	<u>Corylus dagger moth</u>	Insects	Y
<u>Basilodes pepita</u>	<u>Gold moth</u>	Insects	N
<u>Battus philenor</u>	<u>Pipevine swallowtail</u>	Insects	Y
<u>Brychius hungerfordi</u>	<u>Hungerford's crawling water beetle</u>	Insects	N
<u>Catocala dulciola</u>	<u>Quiet underwing</u>	Insects	N
<u>Catocala illecta</u>	<u>Magdalen underwing</u>	Insects	N
<u>Dryobius sexnotatus</u>	<u>Six-banded longhorn beetle</u>	Insects	N
<u>Papaipema speciosissima</u>	<u>Regal fern borer</u>	Insects	N
<u>Stenelmis douglasensis</u>	<u>Douglas stenelmis riffle beetle</u>	Insects	N
<u>Tachopteryx thoreyi</u>	<u>Grey petaltail</u>	Insects	N
<u>Microtus pinetorum</u>	<u>Woodland vole</u>	Mammals	Y
<u>Myotis sodalis</u>	<u>Indiana bat</u>	Mammals	Y
<u>Clonophis kirtlandii</u>	<u>Kirtland's snake</u>	Reptiles	Y
<u>Emydoidea blandingii</u>	<u>Blanding's turtle</u>	Reptiles	Y
<u>Nerodia erythrogaster neglecta</u>	<u>Copperbelly water snake</u>	Reptiles	N
<u>Regina septemvittata</u>	<u>Queen snake</u>	Reptiles	Y
<u>Sistrurus catenatus</u>	<u>Eastern massasauga</u>	Reptiles	Y
<u>Anguispira kochi</u>	<u>Banded globe</u>	Snails	Y
<u>Appalachina sayanus</u>	<u>Spike-lip crater</u>	Snails	N
<u>Catinella protracta</u>	<u>A land snail (no common name)</u>	Snails	Y
<u>Discus patulus</u>	<u>Domed disc</u>	Snails	Y
<u>Mesodon elevatus</u>	<u>Proud globe</u>	Snails	N
<u>Mesomphix cupreus</u>	<u>Copper button</u>	Snails	Y
<u>Philomycus carolinianus</u>	<u>Carolina mantleslug</u>	Snails	N
<u>Pomatiopsis cincinnatiensis</u>	<u>Brown walker</u>	Snails	Y
<u>Pyrgulopsis letsoni</u>	<u>Gravel pyrg</u>	Snails	Y
<u>Striatura meridionalis</u>	<u>Median striate</u>	Snails	N
<u>Triodopsis denotata</u>	<u>Velvet wedge</u>	Snails	N

