

LANDSCAPE STEWARDSHIP PLAN:
Monroe County, Michigan



PREPARED BY

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THE STEWARDSHIP NETWORK

DATE

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The Stewardship Network
Connect to Conserve

Landscape Stewardship Plan for Monroe County, Michigan

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1. Executive Summary

The Landscape Stewardship Plan covering Monroe County and adjacent areas of western Lake Erie in Southeastern Lower Michigan is one of nine stewardship plans developed through a grant by the U.S. Forest Service (USFS) and administered by Michigan Department of Natural Resources (DNR). The project is a collaborative effort between the Michigan Department of Natural Resources: Forest Resource Division, The Nature Conservancy, Huron Pines, and The Stewardship Network. The intent of this project is to connect people and organizations with each other and to foster stewardship information, resources, and assistance programs, thereby increasing our collective capacity to protect and maintain the forest products, services, and values of the region. The plans will provide local landowners with appropriate information about their regional forest resources, engage them in education about current conditions and threats, and spark an interest in forest stewardship within stakeholders. With a concentrated effort by all of the stakeholders, working collaboratively at the landscape scale, we can begin to address the regional challenges that threaten the health and sustainability of our forests and other natural resources.

Michigan's diverse forests has been thousands of years in the making. After the retreat of the Wisconsin glacier over 13,000 years ago, boreal forests began appearing in much of the Lower Peninsula. Several thousand years later, the more complex pine and hardwood forests and swamp forests that we are familiar with today began occupying areas of the Lower Peninsula including Monroe County. These were the forests that the Paleo-Indian and native tribes used sustainably for their daily needs for hundreds of years. By the early 19th century, however, a flood of European immigrants moved into Michigan from the eastern United States, and began clearing the prime timber for economic gain and utilizing the deforested land for farming. Since then, forests have continued to be used for their timber resources- expanding and contracting, depending on timber demands, climate, and increased demands for land needed for food production and urban expansion. What remains is a highly fragmented landscape throughout Monroe County and most of southeastern Michigan. Today, only 26% of total land area in Southern Lower Michigan is forested, and only 43,000 acres, or about 10% of Monroe County, remains forested, the majority of that being privately held. These numbers underscore the critical nature of developing a regional strategy for managing the remaining tracts of forest that provide essential ecosystem services.

Once dominated by forests, prairies, and wetlands, the Monroe County landscape is now mostly agricultural land, upon which many of the rural communities rely. Over the past several decades, forests have been harvested and wetlands drained to provide sufficient cropland. With this change in landscape, many unique ecosystems have been severely diminished or degraded, threatening the ability of native species to thrive in these areas. This diverse landscape is essential to the quality of life in Monroe County. However, management of these ecosystems has become increasingly challenging and emphasizes the need for a coordinated management effort across both public and private land.

To help address those needs, the Michigan Department of Natural Resources offers information and small grants to landowners to develop Forest Stewardship Plans for their properties. Forest Stewardship Plans characterize existing resource features found on a particular property and identify strategies for meeting each landowner's management goals through on-the-ground stewardship activities. For properties that do not qualify for DNR programs, individuals can hire a consultant to assist in the development of a stewardship plan. Information provided in this document and other State and Federal resources are available for individuals to use to write their own plans. Once written, additional support is available for conducting on the ground stewardship activity. The Western Lake Erie Cluster of The Stewardship Network is extremely active in conducting community conservation stewardship programs in Monroe County and throughout the western Lake Erie basin. Monroe County has been a major focus for local restoration efforts due to its unique natural history and current land use. In recent years, local efforts focused on the restoration of remnant native ecosystems have been successful in preserving and developing numerous natural areas across the county.

This document provides information about current management plans associated with this region. It highlights the stakeholders and resource providers relevant to forestry that are available for public and private landowners. Information about prominent resources unique to this region are included, and recommendations that have been proposed for successful forest management are discussed. An important component of this Landscape Stewardship Plan is the collection of stewardship stories told by people living and working in Monroe County. Local land owners and land managers share their experiences and why they are active stewards of their forest systems. These stories are shared in the hope of sparking an interest in landowners, land managers, and local stakeholders to actively steward their forest resources. This collective landscape scale approach to stewardship is critical if we are to protect the ecological and cultural elements of Monroe County for present and future generations.

2. Project Introduction

This Landscape Stewardship Plan focuses on the Stewardship Network’s Western Lake Erie Cluster in the southern Lower Peninsula, with emphasis on Monroe County. This plan was developed by The Stewardship Network as part of a larger collaboration to promote sustainable stewardship of private and public forest land across the state of Michigan. The larger project began in 2015 when the Michigan Department of Natural Resources received a grant from the United State Forest Service to partner with The Stewardship Network (TSN), The Nature Conservancy (TNC), and Huron Pines (HP)—all of which are 501(c)(3) nonprofit and non-governmental conservation organizations—to develop nine Landscape Stewardship Plans, each covering unique Michigan ecosystems (Figure 2.1).

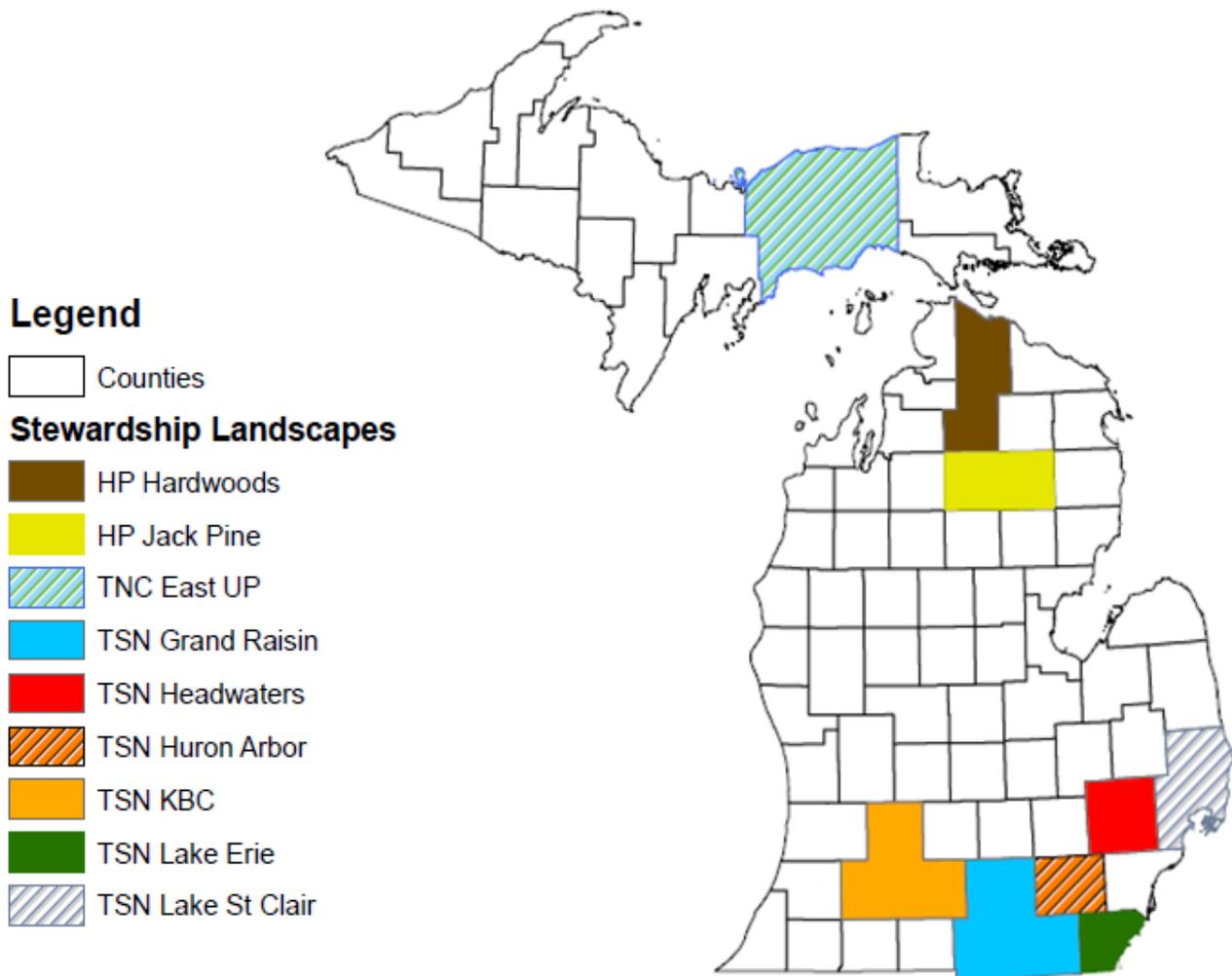


Figure 2.1 The nine Landscape Stewardship Plan areas. This report focuses on TSN Lake Erie.

Each plan covers a one to four county area in Michigan, characterizes the physical and cultural context of the focal landscape, and connects landowners to assistance programs and resources by summarizing available opportunities and providing program contact information. Each Landscape Stewardship Plan also includes a collection of stewardship stories told by the local landowners and land managers working within it. Rather than simply listing recommended land management practices, these stories let real people tell, in their own words, how and why they choose to actively manage their land, the challenges they face, and the resources that they have found helpful.

These Landscape Stewardship Plans aim to inspire people to become more active land stewards by showcasing opportunities through stories and by connecting people with resources for woodland management. By increasing voluntary participation in land stewardship activities, we are ultimately working to protect and preserve Michigan's unique natural resources through collective impact. This can only be achieved at the landscape scale—with private and public land managers working together to maintain healthy forests, clean water, and other natural resources for the use and enjoyment of current and future generations.

The Stewardship Network developed six Landscape Stewardship Plans covering a large swath of the southern Lower Peninsula of Michigan. This region is a mosaic of urban areas, agricultural lands, and small private forests. There is comparatively little forest land under public ownership in southern Michigan, where 75% of Michigan's 10 million residents live, but deliberate and responsible land management activities here have the potential to affect a large number of people.

The Nature Conservancy developed one Landscape Stewardship Plan for the eastern Upper Peninsula, which covers parts of Alger, Luce, Mackinac, and Schoolcraft counties—an area dominated by large blocks of both public and private forest land.

Huron Pines developed two Landscape Stewardship Plans, one focusing on the Jack Pines Ecosystem and one featuring Michigan's Northern Hardwoods in Cheboygan and Otsego counties.

These Upper Peninsula and northern Lower Peninsula landscapes contain fairly large tracts of forest land under a mixture of private, state, and federal ownership. This rural area contains intact and functional forests, but the long-term protection of these resources faces many challenges.

While the lead organizations were responsible for developing their respective Landscape Stewardship Plans, the content of each plan was generated with substantial input from other resource professionals, the landowners, and land managers willing to tell their stories, and based on existing resource assessments, stewardship plans, and other available literature.

Project partners also worked with Dr. Stuart Gage, Michigan State University professor emeritus, to install acoustic monitoring devices to capture the "soundscape" of each landscape.

The sounds of the forest tell their own story. An interactive website to be developed will allow people to view stories in their region, share their own stories, and listen to the sound stories.

Finally, a portion of the grant funding will be administered by the DNR to provide cost-share to landowners within the nine landscape focus areas for developing and implementing unique Forest Stewardship Plans for their properties.

2.1 Project Goals and Objectives

Michigan's forests face a myriad of threats—invasive species, tree diseases, habitat fragmentation, over browsing by deer in some areas, financial challenges for landowners and managers—that sometimes make it difficult to achieve forest stewardship goals. A recent study estimated that only 20% of Michigan's 12 million non-industrial private forest lands are being actively managed, yet active stewardship of private forest land is vital to the long-term health and productivity of the forest resources (including soil, water and wildlife) on which our local economies and communities depend. Therefore, the overarching goal of this project is to increase interest, awareness, and participation in active forest stewardship opportunities through the development of nine Landscape Stewardship Plans covering strategic and unique forest ecosystems throughout the state of Michigan.

Specific objectives that we seek to accomplish in order to achieve that goal include:

- Objective 1: Describe the physical, cultural, and resource management context of each of the nine landscapes to serve as a comprehensive reference for landowners and land managers.
- Objective 2: Facilitate collaborative management of multi-county areas by state, federal and local resource agencies, nonprofit conservation organizations, private sector professionals and individual landowners.
- Objective 3: Promote sustainable forest management practices and encourage people to be more active stewards of their land (e.g., develop and implement a Forest Stewardship Plan).
- Objective 4: Connect people with tools, resources and programs to help them take the next steps toward achieving their personal land management goals and increase our collective capacity to manage forest resources at the landscape scale.

These Landscape Stewardship Plans also aim to support and inform strategies for addressing national priorities and state-level issues identified in "Michigan Forest Resource Assessment and Strategy," which was completed by the DNR in 2010. These priorities and issues are:

- National Priority 1: Conserve Working Forest Landscapes
 - Issue 1.1: Promote Sustainable Active Management of Private Forests
 - Issue 1.2: Reduce Divestiture, Parcelization and Conversion of Private Forestlands
 - Issue 1.3: Reduce the High Cost of Owning Private Forestland
- National Priority 2: Protect Forests from Threats

- Issue 2.1: Maintain and Restore Aquatic Ecosystems and Watersheds
- Issue 2.2: Reduce Threats from Invasive Species, Pests and Disease
- Issue 2.3: Reduce Impact of Recreational Activities on Forest Resources

- National Priority 3: Enhance Public Benefits from Forests
 - Issue 3.1: Maintain Markets for Utilization of Forest Products
 - Issue 3.2: Maintain Ecosystem Services from Private Forestlands
 - Issue 3.3: Provide Effective Conservation Outreach for Private Forestlands
 - Issue 3.4: Maintain Community Quality of Life and Economic Resiliency
 - Issue 3.5: Maintain and Enhance Scenic and Cultural Quality on Private Forestland
 - Issue 3.6: Maintain Forested Ecosystems for Biodiversity and for Wildlife Habitat
 - Issue 3.7: Maintain and Enhance Access to Recreational Activities on Private Forestlands

2.2 The Need for Active Forest Stewardship

Forest land accounts for 55% of Michigan’s total land area, and of Michigan’s 20 million acres of forests, 12 million (60%) are privately owned. State and federal agencies are responsible for managing public lands, but the overall health of Michigan’s unique forest, water, and wildlife resources ultimately depends on the collective management activities of all landowners.

The condition of a particular forest property is highly dependent on the condition of other forest lands throughout the entire landscape. Conversely, the management actions (or lack of active forest management) on a single property can also impact forests, rivers, wildlife, property, and people far beyond the boundary of that individual piece of land. Native wildlife, forest fires, harmful invasive species, tree diseases, and insect pests all move freely among private and public land, obviously not recognizing man-made property boundaries. Likewise, rivers and streams flowing from one property to the next carry the effects of poor land management activities downstream (or even upstream, as is the case with dams or poorly designed road crossings that block fish passage). The interconnectedness of landscape scale ecosystems, regardless of the particulars of property ownership, requires collective management for successful conservation and sustainability efforts.

Maintenance of healthy forest landscapes is also important at the regional and global scale. We depend on our forests for timber and other forest products, to provide wildlife habitat, to help mitigate climate change, to protect the quality and quantity of our water resources, and for the myriad aesthetic, recreational, and spiritual values they provide. Protecting our forest products, services, and values starts with the active stewardship of individual properties by landowners and land managers. Because widespread threats to forest health act scales larger than single parcels, our approach to maintaining healthy, functional and sustainable forests must also incorporate landscape-scale considerations. The purpose of this project is to encourage and

inspire people to actively manage their forests to realize benefits for both individual landowners and the larger community. The next section describes our methodology for doing so.

2.3 Methodology: A Landscape Approach to Natural Resource Conservation

The Michigan DNR applied for and was awarded funding by the USFS in 2015 to coordinate with The Stewardship Network, The Nature Conservancy, and Huron Pines to develop nine Landscape Stewardship Plans. These partners strategically identified landscape types containing a set of unique physical and cultural features that help define each landscape area while also distinguishing them from other landscapes. Of course, ecological landscapes do not adhere to our political boundaries and tend to transition gradually and unevenly from one landscape type to another. However, for the purpose of managing landscape-scale issues and challenges while also keeping the project areas manageable and relevant to local landowners and land managers, we've defined each landscape area as ranging from one to four counties in geographic scope. One advantage of defining the project area based on county boundaries is that these align with jurisdictional areas of different resource agencies and nonprofit organizations. Therefore, the assistance programs, resources, and opportunities offered within each landscape project area are generally consistent and the background information and stewardship stories are tailored to a particular local audience. Nevertheless, people in surrounding counties or other areas with similar characteristics will generally also find that these Landscape Stewardship Plans are useful.

The Stewardship Network's Western Lake Erie Cluster, comprising of Monroe County and immediately adjacent areas, lies in the extreme southeast corner of Lower Michigan near the Greater Detroit Metropolitan area—the most heavily populated part of the state. Monroe County contains the entire or part of 15 large and small watersheds. This region is a mosaic of primarily agricultural lands (214,500 acres) and small private forests (43,000 acres). The Southeast Michigan Counsel of Governments (SEMCOG) estimates that only 20% of the entire county, including both suburban and urban areas, is considered to have a tree canopy. There is comparatively little forest land under public ownership in southern Michigan, so effective forest stewardship requires engaging interest and coordinating efforts among park systems, land conservancies, and many small private landowners. While coordinated and collaborative land management poses many challenges, it can have many benefits: 75% of Michigan's 10 million residents live in this region, so land management activities can affect a large number of people.

The Stewardship Network coordinated with the landscape stewardship project partners to develop the text in Section 2, including the project background and project goals, objectives and methodology. To complete Section 3: Landscape Context, The Stewardship Network reviewed existing resource assessments and management plans/strategies. They also met with government agencies, private resource providers, and nonprofit organizations to collect information on the various assistance programs and opportunities that are available, with a

focus on forest stewardship. Contacts for each program are included as a resource for property owners and land managers.

A key focus has also been to collect stewardship stories, told by local landowners and land managers, illustrate opportunities and practices in the area (Section 4). Rather than simply providing a list of forest recommendations for property owners, we offer these stories to provide real-life examples of context and experience to inspire others to learn more and to take advantage of resources and programs that have been useful to Monroe County residents. The Stewardship Network and our partners identified people who are actively stewarding their land and who want to tell their stories. We had conversations with individual and institutional land owners and managers to hear about the many ways people are caring for the woodlands. All landowner stories were provided voluntarily for inclusion in this plan and with permission to distribute in the hopes of encouraging other landowners to become active land stewards.

3. Landscape Context

Monroe County is home to The Stewardship Network's Western Lake Erie Cluster, a diverse, collaborative community made up of organizations, individual volunteers and landowners, professional researchers, natural resource managers, government agencies, and native peoples. This community works together to restore, preserve, and protect their land and water. Situated at the delta of the Detroit River and on the westernmost end of Lake Erie, Monroe County is positioned in a key location for trade, development, and transportation- opportunities that were not lost on Native Americans, French, British, and eventually American settlers who all inhabited the region over the centuries.

3.1 The Physical, Ecological, and Cultural Landscape

Monroe County is located in the southeastern-most corner of the state of Michigan and borders the state of Ohio to the south, Washtenaw and Wayne Counties to the north, and Lenawee County to the west (Figure 3.1). Lake Erie spans the entire eastern border of the county. The unique geography of Monroe County lends itself to a unique culture, with influences from the county's close proximity to the urban centers of Detroit and Toledo, and a strong sense of independence stemming from its mostly rural landscape with a rich history of agriculture. The county is a thoroughfare for the manufacturing industries, primarily those related to automotive production and steel, and contains major highways and railroads that run north to south. Monroe County is an active member of both the Toledo Metropolitan Area Council of Governments (TMACOG) and SEMCOG.

3.1.1 Geographic Scope

This Landscape Stewardship Plan focuses on Monroe County, although the issues and stories arise from and apply to adjacent areas as well. Monroe County covers roughly 680 square miles in Southeast Michigan and includes the cities of Milan, Luna Pier, Monroe, Petersburg, and part of Flatrock and the villages of Carleton, Dundee, Estra Beach, Maybee, and South Rockwood.

TSN Lake Erie

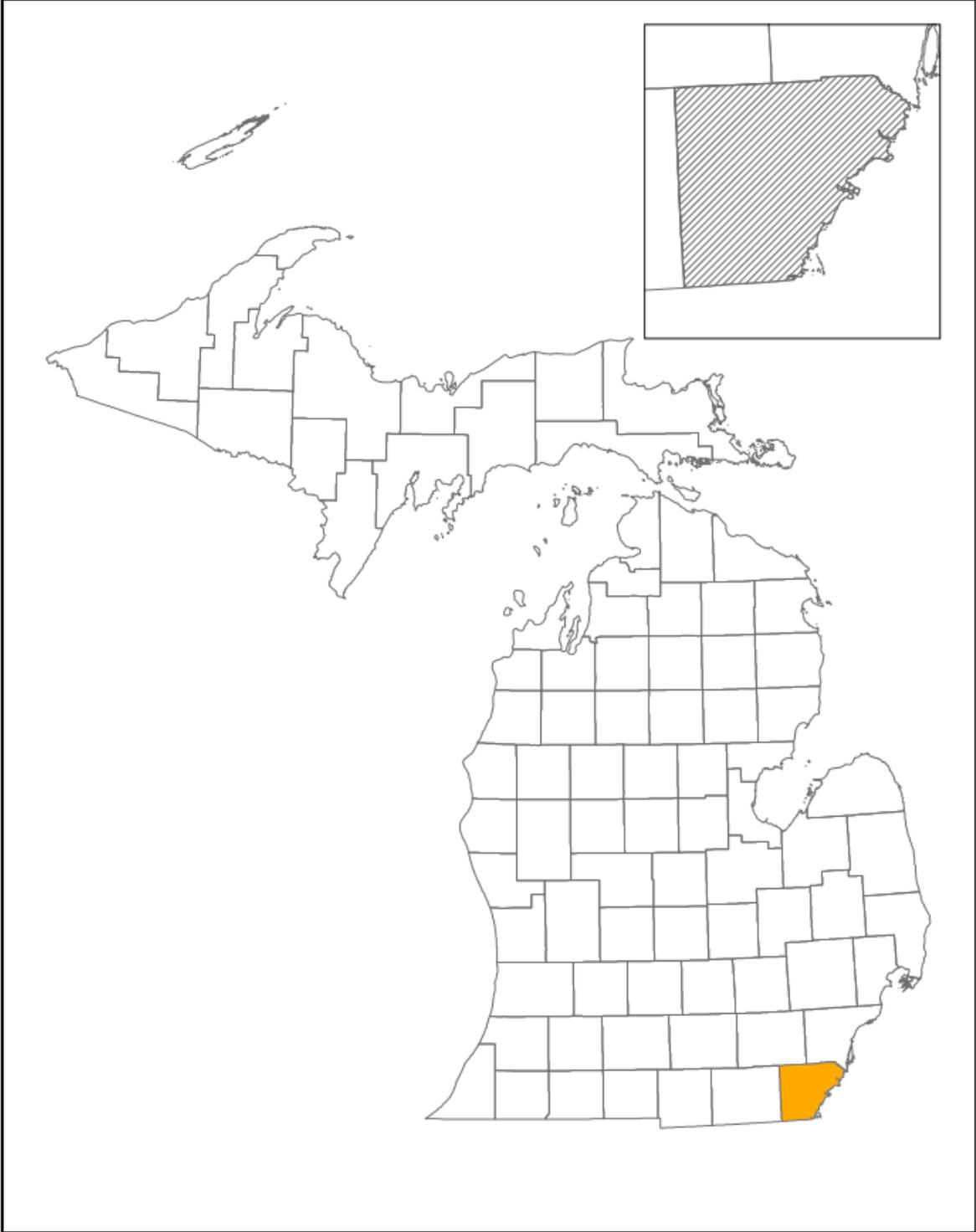


Figure 3.1. General map of Monroe County’s location within the southeast Michigan region. (Michigan DNR)

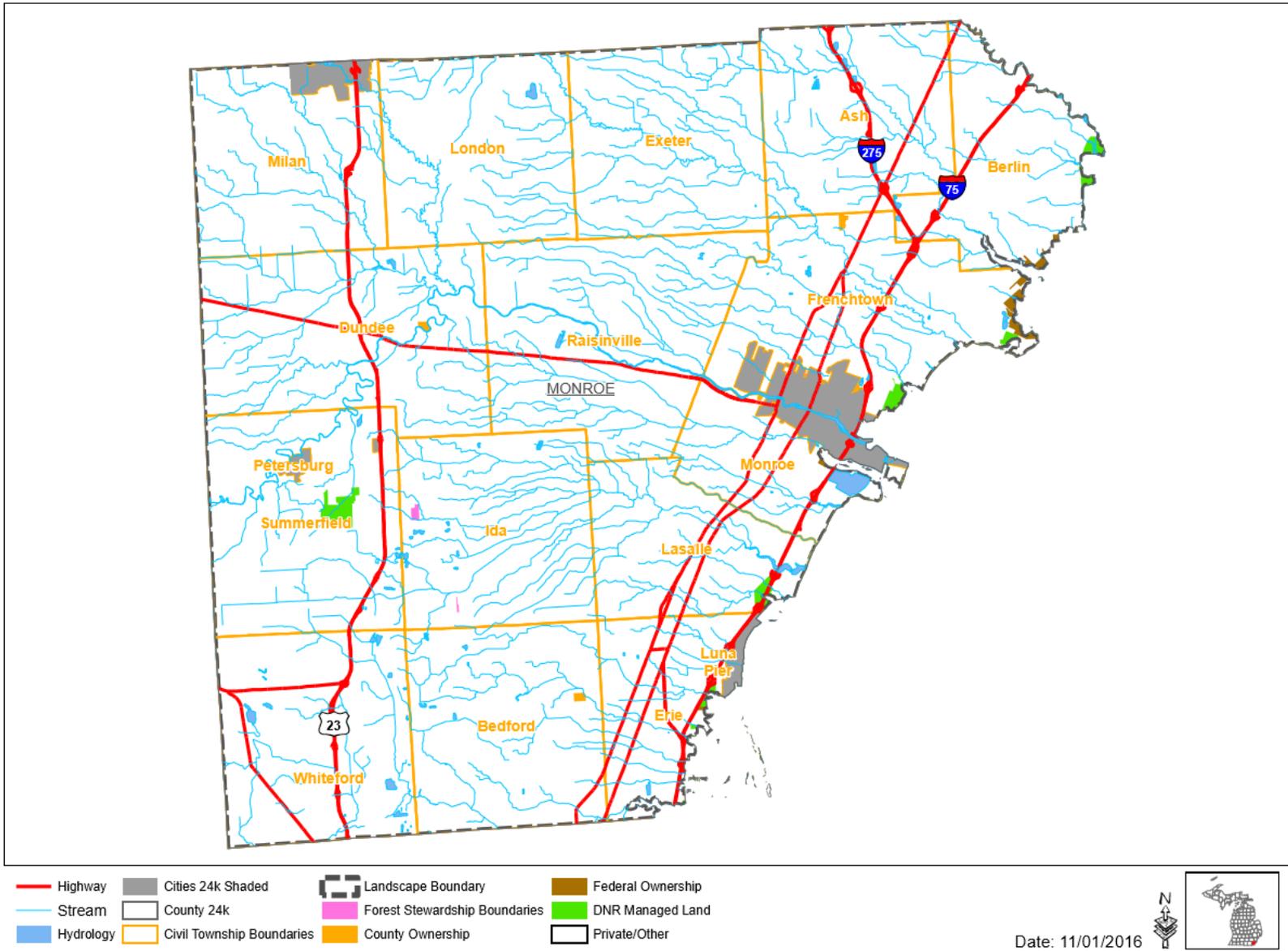


Figure 3.2: Base map of Monroe County showing township boundaries, highways, streams, and cities (Michigan DNR)

2012 Population density (miles) for Monroe County

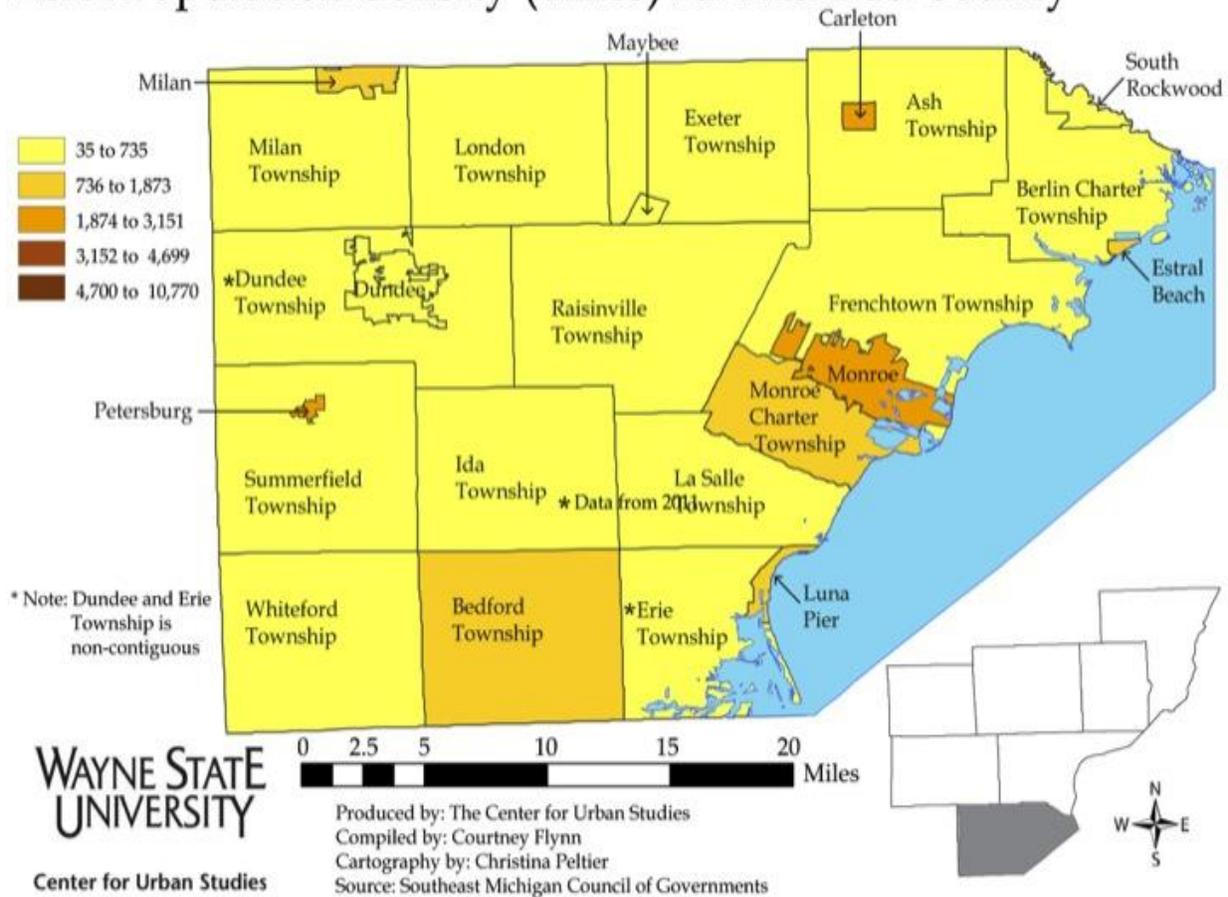


Figure 3.3: Population Density Map for Monroe County (Wayne State University’s Center for Urban Studies)

Although this plan has been specifically tailored for the landowners and land managers living or working in Monroe County, most of its information and many of the listed resources, assistance programs, and Best Management Practices (BMPs) contained within this plan are applicable to adjacent areas. Furthermore, many of the issues confronting Monroe County woodlands are similar to those in other Detroit Metro area counties, which are covered in landscape forest stewardship plans that TSN is doing for neighboring cluster areas (Figure 2.1).

- Lake St. Clair (St Clair and Macomb Counties)
- Headwaters (Oakland County)
- Huron-Arbor (Washtenaw County)
- Grand Raisin (Jackson, Hillsdale, and Lenawee Counties)

3.1.2 Cultural Landscape and Land Use

The Western Lake Erie coastal plain has been utilized by Native Americans since prehistoric times who used the area’s diverse plant and animal communities for food and other natural resources. Lake Erie and its tributaries, particularly the River Raisin, provided easy access to a large geographic area. Twelve separate Native American tribes can trace back some of their history to this area, most notably the Pottawatomi and Wyandot tribes (Paskus, 2017).

Monroe County was established in 1817 and named for then President James Monroe. Original European occupation of the area dates back to the 1780’s when French settlers built ribbon farms, long thin parcels of land that provided the farmer both access to the river and upland resources. The settlement of Frenchtown was also formed along the banks of the River Raisin. This was the site of the Battle of Frenchtown, the worst American defeat in the War of 1812. The site of the battle is now part of the River Raisin National Battlefield Park. The area is also known for being claimed by both the Michigan Territory and the newly formed state of Ohio in 1803, which lead to the Toledo War border dispute. Resolution to the conflict came in 1836 when President Andrew Jackson granted the Toledo strip (then part of Monroe County) to Ohio in exchange for Michigan receiving the Upper Peninsula.

Today, agriculture is the primary land use of Monroe County with over 50% of the area being cropland. Monroe County ranks 4th in the State in revenue from vegetables, 5th from nursery, greenhouse, and floriculture, and 8th in total crop sales. According to SEMCOG’s estimate, the county’s population was 149,176 in 2016, down 1.9% from the number recorded in the 2010 US Census. The largest city and county seat is the City of Monroe. Major employers of the County include the Fermi II nuclear power plant, Promedica Monroe Regional Hospital, Lay-Z-Boy, Tenneco Inc., Monroe County Community College, and Gerdau-Macsteel.

Table 3.1 Land use in Monroe County

Current Land Use	Acres	Percent
Agricultural	193,439.2	54.2%
Single-family residential	110,715.8	31%
Multiple-family residential	879.7	0.2%
Commercial	8,397.8	2.4%
Industrial	8,133.8	2.3%
Governmental/Institutional	5,780.3	1.6%
Park, recreation, and open space	10,066.1	2.8%
Airport	316.1	0.1%
Transportation, Communication, and Utility	14,036.2	3.9%
Water	4,980.9	1.4%
Total	356,745.8	

(SEMCOG, 2008)

The forested ecosystems of Monroe County, as with those across the entire state of Michigan, has been thousands of years in the making. After the retreat of the Wisconsin glacier over 13,000 years ago, boreal forests began appearing in much of the Lower Peninsula. Several thousand years later, the more complex pine and hardwood forests and swamp forests that we are familiar with today began occupying areas of the Lower Peninsula, including Monroe County. These were the forests that the Paleo-Indian and native tribes used for their daily needs in a sustainable way for hundreds of years. By the early 19th century, however, a flood of European immigrants moved into Michigan from the eastern United States, and began clearing the prime timber for economic gain and in order to make room for farming. After the Civil War, the timber industry took off in Michigan as increasing industrialization fueled the demand for timber products. By the late 1800s, Michigan was producing more lumber than any other state.

The early decades of the 20th century brought a series of droughts and economic depression, which some say led to the abandonment of less productive farmland. Second-growth forest expanded during this period to reclaim marginal lands that were formerly tilled or grazed. During that time, soil conservation programs promoted reforestation, often with fast-growing, non-native species selected for timber production and commercial harvest. Land use in Monroe County continued to be influenced by agriculture, residential development, and commercial/industrial development along the shoreline of Lake Erie. Agricultural programs aimed at stabilizing crop prices and promoting production of commodity crops sprang up in the early to mid-1900s, affecting the amount of land set aside for conservation purposes.

Early twentieth century conservation movements in Michigan gave birth to efforts like the Depression-era Civilian Conservation Corp (CCC), which greatly contributed to the reforestation efforts in the state. Continued concerns over agricultural surpluses and environmental degradation led to the establishment of the Conservation Reserve Program in 1985 and the Wetlands Reserve Program in 1990, in which farmers could receive payments to leave land out of cultivation, with some programs promoting prairie and even forest plantings. Much of the public land now owned by the State of Michigan is tax delinquent land that was either abandoned by early timber companies or by families who failed at attempts to farm it.

Today, the forested systems of Michigan and Monroe County continue to expand and contract depending on timber and agricultural demands, a changing climate, and urban expansion. What remains now is a highly fragmented landscape throughout Monroe County that mirrors most of southeastern Michigan. Currently, only 26% of total land area in Southern Lower Michigan is forested, the majority of that being privately held (Albert, 1995). In 2014, SEMCOG estimated that the percent of tree canopy for Monroe County, including suburban and urban areas, is only 20% of total land cover. These numbers underscore the critical nature of developing a regional strategy for managing the remaining tracts of forest that provide essential ecosystem services.

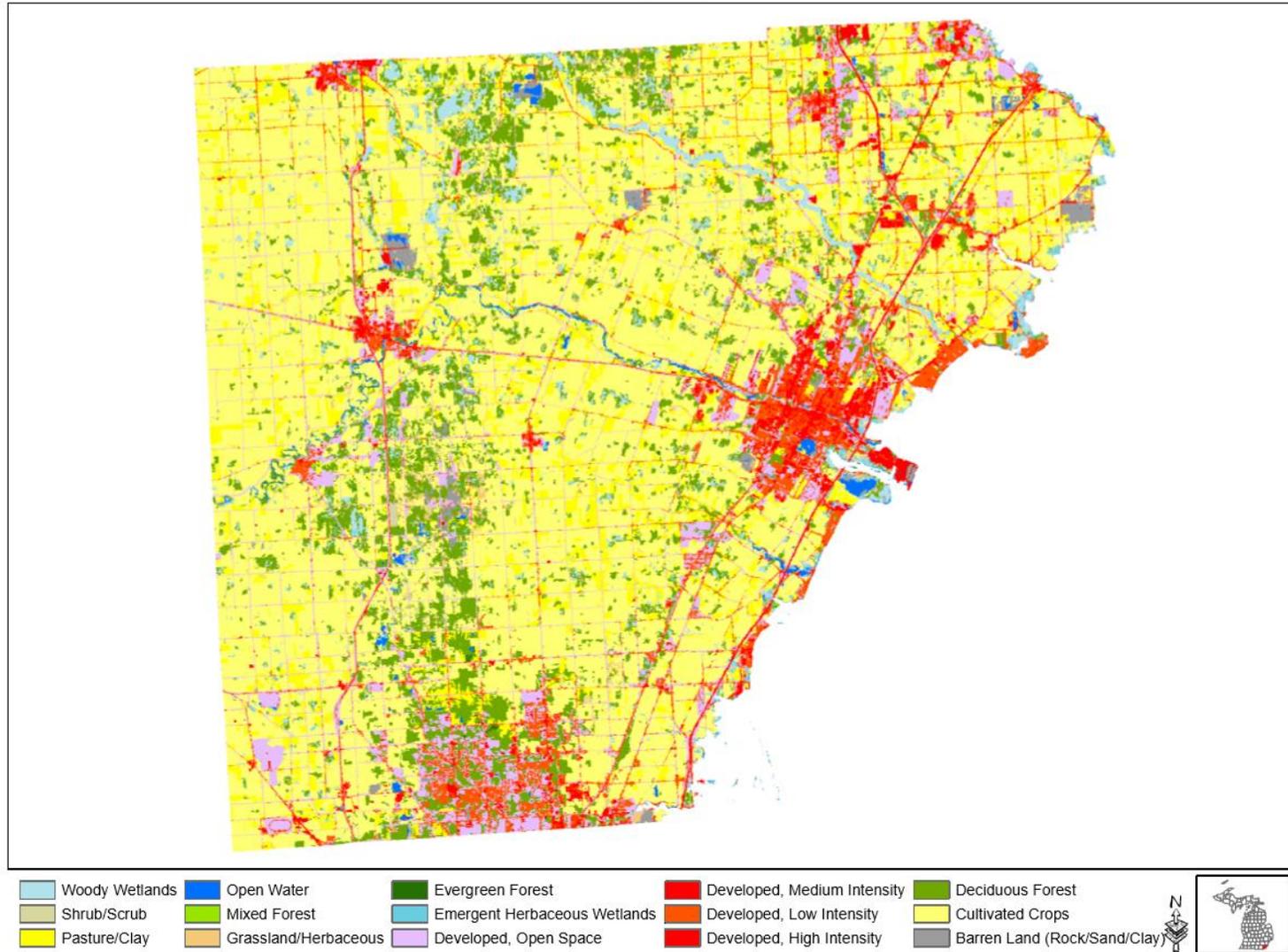


Figure 3.4 Land Use of Monroe County. Cover classes based on aerial imagery and interpretation from the Michigan Department of Natural Resources, Michigan Resources Inventory System/National Land Cover Database

TSN Lake Erie
Ownership Map

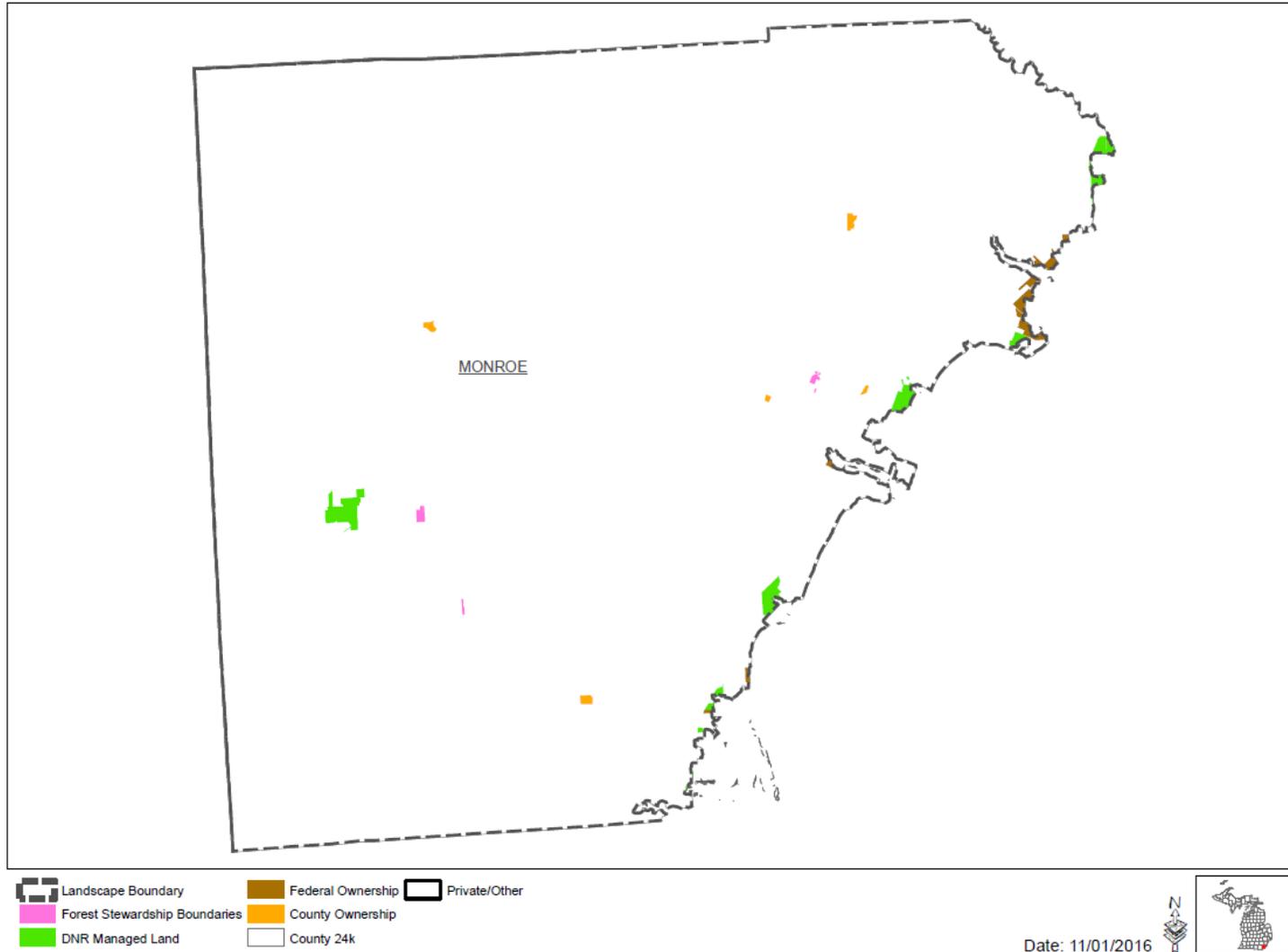


Figure 3. 5 Ownership Map of Monroe County (Michigan DNR)

3.1.3 Climate, Geology, Topography, and Land Cover

Climate

Monroe County is in the humid continental climate zone, with temperatures normally ranging from 10 degrees in winter to 90 degrees in the summer. Annual average precipitation totals approximately 30.09 inches of rainfall and an average of 43 inches of snowfall, the lowest average snowfall of any area in the state. Average relative humidity is 45 percent. The sun shines 67% of the time possible in the summer and 38% in the winter.

Table 3.2 Annual Weather Averages for Monroe County

Annual high temperature:	57.4°F (14.1°C)
Annual low temperature:	40.5°F (4.7°C)
Average temperature:	48.95°F (9.41°C)
Average annual precipitation	33.41 inch (84.86 cm)

(USClimatedata.com)

Michigan State University has weather stations at several locations throughout Michigan as part of their Enviroweather network. While there is not a station in Monroe County, one exists in nearby Blissfield to the west. This service provides real-time weather data as well as historical records of air temperature, precipitation, relative humidity, etc.

(<https://enviroweather.msu.edu/homeAlpha.php>)

Climate Change

Most climate models show Michigan getting warmer (average annual temperature has increased 1.5 F in the last 100 years) and to have more extreme weather events such as rainfall in excess of 2 inches. However, warmer summer temperatures and low summer rainfall may lead to an increase in drought. (<https://www.epa.gov/climate-impacts/climate-impacts-midwest>, <http://www.globalchange.gov/explore/midwest>)

The Great Lakes Integrated Sciences and Assessments Center (GLISA) has developed localized and easy to understand fact sheets summarizing the best available climate data for an area and explains potential impacts of climate change to key sectors. The report emphasizes that, although climate change presents challenges for forest stewardship and management, the importance of maintaining healthy forests in urban as well as natural areas is becoming increasingly important. (<http://glisa.umich.edu/resources/summary>)

According to the third U.S. National Climate Assessment, “The composition of the region’s forests is expected to change as rising temperatures drive habitats for many tree species northward. The role of the region’s forests as a net absorber of carbon is at risk from disruptions to forest ecosystems, in part due to climate change. Among the varied ecosystems of the region, forest systems are particularly vulnerable to multiple stresses. The habitat ranges of many iconic tree species such as paper birch (*Betula papyrifera*), quaking aspen (*Populus tremuloides*), balsam fir (*Abies balsamea*), and black spruce (*Picea mariana*) are projected to decline substantially across

the northern Midwest as they shift northward, while species that are common farther south, including several oaks and pines, expand their ranges northward into the region.” (NCA, Ch. 18: Midwest. www.globalchange.gov)

The Northern Institute of Applied Climate Science (NIACS) and Northern Michigan University have produce vulnerability reports for Michigan forests, identifying “winners” and “losers” among tree species and forest communities (www.nrs.fs.fed.us/pubs/45688). Another report on future tree species distribution under warmer temperatures, published by the US Forest Service, expects most oaks to benefit from climate change in Michigan, but most conifers are negatively impacted. <http://www.nrs.fs.fed.us/atlas/tree>

Geology

Monroe County is located in a geological region known as the Michigan basin, which is characterized by successive bands of sedimentary rock formed between 325 and 360 million years ago and underlain by a strata of Paleozoic rock consisting of limestone and dolomite, sandstone and shale (Bowman, 1981).

Throughout much of the county, the bedrock is within 10 or 20 feet of the surface, and in some instances that rock is exposed. Where the bedrock is close to the surface, several of the formations have proven economically useful. While no metallic minerals are present, the limestone of the area has proven useful for cement production and the sandstone for high quality glass manufacturing.

Karst landforms are also present in many areas of Monroe County. Karst is formed when the underlying carbonate rocks have dissolved as a result of contact with mildly acidic water. These underground voids can lead to sinkholes, caves, and other unstable, and sometimes changing, surface topography. Karst formations may also impact groundwater quality and quantities, by creating direct conduits between the surface and underground water, providing a potential pathway for the pollution of drinking water. Karst sinkholes have been found in many areas of Monroe County. A unique karst feature known as the Great Sulfur Spring is located in the Erie Marsh, which is a tufa mound spring fed from the karstic bedrock aquifer.

Glacial Geology

Almost the entire state of Michigan is covered by glacially deposited material, known as glacial drift. Although many parts of the state have complex hills, ridges, and valleys which were the result of glacial features such as moraines, eskers, and kames, Monroe County owes its general lack of topographic relief to ancient lake beds. The bedrock in Monroe is, in general, directly overlain by a layer of clay till, deposited as a till plain by receding glaciers. This till layer is, in turn, overlain by glacial lake bed sediments, composed of various textures but primarily lake plain clay and lake plain sand. Beach ridges, deposited as ancient Lake Erie successively rose and fell over time, left long sandy ridges in the western half of the county running roughly parallel to the present shoreline.

Topography

Monroe County is located within the Maumee Lakeplain sub-subsection (sub-subsection VI.1.1) and the Huron/Erie Lakeplains ecoregions. The Maumee Lakeplain is an extremely flat and poorly drained landscape with narrow bands of sand over clay of glacial origin. Sandy beach ridges, formed by glacial lakes, are common on both the clay plain and broad drainages, particularly further inland. Monroe County contains the lowest elevation in the state of Michigan, on the shores of Lake Erie, measuring at 571 feet above sea level. The floodplains of rivers such as the River Raisin are gently sloping toward the east to Lake Erie. Slopes range from 0 to 6%. In the relatively flat landscape of the lakeplain, even slight changes in topography interact with soil and climate to define distinctive plant communities.

The US Geologic Survey has published topographic maps covering 7.5 minutes (one eighth of a degree of latitude and longitude) which have a scale of 1: 24,000 so that 1 inch on the map represents 2,000 feet on the land. These maps generally have contour intervals of 10 feet (vertical dimension) and show a number of useful features: forests, rivers, wetlands, etc. The maps are available from multiple sources including: http://www.michigan.gov/dnr/0,4570,7-153-10371_14793-31264--,00.html

Land Cover

The landscape of Monroe County is a mixed land use of agriculture, forest, wetlands, and developed or urban areas. The dominant land use, approximately 54% of the county, is agriculture, a combination of row crops, vegetable, and nursery/floriculture. Urbanized areas, residential, commercial, industrial, and governmental, make up the second most common land use. Approximately 20% of Monroe County is covered by trees, or considered forested. Generally speaking, naturally forested landscapes are a mosaic of vegetation types transitioning from one to another. The DNR land cover analysis classifies forests in broad categories: deciduous forest, mixed forest, evergreen forest, and woody wetlands. Other classifications make finer distinctions among different forest types, based on characteristic soils and species. Donald Dickmann (2004) offers a more detailed classification in *The Michigan Forest Communities Guide* from a forestry perspective—including human-created plantation forests—while Michigan Natural Features Inventory (MNFI, <https://mnfi.anr.msu.edu/communities/>), which surveys plant and animal species and habitats throughout the state, offers an ecological view.

Monroe County contains a variety of natural areas, including upland and lowland hardwood forests, wetlands, and open space. However, little remains of the extensive pre-1800s forest communities of the area. The remaining forested systems in the county are highly fragmented with most of the present woodlands being small (10 -60 acres) woodlots scattered throughout the county. Forest fragmentation has significant ecological consequences. In addition to reducing habitat size and carrying capacity of the area, recent research has documented an array of negative effects of fragmentation: edges are warmer and drier, with more potential for drought stress; higher susceptibility of edge trees to wind damage; and greater potential for species invasions, both by non-native plants and by birds that are nest predators (Snyder, 2014).

Pre-1800s Vegetation

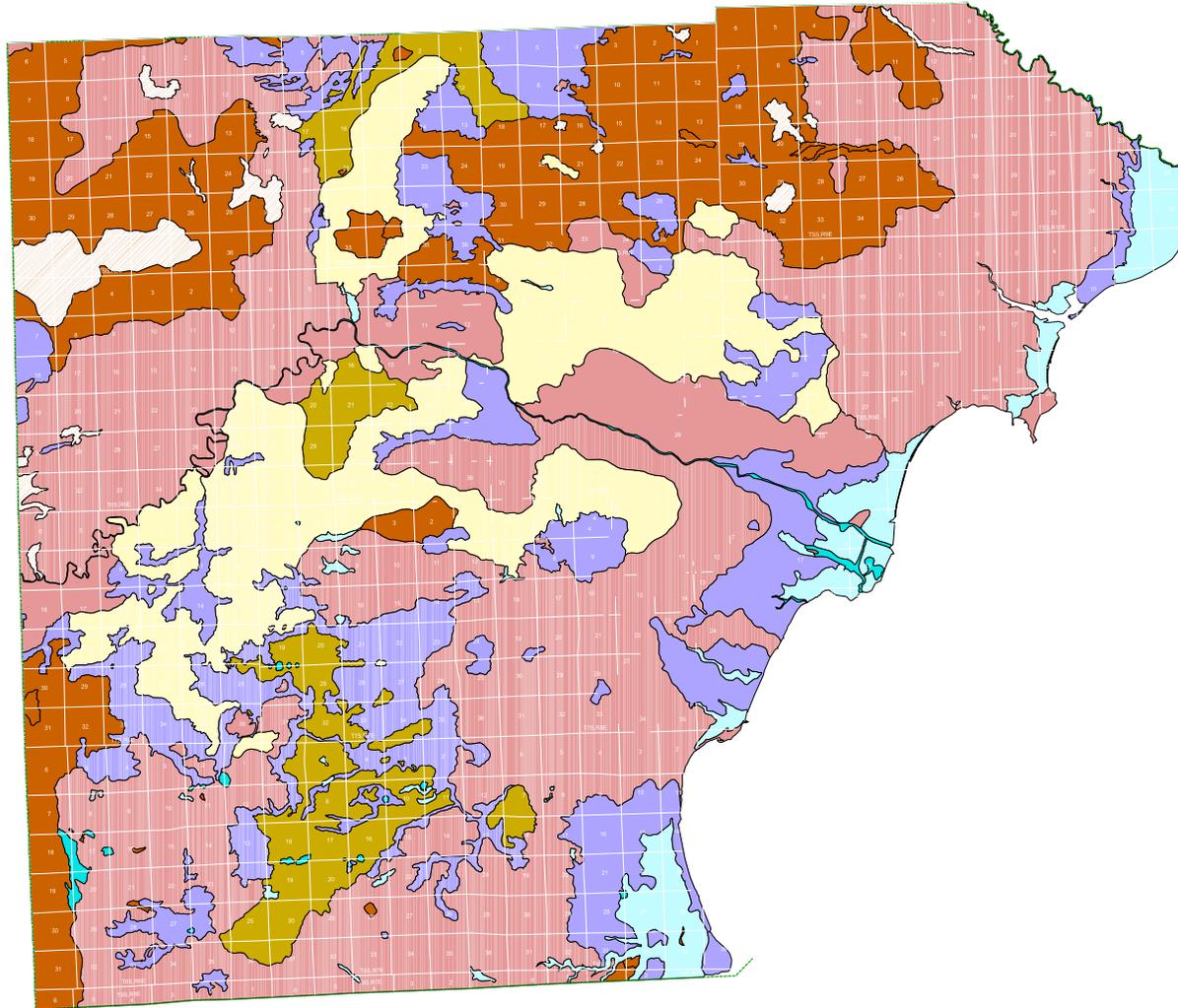
Between 1816 and 1856, Michigan was systematically surveyed by the General Land Office (GLO) and information collected by the land surveyors was used to reconstruct Michigan's pre-European settlement landscape. Surveyors took detailed notes on the location, species, and diameter of each tree used to mark section lines and section corners. Biologists from the Michigan Natural Features Inventory developed a methodology to translate the notes of the GLO surveys into a digital map that can be used by land managers and the general public to assess historical plant communities. Figure 3.6 shows this data for Monroe County.

Maps for each county in Michigan are available at: <https://mnfi.anr.msu.edu/data/veg1800.cfm>

Vegetation circa 1800 of Monroe County, Michigan

An Interpretation of the General Land Office Surveys

By P. J. Comer and D. A. Albert
Michigan Natural Features Inventory
1997



Legend

- ASPEN-BIRCH FOREST
 - ✓ BEECH-SUGAR MAPLE FOREST
 - BEECH-SUGAR MAPLE-HEMLOCK FOREST
 - ✓ BLACK ASH SWAMP
 - BLACK OAK BARREN
 - CEDAR SWAMP
 - GRASSLAND
 - HEMLOCK-WHITE PINE FOREST
 - HEMLOCK-YELLOW BIRCH FOREST
 - JACK PINE-RED PINE FOREST
 - ✓ LAKE/RIVER
 - MIXED CONIFER SWAMP
 - ✓ MIXED HARDWOOD SWAMP
 - MIXED OAK FOREST
 - MIXED OAK SAVANNA
 - MIXED PINE-OAK FOREST
 - ✓ MUSKEG/BOG
 - OAK-HICKORY FOREST
 - OAK-PINE BARREN
 - PINE BARREN
 - SAND DUNE
 - ✓ SHRUB SWAMP/EMERGENT MARSH
 - SPRUCE-FIR-CEDAR FOREST
 - ✓ WET PRAIRIE
 - WHITE PINE-MIXED HARDWOOD FOREST
 - WHITE PINE-RED PINE FOREST
 - WHITE PINE-WHITE OAK FOREST
- ✓ = LAND COVER TYPE PRESENT ON THIS MAP



Scale 1:85,000



Map Projection: Lambert Conformal Conic

SOURCE: Comer, P.J., D.A. Albert, H.A. Wells, B.L. Hart, J.B. Raab, D.L. Price, D.M. Kashian, R.A. Comer, D.W. Schuen (Map Interpretation), M.B. Austin, T.B. Ledford, K.M. Kromoch, L. Prange-Gregory, J.G. Saultley, C.J. Delain, L.J. Springer, (Digital Map Production), 1995, Michigan's Present-day Vegetation, as Interpreted from the General Land Office Surveys 1816-1856, Michigan Natural Features Inventory, Lansing, MI, Digital Map.



Figure 3.6 Monroe County vegetation circa 1800 (MNFI, 1995)

3.1.4 Soils

Soil is the long-term result of weathering on glacial landforms. There is also a biological component of soil that includes decomposing organic matter and the organisms that live in it, so the properties of soils can vary greatly across a landscape and strongly shape plant communities. Soil types, water, and climate are the major determinants of vegetation in a region. Soil sustains growth, holds and filters water, provides habitat for microbes and other living organisms, and recycles dead material, thus providing the nutrients needed to support future growth. Land management practices can greatly enhance soil health by increasing the amount of organic matter in the soil. Landowners can benefit from understanding the relationship between soil characteristics and appropriate land use.

The soils of Monroe County range from mature (those formed in glacial deposits and exposed to soil forming factors) to young (those formed recently such as alluvial sediment and lacustrine deposits). These soils are well suited for agricultural use, especially when drained, but often have limitations for development. Some of the most frequently mapped in the area are Pewamo clay loam, Selfridge loamy sand, Lenawee silty clay, and Hoytville silty clay loam (Bowman, 1981). All the soils in the county have fair suitability for woodlands, although wetlands can cause slow growth and poor regeneration.

Properties	Ecological Habitats				
	Xeric	Dry - mesic	Mesic	Wet - mesic	Hydric*
Average moisture during the growing season	Very dry	Somewhat dry	Moist	Very moist; water may stand in spring	Very wet
Drainage	Excessively drained	Very well-drained	Well-drained	Somewhat poorly drained	Very poorly drained or undrained
Surface soil textures	Sand to loamy sand	Loamy sand to sandy loam	Sandy loam to loam	Loam to clay loam	Sand to clay loam or organic (muck or peat)
Natural fertility	Infertile	Moderately infertile to fertile	Very fertile	Fertile to moderately fertile	Moderately fertile to very infertile

Figure 3.7 Soil properties and ecological habitats (Dickmann, 2004)

The US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) has conducted soil investigations in Monroe County, and the results have been mapped at a scale of 1: 15,840 which is fine enough to represent areas larger than about two acres. The

mapping is supported by a database that contains information about basic soil properties and the appropriate use of soil areas based on those characteristics. They provide numerous interpretations of cover crop production, hydric soils, recreational development, soil health, etc. Under the land management heading, there are several interpretations that relate to forestry such as haul roads, erosion hazard, harvest equipment, seedling mortality, and windthrow hazard.

This detailed soil information is available in printed form from the Monroe County Conservation District offices as well as Web Soil Survey, an internet site that shows recent aerial imagery, allows the user to select an area of interest to assess the soil map units present, and search interpretations such as suitability for paths and trails. The print versions of Soil Survey show appropriate trees to plant on various soil types and a site index for examples of the most common trees that are adapted to the soil characteristics for the mapped area.

Web Soil Survey: (<http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>),

Scientists who study soils developed a taxonomic system for classifying types of soils based on biological, chemical, or physical properties. There are 12 possible classifications that are also explored and defined on the NRCS website for landowners who are especially interested in the specific details of the soil on their property:

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_053588

Smart phone users can take advantage of the SoilWeb app which uses the device's GPS location to display the most common soils at that site. It has basic information that includes a soil profile, landscape position, and simple graphs that display sand, silt, clay, organic matter, and pH with depth.

The Soil and Plant Nutrient Laboratory housed at Michigan State University (<http://www.spnl.msu.edu/>) offers a variety of analytical services to landowners from their samples of soil, compost, plant tissue, water, and other materials related to the growing of plants. Determining pH and nutrient status of the soil through testing is a key method of determining which amendments (lime and fertilizer) should be added for optimal plant growth. For more detailed understanding of the soils on a particular site, contact the Natural Resources Conservation Service or Michigan State University Extension.

3.1.5 Water and Hydrology

Monroe County contains 13 subwatersheds that drain into Lake Erie. The River Raisin and the Huron River are the largest of the river systems in the county. Several smaller tributaries in the county include Plum Creek, Stony Creek, Swan Creek, Otter Creek, and Halfway Creek. Due to the lack of topography, these waterways are typically short, slow moving streams. Many of the streams have been heavily impacted by dredging and channelization to support economic activity of the area including agriculture. Water quality of these streams has historically been negatively impacted by runoff from agriculture and urbanized activity. The lower portion of

the River Raisin was declared an Area of Concern (AOC) by the U.S. Environmental Protection Agency (EPA) under the 1987 Great Lakes Water Quality Agreement. However, many of the Beneficial Use Impairments (BUIs) listed for the River Raisin have been removed in recent years due to the continued efforts of the local citizens and environmental groups to improve the health of and continuously monitor the river. Despite challenges faced with water quality, many of the streams and rivers hold good populations of fish and freshwater mussels, including several that are listed as special concern, threatened, or endangered.

Beginning in the mid-1800s, the beaver (*Castor canadensis*) population entered a steep decline due to trapping and habitat loss. The loss of beavers (and the dams they masterfully construct) drastically changed the landscape, as previously flooded areas drained allowing woody species to encroach on seasonally inundated areas. This landscape change resulted in natural barriers which suppressed fire and eliminated the natural disturbance necessary to maintain the previously dominant ecosystems. Beaver populations are slowly returning to southeast Michigan, but the role they will play in managing existing systems has yet to be determined.

Many management plans produced for this region have recommended the need to return the county hydrology to a more natural state when beaver populations were higher. This is an objective that is often seen when plans address stormwater, nutrient loading, and natural area habitat restoration. Many times forest management plans reflect the same need because forest type and prevalence can be determined by hydrology. This is a very difficult goal to accomplish when much of the land is used in traditional agricultural production, which the local economy relies on heavily.

Lakes

Lake Erie, the smallest of Michigan's Great Lakes, stretches along Monroe County from the mouth of the Detroit River to the Ohio border. Named for the tribe of Indians that lived on its southern beaches, the surface area of Lake Erie is 9,910 square miles, making it the 11th largest lake in the world. It is the shallowest of the Great Lakes, with an average depth of 62 feet and a maximum depth of 210 feet. Historically, Lake Erie played an important role in transportation and the development of the upper Great Lakes region.

Today, Lake Erie is better known for its sport fishing, particularly of walleye and yellow perch, and several charter fishing services operate out of Monroe harbors. Michigan's only state park on Lake Erie is the 1,300-acre Sterling State Park, which offers over a mile of sandy beach, shore fishing, a boat launch, six miles of trails for hiking, biking, and cross country skiing, and lakefront sites at the seasonal campground.

Nearby Lake Erie Metropark, with three miles of Great Lake shoreline, is home to coastal marshes and wetlands that allow for prime wildlife viewing, notably the raptors, or birds-of-prey, that pass through every year from September to November. This is the site of the annual Hawkfest in September, which attracts birders from all over the world because it is a chance to

see tens of thousands of migrating hawks in a single day. The park also offers a wave pool, a boat launch, 18-hole golf course, and multiple family picnic and play areas.

Pointe Mouillee State Game Area just south of the Metropark is also known for wildlife viewing and hunting. The 4,000-acre site boasts one of the world's largest fresh water marsh restoration projects, less than an hour south of the city of Detroit on Lake Erie.

The only natural inland lake in Monroe County is the 67-acre Lake Ottawa. The majority of the inland bodies of water in the county consist of small ponds and water contained in quarries, though these small ponds and lakes still provide important habitat for a variety of plants and animals. Shoreline vegetation, including trees and woodlands, play an important role in lake ecosystems and water quality. The Department of Environmental Quality's (DEQ) Inland Lakes and Streams program has been participating in the Michigan Natural Shoreline Partnership (See Section 3.4.1) to promote natural shoreline landscaping to protect Michigan's Inland Lakes and to educate property owners about using native plants and technologies that benefit lake ecosystems.

3.1.6 Wetlands

Wetlands are defined as areas with 3 key characteristics, which together form the ecological conditions for various wetland regulations:

- **Wetland vegetation or hydrophytes:** Plants that rely on standing water or saturated soil for at least part of the growing season.
- **Hydric soils:** Soil that formed under conditions of saturation, flooding, or ponding during the growing season to develop anaerobic conditions in the upper part.
- **Wetland hydrology:** The movement of water in wetland that typically leads to soil saturation and to the development of characteristic soils and plant communities.

It has been estimated that prior to European settlement, Monroe County held approximately 264,000 acres of wetland and since that time, over 94% of the wetlands have been lost and degraded due to conversion for agricultural, residential, and industrial development; alteration of groundwater hydrology; and invasion of non-native invasive species, according to the USDA.

Several different wetland types are found in Monroe County. The Maumee Lakeplain is a relatively flat and poorly drained landscape and as a result, a variety of both forested and open wetland communities exist throughout the county. These include mixed hardwood swamps, wet-mesic flatwoods, floodplain forests, and the once common but now scarce lakeplain prairies. Lakeplain prairie is among the most diverse landscapes in the state and is home to a high number of rare plants and animals. These unique natural communities consist of both prairie and wetland species that have adapted to seasonal water level fluctuations. Wet-mesic flatwoods are forested wetlands that contain a mix of both upland and wetland hardwood tree species that are also tolerant of seasonal flooding. Small seasonal pools, called vernal pools, are

abundant in wet-mesic flatwoods and are a critical habitat for aquatic invertebrates and amphibians. Detailed information about these and the other unique natural communities in Monroe County, including species characteristic of various types of woody wetlands, is available from the Michigan Natural Features Inventory website and publications.

The US Fish and Wildlife Service provides a mapping program called National Wetland Inventory. The Cowardin System of Classification is utilized and indicates the distinctions among palustrine (inland wetland which lacks flowing water), lacustrine (associated with lakes), and riverine systems. The Wetlands Mapper integrates digital map data with other resource information to display wetland type and extent using a biological definition of wetlands. Wetlands Mapper, however, does not define the limits of proprietary jurisdiction of any federal, state, or local government, so landowners should consult with appropriate agencies (Michigan DEQ or USDA) before conducting clearing, earth moving, or other operations that may affect potential wetlands.

Michigan's wetland protection laws and subsequent regulations sought to limit wetland degradation and loss, thus minimizing the loss of ecological function and vast amount of ecosystem services that wetlands provide. Among their most important functions, wetlands help safeguard water quality in surface water (rivers and lakes) and serve as groundwater recharge areas to fill aquifers. They can also slow runoff water and serve as a buffer to reduce flooding downstream, reduce sedimentation in streams and rivers, and improve overall water quality through filtration. They can absorb excess nutrients (from fertilizers applied in nearby agricultural fields) which helps to slow or prevent eutrophication of lakes and ponds. They also filter pollutants out of runoff water and can bind to (or in some cases break down) toxic pollutants that would be incredibly damaging in other ecosystems.

Part 303, Wetlands Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, administered by the Michigan Department of Environmental Quality is the main state regulation that affects wetland use and alteration. In Michigan, the Section 404 federal authority associated with inland waters and wetlands was assumed by the State in 1984.

The USDA Natural Resources Conservation Service regulates wetlands on agricultural land. Under the Wetland Conservation provisions, USDA program participants are prohibited from converting wetlands on their property to cropland or pasture, unless the wetland acres, functions, and values are compensated for through wetland mitigation. Established in 2014 by the USDA, the Wetlands Reserve Easements program provides a financial incentive to private landowners to encourage the restoration of previously degraded or drained wetlands. NRCS pays a per-acre easement fee, plus 100 percent of the cost to restore the agricultural lands back to native wetland ecosystems. The landowner retains title, control of access, and hunting rights, but must protect and maintain the restored wetland ecosystem for future generations. The landowner can sell the land, but the easement (and its protections) remain enforced in perpetuity.

In addition to their many water quality benefits, wetlands also provide habitat for diverse species, including waterfowl, wildflowers, fish, frogs, and other amphibian species. Even small seasonal wetlands, such as vernal pools or ponds, benefit biodiversity, often serving as key breeding areas for amphibians, reptiles, snails, mussels, dragonflies, and damselflies. They also provide resources for numerous bird species (Thomas et al., 2010).

Coastal Wetlands

Monroe County hosts 22 miles of Lake Erie coastline. In the early 1800s, the majority of it consisted of coastal wetlands. These wetland systems are considered one of the most productive natural communities in the Great Lakes. They are an extremely dynamic system, ever influenced by the changing water levels of Lake Erie. Great Lakes Marsh systems also include Lakeplain prairies and adjacent wooded wetlands located on the fringes of the marsh. During periods of high water in Lake Erie, these prairies were inundated, allowing more water tolerant plant species to eventually establish themselves. Great Lake Marsh is a rare natural community that is globally imperiled. While these wetlands are the most productive global natural system, they are affected by not only Great Lakes water levels, but more importantly, the development of shoreline areas, urban growth, industrialization, and agriculture, which contribute to the degradation of the wetlands from polluted urban and agricultural stormwater runoff, industrial discharges, and sewer overflows (Paskus, 2017).

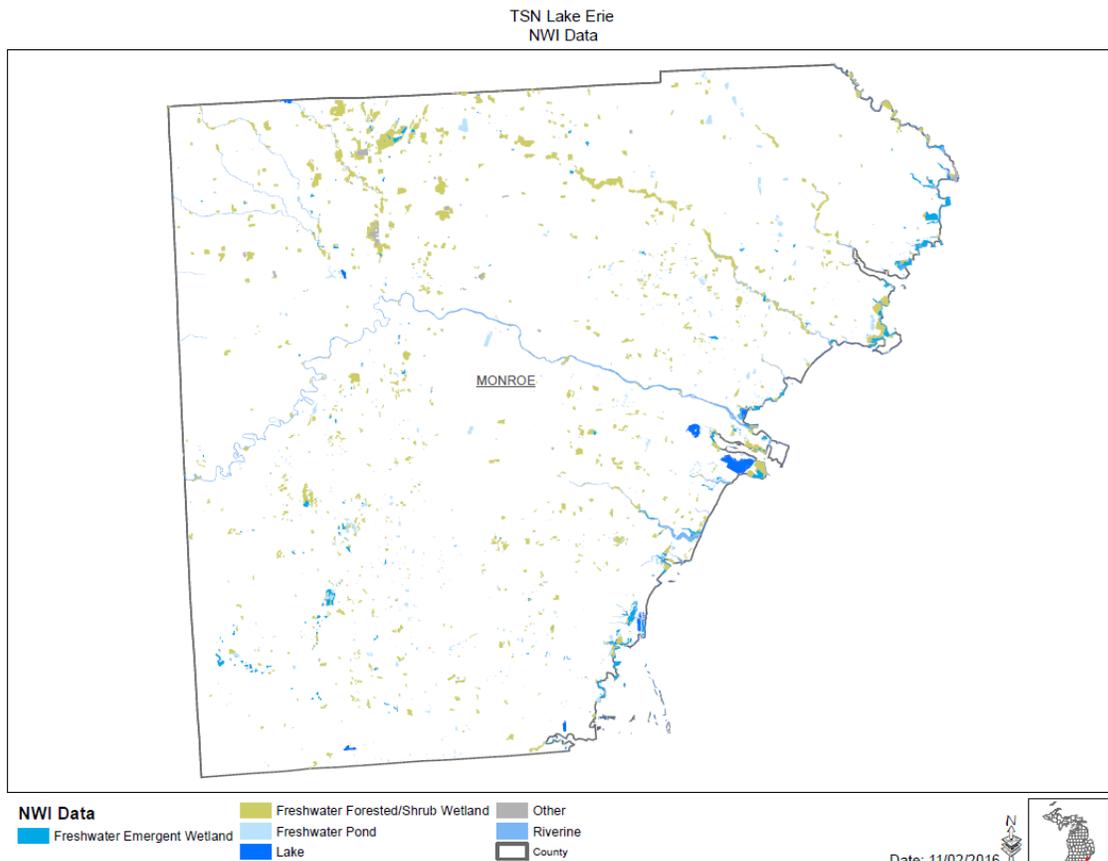


Figure 3.8 National Wetland Inventory Map of Monroe County (Michigan DNR)

3.1.7 Biological Diversity: Natural Communities and Species

While the vast majority of property in Monroe County is either agricultural or urbanized, there still exists a significant amount of land that contains noteworthy native ecological communities. Over 20,000 acres of wetlands, 8,000 acres of parks, 6,000 acres of riparian corridors, and 22 miles of Lake Erie shoreline contain an array of very rare ecosystems and a number of threatened and endangered plant and animal species. One of the largest contiguous areas of lakeplain prairie and oak savanna in Southeast Michigan occurs in Petersburg State Game Area between Monroe and Adrian, which is the release site and now home to the federally endangered Karner blue butterfly (Paskus, 2017).

Threatened and Endangered Species

Biological diversity refers to the variety and abundance of species, communities, and ecosystems in a specific area. Michigan is noted for having more vegetation types than any other Midwestern state. The Michigan Natural Features Inventory, which “conducts field surveys to locate and identify threatened and endangered species and communities throughout the state, and maintains a database of all relevant species and community locations” ([MDNR, Natural Features Inventory](#)), has created a Natural Community Classification for Michigan that includes 77 communities grouped into 18 ecological groups, defined by their landscape occurrence and vegetation characteristics. According to MNFI’s Rare Species Explorer, there are 119 state endangered, threatened, and species of special concern in Monroe County. The MNFI website can be searched by taxonomy (type of organism), habitat, state and federal status, and county.

The U.S. Fish and Wildlife Service lists three endangered species for Monroe County: The Indiana Bat (*Myotis sodalist*), Karner blue butterfly (*Lycaeides melissa samuelis*), and northern riffleshell (*Epioblasma torulosa rangiana*). An additional three species are listed as threatened: the northern long-eared bat (*Myotis septentrionalis*), Rufa red knot (*Calidris canutus rufa*), and the eastern prairie fringed orchid (*Platanthera leucophaea*). Spotted and Blanding’s turtles (*Clemmys guttata* and *Emydoidea blandingii*) are known to occur in Monroe County and are associated with many of the wetland systems found near the coast. Both turtles are currently under consideration for federal listing. Threatened species are animals and plants that are likely to become endangered in the foreseeable future. Identifying, protecting, and restoring endangered and threatened species is the primary objective of the U.S. Fish and Wildlife Service’s endangered species program (USFS Endangered Species list, 2016). See Appendix C for a full list of species listed by the state in Monroe County, according to MNFI.

Four globally rare natural communities occur in Monroe County: Lakeplain Wet and Wet-mesic Prairie, Lakeplain Oak Openings, Wet-Mesic Flatwoods, and Mesic Sand Prairie (Paskus, 2017). All four of these communities are considered imperiled due to the significant habitat loss over the past 200 years. Today, only approximately 1000 acres, or less than .4% of the historical extent of these four communities remain.

Table 3.3 Species of Concern in Monroe County

Species of Concern	# Species	Partly relies on woodlands, trees	Forest is primary habitat
Bird	13	4	0
Butterfly/Moth	4	3	0
Fish	10	3	0
Insect	6	2	0
Mammal	0	0	0
Mussel/Clam	22	5	1
Reptile/Amphibian	5	6	2
Snail (aquatic)	3	3	1
Snail (terrestrial)	5	5	5
Herbaceous Plants	49	48	20
Grand Total	119	79 (66.3%)	29 (24.4%)

(MNFI)

Wildlife Habitat

Wildlife habitat needs can vary greatly depending on animal species. Territories can range from less than an acre for small mammals to about ten square miles for large predators such as bears and coyotes. Some species prefer forest edge habitat, while others require large blocks of grassland or forests. What is required by one species may be detrimental to another, so landowners who want to manipulate habitat need to decide which animals they will inevitably favor. Another approach is to concentrate on improving or managing the native habitat or combination of habitat types (mature forest, early successional forest, prairie, wetlands, etc.) that already occur on the property. This strategy most often satisfies the needs of most of the native species that naturally occur in those ecosystems and helps to make the communities more resilient to system stressors like pests and diseases. This approach will typically allow for smaller, targeted species-specific habitat manipulation (such as food plots for deer) depending on the size of the area being managed, without compromising the integrity of the native system. While traditional agricultural land does not have as much biodiversity as natural plant communities, it is the dominant land use in Monroe County and there are practices that can improve the habitat value of working lands. Most stewardship plans address wildlife habitat and there are many practices that can be used to create or improve support for animals, which includes providing opportunity for obtaining food, water, cover, and enough space to live and reproduce. These resources can be provided by appropriate management of existing natural areas or restoration of plant communities that support the target species.

Forests of Recognized Importance

Forests of Recognized Importance (FORI) are defined by the American Tree Farm organization as “globally, regionally and nationally significant large landscape areas of exceptional ecological, social, cultural or biological values.” FORI occur at the landscape level, not the individual stand or ownership level. In Michigan, FORI on private forest land are mostly

associated with important wildlife habitat, rare forest types, corridors of unique rivers, and Great Lakes coastlines. In the Southern Lower Peninsula, large intact forests greater than 500 acres that provide habitat for state and federally listed species or for species that require core interior habitat can be considered FORI. As of March 2017, no FORI areas were identified in Monroe County.

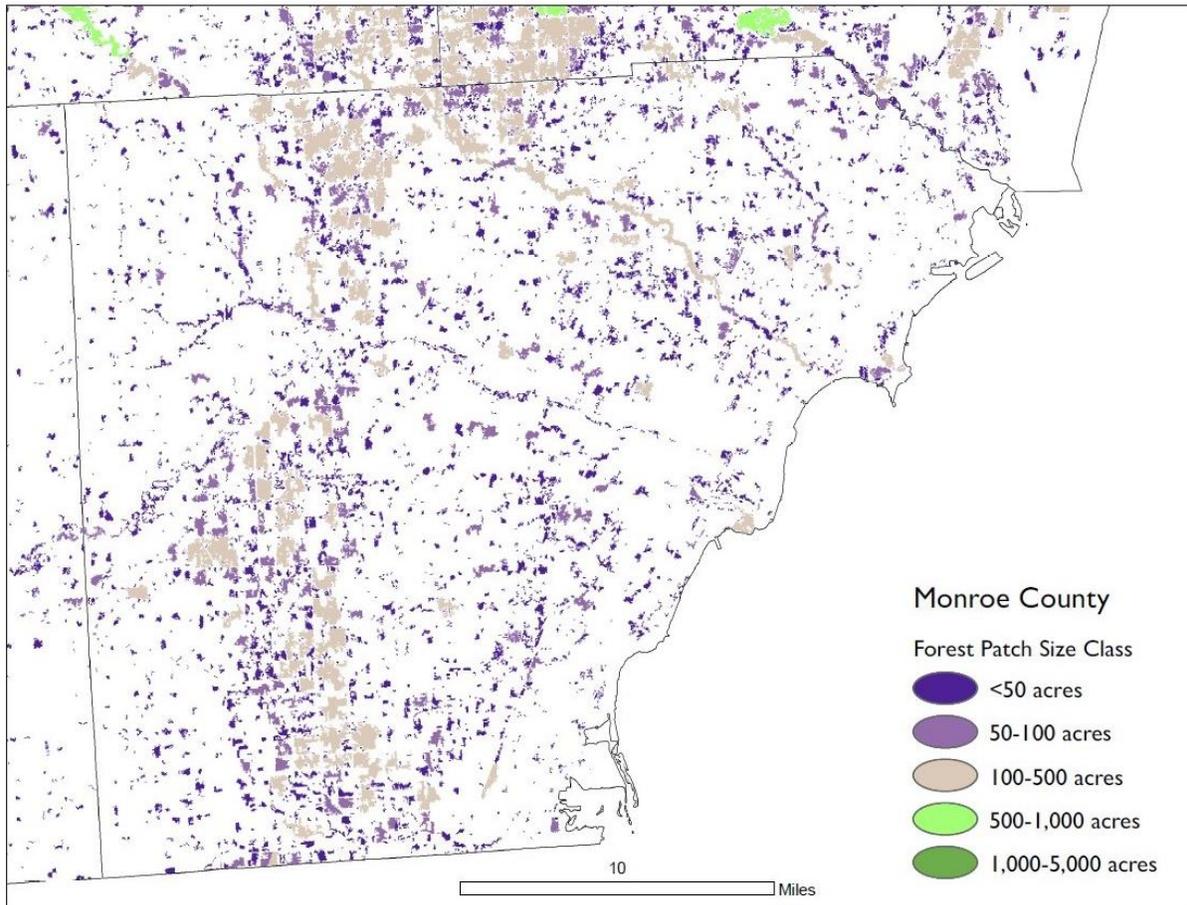


Figure 3.9 Forested areas in Monroe County (MNFI)

Forest types

The flat topography, poorly drained soil types, and seasonal fluctuation in hydrology of the western Lake Erie basin landscape has led to a drastic change in forest type throughout southeastern Michigan since the 1800s. This change is due to increased urbanization and agricultural land use in rural areas. Roughly 55% of the landscape in Monroe County is used for agriculture (Paskus, 2017). This landscape alteration has led to drastic fragmentation of forested areas, resulting in reduction of historically significant forest types and reduced viability of remaining woodlots. Hardwood swamp, beech-sugar maple, wet-mesic flatwoods, and lakeplain oak openings were historically prevalent in specific areas of southeastern Michigan.

In the early 1800s more than 60% of land cover in a five county span of southeastern Michigan was classified as hardwood swamp and beech-sugar maple forests. During that time 13% of Monroe and 5% of Wayne County acreage were lakeplain oak openings. Historically, fire and beaver activity throughout the southeastern Michigan landscape had favored prairie and savanna communities instead of forest. The suppression of fires and elimination of beaver populations throughout the late 1800s resulted in a shift of land cover favoring certain forest types adapted to the lakeplain area in southeastern Michigan.

The persistence of wet-mesic flatwoods is limited to southeastern Michigan as a result of the glacial lakeplain landscape. Historically, forested stands in southeastern Michigan on poorly drained soils were wet-mesic flatwoods and hardwood swamps. At present there are only six documented occurrences of wet-mesic flatwoods in Michigan, totaling 240 acres; these can be found in Monroe, Wayne, and Macomb counties located in the sand/clay lakeplain bordering western Lake Erie. This forest type is common in this region because of seasonal inundation caused by altered drainage which is a result of impermeable subsurface layers and low stream density (Slaughter et al., 2010).

Wet-mesic flatwoods are characteristic of clay lakeplains with channels of lacustrine sand deposits of low ridges and small dunes that are seasonally wet. The slight changes in elevation common to these areas result in flat uplands and depressed wet areas. This community type receives moisture through surface water and loses it through evapotranspiration. Most of the tree species present in these communities, such as lowland hardwoods, are adapted to flood – drought cycles and have developed adaptations specific to inundation, rapid changes in water level, and low oxygen availability during the growing season (Slaughter et al., 2010). Wet-mesic flatwoods lack sugar and beech maples which are characteristic of more common mesic southern forests.

The depressions found in this topography are seasonally wet, supporting lowland hardwoods including oak, maple, and ash species. Understories of wet-mesic flatwoods generally have low species richness due to regular inundation and a closed canopy. However, the windthrow that is common in these areas causes a “pit-and-mound topography” by uprooting trees, which provides microhabitats for certain plant species allowing for increased diversity of ground cover (Slaughter et al., 2010). The wet depressions common to wet-mesic flatwoods often form vernal pools which are critical as breeding ponds for amphibians and aquatic invertebrates. Regular disturbances are crucial to the persistence of these ecosystems. Many of the plant species present are disturbance dependent and rely on factors such as wildfires to thrive.

Remaining wet-mesic forest sites are fragmented woodlots found in a degraded agricultural landscapes and have poor viability due to fragmentation, altered hydrology, invasive species, and excessive herbivory by white-tailed deer. Excessive herbivory has detrimental impacts on community structure, species composition, and successional trajectory (Slaughter et al., 2010) in these forested areas. This type of community is historically associated with wetland complexes and occupied higher topography. The successional turnover of upland areas to wetland

communities is often the result of altered hydrology, such as that caused by beavers for example. Hydrologic disruption resulting from urban and agricultural development have severely limited the presence of wet-mesic flatwoods and reduced them to fragmented woodlots.

Mesic Southern Forests are beech and sugar maple dominated woodlands found in loamy soil type regions. They are thought to be prevalent in Monroe County. However, the number of acres may be overestimated as wet-mesic flatwoods are thought to often be misclassified as the mesic southern forest type. This forest type like other dominate types in Monroe County are common to glacial lakeplains. This forest type can be supported by soils ranging from sand to clay, but soils are typically well-drained and have a high saturation threshold. Soils in this forest type have good soil fertility due to high nutrient input from the decomposition of leaves and woody debris.

The canopy of this forest type is usually dominated by American beech (*Fagus grandifolia*) and sugar maple (*Acer saccharum*) which generally make up about 80% of canopy cover. Other prominent species include red oak (*Quercus rubra*), white oak (*Quercus alba*) American elm (*Ulmus Americana*), and white ash (*Fraxinus americana*). Dominant shrub species in the understory include dogwoods (*Cornus spp.*), and ground cover species such as spring beauty (*Claytonia virginica*), jack-in-the-pulpit (*Arisaema triphyllum*), white and yellow trout lily (*Erythronium spp.*), trillium (*Trillium Grandiflorum*), and wild geranium (*Geranium maculatum*). Rare plants often found in mesic southern forests that are of state concern and common to this region include stiff gentian (*Gentianella quinquefolia*) and prairie trillium (*Trillium recurvatum*) (Kost et al., 2007).

Large tracts of mature mesic southern forests are crucial habitat to many species. Cavity nesters and canopy dwelling species rely on these forested areas as do amphibian species that require vernal pools for reproduction. These species include many state threatened or concerned hawks, warblers, salamanders, and turtles.

The most important management objective for preserving biodiversity in these systems is to preserve and restore large tracts of mature growth. In order to restore woodlands to successful tracts, important factors are the management of white tailed deer (*Odocoileus virginianus*) populations to low densities, reducing anthropogenic disturbance, and preventing the introduction of invasive species. These factors can impede the structural features that are necessary to forest's complex function as wildlife habitat.

Hardwood Swamps are a forested wetland type historically prominent in southern Michigan. Approximately 1,200,000 acres of lowland hardwood forest occurred in Southern lower Michigan in the 1970s (Slaughter et al. 2010). This forest type was characteristic of southern lower Michigan due to the influence of windthrow and fluctuating water levels. Community structure and species composition are influenced by these natural processes. The poorly drained soils that resulted in glacial lakeplains often have dominate clay subsurface layers that impede

drainage and result in seasonal ponding in surface depressions. These depressions that allow for seasonal pooling of surface water are characteristic of southern hardwood swamps. The seasonal fluctuation in surface and ground water levels allows hardwood species to outcompete other tree species and prevents these forest types from being dominated by shrubs and herbaceous ground cover. The weak structure of organic, often anaerobic (low oxygen) soils associated with wetland ecosystems makes trees present susceptible to windthrow. (Slaughter, 2009).

Hardwood swamps present in lakeplain ecosystems are often adjacent to wet-mesic or lakeplain forest and prairie natural communities. Silver maple (*Acer saccharinum*) and green ash (*Fraxinus pennsylvanica*) are often dominant, but American elm and cottonwood (*Populus deltoides*) are also common to this forest type because of their high tolerance of water level fluctuation. However, sites that do not experience extreme fluctuation in water levels often have canopies dominated by red maple (*Acer rubrum*) and black ash (*Fraxinus nigra*). Conifers are often a rarity or are more commonly absent from this community.

Southern hardwood swamps sites adjacent to permanent bodies of water are likely to have higher diversity of amphibians due to the availability of appropriate breeding habitat. This forest type provides habitat for many important amphibian species such as the northern spring peeper, green frog, and striped chorus frog. Many species of birds prefer this forest type for nesting and utilize mature trees for their nesting sites. Some notable species are:

- Great blue heron (*Ardea herodias*)
- Red-shouldered hawk (*Buteo lineatus*)
- Barred owl (*Strix varia*)
- Pileated woodpecker (*Dryocopus pileatus*)
- White-breasted nuthatch (*Sitta carolinensis*)
- Wood thrush (*Hylocichla mustelina*)
- Eastern wood-pewee (*Contopus virens*)
- Rose-breasted grosbeak (*Pheucticus ludovicianus*)
- Black-capped chickadee (*Parus atricapillus*)

Perhaps the most influential species to this ecosystem is the non-native beetle, the Emerald Ash Borer (*Agrilus planipennis*), which thrives in this environment and considers all Michigan ash species potential hosts. This beetle has caused tremendous ash tree mortality since its introduction in 2002. Lastly, while present in diminished populations in Monroe County, the beaver is making a comeback and does inhabit hardwood swamps. Beavers have a huge influence on the succession of hardwood swamps. The disturbance that beavers create by selecting for specific tree species and causing increased and prolonged inundation through the construction of dams has the potential to turn hardwood swamps into emergent marsh wetland or wet meadows. In Monroe, where there are likely few, small, isolated woodlots of this forest type, private landowners should make an effort to ensure that a portion of the surrounding land is suitable for native plants and can allow the woodlot to succeed into a corridor. This effort helps to alleviate the effects of fragmentation and provides suitable habitat and corridors for

species dispersal. It is also crucial to maintain structural diversity by leaving large, dead logs in place. These logs assist with the establishment of plants and provide necessary habitat for many species (Slaughter, 2009).

In the 1800's, Michigan's lakeplain oak openings were located on the glacial lakeplain along the shoreline of Lake Huron in Saginaw Bay, within the St. Clair River Delta, and near Lake Erie (Cohen, 2001). This historical prominence has been degraded to remnants throughout the entire range. The remaining occurrence of this forest type is roughly 0.02% of the historical extent, which was approximately 0.20% of Michigan. About 63% of that 0.20% was present in Monroe County. The remaining acreage was located in Wayne and St. Clair Counties. Currently, less than 0.004% of the surface area of Michigan is considered lakeplain oak openings. Many lakeplain oak openings that occurred in wetland areas were drained for agriculture and others were subject to residential and industrial development. The lowered water table, demand for oak timber across Michigan in the early 1900s, and suppression of wildfires as a result of this development has dramatically reduced the historical range of lakeplain prairies and oak openings. Oak species are dependent on fire disturbance and the decrease of both the occurrence and the intensity of fires in this region allowed for many of these areas to turn into denser forest types. The absence of fire leads to a closed canopy oak community in as little as 20 years as fire-intolerant species invade and thrive (Cohen, 2001).

The oak opening system is so rare because this forest type is specific to the sand channels formed along the Lake Erie shoreline as a result of glacial meltwater streams. This forest type thrives in this region because of the moderate water-retaining capacity of the soils. Historically, they are found in mosaics including sand flatwoods, hardwood swamps, lakeplain wet, wet-mesic, and mesic prairies. The wet-mesic variation found in flat, poorly drained areas is generally dominated by oak species with a ground layer similar to lakeplain wet and wet-mesic prairies and a canopy containing red maple, silver maple, green ash, and cottonwoods. The average canopy often only has 33% coverage (Bakowsky, 1988). They include numerous shrub types characteristic of sandy ridges and a ground layer dominated by graminoids and forbs. The presence of anthropogenic disturbance and the absence of fire provide the opportunity for invasive species to become established, reducing biodiversity of the native plant community.

An amazing, educational resource that illustrates all of the unique aspects of an Oak ecosystem is *Living in the Oak Openings* created by The Nature Conservancy Ohio's Green Ribbon Initiative. This book has been produced for numerous years with the third edition being released to the public in 2016. It is available online to download or in print at the local office. This resource provides landowners with an understanding of the oak ecosystems. It explains dominant and rare species of these ecosystems, the wildlife that it supports, its historic presence, and appropriate management for the ecosystem. It serves as a field guide as well as an educational tool for management.

3.1.8 Forest Resources

Most rural properties in Michigan have at one point or another utilized forests as a source of income, food, and other benefits (wildlife, aesthetics, recreation, etc.). While not as common, urban properties can often utilize forests resources in much the same way but on a much more limited basis. The Soil Survey for Monroe County states that most soils in the county are suitable for growing trees, although there may be some limitations due to wetness. The publication offers information on soil suitability for specific tree species and productivity attributed to local soil types.

Landowners who are interested in increasing tree cover on their property have a variety of options to choose from:

- 1) Transplanting of commercially available nursery stock
- 2) Relocation from another site using a tree spade or other heavy equipment
- 3) Planting seedlings or directly from seed
- 4) Allowing natural regeneration to occur from adjacent trees.

Each option has pros and cons. Options one and two typically have higher survival rates and the end goal of achieving tree cover is realized much faster, however the number and variety of tree species, especially native species, may be limited. The down side of transplants is the process can be quite expensive, especially if many are needed on a large parcel of property. The third option of planting seedlings is the most common approach is suitable for all project sizes. The results are faster than planting from seed, survival rate is typically good, it is relatively inexpensive, and a wide variety of trees species, including native species, are usually readily available (many of the conservation districts and other resource organizations offer tree sales). The last option, natural regeneration, is initially the least expensive, however, it may not produce the most desirable of species, and the process of site clearing or thinning of undesirable trees can be very time consuming.

The landowner will need to take into account their properties specific soil type & fertility, moisture availability, light conditions, and other factors in order to achieve the best results. The use of native trees is highly preferred because they have evolved under local environmental conditions and provide more food for native birds and other wildlife than non-native species. Plantings should be monitored regularly, especially over the first several years, and may need to be watered and mulched to encourage healthy growth. Tree guards may also be necessary if the area has significant populations of deer and rodents. The placement of new trees is always important. Property owners should avoid planting near utilities, especially power lines, and to stay a reasonable distance from sidewalks, driveways, and structures. The local conservation district can provide native tree recommendations and typically sells bare-root seedlings in the spring.

Forest age and structure can vary widely depending on the environmental conditions of the selected site. Determining harvest goals and methods are often tied to forest structure. Even-aged stands are those with trees of similar age while uneven-aged stands can have a wide

distribution of tree ages. The following general harvest methods are typically utilized to meet specific landowners' goals.

- A single or selective cut is the removal of specific trees that will favor an uneven-aged stand.
- A shelterwood cut is accomplished in several phases with the first cut setting the stage for the establishment of a seed bed for a new age class and a later removal cut that releases the already established small trees.
- Clear cutting removes all trees in an area with site reforestation being accomplished by natural regeneration or by planting seeds or seedlings to create an even-aged stand.

Some species (shade intolerant species in this case) such as aspen benefit from a clear cut because they regenerate by root sprouting and require full sunlight to encourage growth. Clear cuts can vary in size, with small ones being called patch cuts, and can be a variety of shapes, such as a strip cut.

Justification of a commercial harvest typically requires enough trees to be logged at one time to make it economically worth the effort. Advice on the feasibility of tree harvest can be obtained from a certified forester. A professional forester will mark trees that have reached their optimal size and should be harvested, but, equally important, identify trees to be retained to optimize yield or be used as seed trees for the next generation. A professional forester will have a strong understanding of how to maintain the productivity and health of the forest. In tree farm systems, a sustainable yield of timber products can be obtained by harvesting less biomass than what is growing. In most areas, a local conservation district forester can provide cost-free assistance to landowners interested in harvesting a woodlot.

Careful harvesting is often used to mimic natural disturbances (death due to diseases, insects, fire, or windthrow) that happen to forests. These disturbances may create a small opening or gap (such as is created by a single mature tree knocked over by wind) or may remove many trees from a large area (large-scale disturbance such as tornado or fire). These disturbances facilitate succession and produce the next generation of trees. Forests that lack a harvest program tend to favor shade tolerant species such as sugar maple and beech. Managing light availability can affectively dictate which species dominate in an area that has been harvested.

There is a wide range of tree-harvesting techniques and equipment, with the simplest tools being a chainsaw and a tractor. Individuals who wish to stick to traditional methods or want to minimize damage to the forest floor often use draft horses. Commercial loggers may use skidders which gather and drag cut trees to loading areas or a forwarder that picks up and carries the cut timber to a loading area. Tree companies that cut large volumes of timber may use a harvester, a machine that cuts the tree off at the stump and then trims the log and cuts it into desired lengths, all in one operation. Tree shears are also used (some have jaws that can cut trees up to 15 inches in diameter) and a feller-buncher (cuts trees off with a saw or shears and then stacks for pickup). All of these machines can potentially cause significant damage to soil

(compaction, rutting, or erosion) so it is preferable to harvest when soils are dry or frozen. Care should also be taken to avoid introduction of weed seed from other work sites.

The value of a timber harvest depends on many factors including the species logged, the end use of the log (veneer material, saw timber, pulpwood, pallet wood, etc.) and distance to the mill or processor. Private foresters, Michigan State University Extension Service, and Conservation District Foresters can all assist the property owner in assessing if a harvest may be worthwhile.

In addition to traditional logging, forests can yield a variety of other products, many of which can be commercial enterprises. Since Michigan has an abundance of sugar maple, the production of maple syrup is common among private landowners. In this process, sugar maples can be tapped to obtain sap, which is boiled down to make maple syrup (about 40-50 gallons of sap for one gallon of syrup). Edible products such as nuts, berries, and mushrooms can be harvested for family use or for sale. (visit <http://www.edibleforestgardens.com/> for more information)

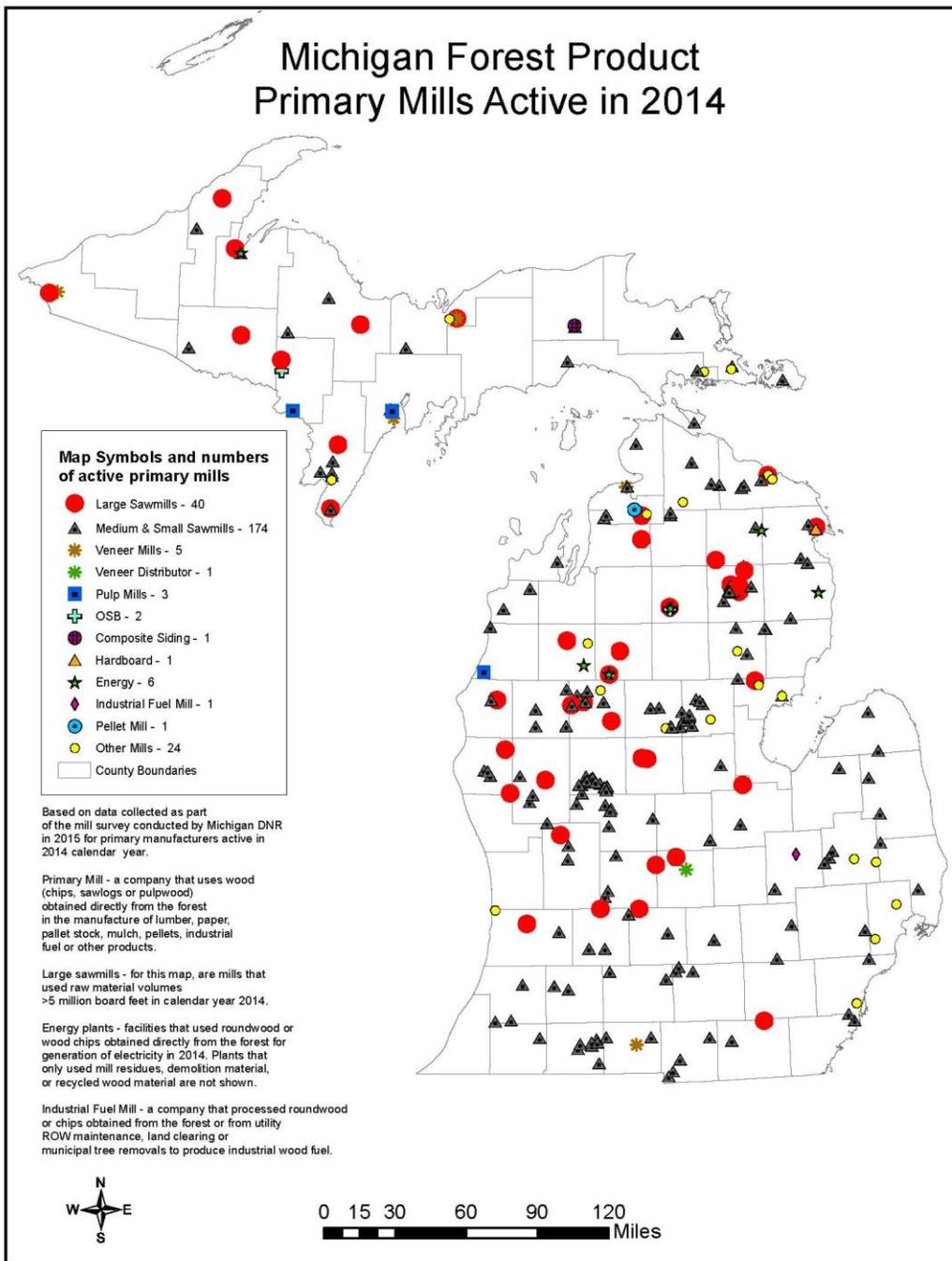


Figure 3.10 Forest Product Industries Map for Michigan (MDNR).

In addition to the sawmills and other industries shown in Figure 3.10 the Michigan DNR's Forest Product Industries website (www.michigandnr.com/wood) shows 15 wood-related businesses in Monroe County.

Permaculture

Permaculture is an agricultural approach designed to be self-sustaining and regenerative by utilizing natural ecosystems, and very often, these systems include many tree species.

Permaculture was developed in Australia by Bill Mollison and David Holmgren in 1968, but has gained popularity around the world. Design elements include layers (canopy to soil layer) and zones that typically concentrate labor intensive activities close to the dwelling with grazing, forestry, and other less active land uses farther out. Mollison said, "Permaculture is a philosophy of working with, rather than against nature; of protracted and thoughtful observation rather than protracted and thoughtless labor; and of looking at plants and animals in all their functions, rather than treating any area as a single product system."

Agroforestry

The Center for Agroforestry at the University of Missouri has published a manual that provides information on agroforestry (the combination of agriculture and forestry). This involves practices such as silvopasture (trees in grazing areas), alley cropping (having herbaceous plants between rows of trees), windbreaks, and forested riparian buffers.

<http://www.centerforagroforestry.org/pubs/training/index.php>

3.1.9 Forest Health

Monroe County's forests have continued to go through dramatic shifts since Europeans first settled there 200 years ago. Cessation of fire as used by Native Americans, large-scale logging, and the ever increasing demands for agriculture and industry have all contributed to forever changing the landscape of Southeastern Michigan. However, these forces were not the only influences to shape the forests that stand today. Since the early 1900s, Michigan's forests have been hit by successive waves of insect and disease outbreaks, often originating from non-native pests and pathogens. Attacks by chestnut blight; Dutch elm disease; gypsy moths; and Emerald Ash borer have killed millions of trees in this area Michigan and have dramatically reshaped Monroe County forests. The introduction and proliferation of non-native invasive species like autumn olive, buckthorn, honeysuckle, and garlic mustard all threaten forest health and can have devastating effects in a relatively short amount of time. These and other threats to forest health make the effort of every landowner important. DNR and local stakeholders offer guidance including web resources and classes to provide tools for responding to forest threats. This section outlines major threats to Monroe County's woodlands, along with resources for learning more and reporting pests.

Pests and Pathogens

Chestnut blight (*Cryphonectria parasitica*) was first introduced in New York in 1904 and rapidly spread to decimate chestnut trees throughout the northeastern U.S. It reached Michigan in 1930 and virtually eliminated chestnuts, which occurred primarily in the southeastern counties near Lake Erie, from naturally occurring forests. With the native American Chestnut virtually eliminated, there have been many efforts to develop blight-resistant American chestnut (*Castanea dentata*) varieties (American Chestnut Foundation,

<https://www.acf.org/resources/faqs/>, and Horton, 2013), as well as hybrids with various Asian species and cultivars. Landowners interested in planting chestnuts for nut production or forest restoration can find trees available online and can consult the Michigan Nut Growers Association, which has a special interest group devoted to chestnuts (<https://michigannut.org/special-interest-groups/>).

Dutch Elm disease (*Ophiostoma ulmi* and two related species), a non-native fungal pathogen spread by bark beetles, arrived in New York on imported timber in 1928. It was first documented in Wayne County in 1950 and since then has killed tens of thousands of mature American elms (*Ulmus americana*) in Michigan. Although large elms have disappeared from most Michigan forests, smaller trees often survive and can be locally numerous, often reaching 6–10 inches in diameter before they succumb to the disease. The disease is carried by both native and non-native bark beetles that carry the deadly spores from tree to tree. Chemical and biological controls have had mixed success, and preventive treatments can be very costly. Efforts are currently underway at several facilities, including test plots at Michigan State University, to develop resistant cultivars of American-only genotypes and hybrids. Landowners looking to plant elms should research cultivars carefully. Some “blight-resistant” types have succumbed to blight over time, and tree growers will need to decide whether they prefer fully American genotypes or will accept hybrids with Asian species.

Gypsy moths (*Lymantria dispar*) were introduced on the east coast of the U.S. in the 1860s and have killed tens of thousands of trees in the Northeast during periodic outbreaks. Michigan experienced the first major outbreak in 1986, when the Gypsy Moth caterpillars defoliated millions of trees on over 64,000 acres in the state. Six years later, a 1992 outbreak resulted in 750,000 acres of Michigan trees defoliated, with other severe outbreaks in 1998 (Figure 3.11) and local outbreaks in 2008, 2013, and 2016. Many of the counties in Southeast Michigan participated in the Michigan Department of Agriculture’s Gypsy Moth Suppression Program. The program assessed gypsy moth damage, provided landowners with information on the species and treatment, and treated areas where landowners permitted with aerially applied Bt and Gypcheck, which successfully supplied relief to the infestation. Defoliation may not outright kill trees, but it does leave them more vulnerable to drought, disease, and future insect outbreaks.

Gypsy Moth Infested Area of the Eastern U.S., 1998

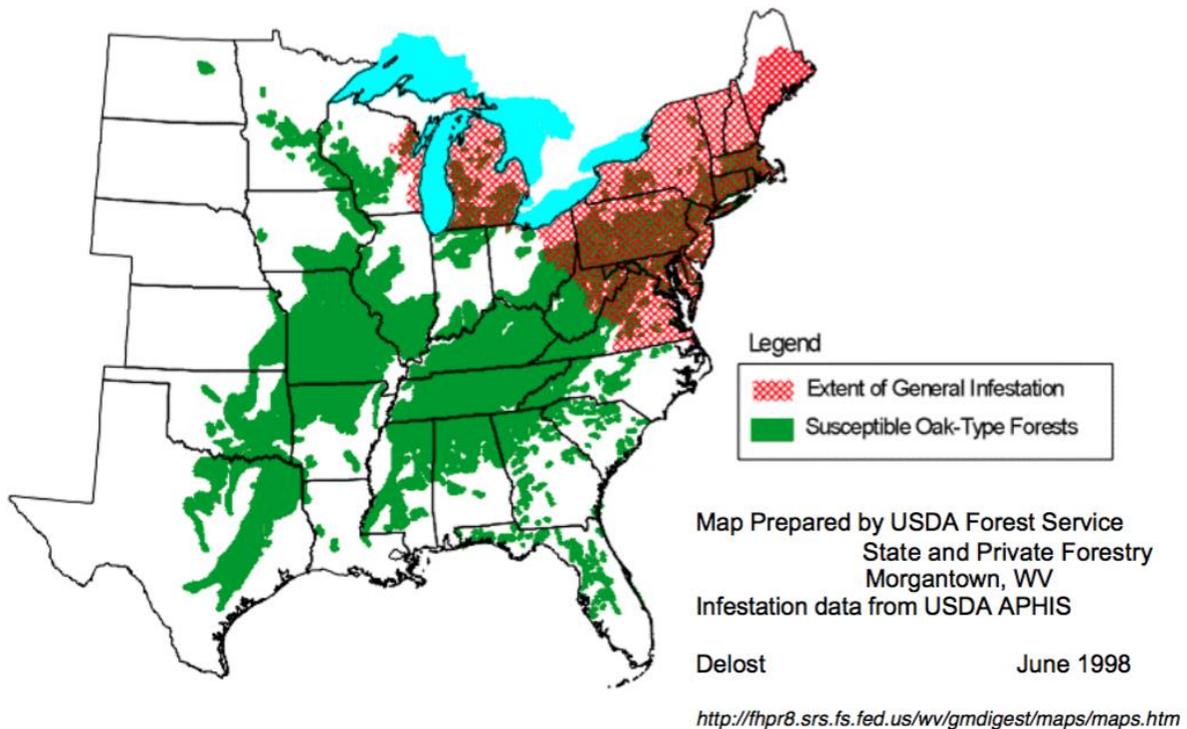


Figure 3.11. Gypsy moth infestation and forests at risk, 1998. (USFS, 1998)

Over recent years Gypsy moth outbreaks have declined in both frequency and severity as natural and introduced biological controls, including a naturally occurring virus [nucleopolyhedrosis virus (NPV)] and a naturally occurring fungus (*Entomophaga maimaiga*), reduced and helped maintain populations at low levels for a number of years in Southern Michigan. Various websites offer guidance to landowners about gypsy moth identification and treatment. Landowners should be observant and contact their local conservation district or MSU Extension if they observe populations again reaching the nuisance level.

Emerald Ash Borer (EAB) (*Agrilus planipennis*) is an invasive beetle whose larvae feed on tissue in the bark of ash trees. It was accidentally brought to the US from Asia and was first documented in Michigan in the early 2000s. Due to the beetle's specificity in targeting ash trees, it has had a significant impact on the wooded areas prominent throughout across Michigan (Slaughter et al. 2010). By 2007, EAB had killed tens of millions of white, green, and black ash trees (*Fraxinus americana*, *F. pennsylvanica*, and *F. nigra*) in southeastern Michigan (McCullough 2013). Control of EAB is currently limited to prevention of human introduction of this species to new locations through transport of infected firewood, raw wood products, and living trees that might be hosting the beetles (Slaughter, 2009).

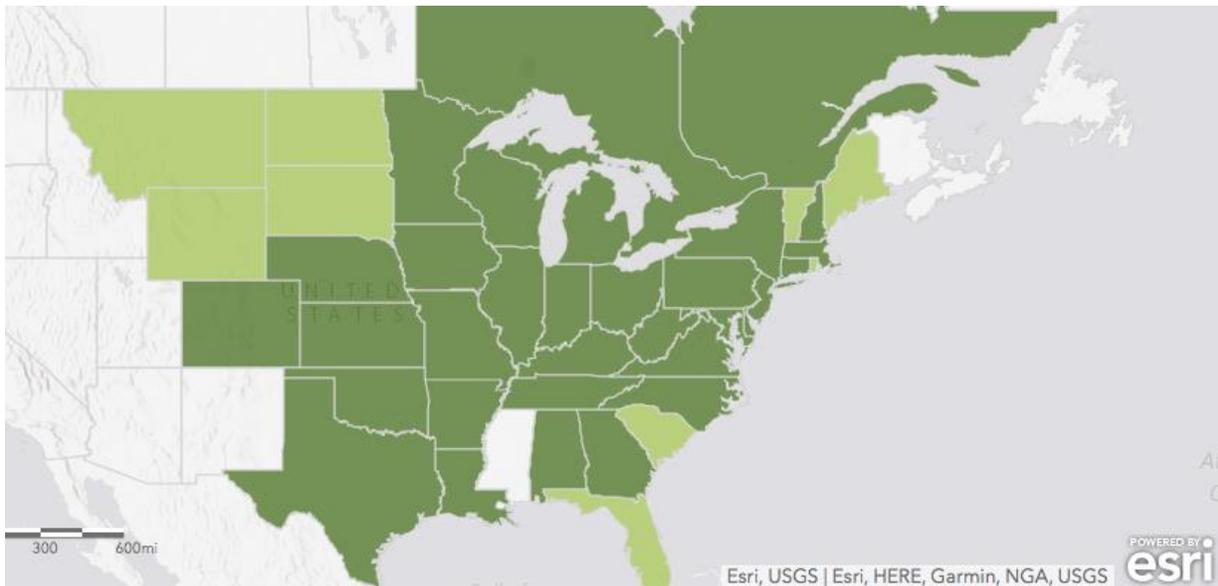


Figure 3.12. Emerald Ash Borer range in the U.S. and Canada, 2017. From <http://www.emeraldashborer.info/index.php>.

Asian long-horned beetle (ALB) (*Anoplophora glabripennis*) has the potential to become a serious threat to Michigan forests because its preferred host is maple and more than one billion maple trees that occur in the state could be at risk. It is also known to attack dozens of other tree species (from 12-15 plant genera), including poplar, willow, sycamore, and horse chestnut. This large, showy beetle was accidentally introduced into the U.S., probably in wood crating or pallets shipped from Asia. ALB larvae feed in tunnels (called galleries) in the wood of tree branches and trunks. The galleries cause branches or entire trees to break and the infestation eventually kills the tree. North American trees have little or no resistance to infestation, which is almost always fatal.

ALB populations are known to be present in areas of southern Ohio, Massachusetts, and New York but has not yet been detected in Michigan. Early detection and eradication are key to controlling this pest. As with other pests, ALB can be transported into new areas in logs and firewood. If ALB is not eradicated and populations spread across North America, the economic and ecological impacts would be enormous. The Michigan Department of Agriculture urges landowners to pay attention to trees, especially maples, with dying branches, and to report any suspect trees or beetles, take photos, record the location, try to collect suspect beetles in a jar, and report to MDA:

- Email: MDA-Info@michigan.gov
Phone: MDARD Customer Service Center (800) 292-3939
Midwest Invasive Species Information Network: www.misin.msu.edu

- Learn more: www.michigan.gov/exoticpests, www.asianlonghornedbeetle.com,
https://www.dontmovefirewood.org/pest_pathogen/asian-long-horned-beetle-html/

[Text in this section excerpted and modified from MDARD's Forest Pest Alert:
http://www.michigan.gov/documents/mdard/AsianLonghornedBeetle_3-14_453144_7.pdf.]

Beech bark disease occurs when an invasive sap feeding insect, beech scale (*Cryptococcus fagisuga*), injures American beech trees (*Fagus grandifolia*), allowing them to become infected with two species of fungus (*Nectria* spp.). The fungus kills areas of woody tissue, which may girdle and kill the tree if the affected area becomes large enough. Up to 75% of trees appear to be killed within three to six years following the start of the infection. During the infestation period, infected trees have abundant dead branches that are easily blown off in windstorms (a condition known as "beech snap"). The beech scale was brought into Nova Scotia, Canada in 1890 and has gradually moved west. It was first documented in Michigan in 2000 and has since spread widely in the state, although it has not yet been reported in Southern Lower Michigan which generally has fewer Beech trees in the forest makeup.

Although there appears to be some natural resistance among beech trees to beech bark disease, there are few control options in natural forest stands. Thinning is recommended to reduce beech density, as lower density stands may be less susceptible to the spread of the scale and fungus, along with removing trees that are affected (McCullough et al. 2005).

Beech Scale Distribution in 2015

J.B. Wieferich & D.G. McCullough
Michigan State University

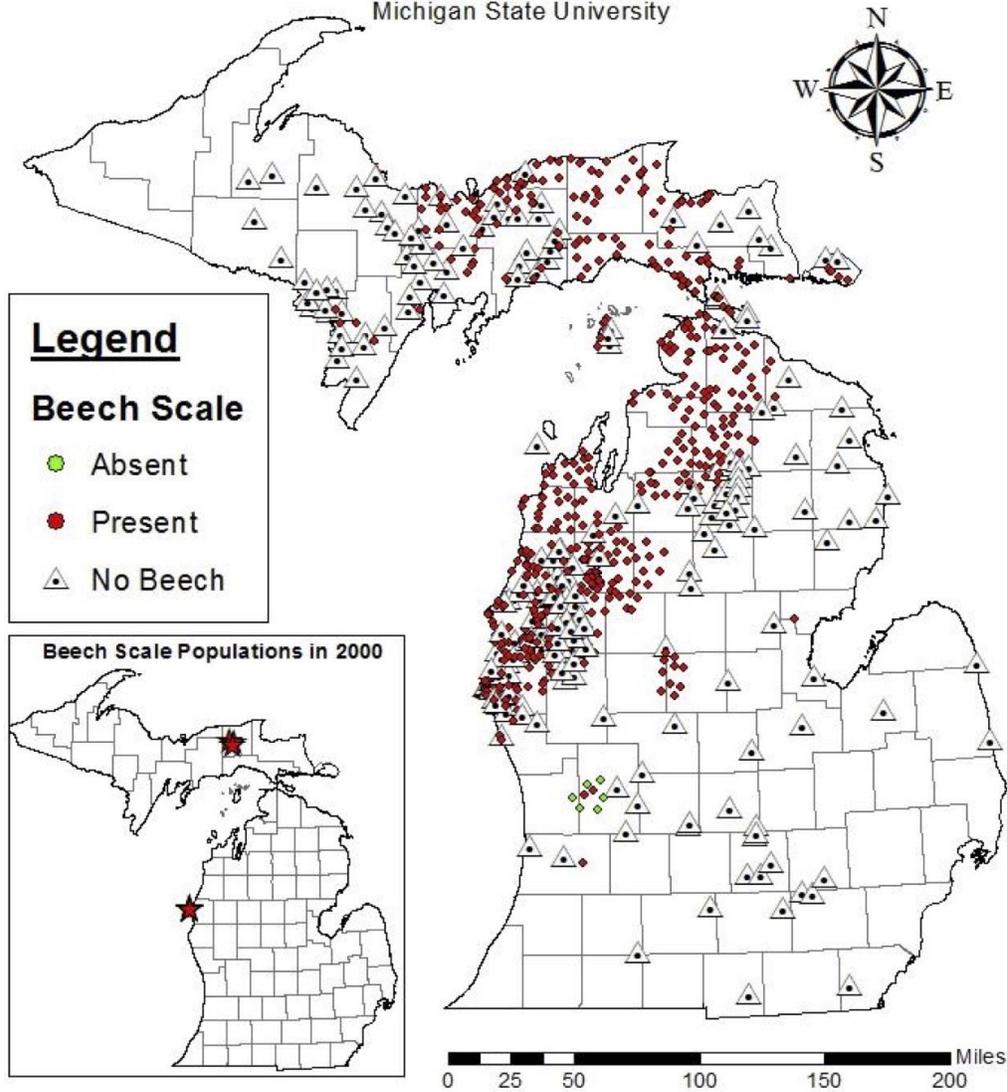


Figure 3.13. Beech scale distribution in Michigan, 2015.

<https://www.na.fs.fed.us/spfo/pubs/fidls/oakwilt/oakwilt.html>

Oak Wilt (*Ceratocystis fagacearum*) is a fungal disease that has become a growing threat in Southeastern Michigan over the past two decades. Since oak trees are a major component of the state's landscape, the disease has the potential to have devastating effects on forests, as well as residential and urban areas. No oak species is known to be immune to the damaging effects of this fungus, and the disease is highly transferrable. Oak wilt kills healthy red oaks, often within a few months, and all species in the red oak group (including black oak and northern pin oak,

(*Q. velutina* and *Q. ellipsoidalis*) are especially susceptible. White oaks may also be affected but appear to be more resistant and less vulnerable to mortality from the disease. Once infected, mortality of red oaks with oak wilt is nearly 100%, and there is no treatment to save the infected tree. Oak wilt moves slowly through root systems and can move from tree to tree via root grafts, which connect the roots of adjacent trees. The fungus also travels short distances over land when new spores are moved by beetles from an infected tree to a freshly pruned or injured tree. Currently, the best management practice for containing Oak Wilt is to trench an infected tree by digging around the tree, cutting off the roots to damage any grafts between neighboring oak trees. This eliminates the pathway through which the disease spreads, protecting neighboring oaks from contracting it. Once an infected tree is trenched, it can be cut and removed (Cook, 2016). In this region of Michigan, oak trees—especially red oaks—are a popular choice for both homeowners and municipalities because they grow well in the local soil, are good for wildlife, and are aesthetically pleasing. The estimated value of red oak timber in Michigan is approximately 1.6 billion dollars (based on Forest Inventory Analysis data from 2011 and current timber prices). The potential widespread mortality of oaks could have enormous, negative impacts in Michigan, ecologically, economically, and aesthetically. Oak Wilt is an issue that will likely become more prominent throughout Southeast Michigan in the very near future and will require attention from all types of landowners and managers.

To report suspected cases of oak wilt:

Email: DNR-FRD-Forest-Health@michigan.gov

Phone: (517) 284-5895

For more information, visit the Midwest Invasive Species Information Network's webpage: www.misin.msu.edu

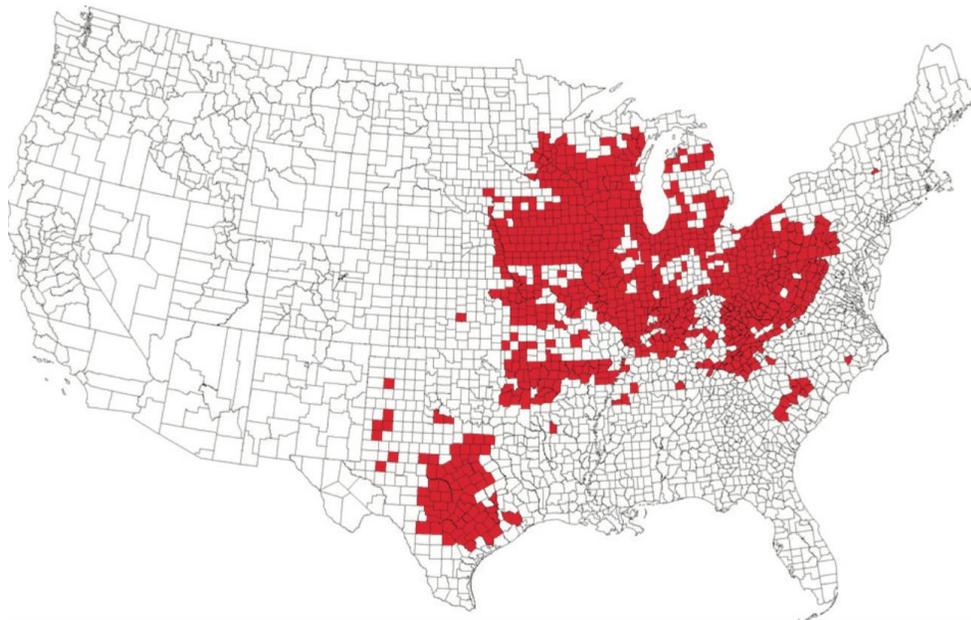


Figure 3.14 Distribution of Oak Wilt in the U.S. From U.S. Forest Service, *How to Identify and Prevent Oak Wilt*. (O'Brian e. al., 2017)

Thousand Cankers Disease (TCD): A newly identified fungal pathogen (*Geosmithia morbida*) being spread by an insect native to the southwestern U.S., the walnut twig beetle (*Pityophthorus juglandis*) is a relatively recent but potentially serious concern for black walnut trees (*Juglans nigra*). When the beetles drill tiny holes to feed on tree branches, they introduce the TCD fungus, which kill small areas of tissue, forming what are called “cankers.” In time, more cankers form, branches die, and the entire tree succumbs, although it may take 10 years before the tree dies entirely.

TCD has not yet been found in Michigan but it has been killing black walnut trees in California and other western states since the 1990s. By 2015, it had been found in six eastern states, including Indiana, Ohio, and Pennsylvania. An effective biological or chemical control for TCD has not yet been identified. A high proportion of black walnut trees will likely die if it becomes established in Michigan. Rapid early detection, removal, and destruction of infected trees are recommended to prevent the disease from spreading.

As noted in a USDA Forest Pest Alert, “Michigan’s forests are home to approximately 8.5 million black walnut trees with an economic value of more the \$86 million and ecological value as a food source for birds, mammals and other wildlife. There are also more than 80 walnut growers in Michigan with approximately 4,000 trees in nut production.... Black walnut is a valuable timber species and important for wildlife.” TCD can be transported into new areas in firewood, logs, and woodworking staves. A quarantine in Michigan restricts transport of these materials, as was done for EAB.

Report suspected forest infestations:

Email: MDA-Info@michigan.gov

Phone: MDARD Customer Service Center (800) 292-3939

Midwest Invasive Species Information Network: www.misin.msu.edu

Evergreen Diseases

In recent years, Michigan residents have been observing the die off of many spruce trees. Of the spruce varieties often planted for landscaping, Colorado Blue Spruce (*Picea pungens*) is one of the most common species chosen in Michigan. Because Colorado Blue Spruce is not native to Michigan, they have more difficulty when exposed to pathogens since they did not evolve in these environmental conditions. The humid Michigan summers are ideal for pathogens and there are at least 4 common fungal pathogens that are known to cause problems in spruce species planted in Michigan. It is not uncommon for more than one pathogen to be responsible for a decline in tree health. Identifying a problem and contacting an arborist or tree care professional to diagnose the problem is crucial to preventing further decline of the tree’s health and spreading the disease to other trees. Fungicide may prove effective on new growth if applied with appropriate timing. Diversifying landscaping and planting certain species in areas with desired conditions can increase the resilience of tree species to pests and diseases. (Cregg et al., 2015).

Non-native (invasive) species

Non-native invasive species are a huge concern for native ecosystem preservation. In southeast Michigan, numerous invasive species thrive in forest and grassland areas. They can be very difficult to eradicate. Many invasive species tolerate a wide range of environmental conditions; they grow and reproduce rapidly and abundantly, often maturing at a young age; they can be aggressive and effective competitors for resources including water, light, and soil nutrients; and they may lack the suite of specialist enemies that help to keep them in balance in their native ranges. The effort to prevent the establishment of new invasive species in Michigan and the spread of existing ones has drawn a lot of attention in the last few decades. Funding and resources have been allocated to this cause and have contributed to the successful development of best management practices for treatment of many established invasive species. Private landowners are very likely to find many of the invasive species common to this region on their own property. Listed below are some of the most prominent established invasive species found throughout Monroe County affecting forest resources:

- Phragmites (*Phragmites australis*)
- Reed canary grass (*Phalaris arundinacea*)
- Autumn olive (*Elaeagnus umbellata*)
- Buckthorn: common (*Rhamnus cathartica*) glossy (*R. frangula*)
- Honeysuckles (*Lonicera spp.*)
- Tree of Heaven (*Ailanthus altissima*)
- Siberian Elm (*Ulmus pumila*)
- Dame's rocket (*Hesperis matronalis*)
- Japanese barberry (*Berberis thunbergii*)
- Spotted knapweed (*Centaurea maculosa*)
- Garlic mustard (*Alliaria petiolate*)

Invasive species can negatively impact ecosystems in complex ways. They can outcompete and displace native species; reduce or alter wildlife habitat (although several invasive species were intentionally introduced and planted with the intent to benefit wildlife); reduce forest health, productivity, and regeneration; and alter ecosystem processes including nutrient cycling, beneficial soil fungus (mycorrhizae), and leaf litter dynamics. These species need to be actively managed. If left unchecked, they can take over an entire area by out-competing native plants and invade fields and forest openings so densely that recreation and trails are negatively affected. Not only do they have a significant negative impact on the native plants, but they also affect native wildlife. Many of these invasive species are not a food source for wildlife. By outcompeting native plants and not meeting the resource needs of native wildlife, they disrupt the food webs of terrestrial ecosystems and deplete the necessary resources for native plants and animals to survive.

A key to avoiding infestation by invasive plants is to have a healthy community of native or intentionally introduced plants (crops, orchards, etc.) and to monitor them regularly. The more robust the desired vegetation is, the less likely invasive species will proliferate. Soil-disturbing

activities such as plowing, land clearing, and vehicle use can create a favorable condition for invasive plant establishment. Disturbed areas should always be followed up quickly by reseeding or planting to limit invasive species competition and monitored thereafter for possible infestation.

Timber harvests can have serious unintended negative effects on a forest ecosystem if the landowner does not realize that there are invasive species present. Landowners should be aware of invasive species in the area and plan to treat such infestations prior to a harvest.

Private landowners should learn to identify commonly found species and become familiar with how to appropriately treat them so that they may prevent the degradation of their land and natural resources. Since cutting or mowing is not always effective on many of these species (and in some cases, this can exacerbate the problem) and the task of eradicating these invasive species may be too much for a landowner to take on, numerous resource providers and contractors in this region can be utilized to provide technical assistance to landowners. Landowners are encouraged to seek treatment recommendations from the Michigan DNR, Western Lake Erie Cluster of The Stewardship Network, or their local conservation districts.

Invasive Shrubs

Woody invasive shrubs are a pervasive challenge in Monroe County, with dense thickets of non-native shrubs invading natural areas, open fields, and forests. They are a particularly important problem because they completely alter the forest community and, in many cases, prevent the growth of native species. Some key species of concern are:

- Autumn olive (*Elaeagnus umbellata*)
- Buckthorn: common (*Rhamnus cathartica*) glossy (*R. frangula*)
- Bush honeysuckles (*Lonicera* spp.)
- Japanese barberry (*Berberis thunbergii*)
- Multiflora rose (*Rosa multiflora*)
- Privet (*Ligustrum vulgare*)

Many of these invasive shrubs out compete native Michigan varieties by leafing out earlier, often in March, and retaining leaves later into the fall, making it difficult for other plants to survive in their shade. Many are forest invaders, thriving in or tolerating shade. All of these species fruit abundantly, producing thousands of seeds that can be transported by birds and mammals. Control can be achieved by several methods, and often a combination of methods is the most effective. Fire will set the plant back, but will not usually kill the shrub, especially larger plants. Because the plant stump sprouts after fire or cutting, it is usually treated with herbicide (triclopyr appears to be an effective chemical) afterwards. The herbicide can be sprayed on a cut stump (avoid spring when sap is rising), applied to foliage (normally done in late fall when other plants are dormant), or as a basal bark treatment (apply to lower 18 inches of trunk except when sap is rising).

Invasive Trees

Black locust (*Robinia pseudoacacia*), Norway maple (*Acer pseudoplatanus*), and tree of heaven (*Ailanthus altissima*) are the key invasive tree species found in Monroe County. These tree species can be locally abundant but are typically not as widespread of a problem as invasive shrubs. Black locust can spread clonally and can become an aggressive invader on sandy post-agricultural areas, but its rot-resistant timber is considered useful for fencing materials. Landowners should be aware of how to identify and treat these species if needed.

Vine Management

Fast-growing non-native vines (oriental bittersweet, English ivy, Japanese honeysuckle, Chinese yam, black swallow-wort, pale swallow-wort, mile-a-minute weed, and kudzu) are growing problems in Michigan. Oriental bittersweet (*Celastrus orbiculatus*) is a particular challenge, creating dense and impenetrable thickets. These vines can shade the trees' leaves and reduce tree growth or kill young trees by out-competing them for resources. They can cause structural problems due to the added weight which can break branches or topple the tree. A few vines even grow thick enough to "strangle" the tree. Some vines start as a groundcover and form a dense mat of leaves, smothering wildflowers and other flora of the forest floor. These dense mats grow around the tree's base, trapping moisture against the trunk which can result in fungal and bacterial diseases. Native grape vines are also capable of causing damage, but poison ivy and Virginia creeper usually do not damage trees and serve as a food source for wildlife.

Invasive Herbaceous Plants

Landowners should be vigilant in looking for herbaceous invasive species such as garlic mustard, dame's rocket, narrowleaf bittercress, black jetbead, spotted knapweed, and others that may invade their forested system.

One of the most prolific species, garlic mustard, is a biennial herbaceous plant that has the ability to dominate the forest floor, limit the growth of other plants, and prevent reproduction of native species. It spends its first year as a small rosette and sends up a flowering stalk in the second year that produces a prolific number of seeds. Seeds can be transported by birds, rodents, deer, and humans and can remain viable for 10 years, even in very harsh conditions. Garlic mustard releases allelopathic compounds that harm other plants by interfering with mycorrhizal relationships (an interaction between fungi and plant roots that provides nutrients to the plant). Control can be achieved by pulling (preferably before flowering), herbicide application (early season application can be done before other plants emerge), limiting disturbance, and maintaining a high level of canopy. Treatment has to be performed over multiple years to reduce the negative impacts of this invasive plant. For invasive species control, monitor the land to determine infestations early in their development, treat satellite populations first, and then work towards more densely infested weed areas to be efficient. The Stewardship Network features an annual Garlic Mustard Challenge, encouraging residents in different cluster areas to compete to see who can remove the most.

Aquatic Invasive Species

There is a wide array of non-native, invasive plants that thrive in water and along shorelines. Property owners on lakes, streams, and wetlands should be aware of them as they can limit land use and cause harm to healthy systems. Major wetland and aquatic invasive species in Monroe County include non-native phragmites, reed canarygrass, non-native cattails, purple loosestrife, flowering rush, Eurasian milfoil, and European frogbit, as well as hydrilla, curly leafed pondweed, elodea, and starry stonewort. The Lake Erie shoreline and coastal wetlands of the county have been especially hard hit by phragmites and non-native cattail. Extensive phragmites control efforts by federal, state, and local government entities as well as partnerships with private stakeholders have made significant progress in controlling phragmites along the Lake Erie coastline. Ongoing monitoring and follow-up treatments will be necessary for the near future to keep the plant in check. Unfortunately, in several instances, with the successful control of phragmites, some land managers are reporting a significant upsurge of flowering rush and European frog-bit in those wetland systems.

Aquatic plant growth is often accelerated by excess nutrients from lawn and agricultural runoff, increased surface runoff due to an increase in area of impermeable surfaces (roads), failed septic systems, and other sources. Landowners should be mindful that their land management practices may affect the water quality of their community, especially the application of fertilizers and pesticides. If landowners have open water bodies or streams on their property, the establishment of natural vegetative shoreline buffers can help reduce storm water runoff and potential issues with problem plants. The treatment of invasive species in wetlands or aquatic systems should only be done with wetland safe products and with the appropriate DEQ permits.

Monroe County has miles of Lake Erie coastline with multiple harbors and boat launches with direct access to some of the finest fishing in the state. Unfortunately, those who utilize the Great Lakes for recreation, drinking water, or as a source for income are now facing several challenges in the form of aquatic invasive species. Some current and possible aquatic invasive animals to contend with are invasive carp (silver, bighead, and grass), Northern snakehead, red swamp crayfish, zebra mussel, quagga mussel, and New Zealand mudsnail. To avoid the spread of these invasive species, boats (motorized and non-motorized) should be fully cleaned, drained of any bilge or other water, and dried before leaving a launch site. Boats should be left to dry for five days before entering another body of water. Tackle should be decontaminated before changing locations, and all bait should be disposed of only in a trash can.

3.1.10 Tourism and Recreation

Tourism is an important element in the economy of both the state of Michigan and Monroe County. The economic impact of all forms of recreation in Michigan was estimated to total \$18.7 billion and it accounted for 194,000 jobs in the state. Many of Monroe County's tourist attractions are based on outdoor recreation such as boating, hunting, fishing, and related

activities. Outdoor enthusiasts visit Lake Erie's coastal marshes to view the large number and diversity of both resident and migratory birds. Agricultural offerings such as orchards, berry farms, and nurseries attract tourists during the appropriate seasons.

The Federal Government operates two recreation facilities in the county. The US Fish and Wildlife Service (FWS) established the Detroit River International Wildlife Refuge in 2001 to build a sustainable future for the Detroit River and western Lake Erie ecosystems. The refuge consists of nearly 6,000 acres of unique habitat, including islands, coastal wetlands, marshes, shoals, and waterfront lands within an authorized boundary extending along 48 miles of shoreline, including all of Monroe County's Lake Erie coastal areas. A new visitor center is scheduled for opening in 2017. In 2010, the National Park Service took over land formerly owned in part by Monroe County to form the River Raisin National Battlefield Park, which commemorates the 1813 battle that took place at this location.

The State of Michigan has several facilities in Monroe County, which include a variety of park-types including a State Park (Sterling) and State Game Areas (Erie, Petersburg, and Pte. Mouillee). Sterling State Park is one of Michigan's most heavily used State Parks, and it offers a campground, swimming beach, hiking trails, fishing, boating, and nature study opportunities. A recent land acquisition has created a pedestrian and bicycle connection to the park directly from the City of Monroe. The three State Game Areas (Erie, Petersburg, and Pte. Mouille) offer hunting and fishing, as well as opportunities for hiking and nature study (Monroe County Recreation plan, 2013).

Monroe County has five county parks totaling 221 acres of land.

- Heck Park hosts a Vietnam Veterans Memorial as well as walking paths, shelters, play and exercise areas, basketball courts, benches, grills, landscaping, and drainage improvements. A habitat improvement project has recently (2012) converted a portion of mowed lawn to native prairie vegetation.
- Nike Park, located on Newport Road in Frenchtown, was originally part of a World War II Nike missile base. A 1999 DNR grant allowed for the development of an accessible play area, pathways, parking improvements, and large areas of open space.
- Vienna Park in Bedford Township has a small pond and natural area as well as active recreational facilities such as soccer fields, ball diamonds, and disc golf.
- Waterloo Park, the smallest county park with only 9 acres, is located on the River Raisin at the end of Mulhollen Drive in Monroe Township. The park has many facilities, including a fishing pier, canoe landing, paved path, exercise equipment, and playground, all designed to be barrier-free.
- West County Park consists of sixty acres of former farmland on Rightmire Road in Dundee Township. Much of this site, which fronts the River Raisin, was enrolled in the USDA Conservation Reserve Enhancement Program (CREP) in 2002 and was planted with a mixture of native trees, shrubs, grasses, and wildflowers. The addition of trails,

small shelters, parking areas, and benches have all made this site an attractive nature preserve.

The Navarre-Anderson Trading Post in Frenchtown Township is a county owned historical site consisting of 5.6 acres of restored and recreated historic structures, a historic school house repurposed as a country store, interpretive information, and scenic open space along the River Raisin.

Public trail systems in the county include the River Raisin Heritage Trail, the I-275 trail, and various other trails and pathways within existing parks. The River Raisin Heritage Trail is the designation given to the Sterling State Park trail system and its connection, within the City of Monroe, to the River Raisin Battlefield site.

Marinas

Monroe County has thousands of boat slips in privately owned marinas up and down the Lake Erie coast line. The marinas vary widely in terms of size and facilities. Indoor boat storage, charter fishing, oil and gasoline sales, bait and tackle, boat rental, and other services are available at select locations.

Gun Clubs / Shooting Ranges

The many sportsmen's clubs in Monroe County reflect the area's heritage as one of the region's premier waterfowl hunting areas. Monroe County contains 14 shooting ranges, most of which are private clubs that have facilities for archery, skeet, target shooting, and other firearm activities. A "hunting preserve" in Milan Township provides for the shooting of pheasant.

3.1.11 Archaeological, Cultural and Historic Sites

Archaeological Sites

Landowners who believe they have found Native American artifacts in their forests should contact the State Archaeologist's office at the State Historic Preservation Office, and record and report the artifacts (reporting form available at http://www.michigan.gov/mshda/0,4641,7-141-54317_19320_54320---,00.html, with explanations at <http://www.miarch.org/site-recording.html>). The State Archaeologist can also offer advice about consulting archaeologists who can help assess the site where possible artifacts are found. Any site that appears to be a burial ground must not be disturbed. According to SHPO guidance, "It is illegal to intentionally disturb human remains and associated artifacts. If you accidentally discover human remains, immediately stop any activities in the area and contact the police and the State Archaeologist. Respect the dignity of burial sites by protecting and reporting them. Do not disturb them." (Michigan State Historic Preservation Office).

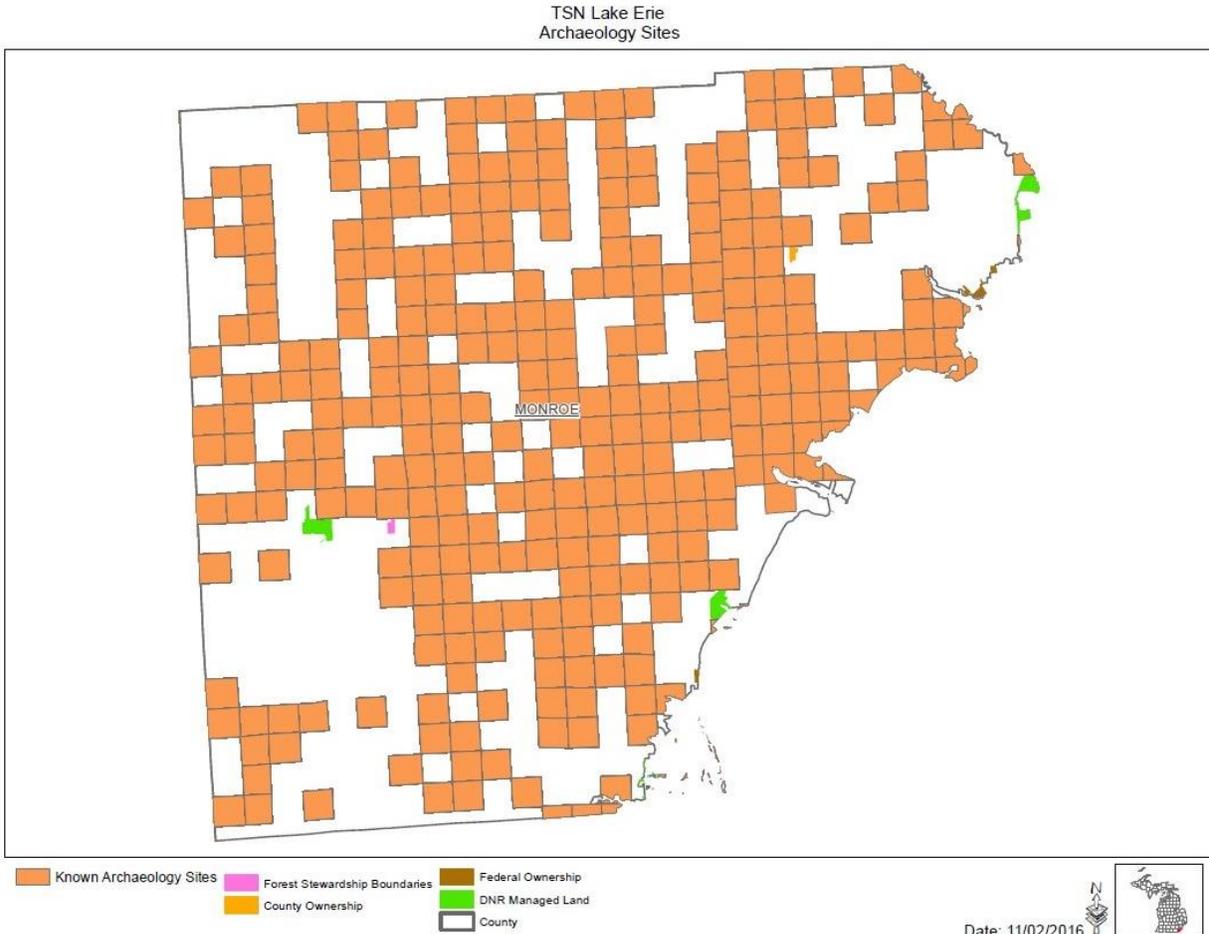


Figure 3.15 Known Archaeological Sites in Monroe County

Cultural and Historic Sites

Monroe County has 18 historic sites listed on the National Register of Historic places, according to National Park Service listings (<https://www.nps.gov/nr/index.htm>), and 24 sites that are designated as Michigan State Historic Sites by the Michigan State Historic Preservation Office (<http://www.michigan.gov/mshda/0,1607,7-141-54317---,00.html>). Most historic sites are in cities, but a few are in rural areas with woodland characteristics.

3.1.12 Challenges and Resources for Forest Stewardship

A review of natural resource documents and web resources for the Northeastern U.S., the state of Michigan, southeastern Michigan, and Monroe County, as well as interviews with stakeholders, suggests that the following are key issues that frame forest stewardship in this landscape:

- Timber is not a major product in Monroe County, but forests are highly valuable for non-timber uses, including harboring biodiversity and wildlife habitat, water quality, recreation and aesthetic enjoyment, agroforestry and non-forest timber products, and hunting.

- Land use patterns (a mix of agriculture and residential development) have led to fragmented forests. Parcelization, the process in which land is divided into smaller parcels, has led to a proliferation of private landowners with small amounts of forest on their land. Only 10% of the County's total forested land remains in parcels ranging between 10-60 Acres.
- Coordinated management is a large challenge in a fragmented and parcelized landscape. Managing in even small ecological units requires a coordinated effort among many different landowners, public and private.
- Despite the fragmented landscape, Monroe forests and associated landscapes harbor considerable biodiversity, with 66% of the County's rare species (threatened, endangered, and special concern plants and animals) relying at least partly on forest habitats and 24% entirely dependent on forests.
- Two forested natural communities merit particular attention in the landscape. Lakeplain Oak Openings and Wet-Mesic Flatwoods are of statewide and national conservation concern due to their rarity.
- Invasive plant species, both shrubs and herbaceous, are major challenges for forest stewardship and are taxing many institutional and private landowners' resources.
- Non-native pests and pathogens have affected Monroe County woodlands in dramatic ways, most recently with the Emerald Ash Borer (EAB) killing off millions of trees. The EAB experience shows the importance of early detection and eradication of new and emerging threats to forest health: Asian Longhorned Beetle, Oak Wilt, Thousand Canker Disease, Beech Bark Disease (Beech Scale), and others.
- Climate change poses additional management challenges, with some forest species increasingly vulnerable to changing weather patterns, but nurturing healthy forests can also contribute to efforts to combat increasing atmospheric carbon dioxide.

3.2 Acoustic Monitoring

Land managers, researchers, and educators have typically utilized standardized protocols in the collection of biological data to create an ecological integrity assessment of their property or study site. Traditionally, visual field observations of vegetation, animal, and invertebrate populations are collected to help better understand biological makeup, conservation status, and potential changes to ecological health.

Today, an emerging assessment tool, acoustic monitoring, is a potential game changer for researchers and landowners looking to record and analyze information in their forests and other properties that can't necessarily be collected by visual means or with people present. This acoustic assessment expands on the traditional audible data collection of bird and frog calls to include the entire soundscape of a particular ecosystem.

A “soundscape” is a term aptly used to describe a recording of all the sounds within a landscape. This includes:

- Geophony: Sounds created by non-biological sources (rivers, wind, precipitation, etc.)
- Biophony: Sounds created by organisms within a habitat (the calls of birds, frogs, mammals, etc.)
- Anthropophony: Sounds created by humans, both intentionally and unintentionally (Music, walking, the sounds of machinery, etc.)

An undisturbed habitat would play host to both geophony and robust amount of biophony, with organisms creating noise for a plethora of reasons including calling potential mates, confusing predators, and warning competitors to avoid their territory. By carefully dissecting and analyzing recordings, researchers can separate out different sounds and calls to get a sense of the diversity and density of the sound-making species present in the area of study. Soundscapes undoubtedly fluctuate throughout seasons with species migration, seasonal mating vocalization, or in response to natural events such as instances of severe weather. But researchers are finding that resource extraction, climate change, and the effects of humans living and recreating within close proximity of forests are also having an impact on ecosystems; impacts that otherwise may not have seemed significant through optical observation, if apparent at all.

In addition to hearing stories about the focus areas for this project from land managers, it is important to allow the ecosystems to tell their own stories through acoustic monitoring. Dr. Stuart Gage, Professor Emeritus from Michigan State University has spent much of his career developing principles, methods, and applications behind ecoacoustics, or the assessment of biodiversity based on sounds emanating from the environment. Under Dr. Gages’ direction, sound recorders were placed within each of the Landscape Stewardship Plan areas. Audio data was collected from a preserve in the Western Lake Erie landscape from May 17th, 2016 to June 23rd, 2016. A battery powered recorder was attached to a tree at a private residence in Petersburg, MI. The recorded ecosystem was an isolated woodlot, dominated by oak trees. Like all the other monitors, the intent was to record one minute of soundscape every half hour, but unfortunately, there were technical difficulties with this monitor, and the investigator was unable to glean any recordings from the device. Normally, the data would have been stored on an SD card, and sent to Dr. Gage to be analyzed and stored in the REAL (Remote Environmental Assessment Laboratory) database. The REAL website (www.real.msu.edu) has a section devoted to this Landscape Stewardship Plan project, in addition to many other projects and information on acoustic monitoring. Visitors have access to the background information of the project, monitor locations, and the ability to listen to sound clips from all of the other sites. Select recordings will be made available on the project’s online story map.

For landowners, scholars, and researchers who are interested in doing acoustic monitoring on their land *Ecoacoustics: The Ecological Role of Sounds*, Almo Farina and Stuart H. Gage (Editors)

Wiley Press July 2017, provides additional information, tools and references based on the current state of this field of research.

Also, many ornithologists and herpetologists are well versed in the calls of the organisms they study. For a more species specific method of learning about the organisms present on the land, individuals may contact their local Audubon chapter, Michigan Society of Herpetologists, Michigan Partners in Amphibian and Reptile Conservation or the Michigan Department of Natural Resources, to learn about the experts, enthusiasts, and resources in their area who may be able to help identify species.

3.3 Existing Stewardship Plans

Planning can occur at multiple scales, from multi-state areas to pocket habitats within residential yards in a city. The following section outlines preexisting plans that are available to private landowners for guidance, reference, or inspiration. Elements of these plans may not apply to every project due to differences in ecosystems, scale, or region, but they can serve as models for people looking to write their own plan and show the value of collecting management information and organizing it in one place.

3.3.1 Government plans

Michigan Department of Natural Resources

Statewide forest surveys by the USFS has estimated that Michigan supports approximately 19.3 million acres of forest, (*Michigan Forest Resource Assessment and Strategy, MDNR Forest Management Division, June 2010*) of which 18.6 million acres considered timberland, making Michigan's timberland acreage the 5th largest in the United States.

(www.michigan.gov/documents/dnr/1.2Introduction_242962_7.pdf)

Today, over 60% of forestland in Michigan is privately owned, with the majority (53%) of the private ownership held by non-industrial landowners, or family forests.

www.macd.org/forest_conservation. Michigan's remaining 40% of forestland is owned by the Federal government (3 million acres), (*USDA Forest Service Land Areas Report, Sept. 1999*) and by the State of Michigan. Of the almost 4.6 million acres of land owned by the State of Michigan, the majority (3.8 million acres) is under the management of the MDNR Forest Resources Division and managed primarily for forest products, but has complementary benefits for wildlife and recreation. These state managed forests make up the largest state forest system in the nation. (*Managing Michigan's State-owned Forests: Harvest Levels, Market Trends and Revenue Realities, Michigan Environmental Council, May 1, 2013 Rev.*) Michigan ranks first nationally in state-owned timberland and 8th in publicly owned timberland, which includes all federal, state, and local governments. (*USDA Forest Service FIA database*).

MDNR State Forest Management Plans:

The MDNR administers state forest resources for economic, recreational, and environmental values and is committed to the sustainable management of this valuable commodity.

“Sustainability assures the viability of biological communities and their economic vitality by protecting and maintaining the natural environment upon which the citizens and economy of Michigan depend”. (*Michigan Department of Natural Resources, Forest, Mineral, and Fire Management and Wildlife Divisions, April 10, 2008, Michigan State Forest Management Plan, David L. Price, Editor*). In order to achieve their management goal, the MDNR Forest Resources Division has developed a [five-year strategic plan](#) (*Seeing the Forest, The Trees & Beyond, Forest Resources Division Strategic Plan, 201-2018, MDNR*) to help guide decision making regarding the health of Michigan’s state forest resources. The strategic plan lays the groundwork for meeting the division’s mission and strategic direction.

Michigan’s [State Forest Management Plan – 2008 \(10-year plan\)](#) is a strategic planning document, intended to be a framework containing the goals and objectives for resource uses and values of state forestlands. The document reflects the challenges of managing forests for multiple benefits, achieving sustainability objectives, and integrating ecosystem management practices. The plan was amended in 2014. (www.Michigan.gov/forestmanagement)

The **Regional State Forest Management Plans**, which were approved in 2013, are more prescriptive and designed to inform landscape-level decision making and provide operational direction for the management of state forest resources for all 101 management areas throughout the entire state. (www.Michigan.gov/forestmanagement) Each Regional State Forest Management Plan is organized into Management Areas – groupings of roughly 30 forest compartments in each region (Western Upper Peninsula, Eastern Upper Peninsula and Northern Lower Peninsula) that range in size from approximately 17,000 to 105,000 acres. (*Managing Michigan’s State-owned Forests: Harvest Levels, Market Trends and Revenue Realities, Michigan Environmental Council, (May 1, 2013 Rev.)*)

Michigan’s [Forest Action Plan](#) is a statewide assessment of forest conditions and forest resource strategy to be addressed over a 10 year period (2010-2012). Since over 60% of forestland in Michigan is privately owned, the Forest Action Plan was developed to focus on assisting private landowners through cooperative programs for forest stewardship, urban and community forestry, forest health, wildfire management, and forest legacy. The planning period for the Forest Action Plan is 2010-2020. The Michigan Forest Resource Assessment and Strategy (Forest Action Plan) strives for greater integration of cooperative forestry programs, wildlife management goals and comprehensive outdoor recreation planning for the long-term, sustainable stewardship of the private forest resources of Michigan. (*State and Private Forestry, Michigan Forest Resource Assessment and Strategy (Michigan’s Forest Action Plan), Mid-Term Five-Year Review, Michigan Department of Natural Resources, Forest Resources Division, 2015*)

MDNR Petersburg & Pointe Mouillee State Game Area Master Plans

Two of the largest forest areas in Monroe County are managed by the MDNR. The Pointe Mouillee DNR Wildlife Field Office staff are responsible for both properties. The Petersburg State Game Area (PSGA) is located in Summerfield Township, MI. The area was dedicated by the Natural Resource Commission in 1951 and currently encompasses 589.5 acres. The land’s use was historically dominated by agriculture. Poor soils caused many crop fields to be decommissioned and reverted to natural habitats types over the years. The current property consists of roughly 40% prairie, 40% hardwoods, 10% upland brush, 5% pines, and 5% agricultural land. The Petersburg prairie area is characteristic of an oak savannah that is dominated by warm seasonal grasses and lupines. It can be classified as a rare mesic sand prairie. The wooded areas are mainly composed of oak, hickory, maple, ash, and aspen.

The area surrounding PSGA mainly consists of agricultural fields or idle land that is in varying stages of succession. Rural development continues to increase in the that area. The MDNR plans to add an additional 93 acres to the PSGA over the next 10 years and eventually acquire enough land to reach their goal of 920 acres.

The current draft of the PSGA Master Plan outlines management priorities consistent with goals for Michigan State Game Areas identified in the Southeast Michigan Regional Wildlife Area Management Plan. One of the main goals is to increase successful hunting opportunities on the property, which could potentially be achieved through habitat restoration and management of game species. The ability to hunt wild turkey and white-tailed deer is the largest recreational demand for the area. Another driving force for habitat management on this property is the reintroduction of the Karner blue butterfly in 2008, a species that is listed as Threatened by the State and Endangered by the federal government. In addition to maintaining healthy ecosystems that will allow these species to achieve and sustain healthy populations, another top priority is the acquisition of additional acreage bordering the current property. See the tables below for specific goals and the rationales behind them

Table 3.4 Goals of the PSGA Master Plan

Goal 1	Oak savannah habitat restoration with lupine and nectar plant component. Woody vegetation control and invasive species removal.
Rationale	<ul style="list-style-type: none"> ○ Oak savannah is a component of Mesic Sand Prairie (rare MI natural community, habitat for Karner blue butterfly (KBB) ○ Lupine is essential for KBB lifecycle, is the only food source for caterpillars those. ○ Prairie openings must be maintained to prevent the establishment of woody vegetation and invasive species ○ Prairie openings provide habitat elements for white tailed deer and wild turkey.
Goal 2	Multiple sustainable populations of Karner blue butterfly
Rationale	<ul style="list-style-type: none"> ○ Federal listing of Endangered due to habitat loss and diminishing populations

	<ul style="list-style-type: none"> ○ Reintroduction program begun in 2008 ○ Only one known population in this area ○ There are 3 additional areas where suitable habitat for KBB has been identified
Goal 3	Maintain and create food plots for wildlife in the Petersburg State Game Area
Rationale	<ul style="list-style-type: none"> ○ Area dedicated for wildlife conservation and management ○ Food plots will directly benefit white tailed deer and turkey populations.
Goal 4	Maintain boundary integrity and infrastructure
Rationale	<ul style="list-style-type: none"> ○ Area provides recreational opportunities related to wildlife ○ MDNR promotes consumptive and non-consumptive wildlife related recreational activities that promote the state’s heritage ○ Sufficient parking lots, work roads, gates, and signs are required for users to take advantage of recreational opportunities

As mentioned above, habitat management is a large part of the PSGA master plan, focusing on wild turkey, Karner blue butterfly, and white-tailed deer- though it should be acknowledged that the active restoration and management of native ecosystems has the potential to benefit a plethora of other indigenous species. Below are a set of species specific management recommendations from the plan.

Table 3.5 Species Specific Recommendations from the PSGA Master Plan

Species	Recommendation
Eastern wild turkey	<ul style="list-style-type: none"> ○ Retain mature trees that provide roosting sites ○ Establish brush throughout timber harvest ○ Planting desired food plots ○ Maintain healthy and balanced grasslands and forest openings ○ Maintain mast producing trees during harvest
Karner blue butterfly	<ul style="list-style-type: none"> ○ Maintain savannah openings ○ Plant populations of lupine and nectar plants
white-tailed deer	<ul style="list-style-type: none"> ○ Planting desired food plots ○ Maintain hard mast producing trees ○ Incorporate oaks and mature acorn producing trees ○ Utilized clearcutting or rotational harvest regimes to provide young browse ○ Incorporate conifers to provide thermal cover in snowy areas ○ Maintain grasslands for food and cover

The Pointe Mouillee State Game Area is a MDNR property in southeast Wayne County and northeast Monroe County. The master plan for this property is currently being updated and is expected to be completed in 2018. Habitat management currently focuses on the preservation of game and waterfowl species for recreational hunting, and the importance of preserving land for migratory species. Current featured species are mallard, osprey, ring-necked Pheasant, white-

tailed deer, and wood duck. Below are a set of recommendations from the plan, including those that are specific to the focus species.

Table 3.6 Recommendations from The Pointe Mouillee State Game Area Master Plan

Category	Recommendations
General	<ul style="list-style-type: none"> ○ Maintain a 50:50 ratio of marsh to open water ○ Maintain grasslands that are adjacent to wetlands ○ Maintain a mix of seed producing wetland plants ○ Control invasive phragmites and narrow-leaf cattail ○ Maintaining water control structures
Mallards	<ul style="list-style-type: none"> ○ Provide and maintain nesting tunnels
Ring-necked pheasant	<ul style="list-style-type: none"> ○ Maintain a diversity of large, permanent grassland vegetation ○ Establish escape and winter cover by harvesting timber and saplings for brush and planting switchgrass
Wood duck	<ul style="list-style-type: none"> ○ Maintain forests in floodplains, lowlands, and within 150 feet of wetland edge through single tree and group selection timber harvest ○ Maintain trees, shrubs, and emergent vegetation in wetlands ○ Maintain oak trees near wetlands, lakes, and rivers ○ Reserving large, dead, dying, and cavity bearing trees during timber harvest within 1 mile of wetlands, lakes, and rivers ○ Partner with volunteers to build nest boxes ○ Control glossy buckthorn and invasive Phragmites ○ Maintain flooded marshes and swamps through the use of water control structures and dikes.
White-tailed deer	See table 3.4

Resilient Monroe Resource Atlas

In 2013, the Resilient Monroe project published a plan to address ways of making the three municipalities involved (The City of Monroe, Frenchtown Charter Township, and Monroe Charter Township) to be more sustainable communities and resilient to the effects of changing climate through different methods including the preservation of natural systems and protecting the environment. This plan recognizes that Monroe is home to numerous critical natural areas and that they provide vital ecosystem services to the community. For example, the plan outlines the importance of preserving wetlands, as they reduce the impact of flooding and nutrient loading through runoff. Over 90% of historical wetlands in Monroe County have been lost and a great deal of that area lies along the Lake Erie coast and in the rural areas of the county. Another priority recommendation of this plan was to establish 35-40% canopy cover in

the urban Monroe community to reduce water loss and possibly mitigate some increase in local temperatures that are a result of climate change. While there was a lot of good information in this plan, it could be valuable to do a similar assessment and plan that spans the entire county. The diversity of land use would be mirrored in the diversity of recommendations, making for a more complex project, but certainly one with greater reach and ultimately, greater impact for community resiliency.

3.3.2 Other Stewardship Plans

Great Lakes Restoration Initiative (GLRI) Action Plan (II) was a catalyst for the coordination of federal agencies to address concerns related to the health of Great Lakes' ecosystems. Many of this plan's goals are directly related to forestry and support efforts to prevent and control invasive species, along with restoring habitat to protect populations of native species. Threats to the Great Lakes ecosystems are prioritized and then funded accordingly.

Identifying risks and preventing the spread of harmful invasive species are addressed through early detection monitoring and public education. Federally funded projects are implemented in the identified area at risk, and afterward, local partners continue to care for the area with less costly maintenance and stewardship activities to insure long-term health.

Priority areas are protected to "sustain diverse, complex, and interconnected habitats for species reproduction, growth, and seasonal refuge." Many species that are listed by the State or federal government are under threat because of habitat loss. The GLRI Plan provides strategies to restore habitats and increase the chance for some threatened and endangered species to reach self-sustaining populations. <https://www.glri.us/actionplan/pdfs/glri-action-plan-2.pdf>

Make No Little Plans: Developing Biodiversity Strategies for the Great Lakes

Conservation strategies have been developed by The Nature Conservancy (TNC) for each of the Great Lake's watersheds to assess threats to biodiversity in this region. In the TNC plan, climate change and terrestrial invasive species were identified as two of the biggest threats to ecosystem health in these watersheds. Complexities generated by the sheer size of these issues make the significant need for collaboration and implementation strategies apparent.

As developed and utilized by the TNC, Conservation Action Planning (CAP) is an effective ten step approach to projects which is accomplished by defining conservation targets, identification of critical threats (social, biological, political, economic) to the project, and the development of management and monitoring programs based on the targets and collected information. Once regional priorities are determined, Conservation Action Planning can be utilized to determine a

plan of action for the priorities. Then, as actions are taken and the outcomes monitored and measured, planning can be revised to incorporate new knowledge.

<https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/wholesystem/s/greatlakes/Pages/synthesispaper.aspx>

Environmental Protection Agency (EPA) Lake-wide Action and Management Plans (LAMP) are bi-national action plans and are thought to have some of the greatest potential for ecosystem restoration and management because they bring many stakeholders together and require coordinated collaboration that leads to greater collective impact. By engaging a diverse set of stakeholders, there is potential to broaden participation, limit the costs of education and outreach, have greater access to experienced specialists and technical assistance, and have a greater chance of sustaining stewardship efforts in the future. These practices have evolved to incorporate biodiversity conservation strategies, sometimes referred to as “blueprints.”

Duck’s Unlimited International Conservation Plan

The conservation vision of Ducks Unlimited (DU) revolves around preserving and restoring ecological integrity of integrated landscapes so that they have the capability of providing necessary resources to preserve sustainable waterfowl populations. Ducks Unlimited achieves its conservation goals through long-term, regional conservation strategic planning. All regional plans are developed around guiding principles that encompass Ducks Unlimited’s conservation approach.

These principles are derived from the organization’s international standards and are used by regional offices to guide waterfowl conservation efforts. They provide direction for the identification and conservation of existing and essential waterfowl habitat, including adaptive resource management and appropriate management intervention, as well as increased communication through the expansion of extension initiatives and increased public policy initiatives to support conservation efforts. The use of these principles to guide the strategic planning of conservation programs helps to ensure that the organization’s objectives are “successfully addressing the waterfowl and wetlands conservation goals.”

The DU conservation plan covers the US. Great Lakes System Waterfowl Conservation Region, as designated by the Commission for Environmental Cooperation, and consists of five ecoregions in the Great Lakes watershed. Historically, this area was a transitional zone between prairie and eastern woodland ecosystems. In this region, the Central Hardwoods contained some of the most significant wetlands due to the expansive “prairie pothole type wetlands, shallow lakes, coastal estuaries, and eastern woodlands created by glaciation. A historically significant ecosystem, named the Great Black Swamp, stretched throughout much of southeast Michigan with its farthest northern border being Detroit, MI. This ecosystem was dominated by forested wetlands, coastal marshes along the coast of Lake Erie, and scattered wet prairies and oak savannahs. This ecosystem was dramatically altered by logging and the

draining of wetland for agricultural use. Traces of these unique ecosystems-currently remain as fragmented remnants across the landscape. In total this region have lost over 75% of their wetlands and the remaining sites have been severely impacted by degraded water quality, development, and recreation. Due to these dramatic changes in this region, DU recognizes that the Remaining wetlands need to be managed for a high level of productivity to compensate for the substantial wetland losses.

One of Ducks Unlimited overarching goals is to restore and increase the remaining wetlands in this region and to protect the resources that they provide as breeding and wintering habitat for waterfowl that migrate through the Mississippi flyway. Southeast Michigan often has high levels of breeding mallard and wood duck populations. Important habitat in this region includes “portions of sheltered, vegetated littoral zones of the Great Lakes, coastal marshes, and riverine and palustrine marshes, and adjacent upland habitats of low-gradient river tributaries that empty into lakes.”

In general, declines in populations of migrating waterfowl can be observed as a result of lack of suitable habitat. The marshes found in the western Lake Erie basin are considered to be the most important wetlands in the Great Lakes region. “The Lake Erie marshes annually host hundreds of thousands of waterfowl in spring and fall, and are the most concentrated staging areas for black ducks in North America” (Tori et al, 1990). Restoration of wetland, grassland, and forest complexes improves conditions for breeding sites and stop overs for many waterfowl species, but also supports the preservation of a diverse group of wildlife species that rely on that same habitat.

DU believes that The most important conservation goal for this region is to preserve and enhance high priority coastal areas through watershed-based restoration activities focused on wetlands and adjacent upland area. To achieve their goal, they strive to provide sufficient habitat in both quantity and quality to meet the resource needs of waterfowl for breeding, wintering, and migration. It is believed that conservation activities in these areas will result in improved food resources for waterfowl because of improved water quality and that management activities will reduce invasive species, minimizing their negative impacts to critical these ecosystems. Strategies to accomplish this goal is the emphasis on the restoration of wetlands on both public and private land, to promote intensive management in areas with extremely expansive hydrologic modification to compensate for extreme wetland loss, provide preferred breeding habitat through the maintenance of “shallow water, forested and scrub-shrub wetlands”, protect important habitats that are highly threatened by development, and to utilize farm bill programs in order to increase desired wetland habitat on private land.

https://www.ducks.org/media/Conservation/Conservation%20Plan/_documents/a_ICP2004%20final%208.05.pdf

3.3.3 Private Landowner Forest Management Plans

Three private landowners in Monroe County that have had forest management plans produced and approved by the MDNR Forest Stewardship Division in the past 10 years. The total area addressed in these plans equals 130 acres. There are also at least three other landowners that have had management plans produced by local contractors, but they did not wish to comment on the content of their management plans.

Carl Burhop, a private forest consultant in southeastern Michigan has written many management plans for landowners in this region. All of which he says come with different priorities, but a very common one is the management of woodlots for hunting opportunities. Generally speaking, his plans cover a 10-year time frame. This allows for a realistic amount of effort from the average landowner. Common practices that he generally focuses on are invasive species control, forest stand improvement (pre-commercial practices), and wildlife habitat improvement.

Mr. Burhop mentioned that most landowners chose to create a management plan without looking into any cost-share programs, and unfortunately, this often limits their ability to complete all recommended practices. (Details on available cost-share opportunities can be found in section 5 of this document). The creation of a management plan is required when a landowner enrolls in a cost-sharing program, but details of the plan and individual are kept confidential.

3.4 Resource Providers

3.4.1 Government Agencies and Land Managers

Michigan's Forest Legacy Program

Michigan Forest Legacy Program (FLP) is a partnership with USDA Forest Service with a goal of protecting privately owned and environmentally significant forest lands from being converted to non-forest uses. This voluntary program acquires land through purchase of fee simple title or by conservation easements, legally binding agreements that transfer a negotiated set of property rights without removing the property from private ownership. Conservation easements purchased using FLP funds restrict development, require sustainable forestry practices, and protect a variety of other values. Michigan's FLP encourages partnerships with local governments and land trusts, recognizing the important contributions landowners, communities and private organizations make to conservation efforts. The program requires public access for fee lands but not for conservation easements.

The MDNR state forest resources have been recognized by the Forest Stewardship Council® (FSC®) and the Sustainable Forestry Initiative® (SFI®). Independent auditors have reviewed the MDNR's on-the-ground forest practices against biological, social, and economic requirements in the FSC and SFI standards and certified those practices as sound and comprehensive.

MDNR Forest Stewardship Program (MDNR-FSP) offers resources to private landowners to support forest stewardship efforts, in recognition of the fact that a majority of the state's forests are on private property. MDNR-FSP certifies forest stewardship plan writers to assure that they can offer sound information on best forest stewardship practices, maintains a listing of plan writers in different regions, and offers cost-sharing to landowners to assist them in forest stewardship planning.

Helping Private Forest Landowners Develop Plans for Sustainable Forest Management: A Landowner's Guide. www.michigan.gov/foreststewardship

Michigan Landowner Forest Stewardship Plan (Sample)
www.michigan.gov/.../FSP_Plan_Example_September2014_468852_7.pdf

Plan Writers: www.michigan.gov/dnr/0,4570,7-153-30301_34240_68762---,00.html

A useful publication for management of deer as well as many other game and non-game species is provided by the DNR Landowner's Guide. This 1999 publication also offers instructions on land management planning for forests, grasslands, wetlands, cropland, and backyard habitats.
http://www.michigandnr.com/publications/pdfs/huntingwildlifehabitat/Landowners_Guide/

US Forest Service

The US Forest Service is a multi-faceted agency that manages and protects 154 national forests and 20 grasslands in 43 states and Puerto Rico. In Michigan, there are three National Forests: Huron-Manistee (Northern Lower Peninsula) and Hiawatha and Ottawa (both in the Upper Peninsula). The agency's mission is to sustain the health, diversity, and productivity of the nation's forests and grasslands to meet the needs of present and future generations. They have an elite wildland firefighting team and the world's largest forestry research organization. Their experts provide technical and financial help to state and local government agencies, businesses, private landowners and work government-to-government with tribes to help protect and manage non-federal forest and associated range and watershed lands. They partner with public and private agencies that help plant trees, improve trails, educate the public, and improve conditions in wildland/urban interfaces and rural areas, and promote sustainable forest management and biodiversity conservation internationally.

<https://www.fs.fed.us/>

Fish and Wildlife Habitat Programs

Most stewardship plans address wildlife habitat and there are many practices that can be used to improve conditions for animals. Support for wildlife habitat is available from both public and nonprofit entities. The MDNR has several programs such as the Private Lands Program and the Wildlife Habitat Grant Program for government, profit or non-profit groups, and individuals interested in conservation. The US Fish and Wildlife Service has the Partners for Fish & Wildlife program which works with private landowners to improve fish and wildlife habitat on their lands through voluntary, community-based stewardship programs for conservation. There are also several nonprofit organizations dedicated to providing wildlife habitat including: Audubon, Ducks Unlimited, National Wild Turkey Federation, Pheasants Forever, Ruffed Grouse Society, the Quality Deer Management Association and Trout Unlimited. Many of these organizations have programs to provide financial and technical assistance for enhancing wildlife.

Contact: Jim Hudgins
U.S. Fish & Wildlife Service (Michigan)
2651 Coolidge Road East Lansing, MI 48823
517-351-4230
Email: Jim_Hudgins@fws.gov

US Fish and Wildlife Landscape Conservation Cooperatives (LCCs)

Landscape Conservation Cooperatives (LCCs) address large scale natural resource challenges that transcend political and jurisdictional boundaries and require a networked approach to conservation—holistic, collaborative, and grounded in science – to ensure the sustainability of America’s land, water, wildlife and cultural resources. Michigan is in the Upper Midwest and Great Lakes Landscape Conservation Cooperative. www.GreatLakesLCC.org

Contact: Bradley Potter
Acting Coordinator, U.S. Fish and Wildlife Service
Bradley_Potter@fws.gov
2651 Coolidge Rd, East Lansing, MI 48823

Michigan Department of Environmental Quality

The Michigan Department of Environmental Quality regulates air, land, water, and waste generation activities in the state. The MDEQ endeavors to protect water from both point and nonpoint pollution sources by partnering with watershed groups and others. They issue National Pollutant Discharge Elimination System (NPDES) and storm water discharge permits. Large scale water withdrawals are limited by law and the Water Withdrawal Assessment Tool is designed to predict the effect of groundwater use. Under the land category, earth change activities on areas greater than one acre or located within 500 feet of a lake or stream require a

Soil Erosion and Construction Storm Water permit. Other programs cover regulation of wetlands, handling of septage, and use of flood plains.

MDEQ's Water Resources Division administers MiWaters, a web-based database that provides a streamlined electronic permitting process to fulfill federal electronic reporting requirements and gives online access to public information. The focus of MiWaters is permitting and compliance, including National Pollutant Discharge Elimination System (NPDES), storm water, groundwater discharge, aquatic nuisance control, Part 41 construction, and land and water interface.

Permit Coordination is available through the Environmental Assistance Hotline at (800) 662-9278. (<https://miwaters.deq.state.mi.us/miwaters/#/external/home>)

Michigan Natural Shoreline Partnership

The Department of Environmental Quality's Inland Lakes and Streams program has been participating in the Michigan Natural Shoreline Partnership (MNSP) to promote natural shoreline landscaping to protect Michigan's Inland Lakes. Their mission is "Promoting Natural Shorelines through the use of green landscaping technologies and bioengineered erosion control for the protection of Michigan inland lakes." One of the goals of the Michigan Natural Shoreline Partnership is to educate property owners about natural shorelines and technologies that benefit lake ecosystems. It provides support for practices that restore or preserve the ecological function of the shoreline and stabilize shorelines by reducing erosion. They offer educational resources and the website lists contractors who are certified by the program.

www.mishorelinepartnership.org/

Michigan's Water Strategy

Michigan's Water Strategy is a 30-year plan for Michiganders to protect, manage, and enhance Michigan's water resources for current and future generations. It is organized around nine goals and outcomes designed to ensure the viability and sustainability of Michigan's water resources over time, placing Michigan on a path to achieving its water vision in a way that builds economic capacity while sustaining ecological integrity of this globally-significant resource.

http://www.michigan.gov/deq/0,4561,7-135-3313_3677_76614---,00.html

Southeast Michigan Council of Governments

Working with local watershed groups and member governments, Southeast Michigan Council Of Governments (SEMCOG) provides technical assistance on watershed management issues and regulatory requirements within their jurisdictions. A watershed is an area of land that captures rainwater and eventually carries it to the nearest lake, river, or stream. Michigan has numerous watersheds and Watershed Management Plans serve as guides for communities to protect and improve water quality and related natural resources. These plans consider all uses, pollutant sources, and impacts within a drainage area. More than 150 Watershed Management Plans exist at the local level across the state, many funded through MDEQ nonpoint source grant opportunities. A Watershed Management Plan was required for communities using

Michigan's unique watershed-based Phase II permit. Many of these plans also meet Federal EPA Section 319 requirements.

Common elements of watershed plans across Southeast Michigan include goals, objectives, and actions to address water quality and water quantity (i.e., stream flashiness) challenges in addition to identifying protection and restoration opportunities. This led to development of the Low Impact Development Manual for Michigan: A Design Guide for Implementers and Reviewers.

Additionally, SEMCOG led the development of the Green Infrastructure Vision for Southeast Michigan. The vision brings together a holistic, coordinated plan that addresses all unique elements of green infrastructure, including natural areas, wildlife habitat, parks, hiking/biking trails, water trails, tree canopy, agricultural lands, conservation property, vacant property, and many others. It also focuses on the relationship of green infrastructure to our water resources. <http://semcog.org/Watersheds>

Environmental Protection Agency

The Environmental Protection Agency's website has an environmental information page that lists air, water, and cleanup concerns in Michigan and can be mapped by zip code, county, etc. <https://www.epa.gov/mi/environmental-info-michigan>

USDA Natural Resources Conservation Service and Farm Service Agency

The Natural Resources Conservation Service has tools and other technical resources to assist in Conservation Planning, Conservation Compliance on highly erodible land, nutrient and pest management, and Rapid Watershed Assessment. The agency also conducts the Soil Survey Program, the National Resource Inventory and the Conservation Effects Assessment Project. Some of the key financial assistance programs (see Section 5.5) are Environmental Quality Incentives, Conservation Stewardship, and Agricultural Conservation Easement. Conservation Stewardship is a program that provides technical and financial assistance to qualified farmers whose applications rank high enough (on the Conservation Measurement Tool) to be accepted into the program.

The Farm Service Agency's Conservation Reserve Program (CRP) pays a yearly rental in exchange for farmers removing environmentally sensitive land from agricultural production and planting species that will improve water quality, prevent soil erosion, and reduce loss of wildlife habitat.

The Agricultural Conservation Easement Program has several components including Agricultural Land Easements and Wetlands Reserve Easements. These both provide financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Some easements are permanent while others are 30 year contracts.

Monroe County NRCS
1137 S. Telegraph Road, Monroe, MI 48161
(734) 241-7755

Michigan Department of Agriculture and Rural Development

Michigan Agriculture Environmental Assurance Program

Each of the Conservation Districts is participating in the Michigan Agriculture Environmental Assurance Program (MEAP) which is a voluntarily, proactive program that helps farmers minimize risks from agricultural pollution. This program is designed to reduce farmers' legal and environmental risks through a three-phase process: 1) education; 2) farm-specific risk assessment; and 3) on-farm verification that ensures the farmer has implemented environmentally sound practices. The program's systems are Farmstead, Cropping, Livestock, and the newly developed Forest, Wetlands and Habitats System. <http://www.maeap.org/>

Note: Mailing addresses for MEAP are the same as the Conservation Districts.

Farmland Preservation Office

Richard Harlow, Program Manager

Environmental Stewardship Division

P.O. Box 30449 Lansing, MI 48909

517-284-5663

Email: MDARD-PA116@michigan.gov

http://www.michigan.gov/mdard/0,4610,7-125-1599_2558-14018--,00.html

Detroit and Western Lake Erie CWMA

CWMAs are comprised of private landowners, non-governmental organizations, natural resource management groups, governmental agencies, and others who are interested in combating invasive species. Monroe County is included in the Detroit and Western Lake Erie CWMA. This diverse set of partners developed a comprehensive, strategic, and long-term approach for managing invasive species, focusing on phragmites.

<http://www.michiganinvasives.org/detroitlakeeriecwma/>

Chris May

Director of Stewardship

The Nature Conservancy in Michigan

101 E. Grand River Avenue, Lansing, MI 48906

517-316-2274

cmay@tnc.org

Monroe County Planning Department

Monroe County Planning Department has planning staff and a number of resources on their webpages that might be useful for landowners for preparation of stewardship plans for their individual properties. These resources include GIS maps and annual reports and plans that contain pertinent information about the physical attributes and resources in the area.

Monroe County Planning Department

125 East Second Street, Monroe, MI 48161

(734) 240-7375

http://www.co.monroe.mi.us/officials_and_departments/departments/planning/index.php

Monroe Conservation District

The Monroe Conservation District provides information and technical assistance to many different individuals and agencies working in the Monroe areas who are managing land or water. Landowners can be assisted by technicians to execute conservation practices and programs on their properties.

3.4.2 Nonprofit, Non-Governmental Conservation Organizations

The Stewardship Network (TSN)

The Stewardship Network (TSN) is a 501(c)(3) corporation with a mission to connect, equip, and mobilize people and organizations to care for land and water in their communities. TSN is dedicated to training, developing, and supporting a vibrant group of volunteer and professional stewardship leaders. TSN builds the capacity of partner organizations and individuals through development of model projects and implementation of region-wide initiatives. TSN helps groups and individuals tap into the Network's wealth of knowledge and experience in preserving and protecting our native biodiversity. The Stewardship Network trains volunteers in scientifically-based, field-proven conservation techniques they put into practice on partner organizations' properties.

The Stewardship Network is the recognized national and international award-winning leader in this approach. Founded and headquartered in Ann Arbor, TSN supports 16 local collaborative conservation clusters (CCCs) in Michigan, Ohio, Indiana, Minnesota, and New Hampshire. In honoring TSN with its 2015 Science & Practice of Ecology and Society award, the journal *Ecology and Society* commended "the local roots" of TSN, writing "Different from other organizations, TSN asks communities the critical question, 'What do you need to care for land and water?'" TSN then helps each local cluster determine its geographic boundaries and program priorities; recruit, train and engage volunteers; and secure the resources and expertise to act as stewards for its local land and water.

The Network hosts a series of initiatives that support their on-the-ground CCCs, including monthly webcasts; the Science, Practice & Art of Restoring Native Ecosystems Conference; the Spring Clean-up Challenge (removal of invasive species, starting with Garlic Mustard); the October Volunteer Restoration Challenge (starting with biodiverse tree planting, native prairie grasses, wetlands restoration); websites; newsletters; and turnkey systems for database management, e-communication, registration, and contributions.

416 Longshore Dr., Ann Arbor, MI 48105

(734) 996-3190

staff@stewardshipnetwork.org

www.stewardshipnetwork.org

The Western Lake Erie Cluster of the Stewardship Network, which serves Monroe and Wayne Counties, formed in 2013 with leadership from the River Raisin Institute. We live and work in a very special area, side by side with rare and imperiled terrestrial habitats and Lake Erie – the most biologically diverse body among the Great Lakes. We want to create a strong network between the many groups already working to protect and restore these special areas, and build a better appreciation for these amazing resources among local citizens. Contact the Western Lake Erie Cluster Coordinator by email at wlec@stewardshipnetwork.org.

Michigan Natural Features Inventory

The Michigan Natural Features Inventory (MNFI) program, administered by Michigan State University Extension, conducts field surveys to locate and identify threatened and endangered species and communities throughout the state; created and maintains a database of all relevant species and community locations; provides data summaries and analysis in support of environmental reviews; and provides biological expertise to individuals, agencies, and other interested parties. (See Appendix 3 for MNFI's threatened and endangered list for Monroe County.) <https://mnfi.anr.msu.edu/>

Southeast Michigan Land Conservancy

The Southeast Michigan Land Conservancy (SMLC) is a regional nonprofit organization dedicated to preserving habitat to support the conservation of natural ecosystems and their services in southeast Michigan. SMLC has the ability to own and manage property for conservation purposes, but they also work with landowners to help them protect their private property for future generations. They assist local governments with public land projects as well. SMLC serves as an educational resource to the broader community and coordinates local volunteer stewardship workdays on managed properties. <http://www.smlcland.org/>

The Nature Conservancy

The Nature Conservancy (TNC) works with landowners to restore natural areas and protect native ecosystems. TNC provides technical and sometime financial assistance for restoration projects. Many of these projects take place on private land. Their staff specializes in ecosystem type characteristics of the region. In Monroe, the Ohio Nature Conservancy is responsible for much of the work being done in the Oak Openings Region. TNC participates in the Detroit & Western Lake Erie Cooperative Weed Management Area and partners with local municipalities and landowners to monitor and treat priority invasive species throughout the western Lake Erie basin. Regional offices often have specialized staff available to provide information or technical assistance for ecological concerns and are generally located within a priority area.

<https://www.nature.org/>

River Raisin Institute

The River Raisin Institute is a local, non-profit organization that provides environmental education, sustainability awareness, and ecological stewardship programming to the Monroe County Community. Staff are available to connect the community with resource providers, share information about environmental issues to the Monroe County Community, and coordinate local volunteer stewardship efforts.

Michigan State University Extension Service

Michigan State University's Extension Service offers information on natural resources, agriculture, lawn and gardens and other topics. They also have a Conservation Stewards Program: http://msue.anr.msu.edu/program/info/conservation_stewards_program

963 S Raisinville Road, Monroe, MI 48161

msue.monroe@county.msu.edu

734-240-3170

<http://msue.anr.msu.edu/county/info/monroe>

Master Gardener Program

Michigan State University Extension conducts a Master Gardener Program to train adults in horticulture education and as volunteer leaders. The Master Gardener Helpline is set up to answer questions about gardening (plant identification, disease or pest questions, or basic garden-care). You can find a current list of county master gardener contacts on the following website:

http://msue.anr.msu.edu/program/master_gardener_volunteer_program/contact_us/michigan_master_gardener_groups

Habitat Network

The Nature Conservancy and the Cornell Lab of Ornithology launched Habitat Network, a free online citizen science platform that invites people to map their outdoor space, share it with others, and learn more about supporting wildlife habitat and other natural functions across the country. Forty million acres of U.S. land are covered by lawn—short grass that has minimal ecological function and costs property owners more than \$30 billion to maintain each year. Habitat Network offers alternate solutions for yards, parks and other urban green spaces to support birds, pollinators and other wildlife, plus manage water resources, and reduce chemical use of pesticides and fertilizers to keep nature in balance. “Science shows us that small changes in the way properties are managed can make a huge impact towards improving our environment,” said Megan Whatton, project manager for Habitat Network at The Nature Conservancy. “Creating and conserving nature within cities, towns and neighborhoods are key to global conservation.”

<http://content.yardmap.org/learn/> (also has supporting articles)

Michigan United Conservation Clubs

Michigan United Conservation Clubs partner with Pheasants Forever, Quality Deer Management Association, and the Department of Natural Resources to deliver the Michigan Wildlife Cooperatives program which was created to improve habitat and hunting experiences on private lands by providing resources, supplying information, and supporting collaboration among individuals and groups. The Michigan Wildlife Cooperatives program provides wildlife and habitat management training and resources to grow and promote cooperative development and expansion. Collective management works especially well for game that has a large home range such as white-tailed deer, pheasants, and turkeys. For wildlife cooperatives, see:

<http://www.mucc.org/cooperatives>

Anna Mitterling: amitterling@mucc.org (517) 346-6454

Amy Trotter: atrotter@mucc.org (517) 346-6484

Sources of Michigan Native Plants

This list of suppliers is meant to provide a start in your search for native plant suppliers near you. Note: The Michigan Department of Environmental Quality's bio-engineering permit does require the use of Michigan native plants below the ordinary high water mark when doing work that requires a permit.

Michigan Native Plant Producers Association (www.mnppa.org/)

The Michigan Native Plant Producers Association comprises 7 independently owned nurseries located throughout the state of Michigan. Together they grow and sell over 400 species of Michigan native plants and seeds, including, trees, shrubs, wildflowers, grasses, and ferns.

Wildflower Association of Michigan (www.wildflowersmich.org/)

The Wildflower Association of Michigan encourages the preservation and restoration of Michigan's native plants and native plant communities. They provide education on native plants and native landscaping through their conference, website, grant program, and quarterly newsletter. They also have sources of native plants and a business directory listed on their website.

Michigan Association of Conservation Districts

Many of Michigan's 78 Conservation Districts host native plant sales in the spring and fall.

3.4.3 Private Sector Natural Resource Professionals

Note: The lists provided are for reader's use but do not constitute an endorsement or guarantee of the quality of service. Other contractors not listed may also be available in your area.

MDNR List of Certified Forest Stewardship Plan Writers

Source: http://www.michigan.gov/dnr/0,4570,7-153-30301_34240-298690--,00.html

Nikita Brabbit (Consulting Forester)

917 West Genesee Street, Lansing MI 48915

nbrabbit@gmail.com; 507-458-4947

Related Programs: Tree Farm, Commercial Forest

Dan Brown (Consulting Forester)

2167 Gunnell Road, Eaton Rapids, MI 48827

brownd94@msu.edu; 517-898-5670

Related Programs: Tree Farm, Commercial Forest

Burhop Forestry Consulting

Carl Burhop (Consulting) Forester

PO Box 362, Dexter, MI 48130

burhopforestry03@yahoo.com; 734-904-5233

Related Programs: Tree Farm, Commercial Forest, TSP

Credentials: Registered Forester, Certified Forester, Association of Consulting Foresters

Darling Forestry LLC

Jason Darling (Consulting Forester)

1111 West Barnes Road, Mason, MI 48854

www.DarlingForestry.com

jason@darlingforestry.com; 517-243-2000

Related Programs: Tree Farm, TSP, Qualified Forest, Commercial Forest

Credentials: Registered Forester

Ecosystems Management LLC
Jack Boss (Wildlife Biologist)
3210 Bewell Avenue SE, Lowell, MI 49331
ecosystemsmgt@att.net; 616-897-8575
Related Programs: TSP, Qualified Forest, Commercial Forest, QDMA
Credentials: Certified Wildlife Biologist

Jacques Forest LLC Forester Type: Consulting Foresters
1251 Spartan Road, Tawas City, MI 48763
Office: 989-362-6245
Tom Jacques (Consulting Foresters) jacquesforest@yahoo.com; 989-329-8079
Jenilee Jacques (Consulting Foresters) jenileerae@gmail.com; 734-272-2365
Related Programs: Tree Farm, TSP, Qualified Forest, Commercial Forest

Spencer Kellum (Biologist)
2318 Parkwood Avenue, Ann Arbor, MI 48104
spencer.kellum@gmail.com; 734-794-3879
Related Programs: Commercial Forest

The Land Steward LLC
Rick McAvinchey (Consulting Forester)
300 Woodbridge Lane, Ortonville, MI 48462
thelandsteward@frontier.com; 248-627-7109
Related Programs: Tree Farm, Commercial Forest
Credentials: Registered Forester, Association of Consulting Foresters

Lee Forestry Services
Doug Lee (Consulting Forester)
404 John K Drive, Auburn, MI 48611
foresterdoug@charter.net; 989-662-0139
Related Programs: TSP, Qualified Forest, Commercial Forest
Credentials: Certified Forester

Dave Mathis (Consulting Forester)
PO Box 28, Chelsea, MI 48118
dmmathis@yahoo.com; 734-395-4113
Related Programs: Tree Farm, Qualified Forest, Commercial Forest

Natural Community Services LLC
John DeLisle (Ecologist)
30775 Longcrest, Southfield MI 48076
j_delisle@hotmail.com; 248-672-7611

Post Hardwoods

Justin Brabon (Industry Forester)
3544 38th Street, Hamilton, MI 49419
jbrabon91@gmail.com; 616-799-0262 or 269-751-7307
Related Programs: Qualified Forest, Commercial Forest
Credentials: Registered Forester

Progressive Forest Management
Pete Klink (Consulting Forester)
PO Box 521, Coldwater, MI 49036
marklink@dklb.net; 517-238-4048
Related Programs: Qualified Forest, Commercial Forest

Quality Hardwoods Inc
Abe Kempf (Industry Foresters)
396 East Main Street, Sunfield, MI 48890
abraham@qualityhardwoodsinc.com; 517-566-8061 or 231-735-3470
www.QualityHardwoodsInc.com
Related Programs: Tree Farm, Qualified Forest, Commercial Forest
Credentials: Registered Forester

River Bend Willow Forestry
Lisa Parker (Consulting Forester)
116 East Willow Street, Lansing, MI 48906
parke204@msu.edu; 517-763-8637
Related Programs: Tree Farm, Qualified Forest, Commercial Forest
Credentials: Registered Forester

David Syckle (Wildlife Biologist)
1410 Charles Avenue, Alma MI 48801
syckl1de@cmich.edu; 989-533-8447

Jeff Tuller (Consulting Forester)
5433 Colby Road, Owosso, MI 48867
tuller@straightturn.com; 810-841-4414 or 989-723-9522
Related Programs: Tree Farm, TSP, Qualified Forest, Commercial Forest
Credentials: Registered Forester, Association of Consulting Foresters

Weber Brothers Sawmill
Amy Salisbury (Industry Forester)
2863 West Weidman Road, Mt Pleasant, MI 48858
amysalisbury@live.com; 989-330-0421
www.WebersSawmill.com
Related Programs: Tree Farm, Qualified Forest, Commercial Forest

Credentials and Programs

- “ACF Foresters” are members of the Association of Consulting Foresters: www.acf-foresters.org
- “Certified Foresters” are certified by the Society of American Foresters: www.safnet.org
- “Forest Stewardship Plan Writers” write Forest Stewardship Plans – www.Michigan.gov/ForestStewardship
- “Master Loggers” are trained, audited and certified by other professional loggers: www.mimlc.com
- “Qualified Foresters” write plans for the Qualified Forest Program – www.Michigan.gov/qfp
- “Qualified Logging Professionals” are loggers trained by the Sustainable Forestry Initiative: <http://sfimi.org>
- “Registered Foresters” are recognized by the State of Michigan – www.Michigan.gov/Foresters
- “Technical Service Providers” write plans for the Environmental Quality Incentives Program: www.nrcs.usda.gov

Professional Forester Classifications

Consulting Foresters

Consulting foresters are independent businesses that work directly for the landowner. Consulting foresters administer timber sales, write Forest Stewardship Plans, manage wildlife habitat, plant trees, and offer other services for forest landowners. There are about 125 consulting foresters in Michigan.

Association of Consulting Foresters : www.acf-foresters.org

Forest Stewardship Plan Writers – www.Michigan.gov/ForestStewardship

Industry Foresters

Industry foresters work for local forest products companies to buy timber from private landowners or to manage forest land owned by their company. Industry foresters buy timber from private landowners and write forest management plans. There are about 100 industry foresters in Michigan.

Michigan Association of Timbermen : www.timbermen.org

Michigan Forest Products Council : www.michiganforest.com

Great Lakes Timber Professionals Association : <http://gltpa.org>

Government Foresters

Government foresters, funded by your tax dollars, provide general forestry information to landowners. Government foresters conduct workshops, hold field days, write articles, and make professional referrals. There are about 35 government foresters who help private landowners (and another 200 working on public land).

Conservation Districts – 20 foresters in the Forestry Assistance Program –

www.Michigan.gov/mifap

MSU Extension – 5 educators statewide: <http://msue.anr.msu.edu/topic/info/forestry>
MDNR – 5 foresters statewide – www.Michigan.gov/PrivateForestLand
USFS : www.fs.fed.us/spf

Southern Lower Michigan Restoration Contractors (from The Stewardship Network)

The Stewardship Network has compiled a directory of contractors who perform an array of services related to ecosystem restoration and stewardship in Southern Lower Michigan. Visit <http://stewardshipnetwork.org/resources/southern-michigan-restoration-contractors> for the most recent version of this document. If you would like to add your own company or suggest a contractor that you have had success with, suggestions may be emailed to staff@stewardshipnetwork.org.

Michigan Certified Natural Shoreline Professionals

Certified Natural Shoreline Professionals have demonstrated competency in shoreline and near shore soils, plant communities, aquatic habitats, water law and permitting, wave energy assessment and the methods and techniques involved in designing natural shoreline landscaping and bio-engineered erosion control on inland lakes. Certification is provided by the Michigan Natural Shoreline Partnership (MNSP) and is updated every three years through continuing education. (from <http://www.mishorelinepartnership.org/>)

To find a Natural Shoreline Professional in your area, visit <http://www.mishorelinepartnership.org/find-a-shoreline-contractor.html> Professionals can be found easily by name or county (there are also many who work state-wide) on spreadsheets created and maintained by MNSP.

4. Landscape Stewardship Stories

A unique component of this project was to interview public and private landowners who actively manage their forested property. This piece highlights the stewardship efforts of private landowners that often go unnoticed. The stories presented in this plan include numerous accounts of restoration efforts on both public and private lands in Monroe County. Many of these restoration efforts happen to include Oak Opening restorations. This is not surprising because The Ohio Nature Conservancy has had a tremendous presence in Monroe County and has offered numerous educational and financial opportunities for restoration projects.

By speaking with neighbors and sharing stories about the experience of managing forest lands, we hope to inspire other landowners to become actively engaged in managing their own land and encourage them to share their own stories in the future.

4.1 Sisters, Servants of the Immaculate Heart of Mary Campus

Monroe, Michigan

Written by Danielle Conroyd

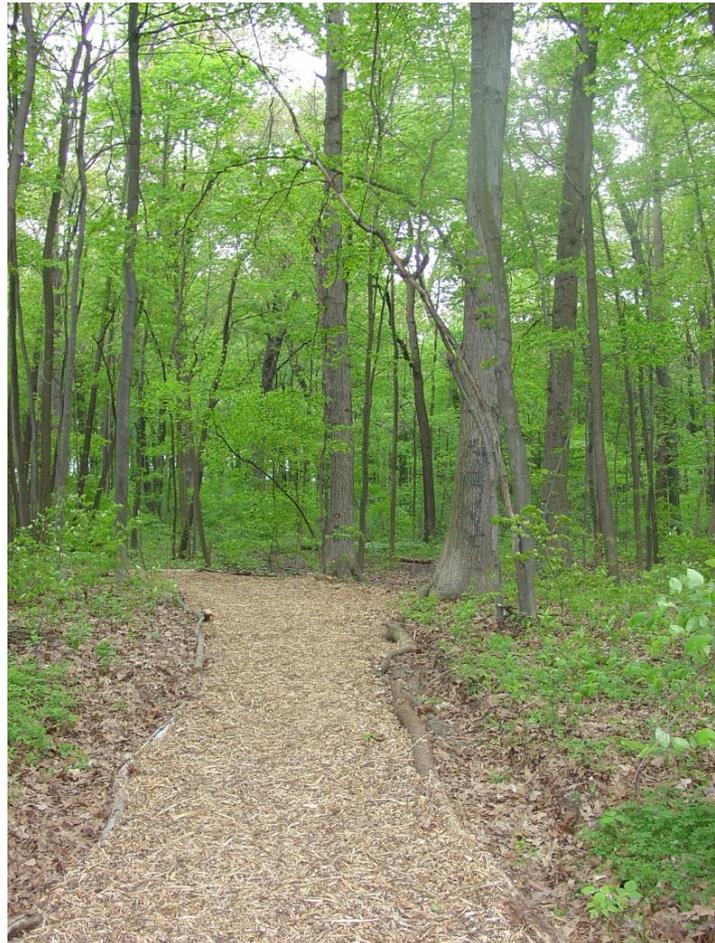
The Immaculate Heart of Mary (IHM) sisters have committed their lives and resources to responding to the needs of the world. Founded in 1845 as a Catholic community of educators, the mission of the IHM community has evolved – continuing to respond in faith and commitment to the world’s changing needs. The IHM sisters have resided on their campus along the River Raisin in Monroe since 1932. As recently as the late 1990s, the IHM campus consisted of 280 acres and contained numerous buildings totaling over 600,000 square feet as well as Sisters Island, a 4-acre island in the River Raisin directly across the street from the main building. Buildings on the campus include the IHM Motherhouse, Saint Mary’s Academy (currently mothballed), and the decommissioned powerhouse. A mature landscape consisted of substantial acreage of lawn, crop fields, a pond, a woodlot, and the previously mentioned island in the River Raisin. The construction of the IHM Motherhouse occurred during the height of the Great Depression and the sisters oversaw the transplanting of a thousand trees from Sisters Island to the new site for landscaping. The IHM Motherhouse campus looks very different today than it did 20 years ago.

The IHM congregation embarked on a long range planning process in 1996. The need to transform their 64-year-old Motherhouse to respond to the aging and health care needs of their members offered an opportunity for re-visioning their entire Monroe campus in ways that responded to the wider needs of the world. Through research, discernment, and study, the IHMs decided to renovate their home and renew their campus in ways that expressed their commitment to sustainable living. The IHM Sisters consider sustainability a moral mandate for the 21st century and they have transformed their entire campus into a learning laboratory for sustainable living. In addition to the award winning LEED certified renovated Motherhouse,

the integrating vision for the campus included the restoration of the site to pre-settlement conditions. A sense of place and connectedness to the River Raisin watershed and the Great Lakes bioregion guided the decisions and actions with respect to site restoration. The plan included the conversion of 11 acres of lawn to a native prairie system, bio swales in the parking lots, a constructed wetland to support a grey water filtration system, and numerous contemplative landscape features.

The IHM commitment to ecological stewardship began decades before the sustainable renovation of their Motherhouse. Beginning in the early 1960s the sisters committed themselves to an ongoing process of environmental stewardship. The congregation decided to actively manage the woodlot on their property. These changes were fostered by the mission of the IHM Sisters to care for their common home and live sustainably.

The historic as well as ecological value of the woodlands on the IHM campus has been a focus of all of the surveys and recommendations from external consultants. One aspect of renovating their Motherhouse and restoring their site included a tree inventory on their campus in 2000. Conducted by *EcoLogic*, LLC, the tree inventory included 163 specimen trees surrounding the IHM buildings and within potential construction areas. In 2005 the IHM sisters welcomed an AmeriCorps team that worked in the oak savannah for 5 weeks to remove invasive species such as autumn olive. The AmeriCorps crew used debris to create wood lined trails throughout the woodlot to make it accessible to the sisters. In 2012 The Nature Conservancy (TNC) and IHM entered into a management agreement to allow TNC to undertake activities of restoration and invasive plant management in the 35-acre remnant oak opening on the IHM campus. Realizing that their woodlot offered a unique restoration opportunity, the IHM sisters welcomed the opportunity to work with TNC Ohio on a full restoration of the oak savannah. All restoration work in the oak savannah ceased when issues arose with the State Historic Preservation Office (SHPO) approval of the plan. Federal funding required SHPO approval so TNC had to stop their work due to the lack of funding. There has been no restoration work since that time.



In 2012, an opportunity arose for the IHM Sisters to sell 120 acres of their property that was no longer being farmed. La-Z-Boy was searching for a site to build a new world headquarters in Monroe and wondered whether the IHM Sisters would be open to selling their land for that purpose. La-Z-Boy wanted a park like setting for their headquarters and the IHM land met that requirement perfectly. In 2013 IHM and La-Z-Boy finalized the purchase agreement for La-Z-Boy to acquire the IHM back property, including the oak savannah woodlot. The IHM sisters wanted to make sure that the oak savannah was preserved and restored and La-Z-Boy agreed to that condition of the sale. In 2016, La-Z-Boy executed a conservation easement for the 35-acre oak savannah. The conservation easement calls for the restoration and preservation of the oak savannah and prohibits the development or removal of the woodlot. As the grantee, the IHM Sisters have the right to participate in the restoration of the oak savannah and to conduct educational site visits. Later in 2016, a restoration specialist from TNC Ohio did a site visit and explained the process for oak savannah restoration with IHM staff. IHM is hopeful that in the coming years the oak savannah will be fully restored and actively managed through the partnership between La-Z-Boy and IHM.



4.2 Layhew Residence

Monroe, Michigan

The Layhews moved into their residence in 1989. What used to be a single parcel field was now a young forest in succession. The original land was divided into separate parcels and sold to numerous landowners having homes on the outskirts of the forest. The Layhews own roughly two acres of the woodlot, like many other neighbors who own less than 5 acres. There are a select few neighboring property owners who own more than 20 acres of the forested land.



Although Diane and Len Layhew use the woodland area for recreational purposes, their appreciation for native species has kept them managing it for many years. The entire wooded area is privately owned and only accessed by the surrounding landowners. Hunting is prohibited and many of the residents do not manage their wooded property, but some use it for low-impact recreation. The Layhews often clear hazardous or dying trees from the woodlot. Last year, they selectively cut 11 trees to thin out areas that are used heavily. Their woodlot has extremely sandy soils, and windthrow is very common. To provide enough sunlight to the wildflowers that are prominent, they clear a lot of the brush from the understory. Mrs. Layhew often propagates many of the forest flowers near the tree line backing up to their home. Their property consists of mostly oak, soft maple, cottonwood, dogwood, birch, and planted evergreen species. They have not had an issue with invasive species other than garlic mustard, which they pull annually. However, neither they nor their neighbors have had a survey done by

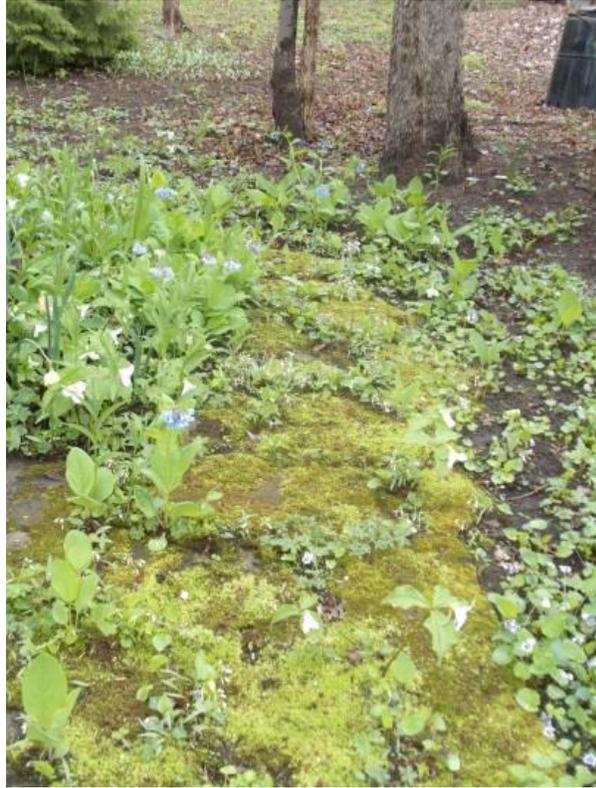


a forester to inventory tree species or identify invasive species throughout the entire forest.

They have a significant amount of wildlife that inhabit their property and the surrounding portions of the woodlot. They often see raccoon, opossum, deer, a substantial amount of various bird species, hawks, and have even seen a red fox and a coyote on their property. They have vernal pools

present in their woodlot during the spring with excessive flooding in the fall when they frequently hear a chorus of amphibians.

The Layhews and their family enjoy recreational opportunities using their woodlot. Their grandchildren enjoy riding off road vehicles through their trails and have a small shooting range in the woodlot. Many of their neighbors do not use their woodlot property while others horseback ride through the trails. The Layhew's appreciation for nature has provided them with a very lovely, usable, easily managed woodlot that they can enjoy with their family. The work that they have done to care for their property has resulted in a woodland that supports wildlife, produces desirable plants species, provides opportunities for recreation, and adds a natural aesthetic for their home.



4.3 Monroe Conservation District

Monroe, Michigan

Written by Ben Lehr, WLEB MAEAP Technician

Conservation districts provide many resources regarding conservation practices and land management to landowners at a county-wide scale. Technicians are on staff to assist landowners in implementing conservation programs on their property, connect them with proper agencies for their inquiries, and provide knowledge about local conservation issues. Technicians can provide guidance for compliance with program requirements, technical support throughout each step, and education about different conservation practices that are a part of each program.

Ben Lehr is one of the technicians with the Monroe Conservation District whose job focuses on assisting landowners in the Western Lake Erie Basin with enrollment into the Michigan Agriculture Environmental Assurance Program (MAEAP). The program verifies that enrollees' farms or properties are environmentally conscious and low-risk to water quality by meeting standards determined by the state-wide program. MAEAP can verify private land in any of these four areas: Farmstead, Cropping, Livestock, and the new Forest, Wetlands, and Habitats System. The conservation district attracts interested landowners through outreach events in the community where they collaborate with other local organizations that focus on conservation to provide interested landowners with current information on best management practices. One example of this was their partnership with Pheasants Forever to host an event introducing landowners to federal conservation programs. In the Monroe County area, a lot of the interest in the Conservation Reserve Program (CRP) comes from word of mouth, since it is a small community where many landowners and farmers have good relationships with each other and share information.

Once an individual is interested, a MAEAP technician helps the landowner enroll in the program and implement the initial planning stages of the practices that are required to meet the verification that they are interested in obtaining. Sometimes this is as simple as planting a riparian buffer strip or can be as large as replanting an out of commission crop field to allow for the establishment of a wetland. The technician is there to support the landowner through the process by providing them with technical support and knowledge to ensure successful projects. They can offer referrals to appropriate nurseries or contractors who share a similar philosophy about their goals. Ben believes that participation in these programs is made easiest and most successful when the landowner and technician can form a personal relationship. When the landowner understands that the technician is there to tell them the things that they don't know and will always be available to assist with decision making, then the implementation of practices have a better chance of success and the landowner will have a more positive experience. A landowner will feel more confident committing to a 10-year contract for funding knowing that they have an expert to rely on and don't have to do it all on their own.

Ben says that often times participating landowners won't ever come back to him with concerns or questions, while other times landowners rely on MAEAP technicians quite heavily to ensure that they are knowledgeable in the best methods for completing their requirements. Having a good experience navigating the requirements of these federally funded programs is what ensures that a landowner will consider re-enrolling in a program. According to Ben, if a program assessment doesn't initially show that the landowner is already meeting the program criteria or still doesn't after a secondary assessment following practice implementation, those individuals are more likely to resist re-enrollment or new enrollment in conservation programs. This is often due to the fact that their particular case wasn't viewed as "successful" by the criteria, or challenges caused them to have to do more work than they had initially expected, resulting in a bad experience implementing conservation practices.

One limitation to some of these federal conservation funding programs is that they are designed on a state-wide basis and don't allow for flexibility in practices that may be more beneficial to a specific geography. For example, the wetland restoration programs allow landowners to convert agricultural land to a wetland, but only in the form of a wet meadow. Generally, lands often being enrolled in the program are poorly drained with hydric soils and will naturally revert back to a wetland comprised of emergent vegetation, shrubs, and upland tree species. However, the criteria of CRP require the landowner to keep the wetland maintained at a wet meadow stage and not allow natural succession to alter the landscape any further. This seems slightly counterproductive to promoting the restoration of natural wetland areas and creating an ecosystem to support biodiversity and conserve wildlife habitat. However, for a 10-year time frame in which landowners are under contract with the CRP program, these expectations of creating and maintaining a wetland at a wet meadow stage are fairly adequate. The challenge comes when a landowner's contract ends. Once the contract ends, landowners have a decision to make as to whether they want to re-enroll in the program and keep their land in its current state or leave the program and either stop managing the land or manage it by implementing additional or different practices. This decision is not easily predicted and therefore hard to forecast what kinds of landscape modifications will be present in the area long term.

Aside from facilitating the MAEAP program locally, the Monroe Conservation District also hosts annual educational events available to the public. These include numerous workshops that cover topics such as soil health, native species selection, and tree care. They host a spring tree sale and a native plant sale annually and participate in many other partner organizations' public, educational events.

4.4 Reinventing the Farm: The Loughney Residence

Petersburg, Michigan

Written by Peter Loughney

The Lay of the Land

In 1953 my parents bought a beat up little one-hundred-acre farm in Ida Township. Mostly sand hills and swamps, it had roughly sixty-five acres of “tillable” farm land and thirty-five acres of second growth woodlot. The farm sits on old Lake Erie beach environment at the northern end of the oak openings region so it has sandy soil with a high water table. The property had a huge sand hill running east and west across it as well as a couple of additional smaller sand ridges. Around 1960 the sand was sold off and now lays under US 23, about a mile to the west. Although there are remnants of the sand ridges still in the wooded sections, the tillable portions are now largely flat, tiled farm land. It has proven great for farming, but is a much altered topography from its natural state.

In the early 1980s, the farm was split lengthwise into two parcels, and I acquired the west half. The property is long and narrow, running north and south, and is divided almost exactly in half by the long abandoned rail bed of the Lakeshore and Southern rail line that ran from Adrian to Monroe. The north half of our property is roughly 1550’ by 700’ with the front corners split off into residential lots long ago. The rail bed occupies a 100’ by 700’ east / west strip almost exactly in the middle of the parcel and the south portion is about 1500’ by 700’. The north half is farm land and woodlot while the south parcel is entirely wooded; all in all, just a bit less than 48 acres.

The north half, bordering Ida West Rd, has about ten acres of farm land and a long narrow strip of wooded land running down the west border, widening out near the rail bed. In the late 1980s we built our home on the edge of the woods just as it widens out, about a quarter mile south of the road, and began to make plans for the six to seven acres near the house. We hoped to craft an enjoyable natural environment in those acres and eventually to do something with the twenty-four acres south of the rail bed.

Getting started

While in the process of building the house, we took the time to plant several pines and spruces in the open areas north and east of the house, maples along the drive, and maples east of the house. There was an existing double row of white pines about three hundred feet north of the house so they became the northern border of our plan.

One of the main features we wanted on our property was a pond. There was a naturally wet area east of the house that had to be dealt with no matter what. A pond served as a fix for the flooding issue and was a much desired feature of our property that also provides suitable aquatic habitat. Construction on the pond began in 2007 with an experienced contractor who we worked with to accomplish our plans. The project was complete in December resulting in a constructed pond of about an acre.

Prairie and grassland habitats are not too common in our area which is dominated with farm fields and small woodlots. A good deal of the grass like environment we do have is managed pasture for sheep and horses or hay fields. So, another feature that we wanted to develop as part of the overall plan was a prairie. We have a lot of wildlife that visit us here on the farm, and we hoped that adding a prairie would help to provide wildlife habitat and increase the richness and diversity of native species.

In fall of 2015 we began our prairie system project. The area that we converted was an 80-foot strip along our north and east borders which resulted in about an acre of prairie. We began the preparation process of killing off the weed populations by treating the area with herbicide. We then planted our native seed mix in late October. We purchased our native seed mix from Ohio Prairie Nursery. The Monroe County Conservation District has a planter specifically designed to plant native seed which is available for the public to rent. The benefit of using their equipment is that it is set up to plant native seed at the appropriate depth. The prairie showed to be very successful in the spring. There are some minor issues with weeds, but the prairie seems to be doing well. Now that the prairie is established we hope to become part of the Monarch butterfly waystation effort.

Trouble in Paradise

In the early 1980s we bought about seven hundred small autumn olive starters from the local conservation district and planted a row running north and south just about three hundred feet east of the house. We soon realized that we had created an invasive plant nursery on a monumental scale. With the hedge about eight feet in height by then it took three days of steady backhoe work to rip the entire hedge out. Never-the-less, we had, or I should say still have, autumn olive plants all along our field and wood lot edges. We began the arduous process of trying to eradicate them from our property through cut-stump treatment. Following treatment, the dead stumps then get removed, and the area is planted with a mowable grass mix. By mowing it once or twice a year, new plants are clipped off before they become

problematic. We continue to fight this battle but hope to have it under control within the next year or two.



In addition to the autumn olive, we have identified buckthorn, burning bush, amur honeysuckle, a bit of garlic mustard, oriental bittersweet, and Phragmites on our property. I have no doubt that we will find additional invasives and more of what we already have

identified, but now we hope to get the worst of it under control and be able to keep up with the necessary treatments annually.

Looking to the future.

We are aware that appropriately treating invasive species on our property will consume a lot of the time spent managing our property, but we do have additional efforts that we plan to undertake. We are very pleased with our prairie so we will be expanding it by increasing the width of the current area by an additional forty feet. We have also identified another half to three quarters of an acre that we will start to prep this spring through the summer to be able to plant in late October. Following that we will be cleaning out about one hundred and fifty feet of the old rail bed to a few scattered trees. There is a small quarter acre plot of open area just south of the rail bed and that will be prepped and planted as a prairie as well. When these two projects are complete we should have about three acres of prairie habitat. Also planned for the summer is to create four hundred to six hundred square feet of shallow frog and turtle habitat on the east side of the pond. Hopefully these projects will prove to be a huge step toward achieving our goal of increased wildlife habitat, especially for Monarchs, and preserving biodiversity.

While we will be thrilled to see the end of the autumn olive, we do want some low to middle story environment. We have begun to plant native species like redbud and dogwood and are saving selective sumac bushes in some of the woodlot and edge environments. The last part of the plan is to begin work on the woodlots. We have a small start already, but have a list of things that we plan to do. Beginning last year and continuing this winter we are clearing brush, small trees, and down timber to create open, drivable lanes through the south portion of the woodlot so that we can get the tractor around comfortably without damaging much of the environment nor the equipment. When completed we will have a lane around the entire perimeter and a diagonal through the middle. This will also allow us to walk the woods more comfortably and enjoy a part of the property that is currently rarely visited.

While all of this is a lot of work, we both enjoy the effort and get a lot of satisfaction from the results. In many ways, our little piece of land is not a big deal but it is what we have and we intend to make the most of it. Hopefully our work will leave it in a better condition than it was when we began and continue to support wildlife for years to come.



4.5 Oak Openings Restoration

The Nature Conservancy

The Nature Conservancy (TNC) in Ohio has been actively engaged in restoration projects throughout Monroe County, Michigan for the past decade. They have completed restoration projects on both public and private lands. In the past 5 years, the TNC Ohio has worked through the Green Ribbon Initiative to achieve restoration and management of rare, globally imperiled natural communities. For example, much of Monroe County focuses on the Lakeplain Oak Openings which historically stretched from Wayne County south to northwest Ohio.

TNC has actively managed 1,200 acres of land in 10 separate sites in Monroe and Wayne County. This work has engaged 17 different landowners. The restoration team completes a full restoration of the landowner's property by removing invasive species, prescribed burning, and removing trees, thus allowing the reestablishment of grasslands and prairies. Aside from the actual restoration, TNC can provide landowners with knowledge of the specific ecosystems present in their geographic area for them to better understand how to manage their property. Through the Green Ribbon Initiative, TNC offers numerous informational tools, training workshops, and "learnshops" to the public throughout the year.

According to TNC's Oak Openings Restoration Manager, Wade Ulrey, they have a pretty well defined structure that is common to all of their restoration contracts. They generally get landowners interested in having their land restored through word of mouth. Public exposure of their work is what makes their restorations so successful. Once a landowner has shown interest in having their oak opening property restored, a TNC staff member will do a site visit and assess the property. This process helps TNC identify landowner use of the property, rare plants and animals that warrant special concern, invasive species that will need to be managed, and potential barriers to accomplishing tasks in the restoration process.

The two main goals of a restoration project facilitated by TNC are to complete a full-scale restoration of the desired property and provide the landowner with a plan to address future management needs. Contracts between landowners and TNC generally cover a 10-year timeframe for the completion of the restoration project. At the completion of each project, the plan produced by TNC will help the landowner understand what type of technical and financial requirements will need to be met in the future to maintain the high quality of the restored property.

The restoration process of an oak opening begins with the mechanical removal of most of the forest understory and large undesired tree species that contribute significantly to canopy cover. This step is necessary to open the canopy to allow light to penetrate down, hit more of the plants at ground level, and remove species that are not desired for the ecosystem. Mechanical treatment for this purpose is very expensive and time consuming. TNC staff and contractors have the capability to do this as efficiently as possible, and the treatment is generally done in the winter or summer season to create a restoration timeline that favors naturally processes. If

both removal of large “junk” trees and understory brush cannot be accomplished in one season, it is recommended that the large trees be removed first and then the understory brush can be removed. Though it seems very destructive, it is a crucial strategy for the restoration process.

Once the understory is cleared, chemical treatment of invasive species and unwanted woody vegetation follows. Though many people are opposed to the use of herbicide, this step prevents the regrowth of species that have a detrimental impact on the entire ecosystem. Once these two steps have been completed, the forest can naturally regenerate with favored oak and herbaceous species that are characteristic of the ecosystem historically.

The final disturbance phase of the restoration project is a prescribed burn. Burning the landscape facilitates the regeneration of native species prominent in certain ecosystems by activating the native seed bank. A prescribed burn begins the maintenance regime cycle. Ecosystems like Oak Savannahs are generally burned every 3 years to support the growth of native species and prevent the establishment of invasive species. In between burns, invasive species should be treated on an annual basis. Following the prescribed burn TNC generally handles maintenance of invasive species for the next few years and then hands over the reins to the landowner with a management plan to follow for long term maintenance.

The Nature Conservancy has produced an amazing resource titled *Living in the Oak Openings* which provides a tremendous amount of information for landowners to understand the characteristics of this rare ecosystem. This guide can help them identify if their forested area may be one of the remnant Oak Openings left in the lakeplain region of southeast Michigan and Northwest Ohio. This book is available to the public through the TNC Ohio office and can also be found online at:

<http://oakopenings.org/landowner-guide/>

4.6 Oak Savannah Restoration

Temperance, Michigan

Tomahawk Archers

In 1950 a group of like-minded individuals passionate about archery originated Tomahawk Archers Club. They later purchased 43 acres of forested property in Temperance, Michigan that would become their club facility. This property was designated for recreational use by the current 110 members. What they didn't know upon inhabiting this property is that it is a rare forest ecosystem known as a remnant oak opening.



By chance, Patrick (Pat) Hogan, Tomahawk Archers' Vice President, met Lindsey Reinartz, GRI Partnership Specialist, Oak Openings Region at The Nature Conservancy Ohio (TNC). She was part of TNC's Green Ribbon Initiative which focuses on educating landowners and restoring the Oak Openings region which stretches from Northwest Ohio to Southeast Michigan. Lindsey Reinartz made a site visit to Tomahawk Archer's property and immediately recognized that their forest had numerous characteristics of the rare oak savannah ecosystems. TNC identified the property as a high integrity forest and formed a partnership that allowed Tomahawk to have much of their land restored to the high quality Oak Savannah and wet prairie ecosystems that it had likely been a century ago.

Pat convinced the Tomahawk board of directors that the restoration of the property was an excellent opportunity for them, because some of the plants and animals that were present on their property were extremely rare. Also, some of the tasks involved in the restoration, like opening the forest canopy and burning the understory, would allow them to navigate their woodlot more easily and have better lines of sight when shooting their target courses. He asked his members to go and look at a neighboring city's property that had been restored by TNC only a few years prior to see what their property could look like when finished. After checking out the Whiteford Township Stoneco Park, the Tomahawk board members quickly realized that the work TNC would be doing on their property was going to be advantageous to their members. They were going to end up with a woodlot that had greater biodiversity, more high quality trees, and improved wildlife habitat.

The oak savannah restoration project began on the front half of the property at Tomahawk Archers in 2014. TNC began mechanical removal of the understory and undesirable tree species in the fall, followed up with herbicide treatment of re-sprouting invasive species, then burned the wet prairie and savannah areas in March of 2016. These steps allow the forest canopy to open up causing more light to reach the understory, and the clearing of the understory

promotes the desired regeneration of the prominent oak species. Burning these ecosystems encourages the regeneration of native species present in the soil's seed bank and is a disturbance necessary for many species of plants to thrive. TNC has produced a management plan for the property and has a 10-year contract with Tomahawk Archers to ensure the complete restoration of the site and help assist the club with maintenance of the forest and prairie areas.

Some of the challenges that Tomahawk faced doing this work are that after some of the necessary treatments, the prairie and forest areas weren't aesthetically pleasing due to burnt and debris cluttered areas. They were able to get help from local Boy Scout troops to "clean up" the property through the removal of debris from their highly utilized areas. Because so many people visit the club and members utilize the property for public archery shoots, it was a little shocking to see the after math of the restoration process.

However, since the restoration began, club members have noticed more bird and turtle species present on their property. They believe since the beginning of this project they have had a tremendous increase in plant and animal diversity, and also a reduction in pests such as ticks and mosquitos. More of the members are taking the time to appreciate the uniqueness of their property and taking an interest in the diversity that they have.

Tomahawk Archers has since hosted numerous public educational hikes on their property for Girl Scouts Troops, Wild Ones, and the Michigan Botanical Club. Pat Hogan hopes that the Tomahawk Archers' property will become a TNC Adopted Natural Area. This will bring more people onto their property and provide them with an opportunity to appreciate the rare ecosystem that is found in small areas throughout southern Monroe County. Participating in this project has brought Tomahawk Archers more publicity and increased the uniqueness and usability of their acreage.



4.7 Stoneco Park

Whiteford Township, MI

Written by Walter Ruhl, Whiteford Township Supervisor

Whiteford Stoneco Park is 100-acre lot residing at the corner of Sterns Rd. and Whiteford Center Rd. in Whiteford Township, MI. This piece of property was formerly owned by Stoneco and used as a storage lot until 2002, when it was donated by the local company to Whiteford Township as a park. This property had little life to it except the 12-acre woodlot present. The remaining 85 acres was uneven gravel. Since its donation, the township has spent the last 14 years trying to make the “park” more user friendly.

The renovation began with Pheasants Forever planting a grass mix to try and turn the park into something a bit more usable and sustaining, but that effort showed little promise. Sometime later work was being done on US-23 and the township accepted a donation of dirt from the project to fill roughly 10 acres of the park. After this process was underway, the township was given the opportunity to share office space with the Ohio Nature Conservancy (TNC) beginning in 2012. Upon inspection of the park TNC staff recognized the “woodlot” as an Alvar prairie and oak opening based on some of the rare species that they had observed.

TNC asked the township if they could begin treating the invasives that had begun to overtake the landscape. The township wanted to show off the work that had been done to this unique town asset. They used stone donated from Stoneco to create a trail system throughout the park. This was a way of getting people to visit the park. It also proved to be an asset for maintenance because it created a barrier for controlled burns which would be a management practice done every few years on the 12-acre prairie. In the fall of 2013, TNC staff completed a controlled burn on the property as the final, major step in restoring the site. TNC will continue to manage the site for invasives over the next couple of years and then hand off the effort to the township with a site management plan that outlines necessary tasks needed to maintain the site’s quality.

Partnership with TNC allowed Whiteford Township to restore this acreage at essentially no cost. While all this restoration work was being done, the township continued to brainstorm ways to use the remaining acreage in the park and make it as user friendly as possible. Six baseball diamonds were built to allow for additional recreational use. The county road commission used space in the park during a project and, in return, paved walking trails around the entire front half to make it more accessible. The township continues to explore opportunities to get people into the park and appreciate all that it has to offer.

Walter Ruhl, current township supervisor, says that they are beginning to incorporate a disc golf course into different aspects of the park and that they are considering using some of the space as a dog park. These additions will provide other recreational opportunities to the public while also immersing people into the natural areas. He says that the park has become an attraction for bird watchers who understand how necessary that type of ecosystem is as habitat for certain species. He has spent much of his time in office ensuring that park becomes a benefit for the community.

He mentioned that since most of the work done in the park up to this point in time has essentially been donated, the township hasn't considered how future improvements and management will be handled. Due to the limited capacity of township staff, he sees the need for a volunteer group to assist with management efforts in the future and sponsors to invest in the park. However, he is extremely hopeful that this park will continue to be an inspiring legacy for the region.



4.8 Phragmites Control Partnership

By Glenn Palmgren

At least 10 public and private landowners in the northern portion of the River Raisin delta had indicated an interest in controlling phragmites in wetlands they owned. The goal of this project was to fund 3–5 years of phragmites control across all of these participating ownerships. During the course of the project, fourteen partners (or participating landowners) were involved with phragmites control in the project area, including the owners of all wetlands capable of supporting phragmites within the project area.

Phragmites is the most widespread and damaging invasive plant in the River Raisin delta. Many species of wildlife, including wetland-dependent birds, reptiles, amphibians, and mammals, have already lost hundreds of acres of emergent marsh and wet prairie habitat in the project area to expanding stands of phragmites. Native plants populations have declined as well. Many landowners in the area recognize phragmites because it has become so ubiquitous in the local area, but are either unaware of the damage it causes, unaware of the proper control techniques, or are financially unable to afford initial control. This phragmites control partnership represented one of the few opportunities to improve habitat for fish and wildlife on private lands in the River Raisin Area of Concern.

DNR, Parks and Recreation Division (PRD) has been controlling phragmites successfully since 2003, at Sterling State Park and at many other state parks and recreation areas throughout Michigan. Phragmites cover can be reduced dramatically through an initial herbicide application, and can be further reduced and maintained at low coverage levels through annual follow-up targeted herbicide application. Control techniques used in this project were consistent with those recommended in *A Guide to the Control and Management of Invasive Phragmites* (www.michigan.gov/documents/deq/deq-ogl-ais-guide-PhragBook-Email_212418_7.pdf), a publication by Michigan Department of Environmental Quality that PRD co-authored with many other experts on the topic.



In September–October 2011, an initial herbicide application of a glyphosate and/or imazapyr-based chemical (varied based on the specific site) approved for use in aquatic environments was made by a combination of aerial (helicopter) and ground-based (truck, marsh vehicle, boat, and backpack/hand) techniques depending on the density, size, and context of each phragmites stand. After the initial treatment, phragmites was reduced considerably, but follow-up treatment was required to control re-sprouts as expected.

Prescribed burning was done in several of the treatment areas within Sterling State Park to help remove dead thatch and stimulate fresh growth, but only chemical control was used on partner lands. Follow-up chemical treatments were completed annually to further control the remaining plants and any new plants that had invaded each site. Phragmites in southeast Michigan, particularly Monroe County, is extremely prevalent and will likely be for the foreseeable future. However, once existing stands are controlled the population can be reduced to manageable levels where it is possible to do relatively simple annual control. Similar to controlling weeds in a lawn or garden, periodic control will be necessary. Control in a larger area will reduce sources for re-infestation.

Throughout this partnership PRD staff worked closely with partner landowners to identify and delineate phragmites populations on their lands and educated them on the significant problem of phragmites and other invasive species. Memorandums of Understanding (MOUs) were signed annually between PRD and each partner landowner prior to treatment. Phragmites mapping and treatment was contracted through a competitive bid process each year by Michigan DNR, with the following vendors receiving contracts for phragmites control work over the course of the project: Hamilton Helicopter, Natural Community Services, Niswander Environmental, Plantwise, and PLM Lake & Land Management. The challenge in this partnership is securing future funding to continue to monitor and control phragmites that has been treated.



4.9 Sterling Marsh and Prairie Restoration

By Glenn Palmgren

Project Description

The original goal of this project was to create 25 acres of Great Lakes submergent and emergent wetland and 25 acres of lakeplain prairie at Sterling State Park. This was to be accomplished by removing fill material originally placed on former lakeplain prairie and placing it in nearshore areas of a nearby deep water lagoon that was historically dredged from Great Lakes marsh. In total, approximately 50 acres of habitat were to be restored along Lake Erie. This project was a rare opportunity to reverse Lake Erie wetland loss.

Indicative of the wetland loss throughout the western basin of Lake Erie, well over half of the wetlands along the western shore have been lost. The loss of wetlands in the River Raisin delta has been even greater. Few opportunities remain in the delta to create new shallow-water wetland habitat for fish, other wildlife, and native plants.

The fill was originally placed on Sterling State Park in the 1980s by the US Army Corps of Engineers when they created a Confined Disposal Facility (CDF) at the park. Uncontaminated material was excavated from along the Lake Erie shoreline and bottomlands to create two CDF cells and placed in several locations within the park. The CDF was created as a disposal site for contaminated dredge spoils. The federal action to create the CDF and place the fill in the park resulted in a loss of wetlands in the 1980s. This project was an opportunity for a federal program to reverse the wetland loss in this critical Area of Concern.



Close-up of project sign.

The hour-glass-shaped lagoon at Sterling State Park was formerly Great Lakes marsh before it was dredged in the 1950s by the Works Progress Administration, to create what is now the upland park day-use area and campground along the Lake Erie shoreline. This lagoon has direct connections with Lake Erie. As part of this GLRI project, 19 acres of wetland was re-established along the lagoon's western edge. The undulating shoreline with deeper water inlets was designed to enhance fish habitat and shorefishing. There will be a net increase in productive, littoral zone and limnological shoreline development as this wetland matures. This will improve aquatic productivity and enhance populations of amphibians, reptiles and fish. Anglers are now better able to access more edge habitat. This provides much better fish habitat and should lead to enhanced fishing success. A Michigan Department of Natural Resources fisheries biologist served on the planning/design team.

Lake plains are broad flat landscapes formed by the lake bottoms of the much larger precursors to our present day Great Lakes. Michigan's lake plains are home to several unique types of plant communities, including lakeplain prairies, lakeplain oak openings (savannas), and Great Lakes marshes. Lakeplain prairies are currently known from only a handful of small areas in Michigan scattered along the Lake Erie, Lake Huron, and Lake Michigan shorelines. Based on a wide-range of studies of these rare plant communities by Michigan Natural Features Inventory (MNFI), less than 1% of Michigan's 158,000 acres of former lakeplain prairies remain today. Before European settlement Monroe County had over 56,000 acres of wet prairie. Today there is less than 2,000 acres. Those lakeplain prairies that remain are in small patches of a few acres or less, and most are badly in need of restoration. MNFI and NatureServe consider lakeplain prairies imperiled globally. Sterling State Park presents an uncommon opportunity to re-establish a large lakeplain prairie landscape, with this project site an integral link connecting existing Great Lakes marsh with a lakeplain prairie restoration already in progress at the park. Under this GLRI project, 33 acres of lakeplain prairie was restored by removal of fill material.



Lakeplain Prairie Area Being Planted

Sequence of Methods and Events

The project began with establishment of the project team and competitively bidding the engineering/design contract in late 2010 and 2011. A public meeting was also held in January 2011 to inform the public of this project. We retained a single engineering/design contractor for this project together with the water control structure and dike restoration work in EPA GLRI project GL-00E00506-1. The purpose was to improve time- and cost-efficiency for both projects because of their close proximity and similar type of work. However, Michigan DNR tracked all expenses under separate accounts for each project to ensure appropriate financial separation between the two grants.

Ducks Unlimited was retained as the engineering/design contractor. Project signs were installed and Ducks Unlimited completed the final design for the project by May 2012. Permits were obtained in June 2012. The construction work was competitively bid. Geo. Gradel Company was retained as the construction contractor and they began work on site in August 2012.

The design for this project involved innovative methods to create the shallow-water wetland. Rather than trying to place and contour fill in up to 9 feet of standing water in the lagoon, Ducks Unlimited's design involved first constructing a dike/haul road in the lagoon along the outer perimeter of the new wetland from shore to shore. Then the area inside the dike was dewatered (pumped out), allowing fill to be placed and dozers to contour the relatively dry ground. Once the interior of the wetland was complete, the dike was breached and progressively demolished by a dredge casting the dike material into the wetland. The design of the wetland accounted for the volume of fill in the dike to be placed within casting reach of the dredge on top of the already-contoured wetland to get it to the final design elevation.

Outcomes

Wetland habitats have been restored (through movement of fill and re-contouring), which improved habitat for native fish and other wildlife. The Michigan Department of Natural Resources used available information to initiate wetland restoration actions through this project, and in doing so has demonstrated to other local and state government agencies involved in the River Raisin AOC (e.g., River Raisin Public Advisory Council, City of Monroe, Michigan Department of Environmental Quality) how it can be done. This project, combined with related habitat projects in the River Raisin AOC, is expected to result in the removal of the fish and wildlife habitat and fish and wildlife populations beneficial use impairments. The removal of these beneficial use impairments contributes to the eventual delisting of the River Raisin AOC.

4.10 Groundwater Stewardship: Karst, Sinkholes, and Farmland in Monroe County

By Ned M. Birkey

Karsts, an eastern European term for sinkholes, are a unique geologic feature in Monroe County. These are the sinkholes that have been known to swallow homes in Florida, not just small depressions or holes created by faulty sewer or water lines.

Sinkholes have been documented in Monroe County since 1899 by Professor William F. Sherzer. His study is still regarded as a thorough look at sinkholes, quarries, springs, artesian wells, and other water related geology. Because Karst features are unique to this ecoregion, the Monroe and Lenawee Groundwater Stewardship Committee implemented a karst educational initiative, beginning in 1999 and running through 2007. The Agriculture Advisory Council has begun to re-instate some educational programs about Karst and tours to help educate citizens and elected officials about the unique geology of the area.

Farmers and rural residents in Monroe County who rely on wells for their water supply are continuously cognizant of potential issues that could affect their water quality. Concerns include; mineral levels, wells going dry, the state of water lines, service and taxes, irrigation wells drilled into limestone, the water level of Lake Erie or local ponds, and household water-holding tanks. A local water issue that has not generated much attention lately are sinkholes. Many do not consider that the flow of surface water can carry contaminants into ground water through sinkholes.

Groundwater contamination happens because of water's ability to move rapidly through cracks in soft bedrock. Carbonate rock, such as limestone or dolomite, will dissolve over time, producing cracks and allowing overburdened areas to collapse, creating a sinkhole. Big Sink, near US 23, was farmed up until the farmer's tractor dropped into the large sinkhole.

Monroe County has bedrock located very close to the soil surface in many areas of the county. In some cases, there is bedrock at or very near to the surface of the ground. Any contaminants that can be carried by water, or other liquids, could enter the groundwater via sinkholes will carry those contaminants directly into the bedrock.

MDOT installed catch basins along US-23 near Big Sink, at the request of karst committee about fifteen years ago. There was a semi-truck accident in the area, and fear spread that gasoline could spill into the sinkhole, and contaminate all the wells in the vicinity. At that time, there were 326 wells within a two-mile area surrounding the sinkhole. One gallon of gasoline can contaminate one million gallons of water, which could be a potential disaster for those using well water.

Farmers and rural homeowners can protect groundwater by installing filter strips surrounding sinkholes located on their property. Township planning commissions can protect groundwater

by adjusting master plans to account for and protect sinkholes and bedrock near the soil surface from further development.

All Monroe County residents can protect groundwater by using the county's Household Hazardous Waste and Clean Sweep Pesticide collection programs instead of dumping unwanted hazardous waste on their property. Farmers and the Road Commission can help protect groundwater by securing alternative drainage instead of using drainage wells, installed years ago, but outlawed since 1962.

Stay tuned for periodic educational workshops and displays in our community to learn more about our unique karst features and what we can all do to keep our groundwater safe.

5. Develop Your Own Story: Resources and Services for Landowners

5.1 Best Management Practices for Forest Health, Water Quality and Wildlife

Best Management Practices (BMPs) are stewardship activities that are generally accepted by resource professionals to be the most effective and up-to-date management practices available for protecting natural resources, including forest health, water quality, and wildlife habitat. Local agencies and organizations can help you select appropriate BMPs to meet your land management objectives. Financial and technical assistance may be available to help you implement certain BMPs on your land, while other BMPs are simple things you can do on your own to become a better steward of your land.

Contacts provided (in Section 3 and Appendix 4) can help you enroll in the programs mentioned, develop a Forest Stewardship Plan, and identify and implement on-the-ground Best Management Practices that will allow you to achieve your own management objectives while also protecting and enhancing Michigan's unique landscape.

Forestry Best Management Practices

Best management practices (BMPs) for forestry involve using practices that reduce impacts to forest health, water quality and wildlife. Some activities such as construction of stream crossings, work in wetlands, and impacts in floodplains are regulated. One of the keys to good BMPs is to work with a professional forester (or other natural resource consultant) to develop a plan for your property (See Forest Stewardship Program in Section 5.2 and American Tree Farm in Section 5.5).

Elements of plans include goals (desired future condition) and objectives (a strategy that moves the system towards the goal in a measurable way). Work plans (or actions) to accomplish goals and objectives are the operations required to obtain the objectives and should identify the person responsible for the action and the resources needed (labor, seed, and other inputs). Setting goals depends on what the landowner values: wildlife habitat, scenery, financial return, etc. A starting point for most plans is to consider past land use (this affects what can be grown), document what is currently present, and inventory the resources on the site (soil, water, plant communities, etc.).

Forest management plans should include an inventory of trees with a description of the stands (tree areas that can be managed similarly). If timber harvesting is part of the plan, it is usually beneficial to have the logging managed by a professional forester. To increase the economic potential of a forest, a timber stand improvement project may be appropriate to remove less valuable trees and thin trees that may be weak or damaged. Pruning can be done to improve the quality of saw logs, but guidance to avoid spread of oak wilt and other cautions should be followed.

Landowners should also consider the financial aspects of implementing the plan. Costs can include consulting fees (for the plan), plant material (seeds or seedlings), site preparation (clearing or tillage), soil amendments (fertilizer, lime, etc.), invasive species control, infrastructure improvements (fencing, signage, and trails) and labor to install practices. Government agencies usually provide technical assistance for free, but incentive programs normally require application and awards are normally competitive. Landowners can work with professional foresters, wildlife biologists, and conservation-minded wildlife groups to identify cost-sharing programs that may fit their particular situation.

Forest Management Plans

A written plan is the foundation for good forest management and accomplishing your unique goals for your forest. There are two programs in Michigan that offer financial assistance to help pay for a portion of the total cost of developing a forest management plan. Plan writers are allowed to set their own prices, so interview several foresters before hiring one to develop your forest management plan.

The Forest Stewardship Program (FSP) encourages long-term stewardship of family forest land by connecting landowners with professional foresters to develop a Forest Stewardship Plan that helps landowners manage, protect, and enjoy their forests. Since 1990, more than 5,700 landowners in Michigan have used a Forest Stewardship Plan to help them manage, protect, and enjoy over 900,000 acres of forest land. The MDNR has trained and certified 150 private sector foresters (available in every county) and 20 wildlife biologists. Funding from the U.S. Forest Service (USFS) helps lower the total cost to landowners, and this partial cost share is made available through grants to the Plan Writer. The cost share is \$225 per plan plus \$0.50 per acre up to \$2,500 per landowner. Landowners can enroll in the program any time of the year by completing an easy two-page form with their Plan Writer. A DNR Service Forester reviews the plan to ensure that it meets USFS standards for a simple yet comprehensive Forest Stewardship Plan. More information about the Forest Stewardship Program is available online at www.Michigan.gov/ForestStewardship. See Section 5.2.

The Natural Resources Conservation Service (NRCS) also administers a financial assistance program (Environmental Quality Incentives Program) to develop a forest management plan. The financial assistance from the NRCS is much greater than the Forest Stewardship Program, but the landowner must apply for a contract with the local NRCS for a “conservation activity plan” (CAP 106). Applications for funding are accepted year round, but there is usually a “sign-up cutoff date” in the winter, and contracts are usually funded in the summer. After getting a contract, the landowner then hires a Technical Service Provider (professional forester certified by the NRCS) to write the plan. The NRCS District Conservationist in each county reviews the forest management plan to verify that it meets program guidelines. The Michigan NRCS has more information about forestry and financial assistance programs on its website. <https://www.nrcs.usda.gov/wps/portal/nrcs/main/mi/technical/landuse/forestry/>

Fees, plan quality, and plan contents can vary widely so call at least three professional foresters to ask about prices and the contents of their plans. Ask for references and a sample plan to read before you hire them. Consulting foresters frequently travel several counties away from their office, so do not feel obligated to hire the closest forester. Very low prices or very high prices are not always accurate indicators of plan quality. You do not have to use either of these two financial assistance programs to develop a forest management plan, but they are helpful to ensure consistent quality of the plan and also to lower your costs.

Timber Sales

One of the primary benefits of investing in a forest management plan is that it helps you prepare for a timber sale. A well-planned timber sale should have both economic benefits for you and ecological benefits for your forest. A forest management plan will help you to determine what trees to sell and, more importantly, what trees to keep so that you can improve your forest when you harvest your timber. All timber sales should be conducted to accomplish your stated goals for your forest, whether those are improving wildlife habitat, increasing access for recreation, removing diseased trees, modifying the species composition, improving “crop trees” for future harvest, or generating some current income.

Timber sales can be a long and complicated process so it is often a good investment to hire a consulting forester to help you administer your timber sale. A consulting forester will help you decide what trees to sell and market the sale to multiple buyers to get the best price for your trees. Your forester will also ensure that the loggers follow “Best Management Practices” to protect your soil and water resources. Consulting foresters also provide customized timber sale contracts which are often more detailed than the typical contract that a timber buyer provides. Foresters can also help you reduce the taxes on the profits of your sale by calculating your “basis” and “depletion” for capital gains. Consulting foresters may charge hourly rates, set fees, or a percentage of the sale price for their services in administering your sale.

Most timber sales in Michigan are either a “lump sum” sale where the buyer pays in full for the marked trees before the harvest begins or a “mill tally” sale where the buyer pays an agreed price for a unit of wood (cords, boardfeet, tons, etc.) when it is cut and delivered to the sawmill. Most selection harvests in hardwoods forests (oak, maple, beech, cherry, etc.) are sold in a lump sum sale. If you are thinning a pine plantation or clearcutting an aspen stand, those types of large volume harvests are often sold in a mill tally sale. Mill tally sales require a higher level of trust and usually some extra oversight.

Whether you hire a consulting forester or not, be sure that you have a clearly written contract that describes exactly what will occur and when it will occur during your timber sale. The seasonal timing of the harvest is important to protect your soil and to reduce the potential to spread diseases like oak wilt. A detailed contract will protect both the seller (landowner) and the buyer (logger or sawmill) in a timber harvest. It is the landowner’s responsibility to know the location of their property corners and property lines so investing in a boundary survey conducted by a licensed land surveyor can be a good investment.

There are many excellent loggers in Michigan so be sure that you are working with a “Qualified Logging Professional.” Look for loggers that have been trained by the Michigan Sustainable Forestry Initiative, are members of the Michigan Association of Timbermen, or are certified as a Master Logger.

Sustainable Soil and Water Quality Practices on Forest Land

The MDNR has a Sustainable Soil and Water Quality Practices on Forest Land Manual that describes a set of voluntary Forestry Best Management Practices (BMPs), which protect soil and water resources while allowing appropriate use of forest resources. Any forest management activities should minimize soil erosion near wetlands and surface water. The Manual contains a section on forest wetland protection practices to use when constructing roads and guidance to reduce soil rutting. It addresses forest management activities that affect the integrity and function of Riparian Management Zones. BMPs include proper location and construction of logging roads, the use of riparian management zones, installation of culverts and other stream crossings, proper use of pesticides and other chemicals, and site preparation for planting. BMPs also include the proper seasonal timing of activities to minimize the spread of insects or disease. The manual has updated information on vegetative erosion control and incorporated information on designated trout streams, vernal pools, fens, and bogs. The Michigan Department of Natural Resources strongly encourages their use by everyone involved with growing, managing, and harvesting trees, such as loggers, foresters, and forest landowners. Tree Farm certification requires compliance with best management practices.

Sustainable Soil and Water Quality Practices on Forest Land - Complete Version (5.60 MB)
http://www.michigan.gov/dnr/0,4570,7-153-31154_31261---,00.html

Michigan's Forestry BMP Program contact: David Price, Forest Planning and Inventory Manager 517-284-5891 PriceD1@michigan.gov.

Management of Wetlands and Aquatic Systems

Many of the Best Management Practices for forestry apply to other land uses as well. Protection of water quality and improvement of wildlife habitat can be achieved by Best Management Practices that are targeted for wetlands, streams, and lakes. Wetlands serve to store runoff and decrease downstream flooding, but many of the area's wetlands have been drained or altered. Especially in urban areas, this can result in flashiness of stream flow (higher peak discharge during rainfall events and lower base flows during dry periods). Increasing infiltration of precipitation by use of vegetation or structures can increase movement of water into the soil thus reducing runoff which transports sediment, nutrients, and chemicals into water bodies. Sediment can clog drainage ways and aggravate flooding as well as reducing light into streams and lakes (thus reducing photosynthesis). Excess nutrients, particularly nitrogen and phosphorus, can increase algal growth and, in some cases, result in the proliferation of

cyanobacteria that produce toxic compounds (this caused drinking water problems in Toledo in 2014).

A starting point for management is to consider which land uses and plant communities are prevalent in the watershed (an area of land that directs surface runoff to a particular point such as the junction with another stream). Impervious surfaces (roads, roofs, etc.) have a greater amount of runoff than a similar land area that is in forest, grass, or cropland. Natural areas tend to have very low amounts of runoff and their water quality is higher than more intensively used areas.

Soil testing should be used to determine the appropriate amount of fertilizer to apply to crops and lawns which helps to limit nutrient losses. Pesticides use can be reduced by following principles of Integrated Pest Management (IPM) which uses economic analysis to determine whether the benefits of applying chemicals to crops is greater than the cost of the treatment. IPM relies on crop scouting to monitor pest (insects, weeds, and diseases) to see if the levels are above the economic threshold for treatment. IPM also advocates use of non-chemical approaches to pest management such as biological controls (predatory insects, planting of resistant varieties, etc.). Landowners who want to avoid synthetic pesticide use completely can follow organic practices (www.attra.ncat.org/organic.html).

Water quality can be protected by keeping vegetation and plant residues on the soil surface to increase infiltration and reduce the water runoff which can cause soil erosion. On crop lands (and other areas such as garden plots) cover crops such as annual rye, oats, and clover can be used to protect the soil surface from the energy of falling raindrops and overland flows. The use of perennial plants (alfalfa, switchgrass, etc.) protects the soil longer than annual crops such as corn and soybean. Erosion control can also be achieved by use of vegetative practices (like grassed waterways) or by installing structures (check dams, detention basins, etc.) that decrease the potential for gully formation.

To protect streams and lakes from excess nitrogen and phosphorus, nutrient management practices such as soil testing to determine appropriate levels of fertilization and the proper timing, placement, and form of fertilizers should be used. Pesticide use can be reduced by following principles of Integrated Pest Management (IPM) which uses economic analysis to determine whether the benefits of applying chemicals to crops is greater than the cost of the treatment. IPM relies on crop scouting to monitor pest (insects, weeds, and diseases) to see if the levels are above the economic threshold for treatment. IPM also advocates use of non-chemical approaches to pest management such as biological controls (predatory insects, planting of resistant varieties, etc.). Remember to read and follow labels on pesticide containers. Landowners who want to avoid synthetic pesticide use completely can follow organic practices (www.attra.ncat.org/organic.html).

See Michigan Nonpoint Source Best Management Practices Manual at:
www.michigan.gov/documents/deq/deq-wb-nps-Intro_250601_7.pdf

Buffer strips around water bodies can reduce the amount of sediment and chemicals that reach the aquatic zone. The buffers can be planted with grasses, forbs, shrubs, trees, or some combination of the plant types. Growing plants (and dead plant residues) can reduce the velocity of water that travels across the soil surface, thus trapping sediment and the chemicals that are attached to it. The width of the recommended buffer or filter strip depends on several factors, such as slope and length of the flow path for water being intercepted, but should be at least 20 feet. Wider strips (100 feet or more) can improve wildlife habitat and provide corridors for animal movement. Inclusion of trees in the buffer can shade streams, moderate water temperature, and improve oxygen supply (dissolved O₂ is higher in water with lower temperatures).

See “BMP Design, Pollutants Controlled Calculation Assistance, and other Technical Manuals” at:

www.michigan.gov/deq/0,4561,7-135-3313_71618_3682_3714-118554--,00.html

Control of invasive species is another important task in maintaining high quality aquatic environments. Plants such as Eurasian milfoil and Asiatic clams can replace native species and disrupt natural ecological processes. It is very difficult to control invasive species after they get a toehold in a new location, so preventing the introduction of these pests is an important strategy to reduce impacts. Cleaning of boats and equipment, avoiding use of invasive species as bait, and proper disposal of pet species can help minimize invasions.

See: www.michigan.gov/invasives/0,5664,7-324-68001-364395--,00.html

Michigan Natural Shoreline Partnership

The Department of Environmental Quality’s Inland Lakes and Streams program has been participating in the Michigan Natural Shoreline Partnership to promote natural shoreline landscaping to protect Michigan's Inland Lakes. One of the goals of the Michigan Natural Shoreline Partnership is to educate property owners about using native plants and technologies that benefit lake ecosystems. (www.mishorelinepartnership.org/)

Soil Erosion Control

There are many techniques to control soil erosion, including planting vegetative barriers such as buffer strips discussed in the Management of Wetlands and Aquatic Systems section above. There are numerous structures for water and sediment management including Water and Sediment Control Basins, which are earth embankments constructed across the slope of minor watercourses to trap runoff and direct it to a stable outlet such as a pipe inlet or grassed waterway. Other structures include terraces, drop inlets (allows water to move safely to a lower elevation), rock check dams, and rock chutes. Because rip rap (stones used to allow water to move without transporting the soil below) can be expensive and unsightly in some locations, biological methods can be a viable alternative. These bioengineered solutions employ living or dead plant material to prevent stream bank erosion with willow stakes, coconut fiber logs,

brush mats, or fascines (bundles of sticks held in place with stakes). Silt fence (typically a plastic mesh with fine holes) can be dug into the ground at the bottom of slopes to prevent sediment transport. Erosion control blankets made with biodegradable mesh and filled with straw or wood fibers can be used in channels to keep soil in place. These blankets stabilize the surface and allow plants to grow in areas that would be difficult to establish vegetation (areas of concentrated water flow). Seed and other materials (fertilizer, mulch, etc.) can be applied to steep slopes with hydroseeding. Many other erosion control products are available (see listings at:

<http://iecaerosionprofessionalsmarketplace.com/>

The MDEQ is responsible for administering the state and federal construction storm water statutes that cover earth change activities (clearing, grading, excavating, etc.) which disturb one or more acres of land or are within 500 feet of a lake or stream. Such actions are regulated under Part 91, Soil Erosion and Sedimentation Control (SESC), of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Owners of properties on which regulated earth changes will occur must obtain a SESC permit from the appropriate Municipal or County Enforcing Agency (typically the county's conservation district or the city planning office).

See: www.michigan.gov/deq/0,4561,7-135-3311_4113---,00.html

Wildlife Management

Your land plan should address what wildlife is desired and how it is to be managed. Wildlife benefit from having appropriate habitat, plentiful food sources, and adequate water supply. Existing natural areas can be managed by inventorying communities present to see if adequate resources are available to support target species. If the desired habitat is not present, the landowner can consider creating the plant community that benefits the target species. Restoration activities can range from planting a few trees, shrubs, grasses, or forbs to large-scale conversions to forest, prairie, or other habitat

Four basic steps to improve wildlife habitat are:

1. Determine the species of wildlife that live in your area.
2. Select the species you want to attract and learn about their habitat and food requirements.
3. Inventory the habitat available and habitat needs on your land and that of adjacent landowners.
4. Design projects to improve wildlife habitat.

The size of your property, the vegetative types and their location, the types of wildlife you want to attract, and the habitat and land management practices on adjoining land determine what can be done to encourage wildlife use in your area. Trees, shrubs, grasses, wildflowers, and perennial and annual flower gardens all provide food and cover for wildlife. Rock piles, brush piles, decaying logs, and compost piles are also valuable cover components. They supply cover for chipmunks, rabbits, weasels, salamanders, toads, snakes, snails, and beneficial insects.

Trees and Shrubs

Trees and shrubs that provide food and cover for backyard wildlife are sought by many birds and mammals. The heavy cover of dense conifers, such as spruce and cedar, attract winter songbirds like cardinals and provide shelter for gamebirds such as ruffed grouse. Trees and shrubs that provide food in the form of seeds and fruit for birds and mammals are highly desirable. Plants which supply fruit (soft mast) that last into the winter include crabapples, mountain ash, American high-bush cranberry, nannyberry, arrowwood viburnum, staghorn sumac, and wild grape. Plants that furnish fruit during spring, summer, and early fall include serviceberry, mulberry, elderberry, raspberries, cherries, and dogwoods. Conifers such as tamarack, white spruce, blue spruce, hemlock, and white cedar, which hold their seeds in a semi-loose cone, may attract crossbills, finches, evening grosbeaks, chickadees, and red squirrels. Trees such as oak, walnut, hickory, hazelnut, or beech that provide hard mast (nuts) attract large seed-eating birds, small mammals, and deer. Standing dead trees (snags) are very attractive to many wildlife species and can furnish cavity nest sites for many songbirds, squirrels, or bats, as well as provide insect larvae for woodpeckers, nuthatches, and flickers.

<http://www.missouribotanicalgarden.org/plantfinder/plantfindersearch.aspx>

Grasses and Wildflowers

Converting mowed areas to grass meadow provides nest sites, food, and cover for wildlife. Tall, native prairie grass such as switchgrass, big bluestem, and Indian grass provide a lush variety of cover 4-7 feet tall; nest sites; and winter cover for quail, pheasants, songbirds such as cardinals and blue jays, rabbits, and deer. Prairie grasses, mixed with prairie wildflowers such as gray-headed coneflower, woodland sunflower, and aster are an attractive way to provide wildlife habitat. Another option to mowed grass is a perennial wildflower garden. These areas are also called songbird or butterfly gardens. Many wildflower mixtures that provide colorful flowers from late April until the October frosts are commercially available. These wildflower mixtures can include a variety of species such as coreopsis, black-eyed Susan, phlox, blazing star, yarrow, and bee balm.

The Michigan Amphibian and Reptile Best Management Practices

The Michigan Amphibian and Reptile Best Management Practices document was created for the Michigan Department of Environmental Quality to provide a comprehensive guide to Best Management Practices that improve and maintain the viability of Michigan amphibian and reptile populations. The manual contains actions to protect wildlife with specific recommendations for regulators, agency land managers, consultants, residential developers, and private citizens to protect, preserve, and restore herpetofauna.

www.herprman.com/amphibian-reptile-management-practices-michigan

Most wildlife prefers native plants and control of invasive species can improve habitat quality. Methods of invasive plant control include: mechanical, chemical, fire, grazing, and competition from noninvasive species. The ability to identify plants is important and there are guides listed in Section 5 that can assist in this activity.

Backyard Wildlife Management Link:

www.michigan.gov/dnr/0,1607,7-153-10370_12148-30777--,00.html

A variety of programs and informational resources are offered by state and federal resource agencies and nonprofit conservation organizations to help you take the next steps toward meeting your own land stewardship goals. See Sections 5 for more information.

Enjoyment

Many landowners who have forest land spend many hours every year working in their woods for a variety of reasons. For some landowners, forests are an economic investment to secure future income. For others, owning a forest is an ethical choice to improve the world by slowing urban sprawl or providing environmental services such as clean air and water. But for many landowners, the primary motive for owning forest land is the enjoyment that they receive by spending time in their woods. Forest owners do a lot of activities in their woods because it is just plain fun! So as you work with your forester to navigate these programs and choose the best ones for you and your property, don't forget that most family forest owners in Michigan own their forest because they simply enjoy being out in their own woods. Good forest management should not only improve the ecology and economics of your forest, but also your enjoyment of your land.

5.2 Forest Stewardship Program

The Forest Stewardship Program was created by the USFS in 1991 to encourage long-term stewardship of family forest land by providing professional planning and technical assistance to private landowners. Ultimately, the purpose of the program is to enhance and sustain the long-term productivity of forest resources and produce healthy and resilient forest landscapes. As part of the process, landowners work with a certified Forest Stewardship Plan Writer to develop a custom plan that describes your personal land stewardship goals, unique forest resources, and suggested management activities.

There are many benefits to developing a Forest Stewardship Plan, including enhanced access to USDA conservation programs, forest certification programs, and forest product and ecosystem service markets. For example, you can use your Forest Stewardship Plan to prepare for a timber sale, improve wildlife habitat, or to enroll in other programs that require a forest management plan. Participation in the Forest Stewardship Program is voluntary and landowners can obtain information and cost-share assistance throughout the year. In Michigan the Forest Stewardship Program is administered by the Michigan DNR, who trains and certifies private sector professional foresters and wildlife biologists to write Forest Stewardship Plans.

Visit www.michigan.gov/foreststewardship to connect with a certified plan writer and take your next step toward managing your land to meet your stewardship goals. More information about the program can also be found at <http://www.fs.fed.us/spf/coop/programs/loa/fsp.shtml/>.

5.3 Qualified Forest Program

The purpose of the Qualified Forest Program, administered by the Michigan Department of Agriculture and Rural Development, is to encourage landowners to actively manage their privately owned forests for commercial harvest, wildlife habitat enhancement, and improvement of other non-forest resources. In exchange for managing their forests in a sustainable fashion, enrolled landowners will receive an exemption from the local school operating millage (up to 18 mills). In order to qualify for the program, landowners must have between 20 and 640 acres; have an approved forest management plan written by a “Qualified Forester;” and must comply with the prescriptions included in that plan. There is a \$50 application fee and an annual fee equivalent to 2 mills to help fund the operation of the program. See www.michigan.gov/qfp for more information or to begin the enrollment process. The application deadline in order to receive tax benefits the following year is September 1.

Qualified Forest Program: Rich Harlow, Program Administrator (517) 284-5630

5.4 Commercial Forest Program

The Commercial Forest Act gives property tax breaks for forest owners in Michigan that voluntarily enroll in the Commercial Forest Program. Landowners must have at least 40 acres of contiguous forest, an appropriate forest management plan (written by a Registered Forester), and conduct commercial harvests as prescribed in their plan. Land that is included under the Commercial Forest Program must be open to the public for non-motorized recreational use (e.g., hunting and fishing). Under this program, landowners pay a specific rate of \$1.25 per acre for property taxes and the state of Michigan pays counties another \$1.25 per acre. The application fee is \$1 per acre with a minimum fee of \$200 and a maximum fee of \$1,000. More information about this program, which is administered by the MDNR, is available online at www.michigan.gov/commercialforest. The application deadline in order to receive tax benefits the following year is April 1.

Commercial Forest Program: Shirley Businski, Program Administrator (517) 284-5849.

Note: While it is not required to use a financial assistance program for developing a plan for these two tax programs, many landowners benefit from using either the FSP or NRCS programs to develop their forest management plan and then enroll in the separate Commercial Forest or Qualified Forest programs. Participating in a financial assistance program may hinder the schedule for developing a forest management plan in time for the application deadlines of the Commercial Forest program (April 1) or the Qualified Forest (September 1) program and delay entry into the tax program for an entire year.

5.5 American Tree Farm System

The American Tree Farm System is a certification program of the American Forest Foundation that acknowledges land management practices meeting certain Standards of Sustainability. As part of this program, a network of more than 82,000 family forest owners sustainably manage 24

million acres of forestland across the country. The American Tree Farm System is recognized by the Programme for the Endorsement of Forest Certification, which is an international forest certification system. Landowners following the Standards of Sustainability can feel proud to be recognized as ambassadors for sustainable woodland stewardship.

The eight Standards of Sustainability that must be met in order to gain recognition as a certified tree farm under the American Tree Farm System program are listed below. An approved Forest Stewardship Plan completed through the Forest Stewardship Program or a qualifying NRCS incentives programs can be written to also serve as a qualifying forest management plan under the American Tree Farm System. A free inspection from one of the Tree Farm Inspecting Foresters is required to enroll. For more information please visit www.treefarmssystem.org.

- **Commitment to Practicing Sustainable Forestry:** Landowner demonstrates commitment to forest health and sustainability by developing a forest management plan and implementing sustainable practices.
- **Compliance with Laws:** Forest-management activities comply with all relevant federal, state, and local laws, regulations, and ordinances.
- **Reforestation and Afforestation:** Landowner completes timely restocking of desired species of trees on harvested sites and nonstocked areas where tree growing is consistent with land-use practices and the landowner's objectives.
- **Air, Water and Soil Protection:** Forest-management practices maintain or enhance the environment and ecosystems, including air, water, soil, and site quality.
- **Fish, Wildlife and Biodiversity:** Forest-management activities contribute to the conservation of biodiversity.
- **Forest Aesthetics:** Forest-management activities recognize the value of forest aesthetics.
- **Protect Special Sites:** Special sites are managed in ways that recognize their unique historical, archaeological, cultural, geological, biological, or ecological characteristics.
- **Forest Product Harvests and Other Activities:** Forest product harvests and other management activities are conducted in accordance with the landowner's objectives and consider other forest values.

My Land Plan

MyLandPlan.com is a resource for woodland owners to help you protect and enjoy your woods provided by the American Forest Foundation (AFF) that provides information about keeping your woods healthy. The AFF planning tool helps you keep track of all your woodland activities and experiences in one place. After you create a profile, you will have access to the Land Plan tool, an exclusive area of the website. The planning tool lets you: map the boundaries of your land; add features and special sites; set goals and plan actions; receive information specially tailored for what you want to do on your land; and record your actions and experiences in your own personalized forest journal.

5.6 USDA Financial and Technical Assistance Programs

Forest Stewardship Plans are accepted by the NRCS when applying for the Environmental Quality Incentives Program funding, although they do not require the same level of detail as NRCS conservation activity plans. Work with your NRCS District Conservationist and forester to fill out supplemental “Job Sheets.” For info see:

www.mi.nrcs.usda.gov/technical/forestry.html

Some of the recommended activities in this plan have potential for financial assistance. NRCS forestry “conservation practices” include forest trails and landings, stream crossings, riparian forest buffers, stream habitat improvement, forest stand improvement, tree and shrub establishment, brush management, early succession habitat, wetland wildlife habitat, and upland wildlife habitat. NRCS conservation practices address “resource concerns” (environmental problems) like soil erosion, soil quality, water quality degradation, plant productivity, habitat fragmentation, invasive plants, forest health, etc. Contact your local NRCS Service Center to apply for financial assistance (see www.nrcs.usda.gov/wps/portal/nrcs/main/mi/contact/local).

Environmental Quality Incentives Program

The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program administered by the USDA Natural Resources Conservation Service. It supports production agriculture and environmental quality as compatible goals. Through EQIP, farmers, ranchers, private forest land owners and federally-recognized American Indian tribes may receive financial and technical assistance to implement structural and land management conservation practices on eligible agricultural land. Program priorities aim to address resource concerns including soil erosion, soil quality, water quality degradation, plant productivity, habitat fragmentation, invasive plants, and forest health. Conservation practices related to forestry may include forest trails and landings, stream crossings, riparian forest buffers, forest stand improvement, tree and shrub establishment, brush management, early succession habitat, wetland wildlife habitat, and upland wildlife habitat. EQIP activities are carried out according to a site specific conservation plan developed in conjunction with the producer. Forest Stewardship Plans are accepted by the NRCS when applying for EQIP funding. All conservation practices are installed according to NRCS technical standards.

The Conservation Reserve Program

The Conservation Reserve Program (CRP) pays a yearly rental in exchange for farmers removing environmentally sensitive land from agricultural production and planting species that will improve water quality, prevent soil erosion, and reduce loss of wildlife habitat. The USDA Farm Service Agency contracts are 10 to 15 years in duration and include a number of practices: CRP-CP2 Native Grass Planting, CRP-CP3 General Tree Planting, CRP-CP4D Wildlife Habitat, CRP-CP12 Wildlife Food Plot, CRP-CP25 Rare and Declining Habitat (Prairie), CRP-CP25 Rare and Declining Habitat (Savanna), CRP-CP42 Native Pollinator Habitat, and others.

Conservation Stewardship

Conservation Stewardship is a program that provides technical and financial assistance to qualified farmers whose applications rank high enough to be accepted into the program. It uses the Conservation Measurement Tool to score current and planned environmental performance. Beginning and socially disadvantaged farmers as well as non-industrial forestland applications compete in separate ranking pools. Supplemental payments reward improved or newly adopted resource-conserving crop rotations. The five-year contracts are eligible for renewal.

Agricultural Conservation Easement Program

The Agricultural Conservation Easement Program has several components including Agricultural Land Easements and Wetlands Reserve Easements. These both provide financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Some easements are permanent while others are 30 year contracts. Contact your local District Conservationist or forester for information and enrollment forms for USDA-NRCS assistance programs. For more information please visit www.nrcs.usda.gov/wps/portal/nrcs/main/mi/programs/.

Healthy Forests Reserve Program

The Healthy Forests Reserve Program (HFRP) helps landowners restore, enhance, and protect forestland resources on private lands through easements and financial assistance. HFRP aids the recovery of endangered and threatened species under the Endangered Species Act, improves plant and animal biodiversity, and enhances carbon sequestration. HFRP provides landowners with 10-year restoration agreements and 30-year or permanent easements for specific conservation actions. HFRP applicants must provide proof of ownership, or an operator (tenant) must provide written concurrence from the landowner of tenancy for the period of the HFRP restoration agreement in order to be eligible. Visit your local USDA Service Center to apply or visit www.nrcs.usda.gov/getstarted

5.7 Capital Gains Information

If you own timber for more than twelve months, profits from timber sales are taxed as capital gains, rather than ordinary income. Expenses, including the cost of a management plan or a consulting forester's fees for a timber sale, can be deducted from profits to determine net income. There are many great tax related resources available on www.TimberTax.org, including the most recent edition of the annual "Tax Tips for Forest Landowners."

5.8 Opportunities for Partnerships between different types of landowners

As we think about stewardship in each of the focal landscapes for The Stewardship Network, partnerships across boundaries are key to the successful stewardship of our forest resources. As noted in many places of this plan, ecosystems don't respect political, jurisdictional, or property boundaries. Much like natural ecosystems, human diversity throughout a landscape can create

strength, foster resiliency, and promote efficiency. Caring for large swaths of land and water that contain a plethora of biotic organisms and abiotic factors whose health and survival are intricately interwoven with the natural system is an immense task that can undoubtedly be daunting to a single landowner. But just as communities come together to celebrate culture, work on local improvement projects, and sustain institutions that support the common good, harnessing the power of human relationships can be a powerful force in preserving the natural world.

These plans have shared the great diversity of resources – public, private and non-profit – available to individual property owners to help them become more engaged in forest management and stewardship. We encourage readers of these plans to become more familiar with these programs and tap into the ones that meet your needs. We encourage you to think about your municipal, state, federal, and tribal governments; non-profits; private businesses; volunteers; foundations and funding mechanisms; and your fellow private landowners as resources you can reach out to and learn from. We encourage you to reach across your property line to let your neighbor know how you are (or would like to) manage your property, and to learn from them and their approaches. We know property owners who have pooled resources to hire a stewardship crew; to share tools; to share their successes and lessons learned as they engage in forest stewardship. The process of getting to know your property is a lifelong one as you watch, listen, and feel to how your land responds to your management activities. Attend workshops, online webinars, conferences. You can find many activities in your community at The Stewardship Network's searchable calendar of events: www.stewardshipnetwork.org/event-calendar. Reach out to us to ask a question; share your idea; tell your stewardship story. We would love to include your story in our ongoing commitment to collecting and sharing stories of stewardship. Email us or give us a call: staff@stewardshipnetwork.org 734-996-3190. We look forward to hearing from you!

Appendix A: Glossary of Common Forestry Terms

The following glossary is adapted from www.dnr.state.md.us/forests/gloss.html.

- Agroforestry** - a land-use system that combines both agriculture and forestry in one location.
- Alley Cropping** - widely spaced rows of trees with annual crops growing in between the rows.
- Basal Area (Tree)** - cross sectional area of a tree at 4.5 feet off ground in units of square feet (ft²).
- Basal Area (Forest)** - basal area of all trees per acre summed up, in units of ft²/acre; measure of density.
- Biomass** – harvesting and using whole trees or parts of trees for energy production
- Board Foot** – a measure of volume 1 foot by 1 foot by 1 inch or 144 cubic inches of wood.
- Bolt** – 8-foot-long log
- Browse** - parts of woody plants, including twigs, shoots, and leaves, eaten by forest animals.
- Carbon Cycle** – the biogeochemical cycle to exchange carbon between the biosphere and atmosphere by means of photosynthesis, respiration and combustion.
- Clearcut** - the harvest of all the trees in an area to reproduce trees that require full sunlight.
- Cord** - a unit of wood cut for fuel that is equal to a stack 4 x 4 by 8 feet or 128 cubic feet
- Cordwood** - small diameter or low quality wood suitable for firewood, pulp, or chips.
- Crop Tree** - a young tree of a desirable species with certain desired characteristics.
- Crown** - the uppermost branches and foliage of a tree.
- Cruise** - a forest survey used to obtain inventory information and develop a management plan.
- Cull** - a sawtimber size tree that has no timber value as a result of poor shape or damage.
- Diameter at Breast Height (DBH)** - diameter of a tree trunk taken at 4 1/2 feet off the ground.
- Diameter-Limit Sale** - a timber sale in which all trees over a specified DBH may be cut. Diameter-limit sales often result in high grading and is a very poor forestry practice.
- Endangered Species** – a species in danger of extinction.
- Even-Aged Stand** - stand with age difference between oldest and youngest trees is minimal (<10 years).
- Food forest** – an agroforestry or permaculture cropping system in which woody plants that produce food (including fruit and nut trees and berry-producing shrubs) are intermingled with other perennial and annual food plants in a way that mimics natural forest ecosystem structure.
- Forestland** – land at least one acre in size that is at least 10 percent stocked with trees.
- Forest Farming** - cultivating high value specialty crops in the shade of natural forests.
- Forest Stand Improvement (FSI)** - any practice that increases the health, composition, value or rate of growth in a stand. Also called Timber Stand Improvement when focused on timber.
- Group Selection** - harvesting groups of trees to open the canopy and encourage uneven aged stands.
- Habitat** - the ecosystem in which a plant or animal lives and obtains food and water.
- Hardwoods** - a general term encompassing broadleaf, deciduous trees.
- High Grading** - to remove all good quality trees from a stand and leave only inferior trees.
- Intolerance** - characteristic of certain tree species that does not permit them to survive in the shade.
- Landing** - cleared area where logs are processed, piled, and loaded for transport to a sawmill.

Log Rule - a method for calculating wood volume in a tree or log by using its diameter and length. Scribner, Doyle and the International 1/4-inch rule are common log rules.

Lump-Sum Sale - a timber sale in which an agreed-on price for marked standing trees is set before the wood is removed (as opposed to a mill tally or unit sale).

Mast - nuts and seeds such as acorns, beechnuts, and chestnuts that serve as food for wildlife.

Non-timber forest products – include forest plant products harvested for food (such as nuts, berries, maple sugar), medicine, crafts, or purposes other than commercial timber. The website <http://www.ntfpinfo.us> offers information on hundreds of uses for more than 1,000 forest species.

Over-mature - trees that have declined in growth rate because of old age and loss of vigor.

Overstocked - trees are so closely spaced that they do not reach full growth potential.

Pole Timber - trees 4 to 10 inches DBH.

Pre-Commercial Operations - cutting to remove wood too small to be sold.

Prescribed Fire – an intentional and controlled fire used as a management tool used to reduce hazardous fuels or unwanted understory plants (invasive, undesirable species, etc.).

Pulpwood - wood suitable for use in paper manufacturing.

Range - cattle grazing in natural landscapes.

Regeneration - the process by which a forest is reseeded and renewed.

Riparian Forest Buffers - strips of land along stream banks where trees, shrubs and other vegetation are planted and managed to capture erosion from agricultural fields.

Salvage Cut - the removal of dead, damaged, or diseased trees to recover value.

Sapling - a tree at least 4 1/2 feet tall and between 1 inch and 4 inches in diameter.

Sawlog - log large enough to be sawed economically, usually >10" diameter and 16' long.

Sawtimber stand - a stand of trees whose average DBH is greater than 11 inches.

Sealed-Bid Sale - a timber sale in which buyers submit secret bids.

Seed-Tree Harvest - felling all trees except for a few desirable trees that provide seed for the next forest.

Selection Harvest – harvesting single trees or groups at regular intervals to maintain uneven-aged forest.

Shelterwood Harvest – harvesting all mature trees in two or more cuts, leaving trees to protect seedlings.

Silvopasture - growing trees and improved forages to provide suitable pasture for grazing livestock.

Silviculture - the art and science of growing forest trees.

Site Index - measure of quality of a site based on the height of a dominant tree species at 50 years old.

Site Preparation - treatment of an area prior to reestablishment of a forest stand.

Skidder - a rubber-tired machine with a cable winch or grapple to drag logs out of the forest.

Slash - branches and other woody material left on a site after logging.

Snag - a dead tree that is still standing and provide food and cover for a variety of wildlife species.

Softwood - any gymnosperm tree including pines, hemlocks, larches, spruces, firs, and junipers.

Species of Special Concern – not threatened or endangered yet, but has low or declining populations.

Stand - a group of forest trees of sufficiently uniform species composition, age, and condition to be considered a homogeneous unit for management purposes.

Stand Density - the quantity of trees per unit area, evaluated in basal area, crown cover or stocking.

Stocking - the number and density of trees in a forest stand. Classified as under-, over-, or well-stocked.

Stumpage Price - the price paid for standing forest trees and paid prior to harvest.

Succession - the replacement of one plant community by another over time in the absence of disturbance.

Sugarbush – plantation of sugar maples, or woodlot managed for maple syrup production.

Sustained Yield - ideal forest management where growth equals or exceeds removals and mortality.

Thinning - partial cut in an immature, overstocked stand of trees to increase the stand's value and growth.

Threatened Species - a species whose population is so small that it may become endangered.

Timberland - forest capable of producing 20 ft³ of timber per acre per year.

Tolerance – the capacity of a tree species to grow in shade

Under-stocked - trees so widely spaced, that even with full growth, crown closure will not occur.

Understory - the level of forest vegetation beneath the canopy.

Uneven-Aged Stand - three or more age classes of trees represented in a single stand.

Unit Sale - a timber sale in which the buyer makes regular payments based on mill tally and receipts.

Veneer Log - a high-quality log of a desirable species suitable for conversion to veneer.

Well-Stocked – stands where growing space is effectively occupied but there is still room for growth.

Windbreaks - rows of trees to provide shelter for crops, animals or farm buildings.

Appendix B: Forest Laws and Programs

Note: This list is not comprehensive and other laws may apply to your situation. Consult an attorney or resource professional for additional assistance.

Federal and State Laws Related to Forest Management

- USA - Federal Insecticide, Fungicide, and Rodenticide Act, 1947
- USA - National Historic Preservation Act, 1966
- USA - Clean Water Act, 1948 and 1972
- USA - Endangered Species Act, 1973
- MI - Michigan Pesticide Control Act, Public Act 171 of 1976
- MI - Natural Resources and Environmental Protection Act, Public Act 451 of 1994
- MI - Right to Forest Act, Public Act 676 of 2002

Michigan Laws Related to Forestry

- Natural Resources and Environmental Protection Act, Public Act 451 of 1994
- Right to Forest Act, Public Act 676 of 2002
- Commercial Forest Act, Parts 511 and 512 of Public Act 451, 1994, as amended
- Qualified Forest Program, Public Acts 42 and 45 of 2013

Appendix C: Threatened, Endangered, and Special Concern Species

The following tables reflects presents the Endangered (E), Threatened (T), and Presumed Extirpated (X) animal species of Monroe County, which are protected under the Endangered Species Act of the State of Michigan (Part 365 of PA 451, 1994 Michigan Natural Resources and Environmental Protection Act). For more information visit:

<https://mnfi.anr.msu.edu/data/county.cfm>

Threatened, Endangered, and Special Concern Species

<i>Scientific Name</i>	Common Name	State Status
<i>Acris blanchardi</i>	<u>Blanchard's cricket frog</u>	T
<i>Agalinis gattingeri</i>	<u>Gattinger's gerardia</u>	E
<i>Alasmidonta marginata</i>	<u>Elktoe</u>	SC
<i>Alasmidonta viridis</i>	<u>Slippershell</u>	T
<i>Ambystoma texanum</i>	<u>Smallmouth salamander</u>	E
<i>Ammocrypta pellucida</i>	<u>Eastern sand darter</u>	T
<i>Ammodramus savannarum</i>	<u>Grasshopper sparrow</u>	SC
<i>Angelica venenosa</i>	<u>Hairy angelica</u>	SC
<i>Aristida longespica</i>	<u>Three-awned grass</u>	SC
<i>Asclepias hirtella</i>	<u>Tall green milkweed</u>	T
<i>Asclepias purpurascens</i>	<u>Purple milkweed</u>	T
<i>Asclepias sullivantii</i>	<u>Sullivant's milkweed</u>	T
<i>Atrytonopsis hianna</i>	<u>Dusted skipper</u>	SC
<i>Baptisia lactea</i>	<u>White or prairie false indigo</u>	SC
<i>Boechera missouriensis</i>	<u>Missouri rock-cress</u>	SC
<i>Callophrys irus</i>	<u>Frosted elfin</u>	T
<i>Camassia scilloides</i>	<u>Wild hyacinth</u>	T
<i>Carex crus-corvi</i>	<u>Raven's-foot sedge</u>	E
<i>Carex davisii</i>	<u>Davis's sedge</u>	SC
<i>Carex festucacea</i>	<u>Fescue sedge</u>	SC
<i>Carex squarrosa</i>	<u>Sedge</u>	SC
<i>Castanea dentata</i>	<u>American chestnut</u>	E
<i>Chondestes grammacus</i>	<u>Lark sparrow</u>	X
<i>Chrosomus erythrogaster</i>	<u>Southern redbelly dace</u>	E
<i>Cincinnatiatia cincinnatiensis</i>	<u>Campeloma spire snail</u>	SC
<i>Cistothorus palustris</i>	<u>Marsh wren</u>	SC
<i>Cuscuta polygonorum</i>	<u>Knotweed dodder</u>	SC
<i>Cyclonaias tuberculata</i>	<u>Purple wartyback</u>	T
<i>Diarrhena obovata</i>	<u>Beak grass</u>	SC

<i>Dichanthelium leibergii</i>	Leiberg's panic grass	T
<i>Emydoidea blandingii</i>	Blanding's turtle	SC
<i>Epioblasma obliquata</i> <i>perobliqua</i>	White catspaw	E
<i>Epioblasma torulosa rangiana</i>	Northern riffleshell	E
<i>Epioblasma triquetra</i>	Snuffbox	E
<i>Erimyzon claviformis</i>	Creek chubsucker	E
<i>Etheostoma spectabile</i>	Orangethroat darter	SC
<i>Euphyes dukesi</i>	Dukes' skipper	T
<i>Eurybia furcata</i>	Forked aster	T
<i>Falco peregrinus</i>	Peregrine falcon	E
<i>Flexamia reflexa</i>	Leafhopper	SC
<i>Gallinula galeata</i>	Common gallinule	T
<i>Gentianella quinquefolia</i>	Stiff gentian	T
<i>Haliaeetus leucocephalus</i>	Bald eagle	SC
<i>Helianthus mollis</i>	Downy sunflower	T
<i>Hibiscus laevis</i>	Smooth rose-mallow	X
<i>Hydrastis canadensis</i>	Goldenseal	T
<i>Hypericum gentianoides</i>	Gentian-leaved St. John's- wort	SC
<i>Hypericum sphaerocarpum</i>	Round-fruited St. John's-wort	E
<i>Ixobrychus exilis</i>	Least bittern	T
<i>Juncus brachycarpus</i>	Short-fruited rush	T
<i>Justicia americana</i>	Water willow	T
<i>Lactuca floridana</i>	Woodland lettuce	T
<i>Lampsilis fasciola</i>	Wavyrayed lampmussel	T
<i>Lechea minor</i>	Least pinweed	X
<i>Lechea pulchella</i>	Leggett's pinweed	T
<i>Leucospora multifida</i>	Conobea	SC
<i>Ligumia nasuta</i>	Eastern pondmussel	E
<i>Ligumia recta</i>	Black sandshell	E
<i>Lipocarpa micrantha</i>	Dwarf-bulrush	SC
<i>Lycaeides melissa samuelis</i>	Karner blue	T
<i>Macrhybopsis storeriana</i>	Silver chub	SC
<i>Mesodon clausus</i>	Yellow globelet	SC
<i>Mesodon elevatus</i>	Proud globe	T
<i>Mesodon pennsylvanicus</i>	Proud globelet	SC
<i>Mesomphix cupreus</i>	Copper button	SC
<i>Morus rubra</i>	Red mulberry	T

<u>Nelumbo lutea</u>	<u>American lotus</u>	SC
<u>Notropis photogenis</u>	<u>Silver shiner</u>	E
<u>Noturus miurus</u>	<u>Brindled madtom</u>	SC
<u>Nycticorax nycticorax</u>	<u>Black-crowned night-heron</u>	SC
<u>Obliquaria reflexa</u>	<u>Threehorn wartyback</u>	E
<u>Obovaria olivaria</u>	<u>Hickorynut</u>	E
<u>Obovaria subrotunda</u>	<u>Round hickorynut</u>	E
<u>Opsopoeodus emiliae</u>	<u>Pugnose minnow</u>	E
<u>Oxalis violacea</u>	<u>Violet wood sorrel</u>	X
<u>Panax quinquefolius</u>	<u>Ginseng</u>	T
<u>Pantherophis gloydi</u>	<u>Eastern fox snake</u>	T
<u>Papaipema beeriana</u>	<u>Blazing star borer</u>	SC
<u>Papaipema maritima</u>	<u>Maritime sunflower borer</u>	SC
<u>Papaipema sciata</u>	<u>Culvers root borer</u>	SC
<u>Papaipema silphii</u>	<u>Silphium borer moth</u>	T
<u>Percina copelandi</u>	<u>Channel darter</u>	E
<u>Percina shumardi</u>	<u>River darter</u>	E
<u>Phalaropus tricolor</u>	<u>Wilson's phalarope</u>	SC
<u>Platanthera ciliaris</u>	<u>Orange- or yellow-fringed orchid</u>	E
<u>Platanthera leucophaea</u>	<u>Prairie white-fringed orchid</u>	E
<u>Pleurobema sintoxia</u>	<u>Round pigtoe</u>	SC
<u>Polygala cruciata</u>	<u>Cross-leaved milkwort</u>	SC
<u>Pomatiopsis cincinnatiensis</u>	<u>Brown walker</u>	SC
<u>Potentilla supina</u>	<u>Sand cinquefoil</u>	T
<u>Ptychobranhus fasciolaris</u>	<u>Kidney shell</u>	SC
<u>Pycnanthemum pilosum</u>	<u>Hairy mountain mint</u>	T
<u>Pyrgulopsis letsoni</u>	<u>Gravel pyrg</u>	SC
<u>Quercus shumardii</u>	<u>Shumard's oak</u>	SC
<u>Rallus elegans</u>	<u>King rail</u>	E
<u>Regina septemvittata</u>	<u>Queen snake</u>	SC
<u>Sagittaria montevidensis</u>	<u>Arrowhead</u>	T
<u>Sander canadensis</u>	<u>Sauger</u>	T
<u>Scleria triglomerata</u>	<u>Tall nut rush</u>	SC
<u>Silphium perfoliatum</u>	<u>Cup plant</u>	T
<u>Simpsonaias ambigua</u>	<u>Salamander mussel</u>	E
<u>Spiza americana</u>	<u>Dickcissel</u>	SC
<u>Sterna hirundo</u>	<u>Common tern</u>	T
<u>Strophostyles helvula</u>	<u>Trailing wild Bean</u>	SC

<u><i>Stylurus plagiatus</i></u>	<u>Russet-tipped clubtail</u>	SC
<u><i>Symphotrichum praealtum</i></u>	<u>Willow aster</u>	SC
<u><i>Terrapene carolina carolina</i></u>	<u>Eastern box turtle</u>	SC
<u><i>Toxolasma lividus</i></u>	<u>Purple lilliput</u>	E
<u><i>Toxolasma parvum</i></u>	<u>Lilliput</u>	E
<u><i>Tradescantia virginiana</i></u>	<u>Virginia spiderwort</u>	SC
<u><i>Truncilla donaciformis</i></u>	<u>Fawnsfoot</u>	T
<u><i>Truncilla truncata</i></u>	<u>Deertoe</u>	SC
<u><i>Tyto alba</i></u>	<u>Barn owl</u>	E
<u><i>Utterbackia imbecillis</i></u>	<u>Paper pondshell</u>	SC
<u><i>Valerianella umbilicata</i></u>	<u>Corn salad</u>	T
<u><i>Vallonia parvula</i></u>	<u>Trumpet vallonia</u>	SC
<u><i>Villosa fabalis</i></u>	<u>Rayed bean</u>	E
<u><i>Villosa iris</i></u>	<u>Rainbow</u>	SC
<u><i>Zizania aquatica</i></u>	<u>Wild rice</u>	T

Appendix D: Additional Resources for Landowners

Other Internet Resources for Landowners

(alphabetically)

- Audubon Society: www.MichiganAudubon.org
- Conservation Easements: www.landtrustalliance.org/topics/taxes/income:tax-incentives-land-conservation
- DNR Forest Resources Division: www.Michigan.gov/Forestry
- DNR Hunting Access Program: www.michigan.gov/hap
- DNR Private Forest Land: www.Michigan.gov/PrivateForestLand
- DNR Urban and Community Forestry: www.michigan.gov/ucf
- DNR Wildlife Division: www.Michigan.gov/Wildlife
- DNR Wildlife Landowner Incentive Program: www.michigan.gov/dnrliip
- Field Identification Guides to Invasive Plants in Michigan:
 - www.mnfi.anr.msu.edu/invasive-species/InvasivePlantsFieldGuide.pdf
 - www.michigan.gov/dnr/0,4570,7-153-10370_12146---,00.html
- Foresters for the Birds: <http://vt.audubon.org/foresters-birds>
- Forestry Taxes: www.timbertax.org
- Heart of the Lakes (Collective of Michigan's land conservancies): www.heartofthelakes.org
- Leafsnap: An Electronic Field Guide: www.leafsnap.com
- Michigan Association of Conservation Districts: www.mcad.org
- Michigan Chapter of the Soil and Water Conservation Society: www.miglswcs.org
- Michigan Environmental Education Curriculum Support: www.michigan.gov/meecs
- Michigan Forest Association Foresters List: www.michiganforests.com/forester.htm
- Michigan Forest Pathways: <http://miforestpathways.net>
- Midwest Invasive Species Network: www.misin.msu.edu
- Michigan Nature Association: <https://www.michigannature.org>
- Michigan Society of American Foresters: <http://michigansaf.org>
- Michigan State University Department of Forestry: www.for.msu.edu
- Michigan State University Diagnostics Laboratory: www.pestid.msu.edu
- Michigan State University Extension Forestry: <http://msue.anr.msu.edu/topic/info/forestry>
- Michigan State University Soil Testing Laboratory: www.spnl.msu.edu
- Michigan Sustainable Forestry Initiative: <http://sfimi.org>
- Michigan Technological University School of Forest Resources & Environmental Science: www.mtu.edu/forest
- Michigan United Conservation Clubs: www.mucc.org
- My Land Plan: www.mylandplan.org

- National Wild Turkey Federation: www.nwtf.org
- National Woodland Owners Association: www.woodlandowners.org
- NRCS Financial Assistance:
www.nrcs.usda.gov/wps/portal/nrcs/main/mi/technical/landuse/forestry
- NRCS PLANTS Database: www.plants.usda.gov
<http://www.missouribotanicalgarden.org/plantfinder/plantfindersearch.aspx>
- NRCS Technical Service Providers:
www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/technical/tsp/
- Pheasants Forever: www.pheasantsforever.org
- Project Learning Tree: www.michiganplt.org
- Project WILD: www.michigan.gov/michiganprojectwild
- Quality Deer Management Association: www.qdma.com
- Ruffed Grouse Society: www.ruffedgrousesociety.org
- Sample Timber Sale Contract:
www.nhdfl.org/library/pdf/Forest%20Protection/timbersaleagreement.pdf
- Ties to the Land (succession planning to pass forest to next generation):
www.tiestotheland.org
- Tree Sales:
www.michigan.gov/documents/dnr/DirectoryOfMichiganSeedlingNurseries:IC4175_25882_87.pdf?20141113140132
- Trout Unlimited: www.michigantu.org
- USDA Soil Web Survey: <http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>
- USFS Ecosystem Services: www.fs.fed.us/ecosystemservices/index.shtml
- USFS Private Woodland Owners: <http://na.fs.fed.us/pubs/misc/flg>
- USFS State and Private Forestry: www.fs.fed.us/spf
- Whitetails Unlimited: www.whitetailsunlimited.com
- Woodland Stewardship: www.woodlandstewardship.org

Books for Landowners

1. *Woodland Stewardship: A Practical Guide for Midwestern Landowners* (2nd Edition). 2009. This book, written by a team of educators and foresters from Minnesota, Wisconsin, and Michigan is an excellent manual on how to manage your forest for a wide variety of goals. (A free pdf of the entire book is online at): <http://woodlandstewardship.org>
2. *Owning and Managing Forest: A Guide to Legal, Financial, and Practical Matters* (Revised). 2005. This book is written by Thomas McEvoy, an Extension Professor at the University of Vermont. It contains excellent advice on the legal and financial issues of owning and managing a family forest.
3. *A Landowner's Guide to Managing Your Woods*. 2011. This book is authored by a landowner, forester, and logger to give a balanced view of forest management and how to maintain a small forest for long-term health, biodiversity, and high-quality timber production.
4. *Michigan Trees: A Guide to the Trees of the Great Lakes Region* (Revised). 2004. This book is the classic text on tree identification in Michigan authored by two U of M professors. It has drawings instead of photos, but the book has more complete information than the ID books with prettier photos.
5. *Michigan Forest Communities: A Field Guide and Reference*. 2004. This book, by Dr. Don Dickmann at MSU, describes 23 forest communities in Michigan. The book is available from MSU Extension. A free pdf is at <http://web2.msue.msu.edu/bulletins/Bulletin/PDF/E3000.pdf>.
6. *The Forests of Michigan* (Revised). 2016. This book by two MSU forestry professors is an interesting history of Michigan's forests over the last few centuries and is available at the University of Michigan Press.
7. *Positive Impact Forestry: A Sustainable Approach to Managing Woodlands*. 2004. This book is written by Thomas McEvoy, an Extension Professor at the University of Vermont. It is a great introduction to silviculture, the science and art of growing and managing forests.
8. *Estate Planning for Forest Landowners: What Will Become of Your Timberland?* 2009. Nothing is more dreadful than death and taxes, but this book helps landowners prepare for both. To ease your pain, it is free at http://www.srs.fs.usda.gov/pubs/gtr/gtr_srs112.pdf. See also www.timbertax.org

9. *Trees Are the Answer (Revised)*. 2010. This book is written by Dr. Patrick Moore, one of the founders of Greenpeace. His perspective on forestry will appeal to both tree huggers and loggers.
10. *Managing Michigan's Wildlife: A Landowner's Guide*. 2001. This book, edited by two biologists for the Michigan Department of Natural Resources, is the classic text in Michigan for landowners on wildlife habitat and managing forests for preferred game species. This book about wildlife habitat management is only available at: www.michigandnr.com/publications/pdfs/huntingwildlifehabitat/Landowners_Guide/index.htm
11. *A Sand County Almanac*. 1949. This book by Aldo Leopold is one of the foundations for environmental ethics that continues to inform forest stewardship of both private and public lands. This book will help you to articulate your own ethical approach to managing your forest.
12. *Last Child in the Woods*. 2008. This book by Richard Louv is a strong argument that our nation's children are suffering from "nature deficit disorder." This book will give you great ideas about how you can bring school groups, scout groups, church groups, or even your own children out into your forest to experience and enjoy nature.

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