Exploring the Prairie Fen Wetlands of Michigan

Michael A. Kost and Daria A. Hyde

MICHIGAN STATE
UNIVERSITY
EXTENSION

E-3045 • New • December 2009

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by

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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
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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.

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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. Nosal, MWT

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

Michael A. Kost, MNFI

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.

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

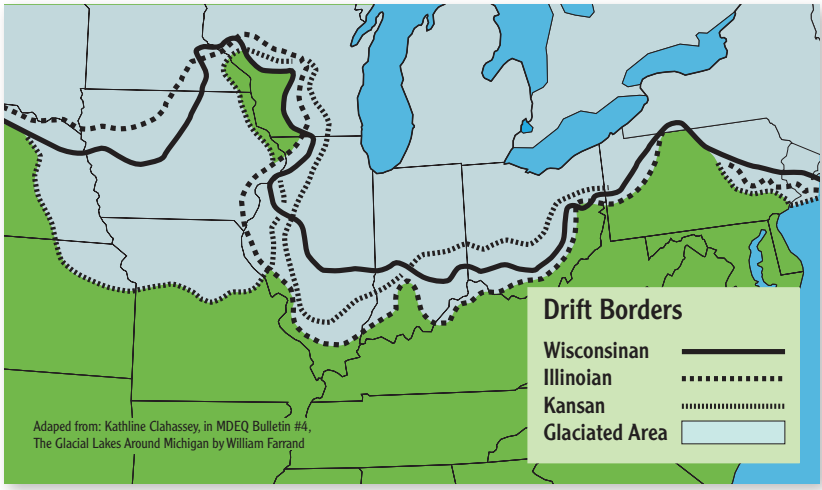
Landscape Context

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

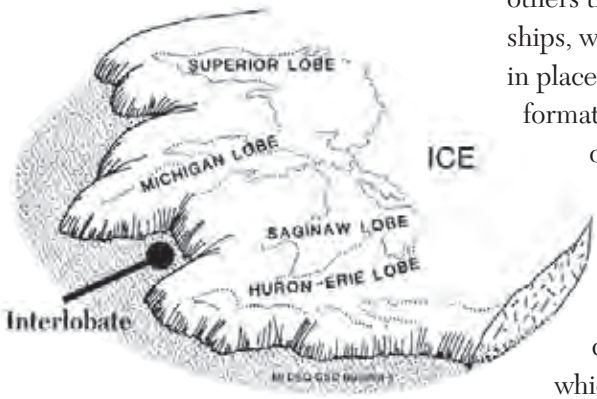


Four major glaciation events influenced the topography of the upper Midwest: Wisconsinan, Illinoian, Kansan and Nebraskan (not shown).

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*



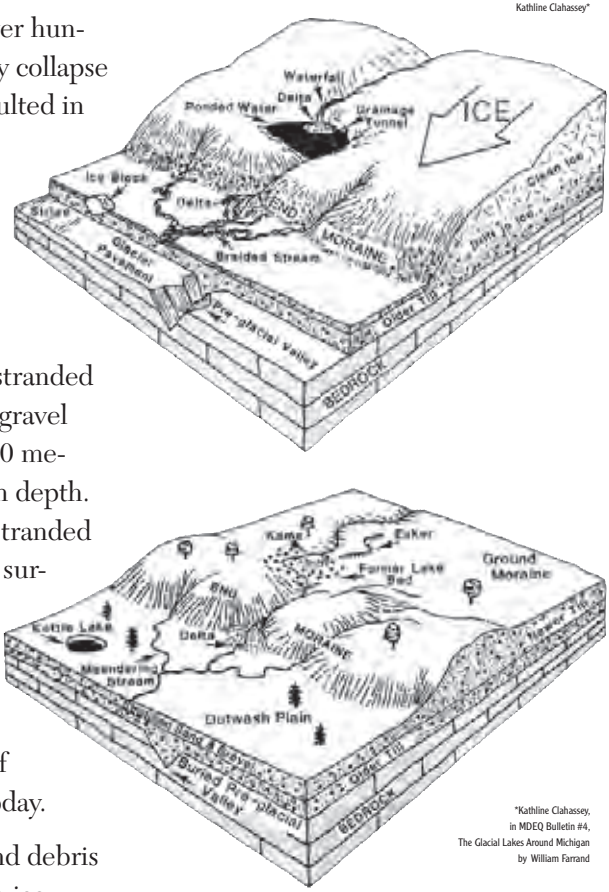
Acting like a gigantic conveyor belt, the glacial ice sheets transported millions of tons of glacial till in the form of rock and sediment to new locations. When the glacier halted its forward progress and slowly began to melt, the glacial till accumulated in the form of steep hills called **moraines** 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*

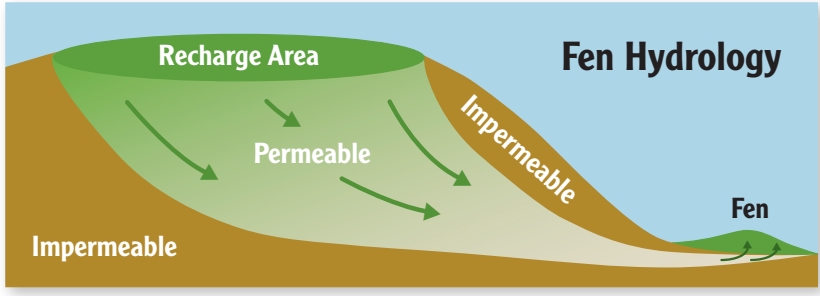


*Kathline Clahassey, in MDEQ Bulletin #4, The Glacial Lakes Around Michigan by William Farrand

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 flood-



Adapted from Amon et. al., 2002.

Rich tamarack swamp in background.

plains 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.

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.

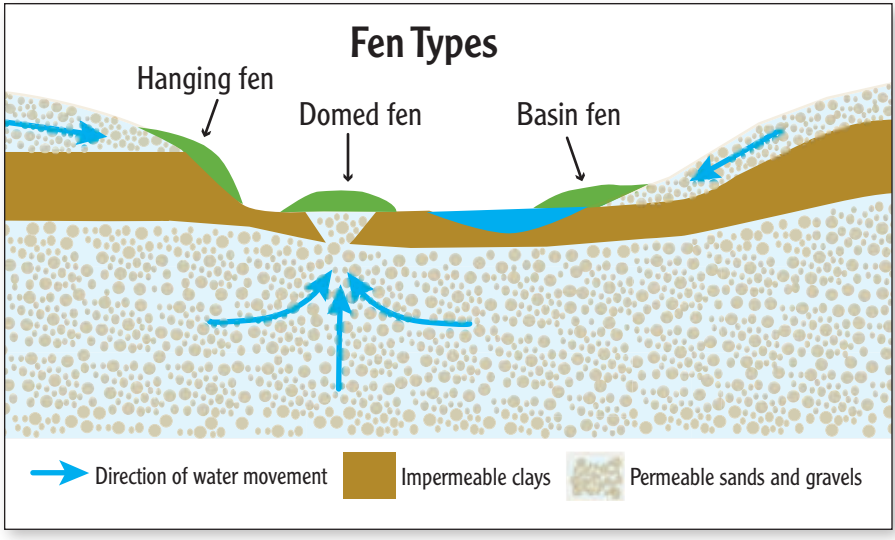
Pitcher plants and sundews live on land, catching flying and crawling invertebrates. Bladderworts grow under water, trapping tiny swimming animals. Bladderworts have small, fleshy, floating appendages known as bladders, which are filled with digestive enzymes and contain a tiny trap door ringed by trigger 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

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.

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

MITCHELL'S SATYR

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.

Haploa tiger moth

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.

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

Barbara J. Barton, MNFI

Duke's skipper

Barbara J. Barton, MNFI

Poweshiek skipperling

David L. Cuthrell

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

Dorcas copper

Silver-bordered fritillary

Barbara J. Barton, MNFI

Silphium borer

David L. Cuthrell, MNFI

David L. Cuthrell, MNFI

Blacklighting (above) and Baltimore checkerspot (below)

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)*.

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.

James S. McCormac, ODNR

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)

Little bluestem (clump)

Buxbaum's sedge

Smallhead rush

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

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.

Leslie Mertz, Wayne State University

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.

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.

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.

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