HUMAN WELL-BEING DEPENDS ON NATURE!
THINK GLOBALLY! ACT LOCALLY!

Annual Report 2018
Our Mission
To guide the conservation and stewardship of Michigan’s biodiversity by providing the highest quality scientific expertise and information.

Our Vision
To be the authoritative source of information on biodiversity that is widely used to conserve Michigan’s unique natural heritage for current and future generations.

MSU Extension Mission
Michigan State University Extension helps people improve their lives through an educational process that applies knowledge to critical issues, needs and opportunities.
THE YEAR IN REVIEW:
2018 PRESENTATIONS, OUTREACH, AND EDUCATION

Professional Groups
- Eco-Action Conference, Lake Michigan College
- Ecological Society of America Members, New Orleans, Louisiana
- Kellogg Biological Station Workshops
- Michigan Eastern Massasauga Working Group
- Michigan Department of Environmental Quality, Aquatic Nuisance Control Program
- Michigan Department of Natural Resources – Wildlife Division
- Michigan Department of Natural Resources and Michigan Department of Environmental Quality, Michigan State University Extension
- Michigan State University Extension Educators and Specialists
- NatureServe, Lansing, Michigan
- Tribal Natural Resource Departments, Bay Mills, Michigan
- US Fish and Wildlife Service, Professional Biologists and Researchers, Milwaukee, Wisconsin
- US Fish and Wildlife Service Working Group

Conservation Organizations and Interested Citizens
- Audubon Society of Kalamazoo
- CISMA (Cooperative Invasive Species Management Area) Partners and Municipal Staff, St. Johns, Michigan
- Conservation Organizations; Federal, State and Local Governments; and Tribal Natural Resource Departments, Charlevoix, Michigan
- Conservation Stewards Program, Algonac State Park, Algonac, Michigan
- Conservation Stewards Program, Pierce Cedar Creek Institute, Hastings, Michigan
- JLW (Jackson, Lenawee and Washtenaw) CISMA, Jackson Master Gardeners, Men’s garden club, the Stewardship Network and Jackson County Conservation District, Jackson, Michigan
- Master Gardeners and Other Groups, South Haven, Michigan
- Michigan Botanical Club, Kalamazoo, Michigan
- Pierce Cedar Creek Institute, Kalamazoo, Michigan
- Muskegon/Southwest Michigan Vernal Pool Patrol, Lansing Community College
- Saginaw Bay CISMA, Saginaw Bay, Michigan
- Stewardship Network Resource Managers, Land Conservancy Members and Academics, Lansing, Michigan
- Vernal Pool Patrol, West Olive, Michigan
- Washtenaw County/Southeast Michigan Vernal Pool Patrol, Lansing Community College
- Washtenaw County Conservation Stewards, Independence Park, Whitmore Lake, Michigan
- Washtenaw County Conservation Stewards, Saline Liberty School, Joan Rodman Plant Preserve, Lodi Township, Michigan
- Washtenaw County Conservation Stewards, Sharon Mills City Park, Nan Weston Nature Preserve, and Leaonard Preserve, Manchester, Michigan

Students and Teachers
- Michigan Science Teachers Association Annual Conference, Lansing, Michigan
- Michigan State University Botany Class
- Michigan State University Wetland Ecology Class
- Michigan State University Class PW 419 Applications of Geographic Information Systems to Natural Resources Management
- Michigan State University Forestry High School Program
- Middle and High School Science Teachers, Gibraltar, Michigan
- Voyager Elementary School, 5th Graders, Howell, Michigan

MNFI Student Project on Vernal Pools

“...I enjoy everything about learning about Vernal Pools. They can spark anybody’s interest and make them want to find out more immediately! The impact it had on me (and probably many others) made me think about how many things in this world are hidden (like the vernal pool) but can only be found if someone cares. A lot like all of the people out there who want to protect vernal pools and the life inside of them!”

Adyson Sykes, 5th Grade Participant

“...Our 5th grade students were first introduced to Vernal Pools when Ms. Daria Hyde visited us. Instantly, I saw their curiosity sparked when learning of the important animals and biodiversity that these wetlands provided. As they continued their research, their fascination only grew as they learned that their real world audience would be scientists from Michigan State University. Learning about Vernal Pools gave my students valuable research skills and motivation to help our local ecosystems and animals. I am excited for them to see a Vernal Pool in real life and truly connect the information from their research to their senses. Once they experience the magic of these ecosystems, we can then become true activists and conservationists.”

Anthony Bonanni, Teacher
Voyager Elementary School, Howell, Michigan

Above: Vernal Pools booklet created by Adyson Sykes
Left: Botanist Phyllis Higman discussing seed collection with a Detroit teacher at Lake Erie Metropark in Wayne County
Photo by: Daria Hyde
59 Projects, More Than 150 Partners, and the General Public

Our work includes Surveys, Rare/Threatened/Endangered Species Inventories, Habitat Assessments, Invasive Species Monitoring, Land Use Planning, and Citizen Science.

The MNFI Website Has a New Look!

• Access to all the information you are used to seeking!
• Improved access for the general public!
• Additional information and resources!
• Check it out: https://mnfi.anr.msu.edu/

Funding: $4,232,950

- Heritage Database 5%
- Unrestricted Project Funding 8%
- MSU Extension 3%
- MSU 2%
- Project Funding 8%
- Teaching 1%
- Gifts 0%

Expenses: $4,201,058

- Projects 92%
- Administration 2%
- Operational Costs 1%
- Professional Development 1%
- Technology Costs 4%
In 2018, the database grew to 19,809 records with a net increase of 767 records.

**Federal Endangered (LE):** Any species in danger of becoming extinct throughout all or a significant portion of its range—legally protected by the Endangered Species Act
- 18 Species
- 547 Records

**Federal Threatened (LT):** Any species at risk of becoming endangered within the foreseeable future—legally protected by the Endangered Species Act
- 11 Species
- 753 Records

**State Threatened (T):** Any species likely to become extinct throughout all or a significant portion of its range—legally protected by the Endangered Species Act
- 358 Species
- 6,784 Records

- 8% State Endangered (E)
- 11% Natural Communities

**State Special Concern (SC):** Any species of concern due to declining or relict populations in the state
- 46% Species
- 8,901 Records

**State Extirpated (X):** Any species no longer found in the state, but which can be found elsewhere in the world
- 1% Species
- 121 Records

**Any species of fish, plant life, or wildlife in danger of extinction throughout all or a significant part of its range**

**An assembly of native species that occurs repeatedly under similar environmental conditions**

**Species, Types, Records**
- Michigan Natural Features Inventory

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**Photo by:**
- Alpena County Squaw Bay Preserve in Huron Pines AmeriCorps member Kailyn Atkinson setting turtle traps at The Nature Conservancy’s Square Bay Preserve in Alpena County
- Yu Man Lee
- Andy Reago & Chrissy McClarren via Flicker, Joshua Mayer via Flicker, Peter Badra
- Photo by: U.S. Fish and Wildlife Service, Aaron Kortenhoven, David Cuthrell
- Photo by: Joshua

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**Explore Michigan’s Rare Species and Natural Communities at:**
[mnfi.anr.msu.edu](http://mnfi.anr.msu.edu)
International Response to a Global Issue

The immense variety of living species, collectively known as biodiversity, is fundamental to human survival - physically, culturally, and psychologically. Nature contributes to people, and their well-being, in material, non-material and regulating ways, providing habitat for wildlife, food, medicine, shelter, and a wide variety of other benefits, including support for jobs and the economy. While not all of nature’s benefits can be cast in terms of dollars, especially when considering cultural benefits, the economic value of those that can be has been valued in the trillions of dollars on a global scale. The value of ecosystem services to people for the entire Americas region is estimated at $24.3 trillion (equivalent to the gross domestic product). Of that, $5.3 trillion is attributable to the United States.

In its quest to strengthen the interface between science and policy, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), an independent body consisting of individual countries with the support of the United Nations, began work in 2014 on four major regional assessments of the status and trends of biodiversity in Africa, the Americas, Asia and the Pacific, and Europe and Central Asia.

MNFI Director Brian Klatt joined more than 1,000 experts worldwide to glean and assess information from thousands of scientific studies and governmental, indigenous and local knowledge sources. MNFI had a direct role in the Assessment for the Americas, with Dr. Klatt leading development of the technical report chapter on assessing future trends of biodiversity and ecosystem services. He also served as a primary author on the report’s Summary for Policy Makers and helped establish critical definitions as part of the IPBES glossary team.
Summary reports for policymakers for each region present important key messages, offer background information, and provide examples of policy options, which include enabling factors and country-level challenges. The reports were approved by the 129 member nations on March 24, 2018, in Medellín, Colombia. The full IPBES regional reports provide comprehensive in-depth information and conclusions about each region’s land-based, freshwater and coastal biodiversity, as well as the state of ecosystem functioning and nature’s contributions to people (NCPs).

The Americas Regional Assessment

Endowed with much greater capacity than the global average to contribute to human quality of life, the majority of countries in the Americas also use nature more intensively than the global average and exceed nature’s ability to renew itself.

Some areas of the Americas have made progress in stemming the rate of declining biodiversity and ecosystem conditions and the many species at high risk of extinction. Trends in population and demographics, economic growth, habitat degradation, human-induced climate change, and air pollution are just some of the drivers impacting biodiversity and ecosystems. Many approaches have been used to address these drivers. Some are effective, some ineffective, and many are hampered by inconsistent governance.

So too, while point-source pollution of the Great Lakes has been enormously decreased, both the Great Lakes and inland surface waters continue to be impacted by invasive species and agricultural runoff. Finally, agroecosystems have contributed enormously to human well-being by supplying food. They are large source of nutrient enrichment to surface waters and negatively impact soil formation.

Increasing global demand for food, water and energy intensifies the ecological footprint of the Americas. Without sustainable practices, the negative consequences for NCPs will impact quality of life and the availability of future options.

MNEI Discovers, Defines and Delivers

Nature’s Contributions to People (NCPs) and Sustainable Development Goals (SDGs) set a framework for policymakers to make informed decisions with impact on the environment.

From its research, field work, and stewardship of the Natural Heritage Database, MNEI delivers scientific information to governmental and non-governmental agencies, the private sector and their environmental consultants, fellow researchers, the public, and the NatureServe Network international database.

As with the collective effort of the hundreds of IPBES scientists, working with a wide range of partners from many disciplines, organizations, and perspectives, MNEFI’s research, consulting services, and conservation planning services inform decisions with impact on biodiversity and ecosystems.

Setting Sustainable Development Goals

In 2015, all UN member states adopted 17 Sustainable Development Goals (SDGs) as part of its 2030 Agenda for Sustainable Development, which provides a shared blueprint for peace and prosperity for the people and the planet. The SDGs are a call to action for global partnership to provide strategies to deal with the intersecting issues of humans and nature.

1. No Poverty
2. Zero Hunger
3. Good Health and Well-being
4. Quality Education
5. Gender Equality
6. Clean Water and Sanitation
7. Affordable and Clean Energy
8. Decent Work and Economic Growth
9. Industry, Innovation, and Infrastructure
10. Reduced Inequalities
11. Sustainable Cities and Communities
12. Responsible Consumption and Production
13. Climate Action
14. Life below Water
15. Life on Land
16. Peace, Justice, and Strong Institutions
17. Partnerships to Facilitate SDGs
So, it should not be surprising to find that any given ecosystem, plant community, or species can provide benefits in more than one of the three groupings of Nature’s Contributions to People (NCPs): material, non-material, and regulating.

Michigan’s wetlands, for example, provide benefits in all these categories. They are critical to fish spawning and waterfowl breeding, which support populations of both game and non-game species, i.e., material benefit. From a non-material standpoint, they are important to our state’s tribal residents in maintaining cultural identity, such as through harvesting of wild rice. And they are important in regulating various processes, such as capturing sediment and contaminants before they enter surface waters.

It is for these benefits, and many others (recreation, aesthetics, education, etc.) that legal protection is extended to many wetlands in Michigan. This legal protection is the main reason why the preservation of North American wetlands was recognized as one of the bright spots in the IPBES reports.

Recognition that Michigan’s natural areas provide a wide array of ecosystem services is integral to management of those areas by the Federal government, state agencies, land conservancies, municipalities, conservation organizations and the public.

Nature’s Multiple Contributions to People

Nature by Nature is Complex and Interrelated

Material Contributions:
- Food and feed
- Materials and assistance
- Energy
- Medicinal, biochemical and genetic resources

Non-Material Contributions:
- Learning and inspiration
- Supporting identities
- Physical and psychological experiences

Regulating Contributions:
- Maintenance of options
- Climate regulation
- Regulation of freshwater quantity, flow and timing
- Regulation of freshwater and coastal water quality
- Regulation of hazards and extreme events
- Habitat creation and maintenance
- Regulation of air quality
- Regulation of organisms detrimental to humans
- Pollination and dispersal of seeds and other propagules
- Regulation of ocean acidification
- Formation, protection and decontamination of soils and sediments.
One of MNFI’s long-term projects is the Integrated State Land Inventory for the Michigan Department of Natural Resources (see story on Muskegon State Game Area). The project is an in-depth inventory of this area for the Michigan Department of Natural Resources in order to provide data, assessments, and recommendations to best manage it. Comprehensive site summaries were conducted for the area. The goals of the project were to evaluate marsh bird use of wetlands managed primarily for waterfowl using data from surveys in Michigan, Ohio, and Wisconsin. Using aerial imagery, wetland areas at 726 survey points in the three states were categorized as impounded (where levees and structures control the water level) or unimpounded. The study also considered surrounding land cover variables, such as emergent wetland, developed open space, open water, and upland forest.

New Data Informs Management Decisions

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The study concluded with recommendations for management of: buffers between natural communities, prescribed burns, tree maturation, subcanopy treatment, invasives, and damage from heavy equipment or off road vehicles.

Setting a Course for Marsh Bird Conservation

Wetland Birds in Decline

Much remains unknown about the best approach to conserve marsh birds. The goal of MNFI’s project was to evaluate marsh bird use of wetlands managed primarily for waterfowl using data from surveys in Michigan, Ohio, and Wisconsin. Using aerial imagery, wetland areas at 726 survey points in the three states were categorized as impounded (where levees and structures control the water level) or unimpounded. The study also considered surrounding land cover variables, such as emergent wetland, developed open space, open water, and upland forest.

Recommend a Long-Term Approach

MNFI found significantly greater abundance, naïve occupancy, and model-estimated occupancy in impounded compared to unimpounded wetlands for most of the 12 species examined. These included the Pied—billed Grebe, American Bittern, Least Bittern, Virginia Rail, American Coot, Sandhill Crane, Marsh Wren, and Swamp Sparrow.

More study is needed to determine the factors driving occurrence patterns, best management strategies, and their effects on the various bird populations. Recommendations included documenting recent management actions at survey points, increasing the use of volunteers to collect environmental and habitat information, and developing an experimental management and monitoring program. As part of the final report, MNFI provided a conceptual design for the monitoring program.

Ongoing Study of Pollinators

Wild bees help pollinate Michigan’s billion dollar agriculture industry. Work continued in 2018 to record occurrences, restoration of habitat, and assessment of management actions for two declining species: the Yellow—banded bumble bee and the Rusty—patched bumble bee. Butterflies are also important pollinators. Ongoing studies of Mitchell’s Satyr, Poweshiek Skipperling, Swamp Metalmark and Karner Blue butterflies document occurrences and assess threats to habitats critical to their survival.

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Ecosystem services, by definition, result from processes: soil formation, carbon storage, stormwater storage, groundwater recharge/discharge, sediment capture, shoreline stabilization, habitat creation, etc. These processes are inherent in the ecosystem itself and regulate a related process that produces benefits. Carbon storage relates to climate change mitigation, stormwater storage to downstream flood protection, sediment capture to water quality protection. Although some of these processes result in benefits outside the ecosystem, some processes remain within it and help maintain the ecosystem itself.

The simple fact that plants grow results in creation of wildlife habitat that may or may not reinforce the process. Fruit-producing shrubs attract birds which disperse the shrubs’ seeds near or far. These same shrubs also attract herbivores that may decimate the shrubs in harsh winters. It is important to understand the processes within ecosystems in order to manage them for the long-term. Read more below as to the fascinating role of fire in regulating ecosystems.

Fire is a Friend... to Ecosystem Regulation

Historically speaking, fires caused by lightning and humans provided essential regulation of several Southern Lower Michigan ecosystem types. Fires reduce colonization by trees and shrubs, foster regeneration of fire-dependent species, and maintain nature’s open structure. For example, suppression of fire causes wetlands to convert to shrub-carr and swamp forests. Oak savanna and prairie ecosystems become closed-canopy forest, where shade-tolerant species regenerate but oak trees do not. Such changes significantly reduce species and structural diversity.

Rx: “Prescribed Burns”

Human-managed burns help provide essential regulation to natural areas by:

- Decreasing the cover of invasive woody species
- Increasing the cover of native grasses and forbs
- Reducing litter levels, allowing sunlight to reach the soil surface and stimulate seed germination and plant establishment
- Elevating plant nutrients such as nitrogen, phosphorus, potassium, calcium, and magnesium
- Increasing plant biomass, flowering, and seed production
- Rejuvenating seed banks to help maintain species diversity
- Protecting fire-dependent host plants for rare insects and critical habitat for game species
- Promoting regeneration of desired tree species

Where to Burn?

MNFI worked with staff from the Michigan Department of Natural Resources Wildlife Division to develop an assessment process for prescribed burns for lands under their management.

The assessment model incorporates variables from three scales:

- Landscape level: physiographic region, surficial geology, and circa 1800 vegetation
- Stand level: fire frequency, fire dependence, departure from historic disturbance regime, aspect slope, natural community element occurrence, stand age, and stand size
- Within-stand level: species and rare species occurrence data

Fire need scores were assigned to 18,654 stands. Information at this level allows for aggregation to larger scales, such as groups of stands, compartments, state game areas, and regions. The model generates summary graphics showing the proportion of fire need scores by acreage and management area. With this information, resource managers can now answer the question.

This project supports Sustainable Development Goals (SDGs):

#3 Good Health and Well-being
#4 Quality Education
#12 Responsible Consumption and Production
#15 Life on Land
#17 Partnerships to Facilitate SDGs

Prescribed Fire Needs Assessment: 2018 Activity Report

Project Partners
- MDNR Wildlife Division
- MNFI

MNFI Team
- Joshua G. Cohen, Principal Investigator
- Clay M. Wilton
- Helen D. Enander

Photo by: Southwest Michigan Land Conservancy
Threats to Ecological Integrity

The establishment and spread of invasive species degrade native biodiversity by altering an ecosystem’s structure and function; displacing critical habitat for native species; interrupting food webs; altering soils, hydrology, and disturbance regimes; compromising pollinator services; changing microclimates; despoiling recreational resources; and degrading the economy. The environmental cost within the United States has been estimated at more than $120 billion per year.

Michigan’s globally rare, coastal natural communities are vulnerable to this threat and are a high priority for stewardship. Long-term monitoring of these ecosystems are vulnerable to this threat and are a high priority for Michigan’s globally rare, coastal natural communities per year.

Finding and Analyzing Invasive Species

New drone technology offers a remote sensing alternative. MNFI conducted a comprehensive study of uncrewed aircraft systems (UAS) and machine learning to monitor for invasive species within rare and Great Lakes endemic coastal ecosystems. The goal was to develop a systematic, effective, efficient, repeatable, affordable, and autonomous monitoring protocol that allows for easy deployment, flexible mission planning, and the acquisition of data that can be tailored to the need and mapped with precision.

The team utilized low cost drones, high-resolution, visible spectrum imagery, and deep learning algorithms. The unique partnership between MNFI and Michigan Aerospace Corporation (MAC) brought together scientists with expertise in ecology, biodiversity conservation, computer programming, remote sensing, and deep learning. Through this project, MNFI and MAC developed a novel but scientifically credible and affordable method for rapidly and precisely monitoring invasive plant species in some of the Michigan’s highest priority stewardship sites.

The monitoring platform comprises:

- UAS capable of collecting high-resolution imagery in a precise and repeatable manner,
- Software enabling ecologists to annotate this imagery to identify invasive plant species of interest,
- Neural network-based algorithms for identifying targeted invasive plant species in the images, and
- Software for generating georeferenced probability maps of invasive plant species infestations.

These site specific georeferenced maps quantify invasive plant species density and distribution and provide resource managers with actionable insight to gauge risk to the site, plan biodiversity restoration, and evaluate the efficacy of control efforts.

Taking the Study of Michigan’s Dunes to the Next Step

Michigan’s iconic dunes provide significant non-material as well as regulating NCPs. These rare and beautiful coastal ecosystems are critical components of the state’s economy, cultural identity, and recreational assets.

Work continued in 2018 on the coast resiliency project. The research, lessons, and GIS methodology developed in the study of Northwest Lower Michigan coastal dunes was applied to the rest of the state’s shoreline. As a result, the state has the best available information on the extent and diversity of sand dunes, a prototype methodology to measure the health of an individual dune system, and health index scores for 18 dune sites along Lake Michigan. The study also generated spatial information on erosion for the entire Lower Peninsula and a portion of the Lake Superior shorelines.

Spatial Data to Improve Coastal Resiliency and Better Inform Local Decision-Making

Development of an Automated Monitoring Platform for Invasives in Coastal Ecosystems

Project Partners
- MNFI
- Michigan Aerospace Corporation
- MDNR Coastal Zone Management Program
- MDEQ Oil, Gas and Minerals Division
- MDOE Community and Spatial Sciences
- The Nature Conservancy
- Michigan Environmental Council
- MSU Department of Geography, Environment, and Spatial Sciences
- United States Geological Survey
- Archives of Michigan
- The Nature Conservancy
- Michigan Environmental Council
- MSU Department of Geography, Environment, and Spatial Sciences
- United States Geological Survey

Project Partners
- MNFI Team
- Joshua G. Cohen, Principal Investigator
- Helen D. Enander
- Phyllis J. Higman
- Rachel A. Hackett
- John J. Paskus, Principal Investigator
- Helen D. Enander
- Joshua G. Cohen

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- #3 Good Health and Well being
- #4 Quality Education
- #8 Decent Work and Economic Growth
- #12 Responsible Consumption and Production
- #15 Life on Land
- #17 Partnerships to Facilitate SDGs
Combining the Power of Tribal Knowledge and Western Science

The collaborative Climate Change Adaptation Project sought to ensure the long-term cultural and natural resource goals for tribal lands essential for food, and cultural and spiritual identity. The inter-tribal adaptation working group included Anishinaabe and Western scientists, cultural leaders and community members from nine participating tribes, the Northern Institute of Applied Climate Science and MNFI, as well as other cultural, tribal, public, and university consultants.

Working Together

Biological and cultural experts shared knowledges, identified needs and opportunities for key forest understory species and plant communities, conducted vulnerability assessments and developed adaptation strategies to manage these plants and communities throughout future climate-driven change.

Preserving Michigan’s Natural Features for One and All

Michigan’s State Trails provide people with recreational access to state’s wide ranging natural beauty. MNFI conducted natural features surveys along four trails in Northern Lower Michigan for the Michigan Department of Natural Resources, Parks and Recreation Division. Results provided baseline information on high-quality natural communities, rare species habitat, targeted rare species of plants and animals to inform management decisions for the North Central, North Eastern, North Western, and Pere Marquette State Trails.

Nature’s Non-Material Contributions to Human Life

Humans value nature for various reasons, but many, if not most, recognize a value that goes beyond the mere provision of food, fiber, or building materials. Just as people around the world will stop to enjoy a sunset, we also stop to appreciate the beauty of a cardinal against snow covered branches, rippling waves of grass in a meadow, and the towering grandeur of mature forests. These speak to our soul. Aesthetic enjoyment of nature is as much a “nature’s benefit to people” as is any of the material benefits, and they add immeasurably to human well-being. For many people, the non-material benefits of nature are even more fundamental than aesthetic enjoyment. They are literally essential to existence. Such is the case for many groups of indigenous people, including Michigan’s tribal members. For many cultures, their very identity is inseparable from nature.

When MNFI provides information that contributes to the conservation of biodiversity, it is for the benefit of all, from the weekend bird watchers to the tribal elder, and it comes not only from MNFI scientists, but also citizen science and holders of indigenous knowledge.


The people of MICHIGAN NATURAL FEATURES INVENTORY

MNFI staff in a Granite Bedrock Glade in Marquette County
Photo by: Jesse Lincoln
Support the Science That Supports Conservation
Give to the MNFI endowment, because our earth has to last forever.

Online at:
Mnfi.anr.msu.edu/about

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Payable to Michigan State University.
Include #A10259

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