Exploring the Prairie Fen Wetlands of Michigan

Michael A. Kost and Daria A. Hyde

Blank front cover

MICHIGAN STATE
UNIVERSITY
EXTENSION

E-3045 • New • December 2009

Exploring the Prairie Fen Wetlands of Michigan

by

Michael A. Kost and Daria A. Hyde

Bradford S. Slaughter, MNFI

Contributing Authors:

Peter J. Badra, Barbara J. Barton, David L. Cuthrell, Amy L. Derosier,
Yu Man Lee, Jack D. McGowan-Stinski, Ryan P. O'Connor,
Douglas R. Pearsall, Steven S. Woods

Michigan
Natural
Features
Inventory

www.msue.msu.edu/mnfi

ISBN 1-56525-023-0

Kost, Michael A., and D.A.Hyde. 2009. Exploring the Prairie Fen Wetlands of Michigan.
Extension Bulletin E-3045.
East Lansing, Mich.: Michigan Natural Features Inventory,
Michigan State University Extension.

Produced by ANR Communications

Acknowledgements

We offer our sincere thanks and gratitude to the many individuals and organizations whose contributions and support made this publication possible. For lending their invaluable expertise to this book, we offer our appreciation to the following contributing authors: Peter J. Badra, Barbara J. Barton, David L. Cuthrell, Amy L. Derosier, Yu Man Lee, Jack D. McGowan-Stinski, Ryan P. O'Connor, Douglas R. Pearsall and Steven S. Woods. We are sincerely grateful for the creative advice and technical support of our colleague Suzan Campbell, who organized numerous photographs and lent her critical eye to the editing, layout and organization of this book. We appreciate the excellent technical skills of Helen Enander, MNFI's mapmaker extraordinaire. Thanks also to Connie Brinson, Kraig Korroch, Suzanne Ridge and Nancy Toben for their critical administrative support of this project.

We are grateful to the photographers and graphic artists who generously provided their photos and drawings for use in this publication. Their images evoke the beauty and wonder of prairie fens and help to describe the complexity and richness of these communities. We have provided a list of photo and graphic sources at the end of this book. We thank Christopher Hoving, Michigan DNR; Douglas Pearsall, TNC; Virginia Hambric; and our colleagues at MNFI, Joshua Cohen, Yu Man Lee, Ryan O'Connor and Bradford Slaughter, for their insightful editorial comments and suggestions. We are thankful for the helpful advice and guidance offered by Nate Fuller and Larry Lyons, Southwest Michigan Land Conservancy, and our MNFI colleagues Dennis Albert, David Cuthrell, Michael Monfils and Mike Penskar.

We gratefully acknowledge the support and expertise of our partners at the Michigan DNR, especially Stephen Beyer, Todd Hogrefe and Christopher Hoving; our colleagues at the U.S. Fish and Wildlife Service (USFWS), Tameka Dandridge and Carrie Tansy; as well as members of the Mitchell's Satyr Working Group. Their commitment to the conservation of prairie fens is truly inspiring. Funding for this publication was provided by the Michigan DNR through a grant from the USFWS as well as MSU Extension's Program Development Fund. Finally, we gratefully acknowledge staff members at ANR Communications at MSU, especially Leslie Johnson for her detailed editorial review, Ken Fettig for his guidance on this project, and Alicia Burnell for bringing our words, ideas and photographs to life through her artistic design of this publication.

Table of contents

Michael A. Kost, MNFI

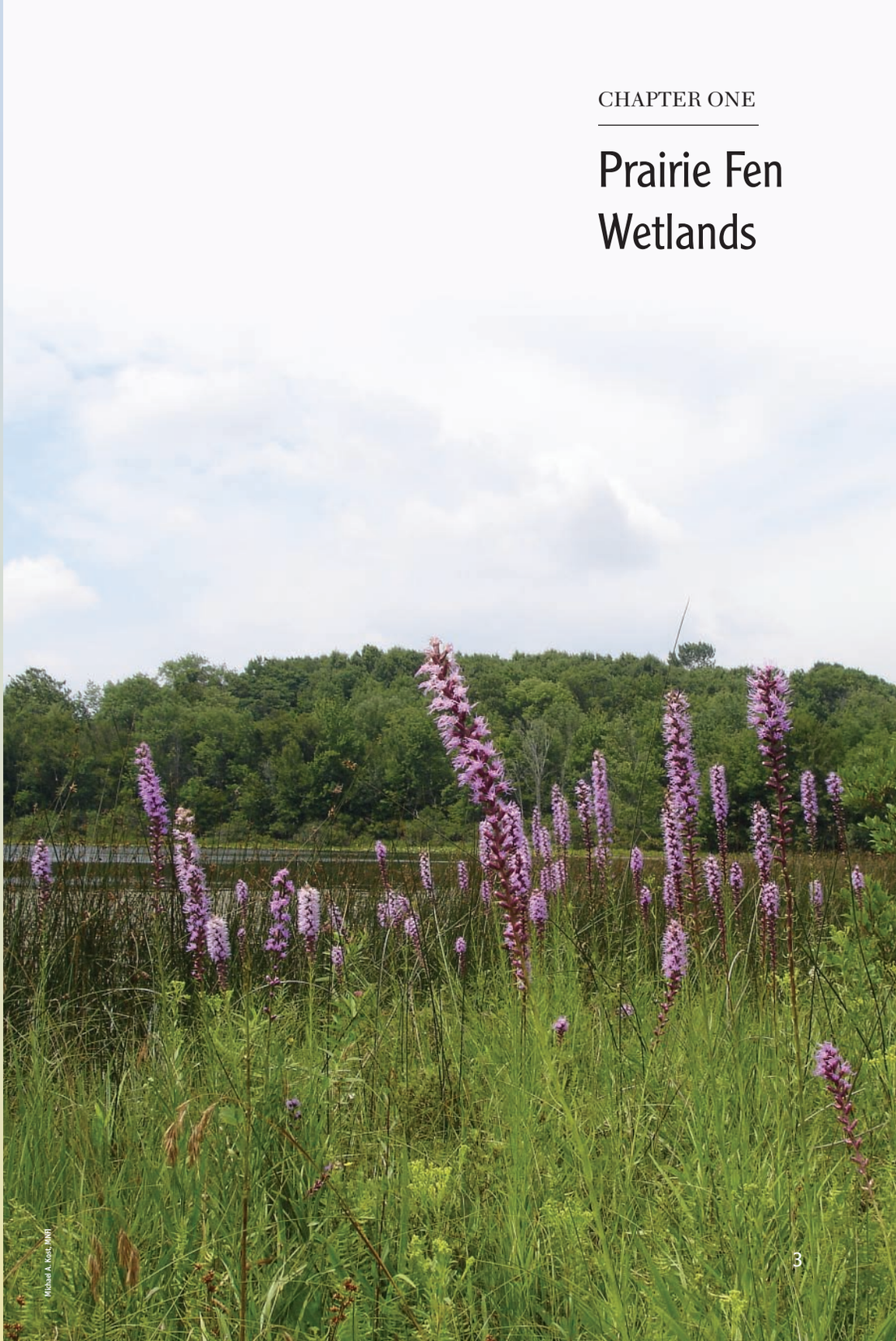
Introduction

Nestled within wet depressions among the rolling hills of southern Lower Michigan, prairie fen wetlands are one of Michigan's biological treasures. These globally rare wetlands are dominated by sedges and grasses and provide habitat to hundreds of native plants and animals. In addition to being incredibly rich in biological diversity, prairie fens form the pristine headwaters of many of the region's rivers and lakes. The streams and lakes that emanate from prairie fens sustain countless species and provide recreational activities cherished by swimmers, boaters and anglers. These wetland communities serve as a rich biological reservoir and form a critical component of the natural landscape of southern Michigan.

Walking through a prairie fen is an amazing experience at any time of the year. The community comes alive in spring with the boisterous calls of mating frogs and toads, melodious songs of nesting birds and colorful blooms of wildflowers. During summer, the sounds of tree crickets and other insects fill the air, and a beautiful array of butterflies, moths and flowering plants forms a dazzling spectacle of color. In fall, migrating songbirds and waterfowl descend on prairie fens to feed on berries and aquatic plants and take refuge among the groves of shrubs and trees and isolated lakes. It is during this time of year that the needles of tamarack, Michigan's only native deciduous conifer tree, turn from bright green to golden yellow, bringing yet another striking display of color to prairie fens. With winter comes a blanket of white and near silence, softly accentuated by the constant gurgling of tiny streams that flow continuously from the many springs that form this unique native ecosystem.

CHAPTER ONE

Prairie Fen Wetlands



Michael A. Kost, MNFI

What is a prairie fen wetland?

A prairie fen is a type of peatland through which flows a continuous supply of cold groundwater rich in calcium and magnesium carbonates. An abundance of groundwater springs and seeps ensures that wet conditions prevail throughout the year. The constantly saturated conditions prevent the breakdown of plant matter, which accumulates year after year, eventually forming loose peat soils. The name "prairie fen" became widely used for describing the fens located within the prairie peninsula region of the Midwest because the community contains many wildflowers and grasses commonly observed in prairies. Prairie fens occur in the glaciated regions of the upper Midwest, predominantly in southern Ontario, Canada, and Michigan, Ohio, Indiana, Illinois, Wisconsin and Minnesota.

Several other types of fens are known to occur in northern Michigan, including northern fen, coastal fen, poor fen and patterned fen. These natural communities are described in detail in "Natural Communities of Michigan: Classification and Description," which is available through the Michigan Natural Features Inventory Web site.

Spicebush swallowtail nectaring on swamp milkweed.

Michael A. Kost, MNFI

Why are prairie fens important?

Like many wetlands, prairie fens deliver critically important ecological services: providing clean water for streams and lakes, storing and slowly releasing storm and floodwaters, and serving as habitat for a broad diversity of plants and animals. Through the process of photosynthesis, the rich plant community of prairie fens releases oxygen (O_2) and water to the atmosphere, providing clean air for breathing and moisture for rainfall. Plants also release clean water vapor to the atmosphere through both respiration and transpiration. Another critical benefit provided by plants through photosynthesis is the removal of carbon dioxide (CO_2), a greenhouse gas, from the atmosphere. In a process known as carbon sequestration, much of the carbon removed from the atmosphere through photosynthesis becomes incorporated into plant tissue, where it is eventually stored for thousands of years in the organic (peat) soils of prairie fens.

In addition to providing habitat for wildlife and clean air and water, prairie fens serve as places for people to connect with and be nourished by nature. Filled with a dazzling array of plant and animal life, prairie fens make exceptional outdoor classrooms for studying the natural world. Whether people visit for bird watching, botanizing, hunting, fishing or quietly exploring nature, these rich wetlands provide places where people can unplug from the hustle and bustle of modern life and be renewed. Prairie fens offer opportunities to spend time with nature, surrounded by life in all its glory, and connect with something much greater than oneself.

Michael A. Kost, MNFI

We hope the following discussion of the ecology and conservation of prairie fens will inspire readers to visit a prairie fen and become involved in conservation efforts to protect and manage these special wetlands.

CHAPTER TWO

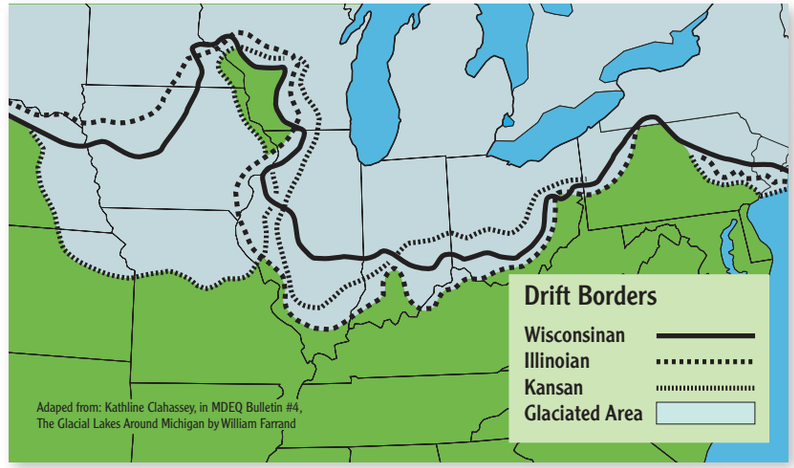
Landscape Context

Gary Reese, MNFI

Geologic setting

The topography of Michigan was largely shaped by the Wisconsinan glacier, which completely blanketed Michigan, reaching its maximum extent in southern Illinois, Indiana and Ohio approximately 18,000 years ago. Once spanning the upper regions of North America and measuring more than a mile in height, the massive glacial ice sheets slowly melted back, finally retreating from Michigan approximately 10,000 years ago. As they moved across upper North America, the glaciers engulfed all that lay in their paths, pulverizing ancient soils, rocks and vegetation. This debris became incorporated into the advancing ice front. Loaded with millions of tons of rock, sand, silt and clay, the mixture of dirty ice slowly melted as the climate gradually warmed, leaving behind massive amounts of glacial debris.

Three lobes of the Wisconsinan glacier, issuing forth from the basins of Lake Michigan in the west and Lake Erie and Lake Huron's Saginaw Bay in the east, came together in the area known as the interlobate region. The joining and eventual retreat of these glacial lobes left behind a

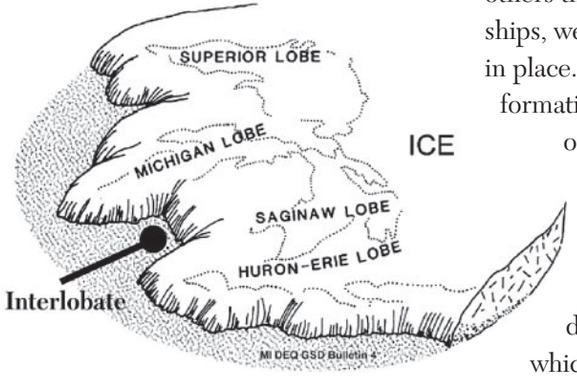


Four major glaciation events influenced the topography of the upper Midwest: Wisconsinan, Illinoian, Kansan and Nebraskan (not shown).

complex landscape of hills, valleys and plains that provide the context for an incredibly rich diversity of local ecosystems. Prairie fens occur predominantly within the interlobate region of the southern Lower Peninsula.

To understand how prairie fens formed, it is helpful to learn how glaciers shaped the landscape.

Kathline Clahassey*

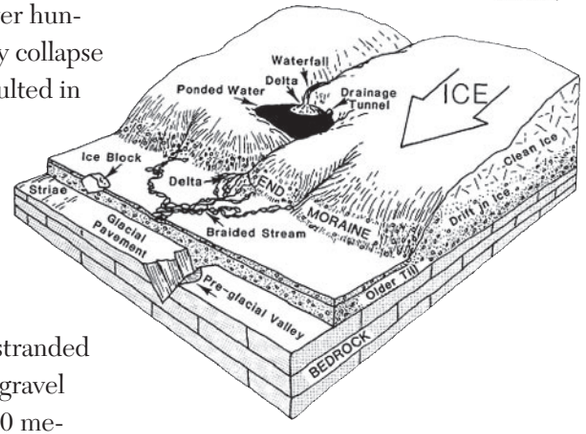


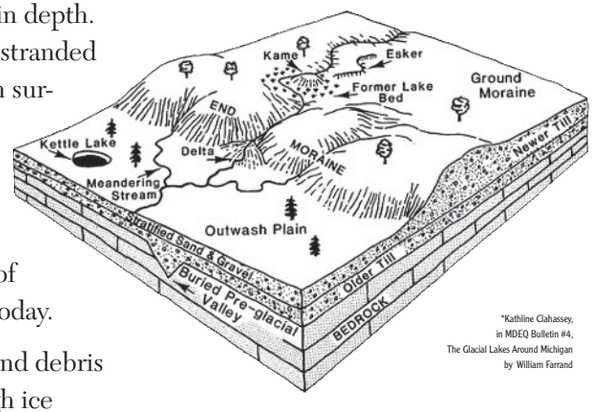
Acting like a gigantic conveyor belt, the glacial ice sheets transported millions of tons of glacial till in the form of rock and sediment to new locations. When the glacier halted its forward progress and slowly began to melt, the glacial till accumulated in the form of steep hills called **moraines** along the edges of the stagnant ice sheets. Fed by the melting glaciers, rivers of glacial meltwater and the debris they carried carved long, narrow channels beneath the ice sheets. Known as **eskers** today, these long, narrow, winding, gravelly hills once served as streambeds for ancient rivers that flowed under the melting ice sheet. As the ice sheet broke apart, enormous ice formations, some the size of football fields, others the size of cities or townships, were left stranded to melt in place. The debris-laden ice formations gave rise to a variety of interestingly shaped hills of glacial debris known as **kames**, as well as an assortment of variously sized ice-block depressions or **kettles**, which were left behind when the ice blocks melted. Conversely, the depressions shaped by the stranded ice blocks now form the basins of most inland lakes within the glaciated regions of the upper Midwest. Today, many of our prairie fens occur along the edges of these ice-block depression lakes.

Larger sized glacial debris, such as boulders and cobble-sized rocks, was generally deposited near the melting ice fronts; smaller particles, such as sand, were carried with the glacial meltwater for many miles, forming rolling to level plains of deep sand known as **outwash plains**. Over hundreds of years, the steady collapse of the dirty ice sheet resulted in the slow deposition of a blanket of sand and gravel over the lower portions of the landscape. Filling the areas in front of moraines and surrounding or burying stranded ice blocks, the sand and gravel deposits often reached 30 meters (100 feet) or more in depth. When they melted, the stranded ice blocks that had been surrounded or buried by outwash deposits left their impressions in the sand to become the lakes and wetlands of the glaciated Midwest today.

The amounts of water and debris released as the mile-high ice sheet and stranded ice blocks slowly melted were immense. Raging rivers of ice, boulders and sediment carved valleys through moraines and outwash plains, forming both the narrow and broad outwash channels that now contain the remnants of these once massive rivers. Rivers such as the Grand, Maple, Huron, Clinton, Kalamazoo and many others now occupy these former meltwater valleys.

Kathline Clahassey*



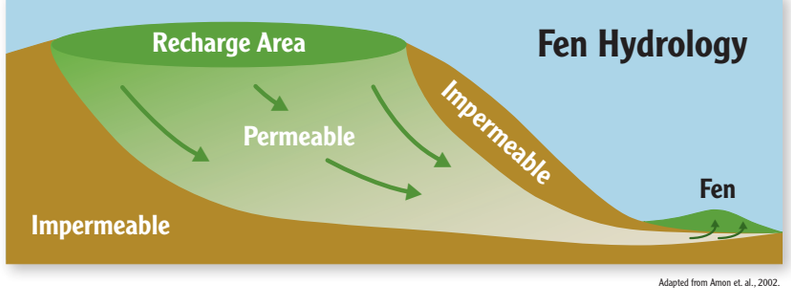


*Kathline Clahassey, in MDEQ Bulletin #4, The Glacial Lakes Around Michigan by William Farrand

Hydrologic setting

The hydrology of prairie fens is supported by a steady flow of cold, calcium-rich (calcareous) groundwater from the underlying glacial deposits. The landforms of the interlobate region are primarily composed of coarse-textured glacial deposits that are rich in calcium and magnesium, both minerals that contribute to alkaline or basic conditions. As a result, the groundwater and soils of prairie fens contain high levels of calcium and magnesium carbonates. The calcareous groundwater moves easily through the loosely compacted outwash sands and coarse glacial tills that make up the outwash plains and hilly glacial landforms. Prairie fens typically develop on portions of outwash plains and outwash channels that are located near the bases of hilly glacial landforms such as moraines, kames and eskers. Because the water table is typically elevated under the hilly glacial landforms, groundwater seepage is often present along their bases where they join lower elevation landforms, such as outwash plains, outwash channels or ice-block depressions. Gravity pulls the groundwater down through the hills of porous glacial deposits and out near their bases.

Prairie fens form in several landscape settings, all of which give rise to the development of groundwater-fed perennial springs and seeps. Because of the constant flow of groundwater, prairie fens act as headwater ecosystems and are always associated with streams, rivers and/or lakes. The community may occupy both narrow and broad floodplains along the upper reaches of streams or occur along the edges of lakes and their associated streams. Although prairie fens often occur within ice-block depressions, many of which support spring-fed lakes, they are not found in isolated depressions that lack an outflow channel. Instead, isolated depressions often contain acidic bogs rather than calcareous fens. Within ice-block depressions that have outflowing streams, prairie fens typically occur along the edges of spring-fed lakes, but they can sometimes occupy an entire lake basin. More commonly, wetland vegetation will colonize an entire ice-block depression with prairie fen occurring in areas where groundwater seepage is most prevalent. In these settings, a prairie fen may share the depression with other wetland natural communities such as emergent marsh, southern wet meadow, southern shrub-carr and rich tamarack swamp.



Adapted from Amon et. al., 2002.

Rich tamarack swamp in background.

Fens and Bogs: What are the Differences?

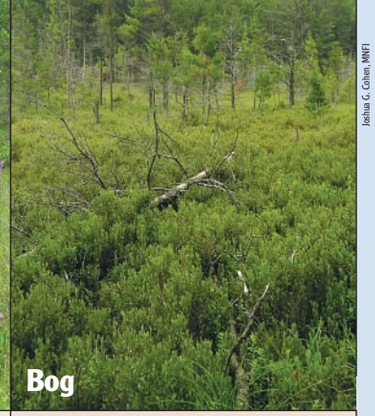
Fens and bogs are wetlands that occur on peat soils and can sometimes be confusing to differentiate. Several of the main characteristics useful in distinguishing between these peatlands are soils, pH, hydrology and dominant vegetation. Fens are neutral to moderately alkaline in pH; bogs are very strongly acidic. Fens are minerotrophic peatlands, fed by a constant supply of cold, mineral-rich groundwater. Bogs are ombrotrophic peatlands, fed by precipitation. Fens support a thick to sparse cover of sedges, grasses, wildflowers and shrubs; bogs are covered by sphagnum mosses with scattered patches of sedges and low ericaceous (from the Ericaceae family) shrubs such as leatherleaf, bog rosemary and swamp laurel. Fens typically contain a greater diversity of plant species, with prairie fens often supporting more than twice as many species as most bogs.

Bog

Michael A. Kost, MNFI

Michael A. Kost, MNFI

Prairie fen



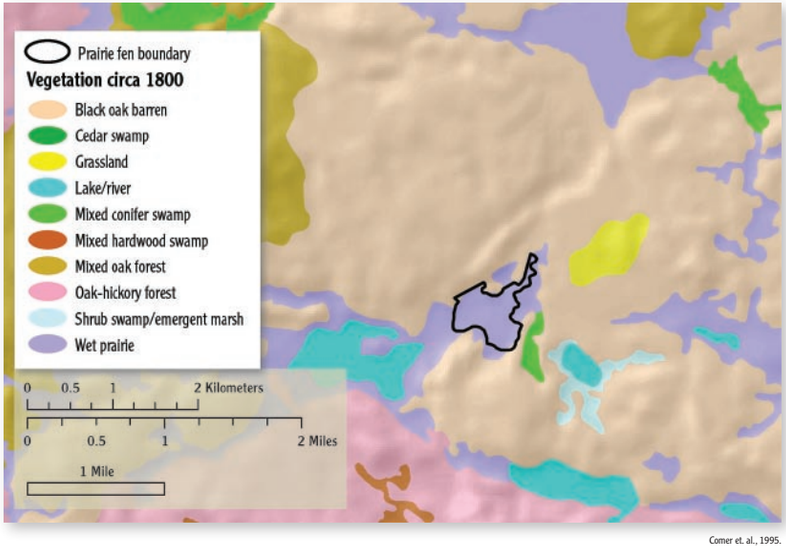
Joshua C. Cohen, MNFI

Bog

	Prairie fen	Bog
Soils	Sedge peat and marl	Sphagnum peat
pH	7.0 to 8.0	4.0 to 4.5
Hydrology	Cold, flowing calcareous groundwater *(minerotrophic)*	Precipitation *(ombrotrophic)*
Dominant vegetation	Sedges, grasses, wildflowers and shrubs	Sphagnum mosses, sedges and ericaceous shrubs
Characteristic plants	tussock sedge *(Carex stricta)* dioecious sedge *(Carex sterilis)* beaked spiked-rush *(Eleocharis rostellata)* big bluestem *(Andropogon gerardii)* Indian grass *(Sorghastrum nutans)* grass-of-Parnassus *(Parnassia glauca)* Ohio goldenrod *(Solidago ohioensis)* Riddell's goldenrod *(Solidago riddellii)* marsh blazing star *(Liatris spicata)* Kalm's lobelia *(Lobelia kalmii)* pitcher plant *(Sarracenia purpurea)* round-leaved sundew *(Drosera rotundifolia)* flat-leaved bladderwort *(Utricularia intermedia)* horned bladderwort *(Utricularia cornuta)* alder-leaved buckthorn *(Rhamnus alnifolia)* shrubby cinquefoil *(Potentilla fruticosa)* poison sumac *(Toxicodendron vernix)* tamarack *(Larix laricina)*	sphagnum mosses (*Sphagnum* spp.) leatherleaf *(Chamaedaphne calyculata)* small cranberry *(Vaccinium oxycoccos)* large cranberry *(Vaccinium macrocarpon)* bog rosemary *(Andromeda glaucophylla)* Labrador tea *(Ledum groenlandicum)* swamp laurel *(Kalmia polifolia)* pitcher plant *(Sarracenia purpurea)* round-leaved sundew *(Drosera rotundifolia)* flat-leaved bladderwort *(Utricularia intermedia)* few-seed sedge *(Carex oligosperma)* tawny cotton-grass *(Eriophorum virginicum)* tamarack *(Larix laricina)* black spruce *(Picea mariana)*

Landscape setting

Set within a landscape of sandy outwash plains and sandy and gravelly hills, the upland vegetation surrounding prairie fens was historically dominated by oak woodlands, oak openings, oak barrens and prairies. These savanna and prairie natural communities thrived on the well-drained, moderately fertile soils of the interlobate region. Today, in place of the widely scattered oaks and prairie grasses, the upland stands of native vegetation surrounding prairie fens support closed-canopy oak forests. The primary factor responsible for the conversion to forest has been the absence of frequent wildfires. Although historical fire cycles for prairies and oak savannas are difficult to determine, it is estimated that on average they ranged from 3 to 15 years, sometimes occurring annually. These wildfires regularly swept across large portions of the interlobate region, moving through the uplands and, when conditions permitted, across wetlands dominated by sedges and grasses, such as prairie fens. By killing woody seedlings and top-killing trees and shrubs, the frequent fires helped maintain the open to semi-open conditions that once characterized many of the upland and wetland natural communities of the interlobate region.



Comer et. al., 1995.

Prairie fens typically occur with several other wetland communities in large wetland complexes known as prairie fen complexes. Natural communities frequently accompanying prairie fens within these large wetlands complexes include sedge-dominated southern wet meadow, shrub-dominated southern shrub-carr and tamarack-dominated rich tamarack swamp. Although nearly absent today, wet-mesic prairies and wet prairies were also commonly associated with prairie fens in the past. Grading downslope from an upland oak savanna, the wet-mesic and wet prairie communities commonly formed an ecotone or transition zone between the drier upland mineral soils and the saturated organic soils of prairie fens and other associated wetlands. Today, nearly all wet-mesic and wet prairies have been colonized by shrubs or trees in the absence of fire or converted to agriculture along with the surrounding uplands.

Kim A. Chapman

Climate

Prairie fens occur in the temperate moist climate of southern Lower Michigan. Within the interlobate region, where prairie fens are most prevalent, precipitation averages between 30 and 38 inches per year, with the highest amounts falling in the southwestern portion of the state. The greater levels of precipitation in the southwest interlobate region are especially evident during winter, when lake-effect snowstorms associated with Lake Michigan frequently occur. In an average year, this area receives up to 20 more inches of snow than areas farther east.

Prairie fens occur where cold groundwater constantly flows

through the organic soils and reaches the surface in the form of steadily flowing springs and seeps. The constant movement of groundwater prevents deep freezing within the soils and allows the shallow headwater streams that emanate from fens to continue flowing, even during the coldest months. Insulated under a blanket of snow in midwinter, the saturated organic soils of prairie fens typically remain unfrozen, despite the freezing air temperatures aboveground.

Because prairie fens occupy depressions, cold, moist air from the surrounding landscape flows into these wetlands after sunset. These pools of low-hanging fog are easily seen in the lowlands throughout many landscapes and further contribute to high levels of available moisture in wetlands. The moist microclimate also helps to hold heat and buffer temperature change, reducing the incidence of frost during the growing season.

Soils

The wet, loosely compacted soils of prairie fens consist primarily of peat but often contain significant deposits of chalk-like marl at the surface or buried as layers within the soil profile. The development of both peat and marl are the result of constantly saturated conditions. Because of the high concentrations of calcium and magnesium carbonates in the groundwater, the soils of prairie fens have a high pH, typically in the range of mildly alkaline (pH 7.4 to 7.8). The availability of important plant nutrients such as nitrogen, phosphorus and potassium is generally very low in prairie fen soils, especially where marl is concentrated, because of the high pH and lack of plant matter decomposition.

Peat is an organic soil that forms when plant matter fails to decompose fully in constantly saturated conditions. In the waterlogged conditions of prairie fens and many other wetlands, aerobic bacteria and other microorganisms that consume dead plant matter are greatly reduced. As a

Marl pool

result, the growth of new vegetation each spring adds another layer of plant debris to the soil surface when it dies back in fall. Over many years, the partially decomposed plant matter gradually builds up in wetlands to form peat, often reaching several meters or more in depth.

Marl is a calcium-carbonate precipitate that forms through the metabolic activity of algae growing in water rich in calcium and magnesium carbonates (i.e., hard water). Marl soils are white to grayish with a fine, silky texture.

Like peat, marl can accumulate to several meters or more in depth on the bottoms of lakes and can eventually fill entire lake basins. Marl may also build up around springs in small pools or on the soil surface, where a thin sheet of flowing water, known as sheet flow, continuously runs across the surface of prairie fens as the result of steady groundwater seepage. In addition to marl, calcium carbonate can precipitate around some springs to form hard pieces of tufa, which resemble whitish to grayish rocks.

Carnivorous Plants

The extreme pH levels of both fens and bogs, along with their waterlogged condition and organic soil, result in low availability of important plant nutrients such as nitrogen, phosphorus and potassium (N, P, K). To cope with the stressful, low-nutrient conditions, some plants have developed novel adaptations to acquire nutrients. In particular, carnivorous plants such as pitcher plants, sundews and bladderworts, which grow in both fens and bogs, meet their nutrient needs by capturing and digesting tiny invertebrates.

Carnivorous plants employ a variety of methods to capture prey. For example, the leaves of pitcher plant form a small pitcher that holds a pool of digestive enzymes. When insects enter the pitcher, their escape is thwarted by stiff, downward-pointing hairs and a waxy substance that coats the inner sides of the leaves, making the upward climb to exit the pitcher nearly impossible. Eventually, the exhausted animal succumbs, drowns in the pool and is digested.

Pitcher plant

Bradford S. Slaughter, MNFI

Carnivorous Plants . . .

Sundews employ a different method. Their leaves are covered with tiny, sticky glandular hairs that are tipped with digestive enzymes. Animals landing on the hairs are trapped by the sticky enzymes as the sundew leaf slowly closes around their bodies and digests the trapped prey.

Pitcher plants and sundews live on land, catching flying and crawling invertebrates. Bladderworts grow under water, trapping tiny swimming animals. Bladderworts have small, fleshy, floating appendages known as bladders, which are filled with digestive enzymes and contain a tiny trap door ringed by trigger hairs. When the trigger hairs are touched, the bladder instantly expands, sucking unsuspecting invertebrates in through the trap door. Once inside, the animals are digested. Pitcher plants, sundews and bladderworts are truly captivating plants that share a similar strategy for coping with the low levels of available nutrients that characterize fen and bog habitats.

Round-leaved sundew

CHAPTER THREE

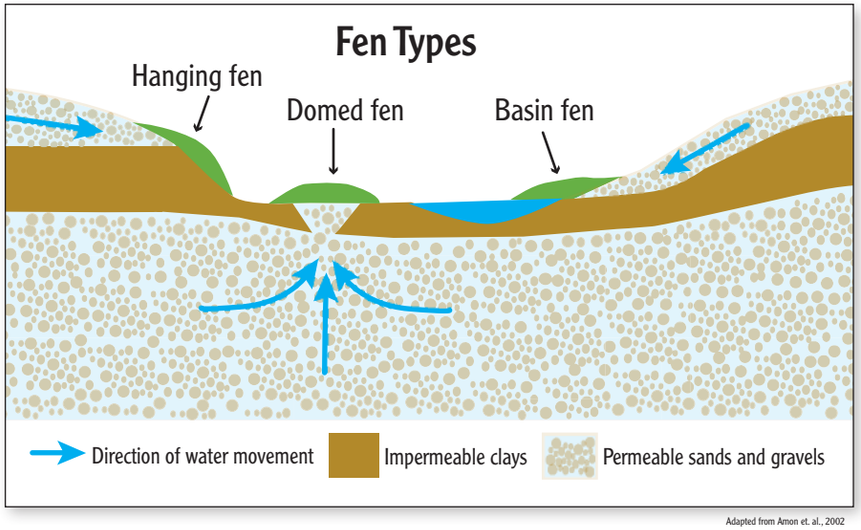
Ecological Processes

Steve Hillebrand, USFWS-DLS

Hydrology

As noted earlier, the groundwater that flows through the organic and marl soils of prairie fens is rich in calcium and magnesium carbonates, which are picked up from the sand and gravel substrates of the surrounding glacial deposits. This cold calcareous groundwater comes to the surface in prairie fens to form perennial springs and seeps. The steadily flowing springs and seeps coalesce to form small rivulets that join to form headwater streams or create sheet flow that covers the soil surface with a thin layer of moving water.

Variations in the volume of groundwater seepage and levels of carbonate concentrations result in very different growing conditions for plants within various portions of a prairie fen. Thus, prairie fens typically contain several distinct vegetation zones that correspond to localized variations in hydrology and water chemistry. The local topography of a prairie fen also can be profoundly influenced by variations in groundwater flow and chemical composition. These factors strongly affect the accumulation of peat and marl soils within a fen.



Adapted from Amon et. al., 2002

Christopher Hoving, MDNR

The buildup of organic matter around springs and seeps allows some fen complexes to support areas of both domed fen and hanging fen (also called mound fen and slope fen, respectively). Domed fens occur as broad, round hills of organic soils. Hanging fens occur as low-gradient slopes of organic soil that can span from the upland edge of a fen to a stream or a level area such as a marl flat. Both domed fens and hanging fens can puzzle observers who are not accustomed to seeing wetlands occurring as hills and sloping terrain. In some locations, the large volume of water and loose peat soils underlying prairie fens create a quaking or floating mat, which shakes and bounces with each careful step. Quaking mats are especially common where prairie fens occupy former lake basins that have filled with peat or marl. These basin fens may occupy the entire basin of an abandoned glacial lake or be limited to areas that receive high amounts of calcareous groundwater seepage such as along the shores of existing lakes.

Natural disturbance

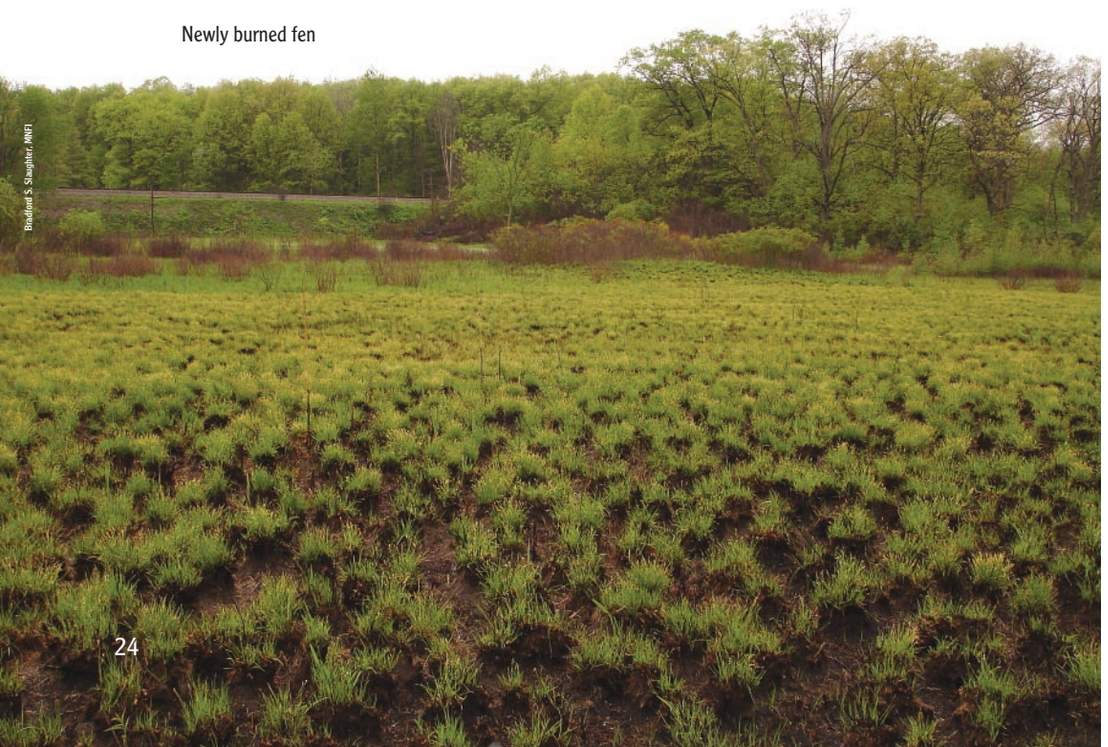
Natural disturbances such as fires, flooding caused by beaver dams, insect outbreaks and windthrow (i.e., tree fall) are important components of prairie fen wetland complexes. These natural disturbances help maintain the open conditions that characterize prairie fens and serve to promote overall biodiversity. Through altering the levels of light, water and nutrients, natural disturbances strongly influence competitive relationships among species, inevitably hindering some while benefiting others. At a broad landscape scale, the random nature of these natural disturbances serves to ensure that prairie fens contain a diverse array of microhabitats that support a variety of plant and animal species.

Fire ecology

Fire plays an essential role in maintaining biological diversity by influencing biogeochemical cycles, creating favorable conditions for species that require open (non-forested) habitats, and influencing the distribution and patterning of natural communities within a landscape. As thick mats of dried leaf litter are consumed by passing flames, large amounts of stored nutrients are released for uptake by growing plants. The pulse of nutrients gives rise to increased flowering, higher rates of seed production and greater annual growth for plants. Herbivores take note of the more nutritious and palatable plant life by preferentially grazing burned lands where available. Like a baton in a relay race, the nutrients released by fire pass through the food chain. Increased flowering results in greater food reserves for animals that feed on pollen and nectar, such as bees, butterflies and moths. Higher rates of seed production benefit animals that consume seeds, such as insects, birds and small mammals. The more robust and nutritious plant leaves and stems are consumed by herbivores (plant eaters) such as mice, muskrats, beaver, deer and many insects. Cascading through the food chain, the nutrients released through burning are eventually passed to the numerous carnivores and omnivores such as frogs, snakes, songbirds, hawks, owls, raccoons, mink, foxes and coyotes.

Burning creates favorable habitat for a wide variety of plants and animals that require open conditions. Seed germination and seedling establishment are greatly enhanced when plant litter is reduced through burning. Without the dense layer of leaf litter, the ground surface receives greater amounts of direct sunlight, which helps trigger seed germination for many species.

Newly burned fen



Bradford S. Slaughter, MNFI

Rebecca Schultz, MNFI

Brian Tang

Milkweed tussock moth and common yellowthroat, participants in the food chain.

Also contributing to increased seed germination are the greater daily temperature fluctuations at the soil surface of recently burned areas. Compared with unburned areas, the blackened soil surface becomes warmer during the day and colder at night because of the absence of an insulating layer of leaf litter, thus stimulating seed germination and creating a longer effective growing season.

Barbara J. Barton, MNFI

The white lady-slipper, a small, rare orchid that grows in prairie fens, has been frequently observed to increase its numbers dramatically following burning.

Burning not only promotes increased seed germination but also temporarily sets back many robust perennials, allowing seedlings and small plants to compete with larger plants for light and growing space. For example, most sedges overwinter as green shoots and grow rapidly in spring, outcompeting many other plants. However, spring burns can increase diversity within prairie fens by temporarily setting back the dominant sedges, benefiting seedlings and small plants such as violets, willow-herbs, gentians, spike-rushes, beak-rushes and many others. The improved conditions for seed germination and seedling establishment are especially critical for annuals such as jewelweed, clearweed and smartweed. The reduced litter levels also increase establishment of species with very small seeds, such as orchids, whose seeds lack the necessary food reserves to sustain growth through a thick layer of litter.

Michael A. Kost, MNFI

Orchids

By Ryan P. O'Connor

Orchids make up one of the largest, most beautiful and most varied plant families in the world, with nearly 30,000 known species. Many have very specific habitat requirements, including some species that are found primarily in fens. These include the brilliant magenta-colored grass pink, found in marl flats, and the late-flowering nodding ladies-tresses, with its tiny pearly-white flowers arranged in dense spirals. Highly restricted to fens and rare throughout its range is the small but striking white lady-slipper. Along the margins of fens grows the magnificent showy lady-slipper. Perhaps the queen of all wildflowers, the showy lady-slipper stands up to 3 feet tall, with large, swollen lower petals blushed with bright pink.

Orchid seeds are tiny and dust-like and contain none of the energy reserves (i.e., endosperm) needed for supporting initial growth that are normally present in larger seeded species. Instead, to germinate and grow, orchid seeds must form a symbiotic relationship with specific species of mycorrhizal fungi living in the soil. The fungi inoculate the orchid seeds

Orchids...

and supply them with nutrients. In turn, the orchid seedlings and adult plants provide the fungi with the products of photosynthesis for supporting their growth. Many orchids take several years to grow, remaining in a somewhat obscure juvenile stage before they are large enough to flower, become pollinated and produce seeds of their own. Orchids are highly vulnerable to herbivores such as deer, which routinely seek them out as a preferred food. This is in part because of their often showy flowers but may also be due to their close relation to vanilla orchids, the source of the flavoring product. Similar compounds are known in many other orchids.

Although orchids are very attractive and sought by many for cultivation, most species do not transplant well and are very difficult to grow in gardens because they require very specific habitat conditions. A better alternative is to visit a local botanical garden or park and witness the full glory of these magnificent and fascinating plants in their natural habitat.

Examples of orchids found in fens:

Grass pink *(Calopogon tuberosus)*
White lady-slipper *(Cypripedium candidum)*
Yellow lady-slipper *(Cypripedium calceolus)*
Showy lady-slipper *(Cypripedium reginae)*
Loess's twayblade *(Liparis loeselii)*
Small green wood orchid *(Platanthera clavellata)*
Tall white bog orchid *(Platanthera dilatata)*
Northern green orchid *(Platanthera hyperborea)*
Small purple-fringed orchid *(Platanthera psycodes)*
Rose pogonia *(Pogonia ophioglossoides)*
Nodding ladies-tresses *(Spiranthes cernua)*
Shining ladies-tresses *(Spiranthes lucida)*


Showy lady-slipper

Daria A. Hyde, MNFI


Grass pink

Bradford S. Slaughter, MNFI


Red-shouldered hawk

BrianTang

Many animal species require open or semi-open wetland habitats, and fires help maintain these conditions within prairie fens by setting back shrubs and trees. Animal species use these non-forested habitats for a variety of activities, including displaying and calling to attract mates, mating, nesting, gathering food, hunting and basking to raise their body temperatures. A great diversity of insects, including butterflies, dragonflies and damselflies, use the open habitats of prairie fens to feed, find mates and lay their eggs. Similarly, many species of hawks and owls use the open habitats of prairie fens to hunt mice and birds. Animals such as frogs, snakes and turtles, which require open, sunny locations to warm themselves, benefit when prairie fens and their surrounding upland natural communities are maintained in an open to semi-open condition.

Fires strongly influence the patterning of natural communities in ways that promote biodiversity. Historically, fires burned across broad landscapes and maintained open conditions in both upland and lowland natural communities. Thus, open upland communities such as oak openings or oak barrens commonly bordered open wetlands such as prairie fens and southern wet meadows. These same upland savanna communities also commonly bordered lakes in southern Michigan.

Kile Kocher, MNFI

Snapping turtle laying eggs.

Where fire was absent or uncommon, forested ecosystems developed in both upland and lowland settings. The landscape pattern of open uplands bordering open lowlands is ideal for plants and animals that use both types of habitats. For example, the dominant prairie grasses big bluestem, little bluestem and Indian grass grow in dry upland savannas and prairies as well as in prairie fen wetlands. Animals such as Blanding's turtles, painted turtles and snapping turtles may spend much of their time in ponds and lakes but travel to open sandy uplands such as oak openings and oak barrens to lay their eggs each spring. Easy access to open upland natural communities by these species enhances biodiversity.

Where natural landscapes remain today, the former oak openings and oak barrens have nearly all converted to closed-canopy oak forest, forcing turtles and other wetland species that require open, sunny upland habitats frequently to travel greater distances for egg laying, basking, hunting or other needs. As a result, these wetland animals now suffer higher rates of predation by raccoons and other predators and greater mortality due to vehicles. How many of us have observed a turtle laying its eggs in the gravel alongside a road? This observation has become common for those traveling roads near wetlands in the spring, as open, sunny natural habitats such as oak savannas rarely occur along the edges of lakes and open wetlands today. Recent studies have shown impacts with vehicles are disproportionately killing female turtles as they travel annually to locate suitable egg-laying habitats, and

Joseph Sage, Indiana Purdue at Fort Wayne

sex ratios of turtle populations are becoming highly skewed, with fewer females present. Historically, fire promoted biodiversity by creating landscape patterns in which open upland and wetland habitats occurred side by side, providing suitable habitats for species that use both dry and wet open communities.

The role of animals in maintaining prairie fens

Historically, beaver strongly influenced flooding regimes within wetlands, and they continue to do so today in many locations. When beaver build dams on streams, water levels behind the dams rise, flooding flat areas adjacent to streams and creating ponds. Low, flat areas adjacent to lakes can also be flooded when outlet streams are dammed. The prolonged flooding kills trees, shrubs and many herbaceous plants, and profoundly alters species composition and environmental conditions. When dams break, herbaceous wetland plants quickly reestablish on the open mud flats, and trees and shrubs may slowly recolonize. By flooding streamside and lakeside wetlands, beaver play a role in helping to

Michael A. Kost, MNFI

maintain open conditions within many wetlands, including the low, flat areas within prairie fens such as those prevalent in basin fens. However, areas of domed fen and hanging fen are not likely to be inundated by flooding because of their elevated position within the wetland complex. In addition to flooding, beaver contribute to creating and maintaining open conditions by consuming the bark of woody plants, felling trees, and killing trees and shrubs in both wetlands and adjacent uplands.

Muskrats influence vegetation composition in prairie fens by consuming cattails and other herbaceous plants and building lodges, which can be as large as 3 meters (10 feet) across and 1 meter (3 feet) high. The surface of abandoned lodges is quickly colonized by a variety of wetland plants, many of which are annuals such as water pepper and smartweeds. Trails made by beaver, muskrats, deer and other animals provide an open growing space for small plants and early successional species that are often absent in undisturbed areas of prairie fens.

Ants can build large mounds in prairie fens that, like muskrat and beaver lodges, contribute to the microhabitat diversity of prairie fens. The colonization of ant mounds by plants, especially grasses and wildflowers that are adapted to drier conditions, further contributes to species diversity.

Muskrat

Todd Loose, NDEQ, Land and Water Management Division

Michael A. Kost, MNFI

ANT MOUNDS

By Barbara J. Barton

Barbara J. Barton, MNFI

An important component of many prairie fens is large mounds created by ants for nesting purposes. These mounds, which can be over 100 years old and measure nearly 1 meter (3 feet) in height, can influence the vegetation of prairie fens in a number of ways. First, ants manage the vegetation on mounds by removing all dead matter from the surface and pruning new green shoots in the spring. The increased exposure to the sun results in warmer temperatures in and on the mounds and triggers seed germination. In summer, shoots are permitted to grow, and these provide shade that cools the surface during the hottest months of the year. Second, mounds in fens have been shown to be higher in microbial activity and nutrients than surrounding areas. This allows certain plants to grow in an otherwise inhospitable habitat. Because ants are constantly moving soil out of the mound and onto the surface, the mounds have lower bulk densities than the surrounding fen soils, so the nest remains dry. In highly saturated environments such as fens, this benefits the ants by providing dry nesting conditions, and the increased soil porosity allows plants that require drier conditions to become established. Finally, seeds that make their way into an ant mound and germinate enjoy favorable growing conditions, especially if they cannot tolerate prolonged saturation. Thus, the presence of ant mounds provides an important refuge for species adapted to drier conditions and results in an overall increase in plant species diversity for prairie fens.

Amphibians and Reptiles in Prairie Fens

By Yu Man Lee

Amphibians and reptiles—such as frogs, toads, turtles and snakes—play important roles in prairie fens and adjacent wetland and upland ecosystems. Although these animals are hard to see at times, they can be quite abundant and are vital parts of the food chain in these ecosystems. Adult frogs and toads—such as northern spring peepers, northern leopard frogs and eastern American toads—can eat large numbers of insects, spiders, earthworms and other invertebrates; their tadpoles feed mostly on algae and other plant matter. Turtles, snakes and larger frog species, such as green frogs and bullfrogs, can feed on diverse items ranging from insects, worms, crayfish, snails and other invertebrates to fish, birds, small mammals, and other frogs, toads, turtles and snakes. Many turtles also eat plants, mushrooms and fruit. Amphibians and reptiles help control populations of the animals and plants they consume. In turn, they provide food to help sustain predators, including other amphibians and reptiles; fish; birds such as hawks, herons and bitterns; and mammals such as raccoons and minks. Maintaining robust populations of amphibians and reptiles helps ensure healthy, functioning ecosystems.

Amphibians and reptiles also can be good indicators of the quality and condition of prairie fens and surrounding wetlands and uplands. Many of these animals

American toad

Green frog

Hognose snake

Brown snake

live both in water and on land and, as a result, are very sensitive to changes in both settings. Amphibians breathe through their skin, which makes them extremely vulnerable to pollution and other changes in the soil, air and water. Similarly, reptiles sometimes breathe through their skin, particularly aquatic species and during hibernation, so they are also very sensitive to chemical pollution and environmental changes in moisture and temperature. Because of their role in the food chain, amphibians and reptiles also can indicate or magnify the impacts of pollution or other environmental changes on their prey. In many ways, amphibians and reptiles can be thought of as sponges that soak up their surrounding environment and serve as good indicators of habitat quality and condition.

Amphibians and reptiles also are valued for other reasons that help make prairie fens such unique and interesting places. Many of the amphibians and reptiles found in prairie fens are quite beautiful and fascinating. For example, frogs such as northern spring peepers, wood frogs and gray treefrogs can survive subfreezing temperatures in the winter by producing a natural antifreeze-like substance. The Blanding's turtle and other turtles found in prairie fens can be very long-lived, frequently surviving 50 years or more. Snakes, such as the eastern massasauga rattlesnake,

Box turtle

Gray tree frog

which occurs in prairie fens, are interesting in that they smell with their tongues and detect vibrations through the lower jaw and body. (Snakes have no sense of hearing as such.) The eastern massasauga also has heat-sensing pits on its head, which detect extremely small differences in temperature and help it to sense its prey. Amphibians and reptiles in prairie fens and surrounding ecosystems also provide benefit to humans by helping to control populations of insects and small rodents. Seeing and hearing frogs and toads are always welcomed as one of the first signs of spring, and observing basking turtles and snakes is a sure sign that summer is on its way.

Blanding's turtle

Insect Outbreaks

Periodic insect outbreaks of the larch sawfly and eastern larch beetle, both native insect species, and the non-native invasive larch casebearer can cause significant mortality of tamarack, temporarily reduce overstory cover and promote open conditions. Tamarack is a large, deciduous, needle-bearing conifer tree that is common in most prairie fens. It often forms dense stands in the absence of natural disturbances such as insect outbreaks, fire or flooding. Tamaracks are often able to recover from insect outbreaks of the larch sawfly and larch casebearer, both of which cause the tree to lose its needles, but outbreaks of the eastern larch beetle, which consumes the inner bark of tamarack, are typically fatal. If open conditions within a prairie fen are maintained, tamaracks, which require high levels of light, will eventually recolonize. When red maple is present, however, it typically assumes dominance following the death of tamarack, and it can prevent further tamarack recruitment by casting heavy shade. The dense shade cast by red maple also contributes to the loss of many prairie fen grasses, sedges and wildflowers that are not adapted to forested conditions.

Larch sawfly

Tamarack turns golden yellow in fall.

Windthrow/tip-up

Windthrow

The rooting depth of trees growing in prairie fens is limited by the lack of oxygen in the waterlogged soils. As a result, large trees are easily blown over by heavy downbursts of wind, leaving large holes or pits that fill with water and provide habitat for aquatic plants and animals. Alongside the holes are tip-up mounds of soil that accumulates under the massive upright root systems and provides habitat for species that require slightly higher and drier conditions. Like other forms of natural disturbance, windthrow is sporadic and unpredictable and helps to maintain a diversity of microhabitats and species as well as the open conditions that characterize the community.

CHAPTER FOUR

Importance to biodiversity

Green darner

James S. McCormac, ODNR

Prairie fens are a globally rare natural community that provides critically important habitat to many plants and animals and significantly contributes to biodiversity in the upper Great Lakes region. Because of the adaptations required to survive in the wet, calcareous conditions that characterize prairie fen, this community supports a unique assemblage of species. By providing habitat for nearly 40 rare plant and animal species, prairie fens act as an important reservoir of species and genetic diversity.

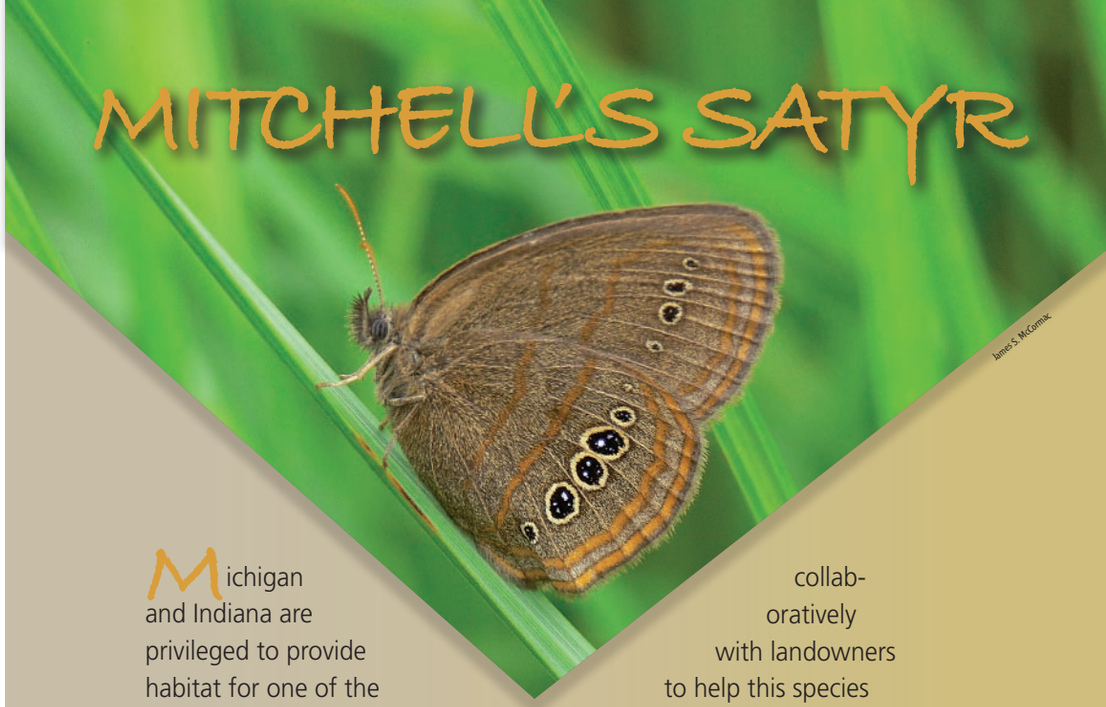
For many, one of the first observations when visiting a fen is the dazzling array of moving color.

Suzan Campbell, MNFI

Viceroy

Many types of butterflies—such as the Baltimore checkerspot, viceroy and silver-bordered fritillary—are commonly seen flitting from plant to plant and sipping nectar from flowers. Upon closer inspection, it becomes apparent that the vegetation is teeming with life—numerous species of leafhoppers, beetles and spiders hop and crawl about. As one approaches a stream or lake, iridescent dragonflies and damselflies catch the eye as they zoom over the water, pursuing prey, cruising their territories and propagating the next generation. In particular, skimmers, emeralds and spiketails are often observed, and because of their affinity for the clear, shallow streams and pools found in prairie fens, these species serve as important barometers of environmental health. The diversity of aquatic insects that occupy the pristine waters associated with prairie fens is striking, with at least 27 family groups and nine orders represented: true bugs, beetles, springtails, true flies, mayflies, stoneflies, caddisflies, dragonflies and damselflies.

MITCHELL'S SATYR



James S. McCormac

Michigan and Indiana are privileged to provide habitat for one of the rarest butterflies in the world. Although found historically in several states, the Mitchell's satyr is currently known to occur within prairie fen complexes at only 17 sites in Michigan and one site in Indiana. Sites that continue to support the Mitchell's satyr contain peat soil with carbonate-rich groundwater seeps and are most often dominated by narrow-leaved sedges with scattered tamarack and poison sumac. The Mitchell's satyr is listed by the federal government as an endangered species because it is in danger of becoming extinct in the near future. The primary threat to the continued survival of this species is habitat loss and modification. Many agencies are working collaboratively with landowners to help this species recover by restoring and protecting its unique habitat.

The Mitchell's satyr is a medium-sized brown butterfly with a wing span measuring 4.1 to 4.4 centimeters (1.5 to 1.75 inches). Its color can range from warm tan to dark chocolate brown. The undersides of its wings each have a row of four or five black eyespots that are dotted with silvery markings, ringed in yellow and encircled by two orange bands. The three central eyespots on its hind wing are the largest. Those lucky enough to view a freshly emerged Mitchell's satyr up close are often thrilled with the iridescent quality of the eyespots and the rich hue of its wings.

Mitchell's satyr eggs and larvae

Mitchell's satyr caterpillar

Mitchell's satyr chrysalis

The lifespan of a Mitchell's satyr is approximately one year, with the adult stage ranging from three to four weeks between mid-June and late July. During this time, the butterflies are usually seen flying low over the vegetation with a slow, rhythmic, bobbing flight in search of mates and suitable locations to lay their eggs. Females deposit their miniscule eggs on the undersides of tiny plants near the bases of sedge tussocks. When the eggs hatch, tiny caterpillars emerge and climb the tussocks to feed on the leaves of sedges and other nearby plants. The small caterpillars are lime-green with pale stripes that run the length of their bodies, a camouflaged color scheme that perfectly conceals their presence among the sedges and grasses.

This butterfly can be easily confused with more common butterflies that occur in similar habitats, including the Appalachian eyed brown, eyed brown, wood nymph and little wood satyr. Most butterfly field guides will assist in distinguishing the Mitchell's satyr from these other more common species, although its characteristic low, bobbing flight pattern is often the best way to tell it apart from similar-looking brown butterflies.

Sarett Nature Center, in Benton Harbor, Mich., has a boardwalk for easy viewing of the Mitchell's satyr and its habitat. Take advantage of this wonderful opportunity to become familiar with this beautiful butterfly. It is hoped that current efforts to conserve this species and its habitat will assure that future generations will be able to explore a prairie fen and delight in seeing this exquisite butterfly.

Sarett Nature Center boardwalk

The Appalachian eyed brown (below, left) is similar to the Mitchell's satyr (below, right).

Prairie Fen Butterflies and Moths (Lepidoptera)

By David L. Cuthrell

A great diversity of insects call prairie fens home. One group, collectively known as the Lepidoptera, consists of butterflies and moths. The Lepidoptera provide a valuable ecosystem service by pollinating flowers, and they receive a benefit in return, a nectar reward. Butterflies are one of the most well-studied insect groups, and a wide variety occur in fens, including some extremely rare species such as the Mitchell's satyr, swamp metalmark, Poweshiek skipperling and Duke's skipper.

Swamp metalmark larvae or caterpillars feed on swamp thistle. This cryptic species can best be found by looking for adults (i.e., butterflies) nectaring on yellow flowers such as black-eyed Susan. The fact that frightened adults fly and land on the undersides of plant leaves adds to the difficulty in finding them.

Haploa tiger moth

Within the Great Lakes states of Michigan and Wisconsin, the Poweshiek skipperling is found strictly in prairie fens that contain either mat muhly or prairie dropseed, both rare species of grass. Because populations of the Poweshiek skipperling that are located in the wet prairies of the Great Plains are declining, sites in Michigan may be the last remaining stronghold for this species.

James S. McCormac, ODNR

Swamp metalmark

Duke's skipper

Poweshiek skipperling

Bradford S. Slaughter, MNFI

Duke's skippers are not restricted to prairie fen habitats. This species can be found in a variety of wetlands that support its caterpillar host plant, lake sedge, including southern wet meadow and inundated shrub swamp.

One unique group found in prairie fens is borer moths of the genus *Papaipema*. Many of these specialized moths are host-specific—this means they can feed on only one or a few species of plants. The larvae hatch from eggs in spring, find an appropriate food plant and then bore into the plant's stem and/or root. Hidden from predators and surrounded by an abundant supply of food, the larvae remain inside the host plant until they leave to pupate in the soil. Small holes 1 inch or more above ground level provide a means for caterpillars to offload their frass (droppings). These holes and associated frass are a sure sign of caterpillar activity within the host plant. Adult moths are best sampled at nighttime by a specialized technique known as blacklighting from late summer to early fall (late August through early October). Four of the more uncommon species known to inhabit prairie fen are the state endangered silphium borer *(Papaipema silphii)*, and the following state special concern species: blazing star borer *(P. beeriana)*, regal fern borer *(P. speciossima)* and sunflower borer *(P. maritima)*.

Dorcas copper

David L. Cuthrell, MNFI

Blacklighting (above) and Baltimore checkerspot (below)

James S. McCormac, ODNR

In addition to the rare moths and butterflies, prairie fens provide habitat for a wide variety of more common species, such as the Baltimore checkerspot, pearly crescentspot, dorcas copper, silver-bordered fritillary, checkered skipper, eyed brown, Delaware skipper, mulberry skipper, dun skipper, viceroy and monarch. The next time you visit a prairie fen, be sure to take along your camera and pay special attention to these flying jewels.

Silver-bordered fritillary

Barbara J. Barton, MNFI

Silphium borer

David L. Cuthrell, MNFI

Dragonflies and Damselflies (Odonata)

By Amy L. Derosier

Adult dragonflies and damselflies are beautiful, well-known insects that can be seen flying around most water bodies during the summer. Dragonflies (Anisoptera) have stocky bodies as adults and larvae; damselflies (Zygoptera) have slender, delicate-looking bodies. These groups of insects, also called odonates, are voracious predators that feed on other flying insects. Mosquitoes make up a significant portion of the diets of these beneficial insects, which are often called mosquito hawks. To be effective flying predators, dragonflies have to be quick, with some species traveling as fast as 56 km per hour (35 mph) in search of prey.

Mating can take place in the air or while the insects are perched on vegetation. Males and females of some species are often observed during aerial mating, "caught in the act" while flying over fens. Odonates deposit eggs in the water or on vegetation, depending on the species. The males can be seen zooming around defending their feeding and mating territory from other odonates. Females can often be seen repeatedly dipping their abdomens into the water as they deposit eggs.

Spreadwing

James S. McCormac, ODNR

For most people, the words "dragonfly" and "damselfly" call to mind the adult winged flyers commonly observed buzzing over lakes and rivers. However, these insects can be found year round in their larval form living underwater. These larval predators are perfect-looking monsters, resembling images from horror films but on a much smaller scale. For their body size, they have huge mouthparts that jet out at blinding speed to grab prey. Larvae typically make their living in one of three ways.

Some species burrow in sand or fine sediments and wait for prey. Burrowers tend to have long back legs with hooks for burrowing into the substrate and a flattish body with a slightly upturned abdomen to allow them to breathe while burrowed. Sprawlers often walk along the substrate and actively hunt for prey. They tend to be flat, with long legs, and hairy-looking. The hairs, or setae, help them stay camouflaged from prey by allowing pieces of sand or detritus to stick to them. Most damselflies and some dragonflies are climbers that stalk prey on vegetation. They have narrow bodies and legs perfectly adapted for climbing.

The next time you visit a fen, head to the stream bank or lakeside and look underwater for these fascinating little monsters.

James S. McCormac, ODNR

Northern bluet (above), Calico Pennant (below, left) and dragonfly nymph (Aeshnidae family) (below, right)

David L. Cuthrell

Amy L. Derosier

Because prairie fens give rise to the headwaters of many rivers and lakes, their role in providing clean, fresh water to aquatic plants and animals is irreplaceable. The cold, oxygen-rich waters that flow through these headwater streams support a wide array of fish, including prized sport fish such as brook trout and largemouth bass as well as panfish such as bluegill, pumpkinseed and green sunfish. Although seldom seen, some additional species of fish occurring in the lakes and streams associated with prairie fens include brook sticklebacks, mud minnows and common shiners. The edges of streams and lakes are a great place to find the shells of aquatic snails, fingernail clams and a variety of mussels with very unusual names, such as slippershell mussel, creek heelsplitter and wabash pigtoe.

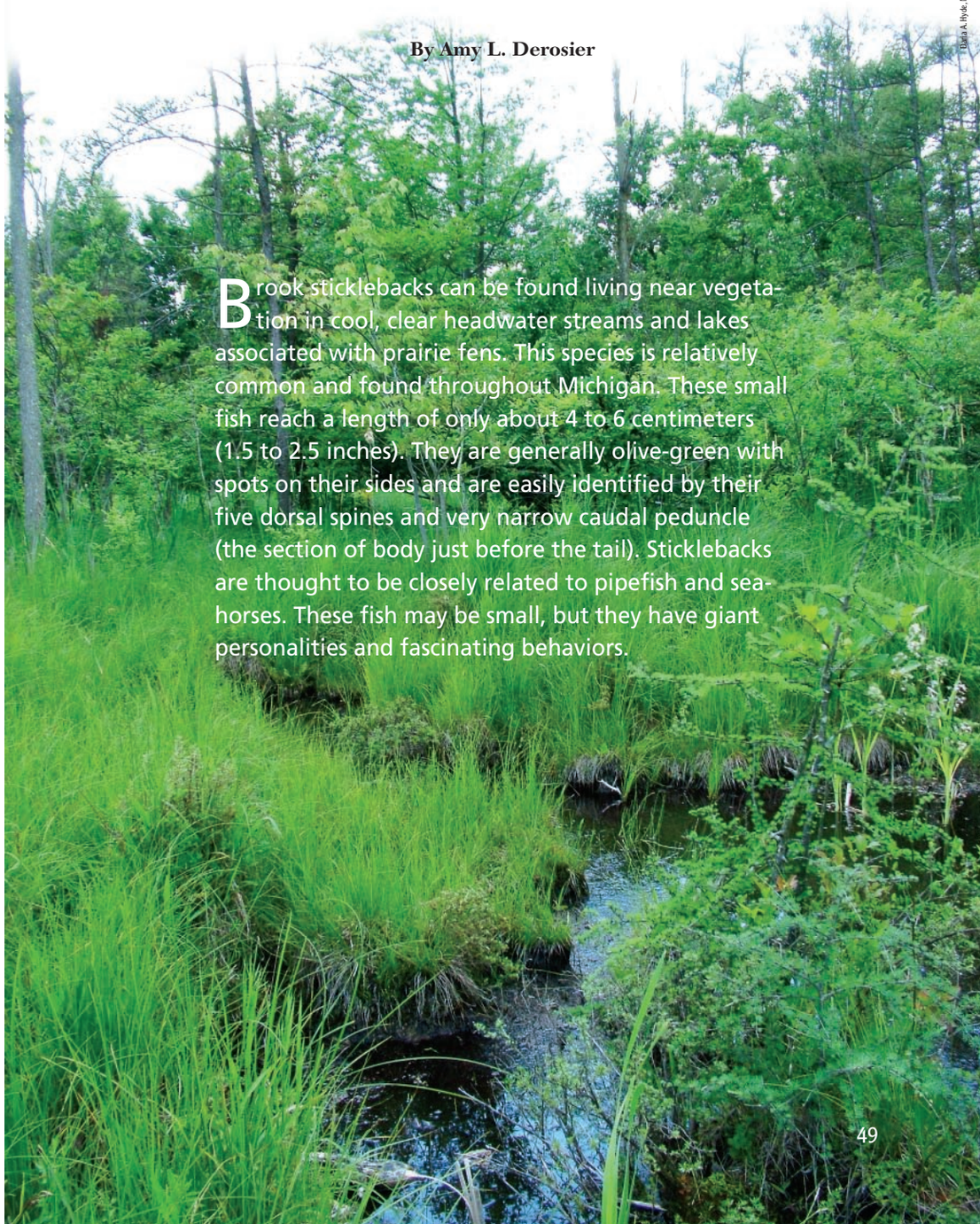
Standing like tiny castles of mud, the chimneys of crayfish burrows are commonly observed in prairie fens, especially in the marl flats and along the edges of lakes and streams. Crayfish act as a keystone species within prairie fens and other wetlands by creating networks of narrow tunnels or burrows that are used by a variety of other species. For example, snakes such as the eastern massasauga utilize crayfish burrows for refuge and overwintering, and aquatic insects such as the larvae of dragonflies inhabit them as well. Further research is needed to identify those species of crayfish that utilize prairie fens and to learn more about their life history and habitat interactions.

Kile Kutcher, MNFI

Crayfish burrow

Brook Sticklebacks

By Amy L. Derosier



Derek A. Hyde, MNFI

Brook sticklebacks can be found living near vegetation in cool, clear headwater streams and lakes associated with prairie fens. This species is relatively common and found throughout Michigan. These small fish reach a length of only about 4 to 6 centimeters (1.5 to 2.5 inches). They are generally olive-green with spots on their sides and are easily identified by their five dorsal spines and very narrow caudal peduncle (the section of body just before the tail). Sticklebacks are thought to be closely related to pipefish and seahorses. These fish may be small, but they have giant personalities and fascinating behaviors.

Sticklebacks and the Gasterosteidae family in general have been studied for many years because of their interesting mating rituals. Males are fiercely territorial and defend their breeding areas against other sticklebacks and other fish of similar size, such as small trout and darters. Males build ball-shaped nests composed of grasses, algae and other plant fibers, which they bind together with concrete-like secretions from their kidneys. They make one door into their 2- to 13-centimeter (0.75- to 5-inch) nests and entice the female in to lay eggs. The female then pushes through the back of the nest to leave, thereby creating a back door. Upon her exit, the male enters the nest, fertilizes the eggs and then proceeds to patch the back door. These opportunistic males will try to entice multiple females into their nests, thus improving their odds of reproductive success.


Konrad P. Schmidt

Brook stickleback

Sticklebacks differ from many animals in that the males do the child rearing. Males fan the nest with their fins to help ensure the eggs get enough oxygen to develop properly. As the eggs hatch, the male pulls apart the nest to construct a "nursery" and corral the young fry. If the fry escape, the male will capture them in his mouth and spit them back into the nursery. He fans the nursery for a day or two, until the fry become strong enough swimmers to evade being captured. Once the fry begin to exit the nursery successfully, the male may abandon the nest or eat the remaining fry. So much for his parenting skills!

In addition to raising its own young, the brook stickleback serves as a host for mussel larvae (glochidia) of the floater mussel (*Anodonta grandis*). When floater mussels release their glochidia into the current, they are drawn into the gills of unsuspecting host fish such as the brook stickleback. The glochidia adhere to the gills, feeding on the fish's body fluids as they develop and then releasing to rest peacefully on the stream or lake bottom.

These feisty little fish eat a variety of insects and can be great at controlling mosquitoes. Predators of brook sticklebacks include brook trout, smallmouth bass and northern pike. Sticklebacks are fascinating and beneficial little fish that rely on the clear, cool waters of prairie fens to give them a home.

Aquatic and Terrestrial Snails (Gastropods)

By Peter J. Badra


Jeffrey C. Nekola

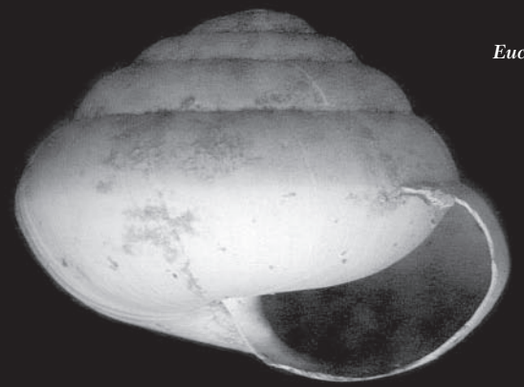
Vertigo morsei

The unique hydrology, chemistry and plant communities of fens provide excellent conditions for dozens of snail species, including several rare species. Both aquatic and terrestrial snails require a cool, moist environment to survive and reproduce. The presence of groundwater near the surface creates microhabitats that are well-suited to snails. Streams and small lakes associated with fens provide habitat for aquatic snails. Both terrestrial and aquatic snails need a calcium-rich environment to support the growth of their shells. They make their shells by absorbing calcium from their surroundings and then process this calcium into shell material with a specialized organ called the mantle. The calcium-rich soils of fens are particularly well-suited to snails. The diverse array of herbaceous plants in fens also provides a source of food and shelter for snails.

North America has more freshwater snail species than anywhere else in the world, with 650 recognized species and more yet to be discovered. Together with the land snails, they represent a rich biological heritage of global importance. Unfortunately, both aquatic and terrestrial

snails have declined severely over the past 80 years. The low mobility of snails, the isolated nature of their populations and their specific habitat requirements make them vulnerable to disturbances. Populations have been lost because of pressures from development, agriculture and forestry. Changes in the hydrology of fens have caused snail populations to disappear. Approximately 60 freshwater snail species that once occurred in North America are now thought to be extinct. Several rare terrestrial snails occurring in Michigan are associated with fens. These include the Pleistocene catinella *(Catinella exile)*, tapered vertigo *(Vertigo elatior)*, six-whorl vertigo *(Vertigo morsei)* and *Euconulus alderi* (no common name).

Much remains to be learned about aquatic and terrestrial snails, including their life history, ecology, distribution and status. The Pleistocene catinella was first described from glacial sediments and was thought to be extinct until live individuals were discovered in Iowa fens in 1986. Currently, this species is known from only 26 fen and cobble beach sites worldwide. *Euconulus alderi* was not known to occur in North America until 1986, when it was discovered at 44 sites in Iowa and Wisconsin. Most of these sites were in fens. The tapered vertigo is also most often found in fens and tends to be absent from disturbed sites. The only populations of the six-whorl vertigo discovered since 1986 were in fens in Wisconsin, Iowa and Michigan. The habitat of one of the largest populations of this species has been degraded by all-terrain vehicle (ATV) use. Two previously undescribed snail species endemic to the fens of the Midwestern United States have been discovered in recent years (1990) (*Hawaiia* n. sp. [new species] and *Punctum* n. sp.). With further investigation, more are likely to be found.



Euconulus alderi

Jeffrey C. Nekola

Nearly half of the amphibian and reptile species found in Michigan can occur in prairie fens. Frogs such as the northern leopard frog or green frog may startle and leap into nearby pools or streams to avoid human footsteps. These and many other types of frogs utilize fens and adjacent wetland habitats for feeding, mating, egg laying and overwintering. Although usually quite cryptic, the eastern garter snake or northern ribbon snake can occasionally be spotted sunning in the lower branches of shrubs and small trees. Many species of snakes occur in fens, which provide habitat for feeding, basking, mating and producing young. In addition, many kinds of turtles inhabit prairie fens and adjacent streams and lakes. Turtles are fascinating creatures, and it is always a delight to catch sight of the beautifully patterned shell of an eastern box turtle or the bright yellow throat of the Blanding's turtle.

Nathan Herbert

Eastern garter snake

Rare Amphibians and Reptiles (Herps) IN PRAIRIE FENS

By Yu Man Lee

Prairie fens provide habitat for a number of amphibians and reptiles, collectively referred to as herpetofauna or "herps," including several rare and/or declining species in Michigan and the Great Lakes region. These include the eastern massasauga (state species of special concern and federal candidate), Kirtland's snake (state endangered), spotted turtle (threatened) and Blanchard's cricket frog (state species of special concern).

The eastern massasauga is a small, heavy-bodied rattlesnake, with adults averaging 60 to 80 centimeters (2 to 2.5 feet) long and reaching a maximum length of about 91 centimeters (3 feet). This species is found throughout Michigan's Lower Peninsula, with scattered remnant populations in the Midwest and Northeast. This species occurs in prairie fens as well as other open and forested wetlands and uplands. The eastern massasauga is very well-camouflaged and secretive and is generally difficult to observe in its natural habitat. Its main defense is to hide, and it will typically bite only if threatened, picked up or stepped on. In Michigan, the eastern hognose snake, northern water snake, eastern milk snake and eastern fox snake look similar to and can be mistaken for the eastern massasauga. Because of its small tail, the massasauga's rattle sounds more like the buzz of an insect than the loud and menacing sound produced by larger rattlesnakes.

Spotted turtle

Eastern massasauga

Kirtland's snake

Blanchard's cricket frog

The Kirtland's snake is another rare and highly elusive snake found in prairie fens. Little is known about this small, secretive snake because it spends most of its time underground in crayfish and other burrows and appears to be active primarily at night. Other snakes are typically active and bask during warm, sunny weather, but this snake seems to emerge more frequently during cool or moderate, rainy conditions. This may be related to the habits of its preferred prey, which is believed to be earthworms.

The spotted turtle, one of Michigan's smallest and prettiest turtles, is found in ponds, streams and various wetlands with clear, shallow water, muddy substrates, and aquatic and emergent vegetation. In prairie fens, these turtles are often found in the small, cold, clear seeps and rivulets that flow through these wetlands. Spotted turtles can tolerate cooler temperatures than other turtle species and are often the earliest turtles seen basking on logs and grass or sedge hummocks in the spring.

The Blanchard's cricket frog is a tiny, warty-skinned frog, with adults less than 3.8 centimeters (1.5 inches) long. Despite its small size, this frog has a loud, distinctive call consisting of a series of metallic clicks that sound like two marbles tapped together. This species is usually found in open, muddy habitats or on floating vegetation along the shores of permanent ponds, lakes, and slow-moving streams and rivers. Adult frogs are very short-lived, generally surviving only one or two breeding seasons.


Gary Kramer, USFWS-DLS

Great blue heron

A wide variety of birds inhabit prairie fens, including songbirds, raptors, shorebirds and game birds. The common yellowthroat, yellow warbler and swamp sparrow are songbird ambassadors that visitors to fens commonly hear and see. It is not unusual to look up and see a red-tailed hawk soaring overhead. This and many other raptor species hunt in prairie fens. The loud, ancient-sounding calls of a great blue heron or sandhill crane are often heard as these birds make their slow, elegant ascent from the wetland. Like many other birds, they are commonly heard before they can be spotted, despite their large size. These species, along with the green heron and the belted kingfisher, are a treat to observe hunting along the streams and lakes


Roy Van Loo, Jr.

Sandhill crane

of prairie fens. The eerie courtship song of the Wilson's snipe may be heard in the spring and early summer, as the male rapidly vibrates its specialized outer tail feathers while performing daring headfirst dives high above the wetland. Visitors to marl flats may be greeted by the loud, piercing alarm calls of a killdeer feigning a broken wing to lure them away from its nest. Game birds, including the American woodcock and ruffed grouse, are often flushed from the shrub thickets and rich tamarack swamps associated with prairie fens. Turkey and pheasant also forage in fens and associated habitats. The various birds encountered in prairie fens provide an interesting and rich experience to even the most casual observer.


Lee Kinney, USFWS-DLS

Cooper's hawk


John & Karen Hollingsworth, USFWS-DLS

Swamp sparrow

Wilson's snipe


Dave Menke, USFWS-DLS

Turkeys


Harry Zeman, National Wild Turkey Federation

CHAPTER FIVE

Vegetation

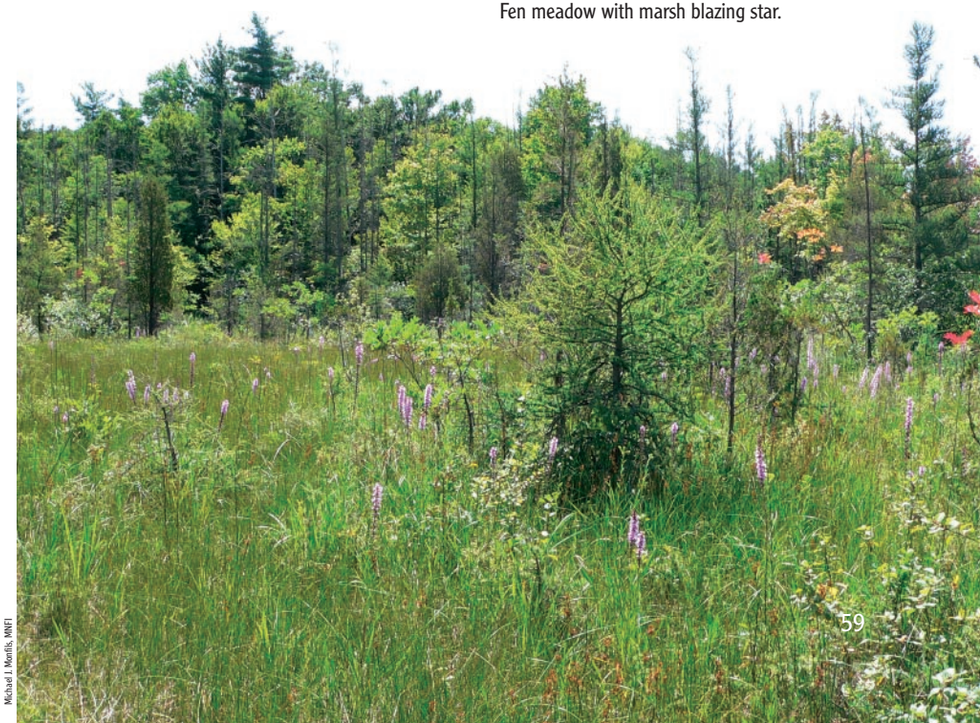
Rush

Todd Losee, MDEQ, Land and Water Management Division

The vegetation of prairie fens is generally open and dominated by sedges and grasses, but scattered shrubs and trees are also frequently present and sometimes contribute to a savanna-like look. Variation in species composition within prairie fens depends on a variety of environmental factors, including the degree of groundwater influence, local water chemistry, amount of peat or marl accumulation, percentage of shrub and tree and cover, and past natural and anthropogenic (human-induced) disturbances. Prairie fens typically contain several distinct vegetation zones that correspond to gradual differences in these environmental factors. Vegetation zones common to many prairie fens are **fen meadow**, **marl flat** and **wooded fen**. Not all vegetation zones occur in all prairies fens.

Fen meadow is typically the largest vegetation zone of a prairie fen and often occurs on gradual slopes, where it may be referred to as hanging fen or domed fen. Other similar wetlands, such as southern wet meadow and emergent marsh, often occur adjacent to prairie fens in large wetland complexes.

Fen meadow with marsh blazing star.



Michael J. Monfils, MNFI

Fen meadows are recognizable by their overall short stature. Grasses, sedges, low shrubs and a great diversity of wildflowers dominate this zone, and it is here that the "prairie" component of prairie fen is most pronounced.

Though they are not always present, prairie grasses such as big bluestem, little bluestem and Indian grass can be prime indicators of fen meadows. Other plant species that can be especially helpful in recognizing the presence of fen meadows include shrubby cinquefoil, a small, round

Dana A. Hyde, MNFI

Tussock sedge

Susan L. Campbell, MNFI

Indian grass

shrub with bright yellow flowers; Ohio goldenrod and Riddell's goldenrod, both bright yellow, flat-topped goldenrods; marsh blazing star, with its slender spike of purple flowers; and poison sumac, a tall shrub with a candelabra-like silhoutte.

Along with grasses, fen meadows are dominated by a diversity of sedges from the genus *Carex*. Tussock sedge, in particular, can be dominant, forming a hummocky microtopography that provides important habitat for

many plants and animals. Where seasonal floodwater collects for prolonged periods, as in low swales and level areas within prairie fen complexes, tussock sedge develops tall, permanent root pedestals or tussocks that can grow to heights greater than 1 meter (3 feet). From the sides and tops of the tussocks grow not only shoots of tussock sedge but also a variety of other plants, many of which are too small to compete for sunlight with the robust sedges and grasses without the aid of the elevated platforms. During seasonal flooding events, the tops of the tall tussocks typically remain as small islands above the water, providing a safe haven for both plants and small animals. The tussocks are also used as basking platforms by snakes and as nesting habitat by marsh wrens.

Tall shrubs and trees, especially poison sumac and tamarack, may also be scattered throughout fen meadows, giving this zone a savanna-like appearance. It is often referred to as a tamarack savanna. The widely scattered delicate tamaracks and open-branched poison sumacs, set

James S. McCormac, ODNR

Poison sumac

against the waves of sedges, grasses and brightly colored wildflowers, are a truly beautiful sight to behold.

Marl flats are distinct features of fens. They form in areas of calcareous groundwater seepage and support a short, sparse assemblage of plants. Marl flats may occur as small pools or extensive level areas occupying the basins of former lakes (i.e., basin fens). Marl flats located in basin fens often contain low peat ridges, which are interspersed throughout the broad flats and support sphagnum mosses, pitcher plant, round-leaved sundew, and stunted and gnarled tamaracks. The low ridges of peat can differ markedly in pH from the surrounding fen, with pH values of 4.5 (very strongly acid) commonly occurring on the sphagnum moss-dominated hummocks, while the surrounding marl flat may reach pH values of 7.5 (mildly alkaline) or higher.

Marl flat

David L. Cuthell, MNFI

Michael A. Kost, MNFI

Wooded fen

The high pH and alkaline conditions of marl flats severely restrict the availability of important plant nutrients such as phosphorus and potassium. Because few plants are adapted to growing in the nutrient-poor, waterlogged conditions of marl flats, this zone is sparsely vegetated and populated by plants that are short or stunted. Thus, marl flats provide critical habitat for many small plants that are often outcompeted by robust perennials in other vegetation zones and wetland natural communities. Carnivorous plants such as pitcher plant, sundew and bladderwort are common features of marl flats. These small plants satisfy many of their nutrient needs by trapping and digesting tiny invertebrates. Beaked spikerush is often a dominant plant in marl flats. The presence of this species is usually revealed by its long, slender leaf blades, which fall to the ground and root at the tips, forming low arches that trip visitors attempting to pass through.

The **wooded fen** zone represents portions of the fen that are slowly succeeding to closed-canopy communities such as southern shrub-carr and rich

Common plants found in each vegetation zone of prairie fen.

Scientific name	Common name	Marl flat	Fen meadow	Wooded fen	Life form
Cladium mariscoides	Twig-rush	x			Sedge
Eleocharis elliptica	Golden-seeded spike-rush	x			Sedge
Eleocharis rostellata	Beaked spike-rush	x			Sedge
Rhynchospora alba	White beak-rush	x			Sedge
Rhynchospora capillacea	Beak-rush	x			Sedge
Juncus brachycephalus	Smallhead rush	x			Rush
Drosera rotundifolia	Round-leaved sundew	x			Forb
Lobelia kalmii	Bog lobelia	x			Forb
Parnassia glauca	Grass-of-Parnassus	x			Forb
Sarracenia purpurea	Pitcher plant	x			Forb
Tofieldia glutinosa	False asphodel	x			Forb
Triglochin maritimum	Common bog arrowgrass	x			Forb
Utricularia cornuta	Horned bladderwort	x			Forb
Utricularia intermedia	Flat-leaved bladderwort	x			Forb
Zigadenus glaucus	White camas	x			Forb
Sphagnum spp.	Sphagnum mosses	x			Moss
Carex flava	Yellow sedge	x	x		Sedge
Carex sterilis	Dioecious sedge	x	x		Sedge
Cypripedium candidum	White lady-slipper	x	x		Forb
Toxicodendron vernix	Poison sumac	x	x	x	Shrub
Larix laricina	Tamarack	x	x	x	Tree
Agropyron trachycaulum	Slender wheat grass		x		Grass
Andropogon gerardii	Big bluestem		x		Grass
Andropogon scoparius	Little bluestem		x		Grass
Bromus ciliatus	Fringed brome		x		Grass
Calamagrostis canadensis	Blue-joint grass		x		Grass
Muhlenbergia glomerata	Marsh wild timothy		x		Grass
Sorghastrum nutans	Indian grass		x		Grass
Carex buxbaumii	Buxbaum's sedge		x		Sedge
Carex diandra	Lesser panicled sedge		x		Sedge
Carex lasiocarpa	Wiregrass sedge		x		Sedge
Carex prairea	Prairie sedge		x		Sedge
Aster lateriflorus	Side-flowering aster		x		Forb
Aster umbellatus	Tall flat-top white aster		x		Forb
Liatris spicata	Marsh blazing star		x		Forb
Lysimachia quadriflora	Whorled loosestrife		x		Forb
Pycnanthemum virginianum	Common mountain mint		x		Forb
Rudbeckia hirta	Black-eyed Susan		x		Forb
Solidago ohioensis	Ohio goldenrod		x		Forb
Solidago riddellii	Riddell's goldenrod		x		Forb

Common plants found in each vegetation zone of prairie fen (cont).

Scientific name	Common name	Marl flat	Fen meadow	Wooded fen	Life form
Solidago uliginosa	Bog goldenrod		x		Forb
Onoclea sensibilis	Sensitive fern		x		Fern
Thelypteris palustris	Marsh fern		x		Fern
Juniperus communis	Common juniper		x		Shrub
Potentilla fruticosa	Shrubby cinquefoil		x		Shrub
Salix candida	Hoary willow		x		Shrub
Eupatorium maculatum	Joe-pye weed		x	x	Forb
Eupatorium perfoliatum	Common boneset		x	x	Forb
Viola cucullata	Marsh violet		x	x	Forb
Betula pumila	Bog birch		x	x	Shrub
Cornus amomum	Silky dogwood		x	x	Shrub
Cornus foemina	Gray dogwood		x	x	Shrub
Cornus stolonifera	Red osier dogwood		x	x	Shrub
Ilex verticillata	Winterberry		x	x	Shrub
Physocarpus opulifolius	Ninebark		x	x	Shrub
Rhamnus alnifolia	Alder-leaved buckthorn		x	x	Shrub
Salix bebbiana	Bebb's willow		x	x	Shrub
Salix discolor	Pussy willow		x	x	Shrub
Spiraea alba	Meadowsweet		x	x	Shrub
Juniperus virginiana	Red cedar		x	x	Tree
Carex leptalea	Bristly-stalked sedge			x	Sedge
Cypripedium reginae	Showy lady-slipper			x	Forb
Maianthemum canadense	Canada mayflower			x	Forb
Mitella diphylla	Bishop's cap			x	Forb
Senecio aureus	Golden ragwort			x	Forb
Symplocarpus foetidus	Skunk cabbage			x	Forb
Trientalis borealis	Starflower			x	Forb
Osmunda cinnamomea	Cinnamon fern			x	Fern
Osmunda regalis	Royal fern			x	Fern
Aronia prunifolia	Black chokeberry			x	Shrub
Nemopanthus mucronata	Mountain holly			x	Shrub
Sambucus canadensis	Elderberry			x	Shrub
Viburnum lentago	Nannyberry			x	Shrub
Acer rubrum	Red maple			x	Tree
Betula alleghaniensis	Yellow birch			x	Tree
Pinus strobus	White pine			x	Tree
Ulmus americana	American elm			x	Tree
Toxicodendron radicans	Poison ivy			x	Vine

tamarack swamp in the absence of management or natural disturbances such as fire or flooding. Wooded fen can be dominated by tall shrubs or a mixture of tall shrubs and trees. The wooded fen zone in most prairie fens occupies a significantly greater area today than in the past because of the absence of fire and beaver flooding. Typical tree species include tamarack, eastern red cedar, white pine, yellow birch, red maple and American elm. Shrub species are well-represented in this zone, including poison sumac, bog birch, dogwoods, willows, winterberry, ninebark, black chokeberry and mountain holly. The ground flora of wooded fen is generally made up of herbaceous species from other vegetation zones, especially the fen meadow zone. Many plants typical of forested wetlands can often be found growing in shaded areas on and among


Suzan L. Campbell, MNFI

Black chokeberry


Suzan L. Campbell, MNFI

Yellow birch


Suzan L. Campbell, MNFI

Gray dogwood

the broad root hummocks of tamarack, including sedges, ferns, orchids and other wildflowers.

Associated wetlands

In addition to containing a variety of vegetation zones, prairie fens typically occur within large wetland complexes consisting of several types of wetlands. Often referred to as prairie fen complexes, these large wetlands may include lakes, rivers and a variety of natural communities in addition to prairie fen, such as submergent marsh, emergent marsh, southern wet meadow, southern shrub-carr, rich tamarack swamp and southern hardwood swamp.

Below are short descriptions of each of these associated natural communities. For more detailed descriptions of these and other natural communities, see "Natural Communities of Michigan: Classification and Description," available at the Michigan Natural Features Inventory Web site.

Submergent marsh occurs in the shallow to deep waters of lakes and streams throughout Michigan, including those associated with prairie fens. The community is dominated by plants with submergent leaves and/or floating leaves, such as milfoils, naiads, pondweeds, stoneworts, coontail, bladderworts, water-celery and common water weed.

Submergent marsh


Bradford S. Slaughter, MNFI

Emergent marsh occupies shallow water, typically along the shores of lakes and streams, and is characterized by emergent (i.e., growing out of water) and floating-leaved plants. In prairie fen complexes, emergent marsh often forms a narrow zone separating prairie fen from submergent marsh or open water. Common plants include water plantain, sedges, spike-rushes, pond lilies, pickerel weed, arrowheads, bulrushes and cattails. Beaver and muskrat are often most active in this portion of prairie fen complexes.

Southern wet meadow typically occupies low, level areas within floodplains and former lake basins that experience seasonal flooding. The community is dominated by sedges, especially tussock sedge, and thus is often referred to as sedge meadow. Like interlocking fingers, southern wet meadow and prairie fen often intergrade throughout large wetland complexes in accordance with subtle differences in groundwater discharge and elevation. Southern wet meadow has an overall taller stature than the fen meadow zone of prairie fens. Common plants include tussock sedge, lake sedge, water

Emergent marsh

Michael A. Kost, MNFI

Joshua G. Cohen, MNFI

Southern wet meadow

sedge, bluejoint grass, marsh wild timothy, swamp milkweed, Joe-pye weed, common boneset, late goldenrod and marsh fern.

Southern shrub-carr is a wetland community dominated by tall shrubs such as willows, dogwoods, winterberry and bog birch. This community typically becomes established when wetland shrubs colonize open wetlands such as prairie fen and southern wet meadow. The wooded fen zone of prairie fens represents the transition from open prairie fen to southern shrub-carr. Supporting species from both open and forested wetlands, shrub-carr can have a very diverse flora. In the absence of fire and/or long-term flooding like that associated with beaver dams, trees eventually establish and grow to overtop the shrubs,

Southern shrub-carr

Michael A. Kost, MNFI

Grasses, Sedges and Rushes:
What are the Differences?

By Ryan P. O'Connor

Grasses, sedges and rushes are important plants that often form the dominant matrix of herbaceous vegetation in prairie fens. Collectively, they all superficially resemble one another and are called **graminoids**. All graminoids are monocots and are wind-pollinated.

A popular way of telling grasses, sedges and rushes apart uses the following rhyme:

Sedges have edges, rushes are round,
Grasses are hollow, what have you found?
OR
Sedges have edges, rushes are round,
Grasses have nodes all the way to the ground.

Sedges often have stems that are triangular in cross-section, especially near the base. In contrast, rushes are round in cross-section. Grass stems are usually either flattened or round and have swollen nodes — joints where the leaves attach to the stem. The stems of both sedges and rushes tend to be solid; grasses are hollow between the nodes. For more detailed comparisons between grasses, sedges and rushes, see the table at the right.


Big bluestem

Chuck Pearson, The Nature Conservancy


Little bluestem (grass)

Suzan L. Campbell, MNFI


Little bluestem (clump)

Suzan L. Campbell, MNFI


Buxbaum's sedge

Suzan L. Campbell, MNFI


Smallhead rush

Michael A. Kost, MNFI

Family	Grasses Poaceae	Sedges Cyperaceae	Rushes Juncaceae
Stems	Flattened or round, hollow between nodes	Often triangular, especially at the base, solid throughout	Round, lacking nodes, solid throughout
Leaves	Usually flat, joining the stem with an open sheath encircling the stem down to the node	Usually folded into "M" or "V" shape, arranged in ranks of three, with a closed sheath	Flat or round, often only one to two present on stem, with others tufted near the base or top of the stem just beneath fruit clusters
Fruit/ seeds	A grain held between two tiny overlapping leaflets (palea and lemma)	Achenes (rounded nutlets) usually borne in bristly clusters	Tiny seeds borne in a small capsule surrounded by three tiny petals and sepals
Example species for prairie fen	Big bluestem, little bluestem, fringed brome, blue-joint grass, Indian grass	Tussock sedge, twig-rush, Buxbaum's sedge, spike-rush, beak-rush, nut-rush, bulrush	Canadian rush, smallhead rush, path rush
Example genera for prairie fen	*Andropogon, Bromus, Calamagrostis, Glyceria, Panicum, Poa, Muhlenbergia, Sorghastrum,* etc.	*Carex, Cladium, Cyperus, Dulichium, Eleocharis, Eriophorum, Rhyncospora, Schoenoplectus, Scirpus, Scleria,* etc.	*Juncus*
Diversity in Michigan	79 genera comprising 255 species	16 genera comprising 264 species	Two genera comprising 30 species

Michael A. Kost, MNFI

Rich tamarack swamp.

forming a forested wetland such as a rich tamarack swamp or southern hardwood swamp.

Rich tamarack swamp is a forested wetland dominated by tamarack. Like prairie fen, rich tamarack swamp develops on organic soils (i.e., peat) in areas where cold, calcareous groundwater creates mildly alkaline soils. These conifer swamps typically contain a very diverse ground flora and shrub layer, with many species present from the wooded fen vegetation zone described above for prairie fen. In the absence of fire and flooding by beaver, the wooded fen zone of prairie fen can succeed to rich tamarack swamp.

Southern hardwood swamp is a forested wetland dominated by a mixture of hardwoods, including maples and ashes. The community occupies shallow depressions and floodplains associated with headwater streams. Like rich tamarack swamp, southern hardwood swamp can develop when shrubs and trees invade open wetlands such as prairie fens and southern wet meadows. In the absence of natural disturbances that set back woody vegetation, the wooded fen zone of prairie fens can eventually succeed to southern hardwood swamp.

Southern hardwood swamp.

Michael A. Kost, MNFI

CHAPTER SIX

Threats

Purple Loosestrife

Michael A. Kost, MNFI

Like other wetlands, prairie fens have been greatly affected by a wide variety of perturbations, including altered hydrology, nutrient loading, sedimentation, invasive species, fire suppression, cattle grazing, and outright destruction through filling for development or dredging to create ponds and lakes. As a result, prairie fens are now considered rare in Michigan and throughout their range.

Altered hydrology

Removing water from prairie fens through draining and ditching creates drier conditions that foster the rapid growth of woody plants and conversion to shrub-carr and swamp forest. Ditches along roads built through prairie fens can act as drains, allowing shrubs and trees to grow rapidly in ground previously too wet to support these woody plants. In addition, because groundwater constantly flows through the soils of prairie fens, roads can act as dams, creating very different growing conditions on each side. For example, one side of a road may become flooded and support the growth of cattails, while the opposite side may become drier, with ideal conditions for rapid colonization by shrubs and trees.

Todd Losee, MDEQ, Land and Water Management Division

Draining and ditching.

Increased groundwater withdrawals for residential, commercial or agricultural uses can lower local water tables, allowing shrubs and trees to grow rapidly and form shrub-carrs and swamp forests. Land use planning to protect groundwater reserves in areas surrounding prairie fens is critical to maintaining this natural community.

Nutrient loading—the addition of nutrients from leaking septic tanks, drainfields, agricultural runoff, lawn fertilizer and salt spray—can result in the proliferation of invasive species such as narrow-leaved cattail, Phragmites or common reed, reed canary grass and purple loosestrife. Additions of nitrogen, phosphorus and salts provide a competitive advantage to these aggressive invasive plants, allowing them to form near monocultures in previously diverse habitats.

Todd Losee, MDEQ, Land and Water Management Division

Wetland alteration

Sedimentation—the deposition of mineral sediment on the surface of organic soils—also creates ideal conditions for the rapid growth of invasive plants. Sediment typically enters prairie fens through runoff from agricultural fields and sparsely vegetated slopes or via flooding along stream corridors in watersheds that have experienced significant increases in roads, parking lots and rooftops. These impervious surfaces prevent rainwater from soaking into the ground where it falls. Instead, they channel large volumes of water into streams, greatly increasing stream sediment loads and exacerbating the frequency and severity of flooding events.

Filling to create roads or development can directly eliminate prairie fens and other wetlands. Similarly, prairie fens and other wetlands are also destroyed through dredging to create ponds and lakes. Like a gigantic drainage ditch, a pond dug in a portion of prairie fen can lower water levels throughout the remaining wetland, facilitating the conversion to shrub-carr and swamp forest.

Fire suppression

Prairie fens once occurred in a landscape dominated by oak openings and oak barrens, natural communities in which fire played a central role in maintaining open, park-like conditions.

Shrub encroachment.

Daria A. Hyde, MNFI

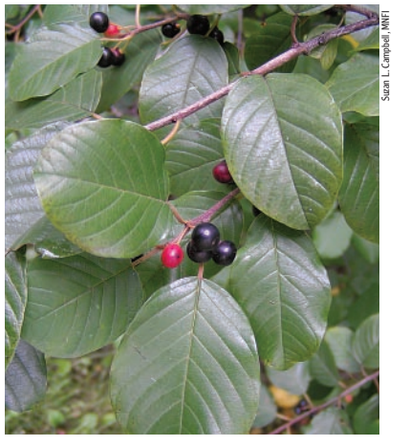
Jack McGowan-Stinski, TNC

Prescribed fire burning off thick leaf litter.

As wildfires burned across these upland comunities, they frequently carried into prairie fens. By maintaining open conditions, fires promoted diversity of both species and landscapes. In the absence of fire, open upland and wetland communities typically become dominated by shrubs or trees, greatly reducing the amount of sunlight reaching the ground and eliminating habitat for plants and animals that require full or partial sun. As shrub and forested communities increase in abundance, open communities are lost, effectively reducing the diversity of ecosystems within a landscape. Even where open conditions continue to exist, the absence of fire typically results in species loss. Where fires have been excluded, the ground becomes covered with a thick layer of leaf litter that inhibits seed germination and seedling establishment, and the plant communities become dominated by tall, robust perennials that effectively block light and growing space for smaller species. Plants most affected by these changes include species with small seeds, such as orchids, which are incapable of growing through the thick layer of leaf litter; annuals, which require seed germination every year; short species; and those that fix nitrogen, such as legumes.

Invasive species

The proliferation of invasive species represents another significant threat and is typically exacerbated when prairie fens have been previously altered by ditching, draining, nutrient loading, cattle grazing or other forms of anthropogenic change. Because they outcompete native species for nutrients, light, space and sometimes even pollinator visits, invasive plants can profoundly alter species composition and ecological processes. Invasive plants that often colonize prairie fens include Phragmites, reed canary grass, narrow-leaved cattail, hybrid cattail, purple loosestrife, glossy buckthorn, common buckthorn, multiflora rose and autumn olive. The tall shrub glossy buckthorn has become especially widespread in prairie fens, where it forms dense thickets in which few native plants are able to survive.



Suzan L. Campbell, MNFI

Glossy buckthorn

Invasive cattail

Rebecca K. Schillo, MNFI

Reed canary grass

Todd Lonie, MDEQ, Land and Water Management Division

Phragmites

Suzan L. Campbell, MNFI

Grazing

Cattle grazing in prairie fens can significantly lower the water quality of lakes and streams, alter community structure and species composition, and lead to colonization by invasive species. Because prairie fens serve as the headwaters of streams and lakes, direct nutrient additions from cattle manure can significantly degrade water quality, creating ideal conditions for the growth of harmful bacteria and invasive aquatic plants. By preferentially grazing some species and avoiding others, cattle strongly influence plant species composition. Ground-nesting animals are disturbed by trampling, and species associated with tall sedges and grasses can be displaced as cattle preferentially graze these plants. In addition to grazing sedges, cattle can destroy the tall root pedestals of tussock sedge by trampling, profoundly altering community structure and species composition. Active grazing can suppress wetland shrubs and help maintain open conditions, but it typically does not prevent resprouting. Once released from grazing, these woody plants grow quickly from well-developed rootstocks, rapidly converting open prairie fens and southern wet meadows to southern shrub-carr. On the soft organic soils of prairie fen, the hoofprints of cattle create thousands of moist holes, which are ideal sites for seed germination and seedling

Cattle path.

Dana A. Hyde, MNFI

Long Lake prairie fen.

establishment. Where invasive plants are present, these open microsites are rapidly colonized by invasive plants. By creating thousands of microsites for seed germination and reducing the vigor of native plants through grazing and trampling, cattle create the perfect conditions for successful colonization of prairie fens by invasive plants. Lastly, through their manure, cattle can significantly increase nutrient availability, further enhancing growing conditions for invasive plants.

Climate change

Global climate change may represent an additional threat to wetland ecosystems such as prairie fens. In the Great Lakes region, groundwater levels are significantly influenced by water levels in the Great Lakes. The lack of winter ice cover on the Great Lakes in recent years has resulted in greater annual levels of evaporation from the open surface waters. If the increased loss of water from the Great Lakes continues and results in a significant drop in the regional water table, groundwater discharge from springs and seeps may slow or cease altogether, with devastating consequences for wetlands such as prairie fens that rely on the constant flow of cold groundwater to maintain saturated conditions. As conditions become less waterlogged, shrubs and trees would be quick to colonize, converting formerly open wetlands such as prairie fen to shrub-carr and forest.

CHAPTER SEVEN

Restoration and Management

Queen-of-the-prairie

Bradford S. Slaughter, MNFI

Park Lyndon prairie fen.

IN today's world, maintaining the ecological integrity of prairie fens requires active conservation and management. By working together, landowners, natural resource managers, researchers and policymakers can develop and implement successful long-term strategies to protect and restore these important wetlands. Critical to the long-term viability of prairie fens are strategies aimed at restoring and protecting regional hydrology; safely reintroducing fire through prescription burning, where appropriate; and controlling the spread of invasive species.

Restoring and maintaining hydrology is a top priority for the long-term protection of prairie fens. Diversity and the ecological integrity of prairie fens depend on the constant flow of clean, cold, calcareous groundwater. Primary actions for protecting hydrology and water quality may include first identifying and then eliminating or reducing the sources of nutrient loading, sedimentation, artificial drainage and excessive groundwater withdrawals. Monitoring water quality of streams, lakes, and discharge from wastewater treatment facilities and concentrated animal

feeding operations (CAFOs), and enforcing regulations to protect water quality will help ensure that water remains clean. Land use planning and zoning can protect the hydrology of prairie fens by reducing impervious surfaces, protecting groundwater recharge areas and limiting excessive withdrawals of groundwater near prairie fens. With their deep roots, native prairie plants increase water infiltration into the soil, which helps to reduce runoff and facilitate recharge of local aquifers. Encouraging the use of native landscaping in residential areas and restoring prairie and savanna in the landscapes surrounding prairie fens will help ensure an abundant supply of clean, cold groundwater. Establishing buffer strips of native prairie vegetation between prairie fens and agricultural fields and suburban lawns can also help reduce nutrient loading and sedimentation. Filling ditches that drain prairie fens and restoring natural meanders to streams can help restore hydrology and reduce sedimentation associated with stream flooding.

The presence of native mussels often indicates clean water.

Chuck Pearson, The Nature Conservancy

ECOLOGICAL RESTORATION *at Ives Road Fen*

By Steven S. Woods, Jack D. McGowan-Stinski and Douglas R. Pearsall

Located immediately south of Tecumseh in Lenawee County, Ives Road Fen is a biological gem set within a river valley surrounded by farm fields. This globally rare fen remained natural by default—it simply could not be drained well enough to plow.

In 1994, The Nature Conservancy began an ongoing restoration program at Ives Road Fen. Restoration efforts have focused on restoring natural hydrologic and fire regimes, removing invasive plants and reestablishing native plants, and monitoring change. The cornerstone of this successful restoration story has been the hard work and dedication of thousands of talented volunteers from all types of backgrounds.

Restoring hydrology

Water flow is one of the most distinguishing characteristics of a fen, and at Ives Road Fen this natural process had been severely disrupted by the creation of drainage ditches and tile lines. The altered hydrology led to the reduction or elimination of many native species and the rapid spread of invasive plants. Efforts to restore the natural flow of water through the fen have included filling drainage ditches, removing drain tile and controlling the invasive shrub glossy buckthorn, which soaks up and transpires large amounts of water from the fen.

Reintroducing fire

Fire is a natural part of the fen ecosystem that maintains open conditions and helps many native plants to thrive. In its absence, invasive plants and tall trees and shrubs tend to dominate and crowd out native fen plants. At Ives Road Fen, fire is being reintroduced by trained professionals under controlled conditions to help control invasive plants and restore vital ecological processes. Techniques being employed to reintroduce fire at Ives Road Fen include conducting prescribed burns, burning brush piles and spot-burning seedlings of invasive plants such as glossy buckthorn.

Controlling invasive species

Controlling invasive plants is one of the most complex and complicated challenges at Ives Road Fen. Invasive species such as glossy buckthorn, purple loosestrife and reed canary grass displace native plants, disrupt critical ecological processes and degrade animal habitats. Various methods are being used to prevent the success and spread of these species, ranging from hand pulling, cutting and spot-burning seedlings to prescribed burning and selectively applying herbicides.

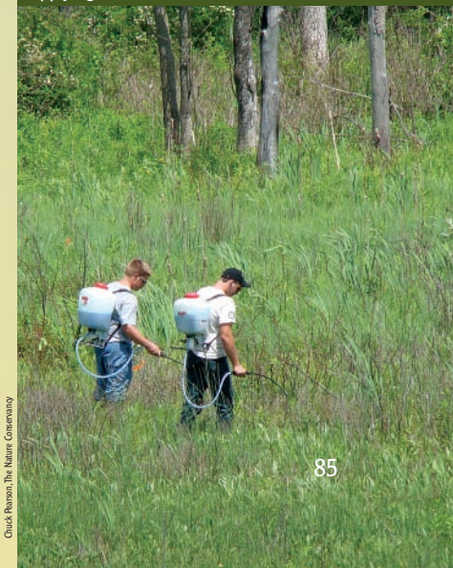
Cutting invasive shrubs.


Chuck Pearson, The Nature Conservancy

Brush piles.


Chuck Pearson, The Nature Conservancy

Applying herbicide.


Chuck Pearson, The Nature Conservancy

Painting herbicide on cut buckthorn..

Chuck Pearson,The Nature Conservancy

Burning brush piles.

Chuck Pearson,The Nature Conservancy

Volunteers with huge brush pile.

Chuck Pearson,The Nature Conservancy

Restoring native plants

An important component of the successful restoration program at Ives Road Fen has been the gathering and sowing of native seeds. Seed collection typically begins in late summer and continues through late fall, with seeds being gathered from roughly 40 native species. After collection, the seeds are bagged, dried, weighed and stored until use. To help to speed the recovery of native fen vegetation, mixtures of the seeds are then broadcast over areas that have been cleared of buckthorn and burned.

Restoring savanna to adjacent uplands

Oak savanna is being restored to portions of the adjacent uplands surrounding Ives Road Fen in an attempt to improve the overall landscape context of the fen and provide important habitat for animals such as turtles that utilize both uplands and wetlands.

Monitoring

To help gauge the success of restoration efforts at Ives Road Fen, several monitoring strategies are being employed. In the spring of 1997, 18 groundwater monitoring wells were installed to document changes in groundwater levels as ditches are filled, drain tile removed and native plants returned home. Monitoring activities also include mapping areas occupied by invasive plants and measuring the percent cover of invasive versus native vegetation.

Adrienne Bock, MNR

Fringed gentian

Partnerships

Throughout the restoration at Ives Road Fen, partnerships have played a vital role by providing both time and money. Since the purchase of Ives Road Fen in 1987, countless volunteer hours have been logged, partnerships formed and funding provided through a variety of grants. Because of the rare nature of the fen and its associated flora and fauna, local, state and federal agencies have stepped in to support the innovative restoration work being undertaken. Partnerships have also been created with many educational institutions, including local schools, colleges and universities, with faculty members and students regularly conducting ecological research and field trips at the site.

Stewardship

More than 10 years ago, The Nature Conservancy began its stewardship work to protect Ives Road Fen. To date, staff members and volunteers have:

- Removed more than 2.5 million adult buckthorn stems.
- Burned nearly 4,000 brush piles.
- Spot-burned 10 million buckthorn seedlings.
- Conducted more than 30 prescribed burns.
- Removed 1.5 tons of garlic mustard by hand.
- Treated 500,000 purple loosestrife and 10,000 cattail plants.

Though the restoration work may never be completely finished, the ultimate aim of conserving and restoring nature through forging successful community-based partnerships is off to a great start at Ives Road Fen.

In addition to restoring hydrology, management to restore and maintain biodiversity of prairie fens includes conducting prescribed fires, reducing the cover of shrubs and trees, and removing invasive species. In the past, fires resulting from lightning strikes and the activities of Native Americans regularly burned across the upland oak savannas and, when conditions permitted, carried through wetlands such as prairie fen. Along with fire, occasional beaver flooding, insect outbreaks and windthrow all helped maintain open conditions. In the absence of these natural disturbances, shrubs and trees have aggressively colonized open wetlands such as prairie fens, significantly reducing their abundance and size. Further contributing to the rapid expansion of woody plants are hydrologic changes that have drained prairie fens or lowered regional water tables. The compound effects of altering hydrology and reducing the frequency of natural disturbances make shrub and tree control a high priority management concern in many prairie fens.

Prescribed fires are used for a variety of management objectives, including decreasing the cover of shrubs and trees, stimulating seed germination and seedling establishment, bolstering flowering and seed production, and controlling invasive species. Prescribed burns are carried out by trained and experienced professionals, who follow specific prescriptions that include using fire only when weather conditions enable it to be easily managed. Because prairie fens contain an abundance of available water, control lines or burn breaks to contain a fire are easily established. Existing lakes, rivers and streams frequently serve as reliable firebreaks, and where they are lacking, portable gas-powered water pumps and fire hoses are used to create

Christopher Hoving, MDNR

Burned shrubs.

Christopher Hoving, MDNR

Prescribed fire to control shrub encroachment.

broad "wet lines" that effectively prevent the spread of fire beyond the area prescribed for burning. Because of the small and fragmented condition of our remaining prairie fens, using prescribed fire as a management tool should include setting aside significant portions of fen to remain unburned in any given year to help lessen impacts to fire-sensitive species. Unburned areas also enable fire-sensitive species to recolonize burned areas, thereby helping to protect local biodiversity. Lakes, streams, rivers and wet lines can serve as firebreaks for establishing unburned refuge areas within a prairie fen. When planning a prescribed burn, additional factors to consider for minimizing impacts to fire-sensitive species include the seasonal timing of the burn, heat intensity, rate and direction of flame spread, cloud cover, temperature and relative humidity.

Invasive plants, which often proliferate following hydrologic alteration, nutrient loading and sedimentation, have significantly reduced diversity in many prairie fens. Removing invasive species typically requires targeted control efforts, which may include cutting, brush hogging, flooding,

applying herbicides, burning and, for purple loosestrife, introducing biological control agents. Mechanical methods by themselves, such as cutting or brush hogging, are generally ineffective because many plants have well-developed root systems that allow for vigorous resprouting. However, using these methods in conjunction with herbicides and prescribed fire can be tremendously effective. When using herbicides, it is important to follow the label instructions, and in wetlands, it is critical to use only herbicides approved for use in or near open water. Because of the highly sensitive environmental conditions of prairie fens, it is advisable to consult with a trained professional before using herbicides in this natural community.


Susan L. Campbell, MNFI

Multiflora rose (an invasive shrub).

Controlling invasive plants is much easier and less costly when they are just becoming established and their populations are small. Reducing or eliminating well-established populations of invasive plants typically requires a long-term commitment to apply control treatments repeatedly over multiple years, and to carry out annual monitoring to detect resprouting and reemergence from the seed bank. Therefore, early detection coupled with a rapid response to remove the new invaders is the most cost-effective control strategy. Learning to recognize the various invasive species and understanding their biology and growing requirements are critically important to applying control techniques successfully and can help foster creative and innovative approaches to effective control.


Michael A. Kost, MNFI

Volunteers applying herbicide to control glossy buckthorn.

Volunteer stewardship

With the aid of volunteer stewards, many land managers have recently experienced great success in their efforts to restore ecological integrity to formerly degraded prairie fens in Michigan and other states. Volunteer stewards are now actively engaged in helping to restore and protect biodiversity in prairie fens by reducing the prevalence of invasive plants, removing overabundant trees and shrubs, and collecting data to monitor the success of their efforts. Volunteer stewardship activities vary seasonally and can include assisting in prescribed burns, cutting woody plants, applying herbicide to stumps, collecting and sowing seeds of native plants, growing and planting native plants, and monitoring populations of rare plants and animals. With the active growth of this budding movement toward volunteer stewardship comes renewed hope for our local natural areas and the species they support, including the natural treasures we call prairie fens.

For assistance in finding opportunities to participate in local stewardship activities, contact the Volunteer Stewardship Network by visiting its Web site.

Conclusion

Prairie fens are globally rare wetlands that support a unique and rich diversity of plants and animals, including many rare species. These important wetlands offer excellent opportunities for outdoor education, hunting, botanizing, bird watching and nature viewing. They provide critical ecological services such as delivering clean water to lakes and streams, producing clean air through photosynthesis, and reducing greenhouse gases by storing carbon in plant tissues and organic soils. Their presence in the landscape reminds us of the importance of natural places and the roles they play in our lives. Whether we venture onto the wet ground or view them from the safety of a boardwalk or passing car, prairie fens offer us their bounty of beauty, peace and wonder.

Michael A. Kost, MNFI

Boardwalk through prairie fen.

Michael A. Kost, MNFI

Places to visit a prairie fen

Explore a prairie fen by visiting local natural areas within the state game areas, state recreation areas, state parks, nature centers and nature preserves of the southern Michigan interlobate region. The following areas offer opportunities to experience prairie fens.

State lands

Bald Mountain Recreation Area
Barry State Game Area
Brighton Recreation Area
Fort Custer Military Reservation
Island Lake Recreation Area
Davisburg State Wildlife Area
Gourdneck State Game Area
Highland Recreation Area
Holly Recreation Area
Lost Nation State Game Area
Oak Grove State Game Area
Ortonville State Recreation Area
Pinckney State Recreation Area
Seven Lakes State Park
Sharonville State Game Area
Waterloo Recreation Area
Yankee Springs Recreation Area

County parks

Independence Lake County Park, Washtenaw County
Park Lyndon County Park, Washtenaw County

Metroparks

Kensington Metropark[1]
Huron Meadows Metropark
Indian Springs Metropark[1]

City parks

Spring Park, Middleville

Nature centers

Sarett Nature Center[1]
Ebersole Environmental Education Center[1, 2]
Kalamazoo Nature Center

Land conservancies

The Nature Conservancy
- Paw Paw Prairie Fen Preserve[1]
- Ives Road Fen Preserve
- Grand River Fen Preserve

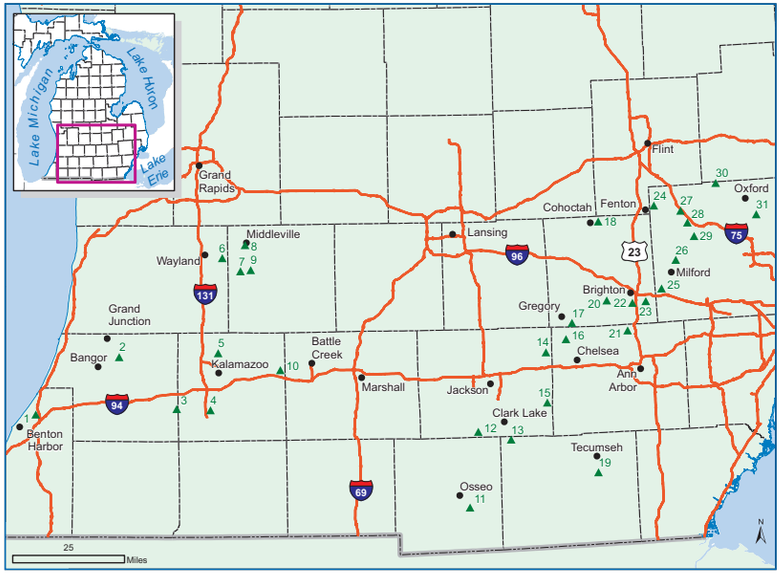
Southwest Michigan Land Conservancy
- Jeptha Lake Fen Preserve[1]

Michigan Nature Association
- Goose Creek Grasslands

[1] *These areas provide viewing platforms or boardwalks for visitors. Contact these organizations to make arrangements to visit.*

[2] *Lansing School District controlled property, permission required.*

Locations of select prairie fens in southern Michigan



No.	Site	Ownership
1	Sarett Nature Center	Nature Center
2	Jephtha Lake Fen Preserve	Southwest Michigan Land Conservancy
3	Paw Paw Prairie Fen Preserve	The Nature Conservancy
4	Gourdneck State Game Area	State of Michigan
5	Kalamazoo Nature Center	Nature Center
6	Ebersole Environmental Education Center	Lansing Public School District
7	Yankee Springs Recreation Area	State of Michigan
8	Spring Park, Middleville	City of Middleville
9	Barry State Game Area	State of Michigan
10	Fort Custer Military Reservation	Federal
11	Lost Nation State Game Area	State of Michigan
12	Grand River Fen Preserve	The Nature Conservancy
13	Goose Creek Grasslands	Michigan Nature Association
14	Waterloo Recreation Area	State of Michigan
15	Sharonville State Game Area	State of Michigan
16	Park Lyndon County Park	Washtenaw County
17	Pinckney State Recreation Area	State of Michigan
18	Oak Grove State Game Area	State of Michigan
19	Ives Road Fen Preserve	The Nature Conservancy
20	Brighton Recreation Area	State of Michigan
21	Independence Lake County Park	Washtenaw County
22	Huron Meadows Metropark	Huron-Clinton Metroparks
23	Island Lake Recreation Area	State of Michigan
24	Seven Lakes State Park	State of Michigan
25	Kensington Metropark	Huron-Clinton Metroparks
26	Highland Recreation Area	State of Michigan
27	Holly Recreation Area	State of Michigan
28	Davisburg State Wildlife Area	State of Michigan
29	Indian Springs Metropark	Huron-Clinton Metroparks
30	Ortonville Recreation Area	State of Michigan
31	Bald Mountain Recreation Area	State of Michigan

Plants Commonly Found in Prairie Fens

Scientific name	*Common name*	*Status*	*Life form*
Acer rubrum	Red maple		Tree
Agalinis purpurea	Purple gerardia		Forb, A
Agropyron trachycaulum	Slender wheat grass		Grass, P
Alnus rugosa	Tag alder		Shrub
Amphicarpaea bracteata	Hog peanut		Forb, A
Andropogon gerardii	Big bluestem		Grass, P
Andropogon scoparius	Little bluestem		Grass, P
Angelica atropurpurea	Angelica		Forb, P
Apios americana	Groundnut		Forb, P
Apocynum cannabinum	Indian hemp		Forb, P
Aquilegia canadensis	Wild columbine		Forb, P
Aronia prunifolia	Black chokeberry		Shrub
Asclepias incarnata	Swamp milkweed		Forb, P
Aster borealis	Northern bog aster		Forb, P
Aster firmus (A. lucidulus)	Smooth swamp aster		Forb, P
Aster laevis	Smooth aster		Forb, P
Aster lanceolatus	Eastern lined aster		Forb, P
Aster lateriflorus	Side-flowering aster		Forb, P
Aster novae-angliae	New England aster		Forb, P
Aster puniceus	Swamp aster		Forb, P
Aster umbellatus	Tall flat-top white aster		Forb, P
Berula erecta	Water parsnip	T	Forb, P
Betula alleghaniensis	Yellow birch		Tree
Betula pumila	Bog birch		Shrub
Bidens coronatus	Tall swamp marigold		Forb, A
Boehmeria cylindrica	False nettle		Forb, P
Bromus ciliatus	Fringed brome		Grass, P
Cacalia plantaginea	Prairie Indian plantain	SC	Forb, P
Calamagrostis canadensis	Blue-joint grass		Grass, P
Calopogon tuberosus	Grass pink		Forb, P
Caltha palustris	Marsh marigold		Forb, P
Calystegia sepium	Hedge bindweed		Forb, P
Campanula aparinoides	Marsh bellflower		Forb, P
Cardamine bulbosa	Spring cress		Forb, P
Carex aquatilis	Water sedge		Sedge, P
Carex bebbii	Bebb's sedge		Sedge, P
Carex buxbaumii	Buxbaum's sedge		Sedge, P
Carex comosa	Longhair sedge		Sedge, P
Carex cryptolepis	Northeastern sedge		Sedge, P
Carex diandra	Lesser panicled sedge		Sedge, P
Carex flava	Yellow sedge		Sedge, P
Carex hystericina	Bottlebrush sedge		Sedge, P
Carex lacustris	Lake sedge		Sedge, P
Carex lasiocarpa	Wiregrass sedge		Sedge, P
Carex leptalea	Bristly-stalked sedge		Sedge, P
Carex pellita (C. lanuginosa)	Woolly sedge		Sedge, P
Carex prairea	Prairie sedge		Sedge, P
Carex pseudo-cyperus	Cyperus-like sedge		Sedge, P
Carex sartwellii	Sartwell's sedge		Sedge, P
Carex sterilis	Dioecious sedge		Sedge, P
Carex stipata	Awl-fruit sedge		Sedge, P
Carex stricta	Tussock sedge		Sedge, P
Carex tetanica	Rigid sedge		Sedge, P
Carex vulpinoidea	Fox sedge		Sedge, P
Chelone glabra	Turtlehead		Forb, P
Cicuta bulbifera	Water hemlock		Forb, P

Plants Commonly Found in Prairie Fens – Continued

Scientific name	*Common name*	*Status*	*Life form*
Cicuta maculata	Water hemlock		B-Forb
Cirsium muticum	Swamp thistle		B-Forb
Cladium mariscoides	Twig-rush		Sedge, P
Clematis virginiana	Virgin's bower		Vine
Comandra umbellata	Bastard toadflax		Forb, P
Cornus amomum	Silky dogwood		Shrub
Cornus foemina	Gray dogwood		Shrub
Cornus stolonifera	Red osier dogwood		Shrub
Corylus americana	Hazelnut		Shrub
Cuscuta gronovii	Common dodder		Forb, A
Cypripedium calceolus	Small yellow lady-slipper		Forb, P
Cypripedium candidum	White lady-slipper	T	Forb, P
Cypripedium reginae	Showy lady-slipper		Forb, P
Deschampsia cespitosa	Hair grass		Grass, P
Dioscorea villosa	Wild yam		Forb, P
Drosera rotundifolia	Round-leaved sundew		Forb, P
Elaeagnus umbellata	**Autumn olive**		**Shrub**
Eleocharis elliptica	Golden-seeded spike-rush		Sedge, P
Eleocharis erythropoda	Spike-rush		Sedge, P
Eleocharis rostellata	Beaked spike-rush		Sedge, P
Equisetum arvense	Common horsetail		Fern Ally
Equisetum fluviatile	Water horsetail		Fern Ally
Eriophorum viridi-carinatum	Green-keeled cotton grass		Sedge, P
Eupatorium maculatum	Joe-pye weed		Forb, P
Eupatorium perfoliatum	Common boneset		Forb, P
Euthamia graminifolia	Grass-leaved goldenrod		Forb, P
Fragaria virginiana	Wild strawberry		Forb, P
Fraxinus nigra	Black ash		Tree
Galium asprellum	Rough bedstraw		Forb, P
Galium boreale	Northern bedstraw		Forb, P
Galium labradoricum	Bog bedstraw		Forb, P
Gentianopsis procera	Small fringed gentian		Forb, A
Geranium maculatum	Wild geranium		Forb, P
Glyceria striata	Fowl manna grass		Grass, P
Helenium autumnale	Sneezeweed		Forb, P
Helianthus giganteus	Tall sunflower		Forb, P
Hypoxis hirsuta	Star grass		Forb, P
Ilex verticillata	Winterberry		Shrub
Impatiens capensis	Jewelweed		Forb, A
Iris virginica	Southern blue flag		Forb, P
Juncus brachycephalus	Smallhead rush		Rush, P
Juncus canadensis	Canadian rush		Rush, P
Juncus dudleyi	Dudley's rush		Rush, P
Juncus effusus	Soft-stemmed rush		Rush, P
Juncus tenuis	Path rush		Rush, P
Juniperus communis	Common juniper		Shrub
Juniperus virginiana	Red cedar		Tree
Larix laricina	Tamarack		Tree
Lathyrus palustris	Marsh pea		Forb, P
Leersia oryzoides	Cut grass		Grass, P
Liatris spicata	Marsh blazing star		Forb, P
Lilium michiganense	Michigan lily		Forb, P
Lilium philadelphicum	Wood lily		Forb, P
Lindera benzoin	Spicebush		Shrub
Liriodendron tulipifera	Tulip tree		Tree
Lobelia kalmii	Bog lobelia		Forb, P

Plants Commonly Found in Prairie Fens – Continued

Scientific name	Common name	Status	Life form
Lobelia siphilitica	Great blue lobelia		Forb, P
Lonicera dioica	Red honeysuckle		Vine
Lycopus americanus	Common water horehound		Forb, P
Lycopus uniflorus	Northern bugleweed		Forb, P
Lysimachia quadriflora	Whorled loosestrife		Forb, P
Lysimachia thyrsiflora	Tufted loosestrife		Forb, P
Lythrum salicaria	**Purple loosestrife**		**Forb, P**
Maianthemum canadense	Canada mayflower		Forb, P
Mentha arvensis	Wild mint		Forb, P
Menyanthes trifoliata	Buckbean		Forb, P
Monarda fistulosa	Wild bergamot		Forb, P
Muhlenbergia glomerata	Marsh wild timothy		Grass, P
Muhlenbergia mexicana	Leafy satin grass		Grass, P
Nasturtium officinale	**Watercress**		**Grass, P**
Nemopanthus mucronatus	Mountain holly		Shrub
Onoclea sensibilis	Sensitive fern		Fern
Osmunda cinnamomea	Cinnamon fern		Fern
Osmunda regalis	Royal fern		Fern
Oxypolis rigidior	Cowbane		Forb
Panicum clandestinum	Panic grass		Grass, P
Parnassia glauca	Grass-of-Parnassus		Forb, P
Parthenocissus quinquefolia	Virginia creeper		Wine
Pedicularis lanceolata	Swamp betony		Forb, P
Phalaris arundinacea	**Reed canary grass**		**Grass, P**
Phragmites australis	**Common reed**		**Grass, P**
Physocarpus opulifolius	Ninebark		Shrub
Pilea pumila	Clearweed		Forb, A
Pinus strobus	White pine		Tree
Poa palustris	Fowl meadow grass		Grass, P
Polygonum amphibium	Water smartweed		Forb, P
Polygonum hydropiper	Water pepper		Forb, A
Populus tremuloides	Quaking aspen		Tree
Potentilla fruticosa	Shrubby cinquefoil		Shrub
Potentilla palustris	Marsh cinquefoil		Forb, P
Prunus serotina	Black cherry		Tree
Pycnanthemum virginianum	Common mountain mint		Forb, P
Rhamnus alnifolia	Alder-leaved buckthorn		Shrub
Rhamnus frangula	**Glossy buckthorn**		**Shrub**
Rhynchospora alba	White beak-rush		Sedge, P
Rhynchospora capillacea	Beak-rush		Sedge, P
Ribes hirtellum	Swamp gooseberry		Shrub
Rosa multiflora	**Multiflora rose**		**Shrub**
Rosa palustris	Swamp rose		Shrub
Rubus pubescens	Dwarf raspberry		Forb, P
Rubus strigosus	Wild red raspberry		Shrub
Rudbeckia hirta	Black-eyed Susan		Forb, P
Rumex orbiculatus	Great water dock		Forb, P
Sagittaria latifolia	Common arrowhead		Forb, P
Salix bebbiana	Bebb's willow		Shrub
Salix candida	Hoary willow		Shrub
Salix discolor	Pussy willow		Shrub
Salix lucida	Shining willow		Shrub
Salix petiolaris	Slender willow		Shrub
Sambucus canadensis	Elderberry		Shrub
Sarracenia purpurea	Pitcher plant		Forb, P
Saxifraga pensylvanica	Swamp saxifrage		Forb, P

Plants Commonly Found in Prairie Fens – Continued

Scientific name	Common name	Status	Life form
Schoenoplectus acutus (*Scirpus acutus*)	Hard-stem bulrush		Sedge, P
Schoenoplectus pungens (*Scirpus americanus*)	Three-square		Sedge, P
Schoenoplectus tabernaemontani (*Scirpus validus*)	Soft-stem bulrush		Sedge, P
Scirpus atrovirens	Bulrush		Sedge, P
Scleria verticillata	Nut-rush		Sedge, A
Scutellaria galericulata	Common skullcap		Forb, P
Selaginella eclipes	Selaginella		Fern Ally
Senecio aureus	Golden ragwort		Forb, P
Senecio pauperculus	Balsam ragwort		Forb, P
Silphium terebinthinaceum	Prairie dock		Forb, P
Sium suave	Water parsnip		Forb, P
Smilacina stellata	Starry false Solomon's seal		Forb, P
Solidago altissima	Tall goldenrod		Forb, P
Solidago canadensis	Canada goldenrod		Forb, P
Solidago gigantea	Late goldenrod		Forb, P
Solidago ohioensis	Ohio goldenrod		Forb, P
Solidago patula	Swamp goldenrod		Forb, P
Solidago riddellii	Riddell's goldenrod		Forb, P
Solidago rugosa	Rough goldenrod		Forb, P
Solidago uliginosa	Bog goldenrod		Forb, P
Sorghastrum nutans	Indian grass		Grass, P
Spartina pectinata	Cordgrass		Grass, P
Spiraea alba	Meadowsweet		Shrub
Spiranthes cernua	Nodding ladies-tresses		Forb, P
Symplocarpus foetidus	Skunk cabbage		Forb, P
Thalictrum dasycarpum	Purple meadow rue		Forb, P
Thelypteris palustris	Marsh fern		Fern
Thuja occidentalis	Northern white cedar		Tree
Tofieldia glutinosa	False asphodel		Forb, P
Toxicodendron radicans	Poison ivy		Vine
Toxicodendron vernix	Poison sumac		Shrub
Triadenum fraseri	Marsh St. John's-wort		Forb, P
Trientalis borealis	Starflower		Forb, P
Triglochin maritimum	Common bog arrowgrass		Forb, P
Typha angustifolia	**Narrow-leaved cattail**		**Forb, P**
Typha latifolia	Broad-leaved cattail		Forb, P
Typha xglauca	**Hybrid cattail**		**Forb, P**
Ulmus americana	American elm		Tree
Utricularia cornuta	Horned bladderwort		Forb, A
Utricularia intermedia	Flat-leaved bladderwort		Forb, P
Vaccinium corymbosum	Smooth highbush blueberry		Shrub
Valeriana ciliata	Common valerian	T	Forb, P
Valeriana uliginosa	Bog valerian		Forb, P
Viburnum lentago	Nannyberry		Shrub
Viola cucullata	Marsh violet		Forb, P
Viola nephrophylla	Northern bog violet		Forb, P
Vitis riparia	Riverbank grape		Vine
Zigadenus glaucus	White camas		Forb, P
Zizia aurea	Golden alexanders		Forb, P

Species in **bold** are considered invasive in Michigan. Status is provided for rare plants by the following acronyms: T, state threatened (protected by law); and SC, state special concern. Life form acronyms are as follows: P, perennial; B, biannual; and A, annual.

Animals Associated with Prairie Fens in Michigan

Common name	Scientific name	Status
Amphibians		
Blanchard's cricket frog	*Acris crepitans blanchardi*	T
Bullfrog	*Rana catesbeiana*	
Eastern American toad	*Bufo americanus americanus*	
Gray tree frog	*Hyla versicolor* and *Hyla chrysoscelis*	
Green frog	*Rana clamitans melanota*	
Northern leopard frog	*Rana pipiens*	SGCN
Northern spring peeper	*Pseudacris crucifer crucifer*	
Pickerel frog	*Rana palustris*	
Western chorus frog	*Pseudacris triseriata*	
Wood frog	*Rana sylvatica*	
Birds		
Alder flycatcher	*Empidonax virescens*	
American crow	*Corvus brachyrhynchos*	
American goldfinch	*Carduelis tristis*	
American redstart	*Setophaga ruticilla*	
American robin	*Turdus migratorius*	
American woodcock	*Scolopax minor*	SGCN
Bank swallow	*Riparia riparia*	
Barn swallow	*Hirumdo rustica*	
Barred owl	*Strix varia*	
Belted kingfisher	*Megaceryle alcyon*	
Black-billed cuckoo	*Coccyzus erythropthalmus*	SGCN
Black-and-white warbler	*Mniotilta varia*	
Black-capped chickadee	*Poecile atricapilla*	
Blue-winged teal	*Anas discors*	SGCN
Blue-winged warbler	*Vermivora pinus*	SGCN
Brown creeper	*Certhia americana*	
Brown-headed cowbird	*Molothrus ater*	
Cedar waxwing	*Bombycilla cedrorum*	
Common grackle	*Quiscalus quiscula*	
Common redpoll	*Carduelis flammea*	
Common yellowthroat	*Geothlypis trichas*	
Cooper's hawk	*Accipiter cooperi*	SC
Dark-eyed junco (in winter)	*Junco hyemalis*	
Downy woodpecker	*Picoides pubescens*	
Eastern screech owl	*Otus asio*	
Gray catbird	*Dumetella carolinensis*	
Great blue heron	*Ardea herodias*	SGCN
Great crested flycatcher	*Myiarchus crinitus*	
Great horned owl	*Bubo virginianus*	
Green heron	*Butorides virescens*	SGCN
House wren	*Troglodytes aedon*	
Killdeer	*Charadrius vociferus*	SGCN
Mallard	*Anas platyrhynchos*	
Northern flicker	*Colaptes aurautus*	SGCN
Northern harrier	*Circus cyaneus*	SC
Northern rough-winged swallow	*Stelgidopteryx serripennis*	

Animals Associated with Prairie Fens in Michigan – Continued

Common name	Scientific name	Status
Northern saw-whet owl	*Aegolius acadicus*	
Pine siskin (in winter)	*Carduelis pinus*	
Red-bellied woodpecker	*Melanerpes carolinus*	
Red-shouldered hawk	*Buteo lineatus*	T
Red-tailed hawk	*Buteo jamaicensis*	
Red-winged blackbird	*Agelaius phoeniceus*	
Ring-necked pheasant	*Phasianus colchicus*	
Ruby-throated hummingbird	*Archilochus colubrus*	
Ruffed grouse	*Bonasa umbellus*	
Sandhill crane	*Grus canadensis*	
Sedge wren	*Cistothorus plantensis*	SGCN
Song sparrow	*Melospiza melodia*	
Sora	*Porzana carolina*	SGCN
Swamp sparrow	*Melospiza georgiana*	
Tree swallow	*Tachycineta bicolor*	
Turkey vulture	*Cathartes aura*	
Warbling vireo	*Vireo gilvus*	
White-crowned sparrow (in winter)	*Zonotrichia leucophrys*	
White-throated sparrow (in winter)	*Zonotrichia albicollis*	
Wild turkey	*Meleagris gallopavo*	
Wilson's snipe	*Gallinago delicata*	SGCN
Willow flycatcher	*Empidonax traillii*	
Winter wren	*Troglodytes troglodytes*	
Yellow-billed cuckoo	*Coccyzus americanus*	SGCN
Yellow-breasted chat	*Icteria virens*	SGCN
Yellow warbler	*Dendroica petechia*	
Insects: Butterflies and Moths		
Aphrodite fritillary	*Speyeria aphrodite*	
Appalachian eyed brown	*Satyrodes appalachia*	
Baltimore checkerspot	*Euphydryas phaeton*	
Blazing star borer moth	*Papaipema beeriana*	SC
Checkered skipper	*Pyrgus communis*	
Delaware skipper	*Anatrytone logan*	
Dorcas copper	*Lycaena dorcas*	
Duke's skipper	*Euphyes dukesi*	
Dun skipper	*Euphyes vestris*	
Eyed brown	*Satyrodes eurydice*	
Great spangled fritillary	*Speyeria cybele*	
Larch casebearer	*Coleophora laricella*	
Least skipper	*Ancyloxypha numitor*	
Little wood satyr	*Megisto cymela*	
Mitchell's satyr	*Neonympha mitchellii mitchellii*	E, FE
Monarch	*Danaus plexippus*	
Mulberry skipper	*Poanes massasoit*	
Northern pearly eye	*Enodia anthedon*	
Pearly crescentspot	*Phyciodes tharos*	
Poweshiek skipperling	*Oarisma poweshiek*	T
Red admiral	*Vanessa atalanta*	

Animals Associated with Prairie Fens in Michigan

Common name	Scientific name	Status
Regal fern borer moth	*Papaipema speciossima*	SC
Silphium borer moth	*Papaipema silphii*	T
Silver-bordered fritillary	*Boloria selene*	
Silver-spotted skipper	*Epargyreus clarus*	
Sunflower borer moth	*Papaipema maritima*	SC
Swamp metalmark	*Calephelis mutica*	SC
Tawny crescent	*Phyciodes batesii*	SGCN
Viceroy	*Limenitis archippus*	
Wood nymph	*Cercyonis pegala*	
Insects: Ants and Wasps		
Larch sawfly	*Pristophora erichsonii*	
Insects: Beetles		
Eastern larch beetle	*Dendroctonus simplex*	
Insects: Damselflies		
Pond damsels	Family: *Coenagrionidae*	
Spreadwings	Family: *Lestidae*	
Insects: Dragonflies		
Gray petaltail	*Tachopteryx thoreyi*	SGCN
Skimmers	Family: *Libellulidae*	
Emeralds	Family: *Corduliidae*	
Spiketails	Family: *Cordulegastridae*	
Ringed boghaunter	*Williamsonia lintneri*	SGCN
Insects: Leafhoppers		
Leafhopper	*Flexamia reflexus*	
Huron River leafhopper	*Flexamia huronia*	
Insects: Spittlebugs		
Angular spittlebug	*Lepyronia angulifera*	SC
Red-legged spittlebug	*Prosapia ignipectus*	SC
Insects: Tree Crickets		
Tamarack tree cricket	*Oecanthus laricis*	SC
Fish		
Bluegill	*Lepomis macrochirus*	
Brook stickleback	*Culaea inconstans*	
Brook trout	*Salvelinus fontinalis*	
Common shiner	*Notropis cornutus*	
Green sunfish	*Lepomis cyanellus*	
Largemouth bass	*Micropterus salmoides*	
Mud minnow	*Umbra limi*	
Northern pike	*Esox lucius*	
Pumpkinseed	*Lepomis gibbosus*	
Smallmouth bass	*Micropterus dolomieui*	

Animals Associated with Prairie Fens in Michigan – Continued

Common name	Scientific name	Status
Mammals		
Beaver	*Castor canadensis*	
Coyote	*Canis latrans*	
Eastern cottontail	*Sylvilagus floridanus*	
White-tailed deer	*Odocoileus virginianus*	
Masked shrew	*Sorex cinereus*	
Meadow jumping mouse	*Zapus hudsonius*	
Meadow vole	*Microtus pennsylvanicus*	
Mink	*Mustela vison*	
Muskrat	*Onadatra zibethicus*	
Northern short-tailed shrew	*Blarina brevicauda*	
Raccoon	*Procyon lotor*	
Red squirrel	*Tamiasciurus hudsonicus*	
Red fox	*Vulpes vulpes*	
Southern bog lemming	*Synaptomys cooperi*	SGCN
Star-nosed mole	*Condylura cristata*	
Mollusks *(Snails and Mussels)*		
Snails (Gastropod)		
Golden fossaria	*Fossaria obrussa*	
Oval amber snail	*Novisuccinea ovalis*	
Pleistocene catinella	*Catinella exile*	SGCN
Six-whorl vertigo	*Vertigo morsei*	SGCN
Snail (no common name)	*Fossaria exigua*	
Snail (no common name)	*Euconulus alderi*	SGCN
Watercress snail	*Fontigens nickliniana*	SC
Mussels (Unionidae)		
Slippershell mussel	*Alasmidonta viridis*	SGCN
Giant floater	*Pyganodon grandis*	
Wabash pigtoe	*Fusconaia flava*	
Strange floater	*Strophitus undulatus*	
Creek heelsplitter	*Lasmigona compressa*	SGCN
Clams (Sphaeriidae)		
Fingernail clams	Family: *Sphaeriidae*	
Reptiles		
Blanding's turtle	*Emys blandingii*	SC
Eastern box turtle	*Terrapene carolina carolina*	SC
Eastern garter snake	*Thamnophis sirtalis sirtalis*	
Eastern hognose snake	*Heterodon platirhinos*	
Eastern massasauga	*Sistrurus catenatus catenatus*	SC, FC
Eastern milk snake	*Lampropeltis triangulum triangulum*	
Kirtland's snake	*Clonophis kirtlandii*	E
Northern ribbon snake	*Thamnophis sauritus septentrionalis*	
Northern water snake	*Nerodia sipedon*	
Painted turtle	*Chrysemys picta*	
Snapping turtle	*Chelydra serpentina*	
Spotted turtle	*Clemmys guttata*	T

Acronyms for status are as follows: SGCN, species of greatest conservation need; SC, state special concern; T, state threatened (protected by law); E, state endangered (protected by law); FE, federally endangered (protected by law); FC, federal candidate.

Rare Plants of Prairie Fens in Michigan

Scientific name	*Common name*	*Status*
Asclepias purpurascens	Purple milkweed	T
Aster praealtus	Willow aster	SC
Berula erecta	Cut-leaved water parsnip	T
Cacalia plantaginea	Prairie Indian plantain	SC
Calamagrostis stricta	Narrow-leaved reedgrass	T
Cypripedium candidum	White lady-slipper	T
Dodecatheon meadia	Shooting star	E
Drosera anglica	English sundew	SC
Eryngium yuccifolium	Rattlesnake master	T
Filipendula rubra	Queen-of-the-prairie	T
Helianthus hirsutus	Whiskered sunflower	SC
Muhlenbergia richardsonis	Mat muhly	T
Phlox maculata	Wild sweet William	T
Polemonium reptans	Jacob's ladder	T
Pycnanthemum muticum	Broad-leaved mountain mint	T
Sanguisorba canadensis	Canadian burnet	T
Silphium integrifolium	Rosinweed	T
Sporobolus heterolepis	Prairie dropseed	SC
Valeriana edulis var. *ciliata*	Edible valerian	T
Zizania aquatica var. *aquatica*	Wild rice	T

Acronyms for status are as follows: SC, state special concern; T, state threatened (protected by law); E, state endangered (protected by law).

David L. Cuthrell

Mitchell's satyr nectaring on the rare plant Prairie Indian plantain.

Rare Animals Associated with Prairie Fens in Michigan

Common name	*Scientific name*	*Status*
Amphibians		
Blanchard's cricket frog	*Acris crepitans blanchardi*	T
Insects: Butterflies and Moths		
Barrens buckmoth	*Hemileuca maia*	SC
Blazing star borer moth	*Papaipema beeriana*	SC
Culver's root borer moth	*Papaipema sciata*	SC
Duke's skipper	*Euphyes dukesi*	T
Golden borer moth	*Papaipema cerina*	SC
Maritime sunflower borer moth	*Papaipema maritime*	SC
Mitchell's satyr	*Neonympha m. mitchellii*	FE, E
Newman's brocade	*Meropleon ambifusca*	SC
Poweshiek skipperling	*Oarisma poweshiek*	T
Regal fern borer moth	*Papaipema speciosissima*	SC
Silphium borer moth	*Papaipema silphii*	T
Spartina moth	*Spartiniphaga inops*	SC
Swamp metalmark	*Calephelis mutica*	SC
Insects: Beetles		
Cantrall's bog beetle	*Liodessus cantralli*	SC
Douglas Stenelmis riffle beetle	*Stenelmis douglasensis*	SC
Insects: Cicadas and Leafhoppers		
Angular spittlebug	*Lepyronia angulifera*	SC
Huron River leafhopper	*Flexamia huroni*	T
Leafhopper	*Flexamia delongi*	SC
Leafhopper	*Flexamia reflexus*	SC
Kansan spike-rush leafhopper	*Dorydiella kansana*	SC
Red-legged spittlebug	*Prosapia ignipectus*	SC
Insects: Dragonflies		
Gray petaltail	*Tachopteryx thoreyi*	T
Insects: Grasshoppers and Crickets		
Bog conehead	*Neoconocephalus lyristes*	SC
Hoosier locust	*Paroxya hoosieri*	SC
Red-faced meadow katydid	*Orchelimum concinnum*	SC
Tamarack tree cricket	*Oecanthus laricis*	SC
Mollusks		
Watercress snail	*Fontigens nickliniana*	SC
Reptiles		
Blanding's turtle	*Emydoidea blandingii*	SC
Eastern box turtle	*Terrapene c. carolina*	SC
Eastern massasauga rattlesnake	*Sistrurus c. catenatus*	FC, T
Kirtland's snake	*Clonophis kirtlandii*	E
Spotted turtle	*Clemmys guttata*	T

Acronyms for status are as follows: SC, state special concern; T, state threatened (protected by law); E, state endangered (protected by law); FE, federally endangered (protected by law); FC, federal candidate.

Photo and Graphic Sources

Graphics:

Amon, J. P., C. A. Thompson, Q. J. Carpenter and J. Miner. 2002. Pages 10 and 22 in Temperate zone fens of the glaciated Midwestern USA. Wetlands 22:301-317.

Clahassey, Katherine. 1988. Pages 7, 8 and 9 in The Glacial Lakes Around Michigan by William R. Farrand. Bulletin #4. Lansing: MDEQ.

Circa 1800 Vegetation Map

Comer, P.J., D.A. Albert, H.A. Wells, B.L. Hart, J.B. Raab, D.L. Price, D.M. Kashian, R.A. Corner and D.W. Schuen. 1995. Michigan's presettlement vegetation, as interpreted from the General Land Office Surveys 1816-1856. Lansing: Michigan Natural Features Inventory. Digital Map.

Photographs:

Barbara J. Barton, MNFI
Adrienne L. Bozic, MNFI
Suzan Campbell, MNFI
Kim A. Chapman, MNFI
Joshua G. Cohen, MNFI
Connecticut Agricultural Experiment Station
Ezekial Cooley, MDNR
David L. Cuthrell, MNFI
Amy L. Derosier, MDNR
Helen Enander, MNFI
Christine Hanaburgh, MDNR
James H. Harding, MSU
Nathan Herbert, MNFI
Steve Hillebrand, USFWS, National Digital Library
John & Karen Hollingsworth, USFWS, National Digital Library
Christopher Hoving, MDNR
Daria A. Hyde, MNFI
David Kenyon, MDNR
Michael A. Kost, MNFI
Kile Kuchner, MNFI
Douglas A. Landis, MSU
Todd Losee, MDEQ, Land and Water Management Division
Gary Kramer, USFWS, National Digital Library
Mitch Magditch, Toledo Zoo
James S. McCormac, Ohio Department of Natural Resources
Dave Menke, USFWS, National Digital Library
Leslie Mertz, Wayne State University
Michael J. Monfils, MNFI
Jeffrey C. Nekola, University of New Mexico
Chuck Pearson, TNC
Gary Reese, MNFI
Joseph Sage, Indiana Purdue at Fort Wayne (IPFW)
Rebecca K. Schillo, MNFI
Konrad P. Schmidt, Minnesota, DNR
Bradford S. Slaughter, MNFI
Brian Tang, Photographer — http://www.hardrain1.com/
Roy Van Loo, Jr., wildlife artist, Battle Creek, Mich. — http://www.whereisart.com/ArtistProfile.aspx?id=10363
Mindy Walker, Sarett Nature Center
Larry West, photographer, Mason, Mich.
Harry Zeman, National Wild Turkey Federation

Cover photos:

Front: Park Lyndon Prairie Fen — *photo by Michael A Kost, MNFI*
Back: Tamarack trees in the fall at Pickerel Lake, Pinckney Recreation Area — *photo by Daria A. Hyde, MNFI*

Blank back cover

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan Natural Features Inventory