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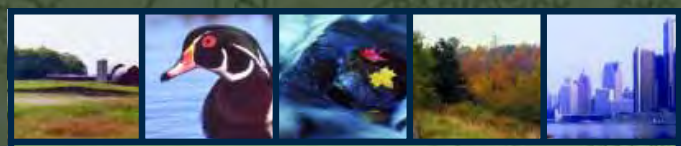
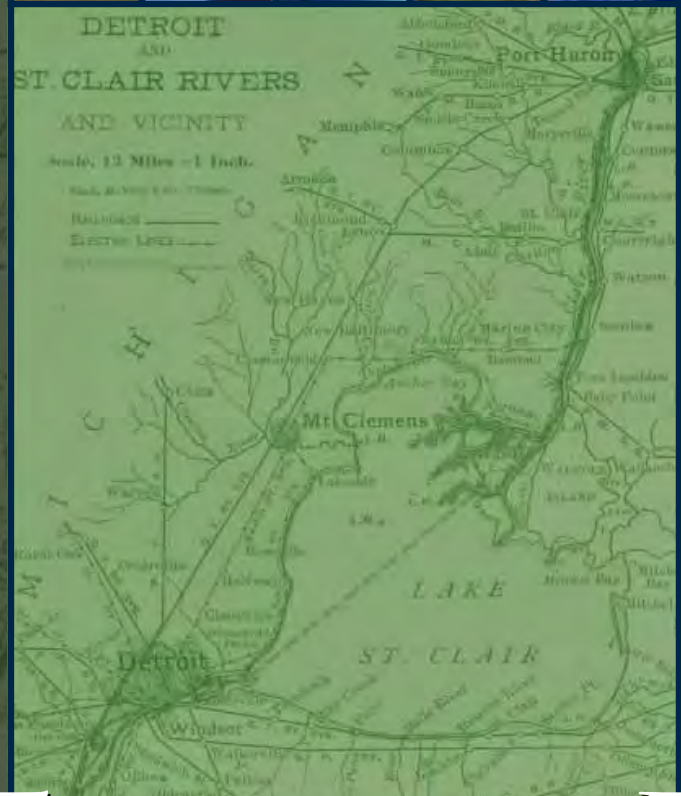
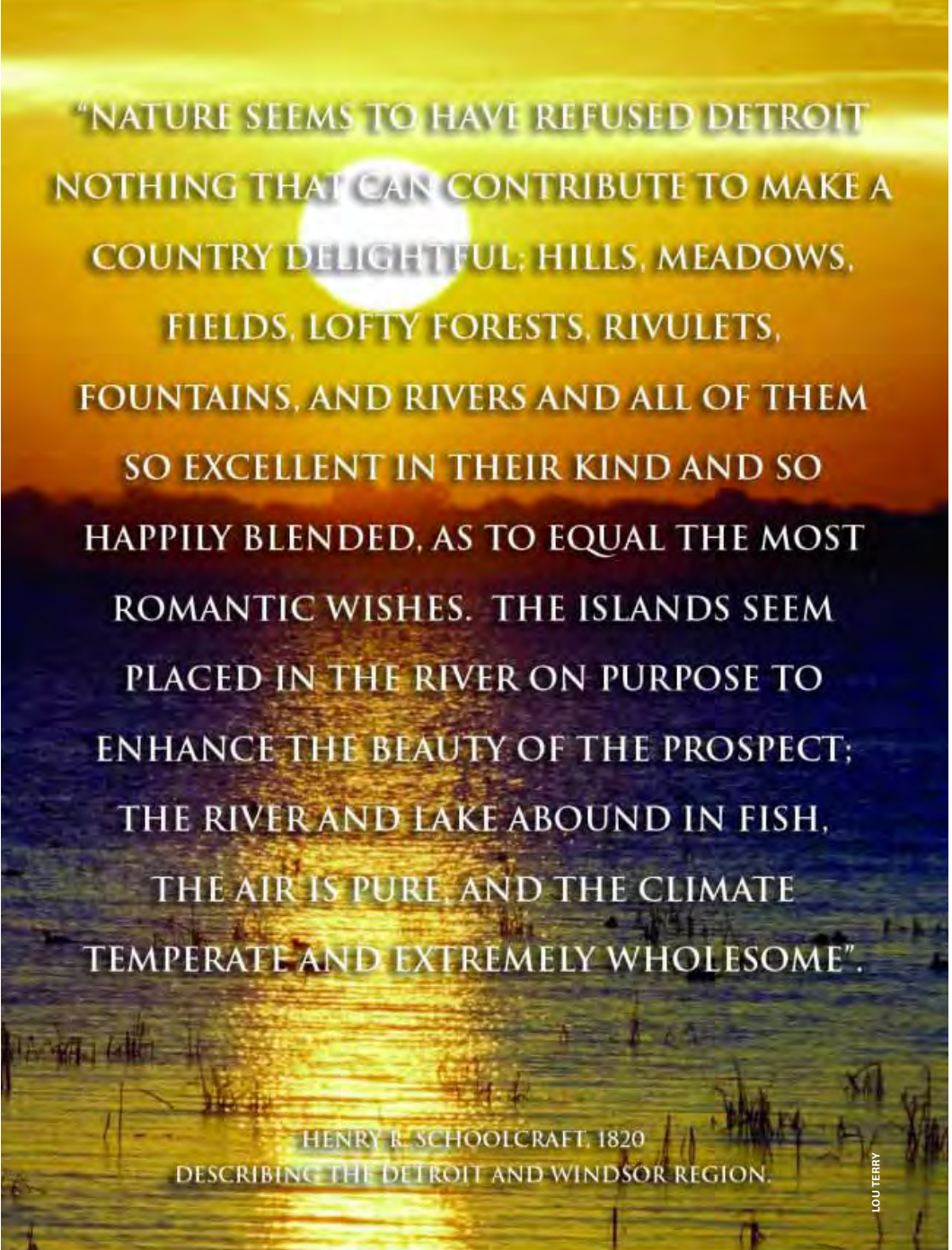




EXPLORE

OUR NATURAL WORLD

A BIODIVERSITY ATLAS OF THE LAKE HURON TO LAKE ERIE CORRIDOR



EXPLORE
OUR NATURAL WORLD

A BIODIVERSITY ATLAS OF THE LAKE HURON TO LAKE ERIE CORRIDOR

This book is dedicated to all of the plants and animals that live in this region and the people who have yet to learn about them.

Project Designer, Manager and Researcher – Lisa M. Appel
Contributing Writers – Lisa M. Appel, Julie A. Craves, Mary Kehoe Smith, Bob Weir and John M. Zawiskie
Editors – Mary Kehoe Smith and Bob Weir
Graphic Design – Peter Schade/Schade Design, Inc. www.schadedesign.com

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LOU TERRY

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PREFACE

In the spring of 2002 we embarked in partnership on the development of a Biodiversity Atlas of the Lake Huron to Lake Erie Corridor, which has focused on the watersheds of the St. Clair River, Lake St. Clair and the Detroit River. This activity has resulted in a first – the publication of an Atlas which documents the natural heritage treasures and the human resources of this area in which we reside and share together. The Walpole Island First Nation lies at the heart and the confluence of these watersheds. It is our home and our lifeblood. As stewards of these lands and waters since time immemorial, it is right and fitting that we have participated in this Biodiversity Atlas project. Indeed, we have been most happy to have the opportunity to do so and to share equitably our indigenous knowledge and values to assist others in caring for and preserving this area.

This decision to share our traditional knowledge is significant and should be briefly explained. For many hundreds of years, our Place, Bkejwanong-the Place where the Waters divide-has been the soul of Indian Territory. We have remained steadfast in our stewardship and caring for our lands and waters in spite of depredations and impacts made on the landscape surrounding us. For many years we have been subjected to, among other impacts, pollution upstream from chemical plants near Sarnia. Our citizens had campaigned alone for many years to get zero discharge since it was our drinking water that was affected and also impacted the flora and fauna and animals and birds that lived with us in our Territory. Our environmental legacy won us a prestigious United Nations award in 1995.

We have always used traditional ecological knowledge to save ourselves and our neighbours. We have survived in this our place for thousands of years. In the late twentieth century, our neighbours began slowly to learn from us and our ways in terms of mutual respect and in equal partnerships. What is really significant here is that we bring to the table a willingness to share our knowledge which includes both our ways of knowing as well as the traditional values which are part and parcel of our understanding of how our watershed system works and how it can be enhanced as we move forward in the future together. The significance of stewardship of First Nations was succinctly highlighted more than fifteen years ago in the 1987 Bruntland Report, "Tribal and indigenous peoples will need special attention as the forces of economic development disrupt their traditional life-styles–life styles that can offer modern societies many lessons in the management of resources in complex forest, mountain, and dryland ecosystems. Some are threatened with virtual extinction by insensitive development over which they have no control. Their traditional rights should be recognized and they should be given a decisive voice formulating policies about resource development in their areas." The Royal Commission Report on Aboriginal Peoples in 1996 echoed these statements. We are now seeing catastrophes across this planet which are directly related to climate changes and global warming. Our Bkejwanong Territory is still hemmed in by industrial developments in the twenty first century. But all is not doom and gloom.

Our traditional knowledge is a rich storehouse which we are prepared to share in an equitable way. It has its underpinnings our values. What are they? Bkejwanong is endowed with a unique ecosystem of wetlands, Carolinian forests and prairie grasslands. We are rich in fish and wildlife. We have a strong cultural heritage that is celebrated by our people. Traditional knowledge and values means that we have to learn how to live in a holistic way with all that interconnects and surrounds us. It is imperative, if we are going to continue to act as stewards and care responsibly for our lands and waters, that we have a dialogue, consensus and equity as we move forward towards building a sustainable future together. That is as it should be; we are all here to stay.

Indeed, the publication of this Biodiversity Atlas truly is a watershed in itself. Until now, there have been a number of comprehensive descriptions of this area but none have included the diversity of the Bkejwanong Territory linking the people and the natural heritage in such a diverse and imaginative way. We are very proud to be making a valuable contribution to this project and to the publication of this Biodiversity Atlas which marks a stepping stone to the future.

Dr. Dean M. Jacobs
Executive Director
Nin.Da.Waab.Jig
Bkejwanong First Nations

November 7, 2002

Description of the Region

This Biodiversity Atlas tells the story of the natural communities found in the Lake Huron to Lake Erie Corridor.

The Corridor is made up of the St. Clair River, Lake St. Clair and Detroit River, as well as the watersheds of southwestern Ontario and southeastern Michigan that drain into these great waterways. Water in the Corridor flows from the mouth of Lake Huron through the St. Clair River, Lake St. Clair and the Detroit River, into Lake Erie. The tributary rivers, creeks, streams and drains in the watersheds connect the surrounding lands to the Corridor.

This Atlas is organized according to elevations above sea level - from lower to higher - from the open waters and tributaries to the shoreline and lakeplain, and finally to the ecosystems of the interior lands that drain into the Corridor.

A wide variety of life forms - biodiversity - make the Corridor unique. The glacial history, climate, soils and water resources have created a landscape that is home to an incredible diversity of natural communities: forests, savannas, grasslands and wetlands. Within these natural communities live species that have global ecological significance.

The Great Lakes Basin


IMAGE COURTESY OF EARTH SCIENCES AND IMAGE ANALYSIS LABORATORY, NASA JOHNSON SPACE CENTER. HTTP://EOL.JSC.NASA.GOV

A goal of everyone involved in producing this Atlas is that readers will gain a better understanding of this amazing region, and a desire to play an active role in caring for it.

Hundreds of endangered, threatened and special concern species live in the Lake Huron to Lake Erie Corridor. The greatest threat to these species at risk is the loss of habitat. However remnants of original ecosystems, like pieces of a patchwork quilt, still exist. Every community has places that can be preserved, enhanced or restored to support native biodiversity.

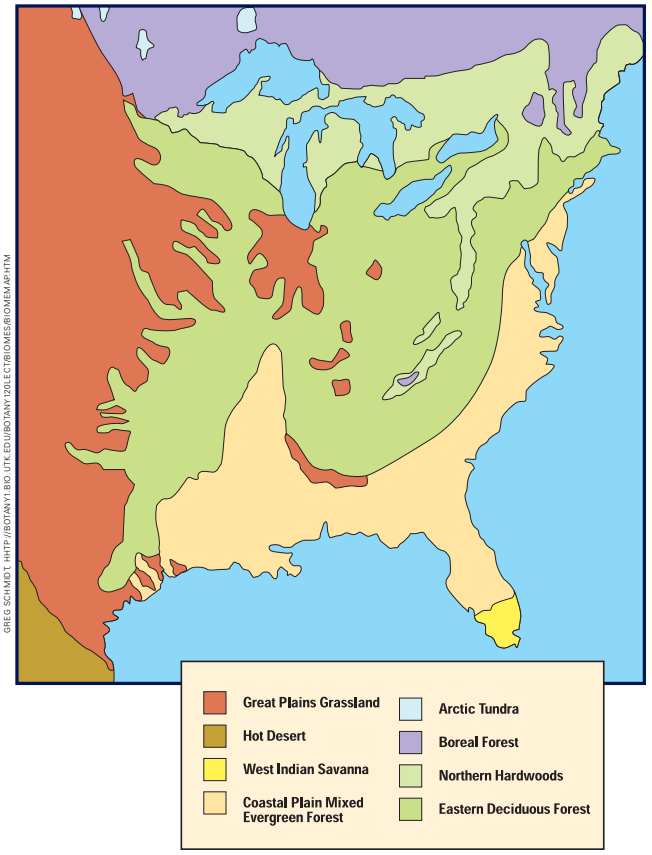
Landscape Ecology

The Lake Huron to Lake Erie Corridor lies within the northern limits of the Eastern Deciduous Forest Region. The Corridor is regarded as part of the "Carolinian Life Zone" because of its link with forest communities located farther south. Many of the species found here are at the northern boundaries of their range. The Corridor also is a transition area between the hardwood forests of the east and the prairies of the west.

A natural community is a distinct assemblage of plants and animals that live together in a common habitat. One of the most important factors defining a natural community is the presence or absence of water. A natural community's composition can be altered by disturbances in the landscape, such as invasive species, alterations in groundwater flow and fragmentation resulting from land development.

Natural Communities of the Lake Huron to Lake Erie Corridor

NATURAL COMMUNITY	TYPE
Great Lakes Coastal Marsh	Wetland
Marsh	Wetland
Wet Meadow	Wetland
Prairie Fen	Wetland
Bog	Wetland
Shrub Swamp	Wetland
Conifer Swamp	Wetland
Hardwood Swamp	Wetland
Floodplain Forest	Wetland
Beech-Maple Forest	Upland
Oak-Hickory Forest	Upland
Oak Barren	Upland
Tallgrass Prairie	Upland
Oak Savanna	Upland



GREG SCHMIDT, HTTP://BOTANY1.BIO.UTK.EDU/BIOTANY120LECTBIOMES/BIOMEMAP.HTM

Although the Lake Huron to Lake Erie Corridor does not boast dramatic topography, its vegetation is a mosaic of natural communities. This mosaic is a result of small physical changes in the landscape created by the advance and retreat of glaciers long ago. The glacial features created different physical characteristics in the landscape, such as slope, aspect, topography and soil type. These variations have led to many distinct associations of plants and animals.

This book describes many types of natural communities as if they are separate units, but they actually exist in a continuum – the grassland, savanna, forest and wetland all blend into one another, each determined by subtle changes in the topography, soils and water conditions.

Biodiversity Worth Protecting

When considering biodiversity conservation, most people think of tropical rainforests around the equator. However right here in the middle of North America, the Lake Huron to Lake Erie Corridor is home to a biodiversity that is unlike anywhere else in the world.

With its fascinating open waters, lush freshwater wetlands along the coast, tallgrass prairie and savanna ecosystems near the shoreline, and woodlands that once existed across much of its inland area, the Lake Huron to Lake Erie Corridor is a uniquely beautiful part of Earth.

What happens in this region can have an impact on other parts of the world. The Corridor provides important habitat for more than 90 species of migratory birds as they fly in autumn and spring to destinations as far away as the Arctic and South America. Thus, loss of habitat here affects not only resident wildlife but also those traveling through from elsewhere.

The Corridor possesses certain qualities that have global significance. For example, Lake St. Clair and the Detroit River have some of the best fisheries for smallmouth bass and muskellunge in the world.

Another example of a globally significant feature is the St. Clair River Delta, which is one of the largest freshwater deltas on Earth. The Great Lakes coastal marshes have a biological productivity rivaling that of the tropical rainforests. Despite significant losses of these coastal marshes, the Corridor still has enough to be considered one of the largest and most productive feeding and spawning grounds for ducks and fish in the midwestern United States.

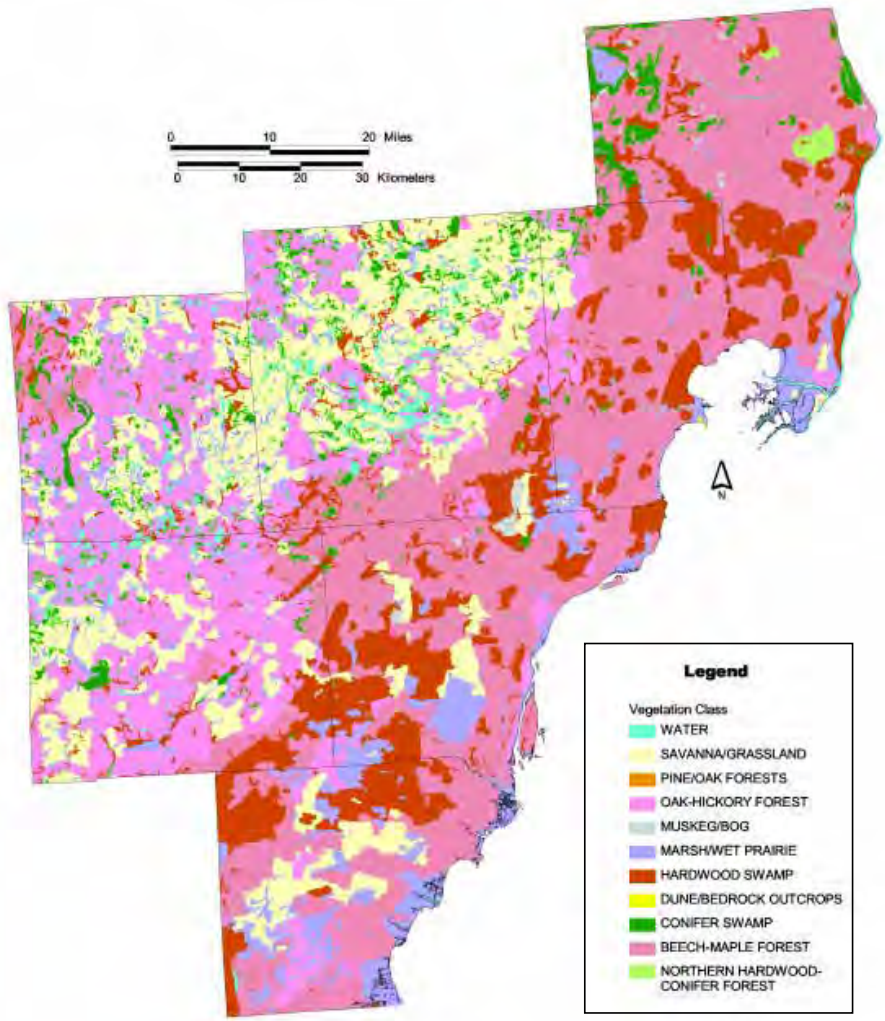
Moving away from the water, lands bear tallgrass prairie and oak savanna ecosystems. The luxuriant growths of grasses and wildflowers in prairies contain some of the Corridor's greatest biodiversity, with as many as 200 plant species inhabiting a single remnant prairie. Today, less than one percent of the original prairie and oak savanna communities exist in Michigan and Ontario. The extensive loss of these special ecosystems and their unique character leave them at risk of global extinction.

Abundant natural resources were the foundation of the economic prosperity of southern Michigan and southwestern Ontario. Unfortunately, much of this natural heritage has given way to development. Habitat loss from human settlement has resulted in the extirpation of many wildlife species from the region. Buffalo, elk, moose, black bear, lynx, bobcat and grey wolf all disappeared in the middle of the last century. Viewing the landscape now, it is hard to imagine that this area was once a great wilderness.

Despite humans' dramatic alteration of the landscape, wildlife continues to persist. Fortunately there are protected lands that contain examples of the Corridor's rich natural heritage. Look to Appendix A for a map of protected areas in the region.

Learn more about the region's natural communities and how you can help protect them in the pages that follow.

SOUTHEASTERN MICHIGAN VEGETATION, CIRCA 1800



Michigan Natural Features Inventory, Michigan State University Extension, Data Source: Vegetation circa 1800 of Michigan, digital dataset. Michigan Natural Features Inventory.

The Physical Landscape

"Geologically, the Great Lakes ecosystem is very young and can be thought of as an evolutionary laboratory."

– The Nature Conservancy

The Lake Huron to Lake Erie Corridor's present physical landscape has been profoundly affected by a remarkable geologic event - an ice age. Long ago, glaciers more than a mile (1.6 km) thick covered the entire Great Lakes Region. As they moved from north to south, the glaciers picked up and carried sediments and bedrock, then deposited them to shape landforms throughout the region.

Geologists have studied these landforms as well as sediment types, erosional features and fossils to piece together this area's glacial history. Their findings reveal the crucial role that ice played in the evolution of the biodiversity that exists today.

The Ice Age

For the last two million years, Earth has been in an ice age, characterized by two alternating climatic states known as glacial periods and interglacial periods.

During glacial periods, our planet cooled. Giant sheets of ice expanded and covered 30 percent of the land located at mid to high latitudes in the Northern Hemisphere. These cold, dry glacial periods lasted about 100,000 years.

Interglacial periods begin when Earth abruptly warms and the ice sheets melt. Warm, moist conditions allow soils to develop and life to return to the terrain. Interglacial periods are relatively brief, typically lasting 10,000 to 15,000 years. North America's most recent glacial period is called the Wisconsin Stage. It began about 110,000 years ago and ended about 10,000 years ago when the Holocene Epoch began. During the peak of the Wisconsin Stage about 20,000 years ago, ice completely covered what is now the Great Lakes Basin. The southern edge, or terminus, of this ice sheet extended as far south as the Ohio River.

For the last 10,000 years the Earth has been in a warm interglacial period known as the Holocene Epoch. The timing of natural cycles suggests the Earth should again be heading back to a cold glacial period within the next several thousand years.

Buhr Park Children's Wet Meadow, Ann Arbor, Michigan.

Glacial Processes, Landforms and Sediment Types

In 1840, the famous naturalist Louis Agassiz was one of the first to champion the concept of an ice age. From observations of the processes, landforms and sediments associated with modern mountain glaciers, Agassiz concluded that massive continental ice sheets once existed in Scandinavia and all of northern Europe. The theory that the present is the key to the past is called actualism. It is an important philosophical concept used by geologists to unravel Earth's history. By mapping glacial grooves, sediment types and landforms, geologists can reconstruct the former extent and flow of the ancient continental ice sheets that once covered the Great Lakes Basin. This type of study provides a link between the ice age theory originally described by Agassiz in Europe and the glacial history that defines the landscape of southeastern Michigan and southwestern Ontario.

Glaciers Leave Tracks

Glaciers create unique landforms, sediment types and erosional patterns. They also carry rocks of all sizes for great distances. Many of the glacial rocks found in the Lake Huron to Lake Erie Corridor came from the Canadian Shield north of Lake Huron. These relocated rocks are called glacial erratics. Their surfaces commonly have grooves and facets from being scraped under the ice. The shearing and abrasion by the rock-studded ice also grooves the underlying land surface.

Moraines

Glacial ice results from condensed snow accumulating year after year without melting. When the ice becomes about 66 ft (20 m) thick, it begins to slowly flow under the force of its own weight. As the ice moves, it scrapes and shears the underlying land surface. Moving like a conveyor belt, the glacier picks up rocks and sediments of all types and sizes, and transports them to lower, warmer latitudes. When the edge of the glacial ice melts, it deposits poorly sorted sediment called till.

JOHN M. ZAWISKIE

This is till beneath the lower east side of Detroit. Till is a poorly sorted sediment deposited by melting ice. It contains pebbles, cobbles and boulders set in clay or fine sand. Soils that developed on clay-rich till support beech-maple forests, while better-drained soils developed from sandy till support oak-hickory forests.

Sometimes the rate of melting exactly matches the rate of ice flow, so the glacier's terminus becomes stationary. The flowing ice behind it continues to bring more till, which is deposited on top of the till already at the edge. This creates a ridge or hill, called an end moraine.

When a glacier melts rapidly, the terminus does not pause to build an end moraine. Rather, it deposits sheets of till that form rolling plains called ground moraines.

JOHN M. ZAWISKIE

A glacier in the Queen Alexandria Range of Antarctica forms an end moraine.

A Modern Day Glacier

Pictured is a modern day glacier in southwest Alaska transporting glacial erratics. Glacial erratics are large boulders carried great distances from their original bedrock source by glaciers.

DR. SHARON JOHNSON

USGS DIGITAL DATA SERIES DD921

The low hills in the center of the photo are kames in Greenland.

(INSET) NATURAL RESOURCES CANADA, TERRAIN SCIENCES DIVISION, CANADIAN LANDSCAPES

Kettle

Sometimes a block of melting ice detaches from the glacier and is left on the outwash plain where it becomes buried by sediments. When the ice block melts, it forms a kettle depression, which often fills with melt-water or groundwater and becomes a lake. Kettle lakes and kames commonly are both found on ground moraines; together they form kettle and kame topography. A good example of this is at Stony Creek Metropark near Rochester, Michigan.

(Above inset) A kettle lake ringed by spruce trees and permafrost patterned ground in the Hudson Bay lowlands of Canada.

Kames

Kames are low hills of layered sand and gravel deposited by glacial melt-water. These sediments could come from streams that flow beneath the glacier and emerge as a delta at the ice front, or from river and lake sediments deposited on top of the glacier.

Landforms Beneath Glaciers: Eskers

OAKLAND COUNTY PLANNING & ECONOMIC DEVELOPMENT SERVICES

In some cases, long, winding rivers flow in tunnels beneath a glacier. Sediments deposited into these tunnels form ridges of layered sand and gravel that are left behind when the glacier recedes. These landforms are called eskers. The yellow highlighted portion in the aerial photograph above is an esker in Oakland County, Michigan.

Environments in Front of Glaciers

The great amount of melt-water released by glaciers can result in the formation of rivers in front of the ice. These rivers carry sediments away from the glacier. They deposit the sediments in well-sorted sheets of sand and gravel. These deposits are called outwash.

BALTHAZAR KORAB

Outwash is well-sorted sand and gravel deposited by braided streams. The example featured above was photographed beneath the Cranbrook Institute of Science in Bloomfield Hills, Michigan. This type of sediment is found in outwash plains, kames and eskers. Outwash deposits evolve into extremely well-drained soils which, on uplands, support oak barren, woodland and prairie communities.

THOMAS LOVELL

Pictured is the Exit Glacier in Alaska with moraine and outwash plain (stream deposits.)

Glacial Lakes

Large glacial lakes are created by water that has ponded between the ice front and the previously formed end moraines. Sediments deposited in deeper parts of glacial lakes are typically fine-grained clay and silt. Sand and gravel usually are deposited in long ridges in near-shore sandbars, along beaches and in coastal dunes.

As water drains from a glacial lake, it leaves a flat lakeplain with beach ridges, channels and wave-cut terraces. The topography of Essex County, Ontario, exemplifies the flat landscape left by glacial lakes.

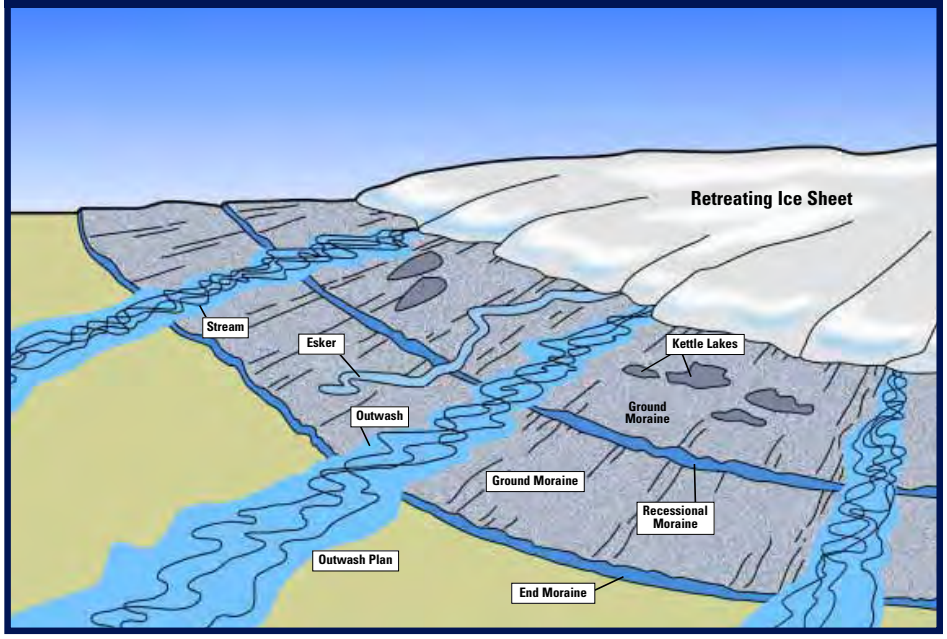
Water-lain moraines are low-lying landforms that develop where the ice meets the glacial lake. In the Corridor, water-lain moraines on the lakeplain were eroded by the glacial lakes and are not easy to identify today. The cities of Mt. Clemens, Detroit and Windsor were built on the Detroit water-lain moraine. The Leamington Moraine is only visible as a high knob west of Leamington, Ontario. Farther east, Ridgetown, Ontario, was named for the morainal deposits on which it sits. Aboriginal people and pioneers traveled along these moraines because they supported forests that were easier to traverse than the surrounding swamps of the lakeplain. One route used by pioneers was the Talbot Trail, which followed a moraine from Essex to Ridgetown, Ontario.

DR. J. BRIGHAM-GRETTE

A sandy beach ridge with wide-spreading oak trees lies parallel to the Detroit River shoreline in Brownstown Township, Michigan. Pioneer cemeteries often were built on the sandy ridges left by ancient glacial lakes.

(Left) Lacustrine clay and silt are sediments deposited in glacial lakes. The soils that later formed on these deposits are poorly-drained and, generally, support hardwood swamp forests and lakeplain prairie.

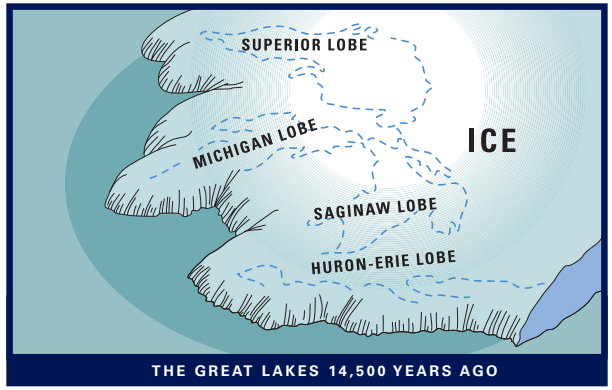
LANDFORMS CREATED BY GLACIERS



The Glacial History of the Lake Huron to Lake Erie Corridor

The Great Lakes were not always as we know them today. Their basins were formed by glacial erosion of pre-existing river valleys, which then filled with melt-water. The lakes have since evolved in shape, size and even the direction in which their waters flow.

14,500 years before present: Four glacial lobes covered what is now most of Michigan and all of Ontario. The retreating ice front paused and built the Valparaiso, Charlotte and Fort Wayne Moraines. When the glacial lobes retreated farther, the first glacial lakes began to form.



THE GREAT LAKES 14,500 YEARS AGO

SOURCE OF GLACIAL POSITIONILLUSTRATIONS: FARRAND, W.R. AND KELLY R.W., 1967 REPRINTED 1987, *THE GLACIAL LAKES AROUND MICHIGAN.* BULLETIN NO. 4, PUBLISHED BY THE MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY, GEOLOGICAL SURVEY DIVISION

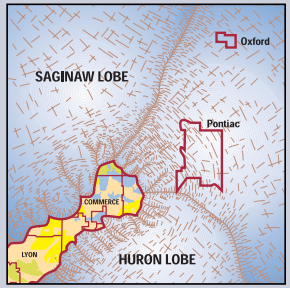
Interlobate Area Between the Saginaw and Huron-Erie Lobe

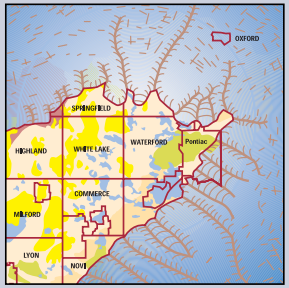
As the Earth warmed and the ice began to quickly retreat, the space between the Saginaw Lobe and the Huron-Erie Lobe widened, which caused a seam, or an "interlobate" area to open. Deposited within the interlobate area were a series of outwash plains with numerous kames, eskers, and kettle lakes flanked by moraines made of till from both lobes. The drawings to the right show the development of the interlobate area between the Huron and Saginaw Lobes between 14,500 to 13,800 years ago.

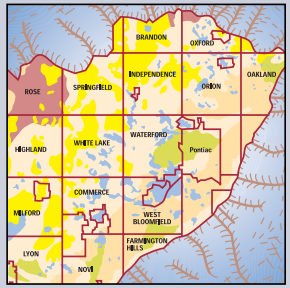
ICE FRONT POSITIONS FROM TWENTER AND KNUTILLA, 1972

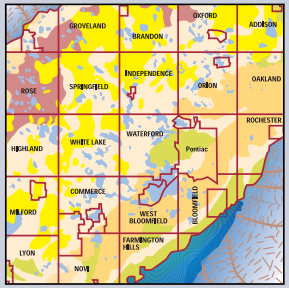

SANDY SHIPLE

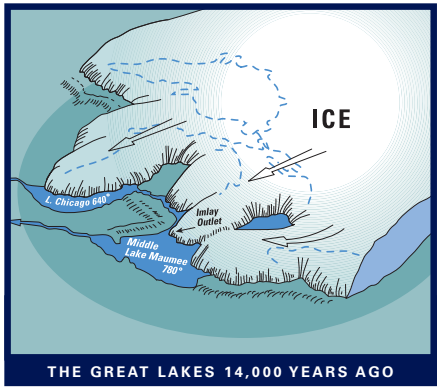
This terminus of a Greenland ice sheet is what Port Huron, Michigan, and Sarnia, Ontario, may have looked like 13,000 years ago.





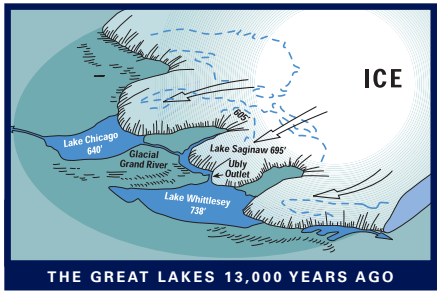






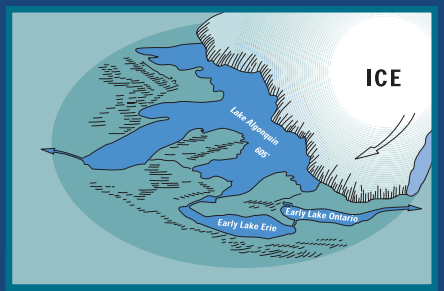
THE GREAT LAKES 14,000 YEARS AGO

14,000 years before present: Glaciers formed the Defiance Moraine at the edge of the Huron-Erie Lobe. When the ice melted back from this location, Lake Maumee formed. The lake subsequently changed in shape and size, and created an expansive lakeplain in southeastern Michigan and southwestern Ontario. A series of water-lain moraines formed in the lakeplain as the ice front receded. They include the Detroit, Mt. Clemens, Emmet and southern portion of the Port Huron Moraines in Michigan, and the Wyoming, Leamington and Blenheim Moraines in Ontario.



THE GREAT LAKES 13,000 YEARS AGO

13,000 years before present: The receding glaciers made a strong readvance. This ice front built the region's most prominent topographic feature, the Port Huron Moraine, which extends almost continuously from Minnesota to New York. Lake Whittlesey, the largest glacial lake to occupy the region, also was formed during this stage. Later, a combination of retreating and re-advancing ice created a series of glacial lakes, each with a different outline and elevation, which occupied parts of the lakeplain area until 11,000 years ago. Due to erosion, only the former shorelines of lakes Maumee, Whittlesey, and Warren can be easily recognized today in the form of low, continuous, sandy ridges within a few kilometers of the Lake Huron to Lake Erie Corridor's shorelines.



THE GREAT LAKES 11,000 YEARS AGO

11,000 years before present: The beginning of the Lake Algonquin Stage. Waters drained south to early Lake Erie, cutting the initial channels of the St. Clair River and Detroit River.

THE GREAT LAKES 9,500 YEARS AGO

9,500 years before present: As the ice front retreated, Great Lakes water began draining into northern Ontario rather than through the St. Clair and Detroit Rivers, resulting in extremely low lake levels. Forests grew on the exposed lakebeds. Evidence of this stage can be found in drowned forests on the floor of Lake Huron today.

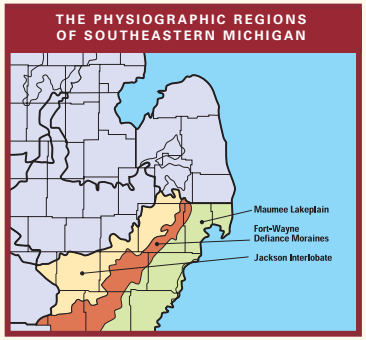
THE GREAT LAKES 6,000-4,000 YEARS AGO

6,000 to 4,000 years before present: The Lake Nipissing Stage. The modern drainage patterns of the Great Lakes were established after the last remaining glacial ice retreated toward Canada's northern latitudes. With the ice burden gone, land in the northern part of the region began to rise (a phenomenon known as isostatic rebound), which cut off the North Bay outlet. Downcutting of the St. Clair River lowered lake levels and shut off the Chicago outlet. The Lake Huron to Lake Erie Corridor has remained the dominant outlet for the upper Great Lakes since then.

The Physiographic Regions of the Lake Huron to Lake Erie Corridor

As a result of their glacial history, the landscape and water bodies of southeastern Michigan can be divided into three major physiographic regions*:

- Interlobate regions are high plains characterized by outwash plains, ground moraines, and kettle and kame topography. The Jackson Interlobate region is a topographically diverse area formed between the retreating Saginaw Lobe and the Huron-Erie Lobe in Michigan. There are steep hills and an incredible number of small lakes and wetlands that extend from north of Pontiac to south of Jackson. A second interlobate region occurs in the upper watershed of the Thames River in Ontario.
- The Fort Wayne-Defiance End Moraines are a series of moraines that form a distinct line of elevation that extends from Romeo, through Ann Arbor to Adrian, Mich.
- The Maumee Lakeplain is the vast plain on the western edge of southern Ontario. In Michigan, it extends from Blissfield in northern Ohio through Detroit into eastern Macomb County and southern St. Clair County. Features on the lakeplain include beach ridges, sand plains and water-lain moraines.



* *Albert, Dennis A. 1995. Regional landscape ecosystems of Michigan, Minnesota, and Wisconsin: a working map and classification. Gen. Tech. Rep. NC-178. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/1998/rlandscp/rlandscp.htm (Version 03JUN98).*

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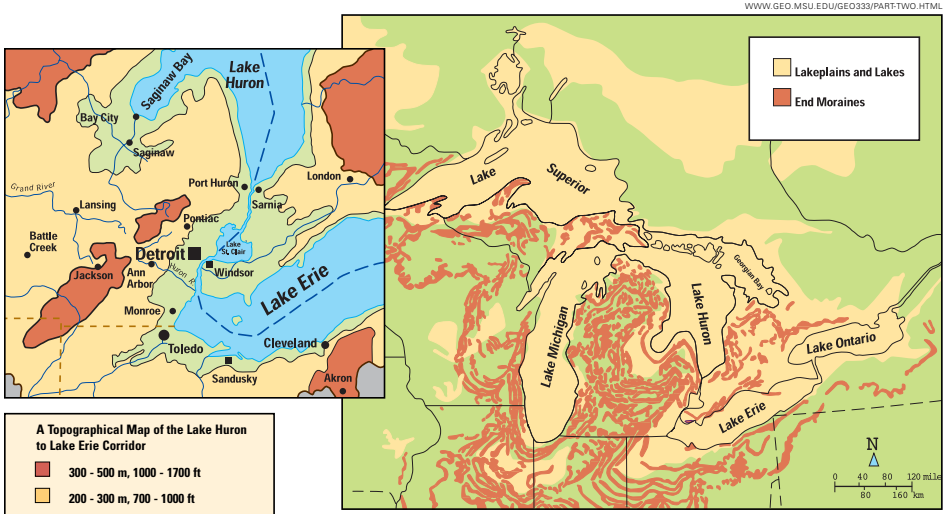


A Topographical Map of the Lake Huron to Lake Erie Corridor

- 300 - 500 m, 1000 - 1700 ft
- 200 - 300 m, 700 - 1000 ft
- 100 - 200 m, 300 - 700 ft

IMAGE REFERENCE: *THE GREAT LAKES ATLAS*, U.S. EPA GREAT LAKES NATIONAL PROGRAM OFFICE

The moraines of the Great Lakes Basin show the immense scale of the ice lobes that flowed over this region during the late phases of the Wisconsin Stage. The lobes came together when glacial coverage peaked about 20,000 years ago. They then retreated in fits and starts, building the pattern of recessional end moraines that define the landscape today.

POST-GLACIAL COMMUNITIES

ABOVE PHOTOGRAPHS COURTESY OF J. SHOSHANI

ILLUSTRATION ARTWORK BY MARGARET PURVES UNDER THE DIRECTION OF J. SHOSHANI

Above is an excavation at the Shelton mastodon site in northern Oakland County, Michigan. This site and others like it provide a record of the transition from the late glacial period to the Holocene Epoch in the Lake Huron to Lake Erie Corridor. The illustration directly above depicts the now-extinct mastodon and Scott's moose that lived in the spruce woodland habitat at the Shelton site 12,000 years ago. Evidence indicates the mastodon community moved into the region with the spruce forests and wet parkland environment that replaced the frigid tundra around 12,500 years ago. Between 11,000 and 10,000 years ago mastodons, mammoths, giant beavers and other large animals became extinct, most likely because of an abrupt global return to a cold, dry glacial climate (known as the Younger Dryas event) and hunting stress by Paleo-Indians who were entering North America. Dramatic warming 10,000 years ago at the end of the last glacial period allowed pine forests to replace spruce. As Earth continued to warm during the early Holocene Epoch, deciduous hardwood forests replaced pine and Archaic Indians moved into the region setting the stage for our modern world.

Soil

Soil may not be the most noticeable part of the scenery, but it is the foundation on which all other life forms depend. Soil gives rise to an incredible variety of natural communities, as different soil types support different kinds of vegetation, which in turn support other life.

To understand the soils of the Lake Huron to Lake Erie Corridor, it is important to understand the sediments deposited by the ancient glaciers. Glacial sediments are the basis, or parent material, from which soils have formed.

The Corridor's soils can be divided into three major classes. Soils that developed from: 1) variably-drained glacial tills; 2) well-drained sediments of outwash plains, eskers, beaches and kames; and 3) poorly-drained sediments of glacial lakes and bogs.

The Jackson Interlobate and Fort Wayne and Defiance Moraine regions have soils that developed from glacial till, outwash plains, eskers and kames. These soils range from excessively well-drained to loam (a rich soil composed of clay, sand and organic matter.) In contrast, the Maumee Lakeplain has poorly-drained loamy and clay soils that evolved from deposits of fine silts and clays left by the glacial lakes. Hardwood swamps normally occupy the flat, poorly-drained lakeplain. However this lakeplain also has ancient beaches and sand deposits that support tallgrass prairie and oak savanna. The development of soils also can be affected by the glacial landforms upon which they are built. For example, soils found at the top of a hill are different from those found at its base. Topography, climate and vegetation all affect the development of soils over time.

LINDSEY MISHLER

This farm in Livingston County sits atop outwash deposits that have very well-drained soils.

ROBERT STEWART

Urban centers like the City of Detroit act as heat sinks. Their large expanses of concrete hold heat, resulting in higher average temperatures in these areas.

Climate

The Great Lakes influence the climate of the Lake Huron to Lake Erie Corridor. The lakes moderate conditions on the land around them because their water warms and cools more slowly than inland areas in response to temperature changes. This results in a relatively long annual frost-free growing period of 160 to 180 days per year.

Average July temperatures range from 68 to 77 ºF (20 to 25 ºC) and average January temperatures range from 18.5 to 27.5 ºF (-7.5 to -2.5 ºC.) Precipitation averages 23.6 to 27.6 in (600 to 700 mm) per year.

A photograph from space of the Lake Huron to Lake Erie Corridor taken by NASA.

IMAGE COURTESY OF EARTH SCIENCES AND IMAGE ANALYSIS LABORATORY, NASA JOHNSON SPACE CENTER, HTTP://EOL.JSC.NASA.GOV

The Connecting Channels

The Lake Huron to Lake Erie Corridor links the upper Great Lakes with the lower Great Lakes.

The Lake Huron to Lake Erie Corridor, nearly 100 mi (160 km) long, is a pivotal link in the flow of water through the Great Lakes Basin. Water from the upper, colder Great Lakes – Superior, Michigan and Huron – funnels into the St. Clair River, passes through Lake St. Clair and flows through the Detroit River to enter the warmer, lower Great Lakes–Erie and Ontario.

Technically, because they do not have the traditional characteristics of river systems, the St. Clair River and the Detroit River are not rivers. Rather they, along with Lake St. Clair, form a connecting channel, or strait, that accepts water, nutrients and sediments from Lake Huron and delivers them to Lake Erie.

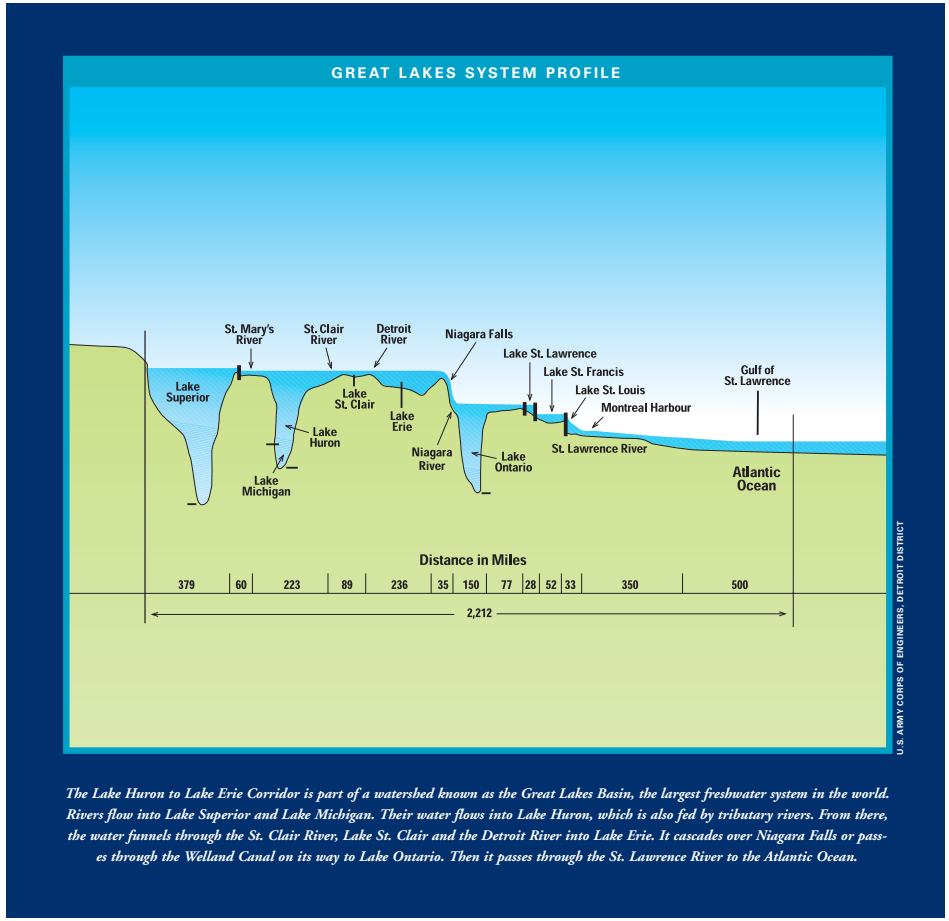
A map of the Lake Huron to Lake Erie Corridor

The St. Clair River, Lake St. Clair and Detroit River System

The St. Clair River is about 44 miles (70 km) long with very few bends. Its width ranges from 833 ft (250 m) at its narrowest point at the Blue Water Bridge to about 3,000 ft (900 m) before widening further near the St. Clair River Delta. The river's only islands are Fawn and Stag Islands, which are located in the upper channel. Water from Lake Huron enters the St. Clair River at a flow rate of nearly 200,000 gal (760,000 l) per second. It takes about 20 hours for water to travel from Lake Huron to Lake St. Clair.

The St. Clair River's outflow into Lake St. Clair slows considerably as the water moves around the many islands and through the bays and distribution channels of the St. Clair River Delta. Sediments have formed, and continue to shape, this delta which is a transitional environment between the St. Clair River and Lake St. Clair.

Lake St. Clair, shaped like a heart, is the shallowest and youngest of the Great Lakes. Its maximum natural depth is only 21.3 ft (6.5 m) Its greatest width is about 25 mi (40 km.)It covers a total area of 432 sq mi (1,115 sq km.) Depending on the wind, water stays in Lake St. Clair for two to 30 days, averaging nine days, before flowing into the Detroit River.



The Lake Huron to Lake Erie Corridor is part of a watershed known as the Great Lakes Basin, the largest freshwater system in the world. Rivers flow into Lake Superior and Lake Michigan. Their water flows into Lake Huron, which is also fed by tributary rivers. From there, the water funnels through the St. Clair River, Lake St. Clair and the Detroit River into Lake Erie. It cascades over Niagara Falls or passes through the Welland Canal on its way to Lake Ontario. Then it passes through the St. Lawrence River to the Atlantic Ocean.

The Detroit River is 32 mi (51 km) long, of varying width and occupied by numerous islands. Near the head of the river at Lake St. Clair are Belle Isle and Peche Island. From these islands, water flows along a single channel whose width ranges from 2,333 to 3,333 ft (700 to 1,000 m). In the lower Detroit River, the water flow spreads into several channels that wind around its many islands. The river gradually widens to more than 3.75 miles (6 km) as it empties into Lake Erie. The natural depth of the Detroit River ranges from 20 to 25 ft (6 to 7.6 m). Its flow rate is similar to that of the St. Clair River. On average, it takes about 20 hours for water to travel from Lake St. Clair to Lake Erie.

Construction of the St. Lawrence Seaway system in the 1950s resulted in creation of commercial navigation channels that altered the depth of the Lake Huron to Lake Erie Corridor. In the late-1950s, a 28 ft (8.3 m) channel was created in the St. Clair River, followed by one in Lake St. Clair. The channel through the Detroit River was completed in 1969.

The St. Clair River Delta is one of the largest deltas in the world.

The St. Clair Delta has three distinct depositional regions: The pre-modern delta was created 3,500 to 5,000 years ago during the Lake Nipissing Stage, when Lake St. Clair levels were about five ft (1.5 m) higher. The modern delta has formed, and continues to form, since that time. The pro-delta deposits are on the lake bottom; they provide the foundation for current sediments accumulated at and above the water line.

St. Clair River Delta

The St. Clair River Delta is the most significant landform of the Lake Huron to Erie Corridor and is a unique feature in the Great Lakes Basin. A delta is a geological formation that occurs when significant amounts of sediment are carried by a river and deposited into a receiving basin, in this case Lake St. Clair.

The sandy shorelines of southern Lake Huron are thought to be the main source of the sand and gravel that have created the St. Clair River Delta. The swift current of the St. Clair River is strong enough to carry these sediments to Lake St. Clair.

The bird's-foot shape of the St. Clair River Delta is similar to that of the Mississippi River Delta. It also shares many attributes with marine deltas because of its numerous islands, bays and distributary channels.

The St. Clair River Delta is always changing. While the river continuously carries more sediment to the delta, wind and water erosion constantly shape older deposits as they are exposed or submerged by changing water levels.

The St. Clair River Delta's many islands, bays and distribution channels have created a huge surface area of coastline that supports one of the largest coastal wetland systems in the Great Lakes.

The lower Detroit River's many islands provide valuable habitat for wildlife.

The shoreline of the St. Clair River Delta near Walpole Island.

The Movement of Water

Water Flows Downhill

Water flows downhill, from higher elevations to lower elevations, from land to waterways, from small streams into larger rivers, bays and lakes. It is important to remember that water and land connect. How we treat the land impacts the water.

The land surrounding a waterway is called a watershed, which means land from which water is shed. Some watersheds are large, covering hundreds of square kilometers and encompassing an entire river system. The drainage area of a single tributary or creek is known as a subwatershed.

TRISH BECKJORD

Water Also Rises

While water as a liquid or solid flows downhill, water as a vapor goes up.

The circulation of water is known as the hydrologic cycle. The hydrologic cycle has three primary parts: precipitation, evaporation and transpiration.

Precipitation is water that falls from the sky as rain, snow, sleet or hail. Precipitation that stays above ground is known as surface water. If surface water flows across the land, it is called runoff. Some runoff flows into puddles, streams, rivers and lakes. Other runoff is absorbed into the ground and becomes groundwater. Groundwater is drawn by gravity through cracks in the dirt until it reaches a zone of saturation, also known as an aquifer.

Evaporation is the change of water into a gas, or vapor. It then rises into the atmosphere. Most evaporation involves the water in bodies of water.

Transpiration is another way in which water re-enters the atmosphere, through vegetation.

Trees and other plants draw up water from the ground through their roots to feed on the nutrients. They release, or transpire, some of that water through their leaves back into the air.

The cycle continues: Water that evaporates and transpires will return to Earth again as precipitation.

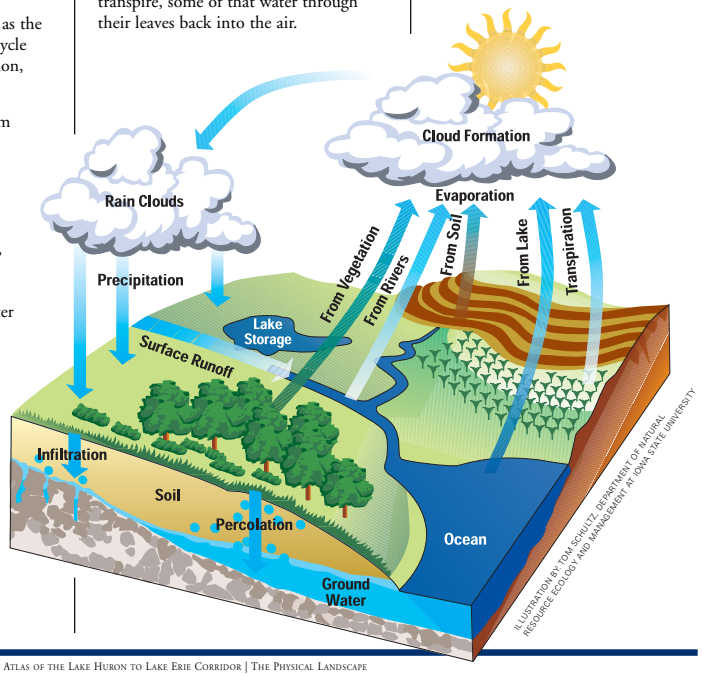


ILLUSTRATION BY TOM SCHULTZ, DEPARTMENT OF NATURAL RESOURCE ECOLOGY AND MANAGEMENT AT IOWA STATE UNIVERSITY

MORAINES OF THE GREAT LAKES AREA. FROM FARRAND, W.R. 1988. MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY, GEOLOGICAL SURVEY DIVISION, BULLETIN NO.4

The details in these maps show how the moraines left by the glaciers bound the watersheds of southeastern Michigan that drain into the Lake Huron to Lake Erie Corridor.

Tributaries of the Lake Huron to Lake Erie Corridor

Tributaries are rivers, creeks and streams that flow into larger water bodies. In the St. Clair River, Lake St. Clair and Detroit River system, only a small percentage of water comes from tributaries. Nevertheless, the tributaries are important connections between these larger water bodies and the watersheds in which they exist.

Rivers and streams, as well as wetlands that border them, are known as riverine systems. In southeastern Michigan and southwestern Ontario, riverine systems also include many man-made ditches and drains. Various creeks flow directly into lower Lake Huron, the St. Clair River, Lake St. Clair, the Detroit River and upper Lake Erie.

River	Watershed Area		Primary Watershed Land Use
Black River	1,940 km2	(746 mi2)	Agriculture
Pine River	351 km2	(135 mi2)	Agriculture
Belle River	2,525 km2	(971 mi2)	Agriculture
Sydenham River	2,439 km2	(938 mi2)	Agriculture
Thames River	5,807 km2	(2,234 mi2)	Agriculture and Urban
Clinton River	1,976 km2	(760 mi2)	Urban, Suburban, and Rural
Rouge River	1,214 km2	(467 mi2)	Urban
Huron River	2,340 km2	(900 mi2)	Urban, Suburban, and Rural
Raisin River	2,782 km2	(1,070 mi2)	Agriculture

On the Open Water

From the earliest inhabitants to modern-day residents, people throughout history in the United States and Canada have prized the Lake Huron to Lake Erie Corridor as a source of water, food, transportation and recreation. Despite human pressures, the Corridor continues to support a remarkable amount of aquatic biodiversity. Protecting this precious water resource is essential to the continued prosperity of the surrounding region.

The Land and Water Connection

While waterways and land may seem to connect only at shorelines, the interconnectedness of water and land goes far beyond a simple beach.

Many animals know this. For example, the beaver fells trees on shore and uses them to build lodges in the water. The bald eagle nests in trees on land, yet feeds on prey caught in the water. Many reptiles and amphibians feed and live in wetlands but nest in uplands. Humans live on land but go on or into the water to fish, boat and swim.

Nearly everything that takes place on land, especially human activity, affects the health and biodiversity of waterways. An example is removing trees and shrubs from a riverbank. It may seem like a simple, isolated action. But it can have widespread effects on the complex system of the river: The loss of roots that anchor soil and absorb rainwater can result in greater surface run-off. The increased water volumes can increase the river's speed, leading to erosion of embankments downstream. The increased amounts of soil going into the river can bury a fish spawning bed. That can reduce fish populations, resulting in smaller catches for anglers.

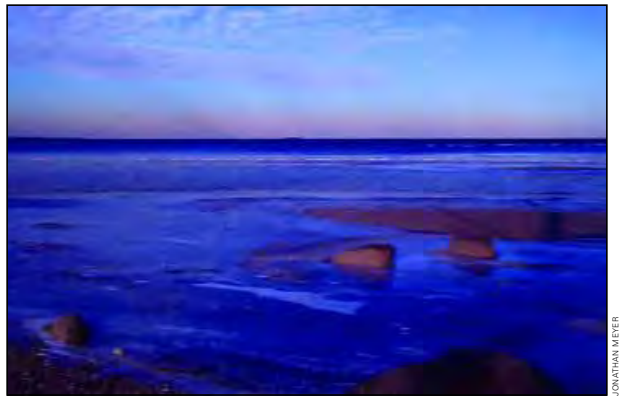
DEBORAH J. BASSETT-MAXWELL

Trees along a stream provide shade and habitat for aquatic organisms. The undercut banks provide hiding and feeding areas for fish and insects.

Whether we live upstream or downstream, on hills or lowlands, in rural or urban areas, we are all connected by water – to each other, to fish and mammals, to birds and insects, to reptiles and amphibians, to wildflowers, shrubs and trees.

ERNIE BERGEN

Turtles and ducks bask together on a log at the Lower Thames Valley Conservation Authority's Lighthouse Cove Conservation Area. Woody debris along watercourses provide habitat for many animals.



JONATHAN MEYER

The shoreline of Lake St. Clair in Tecumseh, Ontario.

Nearshore Waters

The Great Lakes cover one-third of the region known as the Great Lakes Basin. Although the vast waters of the deeper, larger Great Lakes dominate the Basin geographically and ecologically, they are not as biologically diverse or productive as the fringes and shallows of those lakes.

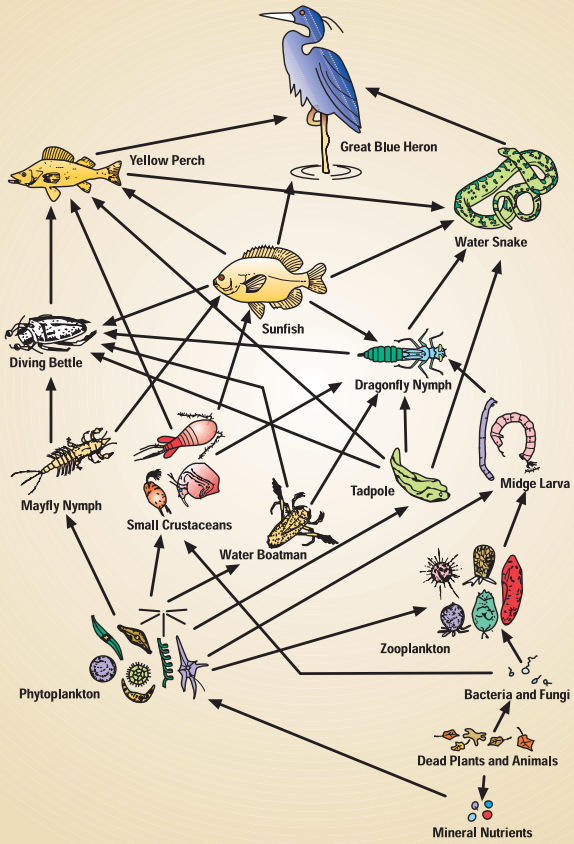
These shallow water areas are known as nearshore waters. They are home to nearly all species of Great Lakes fish, as well as many types of birds and mammals at some point in their life cycles. The water in these areas has the warmth and shallowness to support warm-water fish and other aquatic organisms. Almost the entire Lake Huron to Lake Erie Corridor is categorized as nearshore waters.

Unfortunately, because of their closeness to the land and human communities, nearshore waters are most vulnerable to pollution and degradation. Pollution not only affects the water that passes through the Lake Huron to Lake Erie Corridor, but also settles into the bottom sediments of the Corridor's rivers and lakes, thus impacting aquatic life for decades.

The nearshore water environment has been changed physically, chemically and biologically by human activity. Raw sewage, fertilizers and pesticides, industrial discharges and polluted stormwater runoff are among the contaminants that have entered the Corridor, to the detriment of wildlife and humans.

A coastal marsh in the St. Clair River Delta near Walpole Island

FOOD WEB OF THE GREAT BLUE HERON IN LAKE ST. CLAIR



THE ECOLOGY OF LAKE ST. CLAIR WETLANDS: A COMMUNITY PROFILE, U.S. FISH AND WILDLIFE SERVICE, BIOLOGICAL REPORT 85 (7.7), SEPTEMBER 1986

This diagram shows the complicated relationships within the food chain of the great blue heron. Hundreds of organisms may be involved in any single aquatic food chain. A disturbance in one level can affect many other creatures.

Aquatic Food Web

The food web within nearshore waters has many links, extending from extremely tiny microorganisms to large fish, birds, mammals and humans. Individual food chains can be incredibly complex. They may involve hundreds of different types of organisms. A food chain can be understood by examining the different levels, called trophic levels, through which energy flows. These include producers, consumers and decomposers.

Primary producers form the first link in a food chain. In a freshwater ecosystem, such as the Lake Huron to Lake Erie Corridor, primary producers include phytoplankton, periphyton, and aquatic macrophytes. These are plants that depend on the sun for their energy.

Phytoplankton, also called algae, grow suspended in the open waters. More than 80 species of phytoplankton inhabit the Detroit River and 71 species have been identified in Lake St. Clair. Periphyton are larger algae, which are attached to the lake bottom or to other aquatic plants.

Aquatic macrophytes, or submersed aquatic plants, are large, rooted plants that live under the surface of shallow water, usually less than 23 ft (7 m) deep, where there is good light penetration. They are the dominant primary producers in the St. Clair River, Lake St. Clair and Detroit River system. The macrophyte beds that grow on the fringes of coastal marshes and along the shoreline provide food and cover for waterfowl and fish.

DENISE M. STYKA

The great blue heron* (Ardea herodias) *feeds mostly on small fish, but insects, frogs, and mice are occasionally eaten too. When hunting, the heron will stand motionless waiting for the right moment to strike its prey.

Zooplankton are the most numerous animals in the open waters. These microscopic creatures move about and eat by straining algae from the water. In turn, zooplankton are eaten by many small fish, such as sunfish and minnows, and the larval stages of many game fish species, including yellow perch.

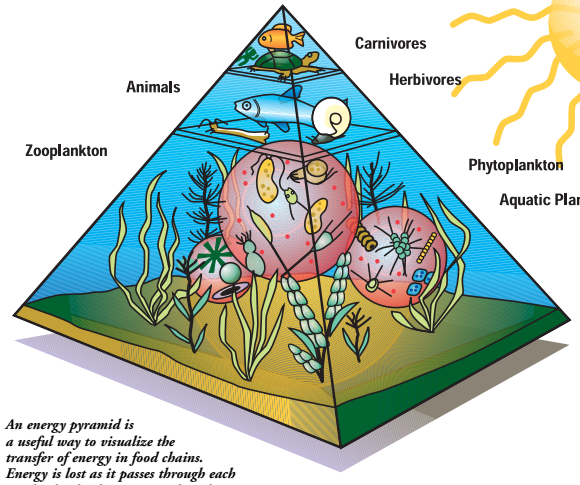
Benthic macroinvertebrates are spineless creatures that live in the bottom of a waterway for at least part of their lives. These creatures include mussels, snails, crayfish, leeches, worms, sow bugs, mayfly and stonefly nymphs. Some feed on dead organic matter (detrius) or filter feed. Other species are predatory, feeding on other smaller organisms.

Secondary consumers in an aquatic ecosystem include reptiles and amphibians such as bullfrogs, painted turtles, and water snakes. They eat insects and other small prey.

Tertiary consumers include such large predatory game fish as walleye and muskellunge. They feed on smaller fish that in turn had fed on zooplankton and insects.

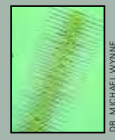
The top, or quarternary consumers, in the aquatic food chain are fish eaters–humans, mammals and birds, such as cormorants and bald eagles.

Decomposers are bacteria and other microorganisms that break down and feed on the decaying remains of aquatic organisms. The breakdown of the organic matter also creates nutrients for green plants. Decomposers play a critical role in maintaining the complex biological and chemical systems of the open water environment.



An energy pyramid is a useful way to visualize the transfer of energy in food chains. Energy is lost as it passes through each trophic level. The presence of producers, or autotrophs, far outweighs the presence of consumers, or heterotrophs. In the biosphere, plants account for 99 percent of all biomass. All other organisms constitute the remaining one percent.

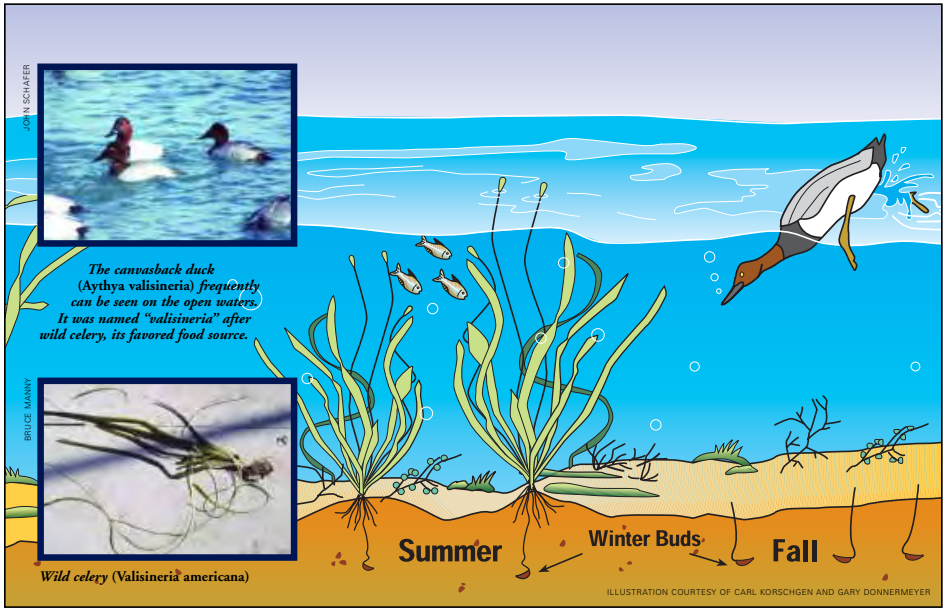
Primary Producers	Tertiary Consumers
phytoplankton, periphyton and aquatic macrophytes	muskellunge, white bass, walleye and northern pike
Primary Consumers	**Quaternary Consumers**
zooplankton, mussels, snails, crayfish and aquatic insects	osprey, tern, bald eagle, great blue heron, raccoons and humans
Secondary Consumers	**Decomposers**
minnows, gizzard shad, emerald shiner, frogs and turtles	invertebrates, bacteria and other microorganisms



DR. MICHAEL WYNNE

Phytoplankton can be seen only with a microscope, which reveals their fascinating shapes and colors.* Fragilaria spp. *(above) are diatoms that are common in the waters of the Lake Huron to Lake Erie Corridor during winter, spring and fall while the blue-green algae,* Oscillatoria spp. *(below), dominate in the summer months of July and August.

(ILLUSTRATION LEFT) THE ECOLOGY OF LAKE ST. CLAIR WETLANDS: A COMMUNITY PROFILE, U.S. FISH AND WILDLIFE SERVICE, BIOLOGICAL REPORT 85 (7.7), SEPTEMBER 1986.



Wild celery* (Valisineria americana) *populations declined by 72 percent from the 1950s to the 1980s in the Detroit River. They have since rebounded and now exceed levels of 50 years ago. This increase is attributed to greater water clarity, which is believed to be the result of water filtration by the zebra mussel, a non-native, invasive aquatic species. Wild celery is the preferred food of diving ducks such as canvasbacks, redheads and scaup.

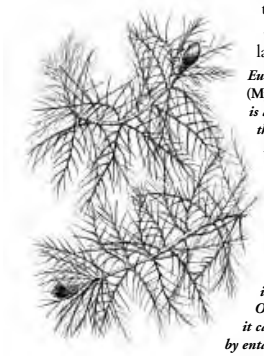
Submersed Aquatic Plants

More than 20 species of submersed plants occur in the St. Clair River, Lake St. Clair and Detroit River system. The most common species are listed in the chart below.

At one time, the shoreline of the Lake Huron to Lake Erie Corridor was lined with large, continuous stretches of submersed aquatic plants, or "weed beds", which are primary producers in the aquatic food chain. Today, the beds are fragmented and only a fraction of their original size. In the lower reaches of the Detroit River, south of Grassy Island, submersed beds occur near coastal marshes, especially in the Canard River Marsh, Humbug Marsh and Gibraltar Bay. The St. Clair River's swift current and straight channel prevent the widespread growth of emergent aquatic plants but they do occur around the river's islands, shoals and shoulders. The extensive coastal marshes of the St. Clair River Delta and the shallows of Lake St. Clair support the largest beds.

Submersed Aquatic Plants common to the Lake Huron to Lake Erie Corridor
Listed in order from most abundant to least abundant

Common Name	Scientific Name
Wild celery	*Valisineria americana*
Redhead grass	*Potamogeton richardsonii*
Eurasian watermilfoil	*Myriophyllum spicatum*
Waterweed	*Elodea canadensis*
Water stargrass	*Heterantha dubia*
Pondweeds	*Potamogeton spp.*
Bushy pondweed	*Najas flexilis*
Coontail	*Ceratophyllum demersum*


AMELIA HANSEN, CORVUS ART

Eurasian watermilfoil* (Myriophyllum spicatum) *is an invasive aquatic species that has spread throughout North America since its introduction in the 1940s. This feathery looking aquatic plant forms thick mats in rivers, lakes and streams where it displaces native aquatic plants, thus impacting fish and wildlife. Once an area is infested, it can interfere with boating by entangling propellers and degrading swimming areas.

Return of the Mayfly

The burrowing mayfly (*Hexagenia spp.*) is one of the most important fish foods in open waters. The burrowing mayfly nymph feeds on the decaying remains of aquatic plants. In turn, both the aquatic nymph and the flying adult mayfly are food for many animals, especially fish and birds.

Large swarms of flying insects are a common sight around water during the summer. These are burrowing mayflies that have emerged from their aquatic larval stage as adults and are mating. They may seem like a nuisance but it is important to remember that they, like many other aquatic insects, provide an important link in the food chain.

Burrowing mayflies are sensitive to poor water quality. In the 1960s, they became scarce because of toxic pollutants in the water and sediments. With improved water quality their population has rebounded, to the benefit of wildlife and people.


ALLEN CHARTIER

An adult mayfly on a leaf blade


SHAWN STATON, NATIONAL WATER RESEARCH INSTITUTE

The northern rifflesheil* (Epioblasma torulosa rangiana) *is a freshwater mussel that requires well-oxygenated, swiftly flowing water and prefers to live in fine to coarse gravel substrate. The northern rifflesheil has suffered dramatic declines in North America and is now globally endangered. A population in the middle to lower reaches of the east branch of the Sydenham River in Ontario still appears to be relatively healthy and is one of three reproducing populations left in North America. A second population may be persisting in the upper portions of the Black River in Sanilac County, Michigan, and a small population was recorded recently in the shallow waters of Walpole Island.

Freshwater Mussels

Historically, the St. Clair River, Lake St. Clair and Detroit River and their tributaries supported large, diverse populations of freshwater mussels. The Detroit River had one of the biggest varieties of freshwater mussels in the entire Great Lakes Basin, with at least 35 species recorded in the early 1900s. Lake St. Clair had 32 recorded species.

The diversity of freshwater mussel species is related to glacial history. During the late stages of the Wisconsin glacial period, there were many drainage routes that flowed through southeastern Michigan and southwestern Ontario. These drainage routes enabled aquatic species to move in from other river basins, such as the Mississippi, St. Lawrence and Allegheny. Consequently, many different freshwater mussels were able to colonize in the Corridor's water bodies.

Mussels that persist today are a globally significant component of the Lake Huron to Lake Erie Corridor's aquatic biodiversity. Today, virtually all of the freshwater mussel species that are listed as endangered, threatened or of special concern in Michigan and Ontario are confined to southeastern Michigan and southwestern Ontario waterways, including Lake St. Clair, the Sydenham River in Ontario, and the Raisin, Huron, Clinton, Belle, Black and Pine Rivers in Michigan. In fact, the Sydenham River is now the most significant refuge for freshwater mussels in the Corridor.

Freshwater mussels are in the Unionidae family, also known as pearly mussels. They are natural water cleansers and an important part of the aquatic food chain. They are food for muskrats, river otters and waterfowl. The mussels also have been important to humans. Early natives used them for food, jewelry and tools. From 1890 to 1950, mussel shells were used by the button-making industry. Between 1920 and 1946, freshwater mussels were harvested for this purpose along a 19-mi (30-km) stretch of the Thames River below London, Ontario.

The Biology of Freshwater Mussels

Freshwater mussels may appear to be a simple lifeform, but they actually have a complex lifecycle. Most species spend their time buried in sand or gravel at the bottom of rivers and streams. Some mussels live to be 100 years old. Only a few species make their home in the still waters of lakes and ponds. They usually remain in one place, although they do have a "foot" that helps them to burrow and move limited distances if disturbed by drought or floods. This foot also helps to anchor them against strong currents and predators such as muskrats that dig deep in the sand for their dinner. Freshwater mussels draw water into their shells so their gills can absorb oxygen and filter plankton, their food source.

DOUG SWEET

The snuffbox* (Epioblasma triquetra) *is a small freshwater mussel with unique markings that look like dripping paint. It lives deep within the sediment of small- to medium-sized rivers and streams, preferring clean sand, gravel or cobble substrate with swiftly flowing water. The banded sculpin and logperch are fish hosts. Distribution of the snuffbox has been reduced significantly throughout North America; most populations have become small and isolated. It is listed as endangered in both Michigan and Ontario.

Mussels' movement upstream and reproduction capability are intricately linked to fish. Female mussels' eggs are fertilized when sperm is drawn in from surrounding water, so a male of the same species needs to be nearby to avoid localized extinction. The fertilized eggs develop into the larval stage inside the female. Once they are developed, the female releases her young when she senses a fish is near. Some mussels will wave specially adapted tissues that look like fish prey in order to lure a fish. The young mussels, called glochidia, have to attach themselves to a host fish or they will die. This generally harmless parasitic stage lasts a matter of weeks before the glochidia mature and drop off the fish to begin a new life, in a different place than the mother.

Mussels are an excellent indicator species, or gauge, of local water quality because they are relatively stationary. They face many more threats now than in the past, including poor water quality, sedimentation, loss of larval fish hosts, channelization of rivers and streams, and invasive species. The greatest threat in the Lake Huron to Lake Erie Corridor is the zebra mussel, a non-native species that reproduces at a tremendous rate without need for a fish host. It displaces native freshwater mussels and wins the competition for food and oxygen. Zebra mussels even colonize the shells of native mussels, encumbering and starving them to death.

The zebra mussel has decimated native freshwater mussel populations in the Corridor. The original number of 35 species in the Detroit River had been dropping relatively slowly, but fell faster after zebra mussels arrived. Surveys found 28 different species in the 1980s but only 24 in the early 1990s. The Detroit River once supported one of the last strongly-reproducing populations of the northern riffleshell, which is on the federal list of endangered species in the U.S. and Canada. However, recent surveys indicate it may no longer exist in the river because of the exotic mussel invasion.

Native freshwater mussels have found a few refuges. Researchers recently discovered isolated populations of native mussels in the nearshore coastal marshes of western Lake Erie, the mouth of the River Raisin and the St. Clair River Delta at Walpole Island. Scientists are conducting investigations to better understand how these populations survive and if they remain stable. Research into freshwater mussels, and the impact of exotic mussels on them, is critical to managing and preserving the Corridor's rich aquatic heritage.

DOUG SWEET

The rayed bean* (Villosa fabalis) *is one of the smallest freshwater mussels. It lives in rivers and along lakeshores swept by shallow waves, where it is often found deeply buried in sand or gravel among roots of aquatic plants. It is extremely rare globally. Its distribution overlaps that of the northern riffleshell. It is important to protect rare fish associated with the habitats of mussels like the rayed bean, whose larval fish hosts are not known. Once widespread in southern Ontario, the rayed bean is now found only in the east branch of the Sydenham River. In Michigan, it is still found in the Pine River in St. Clair County, the Clinton River in Oakland County, the River Raisin in Monroe County and the upper Detroit River.

DTE ENERGY

Workers remove zebra mussels from a water intake pipe at DTE Energy's Monroe Power Plant

A native freshwater mussel colonized by zebra mussels.

The zebra mussel* (Dreissena polymorpha), *like many aquatic nuisance species, was brought here in the ballast water of a transatlantic freighter. Originally from Russia, the zebra mussel was discharged in 1988 into Lake St. Clair, where it quickly multiplied. Within 10 years, it spread throughout the Great Lakes Basin and into the Ohio, Mississippi, Tennessee and Hudson River basins.

Besides decimating native freshwater mussel species, the zebra mussel has taken a huge financial toll. The cost of just keeping zebra mussels from clogging water intake pipes is estimated at more than $2 billion a year.

Zebra mussels have increased water clarity in many rivers and lakes. In doing so, they have changed habitat and food webs, and depleted nutrients. An example of the impact is in Lake St. Clair, where the increased water clarity has allowed sunlight to penetrate to deeper waters, enabling more aquatic vegetation to grow. With more vegetation, the lake can support greater numbers of bass, northern pike and muskellunge but it has become less suitable for light-sensitive fish such as walleye.

Anglers and boaters can help control the zebra mussel's spread. One precaution is to not dump bait into the water. Another is to run the engine briefly while the boat is still on the trailer before launching it into a different water body.

Freshwater Mussel Species at Risk in the Lake Huron to Lake Erie Corridor

Common Name	Scientific Name
Purple wartyback	*Cyclonaias tuberculata*
White catspaw	*Epioblasma oblique perobliqua*
Northern riffleshell	*Epioblasma torulosa rangiana*
Snuffbox	*Epioblasma triquetra*
Wavy-rayed lamp mussel	*Lampilis fasciola*
Hickorynut	*Obovaria olivaria*
Round hickorynut	*Obovaria subrotunda*
Round pigtoe	*Pluerobema coccineum*
Mudpuppy mussel	*Simpsonaias ambigua*
Purple lillyput	*Toxolasma lividus*
Rayed bean	*Villosa fabalis*
Rainbow	*Villosa iris*

Many freshwater mussel species have colorful names, such as purple wartyback and round pigtoe, which give clues to their appearance.

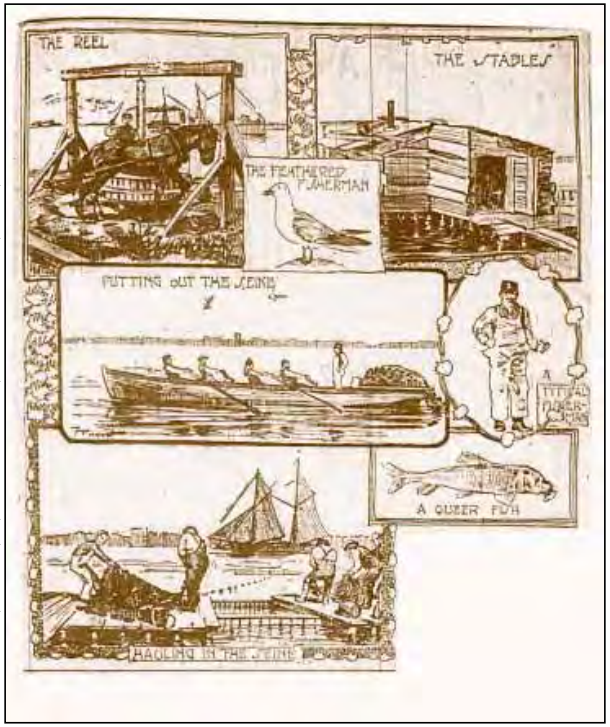
The Lake Huron to Lake Erie Corridor is a Migration Route and Spawning Area for Great Lakes Fish

Fish are the most numerous animals of the open water in the Corridor. Of the 174 species of fish recorded in the Great Lakes Basin, 116 are known to occur in the St. Clair and Detroit River systems and their tributaries. This incredibly large and diverse fish fauna is due to a wide variety of aquatic habitats, as well as the fact that some species found here are at the northern or southern limits of their range.

Since the arrival of European settlers, there have been significant changes in the fish community, particularly during the past century. Exploitation by commercial and recreational fisheries, extensive shoreline modification, pollution and introduction of exotic species have changed the abundance and distribution of fish species. These dramatic changes become apparent when current conditions are compared with this account, written by Bela Hubbard, who lived near the Detroit River in the late-19th Century:

"… All the world is now familiar with this lustrous and exquisite fish (lake whitefish), with which our strait and lakes abound, and which has become an important article of commerce. In our river they are only taken with seine and dragnets, in the spring and fall. The latter is the season of the great run, and commences with the approaching of cold weather in October, lasting until nearly winter…many a time I have watched the boats as they pull upstream – a song keeping time to the oars—drop the net, and row rapidly back to shore. Here both ends are drawn by horse windlass, the bag of the net soon appearing, distended with the shining captives. They are thrown into a pile, from which the finest and largest may be selected at five to ten cents a piece…..The seine of course catches all kinds of fish that come within its sweep, and are not too small to escape its two and half inch meshes. Among these occasionally a huge sturgeon, often of forty pounds weight. And more rarely that prince of a fish and delicate bonne bouche, the muskellunge. The latter is also taken by hook and line in our river and in Lake Ste. Claire."

– Bela Hubbard,
"Memorials of a Half Century", 1887



THE DETROIT FREE PRESS, NOVEMBER 12, 1899. PROVIDED BY JOHN POLASCEK, DOSSIN GREAT LAKES MUSEUM, BELLE ISLE, MICHIGAN

Illustration taken from an article that appeared in the Detroit Free Press, November 12, 1899. The article, "Fishing on a Big Scale," described the commercial fish operations of the United States Fish Commission on Belle Isle. The process used a seine, over 1,000 feet in legnth and 12 foot in depth, first hauled out by men on a boat and later drawn in by horsepower.

Lake whitefish, lake trout and lake herring still occur, but are no longer major seasonal components of the St. Clair River, Lake St. Clair and Detroit River system. Historically, these large cold-water fish were not residents, but migrated through the corridor from Lakes Erie and Huron to spawn in the fall. These three fish species largely disappeared from the region during the early 1900s due to over-fishing, construction of the shipping channel and water pollution. Lake sturgeon, sauger, and blue pike also were once common. Today, the lake sturgeon, sauger and lake herring are species at risk in the region. The blue pike is extinct.

Great Lakes fish use the Lake Huron to Lake Erie Corridor as a permanent home, a seasonal home or a migratory pathway. Most warm-water fish, such as sunfish, sucker, catfish and drum, are permanent residents. Cool-water species such as walleye, lake sturgeon, yellow perch, muskellunge and northern pike are present throughout the year. Populations of these fish also come from other lakes in large numbers during the spring and summer for feeding, spawning and nursery habitat. Larger cold-water fish, such as salmon and rainbow trout, use the Corridor to migrate between Lakes Huron and Erie or to dine on seasonally abundant forage fish.

Different types of aquatic habitats support different fish species. Some fish, such as northern pike and pumpkinseed, are highly dependent on coastal wetlands. Others, such as smallmouth bass and largemouth bass, can be found both in coastal wetlands and non-vegetated waters. Larger fish, such as walleye and muskellunge, frequent deeper channel waters. The loss of coastal wetlands and riparian habitats has contributed to the decline of many fish that depend on aquatic vegetation for spawning, feeding and cover.

The loss of coastal wetlands and their associated beds of submersed aquatic plants can affect fish populations because they provide spawning and nursery habitat for many popular sport fish species. Largemouth bass, smallmouth bass, northern pike, walleye, yellow perch and muskellunge reproduce in Great Lakes coastal marshes.

The wetlands and reefs of the lower Detroit River are the most significant spawning and nursery habitat for the entire river and for most of western Lake Erie. It is estimated more than 10 million adult walleye migrate there annually. Other major spawning areas include Lake St. Clair and the Thames River.

DOROTHY L. FRANCIS

(Right) Yellow perch caught from Lake St.Clair by local fisherman. Fishing is a popular activity in the Lake Huron to Lake Erie Corridor. The extensive wetlands of the St. Clair River Delta contribute to Lake St. Clair's distinction as one of North America's most productive sport fisheries for bass and muskellunge. Lake St. Clair and the Detroit River are recognized as fishing hot spots worldwide.

(Above) This map is a generalized view of spawning areas. The Lake Huron to Lake Erie Corridor provides valuable spawning and nursery habitat for more than 45 species of fish. Among them are minnows and small game fish that spawn in coastal wetlands near shoals, shallow waters around islands, and river shoulders with gravel or silt substrates. Large game fish, particularly lake sturgeon, spawn in deep water where the current is swift and the bottom is hard.

DAVID JUDE

The common carp **(Cyprinus carpio)**, *which is thought to have originated in Eastern Asia, was brought here as a potential food fish in the 1800s. It adversely affects coastal wetlands because it uproots aquatic plants as it feeds, destroying valuable submergent beds.*

DAVID JUDE

The round goby **(Neogobius melanostomus)** *is a small fish that arrived in the early 1990s. It appears to be displacing many native darters and sculpins. The round goby feeds on the eggs of native sport fish as well as zebra mussels. Scientists are studying this new invader's impacts on the aquatic food chain.*

Exotic Fish in the Lake Huron to Lake Erie Corridor

More than 15 species of exotic fish live in the Lake Huron to Lake Erie Corridor. Of these, alewife, rainbow smelt, coho salmon, chinook salmon, rainbow trout, brown trout, common carp, round goby and white perch are found in abundance.

These fish began to appear in the Great Lakes system in the 1800s. Some were deliberately introduced to boost sport fishing. Among them are salmon and trout, which have had little negative impact on native fisheries and are popular with anglers. Other exotic fish, such as the round goby, were released accidentally through the discharge of ballast water from transatlantic freighters and have reproduced in extraordinary numbers.

Common Cold-water, Cool-water, Warm-water, and Forage Fish Species found in the Lake Huron to Lake Erie Corridor

- Cold-water: Lake whitefish, lake herring, lake trout, brown trout#, coho salmon#, Chinook salmon#, rainbow trout#.
- Cool-water: Lake sturgeon, northern pike*, muskellunge*, walleye* and yellow perch*
- Warm-water: Black crappie*, brown bullhead*, yellow bullhead, black bullhead, largemouth bass*, rock bass*, bluegill*, smallmouth bass*, freshwater drum, channel catfish*, common carp#
- Forage: Gizzard shad, minnows, trout perch, killifish, silver sides, sticklebacks, sculpins, rainbow smelt#, alewife#

***= Important game fish species # = Exotic fish species**

A VERY OLD FISH

The Return of the Lake Sturgeon

Historically, the lake sturgeon (*Acipenser fulvescens*) has been a significant member of the Great Lakes fish community.

During the past century, lake sturgeon populations have become so low that fishing is extremely limited. It is listed as an endangered species in the U.S. Causes of the decline include human alteration of the landscape as well as sedimentation and pollution in the water, all of which changed the amount and quality of spawning habitat.

Commercial over-fishing in the late 19th Century is also partly responsible for the population decrease. Annual commercial lake sturgeon production in the Lake Erie and Lake St. Clair system peaked at five million pounds in 1885. It has been near zero since 1910.

However, the lake sturgeon appears to be making a comeback in the region. For the first time in decades, juvenile lake sturgeon have been found in the Canadian waters of the western Lake Erie Basin. Today, the Lake Huron to Lake Erie Corridor supports the largest river-spawning lake sturgeon population in the Great Lakes.

The lake sturgeon belongs to a group of fish that predates the dinosaurs by 40 million years. It is one of the longest-living and most primitive animals in the world. A lake sturgeon may grow to eight feet (2.4 m) in length, weigh up to 300 lb (136 kg) at maturity and live up to 125 years.

TODD SWEET

Lake sturgeon **(Acipenser fulvescens)**

Several primitive physical features make the lake sturgeon unique. Instead of overlapping scales, it has five bony shields and a head covered with bony plates. Like sharks, its skeleton is cartilage and its spinal column continues to the upper lobe of the tail. The underside of the lake sturgeon's snout contains four fleshy barbells, or feelers, that drag on the bottom and have chemical sensors to locate snails, clams, crayfish, worms and insect larvae on which it feeds. Behind the feelers, a tube-like mouth sucks up food like a vacuum cleaner, as it has no teeth. Recent observations have found the lake sturgeon feeds on exotic species such as zebra mussels and round goby. These findings reveal the adaptable foraging behavior of the lake sturgeon, a testimonial to its long existence on Earth.

The lake sturgeon has an extremely late maturity, which has slowed the recovery of its native population. Sexual maturity is not reached until age 15 for males and age 25 for females. They return to rivers in the spring, even when there is still ice, to spawn from early May through June. They spawn on large rocks and coarse gravel in a rapid current. A large female may lay as many as three million eggs, depositing them on gravel bars in fast-flowing water, usually at a depth of 5 to 25 ft (7.5 m). Currently, two lake sturgeon spawning sites are known to exist in the St. Clair River. One is in the upper river near the Blue Water Bridge, where the water is approximately 60 ft (18 m) deep. The other is in the lower river, near the opening into Lake St. Clair, on an artificial reef composed of coal cinders put into the river in the 1880s by commercial ships. After hatching, young sturgeon migrate into adjacent marshes and larger lakes.

Many agencies and universities have been working to restore the lake sturgeon. Since 1997, researchers from the University of Michigan School of Natural Resources have been using telemetry to track the population's seasonal movements in the St. Clair River and Lake St. Clair. Through this tracking, scientists hope to identify key spawning grounds and to better understand migratory patterns. Other agencies and institutions such as the Ontario Ministry of Natural Resources, Michigan Department of Natural Resources, U.S. Fish and Wildlife Service, U.S. Geological Service and Central Michigan University also are researching lake sturgeon and their habitat. Information gathered from all these efforts is essential to the development of long-term strategies for increasing the sturgeon population and protecting spawning locations. Recent research found an increase in two-and three-year-old juveniles. This is encouraging news. With continued research and proper management, it is hoped this ancient fish will be as abundant in the third millennium as it was in ages past.

Fish at Risk

Many fish species found in the St. Clair River, Lake St. Clair and Detroit River are considered to be at risk in either Michigan or Ontario due to declining populations. Decreases in the abundance and diversity of fish are caused by various factors, including water pollution and invasive species. The main causes, though, are loss and degradation of fish habitat. The extensive draining and filling of coastal wetlands, dredging of the navigation channel and hardening of the shoreline have all significantly reduced and degraded habitat. Fish surveys confirm the impacts. For example, few fish species are found near the steel break walls that now dominate much of the Corridor's shoreline.

Fish Species at Risk in the Lake Huron to Lake Erie Corridor

Common Name	Scientific Name
Lake sturgeon	*Acipenser fulvescens*
Eastern sand darter	*Ammocrypta pellucida*
Lake herring	*Coregonus artedii*
Lake chubsucker	*Erimyzon sucetta*
Mooneye	*Hiodon tergisus*
Silver chub	*Hybopsis storeiana*
Northern brook lamprey	*Icthyomyzon fossor*
Bigmouth buffalo	*Ictiobus cyprinellus*
Spotted gar	*Lepisosteus oculatus*
Black redhorse	*Moxostoma duquesnei*
River redhorse	*Moxostoma carinatum*
Northern madtom	*Noturus stigmosus*
Pugnose shiner	*Notropis anogenus*
Bridle shiner	*Notropis bifrenatus*
Pugnose minnow	*Notropis emiliae*
Channel darter	*Percina copelandi*
Sauger	*Stizostedion canadense*

JOSEPH R. TOMELLERI

The northern madtom* (Noturus stigmosus) *is a small, bottom-dwelling catfish that is sensitive to poor water quality.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

The eastern sand darter* (Ammocrypta pellucida) *is a small member of the perch family. It lives almost exclusively in sandy-bottomed areas, where it likes to completely bury itself. Its translucent body and burrowing nature afford it camouflage from predators.

These islands are just the beginning of the new Detroit River International Wildlife Refuge.

The Detroit River International Wildlife Refuge

The Detroit River International Wildlife Refuge is North America's first international wildlife refuge and joint habitat management project. Public Law 107-91 established it in the U.S on December 21, 2002. This was a landmark event in the quest to protect, manage and restore the biologically significant ecosystem of the lower Detroit River, often referred to as the "Conservation Crescent." The new refuge presents an opportunity for dynamic partnerships between the U.S. Fish and Wildlife Service and governments, industries, local communities and various agencies and organizations.

Two seperate laws in the U.S. established an acquisition boundary for the Refuge which stretches nearly 40 mi from the mouth of the Rouge River south to the Michigan/Ohio state line and includes the lands east of Interstate 75 and Jefferson Avenue. This area covers riverfront, islands, shoals, marshes, and coastal wetlands along the Detroit River and western Lake Erie. Initially, the former Wyandotte National Wildlife Refuge made up most of the new Refuge. More recent additions include Mud Island, Calf Island and a 152-acre parcel in Monroe County. In addition, a cooperative management agreement has been signed with DTE Energy's Fermi II Nuclear Power Facility to manage over 600-acres of habitat on that site at the newly established Lagoona Beach Unit of the Refuge. This landmark agreement doubled the amount of property under the jurisdiction of the Wildlife Refuge. Due to the unqiue naure of this urban Refuge, property donations, acquisitions and cooeprative agreements are essential to its expansion within the designated area.

The lands of the refuge have a long and colorful history. During the prohibition era of the 1920s and early 1930s, Mud Island was a center of illegal alcohol transport, or "rum-running." National Steel Corporation purchased the island in 1945 from the U.S. government. The Army Corps of Engineers has used the island as a disposal site for dredged material from the Rouge River bottom, so the island's size has increased over the years. In 1962, Mud Island's size was increased by the addition of material dredged from the bottom of the Trenton Channel. Currently it is an 18.5-acres (7.4-ha) island with 71.5-acres (28.6-ha) of submerged aquatic shoals. National Steel donated the island to the U.S. Fish and Wildlife Service on June 14, 2001.

Grassy Island was a favored whitefish spawning area in the 1800s. Records show the fishery on the island employed 30 men, working day and night from September to November to harvest 45,000 adult whitefish per spawning season. The island was used mainly for navigation purposes until 1961 when it was designated as a national wildlife refuge because of its natural resource values. The abundant beds of wild celery surrounding the island attract thousands of diving ducks during their spring and fall migrations. Bald eagle, lake sturgeon, spotted turtle, osprey and common tern are rare species that have been identified at the refuge.

The dominant features of these Detroit River islands are hardwood forests, swamps, lakeplain prairie and various types of wetland, most importantly Great Lakes coastal marsh. Mammals found on the islands include coyote, gray fox, white-tailed deer, raccoon, woodchuck, muskrat, rabbit, voles and mice. Overall, the new refuge will conserve, protect and restore habitat for 29 species of waterfowl, 65 kinds of fish and 300 species of migratory birds along the lower Detroit River and western Lake Erie.

RIVERS & STREAMS

Riparian zones are the areas along the banks of rivers or streams. These zones serve as an important transitional area and buffer between water and land.

Because riparian zones include both land and water, they are rich with diverse plant communities that are adapted to fluctuating water levels, nutrient rich soils and warm microclimates common to riparian lowlands.

These plant communities, along with moisture variations and natural floating objects such as tree limbs and leaves, provide habitat, and fluid movement corridors for a wide variety of aquatic, avian and terrestrial fauna, especially reptiles and amphibians.

Today, natural buffers of vegetation along watercourses are important habitat. They provide a migratory corridor for wildlife in an increasingly fragmented natural landscape. Streamside vegetation also helps to both retain water and maintain good water quality. In contrast, in landscapes where forests and wetlands have been removed, streams often dry up in late-summer and have poor water quality. Water that does remain has a higher temperature and lower dissolved oxygen content, impairing biological communities.

LOU TERRY

A view of the Huron River in the fall

ST. CLAIR REGION CONSERVATION AUTHORITY

The Sydenham River is one of the most biologically diverse watersheds in all of Canada, supporting at least 82 species of fish and 34 species of freshwater mussels.

MAURA E. MCNICHOL

The south branch of the Pine River at the Pine River Nature Center in Goodells, Michigan.

ESSEX REGION CONSERVATION AUTHORITY

The Canard River at the Essex Region Conservation Authority's Canard Valley Conservation Area.

What's in a River?

Riffles

Riffles are shallow areas with faster flows where rocks break the surface and aerate the water. They are important spawning grounds for fish.

Runs

Runs are fast, deep areas where the water surface is turbulent but rocks do not break the surface.

Pools

Pools are wide, deeper areas with slow currents that occur between riffle-run complexes and are favored habitats of fish.

Floodplains

Floodplains are lands surrounding a stream that are periodically covered with water. They are important for absorbing excess stormwater and reducing streambank erosion.

Meanders

Meanders are bends in stream channels. They form naturally as streams flow through floodplains. They help reduce downstream flooding by using the energy of water to create longer streams with more erosional and depositional areas. Meanders increase the quantity and quality of stream habitats.

Fish Diversity in the Tributaries

The tributaries that flow into the Lake Huron to Lake Erie Corridor are generally too small for large fish but they provide habitat for smaller fish species such as darters and minnows. Historically, the Corridor's watersheds have supported a diverse fish fauna.

Unfortunately, changes in riparian zones, such as the clearing of streamside vegetation, have altered the habitat and resulted in siltation, pollution and increased water temperatures lowering the suitability of rivers and streams to support diverse fish populations.

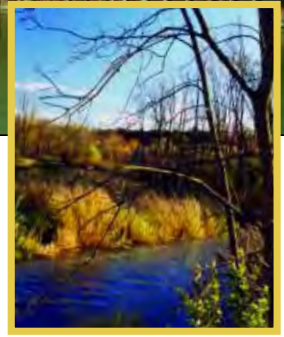
Many of the smaller endangered and threatened fish species of Michigan, such as redside dace and silver shiner, live in the watersheds of southeastern Michigan. Populations of those fish declined because urbanization degraded their waterways. Preserving the remaining pristine headwaters and improving habitat in the lower reaches of rivers is key to maintaining the presence of the fish in the state. Undeveloped headwater areas are important sources of diverse aquatic species that may re-colonize degraded reaches downstream once water quality improves.

River systems in southwestern Ontario also support a great diversity of fish. The Thames River supports nearly two-thirds of Ontario's known fish fauna. The Sydenham River supports eight fish species at risk. Twenty-three species of minnows, such as the pugnose, have been identified in Essex County's many creeks and small rivers, the highest minnow diversity recorded for any region in Canada. Restoring and maintaining the health of the tributaries will help to ensure a diverse fish community remains.

DEBORAH BASSETT-MAXWELL

The annual leaf fall into rivers and creeks supplies organic matter to the stream system. It is a first link in the food chain, feeding benthic macroinvertebrates and other aquatic organisms.

ROBERT STEWART



JESSICA PITELKA-OFFER

Right is Stony Creek in the late fall, which is the headwaters of the Clinton River. Its natural state sharply differs from the urbanization that defines the Clinton River's lower reaches.

JOSEPH R. TOMELLERI

The silver shiner* (Notropis photogenis) *is a small, slender minnow that likes the quieter pools of larger river systems. The watersheds of the Corridor are at the northern end of its distribution in North America. This minnow is becoming rare due to habitat loss.

The Redside Dace

KONRAD SCHMIDT, GENERAL COLLEGE AND JAMES FORD BELL MUSEUM OF NATURAL HISTORY, UNIVERSITY OF MINNESOTA, MINNEAPOLIS/ST. PAUL.

The redside dace (*Clinostomus elongatus*) is an endangered fish in Michigan. It lives in Johnson Creek, a clear, cool headwater stream of the Rouge River. Parts of Johnson Creek are still relatively undisturbed. Headwaters like Johnson Creek hold important potential for re-colonizing ecologically sensitive species in the lower reaches of degraded watersheds.

The Lake Huron to Lake Erie Corridor is characterized by tremendous aquatic biodiversity. From tiny plankton to giant lake sturgeon, many different types of creatures are connected to one another through the aquatic food chain. Sport fish are abundant and the bald eagle has returned to shorelines in the region. But despite humans' efforts to protect water quality, prevent habitat loss and guard against invasive species, many aquatic organisms continue to decline. A few are close to extinction. More actions to protect and restore wildlife habitat are critical to ensuring the aquatic communities of southeastern Michigan and southwestern Ontario remain healthy and diverse. To learn more about how to help protect and restore rivers, lakes and streams contact your local watershed organization listed in Appendix C.

Along the Shoreline

"The natural beauty of the region lying between Lakes Erie and Huron has been recorded by all the early travelers, with words of admiration. Many of the islands were low, and some of the river margins scarcely above the water. But all was green and peaceful. Dark forests extended to the river edge, and many a tall monarch of the wood waved its gigantic arms over the brink, and was reflected in the glassy surface which not tide or flood ever disturbed. The marshes were luxuriant with wild rice that furnished a sumptuous repast to a great variety of birds and waterfowl, and even a welcoming supply to the Indians. Occasional villages and bark wigwams enlivened the shore, surrounded with gardens and cornfields, and the most elevated points were crowned with burial grounds. Most of the shores had high banks and were covered with timber."

–Bela Hubbard, a historical address in 1879 marking the bicentennial of the discovery of Lake St. Clair by LaSalle in 1679.

ERNIE BERGEN

DAN PAVUK

ANDREW FOOT

ANNE C. HAMMERSCHMIDT

(Left) Brighton Beach in West Windsor, Ontario is one of the last natural shorelines on the Detroit River. (Right) Twenty percent of the Canadian shoreline and 87 percent of the Michigan shoreline along the Detroit River have been modified with bulkheading and other shoreline hardening structures. As a consequence, in Michigan, only three percent of the original coastal wetlands remain in the Detroit River.

(Above left) The great egret (Ardea alba) hunts in the shallows of the coastal marshes throughout the Lake Huron to Lake Erie Corridor, feeding on fish, frogs, small mammals and birds. The great egret nested on Stony Island in the Detroit River from the late-1940s to 1978, but abandoned that site due to high water and industrial activity.(Above) Dawn at the mouth of the Thames River at Lake St. Clair.

Prior to European settlement, the shoreline of the Lake Huron to Lake Erie corridor looked very different than it does today. Extensive Great Lakes marshes skirted the shoreline, especially along Lakes St. Clair and Erie. Upland from these marshes there was generally hardwood swamp on poorly drained clay soils and beech-maple forest on better-drained sites. Tallgrass prairie and oak savanna grew in the lakeplain's sandy areas.

Great Lakes Coastal Marsh

Great Lakes coastal marsh is a wetland ecosystem distinct to the Great Lakes. It is the most productive natural system in Earth's temperate zones, providing habitat for mammals, waterfowl, shorebirds, songbirds, reptiles, amphibians, fish, insects, crustaceans and many plant species.

"All the rivers and creeks enter from both sides, through low, swampy land covered with folle avoine, or wild oats. This aquatic grain, though thus named, is nevertheless essentially different from either oats or rice; no vegetable that I ever seen, has a more beautiful appearance than is exhibited by the immense marshes, covered with folle avoine; it is now in blossom, exhaling a peculiarly pleasing fragrance."

–William Darby, 1819, describing the Ontario and Michigan shorelines on the Detroit River.

AMELIA HANSEN CORVUS ART

The aquatic plant, "folle avoine," of which American geographer William Darby wrote is wild rice (*Zizania aquatica*) and once was common in the region's coastal marshes. Wild rice is very sensitive to changes in water flow. As a result of major shoreline alterations, it no longer thrives. In fact, today it is listed as a threatened plant species in Michigan.

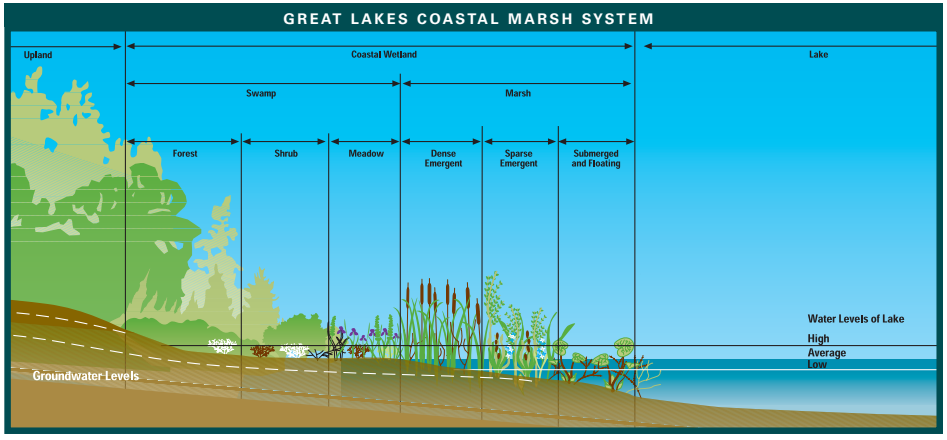
Great Lakes marshes are dynamic systems. Since their topography is almost flat, they are highly influenced by fluctuating Great Lakes water levels. This is especially true in the St. Clair River Delta where a change of only a few inches greatly affects the size and position of wetlands. In high-water years, strong on-shore winds produce s ufficient wave action to uproot plants and cause erosion. In low-water years, marsh habitat becomes more abundant. Changing water levels often cause dramatic shifts in vegetation in a short period of time, shaping the abundance and diversity of habitat available to wildlife. Mudflats appear in the shallows of coastal marshes when the water is low. Mudflats provide habitat for shorebirds that stop to rest and feed during migration. They use their long, pointed bills to probe exposed soil for insects and other invertebrates.

ALLEN CHARTIER

The American lotus* (Nelumbo lutea) *is a floating plant of coastal marshes in the lower Detroit River and western Lake Erie. Its exotic-looking white blossoms inspire the Lotus Garden Club of Monroe, which works to help ensure there is good habitat for this threatened plant species in Michigan.

MARIE BOYLE

The large pink flowers of the swamp rose mallow* (Hibiscus moschetos) *grace the fringes of coastal marshes. Lake Erie Metropark in Michigan is a good place to view them during the summertime.



The Great Lakes coastal marsh system provides a wide range of habitats: mudflats, emergent and submergent wetlands, wet meadows, and tree and shrub swamps. Each zone is occupied by a different plant community, each of which supports a different animal community.

Reptiles and Amphibians at Risk

Reptiles of the region are snakes and turtles. Amphibians are frogs, skinks, newts and salamanders. Both reptiles and amphibians rely on water and land habitats for survival. For turtles, the connection between the aquatic wetlands where they feed, and the uplands where they nest, is critical. Unfortunately, roads and development have fragmented habitats and disrupted this connection. Wildlife is forced to cross roads, resulting in high mortality rates. Overall, reptile and amphibian populations are declining due to habitat destruction, pollutants that cause birth defects, and nest predation by raccoons and other suburban wildlife.


JOHN SCHAFER

The eastern fox snake* (Elaphe vulpina gloydi) *lives in coastal marshes and associated wet meadows. This harmless snake may have a copper-colored head and will vibrate its tail when disturbed; thus it is often mistaken for a venomous snake and needlessly killed by fearful people. Historical and ongoing habitat destruction and persecution have greatly reduced Eastern fox snake numbers.


JOHN SCHAFER

The spotted turtle* (Clemmys guttata) *has distinctive yellow dots on its head and shell that make it easy to identify. This animal inhabits clean, shallow waters with a soft bottom, such as sedge marshes, sphagnum seepages, and fens. They feed on insects, mollusks, crayfish, and other aquatic organisms. Historically, this small, secretive aquatic turtle was fairly common in its specialized habitats throughout southern Michigan and Ontario; however, illegal collection for the pet trade and habitat loss now make it rare.


JAMES H. HARDING


JAMES H. HARDING

The Eastern spiny softshell turtle (Apalone spinifera spinifera) has a distinctive olive colored shell that is flat and leathery looking. It lives in rivers, lakes, and marshes that have soft-bottoms and can be seen basking on logs, rocks, riverbanks, and sandbars.

Rare Birds Dependent on Coastal Marshes find Habitat in the Lake Huron to Lake Erie Corridor


JOHN SCHAFER

Despite being the size of a chicken, the king rail (*Rallus elegans*) is one of the most secretive marsh birds and is not often seen. The king rail nests throughout most of the eastern U.S. and is a permanent resident of the south. The Lake Huron to Lake Erie Corridor lies within the northern edges of its range. King rails were abundant in the area around 1900, especially along the Detroit River and Lake Erie's western shore. It built nests on shrubs or vegetation clumps that grew in shallow areas there. But king rail populations have declined severely following wetland losses throughout their range. In addition, lead poisoning and pesticides may limit rail populations in otherwise suitable habitats.

King rails are endangered in both Michigan and Canada. Fewer than 10 pairs were estimated to exist in Michigan in the mid-1980s. Walpole Island still supports a population of these rare birds.


JOHN SCHAFER

With its highly social nature and striking appearance, the black tern (*Chlidonias niger*) is characteristic of biologically rich marshlands. During the nesting season, it is found in inland marshes in much of northern North America. It spends the winter along ocean coasts in the tropics, from central Mexico through northern South America. Unlike other species of terns, which are highly colonial, black terns prefer some space between their nests; they breed in loose colonies in shallow marshes that are an equal mix of open water and marsh vegetation.

This species was once an abundant breeder in the Lake Huron to Lake Erie Corridor. Early Detroit ornithologist Bradshaw Swales (1875-1928) described them as nesting in "immense numbers" along the Detroit River. But from 1966 to 1996, numbers of black terns declined by 61 percent in North America. Today, black terns are a species of special concern in Michigan and Ontario.

Loss and degradation of inland wetlands are the major causes of declining black tern populations. Invasions of purple loosestrife and other exotic plant species that alter the composition of marshland vegetation may also play a role. Environmental contaminants also may have negative impacts, as some marshes that appear to be appropriate habitat are not occupied by these birds.

The least bittern (*Ixobrychus exilis*) is the smallest member of the heron family. It breeds throughout much of the eastern U.S. and Ontario. Winters are spent in southern Florida and Texas, the West Indies and parts of Mexico and Central America. It nests in freshwater or brackish wetlands with tall, dense vegetation. Semi-open cattail and bulrush marshes are ideal habitat.

The least bittern was once a common summer resident in southern Michigan and Ontario, notably Grassy Island in the Detroit River, and on Grosse Ile, Michigan. Population trends are difficult to assess because this secretive species is not adequately surveyed, but most sources agree populations have declined to the point that the least bittern is now rare. The main cause is habitat loss, with additional pressures from pollution and predators such as raccoon. Least bitterns are considered threatened in Michigan and Canada, although they continue to inhabit Walpole Island's coastal marshes.


JOHN SCHAFER

Waterfowl

Coastal marshes are very important as feeding and resting areas for migrating waterfowl such as geese, swans and dabbling and diving ducks.

Dabbling ducks have broad, flat bills that they use to feed on plants and insects in water less than one foot (30.5 cm) deep. They prefer shallow areas of rivers, lakes and ponds. Dabbling ducks include the common mallard and American wigeon.

Diving ducks have stout bodies, short necks and tails, and large paddle feet. They dive to feed on fish, mussels, insects and aquatic plants. They prefer the deeper, open water areas of large lakes and rivers. Common diving ducks include the canvasback, scaups and redheads.

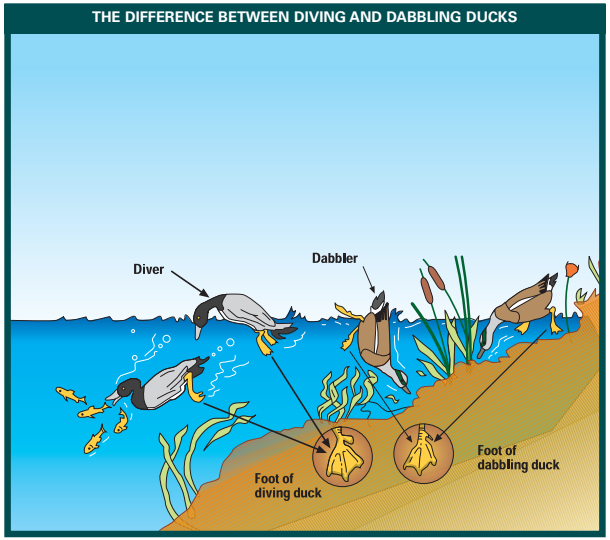
Geese have heavier bodies and longer necks. They have strong legs, well-suited to walking, and prefer to graze on grass and grain in farm fields far away from water.

The most recognizable of these is the Canada goose, whose population has increased to nuisance status, congregating in large numbers around stormwater detention ponds, golf courses and public parks.

Swans are the largest and most graceful waterfowl. Their feathers are completely white and they have long necks which they use to feed on submerged vegetation. Although the tundra swan is native to the Corridor region, the introduced mute swan is now much more common.

Common Name	Scientific Name
Wood duck	*Aix sponsa*
Northern pintail	*Anas acuta*
American wigeon	*Anas americana*
Northern shoveler	*Anas clypeata*
Green-winged teal	*Anas crecca*
Blue-winged teal	*Anas discors*
Mallard duck	*Anas platyrhynchos*
Black duck	*Anas rubripes*
Gadwall	*Anas strepera*
Lesser scaup	*Aythya affinis*
Redhead	*Aythya americana*
Ring-necked duck	*Aythya collaris*
Greater scaup	*Aythya marila*
Canvasback	*Aythya valisinera*
Bufflehead	*Bucephala albeola*
Common goldeneye	*Bucephala clangula*
Long-tailed duck	*Clangula hyemalis*
Hooded merganser	*Lophodytes cucullatus*
Red-breasted merganser	*Mergus serrator*
Ruddy duck	*Oxyura jamaicensis*
Snow goose	*Chen caerulescens*
Canada goose	*Branta canadensis*
Tundra swan	*Cygnus columbianus*
Mute swan	*Cygnus olor*

The Lake Huron to Lake Erie Corridor's coastal marshes are frequented by at least 24 different species of waterfowl during migration. Some species, such as northern pintail and common goldeneye, are present only during migration. Others, such as the mallard duck and Canada goose, are present throughout the year.



This illustration shows the differences between diving and dabbling ducks.


TREVOR FLOYD

The mallard (Anas platyrhynchos) is the most abundant species of duck in the Lake Huron to Lake Erie Corridor. Here, mallards are shown congregating along the shoreline of the St. Clair River with the Blue Water Bridge in the distance.


JOHN SCHAFER

The tundra swan (**Cygnus columbianus**)*, native to North America, migrates about 4,000 mi (6,000 km) a year between its breeding areas in the Arctic and its wintering habitats in western and eastern North America. The open waters and coastal marshes of the Corridor are important resting areas during migration. Once known as the "whistling swan" because of its distinctive melodious voice, the tundra swan is now rare compared with the mute swan.*


JOHN SCHAFER

The wood duck (**Aix sponsa**) *is considered to be one of our most beautiful native ducks. It was common to the region in the late 1800s, and then became rare. Today, this species has made a comeback due to hunting regulations and nest box programs.*


DOROTHY L. FRANCIS

The strong current and heated-water discharges often keep portions of the Corridor's waters from freezing during winter. Large numbers of waterfowl concentrate in the areas of open water. Mute swans (**Cygnus olor**)*, shown in front, have become common in the region since their introduction from Europe in 1919. Like many introduced animals they displace certain native species and over-graze vegetation. The knob on their beaks is the feature that distinguishes them from native tundra swans.*


SHELLEY M. HICKS

Canada geese (**Branta canadensis**) *are abundant in the Lake Huron to Lake Erie Corridor. Large numbers can be seen in open waters and congregating on mowed grounds. Unlike some other animals, they have thrived in manicured landscapes.*

JOHN SCHAFER

The muskrat* (Ondatra zibethicus) *is a common wetland mammal. Muskrats feed on the rhizomes and tender bases of cattails, arrowhead and other aquatic vegetation along with the occasional crayfish and clam. They carry their dinner to feeding platforms constructed of vegetation where they eat the food they prefer and discard the rest, leaving traces of their activity.

Furbearers of the Marsh

The first European settlers of the Lake Huron to Lake Erie Corridor were French trappers and explorers who were attracted by the abundant fur-bearing animals that lived in coastal marshes. The fur trade was the first commerce of the region, based on the great numbers of beaver, muskrat, mink and river otter. It is thought that the beaver played an important role in shaping the local landscape of Detroit.

This account given by Bela Hubbard published in 1887 provides insight to the region before the fur trade locally extirpated the beaver.

"Illustrations of this beaver-made country are numerous enough in our immediate vicinity. In a semi-circle of twelve miles around Detroit, having the river for base, and embracing about 100,000 acres, fully one-fifth part consists of marshy tracts or prairies, which had their origin in the work of the beaver. A little further west, nearly one whole township, Wayne County is of this character.

The lands referable to this origin occupy not the lowest, but elevated and slightly rolling tracts. Numerous small streams have their sources in these prairies, or meander through them. These, flowing with little descent through the lower connecting levels, are ramified in every direction, and form a network or connected chain through the whole surface. Dry ridges intervene, mostly sandy, and producing a scattered growth of white and yellow oaks. The broader marshes, which often extend several miles, are occasionally varied by low islands, containing a heavy growth of timber.

These marshes have a soil of black muck and fibrous peat, averaging two or three feet in depth, and often much more. This is underlaid by clay, with a thin stratum of sand or gravel intervening. Wild hay and cranberries on the open portions constitute a natural product of considerable value; other portions being covered by tamarack trees.

The beaver dams are still discernable. Their builders, so the Indians say, disappeared from this region about the beginning of the present century. Is there another instance where the operations of a single animal have so changed the face of a country, over extensive areas? For the region of which I treat is but a sample of many others, stretching through the border counties of eastern Michigan, and about the tributaries of the Saginaw…The beavers and Indian hunters and Canadian trappers have alike disappeared. Other furs, or substitutes for them, have superseded their value to the dealer, and the skins are but rarely met with in this whole region, which once yielded little other marketable product."

LARRY CORNELIS

Today, beavers* (Castor canadensis) *commonly live along the more remote treed watercourses of the region. This beaver dam is located within a hardwood swamp in Bickford Oak Woods in Lambton County, Ontario.

HOLLY JENSEN

Development of the shoreline has resulted in the extensive loss of Great Lakes Coastal marshes.

ST. CLAIR COUNTY METROPOLITAN PLANNING COMMISSION

U.S. GEOLOGICAL SERVICE

Along Lake St. Clair's southern and western shores, very few wetlands have survived after years of residential, recreational and commercial development. Man-made canals are now a common feature of the shoreline. These photographs, one taken in 1937 and the other in 1999, illustrate dramatic changes.

In 1850, early surveyors noted that Wallaceburg, Ontario was a potential center of regional commerce. However, it was also under the blighting influence of the "immense quantities of marsh and swamp within convenient reach."*

This quote reflects the attitudes of many early European settlers who considered the vast Great Lakes marshes as an obstacle rather than a resource. The settlers went to great lengths to drain and fill wetlands.

Urban growth, industrialization, agriculture and waterfront development have dramatically reduced the acreage of Great Lakes marshes along the Lake Huron to Lake Erie Corridor. Where coastal wetlands once reigned, steel break walls now prevail. The Detroit River has lost 97 percent of its coastal marshes. Similar losses occur along the shorelines of Lake St. Clair and the St. Clair River.

*1965. *Sydenham Valley Conservation Report.* Department of Energy and Resources Management, Conservation Authorities Branch. Toronto, Ontario.

In the distance, great egrets perch on a sumac grove in Canada's St. Clair National Wildlife Area, located in the eastern basin of Lake St. Clair. The Canadian Wildlife Service manages this 289-ha site. Its marshes and shallow water habitat are interspersed with sandy beach ridges formed by wave action. The marshes provide excellent waterfowl habitat and are an important resting point for migrating waterfowl during spring and fall. More than 30 species of wetland-dependent birds breed in the National Wildlife Area, including the least bittern and Virginia rail. The importance of this marsh to bird life has been recognized through its designation as a "RAMSAR" site, meaning it has wetlands listed under the Convention on Wetlands of International Importance Especially as Waterfowl Habitat.

Today's Coastal Marshes

Despite significant changes to the shoreline, coastal marshes persist in the Lake Huron to Lake Erie Corridor, particularly in the St. Clair River Delta and the islands of the lower Detroit River. The St. Clair River, with its relative straightness, uniform width and depth, and fast current, affords little opportunity for wetland growth.

The largest contiguous tract of coastal wetlands in the Great Lakes, encompassing more than 25,000-ac (10,000-ha), is found on Walpole Island. Ninety percent of today's coastal wetlands in the Detroit River are south of Grassy Island.

Dike systems now are used to manage many of the Corridor's largest coastal wetlands, including Pointe Mouillee State Game Area in Lake Erie as well as portions of Walpole Island and the St. Clair Flats State Game Area. Using dikes, water levels within the marshes can be regulated to maximize the growth of wetland vegetation that is beneficial to waterfowl.

ERNIE BERGEN

DEBORAH MAIORANO

A coastal marsh along western Lake Erie.

TRISH BECKLORD

Pointe Mouillee State Game Area is located where the Huron River empties into Lake Erie. Pointe Mouillee means "wet point" in French. It has been known by this name since 1749 when French explorers first appreciated its vast delta and wetlands.

LEROY DEER

St. John's Marsh in Algonac, Michigan, provides important stop-over habitat for migratory birds. In the foreground is giant reed grass,* (Phragmites australis)*, an invasive wetland plant that now dominates many marshes in the Great Lakes system. It degrades the quality of marshland habitat by crowding out native wetland plants that are more beneficial to wildlife. Once established, it is very difficult to control and eradicate.

BRUCE MANNY

(LEFT) VISUAL IMAGE PRODUCTIONS, WINDSOR, ONTARIO. COURTESY OF THE GREATER DETROIT AMERICAN HERITAGE RIVER INITIATIVE

Humbug Marsh is the last remaining natural coastal wetland on the U.S. side of the Detroit River. The one-mile (1.6-km) stretch of undeveloped shoreline is a nesting, resting and feeding island for many resident and migratory birds species. Shorebirds, raptors, migratory songbirds, waterfowl (even the common loon) make use of this unaltered, thus special, habitat. The diversity of birds, fish and insects found in the Humbug Marsh is the highest of any site studied in the Detroit River. It is an important spawning area for walleye that migrate from Lake Erie. Because of its unparalleled natural resource values, the recently acquired Humbug Marsh has become a centerpiece of the Detroit River International Wildlife Refuge.

Protected coastal marshes with rich, abundant wildlife that are open for visitors' enjoyment include:

United States	Canada
1. St. Clair Flats State Game Area	9. Point Pelee National Park
2. St. John's Marsh	10. St. Clair National Wildlife Area
3. Pointe Mouillee State Game Area	11. Tremblay Beach Conservation Area
4. TNC Erie Marsh Preserve	12. Ruscom Shores Conservation Area
5. Sterling State Park	13. Holiday Beach Conservation Area
6. Metrobeach Metropark	14. Lighthouse Conservation Area
7. Lake Erie Metropark	15. Big 'O' Conservation Area
8. Belle Isle	

Migrating raptors from northern and eastern Canada are reluctant to cross large bodies of water. Therefore they funnel down the corridor, concentrating their numbers as they cross the comparatively narrow Detroit River near the western end of Lake Erie.

MICHIGAN NATURE ASSOCIATION

ALLEN CHARTIER

MARY BOHLING

(Above Left) A flock of broad-winged hawks passes over the Lake Erie Metropark.

*(Above Right) A mute swan forages among spiky blue flowers of pickerel weed (***Pontedaria cordata***) that bloom throughout the marshes of the Lake Erie Metropark.*

Lake Erie Metropark

Lake Erie Metropark is a 1,600-ac (640-ha) park near Gibraltar, Michigan, owned by the Huron-Clinton Metropolitan Authority. Situated at the mouth of the Detroit River at Lake Erie, the unique location contains an array of habitats, including Lake Erie shoreline, coastal marshes, islands and oak woodlands, which are home to a wide variety of wildlife.

Since the 1930s, warm-water effluent discharged from upstream industries has kept much of the Detroit River and northwestern portions of Lake Erie ice-free in winter. Many waterfowl stay in the open waters, making the Metropark an ideal location for viewing waterfowl during the winter.

Bald eagles often fish along the Metropark's shoreline. Most notably, a pair recently made its first nesting attempt in Wayne County in 100 years.

The Metropark is best known for tens of thousands of raptors, or birds-of-prey, that can be seen passing overhead during their annual fall migration.

Southeast Michigan Raptor Research is a non-profit organization that monitors and counts the hawks that fly through Lake Erie Metropark and Pointe Mouillee State Game Area each fall. The 10-year annual average for their counts is more than 225,000.

Holiday Beach Conservation Area

The Holiday Beach Conservation Area is a 525-ac (212-ha) park managed by the Essex Region Conservation Authority. It is located on the north shore of Lake Erie near the mouth of the Detroit River in Amherstburg, Ontario. This conservation area offers the natural beauty of the Lake Erie shoreline as well as trails that lead through meadows, woods, coastal marsh and a pine plantation.

Like the Lake Erie Metropark, the unique geography of Holiday Beach provides tremendous opportunities to view the annual fall hawk migration. As many as 96,000 raptors have been seen migrating over the conservation area in a single day! The numerous eagles, hawks, falcons, and vultures flying overhead are best viewed from the three-story hawk tower shown at the right.

The Holiday Beach Migration Observatory is a non-profit volunteer organization that studies fall raptor migrations by counting and banding hawks at the conservation area. Observers strive to record exact numbers of all migrant bird species that fly over the site during daylight hours from late-August to early December.

ROBERT STEWART

The Hawk Tower at the Holiday Beach Conservation Area.

The Lake Huron to Lake Erie Corridor is a Major Pathway for Migration

Songbirds are known for their perching behavior and musical song. Types of songbirds include thrushes, warblers, sparrows and finches. The species featured on these pages nest in the Lake Huron to Lake Erie Corridor. Many species throng to the University of Michigan-Dearborn Campus Natural Area, where the Rouge River Bird Observatory studies the importance of urban natural areas to birds. This nearly 300-ac (120-ha) unique green space is a natural area donated by the Henry Ford estate to the University of Michigan and Wayne County to ensure its preservation as an urban-based wildlife habitat.


JIM SIMEK, NATURE'S IMAGES

The gray catbird **(Dumetella carolinensis)** *frequents shrubby, abandoned fields that are in the early stages of succession. Widespread in North America, catbirds winter along the Atlantic and Gulf coasts and in the West Indies. Although closely related to the mockingbird, catbirds don't often mimic other species. They have a complicated, garbled song and a very cat-like call.*


JIM SIMEK, NATURE'S IMAGES

The rose-breasted grosbeak **(Pheucticus ludovicianus)** *is aptly named, with a large, stout bill that it uses to glean insects from trees and open a wide variety of seeds. The male has a stunning appearance and sings a beautiful song similar to that of the robin. These birds consume large numbers of grasshoppers, caterpillars and beetles when they can find them, thereby helping to control local insect populations. They nest primarily in open deciduous woodlands in central and southern Canada east of the Rockies, the upper Midwest, New England and the Mid-Atlantic States. Rose-breasted grosbeaks winter in southern Mexico through to northern South America.*

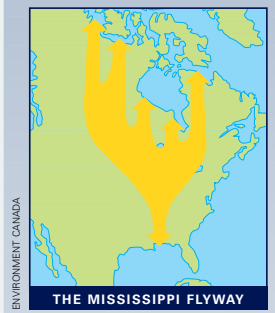

JIM SIMEK, NATURE'S IMAGES

The yellow warbler **(Dendroica petechia)** *is one of the most common and widely distributed warblers in North America, nesting across much of the continent. It winters in Central and South America. They often are victims of the brown-headed cowbird* **(Molothrus ater)**, *which lays its eggs in other birds' nests. The host parents are left to raise cowbird young, usually at the expense of the hosts' own eggs and chicks. Yellow warblers have developed a strategy to combat this parasitism by building a new nest floor over the cowbird eggs, and restarting the nesting process.*

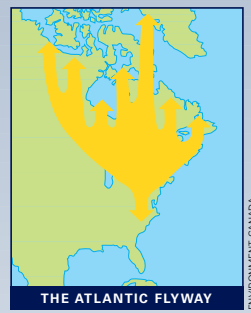
Bird migration is one of the most incredible phenomena in nature.

Many bird species travel thousands of miles annually between their nesting and wintering areas. While routes vary among species and even ages of individual birds, there are four general migratory flyways in North America. The Lake Huron to Lake Erie Corridor is located at the convergence of the Atlantic and Mississippi Flyways. The approximate north-south orientation of the Corridor makes it an important migratory flyway for more than 90 species of birds.

Migration is often the most perilous part of a bird's annual cycle. It is estimated that half of all birds flying south for the winter will not live to migrate north in the spring. Causes of death include: bad weather; predation; collisions with windows, buildings, autos and communication towers; and the loss or deterioration of places to stop, rest and refuel (known as stopover sites). Populations of many migrant birds, particularly those that migrate to the tropics, have been in decline.



ENVIRONMENT CANADA



ENVIRONMENT CANADA

Raptors include 17 different types of eagles, falcons, hawks and vultures that either reside in or pass annually through the Lake Huron to Lake Erie Corridor. Lake Erie Metropark and the Holiday Beach Conservation Area are excellent places to view raptors during their spectacular fall migrations.


ALLEN CHARTIER

The sharp-shinned hawk **(Accipiter striatus)** *is one of the most-traveled hawks. It breeds in northern forests of Canada and Alaska and flies south to Panama for the winter. During migration these hawks can be seen flying in large flocks. They can often be spotted lurking around backyard bird feeders in search of unwary songbirds.*


ALLEN CHARTIER

The broad-winged hawk **(Buteo platypterus)** *is common in deciduous forests of Eastern North America during the summer. In the fall, these hawks leave in huge concentrations for Central and South America. In 1999, the Southeast Michigan Raptor Research Network counted more than a half million broad-winged hawks passing over Lake Erie Metropark during the fall migration.*


JOHN SCHAFER

The northern harrier **(Circus cyaneus)** *is a species of special concern in Michigan. It once was common in southeast Michigan, but has been in decline. Harriers require open grasslands and associated wetlands. Their favored prey is the meadow vole, which is usually abundant in grassland habitat. The main reason for the northern harrier's decline is habitat loss. Other causes include human disturbance, predation and pesticides.*


TERRY C. OTT

The snowy owl **(Nyctea scandiaca)** *is a top predator of the arctic tundra in northern Canada and Alaska. Occasionally it will winter in the Corridor, where it occupies open fields, shorelines and other locations that resemble the treeless habitat of the tundra. This photograph was taken at DTE Energy's Fermi II Nuclear Power Plant near Monroe, Michigan.*

Monarch Butterflies


JOHN SCHAFER

Pictured are monarch butterflies **(Danaus plexippus)** *on Harsens Island in the St. Clair River Delta. During the fall, they can be seen migrating along the shores of the St. Clair River, Lake St. Clair and Detroit River in large numbers while on their way southward to Mexico. Resting migrants may cover entire trees.*

Shorebirds have some of the longest migrations of all birds, with several species flying between South America and the arctic tundra each year. Their bodies reflect the lifestyle to which they are uniquely adapted: long legs for wading in shallow marshes and mudflats, a long bill to probe for invertebrate prey, and large wings and a streamlined body to allow for speedy long-distance flights. These birds are not residents of the Lake Huron to Lake Erie Corridor but stop here for critical resting and feeding as they migrate south. Pointe Mouillee State Game Area is one of the best places in the Midwestern United States to view migrating shorebirds.


JIM SIMEK, NATURE'S IMAGES

The semipalmated sandpiper **(Calidris pusilla)** *winters in South America and nests in the arctic tundra near water. It sometimes makes a 2,000-mi (3,200-km) non-stop journey from nesting areas to its tropical wintering grounds.*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The short-billed dowitcher **(Limnodromus griseus)** *breeds in the wetlands of northern Canada and can winter as far south as Brazil.*

Waterfowl More than a million waterfowl visit the Lake Huron to Lake Erie Corridor each year. The corridor lies on the major migration pathways of both dabbling and diving ducks. The region's coastal marshes are excellent places to view them during migration.


JOHN SCHAFER

Redhead ducks **(Aythya americana)** *can be seen during their migration, when they congregate in large numbers in the Corridor's open waters. In fact, they often are part of mixed flocks of 20,000 or more diving ducks. Redheads winter mostly in the Gulf of Mexico.*


JOHN SCHAFER

The blue-winged teal **(Anas discors)** *is a relatively small dabbling duck that migrates to Central and South America each year. It often is the last to arrive and earliest to leave the Corridor during migration. It can fly at high speeds and maneuver with great accuracy.*

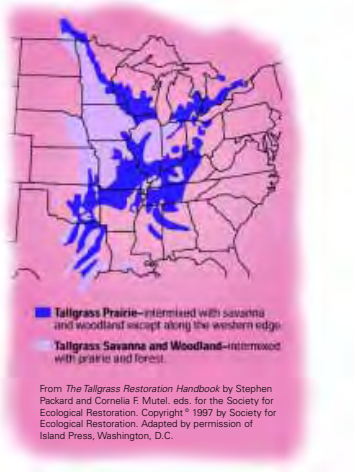

JOHN SCHAFER

The American black duck **(Anas rubripes)** *was considered a migrant in the region around 1915, but was suspected to be nesting there as well. Populations then increased and by the mid-20th Century, it was more abundant than the mallard in Michigan. However between the 1950s and the 1980s, the black duck's population declined dramatically due to loss of habitat, hunting and competition with mallards for nesting sites.*

The landscapes of Ontario and Michigan harbor examples of two globally imperiled natural communities: tallgrass prairie and oak savanna

"The banks of the strait are vast meadows, and the prospect is terminated with some hills covered with vineyards, trees bearing good fruit, groves and forests, so well disposed that one would think that nature alone could not have made, without the help of art."

–Father Louis Hennepin, a Catholic priest and explorer, describing the shorelines of the Detroit and St. Clair Rivers in 1679.



From *The Tallgrass Restoration Handbook* by Stephen Packard and Cornelia F. Mutel. eds. for the Society for Ecological Restoration. Copyright © 1997 by Society for Ecological Restoration. Adapted by permission of Island Press, Washington, D.C.

Historical References

In 1670, the early explorer Galinee noted "grand prairies" along the eastern shore of Lake St. Clair and Walpole Island. When European settlers arrived in the Corridor in the late-1700s, they described mosaics of prairie and "oak openings." Early land surveys that established the boundary between Monroe and Wayne counties in Michigan made repeated references to "extensive open, wet prairie." One of the first botanical descriptions of the prairies in southwestern Ontario characterized a sandy field in the Windsor region as a "garden of rarities."

"The land on its banks is about the richest I ever saw in any country. Six or seven feet deep of earth that would do for a garden, and extensive grass plains stretching for miles into the country, without a tree save here and there a small clump like an island in a plain – the grass, particularly that called blue joint, furnishes excellent pasture and hay."

This description by Robert Stevenson, a pioneer settler, of the land along the Thames River downstream of Chatham in 1843 reflects the attitudes of many settlers who first saw the prairie and discovered its rich soils, which lay beneath the thick growth of grasses and wildflowers. The blue joint grass *(Calamagrostis canadensis)* of which Stevenson wrote was prized by early settlers as "marsh hay."

Upland prairies were the first to succumb to farming cultivation in the early 1800s as farmers used plows pulled by teams of horses to turn the sod. It was said that the sound of ripping roots was akin to the sound of thunder. Drainage of wet prairies came later and required extensive drainage systems to yield highly productive and prized agricultural land. This mass conversion of land from wilderness to agriculture was the first of many dramatic land use changes in the Corridor.

Historical references of prairies originate from: *Baskowsky, Wasyl and John L. Riley. 1992. A Survey of the Prairies and Savannas of Southern Ontario. Proceedings from the 13th Annual North American Prairie Conference. Windsor, Ontario.*

Tallgrass Prairie

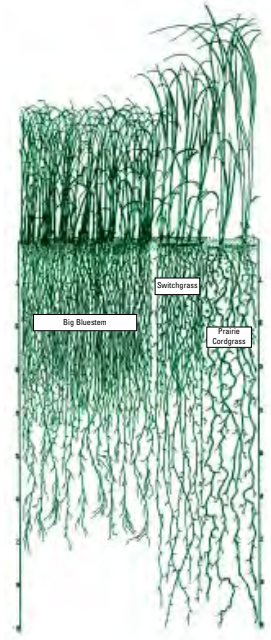
The term "prairie" is the French word for meadow. Prairies are grasslands dominated by grasses, sedges and wildflowers. They are nearly treeless and are defined by an incredible diversity of herbaceous plants that provide an excellent habitat and food source for many creatures. Prairies in North America support more biodiversity than any other type of terrestrial ecosystem.

Stretching from Texas to Canada, the prairie biome once covered vast expanses of land in the middle of the North American continent. Within this great stretch of grassland there are variations in plant communities, distinguished by three main types of prairie: short, mixed and tallgrass. Each supports distinct plant and animal communities. Short-grass prairies occur in the western, drier regions of the biome. As precipitation increases toward the east, mixed-grass prairie gives way to the high, lush vegetation of the tallgrass prairie. Southern Michigan and Ontario are home to tallgrass prairies.

Tallgrass prairies in southern Michigan and Ontario are on the northeastern edge of a "prairie peninsula," first described by botanist Edgar Walter Transeau in 1935. The "prairie peninsula" is an extension of the tallgrass prairie of the eastern Great Plains. Prairie vegetation spread into Michigan and Ontario about 5,000 to 8,000 years ago during a relatively warm, dry period, known as a hypsithermal period, which followed the Wisconsin glacial retreat. As the climate gradually became cooler and wetter, forests re-invaded the prairie, resulting in the mosaic of prairie, savanna and woodlands that the first European explorers encountered.

Warm-Season Prairie Grasses

Tallgrass prairies are named after their dominant plants, the tall grasses, which can reach heights of 3m (nine ft) or more. Many of the native warm-season grasses, such as big bluestem *(Andropogon gerardii)* and Indian grass (*Sorghastrum nutans*), are excellent forage for grazing animals. When the grasses bloom in late-summer, their bold, arching, flowering stalks dominate the prairie landscape. Warm-season grasses break dormancy in early summer and produce much of their growth during the heat of the summer. Cool-season grasses begin growth in early spring and go dormant during summertime. Canada wild rye (*Elymus canadensis*) and Pennsylvania sedge (*Carex pennsylvanica*) are native cool-season grasses. Kentucky blue grass (*Poa pratensis*) is a cool-season grass introduced from Europe that has invaded prairies and is also the dominant plant of the millions of acres of lawn planted in the U.S. and Canada. Kentucky blue grass requires extensive and expensive watering and fertilization that contrasts sharply to the adaptability of the native warm-season grasses.



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Many prairie plants have deep or thick root systems and other adaptations that sustain them through dry summer months. Most of the biomass of prairie grasses is below the ground in their extensive root systems. As old roots die and new roots form, organic matter builds up, creating the rich soils for which prairies are known. Carbon dioxide is caught by this significant soil carbon buildup, which reduces the level of greenhouse gases in the atmosphere.

A view of the restored Dow Prairie during wintertime at the University of Michigan's Nichols Arboretum in Ann Arbor, Michigan. Unlike non-native cool-season grasses, prairie grasses do not flatten under the weight of snow. Their stiff stems provide cover and protection for small animals during winter.

EVAN LARSON

Big bluestem* (Andropogon gerardii) *is easy to identify when it blooms during the fall. Its distinctive flower head looks like a turkey's foot.

Types of Tallgrass Prairie

Tallgrass prairies in the Lake Huron to Lake Erie Corridor occur mostly on sandy portions of the lakeplain, but they also have a patchy distribution on well-drained, sandy- gravelly kames, moraines and glacial outwash landforms. Inland, many wet prairies occur along the margins of river systems on outwash deposits, such as the Huron River. Different landforms support distinct prairie plant communities; their species composition varies greatly, depending on moisture, soils and topography.

Ecologists define tallgrass prairie types by their soil and moisture content, using terms wet, mesic (moderate), and xeric (dry.) These factors dictate the species of grasses and associated wildflowers that can grow in any given locale. Blue joint grass, big bluestem, prairie cord grass (*Spartina pectinata*) and many different sedge species are dominant grasses in a wet prairie. Dry prairies support little bluestem (*Schizachyrium scoparius*), switch grass (*Panicum virgatum*) and Indian grass. Yet, because changes in topography and soils are often subtle, different types of vegetation may grow next to each other. And some species, such as big bluestem, may be found in most prairies regardless of moisture content.

SUSAN R. CRISPIN

(Above) Early historical accounts reveal that bouquets of the eastern prairie fringed orchid* (Platanthera leucophaea) *were gathered in abundance around the bathhouses of Belle Isle Park, Detroit. Today, this unique and stunning orchid of the prairie is an extremely rare plant globally. Only a few, undisturbed natural areas in the Lake Huron to Lake Erie Corridor still support it.

JESSICA PITELKA OPFER

Prairie remnants thrive along railroad tracks such as this one along the Clinton River Trail in Rochester, Michigan. Sparks from passing trains frequently cause fires in the surrounding landscape. Supported by the fires, many of the region's best remaining prairie communities can be found beside railroad lines.

JOHN SCHAFER

The marsh blazing star* (Liatris spicata) *blooms profusely in a wet lakeplain prairie on Harsens Island in the St. Clair River Delta.

Although tallgrass prairie has a scattered distribution throughout southeastern Michigan and southwestern Ontario, the prairies that occur on the lakeplain are special because of the unique plant and animal species which they support.

Some plant species that thrive in a lakeplain prairie community are restricted to the southern Great Lakes region. Their continued presence is important to maintaining biodiversity on a global scale.

Fire and Soil Type

Prairies are fire-dependent communities. Fire prevents trees and shrubs from invading a prairie and converting it into a forest.

Warm-season grasses and prairie wildflowers are uniquely adapted to fire. Their growth tips, or meristems, are below the soil's surface and are not damaged from hot flames. In contrast, the growing tips of trees and shrubs and non-prairie weedy species are damaged by fire. The predominance of warm-season grasses in a prairie helps to carry fire. Once ignited, the grasses carry a surface fire that is hot enough to knock back competing shrubs, saplings and other non-prairie herbaceous plants.

In a normal prairie fire there is very little soil temperature change. Under these natural circumstances fire does not scorch the earth. Measurements taken by scientists indicate that for only a very brief time is there any significant change in temperature. Even then it is usually in the top centimeter of the soil. Slow-moving fires that have a lot of woody material to burn, such as in a degraded prairie invaded by trees and shrubs, can get hotter and cause localized sterilization of soil. Fires that occur more frequently, such as every two to four years, will not have the fuel of litter build-up to create the hotter conditions that might severely damage or kill mature oak trees. The most valuable result of a prairie fire is the blackened soil, which warms quickly under the heat of the sun. This warming favors the growth of prairie grasses that do not break dormancy until a certain soil temperature is reached. This helps them get a head start over weedy, cool-season competitors that could eventually shade them out.

A combination of built-up organic matter and seasonal drought makes prairies naturally prone to wildfires during the summer growing season. In pre-settlement times, these fires could have been caused by either lightning strikes or by native people, who may have set fires to drive game and to maintain the plant and animal communities that sustained them with food, medicines and clothing.

Lakeplain prairies also have persisted because of the unique hydrology of the lakeplain. The soils in which the prairies grow are characterized by 3-9 ft (1-3 m) of highly permeable sand over clay, which results in very wet conditions during spring floods and a very dry environment during the summer. Such extreme variations in the availability of water are better suited to wildflowers and grasses than trees and shrubs.

TRISH BECKFORD

Today, land managers use prescribed (controlled) burns to maintain and improve the health and diversity of tallgrass prairies and oak savannas.

Prairie or Meadow?

Not every meadow or field is a prairie. Although meadows are open, treeless areas with grasses, they usually form as a result of a disturbance, such as logging or land clearing, and are often early signs of forest regeneration. Fallow farm fields also have grasses and wildflowers. But most fallow fields tend to be dominated by Eurasian grasses and invasive plants, such as Queen Anne's lace (*Daucus carota*) or spotted knapweed (*Centaurea maculosa*), that thrive in disturbed areas. Meadows usually are dominated by asters and goldenrods, which do not carry fire as well as the warm-season grasses of a prairie ecosystem.

ROBERT STEWART

Prairies and oak savannas remain in the Lake Huron to Lake Erie Corridor because they are able to withstand stressed environments where trees cannot. The combination of periodic wildfires, drought, spring floods and a warm climate have all contributed to their persistence in the region. Prairies thrive where these effects are most severe, while oak savanna grows where these stresses are less pronounced.

TALLGRASS PRAIRIE


JOHN TIEDJE

Yellow star-grass
Hypoxis hirsuta


JOHN TIEDJE

Wood betony
Pedicularis canadensis


ALLEN WOODLIFFE

Hoary puccoon
Lithospermum canescens


JOHN TIEDJE

Blue-eyed grass
Sisyrinchium albidum

SPRING

In early May, the first wildflowers of the prairie emerge from the ground.


ALLEN WOODLIFFE

Small white lady's-slippers
Cypripedium candidum


ALLEN WOODLIFFE

Bird's foot violet
Viola pedata


JOHN TIEDJE

Golden Alexanders
Zizia aurea

Some prairie remnants have as many as 200 distinct plant species growing in them. Given this diversity, the prairie is constantly changing, with different plants blooming from spring until fall.

These plants are a mere sampling of the beauty that can be found in a tallgrass prairie throughout the seasons.

Each wildflower displays its unique color and scent in hopes of attracting one of the many insects that inhabit a prairie ecosystem.

Very specialized relationships have developed between some insects and the prairie plants that host their larva. For example, rare insects such as Culver's root and blazing star borer moths feed among the many different prairie wildflowers, but require their namesake species (Culver's root and marsh blazing star) to host their larvae.

Prairie grasses support wildlife in many ways. Several varieties of skipper butterflies–dusted, Indian, crossline and Leonard–feed on the leaf blades of little bluestem. Indian grass hosts the larvae of the wood satyr and common wood nymph butterflies.


DAVID L. CUTHRELL

The blazing star borer moth lives in harmony with the prairie ecosystem that supports its larval host plant, the marsh blazing star. This species at risk has been identified in the lakeplain prairies of Algonac State Park, Michigan.


JOHN TIEDJE

Big bluestem
Andropogon gerardii


JOHN TIEDJE

Indian grass
Sorghastrum nutans


ALLEN WOODLIFFE

Little bluestem
Schizachyrium scoparius


RANDY HOLLAND

The common milkweed (Asclepias syriaca) has distinctive seed pods filled with downy hairs, which aid in seed dispersal by wind. These downy hairs, or floss, were used to stuff life preserver jackets in World War II. Today, milkweeds are a raw material for commercial purposes such as rubber, fiber and even fuel production.


CAROLINE BIRBAUER

Prairie cord grass
Spartina pectinata

FALL

In autumn, warm-season prairie grasses have reached their full grandeur, topping out at heights of six feet (1.8 m) or more.


JOHN TIEDJE

Switch grass
Panicum virgatum


GERRY CLEMENTS

Tall sunflower
Helianthus giganteus

Smooth Aster
Aster laevis


ALLEN WOODLIFFE

Culver's root
Veronicastrum virginicum


MARY LAFRANCE

Fringed gentian
Gentiana crinita


JOHN TIEDJE

Bergamot
Monarda fistulosa


MARY LAFRANCE

Canada tick trefoil
Desmodium canadense


MICHAEL P. ROSENBROCK

Yellow coneflower
Ratibida pinnata


GERRY CLEMENTS

Ironweed
Vernonia fasciculata


CAROLINE BIRBAUER

Joe-pye weed
Eupatorium maculatum


MARY LAFRANCE

Michigan lily
Lilium michiganense


MARY LAFRANCE

Mountain mint
Pycnanthemum virginianum


JOHN SCHAFER

Marsh Blazing Star
Liatris spicata


JOHN SCHAFER

Sullivant's Milkweed
Asclepias sullivantii


TRISH BECKFORD

Butterfly Milkweed
Asclepias incarnata


GERRY CLEMENTS

Black-eyed susan
Rudbeckia hirta

SUMMER

Spring is merely the beginning for the color show in a prairie. By mid- to late-July, the wildflower show is in full swing, with a profusion of prairie flowers displaying a riotous combination of colors well into late summer and fall.


ALLEN WOODLIFFE

Ohio Spiderwort
Tradescantia ohiensis

Birds Dependent on Grassland Habitat are in Decline

Grassland birds are declining at an alarming rate in North America. One largely-unnoticed reason is loss and fragmentation of the birds' grassland habitat – assorted prairie types, wet meadows, pastureland and fallow farm fields. Grassland birds also are threatened by high rates of predation, nest parasitism by cowbirds, and earlier and more frequent mowing and harvesting of fields, resulting in reproductive failure.

Historically, grassland ecosystems such as tallgrass prairies depended on periodic fires and animal grazing to maintain their character and diversity. The decrease or extirpation of grazing animals, fire suppression, the introduction of non-native or invasive plant species and changing agricultural practices have dramatically altered grasslands. Birds that rely on grasslands are becoming dependent on humans to create or manage suitable ecosystems. But determining how to manage grasslands for birds can be difficult because each species may have different requirements. Some prominent examples include the Henslow's sparrow, eastern meadowlark, bobolink, and loggerhead shrike.

Bobolinks (*Dolichonyx oryzivorus*) make one of the longest migrations of any songbird, up to 6,200 mi (9,920 km) from nesting areas in the northern U.S. and southern Canada to wintering grounds in South America. Historically, bobolinks nested in the prairies of the Midwestern U.S. and south-central Canada. They were considered abundant in the Lake Huron to Lake Erie Corridor in 1900. As agriculture spread eastward, so did bobolinks. They were most abundant when they could nest in the extensive hayfields required to support the widespread use of horses for transportation and farming.

Today, populations are declining due to habitat loss, changing agricultural practices and cowbird parasitism. Like meadowlarks, bobolinks prefer mixed grasslands and older fields, but can nest in smaller patches of habitat. Breeding

JIM SIMEK, NATURE'S IMAGES

success has been lowered by the introduction of cool-season grasses, which are mowed earlier (during the nesting period) and more frequently than native, warm-season grasses. Since bobolinks exhibit strong fidelity to nesting areas, returning to a successful nesting place in subsequent years, this change in agricultural practices can be especially detrimental.

The Henslow's sparrow *(Ammodramus henslowii)* is a small, inconspicuous bird that requires large, often damp, grasslands usually greater than 250 ac (100 ha). It prefers tall, dense grasses with much standing decaying vegetation and a thick layer of litter. As grasslands mature and these distinctive elements diminish, Henslow's sparrows move to a new location. They make their nests on the ground, often in loose colonies of between two and 50 pairs of birds. Around 1900, they were found sporadically in the Lake Huron to Lake Erie Corridor region, but were known to nest regularly on Grosse Ile. Today, they are threatened in Michigan and endangered in Canada.

WALPOLE ISLAND HERITAGE CENTRE

Loggerhead shrikes *(Lanius ludovicianus)* are unique among songbirds because they prey upon vertebrates, including rodents and other birds. The shrikes lack the strong talons of predatory raptors, so they often impale their prey on thorns, barbed wire or sharp twigs, earning them the nickname "butcherbird." Loggerhead shrikes are birds of open country, such as grasslands that have short vegetation and a scattering of short trees and shrubs from which they hunt. They live year-round in much of their broad North American range, but northern populations are migratory.

Loggerhead shrikes once were fairly common nesters in the region. Now they are nearly extirpated and are considered endangered in Michigan and Ontario, mainly due to habitat loss. Other reasons have yet to be discovered but may include being hit by vehicles as they feed along roadsides, and reduction or contamination of insects, a substantial part of their diet, by pesticides.

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IAN BOST

The bottle gentian* (Gentiana andrewsii) *grows in the wet soils of lakeplain prairies and wet meadows. Its intense blue flowers bloom in the late-summer at Sibley Prairie.

The Greater Sibley Road Prairie Complex in Brownstown Township, Michigan, is an ecological treasure of the largest and highest-quality lakeplain prairie remnants in Michigan. Prior to European settlement, native buffalo roamed the 16,000-ac (6,400-ha) Sibley Prairie. Only 350-acres (140 ha) are left today. The complex is home to at least 170 rare grasses, sedges, rushes and wildflowers including 14 endangered, threatened and special concern plant species in Michigan. Birds such as the American kestrel and bluebird find habitat in its grassy meadows. Duke's skipper, a threatened species in Michigan, has been identified at the site. The prairie remnants are scattered among a mosaic of oak savanna and oak woodlands. Its vast wetlands are significant groundwater recharge areas that flow into Brownstown Creek, the Bakely Drain and Marsh Creek, which connect to the Detroit River south of Gibraltar.

DENNIS ALBERT

The colorful wildflowers of Sibley Prairie

The Michigan Natural Features Inventory has identified the Sibley Prairie as representing "our greatest hope for preserving a functional lakeplain prairie ecosystem." The Nature Conservancy, Southeast Michigan Land Conservancy, and Michigan Nature Association are protecting very small parcels of this natural area. But more protection is needed to ensure the survival of this unique ecosystem and the many rare species that it supports.

Sibley Prairie

Buffalo

"But 15 leagues from Detroit, at the entrance to Lake Erie, inclining to the south to southwest, are boundless prairies which stretch away for 100 leagues. It is there that these mighty oxen (bison), which are covered with wool, find food in abundance."

– Antoine de la Mothe Cadillac, founder of Detroit, describing the landscape of southeastern Michigan in 1702

ILLUSTRATION BY HOLLY JENSEN

The buffalo* (Bison bison) *was generally known as a plains creature. But it also had lived in woodlands well into Alaska in the northwest and in most of the eastern United States, except for New England. Early settlers hunted this shaggy mammal in such places as forest glades in what is now Pennsylvania. Authorities agree that it was extirpated on the Atlantic side of the Alleghenies by 1730 and east of the Mississippi by about 1810. This husky creature was no match for hungry settlers with guns. The bison that frequented prairies in southeastern Michigan and described by Cadillac were killed off by about 1800.

Ojibway Prairie Complex

The Ojibway Prairie Complex contains 550 ac (220 ha) of some of the highest-quality tallgrass prairie and oak savanna left in southern Ontario. It is composed of five natural areas within minutes of downtown Windsor, Ontario. Ojibway Park, Tallgrass Heritage Park, Black Oak Heritage Park and Spring Garden Prairie are owned in part by the City of Windsor Parks and Recreation Department. The Ojibway Prairie Provincial Nature Reserve is owned by the Ontario Ministry of Natural Resources. Remaining lands are owned by private landowners.

At the Ojibway Nature Centre at Ojibway Park, many walking trails invite visitors to experience and learn about rare tallgrass prairie and oak savanna ecosystems. In addition to the eastern massasauga, the eastern fox snake (*Elaphe vulpina gloydii*) and Butler's garter snake (*Thamnophis butleri*) are rare reptiles that find a home in the complex.

EVAN LARSON

BRUCE KINGSBURY

(Above) Ojibway Park in Windsor, Ontario. (Right) The eastern massasauga rattlesnake* (Sistrurus catenatus catenatus) *is found, over much of the year, in wetlands, such as sedge marshes, bogs, fens, and shrub swamps. They may move into adjacent grassland habitats in summer. Wet soils are important to this rattlesnake, as the high water tables found in wet prairies, meadows, and fens prevent the ground from freezing deeply. These snakes often hibernate in the tunnels created by crayfish or small mammals.

The Eastern Massasauga is the only venomous snake native to the region. Despite its reputation, this rattlesnake is normally docile unless provoked. Its distribution is restricted to the southern Great Lakes region of Lower Michigan and Ontario along with northern Indiana and Illinois. Michigan now has the highest remaining populations of the Eastern Massasauga. Because of habitat loss and persecution by humans, this snake is a rare and a protected species throughout its range.

The Great Lakes Coastal Complex

In the St. Clair River Delta at Algonac State Park and Walpole Island, along with locations in Saginaw Bay and Lake Erie, there is a very special association of natural communities called the Great Lakes Coastal Complex. The vegetation ranges from submersed plants rooted in water about 6 ft (2 m) deep to tall, wide-spreading white oaks (*Quercus alba*) that grow on the sandy beach ridges formed thousands of years ago by glacial lakes. The three major natural communities that compose the Great Lakes Coastal Complex are defined by water fluctuations and lakeplain geology: oak savanna, lakeplain prairie, and Great Lakes marsh. All are rare and globally imperiled.

The Great Lakes marsh extends into the nearshore waters, but also includes saturated sand. The prairie borders the inland portion of the marsh on sandy deposits. Oak savanna is scattered throughout the prairie on narrow, sandy beach ridges. Historically, all three of these communities were tied together by fluctuating water levels, which could alter their sizes and boundaries both seasonally and annually.

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

Oak Savanna

"A sandy ridge producing nothing but a few scattering of trees of white oak."

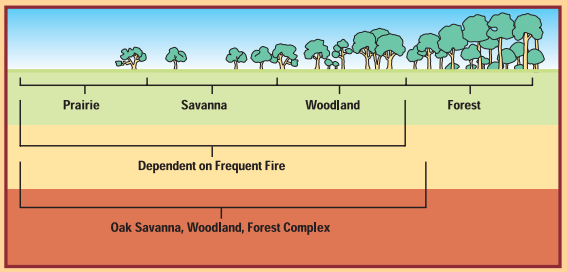
– Survey map for a ridge west of Leamington, Ontario

Oak savannas are characterized by widely spaced trees with shrubs, grasses, sedges, ferns and wildflowers occupying the understory, which means they are on the ground under the canopy of tree branches. The oak savanna ecosystem is a transition community between a prairie and a true woodland ecosystem.

The grassy understory of an oak savanna is filled with many plants species associated both with tallgrass prairie and forest communities. The groundcover is a mosaic of plant species, each with a varying sun and shade tolerance. The open canopy of the savanna, which allows sunlight to reach the groundcover layer, can support prairie plant species in sunnier areas, such as butterfly weed (*Asclepias tuberosa*) and flowering spurge (*Euphorbia corollata*). In shadier areas, fire-tolerant forest shrubs like blueberries (*Vaccinium spp.*) and huckleberry (*Gaylussacia baccata*) grow.

An oak savanna on Walpole Island

Because there are so few quality remnants left, it is hard to fully understand the ecology of oak savannas. However it is thought that the true plant species of savannas are able to thrive in a blend of shade and sun; examples include wild lupine (*Lupinus perennis*) and purple milkweed (*Asclepias purpurescens*).



Prairie: A fire-maintained natural community dominated by grasses with few or no trees

Savanna: a fire-maintained natural community dominated by grasses or sedges but with scattered, fire-tolerant species of trees.

Woodland: a fire-maintained natural community with a grassy turf dominated by trees

Forest: a closed-canopy, wooded natural community that is not dependent on frequent fire.

Types of Oak Savanna

Oak savannas occupy a variety of soils, ranging from wet to dry. In the glacial lakeplains of Michigan and Ontario, oak savannas occur on sand ridges, level sandplains and wet swales between ridges. Further inland, oak savanna and oak barrens grow on well-drained outwash plains, moraines and kames. In all cases, oaks are the dominant trees while grasses and sedges make up most of the groundcover.

Two types of oak savanna are prominent in the lakeplain: dry to mesic, and mesic to wet. Dry oak savannas exist on the dry sandy beach ridges of the lakeplain, where black oak (*Quercus velutina*), white oak and pignut hickory (*Carya glabra*) dominate the tree canopy, and shrubs such as New Jersey tea (*Ceanothus americanus*), American hazelnut (*Corylus americana*), wild plum (*Prunus americana*) and blueberry vegetate the understory. Very dry savannas also may have evergreen trees such as white pine (*Pinus strobus*), red pine (*Pinus resinosa*) or eastern redcedar (*Juniperus virginiana*). The ground cover of this dry savanna type is diverse. Little bluestem and Pennsylvania sedge are dominant grass species. Wildflowers adapted to drought conditions such as tickseed (*Coreopsis lanceolata*), wild lupine (*Lupinus perennis*), rough blazing star (*Liatris aspera*) and wild bergamot (*Monarda fistulosa*) populate sunnier areas.

RANDY HOLLAND

The eastern prickly pear cactus* (Opuntia humifusa), *found in the dry black oak savannas of Ontario's Point Pelee National Park, is the only native cactus in this region.

Wetter savannas occupy flat, poorly-drained soils of the lakeplain. The flora of this wetter savanna type is able to withstand springtime flooding. Bur oak (*Quercus macrocarpa*), pin oak (*Quercus palustris*) and swamp white oak (*Quercus bicolor*) dominate the tree canopy. Shrubs such as winterberry (*Ilex verticillata*), dogwoods (*Cornus spp.*) and chokeberry (*Aronia melanocarpa*) frequent the understory. Many of the grasses and wildflowers in the ground layer are the same as in the adjacent wet prairies. Big bluestem, blue joint grass and sedges are dominant grasses. Forbs that prefer wetter conditions such as common mountain mint (*Pycnanthemum virginianum*), Riddell's goldenrod (*Solidago riddellii*), and ironweed (*Vernonia fasciculata*) are indicators of this savanna type.

Oak Savannas are Maintained by Fire

DENNIS ALBERT

DENNIS ALBERT

Prescribed burns are being used to restore wet oak savannas at Algonac State Park, Michigan. At left is a highly degraded oak savanna, which has been invaded by thick brush, during a controlled burn. At right is the same oak savanna the following spring after a prescribed burn, which opened the tree canopy, cleared away saplings and shrubby growth, and permitted the sun to reach the forest floor. Often, more than one prescribed burn is needed to fully restore the health of a degraded oak savanna.

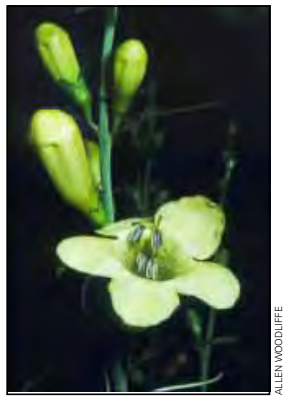
Like tallgrass prairie, oak savanna is a fire-dependent community. Frequent wildfires have historically played a major role in maintaining oak savanna's open structure and grassy understory.

Grazing animals such as the buffalo, as well as drought on the sandy ridges and the lakeplain's unique hydrology, also have contributed to maintenance of oak savanna in the Corridor. Ecologists have discovered that the seasonally high water table of the lakeplain has helped maintain wet savanna communities.

Oak trees, which define savanna in this region, have a thick, fire-resistant bark. Oaks are not killed by low-intensity fire, although often the lower branches are burned off. Trees and shrubs that are more common in woodlands with dense canopies, such as black cherry (*Prunus serotina*), are killed or severely stunted by fire. By removing fire-sensitive woody species and the lower branches of oaks, fire creates the characteristic open canopy of the savanna. Fire also fostered the growth of warm-season prairie grasses such as little bluestem, and other plants that are adapted to periodic fires.

Wildfire suppression by humans has greatly altered the distribution and extent of oak savannas throughout North America. Compared with pre-settlement distribution, oak savannas are nearly extinct. Without periodic fire, woody species invade a savanna. Their shade eventually smothers the prairie vegetation and blocks the open sunlight that oak seedlings need to thrive. Without fire, oak savanna gradually transforms into oak woodlands. This trend is especially apparent in the lakeplain of Michigan, where many of the historical oak savannas have become closed-canopy oak forests.

Usually considered destructive, fire actually has preserved a rich natural heritage. Without fire's regenerative effects, oak savannas and tallgrass prairies, along with the myriad of rare species living in them, could be lost forever.



ALLEN WOODLIFFE

(Left) The smooth yellow false foxglove* (Aureolaria flava) *lives in oak savannas and woodlands with sandy soils. It is parasitic to the roots of white oak and is often found in close association with them.

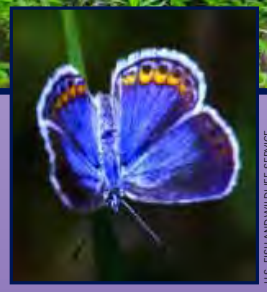
The Karner Blue Butterfly

The Karner blue butterfly (*Lycaeides melissa samuelis*) lives in oak savanna and pine barren ecosystems where its larval host plant, wild lupine, thrives. Wild lupine is known to be the only plant on which the Karner blue's caterpillar feeds. Without this plant, the butterfly can't reproduce. The adult butterfly feeds on a wide variety of wildflowers, such as wild bergamot and butterfly weed.

The loss of oak savannas has brought this little butterfly close to extinction. It is now extirpated from southeastern Michigan and all of Ontario. It is listed as federally endangered in the U.S. and is the subject of recovery efforts that span its native range of New York, New Hampshire, Ontario, Michigan, Ohio, Indiana, Wisconsin and Minnesota.

In Lambton County, Ontario, efforts are being made to restore the butterfly's habitat at Pinery Provincial Park and adjacent nature preserves managed by Lambton Wildlife Inc. in Lambton County, Ontario. It is hoped that the work of a multi-disciplinary recovery team, with cooperation from the U.S. Fish and Wildlife Service, will enable Karner blue butterflies to flourish once again in Ontario.

(Above) The wild lupine* (Lupinus perennis) *thrives at Petersburg State Game Area in western Monroe County, Michigan, where "prescribed burns," or deliberately set and controlled fires, are conducted to help manage this natural area's oak savannas and tallgrass prairies.



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(Right) The Karner blue butterfly.

ONTARIO MINISTRY OF NATURAL RESOURCES

The American badger* (Taxidea taxus) *is a classic mammal of tallgrass prairie and oak savanna. It is becoming increasingly rare in Southern Ontario and Michigan, areas which define the easternmost extent of its distribution across North America. The badger prefers sandy soils where it uses its short, powerful legs for digging. In fact, the badger can dig a hole faster than a man with a shovel. This nomadic animal likes to travel during darkness and can move more than 10 km (6 mi) in one night.

Animals of Oak Savanna

Oak savanna provides habitat for many wildlife species. Songbirds, such as the eastern bluebird, indigo bunting and brown thrasher thrive in the open grasslands occasionally punctuated by oak trees. Oak savanna also supports many small mammal species, such as cottontail rabbit and fox squirrel, which are hunted by raptors, like the sharp-shinned hawk. Larger mammals, such as red fox, white-tailed deer, coyote and badger, find ideal habitat in oak savanna as well.

(Above Right) Oak savanna provides ideal habitat for the eastern bluebird* (Sialia sialis)*, a native species that lives in cavities left in dead trees by woodpeckers or other natural causes. The loss of dead trees and competition from exotic birds – house sparrow* (Passer domesticus) *and European starling* (Sturnus vulgaris) *– have contributed to the decline of this colorful bird. Efforts to place artificial nest boxes are contributing to the eastern bluebird's recovery.

(Below) The American kestrel* (Falco sparverius) *is the smallest and most familiar hawk in North America. It prefers open country with wooded edges where it can find perching sites and an abundance of large insects such as its favored prey, the grasshopper, as well as small animals such as mice and frogs. It also nests in the cavities of trees.

FERN WILSON

ALLEN CHARTIER

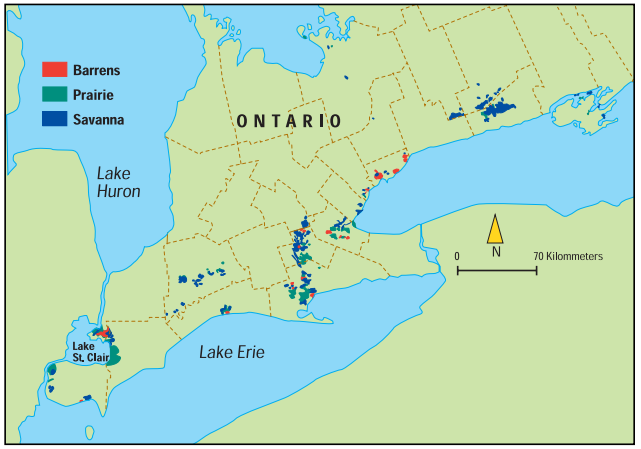
Less than one percent of the original tallgrass prairie and oak savanna vegetation remains in Southern Michigan and Ontario. Because these ecosystems support so many rare plant and animal species, the protection and management of the isolated remnants is critical to preserving our native biodiversity.

The Loss of Tallgrass Prairie and Oak Savanna Habitat in the Region

It isn't known exactly how much original prairie and savanna habitat existed prior to European settlement in Ontario, but it is estimated that 100,000 ac (40,000 ha) once covered the landscape of the southern part of the province. A mere 2,100 ha of prairie and oak savanna remain today. Most of this vegetation is located at Walpole Island First Nation (450 ha), the Windsor Ojibway Prairie Complex (320 ha) and Pinery Provincial Park (1,250 ha).

In Michigan, pre-settlement vegetation is estimated at 122,425 ac (48,970 ha) of lakeplain prairies in St. Clair, Macomb, Oakland, Washtenaw, Wayne and Monroe counties. Unfortunately, less than 800 ac (320 ha) remain today.

These natural areas represent the best of the remaining prairie and oak savanna ecosystems left in the Lake Huron to Lake Erie Corridor. Unfortunately, the remnants perform few, if any, of their original landscape and habitat functions to support mammals, birds, reptiles and amphibians. Butterfly populations have declined to the point that some species, such as Karner blue and frosted elfin, are endangered species in the U.S. and have been extirpated from Ontario. In addition, many plants that once were common in tallgrass prairie and oak savanna ecosystems are at risk of being lost to the region, and in some cases, Earth.



NATURAL HERITGAE INFORMATION CENTRE

This map illustrates the Pre-European settlement distribution of tallgrass prairie and oak savanna in Ontario. Today, exisitng prairie communities are remants of this original distribution.

Places to visit and experience tallgrass prairies and oak savannas in the Lake Huron to Lake Erie Corridor are:

United States	Canada
Petersburg State Game Area	Ojibway Prairie Provincial Nature Reserve
Algonac State Park	Ojibway Park
St. Clair Flats State Game Area	Point Pelee National Park
Lower Huron Metropark	Stone Road Alvar on Pelee Island
Indian Springs Metropark	Pinery Provincial Park
Highland State Recreation Area	Howard Watson Nature Trail
Island Lake Recreation Area	Canatara Park Prairie Reconstruction
Nichols Arboretum Dow Prairie Reconstruction	Dennis Rupert Prairie Preserve
Matthaei Botanical Gardens Prairie Reconstruction	
Gallup Park (City of Ann Arbor)	
Furstenburg Park (City of Ann Arbor)	
Barton Park (City of Ann Arbor)	
Bandemer Park (City of Ann Arbor)	
Brighton Recreation Area	
Sterling State Park	

The Great Lakes Marshes, tallgrass prairies and oak savannas of the Lake Huron to Lake Erie Corridor have diminished greatly since the development of the region by European settlers. Parks and nature preserves make up most of the high-quality natural areas remaining today. An extraordinary diversity of plants and animals still call these remarkable ecosystems home in today's environment. Protecting them is critical for their survival.

Walpole Island First Nation Territory
"Bkejwanong" Land where the Waters Divide

"Walpole Island First Nation lands is a mosaic of wetlands, prairie, and oak savanna habitats without equal in the Great Lakes Basin"

- State of the Lakes Ecosystem Conference, 1998

WALPOLE ISLAND HERITAGE CENTRE

An aerial view of Walpole Island in the St. Clair River Delta

"Waabshkoki" is the Ojibwa name for marsh and all the life and rich biodiversity contained within it. Walpole Island has 42,500 ac (17,000 ha) of coastal marsh. It is one of the largest contiguous portions of coastal marsh left in the Great Lakes Basin. Patches of wild rice are purposefully not harvested to sustain the many waterfowl that visit each year.

Walpole Island is truly an ecological treasure in the Lake Huron to Lake Erie Corridor. The natural communities found on Walpole Island offer clues to how the region's landscape might have looked prior to European settlement.

Among the many beautiful scenes on Walpole Island is a grove of widely spaced oak trees, with dappled light filtering through the canopy and the ground thickly covered with a multitude of wildflowers and grasses. In the distance, oak trees fade seamlessly into prairie meadows of purple, yellow, pink and white blossoms, as well as grasses that reach beyond shoulder height, seemingly to the sky. The air abounds with the buzz of insects, birds calling to one another, and dewy scents.

On the fringes of Walpole Island, coastal marshes filled with cattails, sedges and rushes spread out in every direction. Turquoise water, like that found in the tropics, extends from the marshes into Lake St. Clair. The marsh area is so expansive that one could easily become lost in its many openings, islands and dikes.

The plant and animal life is amazingly diverse. In fact, Walpole Island has some of the highest concentrations of rare species of any place in Canada. The people of Walpole Island First Nation have successfully managed and lived off their lands for thousands of years. The existence of high-quality tallgrass prairie and oak savanna is most likely due to their use of fire, as well as protection from large-scale agricultural development. The people's traditional values and practices are probably the largest factors responsible for sustaining the different habitats and associated plants and animals in their territory. The ecosystems that are threatened on a global scale remain a vital part of the Walpole Island community's past, present and future.

ALLEN WOODLIFFE

Walpole Island is the only place in Canada where the white prairie gentian (Gentiana alba) *is found. This plant is characteristic of high-quality oak savanna ecosystems.*

Visitors can learn more about Walpole Island's natural heritage at the Walpole Island Heritage Centre.

G.M. ALLEN

The eastern portion of St. Clair River Delta constitutes the lands of Walpole Island First Nation. There, 24,000 ha of delta islands are a part of the traditional homeland of the Ojibwe, Odawa, and Pottawatomi people who together comprise a political compact known as the Three Fires Confederacy. The Ojibwe language "Anishinaabemowin" is their native language.

"Mushkode" is the Ojibwa name for prairie and savanna. Walpole Island contains the best remnants in the Corridor of the globally imperiled tallgrass prairie and oak savanna communities. Those at Walpole are home to more than 140 rare plant species.

WALPOLE ISLAND HERITAGE CENTRE

"Mtigwaaki" is the Ojibwa name for deciduous forests, or "bush." Walpole Island contains one of the largest continuous tracts of forested area in southern Ontario.

Heading Inland

The largest portion of the Lake Huron to Lake Erie Corridor lies inland from the open waters. Different ecosystems within this area are home to an astonishingly vast diversity of flora and fauna.

The Lake Huron to Lake Erie Corridor's inland area includes a variety of wetlands and uplands. The wetlands include marsh, wet meadow, prairie fen, bog, swamp, vernal pools and floodplain forest. Each is distinguished by its vegetation, hydrology and chemistry. The uplands are dominated by beech-maple and oak-hickory forests, and oak barrens, interspersed with patches of prairie grassland.

Wetlands

Wetlands are places with varied ecosystems that provide some of the most important life-support systems in the natural environment. The Corridor region boasts unique, biodiverse wetland ecosystems.

Wetlands of the Lake Huron to Lake Erie Corridor

Wetland Type	Pr. Water Source
Coastal Marsh	Great Lakes Water
Marsh	Surface Water
Floodplain Forest	Surface Water
Hardwood Swamp	Precipitation
Wet Meadow	Precipitation
Bog	Precipitation
Wet Prairie	Precipitation
Vernal Pool	Precipitation
Fen	Groundwater

The dominant water source is one of several distinguishing features of wetland communities. Soil type and local topography also influence their development.

ALLEN CHARTIER

***Wetlands provide breeding habitat for twelve species of frogs that live in the Lake Huron to Lake Erie Corridor. Pictured is a northern leopard frog* (Rana pipiens.)**

MELISSA DIETTLOFF

The marsh fern* (Thelypteris paulstris) *grows in the soft, wet soils of wetlands. Ferns are primitive plants that reproduce with spores rather than seeds.

JOHN G. REGNIER

Exploring wetlands is a fun, family activity.

WETLANDS ARE VALUABLE

Wetlands...

- **are diverse and biologically productive ecosystems. They are as ecologically significant as the tropical rainforests and coral reefs elsewhere on Earth;**
- **support many plant and animal species. It is estimated that more than half the species at risk in the United States are associated with wetlands. Protecting wetlands is essential to maintaining our native biodiversity;**
- **provide areas for hunting and fishing, scientific study, canoeing, nature photography and wildlife viewing;**
- **add revenues to local economies as tourists and residents spend money on food, lodging, and boating associated with hunting, fishing. and birdwatching.**
- **act like natural sponges by absorbing water and releasing it slowly. This provides neighboring areas with protection from floods and with a source of water during droughts. An acre (0.4 ha) of wetland can store 1 to 1.5 million gallons (3.8 to 5.7 million liters) of floodwater, which is equivalent of 36 to 55 in (90 to 137.5 cm) of rain per acre;**
- **recharge groundwater supplies as waters from wetlands seep into aquifers;**
- **filter sediment and pollutants carried in stormwater runoff, thereby improving water quality in rivers, lakes and streams. In fact, wetlands often are artificially created to treat stormwater and industrial wastewater.**

Marsh

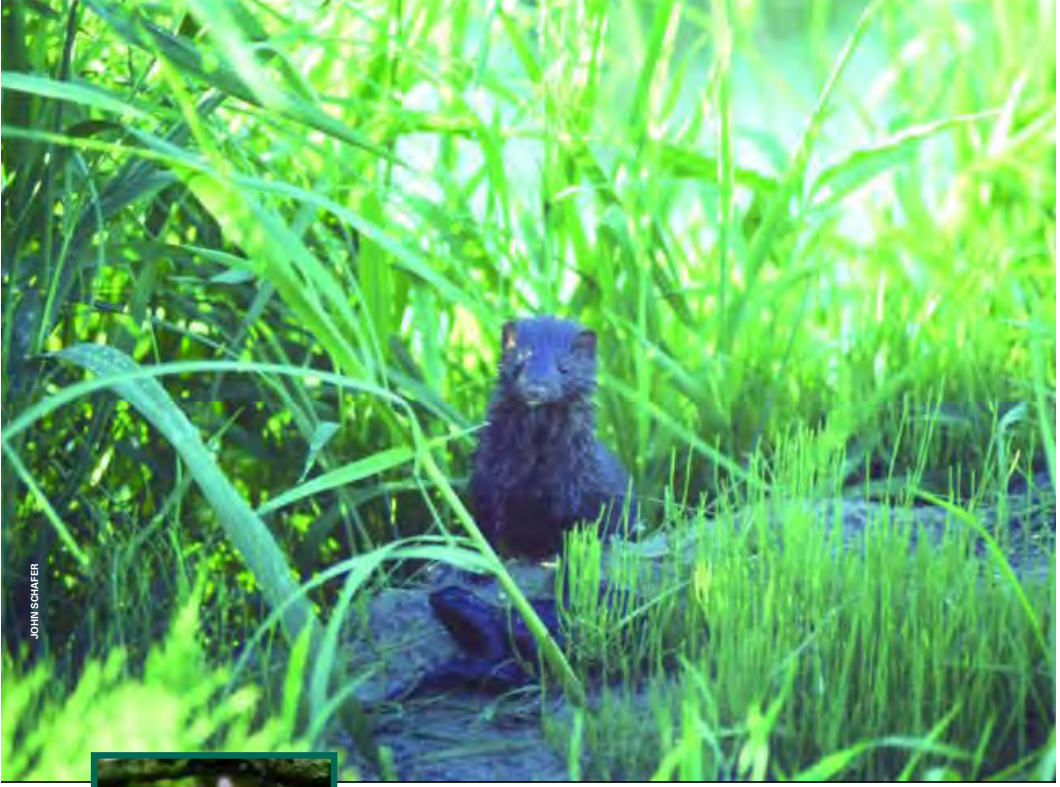
Marshes are wet areas with standing or slow-moving water. They seldom dry out naturally, except in times of drought. Their vegetation is dominated by the common cattail (*Typha latifolia*). Other submersed aquatic plants include pondweed (*Polygonum spp.*), pickerel weed (*Pontederia cordata*), common water plantain (*Alisma subcordatum*), tall water parsnip (*Sium suave*), arrowhead (*Sagittaria spp.*) and common bur reed (*Sparganium eurycarpum*). Marshes also have emergent floating-leaved plants, such as duckweed (*Lemna minor*) and white water lily (*Nymphaea tuberosa*.)

While coastal marshes are influenced by Great Lakes water level fluctuations; inland marshes are affected by surface water and groundwater inputs. These marshes can be found in gradually sloping, wind-protected areas next to ponds, rivers, streams and inland lakes. Marshes also form in shallow depressions that receive drainage from the surrounding uplands. Some marshes might have sandy soils, but most have fine-textured, nutrient-rich soils with large amounts of organic matter.

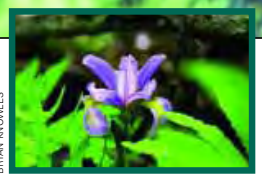
Marshes are highly productive ecosystems with nutrient-rich waters, lush and diverse vegetation, and vast arrays of invertebrate and insect life. Waterfowl, shorebirds and songbirds find food and shelter in the aquatic vegetation. Marshes also provide food to many mammal species, such as raccoon, cottontail, rabbit and deer. Other fur-bearing animals, such as muskrat and mink, live in marshes. Reptiles and amphibians, such as leopard frogs, chorus frogs, snapping turtles, northern water snakes and ribbon snakes are dependent on marshes for breeding habitat.

LOU TERRY

The fragrant white water lily* (Nymphaea tuberosa) *floats in the open water along a marsh edge.



JOHN SCHAFER



BRYAN KNOWLES

The brilliantly colored blue flag iris* (Iris virginica) *grows along the wet shorelines of inland marshes and other wetlands.

The mink* (Mustela vison) *is a wetland mammal that lives along streams and lakes. It is sensitive to human disturbance and requires large tracts of natural habitat to survive.

ST. CLAIR REGION CONSERVATION AUTHORITY

The Wawanosh Wetlands in Sarnia, Ontario is a provincially significant marsh owned by the St. Clair Region Conservation Authority. A 1.5-mi (2.5-km) nature trail winds along the marsh, providing many opportunities to view wildlife.

WETLAND INVADER

ROBERT STEWART

It may look pretty, but the purple loosestrife* (Lythrum salicaria) *has destructive effects on the native plant diversity of freshwater wetlands. Each purple loosestrife can produce millions of seeds, quickly overtaking the vegetative surface cover of a wetland. Although some butterflies use it as a nectar source, purple loosestrife generally is not beneficial to wildlife because it overcrowds the native plants upon which they depend.

AMELIA HANSEN, CORVUS ART

The red-winged blackbird* (Agelaius phoeniceus) *is one of the most common marsh birds. It is highly territorial. Males spend much of their time defending large expanses of cattails where their female mates nest.

Great Blue Herons

The great blue heron (*Ardea herodias*) is one of the most elegant wetland creatures. This large bird can stand motionless, waiting for the right moment to strike the water to catch small fish, its favored prey. Although great blue herons feed in wetland habitats of various sizes throughout the region, they require large natural areas to successfully reproduce.

Great blue herons build nests communally in tall dead trees. These nest collections are called heron rookeries, or heronries. Herons are highly sensitive to human activity and will abandon their nests if disturbed. Before 1900, nesting was widespread through the region including Wayne County, Michigan. But by the early 1900s, Wayne County had only two great blue heronries. A few herons returned to nest on islands in the Detroit River in the late-1990s.

Today, the Corridor's main heronries are located in inland marshes set within large natural areas. Great blue heron rookeries can be observed from a distance at Kensington Metropark and at the West Bloomfield Woods Nature Preserve in Michigan. Bickford Oak Woods in Lambton County, Ontario, also supports a heronry.

JONATHAN SCHECHTER, WEST BLOOMFIELD PARKS AND RECREATION

A great blue heron leaps from its nest at the West Bloomfield Woods Nature Preserve in Oakland County, Michigan. Surrounded by suburban development, this natural area is designated as an Urban Wildlife Sanctuary by the National Institute for Urban Wildlife. The preserve's mature oak-hickory forest, marsh and swamp are home to spring wildflowers, 100 species of birds, mammals, such as mink and red fox, and a great blue heron rookery.


MARK O'BRIEN

The fawn darner **(Boyeria vinosa)** *is named for the two white spots on the thorax that are reminiscent of a baby deer's spots. This dragonfly is common in nearly every stream and creek in Michigan and Ontario. Naiads are found among debris dams and undercut banks with root tangles. Adults emerge in mid-summer. They usually are only seen flying along the banks, especially where fallen tree branches and roots extend into the water. Males are searching for females, while females are searching for egg-laying sites among the rotting wood. The flight season is July through September.*

Dragonflies

Dragonflies and damselflies are among the most fascinating creatures found in wetland and aquatic habitats. Adults lay eggs in vegetation, mud or on the water surface. The eggs usually hatch a short time afterward. The aquatic naiad, or larval, stage can range from three to four months for migratory species to a year for resident species. Adults may live a few weeks to several months, depending on the species. Most adult populations of dragonflies have reached their peak by early July. The dragonfly's carnivorous and highly mobile naiads play an important role in aquatic ecosystems. They may be the highest-order aquatic predator in ponds where fish are absent. In flight, the adult dragonfly's average cruising speed is 25 mph (40 km/h.)

The eastern red damsel (*Amphiagrion saucium*) is a small red damselfly that is only found in seepage areas, such as at Ives Road Fen in Jackson County, Michigan. In contrast, the common whitetail (*Plathemis lydia*), is found in almost any wetland habitat.

Most species of dragonflies and damselflies in the region are non-migratory. Some of the migratory species, such as green darner (*Anax junius*), black saddlebags (*Tramea lacerate*) and wandering glider (*Pantala flavescens*), can be seen flying in large numbers along the Corridor's lakeshores as they head south in the fall. In the spring, green darners fly north along the shore of Lake St. Clair.


MARK O'BRIEN

The common whitetail **(Plathemis lydia)** *is one of the most common dragonflies. It thrives in man-made settlement ponds and stormwater runoff ponds, which usually are oxygen-poor and contain excessive concentrations of nutrients due to contaminated sediments, fertilizers, herbicides and other materials. Adult males develop a white waxy coating on the abdomen as they mature. They establish mating territories and chase off rival males. Females have banded wings and lack the white abdomen. Their naiads are voracious eaters of mosquito larvae and other small aquatic invertebrates. Adults are active from mid-May to September.*


MARK O'BRIEN

The arrow clubtail **(Stylurus spiniceps)** *is a long, black dragonfly with green eyes and light green markings. It can be found in most rivers in southern Michigan and southwestern Ontario. They are known as a "hanging clubtails" because the adults often are seen hanging from overhanging branches along the river. They are exciting to watch as they fly swiftly over the center of a river, sometimes skimming the water surface. Naiads come out of the water and crawl onto the riverbanks in early July. When the adults emerge, they quickly disperse to the woods for several days. After they have sexually matured, they return to the river to feed and mate. The flight season is from July through August.*


MARK O'BRIEN

The eastern pondhawk **(Erythemis simplicicollis)** *is a voracious dragonfly that inhabits a variety of marshy and well-vegetated pond edges where duckweed and mats of algae are found. Both males and females are grass-green with black stripes on the abdomen as they begin their adult stage. As they mature, the female retains this coloring but the male becomes a blue-green color with a whitish cast to the abdomen. Adults eat larger insects, including other dragonflies. They perch on plants or other objects and quickly dart out to seize their prey. This species is quite common in southern Michigan and southwestern Ontario from late-May into September.*

Wet Meadow

Wet meadows are wetland communities of mixed wildflowers, grasses and sedges that grow on saturated loam or muck soils with high water-retention capability. They often are not immediately recognized as wetlands because surface water tends to be visible only during spring flooding, when water depths reach a maximum of about six inches (15 cm) Even when the water level is at its lowest, usually in summer, it remains at or near the soil surface.

Wet meadows depend on a consistently high water table and generally are located within large wetland complexes. They often function as transition zones, or ecotones, from deeper water wetlands to upland. Wet meadows usually form near the base of a hill where percolating springs and seeps emerge and provide a constant source of water to saturate the soil.

The presence of grass-like plants called sedges (*Carex spp.*) defines wet meadows. Tussock sedge (*Carex stricta*) is the most common species and grows in large tussocks, or clumps. Tussock sedge will disappear if ground water levels are reduced by two to four feet (0.6 to 1.2 m)

Many wildflowers and grasses also live in wet meadows. Grass species include blue joint, reed canary (*Phalaris arundinacea*), big bluestem and prairie cord grass. Wildflower species include joe-pye weed (*Eupatorium maculatum*), panicled aster (*Aster simplex*), swamp milkweed (*Asclepias incarnata*), swamp thistle (*Cirsium muticum*) and marsh bellflower (*Campanula aparinoides.*)

A variety of animals find habitat in wet meadows. Many butterflies, including Duke's skipper, mulberry wing and eyed brown, depend on sedges as their major food plants.

Reptiles, such as the Eastern Massasauga rattlesnake, Blanding's turtle and spotted turtle, find nesting habitat and food in wet meadows. A wet meadow's springtime flooding provides a reproductive area for frogs, whose mating calls enliven the grassy meadows with musical croaking.

On Grosse Ile, a wet meadow is protected by the Grosse Ile Land Conservancy's Nature Area. During spring floods, the distinctive clumps of tussock sedge* (Carex stricta) *protrude from the water's surface.

Rare bird species, such as sedge wren, northern harrier, short-eared owl and American bittern, live in wet meadow habitats. The northern harrier, formerly known as marsh hawk, requires large, open wet meadows with tall, dense grassy vegetation and shallow inland marshes to nest. It feeds primarily on small mammals such as mice and voles.

Wet meadows are fire-dependent. In the absence of fire or flooding, all but the wettest wet meadows typically convert to shrub swamp or swamp forest, which causes shade-intolerant species to decline. This reduces the meadow's diverse plant composition, a change that subsequently affects all insects, birds, reptiles and amphibians dependent upon this unique habitat.

Extensively used, and threatened, by agriculture, wet meadows have been ditched, tiled, drained, mined for peat and converted to pasture or cropland. Mowing of blue joint grass, as a source of hay, was widely practiced before 1950 and is still done at St. Johns Marsh and Harsens Island in Michigan.

JOHN SCHAFER

JAMES H. HARDING

The Blanding's turtle* (Emydoidea blandingii) *lives in a variety of unpolluted aquatic habitats in Michigan and Ontario, including marshes, sloughs, and ponds. They require wetlands with abundant vegetation and soft bottoms. During the mating and nesting season, they can be found moving through uplands that are open and sunny. Maintaining small and large wetlands that are connected to upland habitats is critical for the survival of this species.

The yellow lady's-slipper* (Cyripedium calceolus) *grows among sedges in a variety of alkaline habitats, such as wet prairies, wet meadows and fens.

JESSICA PITELKA OPPER

Swamp milkweed* (Asclepias incarnata) *is a common wildflower of marsh edges and wet meadows. Its bright pink blossoms provide nectar for many pollinators, including the monarch butterfly* (Danaus plexippus). *Swamp milkweed and common milkweed are the larval host plants for the monarch. The butterfly lays its eggs on the milkweed. The hatched caterpillars feed on the leaves, then attach themselves to the plant for their pupal stage before they emerge as adult monarchs.

Sedge Wren

The sedge wren (*Cistothorus platensis*), once known as the short-billed marsh wren, is the least known of the five species of wren that nest in the Corridor. Its breeding range is central to southeast Canada and the northern U.S. It winters in Florida and parts of Mexico.

Sedge wrens require wet meadows or sedge wetlands for nesting. They once were common or even abundant in parts of the region but they have been uncommon or rare since about 1900, due to habitat loss.

JIM SIMEK, NATURE'S IMAGES

Late summer wildflowers bloom profusely in a prairie fen in Springfield Township, Michigan.

Prairie Fens

Prairie fens are wetlands that typically lie next to lakes, rivers and streams in glacial outwashes or on coarse-textured end moraines. Because they occur on ice-contact topography, their presence in the Corridor is restricted to the interlobate regions of southeastern Michigan and southwestern Ontario.

Fens occur where water from springs or seeps moves slowly up through calcareous soil, bringing calcium-rich ground water to the surface. This makes both the soil and water somewhat alkaline and leaves white deposits on the soil surface. Because the soil is waterlogged and low in oxygen, a fen has a low rate of decomposition. This allows peat to accumulate. The peaty and alkaline soils distinguish fens from similar-looking wetlands, such as wet meadows.

The vegetation of a fen commonly appears in three related phases, each with distinct dominant and characteristic species: sedge flats, sedge meadow and wooded fen.

Sedge flats are the wettest part of a fen. These areas are located in flooded depressions where water flows from springs or streams. Up to 12 in (30 cm) of water might lie here during springtime. These flats are dominated by sedges and other water and alkaline tolerant vegetation, such as golden-seeded spike rush (*Eleocharis elliptica*), wicket spike rush (*Eleocharis rostella*), hard-stemmed

JULIE A. CRAVES

Grass of Parnassus* (Parnassia glauca) *is an indicator species of prairie fens. The subtle green lines on its white petals serve as nectar guides for pollinating insects.

TRISH BECKJORD

The showy lady's-slipper* (Cyripedium reginae) *is a large, beautiful native orchid that grows in open areas of fen and swamp habitats. Early settlers used roots of this plant as a soothing medicine for nerve problems.

bulrush (*Scirpus acutus*) and twig rush (*Cladium mariscoides.*)

Sedge meadows are the largest part of a fen. These areas are saturated, but not inundated, and have slightly sloping soil with peat deposits. Dominant plants include shrubby cinquefoil (*Potentilla fruticosa*), tussock sedge and fen star sedge (*Carex sterilis.*) In addition, plants common to tallgrass prairies, such as little bluestem and Indian grass, often are present in a prairie fen.

Wooded fens are elevated portions located around the fen's upland edges. They support shrubs and shrub trees, chiefly tamarack (*Larix larcina*), poison sumac (*Rhus vernix*), gray dogwood (*Cornus racemosa*), red-osier dogwood (*Cornus stolonifera*), and pussy willow (*Salix discolor.*)

Fens support rare plant species, such as tuberous Indian plantain (*Cacalia plantaginea*), Richardson's sedge (*Carex richardsonii*), white lady's-slipper

THE MICHIGAN NATURE ASSOCIATION PROTECTS RARE HABITATS

The Michigan Nature Association (MNA) is the oldest land conservancy in Michigan. Officially incorporated in 1952, with roots in the Detroit area, the MNA protects many natural areas in southeastern Michigan including prairie fens. The Calla C. Burr Memorial Plant Sanctuary and Lambs Fairbanks Plant Preserve are located in Rose Township, Oakland County, and protect fen, bog and oak woods habitats in a relatively small area.

The Lakeville Swamp Sanctuary in Oakland County is a larger preserve that is easier to visit, although first-time visitors usually require a guide. It can also be enjoyed from the perimeter roads where fen and conifer swamp communities can be viewed at a distance. The largest American plum tree in Michigan is found at this sanctuary as well as the federally endangered eastern massasauga rattlesnake.

Lakeville Swamp Sanctuary

MICHIGAN NATURE ASSOCIATION

The Calla C. Burr Memorial Plant Sanctuary

orchid (*Cyripedium candidum*), mat muhly (*Muhlenbergia richardsonis*), prairie dropseed (*Sporobolus heterolepsis*), Ohio goldenrod (*Solidago ohioensis*), Riddell's goldenrod *(Oligoneuron riddellii)* and fringed gentian (*Gentiana crinita*), which are adapted to the fens' alkaline environment. Several rare insect species also are associated with prairie fens. These include the tamarack tree cricket, Mitchell's satyr, powersheik skipper and swamp metalmark butterflies.

Protecting the surrounding natural water systems is the best way to preserve fens. Drains and wells used in agriculture and residential development have disrupted groundwater flow and destroyed many prairie fens, along with other wetlands. Fens' cool, alkaline water has also been negatively affected by warm, nutrient- and sediment-laden runoff from farms and yards.

Absence of fire is another threat. Before European settlement, prairie fens in the Corridor were adjacent to dry, open upland communities, such as mixed oak barrens or oak savannas. These communities and prairie fens were maintained by fire that burned surface vegetation and inhibited shrub invasion. In more recent times,fire suppression has caused prairie fens to convert to shrub and conifer swamps.

JAMES H. HARDING

Blanchard's cricket frog* (Acris crepitanis blanchardii) *is a small member of the tree frog family. It does not climb and lives year-round in aquatic habitats. Blanchard's cricket frog prefers early successional wetlands, ponds, and streams with open, usually muddy, shorelines. This frog has a large native range in North America; however, perhaps in part because of sensitivity to polluted habitats, populations have been declining in Michigan and Ontario.

DAVID L. CUTHRELL

A species at risk, Mitchell's satyr* (Neonympha mitchelli) *is a butterfly often found in the open edges of wooded fens where tamarack and poison sumac are scattered within a sedge meadow. Loss of habitat is responsible for this butterfly's decline.

The Proud Lake Recreation Area near Wixom, Michigan, has a deep kettle depression that houses a bog lake with a quaking mat. A conifer swamp with tamarack and poison sumac surrounds the open sphagnum and sedge community. Hardwood swamp with black ash, swamp white oak, basswood and slippery elm trees surrounds the bog. Sedges and skunk cabbage grow in the understory. Oak-hickory forest and open meadows grow on the adjacent hilly uplands.

Bogs

Bogs are unique wetland communities that derive their water from rainfall. They form in lakes, old lake depressions, kettle lakes and sandy depressions in the lakeplain that have become isolated from groundwater and surface water sources, such as streams. Rainwater is naturally slightly acidic and adds few nutrients to the bog environment. Poor drainage creates waterlogged soil and anaerobic conditions. This slows the activity of decomposing bacteria, allowing organic matter to accumulate over time and form layer upon layer of peat.

Plants that live in bogs are adapted to acidic conditions. They are known as acidophiles, or acidic-loving vegetation. The most prominent example is sphagnum moss (*Sphagnum spp.*), which forms thick mats over a bog's surface.

Sphagnum moss builds thick peat soils and its decomposition actually contributes to the bog's acidity over time. The absorbent quality of sphagnum moss has been useful to humans in various ways, including applications as bandages in World War I battlefield hospitals and as a soil conditioner in modern-day gardens.

Shrubs, grasses and wildflowers that can live in a bog's saturated, nutrient-poor, acidic soils include native large and small cranberry (*Vaccinium macrocarpon* and *V. oxycoccos*), highbush blueberry (*Vaccinium corymbosum*), poison sumac, leatherleaf (*Chamaedaphne calyculata*), bog rosemary (*Andromeda glaucophylla*), cotton grass (*Eriophorum spp.*), wintergreen (*Gaultheria procumbens*), sedges and orchids.

Trees that grow on the fringes of bogs are tamarack, white cedar (*Thuja occidentalis*), black spruce (*Picea mariana*) and occasionally white pine (*Pinus strobus.*)

Some bog plants have adapted to the soil's nutrient deficiency by becoming carnivorous. They obtain their nutrients by catching and digesting insects. Examples include pitcher plants (*Sarracenia spp.*) and sundews (*Drosera spp.*)

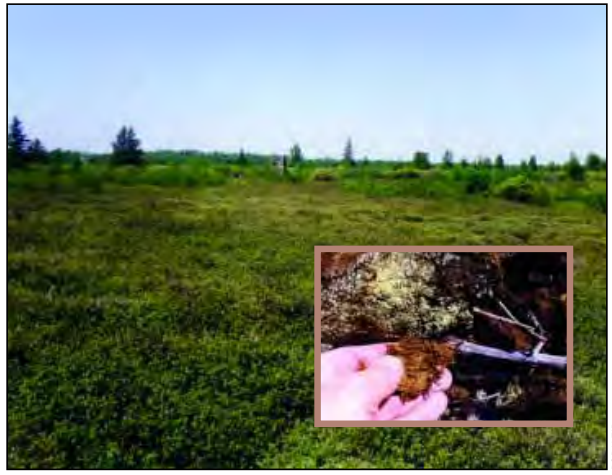
Acidic conditions result in a low diversity of plant species in a bog. Plants that do thrive tend to be restricted to bog habitats. Unfortunately, these plants are becoming rare as bogs are drained for farming and mined for their valuable peat. Homeowners can help reduce bog mining by choosing compost, instead of peat moss, to enrich their garden soil.

BOB WEIR

Cotton grasses* (Eriophorum spp.) *are in the sedge family. Their downy white seed heads may create the appearance of a cotton field in a bog.

TRISH BECKJORD

Grass pink* (Calopogon tuberosus) *is a small, delicate orchid found in bog and fen habitats.



BOB WEIR

The Minden Bog in north-central Sanilac County, Michigan is the headwaters for the Black River, which flows into the St. Clair River at Port Huron. This vast area of 3,000 ac (1,200 ha) is elevated above surrounding terrain, making it the southernmost raised bog in North America. The bog is the main component of the Minden City State Game Area. It is a beautiful, quiet place where the ground appears firm but will shake if jumped upon.

CARNIVOROUS PLANTS

JULIE A. CRAVES

The sweet-smelling sundew* (Drosera spp.) *attracts insects to its sticky red leaves. Once the insect is caught, the leaves slowly close to aid digestion.

JULIE A. CRAVES

The pitcher plant's* (Sarracenia purpurea) *landing pad, red veins and hairs that point downward lead insects to a cup where they drown and eventually are digested.

CHANGES IN BOG HABITAT

Today bogs are more commonly found in the northern reaches of Michigan and Ontario. They used to be scattered throughout the inland area of the Lake Huron to Lake Erie Corridor. Although never common to the flat lakeplain, less than one percent of wetlands in Southern Ontario today are bogs. It is thought that bogs occupied low ground around more than half of Oakland County's 1,468 lakes before European settlement. There also are numerous historical accounts of "cranberry marshes" in Wayne County, particularly in Redford Township. During the 1800s, settlers harvested the fruit of the cranberry shrubs, which are native to North America, for commercial sale in Europe.

Bogs also provided settlers with a source of metal as they harvested bog iron ore, which is formed when iron oxide emerges as a precipitate from a bog's acidic waters. Dr. Douglas Houghton, in his first report as state geologist in 1838, wrote:

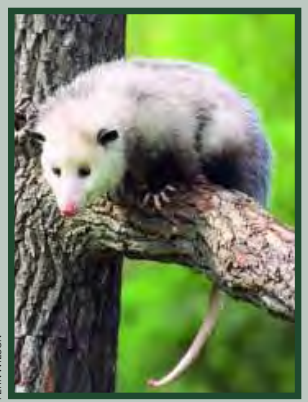
"At a distance of six or seven miles northwest of Detroit, and in the county of Wayne, bog (iron) ore occurs at intervals over an extent of several hundred acres, but I have not been able to examine it with sufficient care to determine its extent; I think however, there can be little doubt but it exists in sufficient quantities to be turned into practical account."

After that region was surveyed, one area in Greenfield Township was found to consist of nearly 73 percent iron peroxide.

In more recent years, shoreline development along inland lakes, urbanization and the draining of wetlands for agriculture have made bogs almost rare in the Corridor region. Some bog habitats are protected by organizations, such as the North Oakland Land Conservancy, which owns several nature preserves containing bogs.

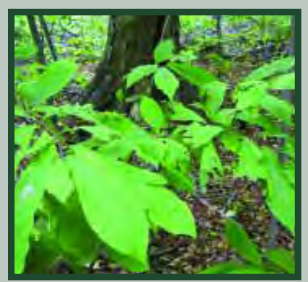
Wooded Communities

Forest was, by far, the dominant vegetation of the Lake Huron to Lake Erie Corridor at the time of European settlement. Differences in glacial topography, soils and moisture resulted in a variety of forest communities across the region. Hardwood swamp, conifer swamp, shrub swamp and floodplain forest developed in low areas and along rivers. In upland areas, oak barrens and forests of beech-maple and oak-hickory grew. Today, only small remnants are left of these forest communities, a vital part of the region's natural heritage.



FERN WILSON

(Above) Southern Michigan and southwestern Ontario are at the northern edge of the range of the opossum **(Didelphis virginiana)**. *This animal's naked ears make it sensitive to cold weather. Opossums prefer to live in woodlands with nearby meadow habitats. Their omnivorous feeding habitats make them adaptable to suburban development.*



The Carolinian Zone

The hardwood forests of southern Michigan and southwestern Ontario are called "Carolinian" because they contain many species common to southerly zones of the Eastern Deciduous Forest Biome, such as the Carolina states. These species, which favor warmer climates and longer growing seasons, include paw-paw (*Asimina triloba*), sassafras (*Sassafras albidum*), black gum (*Nyssa sylvatica*), flowering dogwood (*Cornus florida*), cucumber tree (*Magnolia acuminata*), American chestnut (*Castanea dentata*), Kentucky coffee tree (*Gymnocladus dioicus*), blue ash (*Fraxinus quadrangulata*), hop tree (*Ptelea trifoliata*) and several oak and hickory species. Several mammals and birds, such as the southern flying squirrel, opossum, Acadian flycatcher and summer tanager, do not stray north of this climatic region.

(Above) This map shows the transition zone of southern and northern forest types in Michigan and Ontario. The invisible line between the two types lies below the 43rd parallel.

(Left) The paw-paw **(Asimina triloba)** *is a Carolinian tree species and is at the northern edge of its range in the Corridor region. Growing in the forest's understory, this small tree favors warm moist floodplains and mesic (moderately moist) woods. The paw-paw produces a unique banana-like fruit from red, foul smelling flowers that are pollinated by flies. Here, seedlings are pictured in the understory of a forest on the campus of the Wayne County Community College Downriver Campus in Taylor, Michigan.*

(Left) Old-growth forests, like this one at the Lower Huron Metropark in Michigan, typically have regular gaps in the canopy, rich understory vegetation, deep organic soils and scattered dead, decaying logs and snags (dead trees that are still standing or have only partially fallen.)

The Value of Old-Growth Forests

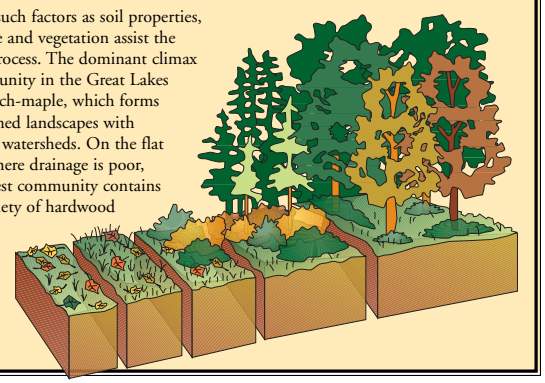
A forest is considered to be a climax forest community, or "old growth," when it reaches 150 to 250 years of age. Old-growth forests have all levels of forest strata, from ground vegetation to canopy crowns formed by mature trees that can be very large.

Because old-growth forests take so long to grow, they provide valuable wildlife habitat that cannot be easily or quickly replaced. Various animals, birds and insects live in all strata of old-growth forests. Predatory birds roost and nest in the upper canopy. Songbirds and small animals, such as squirrels, make nests in the understory and shrub layer. Wildflowers and grasses grow in the herb layer and provide food for foraging animals and butterflies. The litter layer consists of decaying stumps and logs from which plants germinate. The soil contains deep organic matter from decades of accumulated leaves; a variety of spring ephemeral wildflowers, which can't be found in any other habitat, thrive here. Even standing deadwood provides food and housing for birds, such as woodpeckers, and insects upon which they feed.

SUCCESSION

Succession is a natural ecological process that begins with colonization of new land by pioneer species and ends with establishment of a climax community. This progression of events may take hundreds of years. Typically, pioneer species are shade-intolerant and short-lived plants that over time are replaced by shade-tolerant and longer-lived species. The process eventually results in a climax community.

Changes in such factors as soil properties, microclimate and vegetation assist the succession process. The dominant climax forest community in the Great Lakes region is beech-maple, which forms on well-drained landscapes with well-defined watersheds. On the flat lakeplain, where drainage is poor, a climax forest community contains a greater variety of hardwood tree species.



Forests of the Past

Descriptions provided by early surveyors give valuable clues to the size and diversity of forests of the past. In Lambton County, for example, surveyors indicated that townships contained small areas of "good land" covered with "beech, maple and basswood," with "oak and hickory" inclusions at times, interspersed with "black ash and elm swamps." "Tamarack swamps" were noted as common in some townships. Areas of hardwood swamp in Sombra, Brooke, Enniskillen and Dawn townships were described as "enormous." Areas with high, dry lands of beech-maple forest were characterized as having "old Indian sugarbush," a description attributed to the native peoples' practice of using maple sap to produce maple sugar. In some townships, survey notes included "open marsh" with "willow and rose bush." Occasionally, a surveyor described prairies as "open meadow with high grass extending a considerable distance to the right and left."

Since this early description of the vegetation, much of the landscape has been drained and farmed. Less than ten percent of Lambton's original forest cover survives today.

Source for the above information: Sydenham Valley Conservation Report. 1965. Department of Energy and Resources Management, Conservation Authorities Branch.Toronto, Ontario.

CAROLINE BIRIBAUER

Clear Creek forest is one of the largest protected areas of forest in southwestern Ontario. On the 800-acre (324 ha) preserve are ancient oaks, beech and maples.

THE FOREST FLOOR

The floor of mature forests is marked by pit-and-mound topography, created when old trees topple, heaving their root mass upward.The forest floor, known as the litter layer, consists of rich organic soil formed by decomposed fallen leaves. Ferns, mosses and vines, such as Virginia creeper (*Parthenocissus quinquefoila*), thrive in this leaf litter and help recycle nutrients in the forest ecosystem. When old trees die and fall, new seedlings germinate in cracks and crevices of the decaying bark, which supplies nutrients to help them grow and mature.

ROBERT STEWART

The mature hardwood trees at the City of Detroit's Palmer Park offer hints of how the original forests of the Detroit area may have looked.

GLENN OGILVE

At the Lorne C. Henderson Conservation Area in central Lambton County, nature trails wind through floodplain and mixed hardwood forests.

The Forests of Today

Two forest types dominate southern Michigan and Ontario: beech-maple in mesic areas and oak-hickory in more xeric sites. Much of the region's original forest cover has been destroyed. Most surviving forests are fragmented woodlots in varying states of disturbance. The least disturbed upland forests now are dominated by sugar maple (*Acer saccharum*) and beech trees or combinations of white oak, black oak, red maple (*Acer rubrum*) and black cherry.

Disturbances cause changes in forest communities. These include natural disturbances, such as storms that knock down trees. Man-made disturbances involve clearing and filling land for agriculture and development. Today, the Corridor region is characterized by a mosaic of cleared lands and woodlots in various stages of succession.

Many pre-settlement accounts do not mention tree species that are less tolerant of fire, such as black cherry and red maple. They now are common. Black cherry is an opportunistic species that grows in areas of disturbance, including forest edges and openings. Red maple can live in a broad range of site conditions. Its main habitats are swampy lowlands, but it is an aggressive colonizer of upland sites. In recent times, there has been a marked increase in red maple's abundance due to fire suppression and disturbance of pre-settlement forests by humans.

After many years of decline, forest cover has been increasing in some parts of the region. For example, it has grown in the outlying reaches of Detroit's metropolitan area where farmland has been abandoned. Forest cover in St. Clair County, Michigan, has increased since 1900 as deserted farmland has grown into young woodlots. It takes decades for a forest ecosystem to mature. In Ontario, where agriculture remains an important part of the economy, forest cover remains low. Forests cover only three percent of the landscape in Essex County and less than five percent in Kent County. There have been various public and private tree-planting programs in southwestern Ontario over the years and continue today. Citizens can help by increasing the size of their own woodlots and participating in community tree-planting events.

DEBRA A. BOUSSEY

Railroad tracks bisect parts of Black Oak Heritage Park in Windsor, Ontario.

The Problem with Fragmentation

The vast forests that once covered large areas of land in southeastern Michigan and southwestern Ontario have been broken into hundreds of thousands of woodlots, which are surrounded by agricultural fields, roads, transmission lines, railroads and homes.

A major problem with breaking up, or fragmenting, forests is that the remaining pieces aren't large enough to have expansive, dense interiors that provide habitat for certain birds and animals. Loss of this habitat is a key factor in the decline of populations of "interior forest species" of birds, such as scarlet tanager, ovenbird, Acadian flycatcher and many warblers.

Because fragmented forests aren't connected, small forest mammals can no longer travel far without venturing into the dangers of open land. This prevents the exchange of genetic information between breeding populations, which results in a weakening of the gene pool. It also leads to localized extinctions and the reduced ability of animals to re-colonize woodlots. This also applies to plant populations that depend on birds, animals and insects to spread their seed.

Swamp

A swamp is a forested wetland that typically has standing water during part of each year and contains moisture-tolerant tree species. Types of swamp in the Lake Huron to Lake Erie Corridor are conifer, hardwood and shrub swamp.

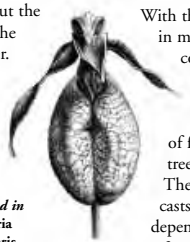
Conifer Swamp

The trees in conifer swamps are predominantly tamarack *(Larix laricina)* with black spruce (*Picea mariana*) and white cedar (*Thuja occidentalis*) present to a lesser extent. Hardwood trees, such as red maple, silver maple (*Acer saccharinum*), black ash (*Fraxinus nigra*), red ash (*Fraxinus pennsylvanica*), yellow birch (*Betula alleghaniensis*) and American elm (*Ulmus americana*), often grow among the conifer trees.

Poor conifer swamps occupy isolated depressions in the landscape. Like bogs, these swamps have acidic soil conditions and deep organic matter deposits of peat moss. Many of the poor conifer swamps that exist today likely were once bogs that, over time, were colonized by tamarack and black spruce.

Relict conifer swamps have peat soils, like the poor conifer swamps, but the soils have a neutral pH due to the infusion of alkaline groundwater. Relict conifer swamps typically occur in a variety of glacial features, such as channeled depressions in glacial outwash, sandy lakeplains, kettle-kame topography and coarse-textured end moraines.

AMELIA HANSEN, CORVUS ART



(Right) Many orchid species are found in bog habitats. Whorled pogonia* (Isotria verticillata), *Loesel's twayblade* (Liparis loeselii), *yellow fringed-orchid* (Platanthera ciliaris), *small green wood-orchid* (Platanthera clavellata), *rose pogonia* (Pogonia ophioglossoides), *dragon's mouth* (Arethusa bulbosa), *grass pink* (Calopogon tuberosus) *and pink lady's-slipper* (Cypripedium acaule) *can be found growing in the Corridor region's tamarack bogs. Pictured is the pink lady's-slipper* (Cypripedium acaule) *whose pink, veined pouch often traps insects when they enter to pollinate the flower.

The spire shape and open branch pattern of tamaracks allow a large amount of sunlight to reach the swamp's ground layer, resulting in the growth of a thick and diverse understory. As many as 28 species of shrubs can grow in the understory of a relict conifer swamp, including spicebush (*Lindera benzoin*), highbush blueberry, poison sumac, winterberry (*Ilex verticillata*) and nannyberry (*Viburnum lentago*), black chokeberry (*Aronia melanocarpa.*) The ground layer is typically composed of sphagnum mosses, sedges and orchids.

Rare animal species closely associated with conifer swamps include tamarack tree cricket, Mitchell's satyr butterfly, eastern massasauga rattlesnake, Blanding's turtle and spotted turtle.

With the suppression of fire in modern times, tamarack has come to dominate many fen communities, transforming them into relict conifer swamps. The lack of fire also has enabled red maple trees to invade conifer swamps. The leafy canopy of the red maple casts dense shade, causing shrubs dependent on the open nature of a conifer swamp to slowly die out from lack of sunlight. This change in the swamp's understory can adversely impact songbirds and other wildlife that depend on the prolific fruit production of shrubs, such as winterberry and black chokeberry, as a food source.

Although conifer swamps were never a significant forest type in the region, many accounts from early settlers indicate there were pockets of them throughout the landscape. During the last 200 years, the swamps were drained and logged, then used for agriculture. Settlers also mined them for peat. Changes in the hydrology of the surrounding watershed have converted them to wet meadow, shrub or hardwood swamp. Tamarack logs were commonly used for fence posts, house and barn beams, and wheel spokes on early automobiles. Today, fewer than one percent of the original conifer swamps still exist.

MAURA MCNICHOL

The winterberry shrub* (Ilex verticillata) *thrives in conifer swamps and a variety of other wetland habitats, such as deciduous swamps, wet woods and the edges of lakes and ponds. Many bird species relish the winterberry's bright red fruit.

Fire, insect outbreaks, flooding caused by beavers, and winds that uproot trees (called windthrow) are important natural disturbances that actually help conifer swamps prosper. Tamaracks' shallow, wide-spreading root systems make them particularly vulnerable to being uprooted by windstorms and fire. Tamaracks are not tolerant of shade, so disturbances that remove trees are beneficial because they result in more light penetration. The same benefits also arise from periodic infestations of larch sawfly* (Pristiphora erichsonii) *and larch casebearer* (Coleophora laricella). *However, long-term flooding caused by beaver dams or other drain blockages, such as road construction, can kill too many tamaracks and result in a conifer swamp's conversion to hardwood swamp, wet meadow or marsh.

The ground layer of a conifer swamp is rich with wetland vegetation.

AMELIA HANSEN, CORVUS ART

The tamarack is unique among conifers in that it is deciduous. Its needles turn yellow in autumn and fall off the tree.

Hardwood Swamp

Hardwood swamps are wetlands that are dominated by deciduous trees. Their soils usually are saturated and sometimes are under water.

In pre-settlement times, hardwood swamps covered vast areas of the flat, poorly-drained terrain. Tree species varied with local conditions. Early surveyors in Wayne County, Michigan, noted the presence of "black ash, sycamore, poplar, aspen, elm, willow and ironwood." Forests of pin oak, swamp white oak, bur oak, silver maple (*Acer saccharinum*), pumpkin ash (*Fraxinus profunda*), Eastern cottonwood (*Populus deltoides*), black willow (*Salix nigra*) and peachleaf willow (*Salix amygdaloides*) grew on the clay plain. Black ash (*Fraxinus nigra*), American elm (*Ulmus americana*) and basswood (*Tilia americana*) were prevalent in swamps with sandy soils.

The drainage and development of the landscape has made hardwood swamps increasingly rare in this region. Those remaining are located in low-lying areas and along the margins of lakes. Red maple, silver maple, black ash and American elm typically dominate the forest canopy. Other common species include sycamore (*Platanus occidentalis*), swamp white oak, pin oak, yellow birch (*Betula allegheniensis*), basswood and blue-beech (*Carpinus caroliniana.*)

Hardwood swamps often have a sparse understory due to dense shade and wet soils. The ground layer is generally composed of decaying wood and leaf litter, especially after heavy flooding. Mounds adjacent to flooded areas are suitable for moisture-tolerant plants, including ferns, spring wildflowers, such as jack-in-the-pulpit (*Arisaema triphyllum*) and smooth Solomon's seal (*Polygonatum canaliculatum*), and moisture-tolerant shrubs, such as spicebush. Flat terrain and sufficient year-round moisture sometimes produce stretches of sedge hummocks.

A hardwood swamp at Crosswinds Marsh in Wayne County, Michigan.

ONTARIO POWER GENERATION

Pumpkin ash* (Fraxinus profunda) *is very water tolerant, growing in swamps where water stands for many months. A signature feature of the species is its enlarged, swollen lower trunk, which compensates for its shallow root system. This tree is rare in the region, found only in remnant hardwood swamps of the lakeplain. The tree pictured above is found in the natural areas of Ontario Power Generation's Lambton Generating Station in Lambton County, Ontario. Pumpkin ash also has been identified in the wet woods of Belle Isle Park in Detroit, Michigan.

WALPOLE ISLAND HERITAGE CENTRE

Black ash was an important tree for native peoples, who wove its wood into baskets. Fresh, green wood was pounded with a mallet until it separated along annual growth rings into thin, pliable strips. These baskets are still made on Walpole Island today, preserving an important part of the region's cultural heritage.

SARAH SCHADE

The bright yellow flowers of the marsh marigold* (Caltha paulstris) *brighten the forest floor of hardwood swamps in springtime.

Salamanders

Salamanders are amphibians that, unlike their more conspicuous cousins, frogs and toads, are secretive and often subterranean. Living in cool moist places in forest soils, under rotting logs, and leaf litter, salamanders absorb water and "breathe"–taking in oxygen and releasing carbon dioxide –through their skin. Adult salamanders also breathe with their lungs, although some species, like the red-backed and four-toed salamanders, don't have lungs. For these reasons, salamanders are very sensitive to pollutants.

Most salamanders breed in vernal forest pools. The juvenile salamanders are similar to tadpoles in their aquatic stage, but always have external gills and are carnivorous, feeding on insect larvae, fairy shrimp, and other invertebrates. In mid- to late-summer, these juveniles transform to their terrestrial adult forms.

In healthy woodland habitats, adult salamanders can be numerous and can play an important role in the food chain of a forest. As predators, they feed on insects, spiders, and worms, but in turn are eaten by larger animals, such as songbirds and mammals. The loss of forest habitats, contamination by pesticides, fertilizers, and sewage, and the loss of vernal pool and wetland habitats threaten populations of these fascinating woodland creatures.

ALLEN CHARTIER

The spotted salamander* (Ambystoma maculatum) *lives in relatively undisturbed woodlands where vernal pools occur. It is at risk due to the degradation and fragmentation of forest habitats.

(Above right) Spotted salamanders reproduce by laying up to 250 eggs in gelatinous masses in vernal pools; these eventually hatch into gilled aquatic larvae. Within two to three months, the larvae mature into terrestrial adult salamanders. (Note: this egg mass was disturbed for scientific evaluation; normally, citizens should never touch egg masses as it may damage them.)

Vernal Pools

As their name suggests, vernal pools form during spring when water accumulates in depressions, or low areas, of forests, meadows and farm fields. These seasonal wetlands then dry out amid summer's heat. Wetland vegetation may become established but annuals usually dominate. Vernal pools are important to many amphibian species. Salamanders, toads, wood frogs, tree frogs and spring peepers depend on vernal pools for their aquatic larval stage. Tadpoles grow rapidly by feeding on bacteria, algae and organic debris in the pool before moving uponto the land for the terrestrial frog stage. With water present only temporarily, vernal pools don't support fish that normally prey on the eggs and tadpoles. Many predatory insects that feed on mosquitoes, such as dragonflies and damselflies, also breed in vernal pools.

Shrub Swamp

Shrub swamps are wetlands dominated by shrubs that grow on seasonally flooded, poorly drained soils with fluctuating water levels. These swamps generally form in glacial depressions or next to streams, rivers and ponds. Their soil is muck that normally ranges from saturated to inundated with a few inches of water. Ecologists often refer to this community as shrub-carr, meaning a wetland dominated by tall shrubs.

Shrub swamps are ever-changing systems. They may start as a shallow body of standing water or as a floodplain along lakes, ponds, rivers or streams. Water-loving shrubs are the first vegetation to grow there. Over time, decayed vegetation accumulates until water depths decrease, allowing denser brush growth. Further succession eventually results in shallower waters and built-up organic soils that support more woody cover. The rate at which this succession from wetland to upland occurs depends on water levels. Several years of wet weather can slow the transition; several dry years can hasten it.

These ecosystems are strongly influenced by their drainage basins, the chemical composition of waters flowing into the basins and the amount of surface water input.

Due to these variable conditions, shrub swamps may be wetter than lowland forests but generally do not contain large numbers of deep-water marsh plants, such as cattail and bulrush. These plants may appear around edges or openings, however.

Dominant shrub growth typically includes alder (*Alnus spp.*), buttonbush (*Cephalanthus occidentalis*), willow (*Salix spp.*) and dogwood (*Cornus spp.*) These provide food and habitat for mink, muskrats, raccoons, beavers, deer and cottontail rabbits. Mallards, wood ducks, nuthatches, black-capped chickadees and several kinds of warblers nest in shrub swamps, as do snakes, turtles, frogs, insects, butterflies and dragonflies. Beavers remove invading trees and help retain a shrubby appearance.

LARRY CORNELIS

JOHN SCHAFER

The distinctive ball-shaped flowers of the buttonbush (Cephalanthu occidentalis) are a favorite nectar source for many insects, including the tiger swallowtail butterfly.

The buttonbush flourishes within the Bickford Oak Woods Conservation Reserve in Lambton County, Ontario. The 741-ac (300-ha) natural area was recently protected by the Nature Conservancy of Canada with the help of the Ontario Ministry of Natural Resources and other partners. This large forest, which is surrounded by agricultural land use, is unusual in Lambton because the county has lost 90 percent of its forest cover.

Trees common to beech-maple and oak-hickory forest communities occupy the reserve's rolling clay-soil topography. In lower areas, pockets of buttonbush and winterberry shrubs grow within a silver maple swamp that also contains swamp white oak, bur oak, American elm and willows. The site harbors two unique tree species, swamp cottonwood (*Populus heterophylla*) and Shumard oak (*Quercus shumardii*), both of which thrive in the wet, clay lakeplain soils. The destruction of lakeplain hardwood swamps makes these two tree species rare today in the region.

Birds that require large continuous tracts of forest to survive, such as cerulean warbler, rose-breasted grosbeak, wood thrush and white-breasted nuthatch, find habitat in Bickford Oak Woods. The rare Butler's garter snake, which is susceptible to habitat fragmentation, has been identified here. Other wildlife spotted includes wild turkey, wood duck, white-tailed deer and beaver.

While construction and dredging projects can destroy shrub swamps, some logging and farming practices on adjacent uplands can convert forested wetlands into shrub swamps. Surface water runoff and streams that flow from agricultural or developed areas can convey pollutants and unnatural nutrient levels that also can change the swamp's character.

Floodplain Forest

Floodplain forests are forested areas along rivers and streams that flood during heavy rains or spring melt. Soils are usually heavy sand or mud, rich in nutrients and poorly drained. Although standing water may remain well into the growing season, floodplain forests usually become very dry in late-summer and may contain trees representative of upland forest communities.

Floodplain forests are very important to the health of adjacent rivers and streams. They improve water quality by filtering pollutants and reduce soil erosion by stabilizing banks. Floodplain forests also improve aquatic habitats by supplying woody debris and providing shade that keeps water temperatures cool. They benefit humans by absorbing potential floodwater from heavy spring rains and melting snow.

Vegetation in a floodplain forest generally consists of deciduous trees with supporting herbs and shrubs. Skunk cabbage (*Symplocarpus foetidus*), marsh marigold (*Caltha palustris*) and golden ragwort (*Senecio aureus*) are just a few of the wildflowers that grow in the wet, organic soils. In higher, drier areas, typical spring wildflowers, such as early meadow rue (*Thalictrum dioicum*) and wild geranium (*Geranium maculatum*) blanket the forest floor.

Seasonal flooding, mild temperatures and a nutrient-rich environment influence the types of trees that grow in a floodplain forest. The constant input of sediments creates slight changes in the topography of the floodplain and varying sediment types. This allows trees, such as red oak (*Quercus rubra*), white oak and American beech (*Fagus grandifolia*), to grow on the higher, drier sediment deposits in the floodplain. Trees that are tolerant of seasonally wet conditions,

ALLEN CHARTIER

(Inset Left) The cardinal flower* (Lobelia cardinalis) *has a brilliant red flower whose nectar is a favorite of hummingbirds. It is found growing along the shady edges of streams and ponds and in low, wet woods.

(Inset Right) The spotted touch-me-not* (Impatiens capensis) *is an annual wildflower whose orange flowers brighten the edges of rivers and streams and damp, open areas in and around marshes.

The wild ginger* (Asarum canadense), *with its heart-shaped leaves, grows in large colonies on the floor of floodplain forests. This rhizome has a peppery taste and a smell similar to that of the commercially marketed ginger plant* (Zingiber officinale), *which hails from tropical areas. Wild ginger has been used to make a flavorful candy by boiling the root stocks and simmering them in sugar syrup.

IAN BOST

Sycamores* (Platanus occidentalis) *display a distinct black, white and gray mottled bark and often grow along rivers. When settlers entered the region, they looked for these "white ghosts" of the forest to lead them to water.

Thriving in the humid, nutrient-rich floodplain environment, this mature riverbank grape* (Vitis riparia) *climbs the trunks of American beech trees in the floodplain forest of the Pine River Nature Center in St. Clair County, Michigan.

such as silver maple, eastern cottonwood, black willow and American elm, thrive in lower areas.

Warm and humid summer temperatures and cooler conditions in the spring create a distinct microclimate in the floodplain environment. The cooler spring temperatures prevent trees from leafing out before spring frosts, which results in a rich woody plant community and promotes the growth of tree species at the northern edge of their range. Many trees more common to the southern U.S., such as redbud (*Cercis canadensis*), honey locust (*Gleditsia tricanthos*), Kentucky coffee tree, sycamore, and northern hackberry (*Celtis occidentalis*), thrive in the floodplain's unique microclimate.

The delicate white flowers of spring cress* (Cardamine bulbosa) *bloom along the moist edge of a vernal pool at the Lower Huron Metropark, which contains one of the finest examples of floodplain forest in southeastern Michigan. Located along the Huron River, the forest's towering trees form an arboreal cathedral, and a colorful community of springtime wildflowers carpets its floor. This natural area has particular significance because of its old-growth trees, which are a rarity in this highly developed region.

JOHN SCHAFER

Ostrich ferns* (Matteuccia struthiopteris) *grow in low, wet open woodlands along streams and in swamps.

ESSEX REGION CONSERVATION AUTHORITY (ERCA)

The Canard Valley Conservation Area in Essex County, Ontario, has one of the largest populations of the Kentucky coffee tree* (Gymnocladus diocus) *in Canada.

ERCA

The corky ridges of Kentucky coffee tree bark are distinctive.

Birds that need Large Areas of Forest are in Decline

ROGER ERIKSSON

Red-shouldered Hawk

The red-shouldered hawk *(Buteo lineatus*) is one of the most beautiful hawks. It is secretive and prefers extensive, mature floodplains and deciduous swamp forests where it preys on amphibians, crayfish, snakes and even ducklings.

The red-shouldered hawk was once the most abundant breeding hawk in the eastern part of its North American range, including southern Michigan and southwestern Ontario. But by 1960, it was nearly eliminated. It now is considered a species at risk in Michigan and Ontario. The bird no longer winters in this area, preferring the southern states through central Mexico.

The population decline has resulted from habitat loss and the species' sensitivity to disturbance. As riparian habitats have been destroyed or fragmented, red-shouldered hawks have been replaced by the more adaptable red-tailed hawk.

ROGER ERIKSSON

Cerulean Warbler

The cerulean warbler (*Dendroica cerulea*), named for the bright blue color of the male, nests in North America and winters in South America. It once was abundant in southeastern Michigan and southwestern Ontario. Early Detroit ornithologist Bradshaw Swales noted ten pairs in one woodlot in Grosse Pointe in 1902. Now it is rarely found nesting in that area, and is listed as a species at risk in both Michigan and Ontario.

It is difficult for humans to see this warbler, which lives in the canopy of mature forests, often along watercourses. The dramatic declines in its numbers have made a glimpse even more challenging. Special efforts have been made in recent years to document habitat requirements and populations of cerulean warblers in the U.S.

Cerulean warblers nest in eastern North America, including the Corridor. One factor in its decline is loss of the large tracts of mature forest that it requires for breeding. Another contributor may be destruction of its winter habitat in South America through conversion of primary forest to farmland.

Scarlet Tanager

The scarlet tanager (*Piranga olivacea*) is a migratory songbird that winters in the canopy of tropical forests in northwestern South America and lives in eastern North America during warmer seasons. An inhabitant of deciduous forests and pine-oak woodlands, it feeds primarily on insects, supplemented by berries and buds. Loss of large tracts of forest has contributed to this bird's decline in the Corridor region.

JULIE A. CRAVES

Interestingly, the male scarlet tanager's feathers change color with the season. In autumn, the brilliant red plumage on his body turns olive green, a color similar to that of the female scarlet tanager.

Beech-Maple Forest

Beech-maple forests grow in damp, nutrient-rich soils in well-drained portions of lakeplain, till plains and moraine ridges. As the primary climax forest of the region, the beech-maple represents the highest order of forest community succession.

As the name implies, American beech and sugar maple dominate this forest type. Basswood, red oak, white oak, white ash (*Fraxinus americana*), shagbark hickory (*Carya ovata*), black walnut (*Juglans nigra*) and tuliptree (*Liriodendron tulipifera*) are common associates. Depending on drainage conditions, they can be as numerous as the beech and maple. In cooler areas, farther north into St. Clair and Lambton counties, Eastern hemlock (*Tsuga canadensis*) and yellow birch become more common.

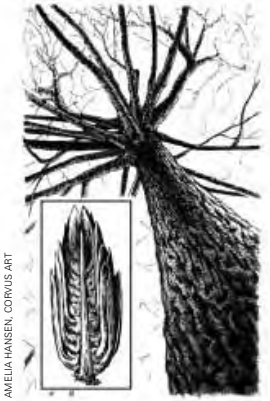
At the time of European settlement, beech-maple forests were, far, the dominant forest type, covering most of southern Michigan and southwestern Ontario, as well as in much of Ohio and Indiana. Today, fragments of this forest remain as isolated woodlots between farm fields and development, or as publicly protected land.

STACEY WELKENBACK

Beech-maple forests, like this one at Kensington Metropark in Michigan, have a dense to moderately dense canopy of deciduous trees, very few or no shrubs, and a well-developed herbaceous forest floor that tolerates the shade provided by the leafy canopy.

ELAINE DANIELSON

Bottlebrush grass* (Hystrix patula) *is a common grass of woodlands.



AMELIA HANSEN, CORVUS ART

(Right) A Carolinian species, the tuliptree* (Liriodendron tulipifera) *is sensitive to frost. It is the tallest-growing tree of eastern North American forests, reaching heights of about 150 ft (50 m) Its showy yellow flowers resemble those of the tulip. The tree's honey is known to be a delicacy.

Fungus

Fungi play an important recycling role in forest ecosystems. They decay organic matter, making nutrients from the dead plants available for future plant growth. They can be found in a variety of shapes and colors. Some, such as morel mushrooms, are good to eat, and others, such as the fly agaric, are deadly poisonous.

BOB WEIR

JULIE FOUNTAIN

(Left) This coral mushroom* (Hericium ramosum) *can be found on fallen logs of beech and maple.

BOB WEIR

(Above) Polyspores are genera of fungi that grow as brackets on dead and living trees.

Woodland Wildflowers

Beech-maple forests are home to an impressive array of wildflowers, including jack-in-the-pulpit, wild leek, wild ginger, wild geranium, toothwort, trout lily, spring beauty, mayapple, woodland phlox and large flowered trillium. These plants, known as "spring ephemerals," flower before trees have fully leafed out, which allows them to take advantage of the seasonal sunlight. They die back as shade from the trees increases.

TRISH BECKJORD

The large-flowered trillium (*Trillium grandiflorum)* is one of the best-known spring wildflowers. It takes six years from the time a seed germinates for the trillium to produce its first flower. As with many woodland wildflowers, ants play an important role in dispersing its seeds.

MAURA MCNICHOL

Flies pollinate the purple trillium (*Trillium erectum*), also known as "Stinking Benjamin." They are attracted to its ill scent.

The wild columbine (*Aquilegia canadensis*) grows in the shade of many woodland habitats. The bright orange and yellow flowers provide nectar to many butterflies in the spring.

TRISH BECKJORD

Shown nestled among the roots of the American beech, the yellow flowers of the trout lily (*Erythronium americanum*) carpet the forest floor in spring.

TRISH BECKJORD

Pollinated mostly by bumblebees, dutchman's breeches (*Dicentra cucullaria*) are wildflowers found in woods rich with organic matter. This plant was named for the flower's likeness to pants worn by traditional Dutch men.

JOHN TIEDJE

The beautiful white flowers of the mayapple (*Podophyllum peltatum*) are hidden underneath their large leaves. This plant often grows in circular colonies on the forest floor. The fruits of this plant are edible, but other parts of the plant are extremely poisonous.

LINDSEY MISHLER

The distinctive flower of the jack-in-the-pulpit (*Arisaema atrorubens*), a wildflower of damp woodlands, is known as a spadix. This forest herb is also easily recognized in the fall by its showy red berries.

MARIE BOYLE

The wild geranium (*Geranium maculatum*) thrives in the light shade of open woods.

DON HILL

The delicate white flowers of the bloodroot (*Sanguinaria canadensis*) are short-lived, sometimes lasting only a week. This early-blooming spring wildflower is known for the red juice that can be extracted from its stem and rhizome, which was used by native peoples to dye baskets.

Forest Animals

MICHIGAN NATURE ASSOCIATION

The distinctive white and pink flowers of the painted trillium (Trillium undulatum) *bloom at the Irene and Elmer P. Jasper Woods Memorial Nature Sanctuary in Kimball Township, St. Clair County. The painted trillium is rare, with Michigan's only known populations found in this locale.*

The Irene and Elmer P. Jasper Woods Memorial Nature Sanctuary, owned by the Michigan Nature Association, is graced with towering stands of eastern hemlock (Tsuga canadensis) *that grow inside a beech-maple forest on rolling topography. The eastern hemlock's dense foliage shades the forest floor, creating darkness even in the afternoon sun. Although the area is dominated by hemlock, associates include yellow birch, sassafras and eastern white pine. The presence of the eastern hemlock, which is common in more northern forests, marks the transition between southern and northern forest types in the Corridor.*

JIM SIMEK, NATURE'S IMAGES

PHILIP MYERS

(Above) The southern flying squirrel (Glaucomys volans) *doesn't really fly, but it has a loose membrane of furred skin between its front and back legs that allows it to glide through the air from tree to tree. These small squirrels have been known to glide as far as 240 ft (80 m) The southern flying squirrel lives in mature forests, often nesting in tree cavities left by woodpeckers. It likes to feed on acorns, hickory nuts and the seeds of beech, maple and poplar trees. It rarely is seen by humans because of its nocturnal nature.*

(Above) The red-headed woodpecker (Melanerpes eryhthrocephalus), *found throughout eastern North America, has been known by many colorful names, such as tri-colored woodpecker and flying checkerboard. It populates open, deciduous woods in the Corridor region in summer and migrates to the southern U.S for the winter.*

Red-headed woodpeckers excavate cavities in dead trees in which to raise their young. They have a broad diet of insects, nuts, fruit and even the eggs and the young of other birds. The characteristic tapping sound heard in woods is a sign that a woodpecker is working on a tree.

In this region, the red-headed woodpecker was once the second most abundant woodpecker, after the downy. Populations have been declining due to habitat loss, especially removal of dead trees. Some breeding pairs have built nests on poles, but studies show that the young don't hatch if poles are newly treated with creosote. The red-headed woodpecker has declined throughout its range, and is a species at risk in Canada.

(Left) The passenger pigeon (Ectopistes migratorius), *whose native habitat was the deciduous forests of eastern North America, once was Earth's most abundant bird species. Numbering three to five billion, passenger pigeons may have comprised 25 to 40 percent of the native North American bird population. Accounts by early pioneers stated that migrating flocks were so thick they obscured the sun.*

Sadly, this species is now extinct. Its demise resulted from mass conversion of forests to farmland and uncontrolled hunting and slaughter by European settlers. The last passenger pigeon specimen in Michigan was shot in Dearborn in 1898.

Invasive Forest Plants

Originally from Asia, common buckthorn (Rhamnus cathartica) *is an invasive species that threatens native plant diversity in forest habitats. Left unchecked, common buckthorn forms dense thickets that crowd and shade native shrubs and herbs. Its expansion has been furthered by fragmentation of forests and the spread of its seeds by birds that feed on its many berries.*

Garlic mustard (Alliaria petiolata) *is a biennial herb that came from Europe, where it was consumed as an edible green. It is an invasive species and has carpeted many disturbed urban woodlands, smothering native plants, including spring wildflowers. Removing garlic mustard is difficult, yet important for maintaining plant diversity in forests. Restoration ecologists study the life cycle of this and many other invasive plant species in order to determine how to control their spread.*

The tatarian honeysuckle (Lonicera tatarica) *is an invasive, deciduous shrub that is native to China, Korea and Japan. It was introduced to the United States in 1846 as an ornamental plant. Its prolific seed production and the fact that birds readily feed and disperse the seeds have enabled it to escape into the wild. Other Asian invasive bush honeysuckles include Amur and Morow. These shrubs' vigorous growth allows them to out-compete native vegetation for light and other resources. They can be particularly abundant on the disturbed edges of fragmented forests, where they dominate the understory.*

JIM SIMEK, NATURE'S IMAGES

The wild turkey (Meleagris gallopavo) *had disappeared from Michigan and Ontario by the early-1900s due to over-hunting by early settlers and intensive destruction of large forest tracts. Successful reintroduction efforts have brought this magnificent game bird back to the area.*

MARY BOHLING

The eastern screech owl (Otus asio) *is a small owl common to deciduous woodlands and even suburban settings, if there are sufficiently large trees and suitable snags for nesting.*

JAMES H. HARDING

The five-lined skink (Eumeces fasciatus) *is one of two lizards native to Michigan. Found in wooded habitats and open areas in woodlands, where it likes to bask in the sunlight on stumps, logs, and rocks, the five-lined skink feeds on insects like grasshoppers, spiders, and centipedes. This lizard has a unique predator escape system- when the skink is grabbed by its tail, the tail breaks off and later re-grows.*

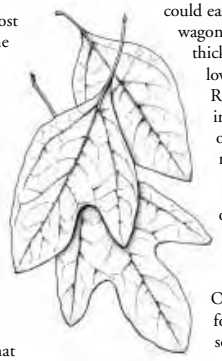
LARRY CORNELIS

Witch hazel* (Hamamelis virginiana) *blooms in the fall when most plants are dispersing seed. From September to December, its bright yellow blossoms brighten the oak-hickory woodlands. Witch hazel oil has been used for many years to treat a variety of skin problems.

Oak-Hickory Forest

Oak-hickory forests occur most commonly on rolling moraine ridges and well-drained sand plains, where the drier conditions favor oak and hickory trees over moisture-loving beech and sugar maples.

The rolling topography of Oakland County, Michigan, once was home to great expanses of oak-hickory forests. Early settlers there were struck by the preponderance of forests graced with large oak trees that seemed like parks through which they could easily drive their horses and wagons - much different than the thick floodplain forests of lowlands closer to the Detroit River and Lake St. Clair. So impressed were these people of the early 1800s that they named the area "Oak Land."



Red oak, white oak, black oak and pignut hickory (*Carya glabra*) are the dominant species in an oak-hickory forest. Other tree species in these forests vary according to the soil's moisture content. They can include red maple, sugar maple, white ash, black cherry, basswood in more mesic sites and scarlet oak (*Quercus coccinea*) and sassafras in drier areas. Overall, the dominant tree species in oak hickory forests have changed since pre-European settlement times. The suppression of fire has resulted in red maple and black cherry trees increasing in pre-dominance.

HOLLY JENSEN

Typical understory herb and shrub species include witch hazel, choke cherry (*Prunus virginiana*) and downy arrowwood (*Viburnum rafinesquianum.*) Blueberries also grow wild in the dry understory of these forests. Spring ephemeral wildflowers include hepatica (*Hepatica spp.*), bloodroot, rue anemone (*Anemonella thalictroides*) and Dutchman's breeches. Pennsylvania sedge often will grow in grassy tufts throughout the understory. In autumn, the forest floor is resplendent with asters and goldenrods.

(Above) the gray squirrel* (Sciurus carolinensis) *is a common mammal of forest ecosystems.

(Left) Sassafras* (Sassafras albidum) *is a small to medium-size tree that can be found in the understory of oak woodlands. It is one of few tree species that has more than one kind of leaf. In fact, the sassafras has three differently shaped leaves, with one, two or three lobes. The two-lobed leaves look like mittens. In autumn, their fall color is brilliant pink, red and orange. In the past, the essential oil derived from this plant was used to flavor medicines, candy and root beer. Illustration by Amelia Hansen, Corvus Art.

What Makes Fall Color

The Corridor's landscape can be spectacular in autumn as the green leaves of trees turn glorious shades of red, purple, orange and yellow.

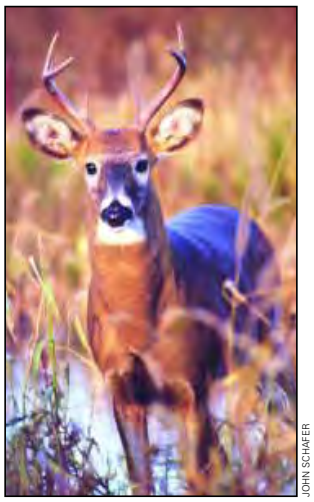
This color change is caused by a chemical process in the leaves. They are green during the tree's summer growth period because they contain chlorophyll, which they use to absorb energy from sunlight and to transform carbon dioxide and water into carbohydrates to feed the tree. Leaves stop making food in the fall as the tree heads into its winter rest period, so the chlorophyll breaks down and the green color disappears.

IAN BOST

That allows carotene and xanthophylls, which are orange and yellow pigments that have been in the leaf all summer, to become visible and give the tree its "fall color." Anthocyanin pigments found in trees such as dogwood, sumac and sugar maple produce a host of hues ranging from brilliant orange to crimson to purple. Brown leaves, common to oak trees, come from a mixture of pigments.

DAN RAVLYK

The red-tailed hawk* (Buteo jamaicensis) *is the most common raptor in the Corridor region. It often can be seen sitting in roadside trees or atop fence posts, waiting and watching to prey upon small rodents.



JOHN SCHAFER

White-tailed deer* (Odocoileus virginianus) *have become extremely populous throughout the Corridor and extremely harmful to natural areas, particularly in the absence of hunting. Other than humans, there are virtually no predators left to keep their numbers in check. As natural habitats become increasingly rare, deer are having a dramatically negative effect on the remaining natural areas.

Deer browse heavily on the wildflowers and grasses of the forest floor. Trilliums and other spring wildflowers can disappear altogether. In fact, the native plant diversity of many of our parks is threatened. At the Pinery Provincial Park, Point Pelee National Park and Rondeau Provincial Park in Ontario, and many Huron-Clinton Metroparks in Michigan, the diversity of forest ecosystems are in danger because of over-browsing by deer. Such alteration of the ecosystems provides opportunities for invasive species, such as garlic mustard, to move in and further disrupt plant communities. Managing deer populations through hunting has become important in the protection of native biodiversity.

At the Highland Recreation Area in Oakland County, the State Park Stewardship Program is restoring the quality of an oak barren ecosystem. Lack of fire, changes in surrounding land use, unchecked brushy growth, proliferating pine trees and non-native invasive species, such as spotted knapweed **(Centaurea maculosa)**, *all threaten the integrity of this vanishing ecosystem. Partnerships with recreational users to remove brush and a prescribed (controlled) burn program conducted by the Michigan Department of Natural Resources are helping to bring back the native prairie grasses. Removal of invasive shrubs and trees allows the large old oak trees to flourish.*

Oak Barren

Oak barrens occur on dry, gravelly or sandy moraines and glacial outwash. Oak barrens are characterized by widely scattered clumps of oak trees and shrubs, standing tall and stately in otherwise open fields of prairie grasses and wildflowers. There are few oak trees – no more than ten per acre – in oak barrens but they have a commanding presence, with their crowns and massive branches spreading 100 ft (33 m) or more in all directions.

Also historically known as "barrens," "oak openings," "barren and scrubby timber" and "scattered timber," these communities are a transitional zone between dry prairies and forests.

The dominant trees in oak barrens are white oak, black oak and dwarf chinquapin oak (*Quercus prinoides*), occasionally joined by northern pin oak (*Quercus ellipsoidalis*), pignut hickory and shagbark hickory. Plant species are needle grass (*Stipa spartea*), little bluestem, big bluestem, Indian grass, stiff goldenrod (*Solidago rigida*), butterfly weed (*Asclepias tuberosa*), aromatic sumac (*Rhus aromatica*), sand milkweed (*Asclepias amplexicaulis*), wild lupine and rough blazing star (*Liatris aspera.*) Many rare grassland birds find habitat in oak barrens, including the bobolink, loggerhead shrike, and the Henslow's, savanna, grasshopper and vesper species of sparrow.

Soils in oak barrens may vary from pure sand to loam. Historically, their dryness made this community prone to frequent wildfires and promoted the presence of prairie grasslands among the scattered oaks. Fire helped to recycle nutrients into the soil and remove accumulated plant litter. This allowed soils to warm more quickly, a factor favored by warm-season grasses. Without fire, oak barrens convert to brush and, eventually, forest. Native peoples intentionally set fires to control underbrush, which made these habitats good for hunting.

Rough blazing star* (Liatris aspera) *grows in the dry prairies often associated with oak barren ecosystems.

Remnants of an oak barren ecosystem grow at the Island Lake Recreation Area, near Brighton, Michigan. Ecological restoration efforts, which include prescribed burns and brush removal, are helping to bring back its native plant diversity.

Pictured is a pine plantation at Island Lake Recreation Area. In the past, pines often were planted in oak barrens and savanna ecosystems because they could thrive in poor, sandy soils. At the time it was not understood how these plantings would diminish the native biodiversity of oak barrens and savannas. The shade produced by these evergreens inhibits the growth of the ecosystems' rich grassland flora.

The stiff goldenrod* (Solidago rigida) *looks unlike most goldenrods with its wide, rigid leaves and stiff stature. The yellow blooms contribute to the late summer color found in oak barren and prairie communities.

Insects

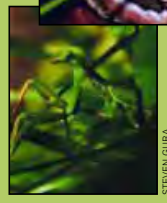
Insects are one of the most important members of ecosystems. They perform functions that are necessary for life on Earth, such as pollination and decomposition. The number of the earth's insect species is unknown, but about one million have been identified so far. They include beetles, wasps, bees, ants, butterflies, moths, flies, bugs, mantids, cockroaches, stick insects, grasshoppers, dragonflies and damselflies. New species are constantly being discovered.

STEVEN GURA

Wasps are closely related to bees. But while bees feed on plants, wasps are predatory and feed on other insects, such as house flies.

ALLEN CHARTIER

The praying mantis* (Stagmomantis carolina) *is carnivorous, feeding on other insects. It strikes its prey so fast that it is able to catch flies and mosquitoes.



STEVEN GURA

The cecropia moth* (Hyalophora cecropia) *is North America's largest silkmoth, with a wingspan reaching almost six inches (15 cm)

The red milkweed beetle's* (Tetraopes tetraophthalmus) *bright orange color warns birds that it eats milkweed and thus tastes very bitter. Its scientific name,* Tetraopes, *means it has four eyes.

The natural communities of the Lake Huron to Lake Erie Corridor are rich in biodiversity. Whether they are on land or in water, on open or forested land, each one supports plants and animals that play an important role in the web of life.

The next chapter explores the impact humans have had on the landscape and its biological communities.

Human Influence

Humans have lived in the Lake Huron to Lake Erie Corridor for more than 9,000 years. Aboriginals, fur traders, European settlers and modern Americans and Canadians have all called this region home. It is the human inhabitants of the last 150 years who have most dramatically changed the landscape and destroyed habitat. Today, large-scale development, pollution and exotic invasive species threaten the existence of natural communities and the amazing diversity of life they support. Protecting the region's rich natural resources and abundant waterways is essential if their benefits and beauty are to be enjoyed for generations to come.

A modern view of the City of Detroit. This land was once lined with coastal marshes where thousands of waterfowl stopped to rest and feed during migration.

10,000 B.C. Paleo-Indian Period: Hunters, known as "ice runners," follow receding glaciers in search of mastodon and other large game.

8,000 B.C. Archaic Indian Period: Indian cultures advanced through social and technological developments. The increasing diversification and sophistication is reflected in craft and ceremonial items. Native metal was mined to make tools, decorative items and weaponry, fish weirs were developed, and extensive trade routes around the Great lakes and beyond brought items from the east coast of North America.

1,000 B.C. Early Woodland Indian Period: Native people experiment with growing crops and storing grain (beans and squash), nuts, and dried meat; harvesting sap from sugar maple (for sweetener) and birch, walnut, and bitternut (for vinegar); and making pottery.

600 A.D. Late Woodland Indian Period: Native people use gill nets to fish, store fish for winter consumption, develop corn that would mature in a 140-day growing season, and replace the spear with bow and arrow to hunt deer, bison, elk, bear, and wild turkey.

1701 Cadillac arrives by canoe to establish the settlement at Detroit.

1700s European settlement brings infectious diseases, such as smallpox, that killed many Indian elders and caused the loss of oral traditions regarding human interaction with the environment. Farms and windmills line the Detroit Riverfront.

1800s Detroit Riverfront becomes dominated by commercial and excursion vessels.

1820s Settlement of southeastern Michigan begins in earnest. Within a generation, the land was cleared and towns, farms and mills were constructed throughout the Rouge River watershed.

1824 Welland Canal opens, allowing invasive species, such as the sea lamprey, to migrate westward from Lake Ontario.

1850s U.S. Congress passes Swamp Land Act, which increases the drainage of wetlands in Michigan.

1851 Gum Bed discovered in Inniskillen, Ontario, resulting in the birth of the oil industry in North America.

1854 The Ontario Drainage Act passes, allowing for the mass drainage of wetlands and the establishment of townships and drainage systems.

1890 Lumbering peaks in southeastern Michigan and southwestern Ontario as the lands were stripped of forests.

1900s Industrialization begins to dominate the Detroit Riverfront.

1919 Canadian and U.S. governments pass the Migratory Bird Species Act, the first international recognition of the need to protect wildlife.

1940s "Chemical Valley" begins operation in Sarnia, Ontario.

1952 St. Clair Metropolitan Beach Association (later known as Michigan Nature Association) incorporates, marking the birth of the Land Trust/Conservancy movement in Michigan.

1959 St. Lawrence Seaway opens, which facilitates the passage of larger ocean-going ships and migration of invasive species carried in ships' ballast into the Great Lakes.

1970 The U.S. Fish and Wildlife Service places the bald eagle on the endangered species list.

1972 The U.S. and Canadian governments sign the Great Lakes Water Quality Agreement.

1984 Ontario reintroduces the wild turkey.

1998 Detroit River is named as an American and Canadian Heritage River.

1999 U.S. Fish and Wildlife Service removes the bald eagle from the endangered species list.

2001 The U.S. government establishes the Detroit River International Wildlife Refuge.

WALPOLE ISLAND HERITAGE CENTRE

Walpole Island First Nation monitors the water quality of the St. Clair River and Lake St. Clair. Heavy industry in Sarnia and Port Huron directly discharged chemicals into the St. Clair River from the 1940s to the 1970s, threatening Walpole Island's water supply through toxic contamination. The people of Walpole Island have undertaken water quality monitoring efforts to address pollution concerns as they continue to champion the clean water and healthy ecosystems that are integral to their health and way of life.

The Original Inhabitants

Native peoples, or Aboriginals, first came to the Lake Huron to Lake Erie Corridor since time immemorial according to their own oral history, but scientific evidence suggests they arrived 10,000 to 12,000 years ago. Big game hunters called "ice runners" followed the ice edge of receding glaciers to hunt large beasts. During this period, known as Paleo-Settlement, the Native Peoples' lifestyles adapted as climatic changes caused spruce forests to give way to pine and later to the ecosystems that exist today. The Archaic, or early cultures, practiced a hunting and gathering way of life as they evolved from the Paleo-Indian culture.

The Early Woodland period began around 1000 B.C. when Aboriginal tribes changed lifestyles from nomadic hunting to growing crops and making pottery. This began with the cultivation of sunflowers and squash, followed by beans and corn. Corn is of particular importance. As a domesticated crop, it was transported north from the tropical and semi-tropical climates of Middle America.

Overall, the Aboriginals had little effect on the landscape. They coexisted with plants, animals and ecosystems that supported them. Their greatest effect on the landscape probably was setting fires to improve hunting grounds and maintain grassland habitat. The incredibly diverse prairie and oak savanna ecosystems of modern-day Walpole Island are the result of regular burning.

During the Late Woodland period, the Aboriginals made several important advances. Gill nets, fish weirs and impoundments were used to catch whitefish, lake trout and other fish during spawning runs. These fish could be smoked, dried or frozen for use during winter. The bow and arrow replaced the spear for hunting. Corn horticulture became practical in southern Michigan when varieties were developed that could mature quickly in a short growing season. Small clearings were made in forests to grow crops.

This agricultural adaptation was reflected in the increased density and number of villages and burial sites of the Late Woodland period. In southern Michigan, agricultural groups, such as the Miami and Potawatomi tribes, built large stockade villages near their farms. Peace and treaty agreements among the tribes decided who had control of areas. Clan chiefs inserted "Clan Poles" into shorelines to mark fishing territories.

Tribal elders established protocols for interacting with the environment. Unfortunately, Europeans brought small pox and other infectious diseases that killed many elderly, weak and very young members of tribes. As native elders died, so did much of the traditional ecological knowledge. Today, globalization has a similar negative effect on native cultures worldwide.

Native peoples incorporated rules for human interaction with the environment into their lifestyles. For instance, the Ojibwe people of Walpole Island followed a seasonal cycle of farming, hunting and fishing. During the spring spawning runs, they traveled to the St. Clair River Delta where plentiful fish were netted, trapped and speared. In late spring, they established base camps along the St. Clair River where they planted corn, gourds and squash. By early summer, additional food sources such as waterfowl, clams and water mammals became available. The people also cultivated tobacco and harvested sweet grass for ceremonial purposes. In late summer, they harvested crops and nuts, such as hickory and walnut, which were valued for their nutmeats and oil extraction. They spent late fall and winter in areas with abundant game for hunting.

COURTESY OF W. DUNCAN AND NIVIN MACMILLAN AND THE AFTON HISTORICAL SOCIETY PRESS

This watercolor by Seth Eastman (Indian Sugar Camp ca. 1850) depicts a typical Aboriginal sugar maple camp where sap was harvested in early spring. As a horticultural practice, Native Peoples maintained large groves of trees in order to harvest sap to make sugars, syrups and vinegars.

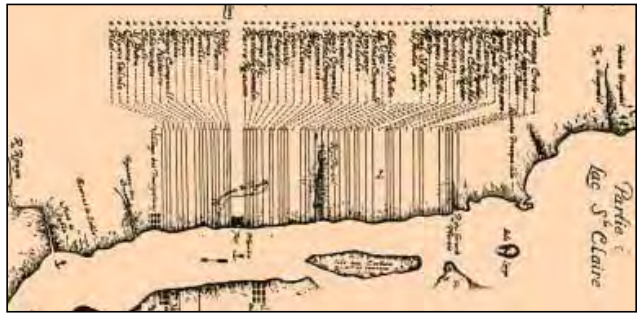
Many current members of Walpole Island First Nation still rely on the landscape for food, water and ceremonial traditions. Hunting and fishing licenses and rental of marshlands provides the community's main industry and source of income.

Many tribes have occupied the Corridor region during a long, rich and complex history of Aboriginal settlement. Generally, the location where a tribe lived was dictated by seasonal migration between hunting and farming grounds, as well as tribal warfare and climate. During the 18th and 19th centuries, Potawatomi and Wyandot lived near the Detroit River and Ojibwe lived in villages in the St. Clair River Delta.

After Michigan Territory came under American control, waves of white settlers entered the Detroit River and Lake St. Clair area of Michigan in large numbers during the early 1800s, claiming the land as a territory of the United States of America. They made native peoples live on "reservations." About 20 years later, the Native Peoples were forced to move from their water-abundant homeland to reservations in dry, hot Iowa, Kansas and Oklahoma. Today, there are no federally recognized reservations located in southeastern Michigan.

On the Canadian side of the waterway, Native People retained reserves and surrendered other lands to the British Crown in a series of treaties from 1790 to 1827. Most all of southwestern Ontario was surrendered with exception of islands in the St. Clair River Delta and the beds of lakes and rivers. The Walpole Island First Nation territory is un-ceded land. The Chippewas settled on reserves in Sarnia, Kettle Point and Stony Point. Three tribes from the Algonquin Nation – Ojibwe, Odawa and Pottawatomi – formed the Walpole Island First Nation.

European settlement activities of the 1800s and 1900s dramatically changed the landscape of the Lake Huron to Lake Erie Corridor. Lumbering, agriculture, industrial growth and urban development transformed the region from wilderness to a major center of industry. This growth has not come without cost to the natural environment and native biodiversity. In fact, more than 280 endangered, threatened and special concern plant and animal species are striving to survive in the Corridor. The primary reason for their decline is loss of habitat.



COURTESY OF THE DETROIT PUBLIC LIBRARY

Pictured is a portion of a map of Detroit from 1752. The first French settlers of Detroit and Monroe divided the land into "ribbon farms," which were long, narrow bands each bordering the river while extending several hundred yards inland. This method of land division ensured that each farmer had access to water for irrigation and easy travel. Map Title: Carte de la riviere du Detroit depuis le Lac Erie jus'ques au Lac Ste. Claire [map] / donne' par Mr. de Lery fils, 1752; adapted by C.E. Hickman.

The Fur Trade and Early Pioneers

French explorers were the first Europeans to enter the Great Lakes region. Their sailing ships only able to go as far as the Niagara Falls area, so they headed farther inland by rowing long wooden boats – "bateaux" in French – that they made from trees growing in the area's vast forests. They encountered Aboriginals who taught them to build massive open-water canoes. Eight to 12 men could paddle the canoes, which were capable of carrying non-rowing passengers and up to two tons of cargo.

As they made their way through the Great Lakes in the early to mid-1700s, these French adventurers saw rich marshes and fur-bearing mammals. They saw that the natives used animal skin for clothing. Realizing the pelts could be shipped to France to make fashion attire, they started what became known as the fur trade. They traded European textiles, jewelry, containers, alcohol and firearms with the natives for the furs, which many traders sold at trading posts.

This painting shows the Detroit waterfront in 1794, more than three decades after the British gained control of Michigan territory. Not until 1796 did they withdraw in favor of the Americans, who had been awarded the area in 1783 at the end of the Revolutionary War. Michigan was admitted as one of the United States in 1837. Print courtesy of the Burton Historical Collection, Detroit Public Library.

Some of the early Frenchmen enjoyed a unique relationship with the native people and were quick to adopt the Aboriginals' respect for life and land. They worked enough each day to subsist and set stores for winter, while they also reveled in their leisurely outdoor way of life. They were known as "Muskrat French" because they adapted so well to their new environment.

Antoine de la Mothe, Sieur de Cadillac founded Detroit. He was a Frenchman who believed that the wealth and position of France in the New World depended upon control of the fur trade. He considered Detroit's strategic location, connecting the upper and lower Great Lakes, important to achieving this goal.

The book, *Detroit: A Wilderness Outpost of Old France*, describes the site upon which Fort Ponchartrain du Detroit was built in 1701 (now Fourth Street) as "a curving and rather flat topped hill" that "was wooded with big oak and other hardwood trees and all were as straight as arrows. Like huge posts they rose from the forest floor, and high overhead was a thick green cover formed by the branches. In the daytime little sunlight came in through the tree tops, and what did cast a green gloom over the ground." Upon this site, Cadillac instructed his men to fell the trees and build a stockade, the area's first permanent structure. These first settlers depended upon trading, trapping and subsistence agriculture to survive.

This first wave of immigration to the region set the theme for European colonization – exploitation of resources. Once one resource was exhausted, another one was quickly harvested. Over the years the demand for commodities such as fur, lumber, fish, farmland, and more recently property for development, has led to a reduction in natural biodiversity.

*Lewis, Ferris E. 1951. *Detroit: A Wilderness Outpost to France.* Wayne State University Press. Detroit, MI.

Lumbering

The lumbering boom began in the early 1800s and lasted for nearly 80 years. The peak years, 1870 to 1880, coincided with the advent of the Steam Age, when steamships plied the waters and steam locomotives pulled trains. These powerful engines, which connected the Great Lakes with eastern North American cities, were fueled by wood. In the Sydenham and Thames watersheds of Ontario, accounts from that era describe piles of cordwood lining roads to fuel steamship transportation at ports, such as Sarnia, Ontario. Canadian records document nearly 1.67 million cords of wood taken from Kent, Lambton and Middlesex counties between 1870 and 1900. That volume represents more than 213 million cubic ft (6.4 million cubic m) of wood. Forests were logged until the lumber was exhausted. Often lumber companies would purchase land, log it, then sell it to settlers who would remove stumps and complete the conversion from forest to farm field.

PORT HURON MUSEUM, PORT HURON, MICHIGAN

The first steam sawmills of the Great Lakes were located along the St. Clair River and its tributaries. Pictured is the Black River Steam Mill of Port Huron in 1863. Built by Francis Browning of Detroit in 1833, it was the first steam sawmill in what was then known as the Northwest Territory. At its peak, the mill could produce 5 million board feet of lumber annually.

NORA PENHALE, THE OBSERVER, SARNIA, ONTARIO

Farm fields are in close proximity to the urban fringes of Sarnia, Ontario. Agriculture is expected to continue to be the major land use in southwestern Ontario over the next decade.

Agriculture

The pattern of settlement in the region followed major river systems. Navigable rivers were needed for transportation because vast wetlands and swamp forests made inland travel difficult. Tallgrass prairies, which were relatively dry and already void of trees, were the first ecosystems to be converted to farmland. However, the prairie grass' sinuous roots often ran deeper than the plants grew tall. Teams of four or more horses or oxen were needed to pull a plow through those roots. The tearing of roots created a sound that early farmers compared to thunder.

The wet, flat clay soils of the lakeplain in Michigan were not suitable for farming until the Swamp Lands Act of 1850 encouraged settlers to drain wetlands. The drained areas proved to be some of the most valuable agricultural lands in Michigan. By 1873, most of the land between the Detroit and Clinton rivers had been converted to agriculture. In Canada, passage of the Ontario Drainage Act in the 1880s resulted in the creation of farm and township drainage systems that made land usable for agriculture. The wettest areas–swamp forests, as well as wet prairies and marshes–required dikes and pumps, which encouraged more and more settlers. By the early 1900s, these mass drainage projects had converted about 90 percent of southwestern Ontario's original woodlands to agriculture.

Agriculture dominates land use and remains a major industry in southwestern Ontario. In fact, it is the second-largest sector of Lambton County's economy. In contrast, agriculture has declined in southeastern Michigan. Between 1990 and 2000, agricultural land use declined by 13 percent. Farms continue to disappear as lands are converted from agricultural to residential use in the Metropolitan Detroit area.

Like logging, agriculture has greatly altered the Corridor's landscape. With greater knowledge of how their industry impacts the land and surrounding waterways, more farmers have begun to utilize low-impact farming practices. These include crop rotation and rotational grazing, conservation tillage and contour plowing, buffer strips and reduced use of pesticides, herbicides and chemical fertilizers.

Our Industrial Heritage

The Lake Huron to Lake Erie Corridor holds a unique place in the history of North American industry. From the discovery of oil to the mass production of automobiles, industrial advances made in the region changed not only the landscape but also the way we live.

Canada's oil industry was born in central Lambton County. In 1858, James Miller Williams dug North America's first commercial oil well in the oil gum beds of Enniskillen Swamp. He soon built a refinery to produce illuminating oil (kerosene) for lamps. Williams has become known as the Father of North America's Oil Industry

The location was aptly named Oil Springs. Men rushed in to extract oil. The world's first oil gusher occurred there in 1862. With no effective controls in place, oil spewing from new wells flowed into local waterways. Refineries sprang up in the area and excess oil was transported on rough roads made from tree logs for shipment by rail and boat to processors elsewhere in Ontario and overseas. Although the booms in Oil Springs and nearby Petrolia ended long ago, some oil production continues in the area to this day.

The historic oil industry led to the development of Chemical Valley in Sarnia, where industries were able to locate along the St. Clair River to make use of its water for their processes and shipping.

Chemical Valley began with the 1942 opening of the Polymer synthetic rubber plant. It was built to provide the Allies with a replacement for natural rubber they could no longer get from Far East plantations. Several companies soon built chemical plants nearby. After World War II ended in 1945, the industry continued to thrive and more plants were built along a 19-mi (30-km) stretch of the St. Clair River to produce various chemicals, petrochemicals and plastics.

Another factor in Chemical Valley's development was the existence of a huge bed of salt, lying 1,500 to 2,000 ft (450 to 600 m) below the surface of Southwestern Ontario and southeastern Michigan. Salt mines and wells were developed throughout the Lake Huron to Lake Erie Corridor, most prominently in Sarnia, Windsor and Detroit. The chemical plants used the salt, to make certain products, and the emptied underground salt wells to store hydrocarbons.

Detroit is known as the Motor City, the automotive capital of the world. It was here that Henry Ford emerged as a leader among early inventors of the motorcar, the "horseless carriage." The Ford Motor Company, created by Ford and his business associates in 1903, introduced the assembly line in 1913. With the ability to economically produce hundreds of cars each week, Ford's factories employed thousands of men and women. Many other industries grew in concert with the automotive industry, making Detroit one of the most important manufacturing centers in the Midwest U.S.

All of these events were good for the economy but had harmful effects on the environment.

Throughout the 1970s, industrial and chemical pollution was prevalent throughout industrialized Canada and the United States, including the Great Lakes Basin. Public outcry in the 1960s that "Lake Erie is dead" was punctuated by a fire on the Cuyahoga River near Cleveland, Ohio, which burned with an eerie glow due to high concentrations of petrochemicals on the water's surface in 1969.

In 1972, Canada and the United States signed the first Great Lakes Water Quality Agreement to rid the Great Lakes of "persistent toxic substances." Other statutes have since been passed in both countries. The measures have helped reduce industrial pollution and allow water quality to improve.

RICHARD W. FORD AND SHELL CANADA

Refineries were built to process crude oil extracted in Lambton County, Ontario in the mid-to late-1800s. Pictured is a refinery in Petrolia.

GLENN OGILVE

ROBERT STEWART

(Top) A modern view of "Chemical Valley" in Sarnia, Ontario.
(Above) The riverfront of the lower Detroit River is dominated by industry in Michigan.

Our Most Valuable Resource: Water

Humans and wildlife rely on clean water for survival. Our water resources are threatened by contaminated sediments, shoreline development, habitat loss, storm water and agricultural runoff, and the direct discharge of animal and human wastes. There is a critical need to protect the environment from these influences if native biodiversity and our own health are to remain secure.

Maintaining aquatic biodiversity requires essential actions: protecting water quality, preserving coastal and riparian zones, restoring degraded habitats and controlling invasive exotic species. Each one of these actions is important to the health and diversity of our water resources.

Stressors to the Aquatic Ecosystem

The Lake Huron to Lake Erie Corridor is subject to many stressors from many sources: habitat loss and degradation from development, chemical contaminants from industry, agricultural runoff, bacteria from municipal sewage discharges, and invasive exotic species.

The Michigan shoreline is extensively developed with marinas, cottages, homes and industry; little of the natural character of the land is left. The Ontario shoreline has many hectares of agricultural usage as well as recreational and residential development. Materials dredged from waterways have been deposited on both sides of the Corridor. Development has resulted in widespread loss of coastal wetland and extensive shoreline modifications.

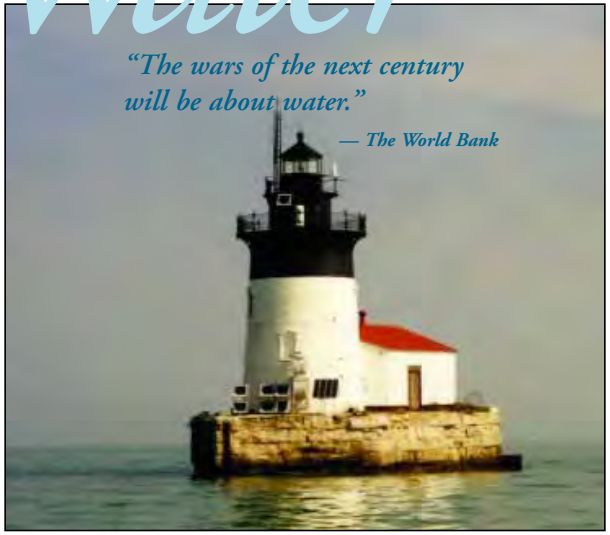
Roughly 90 percent of the Michigan shore and 20 percent of the Canadian shore have been modified with revetments and other shoreline hardening structures. Wetlands have been lost due to dredging, bulkheading or backfilling. Wetlands that do remain generally exist on the islands of the St. Clair and Detroit rivers and the St. Clair River Delta.

Agricultural runoff from lands in Michigan and Ontario has added nutrients such as nitrogen and phosphorous to the waterways and disturbed their chemical balance, which can lead to the excessive growth of algae. Intensive agricultural practices can cause soil erosion and sedimentation, as runoff from farms is deposited into water bodies.

Dredging to facilitate shipping has changed the waterways' morphology.

"The wars of the next century will be about water."

— The World Bank



KAREN JOHNSON

Built in 1885, this lighthouse is a familiar sight in the lower Detroit River.

DEBRA A. BOUSSEY

Dawn at Belle River Beach on Lake St. Clair in Essex County, Ontario. With more than 93 public and private marinas along both sides of the connecting channels, the Corridor supports more boats per square nautical mile than anywhere else in the world.

ROBERT STEWART

The role of the Lake Huron to Lake Erie Corridor in moving cargo is vital to economies in Canada, the United States and other countries in the world.

ROBERT STEWART

Southeastern Michigan boasts the highest concentration of registered boats in Michigan and has the largest number of recreational watercraft per capita in North America.

Detroit is the busiest port in the Great Lakes. In 1969, a channel for commercial shipping was dug to a depth of 28 ft (8.5 m) in the Detroit River. Since the channel construction, large ocean-bound freighters have become a common sight.

Wave action from the heavy shipping traffic places stress on coastal marsh communities. Winter ship travel, along with the ice clearing that aids navigation, have destroyed ice bridges once used by mammals to move between Michigan and Ontario.

Beaches in the Corridor are often deemed unfit for swimming due to bacterial contamination, much of it caused by the discharge of untreated sewage. Building and upgrading community sewer systems is essential to protecting water quality and enjoyment of the beaches.

Invasive Aquatic Species

At least 139 aquatic organisms have been introduced to the Great Lakes Basin since the 1800s. Many of these exotic, or non-native, species have arrived in ballast water brought by ocean-going ships from elsewhere in the world. Their rate of entry increased after the St. Lawrence Seaway opened in 1959, allowing more transoceanic traffic to travel the Great Lakes.

Without natural predators, some exotic species populations rapidly grow and pose a major threat to the stability of the aquatic food chain. In fact, invasive exotic species are the second-greatest threat (behind habitat loss) to the Corridor's ecosystems. Some of the most common aquatic nuisance species in the Corridor include the sea lamprey, zebra mussel, round goby, purple loosestrife and Eurasian water milfoil.

DAVID JUDE

Native to the Black and Caspian seas, the tubenose goby* (Proterorhinus marmoratus) *is a recent invader of the Great Lakes. It first appeared in the St. Clair River in the late 1990s after being released in the ballast water of an ocean-going freighter.

AREAS OF CONCERN AND CONTAMINATED SEDIMENTS IN THE LAKE HURON TO LAKE ERIE CORRIDOR

DATA SOURCE: U.S. ENVIRONMENTAL PROTECTION AGENCY

The dots on the map do not indicate the specific location of contamination

Contaminated Sediments

Many parts of the Detroit and St. Clair rivers and Lake St. Clair are contaminated with heavy metals, oil, dioxins, PCBs and other toxic chemicals. The heaviest pollution is in industrial areas, although pollution has been found 60km downstream from any known pollution source.

Since passage of the Clean Water Act in 1972, stricter pollution control standards have greatly decreased point source pollution in the Lake Huron to Lake Erie Corridor. However, historic pollution remains a problem in the form of contaminated sediments.

Contaminated sediments negatively impact the aquatic ecosystem in a variety of ways. The diversity and abundance of benthic organisms is very low in contaminated areas. Thus many sections of the Corridor have impaired benthos. Fish have absorbed toxic pollutants, prompting authorities to issue restrictions on the amount, size and type of fish that people should consume. Toxic chemicals also are blamed for birth defects, low reproductive success and some tumors and deformities in fish and wildlife.

Today, ensuring the proper disposal of toxic chemicals and the regulation of industrial discharges into waterways are important measures to curb pollution and foster healthy aquatic ecosystems.

Areas of Concern

The International Joint Commission (IJC) was created by the U.S. and Canada in 1909 to assist governments in monitoring and improving water conditions in the Great Lakes-St. Lawrence River system. The IJC has classified five parts of the Lake Huron to Erie Corridor as Areas of Concern due to degradation of the water and/or surrounding habitat. These degradations are called Beneficial Use Impairments. An impaired beneficial use means that enough of a change has occurred in the chemical, physical, or biological integrity of an area to cause any of the following:

- Restrictions on fish and wildlife consumption
- Tainting of fish and wildlife flavor
- Degradation of fish and wildlife populations
- Fish tumors or other deformities
- Bird or animal deformities or reproduction problems
- Degradation of benthos
- Restrictions on dredging activities
- Growth of too much algae or undesirable algae, which is known as eutrophication
- Restrictions on drinking water consumption, or taste and odor problems
- Beach closings
- Degradation of aesthetics
- Added costs to agriculture or industry
- Degradation of phytoplankton and zooplankton populations
- Loss of fish and wildlife habitat

Within each Area of Concern, volunteers representing all population sectors have developed Remedial Action Plans (RAPs) to restore the beneficial uses of water in the Great Lakes Basin.

The St. Clair and Detroit Rivers are binational projects, while only the U.S. addresses the Clinton, Rouge and Raisin rivers. The design and execution of RAPs involve collaborative efforts by the public, non-governmental organizations, educators, First Nations and government agencies. The goal of these plans is to delist the rivers once all impairments have been removed. By mid-2003, of the IJC's original list of 43 Areas of Concern in the Great Lakes-St. Lawrence River system, Collingwood Harbour and Severn Sound in Ontario have been delisted, while many others are working towards that goal.

BRUCE MANNY

Contaminated sediments have been known to cause tumors in fish.

NONPOINT AND POINT SOURCE POLLUTION

There are two types of pollution that affect water quality: point source and nonpoint source pollution.

Point source pollution refers to the direct discharge of contaminants to a water body. Sources include overflows from sewage treatment plants and discharges from industries.

Nonpoint source pollution is a result of urbanization and poor agricultural practices. Urbanization has created many impervious surfaces that water can't penetrate such as rooftops, sidewalks, roads and parking lots. Rainwater runoff from these surfaces, as well as farm fields, carries such contaminants as antifreeze and pesticides to the nearest available sewer or waterway.

The Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) is not only a symbol of the United States, but an outstanding example of the impact of environmental contaminants on wildlife.

These large birds of prey feed primarily on fish. They are permanent residents of Michigan and Ontario, wintering as far north as open water permits. During the winter of 2001-2002, the Michigan statewide annual survey found the county with the most bald eagles was Monroe, where 70 were counted.

Bald eagles once nested throughout the Corridor region. During the 20th Century, gradual population declines were attributed to habitat loss, hunting, trapping and nest robbing. In the middle of the century, disaster struck. The use of chemicals that persist in the environment, most notably the insecticide DDT, began demonstrating a profound impact on wildlife.

Chemicals in the environment, such as DDT, are passed up the food chain as organisms are consumed. The chemicals are stored in animals' tissue, so the concentrations increase with each step up the food chain, a process known as bio-magnification. Since eagles and other birds of prey are at the top of the food chain, the contaminant level in their systems is high. It causes a variety of health complications, especially reproductive problems that can include not laying eggs, laying eggs that don't hatch and the hatching of unhealthy chicks that don't survive.

Populations of eagles in both countries plummeted. By the 1970s, fewer than 100 pairs of bald eagles nested in Michigan. Although DDT was banned in 1972, bald eagles failed to raise a single chick in the Great Lakes region in 1980.

Since the mid-1980s, the number of bald eagles has started to rebound. However most bald eagles in the region still have reproductive problems. While the typical lifespan of bald eagles is about 30 years, those in Ontario live only eight to 10 years. Examination of dead birds has found elevated levels of mercury and lead, showing that environmental contaminants are still playing a role in the Great Lakes ecosystem.

U.S. FWS, NATIONAL IMAGE LIBRARY

The bald eagle is slowly coming back to the shores of the Lake Huron to Lake Erie Corridor.

In the Great Lakes region today, most eagles nest in upper Michigan, northwest Ontario, and along the northern Lake Erie shoreline. Only a few have tried to nest in the Lake Huron to Lake Erie Corridor in recent decades. A successful nest in 2001 at Lake Erie Metropark was the first in Wayne County, Michigan in 100 years. But until nesting attempts are consistently successful, there is still a need for concern and vigilance.

Impervious Surfaces

Looking down from the Blue Water Bridge or the Ambassador Bridge, the cities of Sarnia, Port Huron, Windsor and Detroit appear to be covered with trees. But amid those trees are large tracts of impervious surfaces such as rooftops, driveways, streets and parking lots.

These surfaces cause water to run directly into storm sewers and streams rather than be slowly absorbed into the ground. This absence of lingering water is detrimental to humans and animals. Contaminants carried by runoff into waterways harm aquatic life.

Studies performed at the University of Michigan have determined that water, land and the species that live in both environments are significantly harmed when only eight percent of the land is covered with impervious surfaces.

Likewise, subdivisions and shopping malls, especially those built in former rural areas, cause habitat loss, wetland degradation and fragmentation of natural landscapes. Shoreline development creates a barrier to migration for birds and aquatic creatures. Such changes force plant and animals species to live in isolated pockets, causing them to eventually lack genetic diversity.

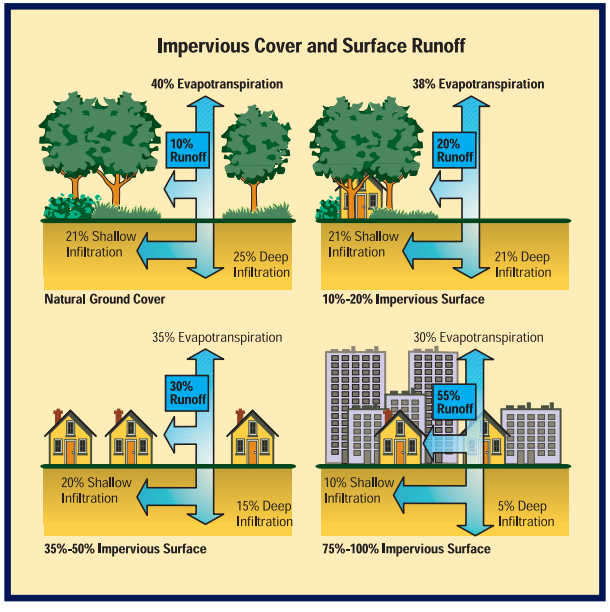
Unfortunately, little can be done to restore places where homes and businesses already have been built. But much can be done - when society and government work together-to keep further development within existing urban districts rather than allowing it to spread into open areas.

Water and Land; Land and Water

Water is constantly moving, whether flowing downhill, seeping deeper into the ground, evaporating into the air or returning to Earth as precipitation. Although water and land are distinct elements, they are inherently linked. Water defines a beach. Land embraces a lake or river. Water saturates soil. Soil and rock contain underground aquifers.

ROBERT STEWART

Road repair on Michigan's Interstate 75. Highways are becoming increasingly congested as more and more workers commute from the outer fringes of the Detroit Metropolitan area.



U.S. ENVIRONMENTAL PROTECTION AGENCY

Hydrology is the study of water's properties, distribution and circulation on and within Earth and the atmosphere. The judicious use of land is called land use planning. Like water and land, hydrology and land use planning go hand-in-hand. Indeed, they must. Both land and water are necessary to maintain vegetation. And vegetation is necessary to provide shelter and food for humans and animals.

There is a natural interplay of land and water, even during seasonal fluctuations that include winter snows, spring thaws, early summer rains, and late summer draughts. But mankind has a way of manipulating nature.

Farmers, landowners and municipalities sink wells that pump groundwater from the aquifer for irrigation, consumption and industrial usage. People construct ditches, dikes, and drains to carry surface water away quickly. All these actions adversely affect underground water resources. Impervious surfaces built on top of the ground add to the problem by preventing fresh rainwater from seeping into the soil to recharge the aquifer. Short-rooted monoculture lawns such as non-native Kentucky bluegrass, which require watering, fertilization and herbicides, contribute unhealthy nutrients and chemicals to rivers and lakes.

Fortunately, as the impact from humans becomes better known and understood, there is an increasing willingness by farmers, landowners, and municipalities to make the connection between land and water in their everyday lives. They have begun to make land use decisions and adopt land use policies that preserve woodlands and protect wetlands and waterways. These measures are necessary because, as an old Aboriginal phrase puts it: "Without water, we are not."

FORD MOTOR COMPANY

A killdeer* (Charadrius vociferous) *nest of eggs is spotted on the 10.4-ac living green roof at Ford Motor Company's Ford Rouge Center in Dearborn, Michigan. The roof is constructed of a bioengineered storm water management system that includes drought tolerant sedum and a recycled fabric growing medium. Many innovative solutions have been put into place at the Ford Rouge Center to manage the flow of water on the property in a way that is beneficial to the environment. The use of porous pavement, buffer strips and living green roofs all help to filter and clean stormwater run-off helping protect water quality and providing wildlife habitat.

Urban Sprawl

Development is quickly gobbling land in the Corridor. In fact, it is estimated urban sprawl will lead to more than 400,000 people moving to the headwaters of southeastern Michigan's major river systems in the next 20 years. Areas surrounding Windsor, Sarnia and London, Ontario are also subject to this type of pressure.

The definition of urban sprawl varies among professionals. Generally, it means the growth of low-density residential and commercial developments on the outer edges of cities and towns. Open spaces such as farms, forests and recreation areas – suddenly are filled by houses, roads, and strip malls.

There are a number of negative effects that run counter to the benefits of urban sprawl:

Loss of fish and wildlife habitat– The natural areas on the fringes of urban centers often still support ecosystems and biodiversity that are important to the region's natural heritage. In southeastern Michigan, for example, high-quality headwater areas are important sources of aquatic biodiversity to re-colonize the degraded lower reaches of rivers.

Poor water quality–The addition of impervious surfaces increases the amount of polluted runoff entering nearby rivers and streams.

Flooding–As wetlands that once absorbed and held rainwater are lost, and impervious surfaces are added in headwater areas, flooding could occur downstream.

Higher taxes–A common misconception is that new subdivisions bring greater community wealth. On the contrary, the increased cost of building new schools, roads and other infrastructure outweighs the increase in tax revenue. A study conducted by the U.S. Department of Agriculture, Economic Research Service (Agricultural Report No. 803, June 2001) noted that "residential development requires $1.24 in expenditures for public services for every dollar it generates in tax revenues, on average. By contrast, farmland or open space generates only 38 cents in costs for each dollar in taxes paid."

TRISH BECKLORD

Urban sprawl transforms natural areas into expansive subdivisions that are costly to local governments and harmful to the environment.

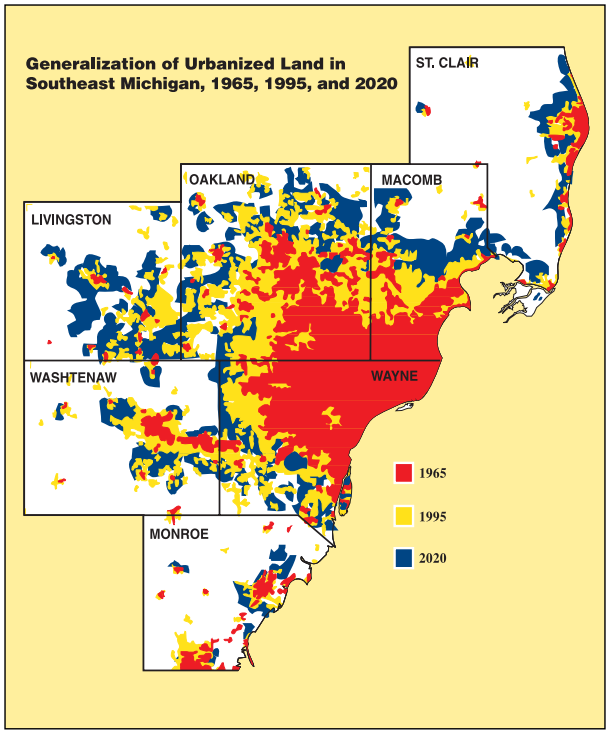
Rural character is lost – Ironically, the rustic quality of the countryside that first attracted homeowners quickly changes as urban sprawl's buildings, roads and parking lots take over the fields, farm structures and natural areas of the rural community.

Light pollution–Illumination of buildings and neighborhoods creates an outdoor glow that obscures the night sky, preventing enjoyment of the stars and other celestial objects, and actually negatively impacting the ability of migrating birds to navigate by the stars.

Less exercise, more pollution–Often the subdivisions are not within walking distance of workplaces, stores or public transportation. Consequently the residents depend heavily on vehicles to get around.

Lack of foresight and planning leads to the problems that arise with the onset of urban sprawl in an area. The carefully planned use of the land and good leadership to address the needs of humans while respecting natural resources can direct development in a way that benefits both humans and nature.

Many innovative solutions have been developed to alleviate the negative effects of urban sprawl. Land use planning and farmland preservation policies are two tools that communities can use to direct development in better ways.



MAP COURTESY OF THE SOUTHEAST MICHIGAN COUNCIL OF GOVERNMENTS, SEMCOG.

Growth and development pattern predictions for the next 30 years show the outer regions of Metropolitan Detroit changing from undeveloped and agricultural land to subdivisions, strip malls, gas stations and fast food restaurants.

Government Land Use Planning

Local governments have a responsibility to take the lead in land use planning. If they don't, land use decisions are at the mercy of private interests that usually place a higher value on profit than environmental protection.

To plan, local governments can:

- Conduct an inventory of important natural features to identify areas worthy of protection.
- Develop a master plan (also called an official plan) for land use that provides for environmental protection and encourages the use of native landscaping and cluster development.
- Make zoning decisions that preserve high-quality areas and are consistent with the master plan.
- Create incentives and encourage reuse of land in urban areas.

ROBERT STEWART

Farms like this one in Oakland County, Michigan are likely to be developed in the next decade unless protections are put in place.

Farmland Preservation Efforts

The threat of urban sprawl to farmland has been intense in recent years. Farmers can make a greater profit from selling their land to a developer than they can from farming. Many farmland preservation efforts are under way to help farmers keep their land in agricultural use. Efforts include programs to purchase the development rights to a property as well as conservation easements that allow for certain tax benefits and exemptions.

Shiawassee and Huron Headwaters Resource Preservation Project

The northern part of Oakland County, Michigan has experienced rapid growth in recent years as the population of Metropolitan Detroit has spread outward. Land has been consumed by subdivision developments, strip malls and gas stations. This trend has resulted in the loss of natural areas and open spaces, as well as additions of paved surfaces that threaten the water quality of sensitive headwater areas.

Springfield Township has managed development in a way that protects local natural resources and benefits the community. Located in the Interlobate region of northwest Oakland County, the township contains the headwaters of the Clinton, Huron, Flint and Shiawassee rivers. The hilly terrain has many lakes, streams and wetlands. Oak-hickory forests and tallgrass prairie grow on the uplands. Rare natural communities, such as prairie fens and wet meadows, are found in the lowlands. Some of these habitats are globally significant, harboring rare species of plants and animals found only in the Great Lakes region.

Springfield Township always has valued its natural resources, which residents feel add to the quality of life in the area. In order to protect these natural resources, the township partnered with the Michigan Natural Features Inventory to conduct the Shiawassee and Huron Headwaters Resource Preservation Project. The project included:

- Developing a method to identify and rank ecosystems in the township
- Conducting field inventories in sites that ranked as high-quality ecosystems
- Reviewing land use planning documents from surrounding municipalities
- Collecting information on natural resource protection tools and techniques through a national literature search

Springfield Township protects ecologically fragile areas by acquiring them. One such example is the Long Lake Natural Area, a 37-ac (14.8-ha) parcel that lies within an already protected 600-ac (240-ha) ecosystem complex. This natural area contains one of the highest quality prairie fens in the Midwestern U.S.

This work resulted in the identification of high-quality natural areas, threats to these ecosystems and methods to protect them. It was determined that encouraging the use of native plants in residential and commercial landscaping was an important way of protecting native ecosystems and preserving water quality. To help residents and developers incorporate native plants into their landscapes, an informational CD-ROM was created through the Springfield Township Native Vegetation Enhancement Project. It provides a database of 230 native plants for use in landscaping and helps build awareness of the region's natural heritage.

The township also incorporated policies into its master plan to promote the retention of natural areas and open space. As a result, each new proposed development is screened to determine if it contains a significant natural area. If it does, the natural area is permanently preserved within the development. Homes are clustered outside the natural area and conservation easements are granted to the local land conservancy. Landscape plans integrate native plants and avoid the use of exotic, invasive species that could invade the natural areas. Efforts are even being made between subdivisions to link protected open spaces, preventing habitat fragmentation.

Overall, these policies benefit the community. Natural areas are preserved and residents can enjoy their beauty. Developers gain from lower construction costs and higher sale prices for lots adjacent to nature preserves. The Shiawassee and Huron Headwaters Resource Preservation Project serves as a model for other municipalities to protect themselves from the hazards of urban sprawl and to preserve their high-quality ecosystems.

Keep It Natural

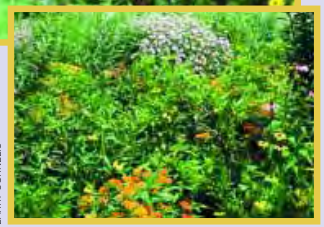
Many homeowners have discovered the joys of native landscaping. Using native plants in the landscape can be as simple as incorporating native wildflowers into a flowerbed or creating a rain garden. Large-scale projects include converting a lawn to a meadow or allowing a property to naturalize to a woodland setting. Each of these actions provides benefits to wildlife and homeowners.

The Benefits of Using Native Plants

- Native plants are attractive and reflect the beauty of the area before it was developed. Planting a native wildflower is like planting a piece of ecological history.
- Native plants are well-adapted to local conditions and don't need fertilizers, pesticides or lawn equipment for maintenance, which saves the homeowner time and money.
- Most native species are perennial, coming back year after year, which reduces the need to buy annual plants.
- Native plants promote biodiversity and provide food, rest, and shelter to local wildlife. Even a wildflower garden in an urban setting can attract native butterflies and songbirds.
- Native landscaping can reduce air pollution and save energy. Gasoline or electric mowers no longer need to be used once a lawn becomes a wildflower meadow.

LARRY CORNELIS

- Native plants improve water quality and reduce soil erosion. The deep and fibrous root systems of many native plants anchor soil and create millions of tiny channels for rainwater to follow back into the earth. In contrast, the depth of roots in a typical lawn grass is only six inches (15 cm), causing heavy rainfall to run off and carry fertilizers and pesticides with it.



LARRY CORNELIS

Native prairie plants fill a backyard in Chatham-Kent, Ontario all summer long with gorgeous blooms that require little maintenance.

Invasive Exotic Plant Species

Plants that grow outside of the location where they evolved are considered to be exotic. Invasive exotic species are a worldwide problem, impacting nearly every corner of the globe economically and environmentally.

Invasive exotic plants usually are highly adaptable and can survive in a range of conditions. Without the insects, fungi, diseases, herbivores and competition from other plants that control them in their native settings, the exotics can spread quickly to natural areas, agricultural lands and waterways. Purple loosestrife can overtake prairie fens and other rare wetland types. Even high-quality forests can be invaded by garlic mustard.

Exotic plants can diminish local wildlife populations by displacing native plants that normally provide them with food and cover. For example, the invasion of common reed grass in wetlands affects waterfowl.

The spread, and control, of exotic invasive plants can be costly. In the U.S., exotic weeds cause an overall reduction of 12 per cent in crop yields, costing $24 billion in crop losses and $3 billion in control expenses annually. This amount is growing each year as existing exotic invasive plant species spread and new ones are introduced.

Citizens can help by learning which plants are invasive in their area and not planting them in their gardens. Volunteering with a local land conservancy or other conservation organization to remove exotic invasive plant species also will help to maintain the biodiversity of local nature preserves and parks.

Stewardship: The Restoration and Management of Natural Areas

Given the great loss of habitat in the Lake Huron to Lake Erie Corridor, restoration of native ecosystems helps preserve the region's natural heritage. Many projects, such as prairie restoration, tree plantings and the creation of wetlands, have been implemented throughout southeastern Michigan and southwestern Ontario.

But it is impossible to fully replace what had been created through 10,000 years of evolution. Restoration projects often take years to provide tangible benefits to wildlife. This is why protection of existing natural areas is imperative if native biodiversity is to exist in the future.

The identification and management of existing natural areas are important to maintaining biodiversity. Ways of protecting and restoring natural areas can include controlled (prescribed) burns, removing invasive exotic species and sowing native plant species.

Crosswinds Marsh Project

Crosswinds Marsh is an example of a successful large-scale wetland mitigation project that created a wetland in Sumpter Township, Michigan. The project was designed to make up for destruction of a wetland when the Detroit Metropolitan Airport was expanded. Although this project was successful, studies show that most wetland mitigation projects undertaken by developers are predominantly unsuccessful. They are expensive, difficult to properly locate, and take many years to establish before they benefit wildlife. Some wetlands like swamp forests, fens and bogs are impossible to replace.

The whole restoration area at Crosswinds had once been wetland, but it was drained and farmed for a century. It took three years for marsh construction and another three for re-vegetation. In 1997 the 1,050-ac (420-ha) site opened as a public park, owned by Wayne County.

The project included transplanting endangered plant species from the airport site to Crosswinds. Deep and shallow water areas were created in the marsh. Deepwater areas are 12 to 20 ft (3.6 to 6 m) deep and support a diverse fish community. Only 120 ac (48 ha) of the site was seeded; the remaining vegetation established on its own.

So far, ecologists have identified more than 200 species of birds, both migratory and resident, at Crosswinds. A nesting pair of bald eagles has been seen, although no young have been raised yet. The site also is the home of coyote, mink, muskrat, raccoon and red fox. Current management efforts include removing invasive exotic species, such as purple loosestrife, giant reed grass and Eurasian watermilfoil, and monitoring the project's success.

Wildlife Habitat Council

The Wildlife Habitat Council (WHC) is an international nonprofit organization that provides resources and alternative methods for companies to protect and enhance wildlife habitat, reduce their environmental footprint, and promote environmental stewardship at corporate facilities. Corporations can become members of WHC and become involved in their Wildlife at Work[SM] program whereby a team of company employees create a wildlife team and create a wildlife management plan for their property. The team can then implement wildlife habitat improvement projects on their business property, often with the assistance from local environmental groups, community groups, and governmental agencies. Habitat projects on corporate properties are varied, but have included the transformation of lawns to meadows, the installation of nest boxes to provide for cavity-nesting birds, reforestation, and prairie restoration. Partnerships with the community help create important links between the company and conservation efforts in the region. Currently, there are twenty Certified

DTE ENERGY

Corporate Habitats in southeastern Michigan and southwestern Ontario. They include several DTE Energy sites in Michigan and Ontario Power Generation's Lambton Generating Station south of Sarnia.

Tallgrass Prairie Buffer

RURAL LAMBTON STEWARDSHIP NETWORK

The Rural Lambton Stewardship Network installed a tallgrass prairie buffer on a farm in Lambton County, Ontario. This organization works in partnership with local farmers on conservation projects that are beneficial to wildlife and water quality.

Natural Shorelines Benefit Wildlife and Water Quality

Steel breakwalls and other shoreline-hardening structures dominate shorelines of the Lake Huron to Lake Erie Corridor. Studies have shown that this has negative effects, including:

- Reduction of water quality because of siltation and nutrient enrichment
- Destruction of physical habitat such as woody debris and gradually sloping shorelines
- Loss of aquatic plants that protect shorelines from erosion and provide places for reptiles, amphibians, waterfowl and mammals to bask, feed, rest and breed
- Degradation of nearshore waters, either directly from habitat loss or indirectly from poor water quality. Many fish and aquatic insects depend on nearshore waters for habitat.

Waterfront property owners can help improve water quality and increase wildlife habitat by establishing a buffer of native vegetation at their shoreline. Shoreline buffers reduce erosion, filter pollutants from runoff and provide habitat for fish and wildlife.

In areas where erosion needs to be prevented, new types of shoreline structures are being developed through soil-bioengineering. They incorporate vegetation into the erosion protection structures, improve habitat and usually cost less than traditional engineering practices that use concrete and steel.

The Macomb Buffer Initiative

The Macomb Buffer Initiative Program transformed the edge of an eroded shoreline in Lake St. Clair to a buffer of native vegetation, blooming with wildflowers. One of the major focuses of the initiative is on lawns that are mowed to the water's edge. Landowners are encouraged to install buffers with native flowering shrubs, wildflowers, grasses, sedges, and emergent and submergent aquatic plants that enhance the natural beauty of the shoreline. Buffers of native vegetation reduce soil erosion and trap fertilizers, chemicals and other potential pollutants, including pet wastes and pesticides. They also deter overpopulation by Canada geese.

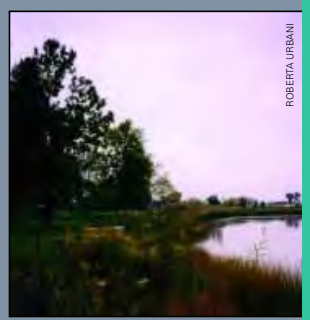
SETH HOPKINS

SETH HOPKINS

SETH HOPKINS

SETH HOPKINS

Blue Heron Lagoon



ROBERTA URBANI

The shoreline of Blue Heron Lagoon on Belle Isle in Detroit, Michigan was restored to a natural condition through a partnership with the U.S. Fish and Wildlife Service, U.S. Forest Service and DTE Energy, which supported the involvement of local students in planting native plant species.

Soil Bioengineering

Citizens help to alleviate erosion on the Pine River's shoreline through installing fascines and other soil-bioengineering practices at Goodells County Park in St. Clair County, Michigan. Soil-bioengineering combines mechanical, biological and ecological concepts to stabilize eroding slopes and provide habitat restoration. Supported by the Southeast Michigan Resource Conservation and Development Council, this project demonstrates practical low-cost techniques that can be used to prevent erosion in a habitat-friendly way.

DEBORAH BASSETT-MAXWELL

MARIE BOYLE

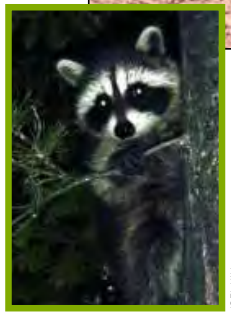
FERN WILSON

Urban Wildlife

Many wildlife species have adapted to the man-made environment. Raccoon, cottontail rabbit, squirrel, striped skunk, red fox, opossum, woodchuck and in some cases even coyote are common mammals in urban and suburban areas. In many cases, these wildlife species have been able to meet their needs for food, water, space and cover in city parks, backyards, abandoned lots and cemeteries.

Pigeons, gulls, grackles and house sparrows are common sights in most urban areas, where they feed on garbage. In suburbia, starlings and blue jays thrive in habitats provided by lots edged with trees and shrubs. Blue jays steal from the nests of songbirds and starlings nest in cavities that would otherwise be used by native bird species.

Many bird enthusiasts attract a variety of songbird species to their yards through bird-friendly gardens and feeders. Northern flickers, cardinals and song sparrows are among birds known to frequent a properly managed backyard. These habitat enhancements also help migrating birds that pass through the region on their way to their summer and winter homes.



JOEL HILL

MARIE BOYLE

Public parks could be important refuges for diverse wildlife populations in an urban setting. Communities could improve their parks' habitat value through such actions as removing invasive species, restoring native plant communities and reducing manicured lawns.

JOHN SCHAFER

The Peregrine Falcon

Peregrine falcons are birds of prey, known for their swift flight. Distributed worldwide, they once nested throughout North America. They occupied high cliffs in Ontario and northern Michigan before those areas were settled.

By the mid-1960s, peregrine falcon populations were declining throughout the U.S. and had disappeared completely east of the Mississippi River. The main threat to the peregrine falcon and other birds of prey was the common use of organo-chlorine pesticides, such as DDT. Studies show the peregrine falcon retains the highest DDT residue of all vertebrates, causing reproductive problems. The species has recovered slowly since DDT was banned in North America in 1972. Unfortunately, the birds are still exposed to toxic pesticides at their wintering grounds in Central America.

The peregrine falcon's resurgence has been aided by recovery efforts begun in the late 1980s, particularly restocking programs. They involve breeding peregrines in captivity and releasing them into the wild. Birds released from Sudbury, Ontario and Pittsburgh, Pennsylvania formed a pair that became the first to successfully nest in Michigan, at a downtown Detroit location in 1993. Peregrines recently have been seen nesting in five spots in the downtown Detroit area. They also nest in Canadian urban centers such as London, Ontario.

Peregrines bred in captivity apparently adapt better than their wild relatives to the urban environment. Instead of natural high places such as cliffs, the adapted birds make use of artificial structures such as skyscrapers and power plant stacks. They feed on pigeons, mourning doves, starlings, flickers and woodcocks. Populations of pigeons and starlings often grow so large that they become a nuisance in urban areas.

The Michigan Department of Natural Resources has provided funding through its Natural Heritage Program to monitor falcon populations in the Detroit area and gain a better understanding of this unique raptor.

JUDITH YERKEY

JUDITH YERKEY

JUDITH YERKEY

JUDITH YERKEY

Shaping the Lake Huron to Lake Erie Corridor's Future: You can help

It might seem like a lone individual's efforts could not affect the Lake Huron to Lake Erie Corridor's environment, compared with the powerful forces of nature and technology that created it over the past 10,000 years. However, there are things you can do to help restore and sustain this ecological treasure.

KAREN JOHNSON

DOROTHY L. FRANCIS

Swimming is a popular activity on beaches throughout the Lake Huron to Lake Erie Corridor. Every summer, thousands flock to the lakes and rivers around the region for relief from the summer heat.

- Share what you have learned from this book. Education is critical to understanding and maintaining the Corridor's natural heritage. Talk with your family and friends about what you have read. Pass this book along to someone you think would be interested in knowing more.
- Visit your local natural areas. Experiencing and appreciating nature are the first steps toward protecting it.
- If you have a garden, beautify it with native plants. Bringing back native plants to neighborhoods throughout the region could do much to improve wildlife habitat, sustain native biodiversity and enhance water quality.
- If there are creeks or rivers flowing through your community, take a moment to look at them. Do they appear to provide a healthy environment for plants and animals? As you have read, healthy aquatic ecosystems are dependent upon good water quality. Contact your local watershed council or conservation authority. They often have activities designed to monitor and improve the health of rivers, lakes and streams.
- Help protect significant natural areas in your community by getting involved with a local land conservancy or other conservation organization.
- Volunteer for ecological projects in your area. These can include planting trees, managing invasive plants, collecting seeds and removing litter and trash from natural areas and along waterways. Helping local nature organizations with this kind of work, even just once a year, can go a long way when combined with the efforts of many other volunteers.
- Help scientists identify the best ways of managing native ecosystems. You can do this by participating in various citizen activities, such as wildlife monitoring and annual bird counts, that help to gather important data for scientific research. At the same time, you will learn more about the creatures that live in the region.
- You can play a role in shaping future development in your community. Development comes under the authority of your municipal council or local planning body, depending on where you live. Generally their decisions are guided by master (or official) plans, policies and bylaws that are set through public processes. You and other citizens can have a say in development decision-making by attending public hearings and taking other opportunities to express your views on what you want your community to look like.

Whatever your age, wherever you live, you can make a difference in the future of the Lake Huron to Lake Erie Corridor.

> ***"Let us be good stewards of the Earth we inherited. All of us have to share the Earth's fragile ecosystems and precious resources, and each of us has a role to play in preserving them. If we are to go on living together on this Earth, we must all be responsible for it."***
>
> ***– Kofi Annan,***
> ***United Nations Secretary-General, 2001***

Students help install soil-bioengineering practices to improve coastal marsh habitat on Grosse Ile, Michigan.

JESSICA PITELKA OPPER

The Clinton River Watershed Council engages students in monitoring water quality and learning about the aquatic life that inhabits the river.

JOHN G. REGNIER

Children explore a wetland in Essex County, Ontario, looking for insects and having fun.

Afterward

When I first came to Michigan from my native New York, I was struck by the beauty and vastness of its natural resources. I realized, too, that with this gift comes a tremendous responsibility to protect and preserve our environment for future generations. I take this charge very seriously, as does DTE Energy and our utility subsidiaries, Detroit Edison and MichCon.

At DTE Energy we believe that economic activity and environmental protection can be mutually supportive. We are committed to promoting responsible use of traditional and alternative energy solutions to fuel society's growth in the present, without compromising the quality of the environment for future generations. We operate our facilities in full compliance with environmental regulations and go beyond those requirements where feasible. We are reducing our impact on the environment through the installation of innovative pollution control equipment. We are also working towards a sustainable energy future by investing in new technologies based on hydrogen, fuel cells, distributed generation and other renewable sources.

Our corporate commitment to the environment is well illustrated through the stewardship activities we sponsor. And the environmental commitment and dedication of our employees is demonstrated daily through their actions. We have an obligation to enhance the quality of life for today's society and for generations to come. Environmental stewardship is at the heart of this commitment.

DTE Energy has a vested interest in protecting and enhancing our natural heritage. MichCon's natural gas reserves stretch from Traverse City to Taylor. And Detroit Edison's electric generating plants are located from Michigan's "Thumb" to its southeastern border. In fact, the majority of our electric facilities are along the St. Clair and Detroit Rivers.

That's why we're so pleased to support the publication of *Explore our Natural World: A Biodiversity Atlas of the Lake Huron to Lake Erie Corridor*. We believe this publication will help all citizens of southeastern Michigan and southwestern Ontario, as well as the many visitors to our region, grow in their appreciation and understanding of the beauty and variety of nature that surrounds us. Explore our Natural World has much to teach us about this unique region which is home to so many species of plants and animals.

At DTE Energy, we believe that protecting the environment begins in our own backyard. We appreciate the work of the Wildlife Habitat Council as they advise us in managing our "backyards" to benefit wildlife. To date, seven DTE Energy facilities are certified by the Wildlife Habitat Council as wildlife sites, including three along the St. Clair and Detroit Rivers, and two on Lake Erie.

DTE Energy established the St. Clair River Waterways for Wildlife Project in 1995, with the guidance of the Wildlife Habitat Council. That partnership joined businesses, municipalities, state and provincial agencies and individuals from both sides of the St. Clair River in a common goal of enhancing wildlife habitat and protecting biodiversity along the river.

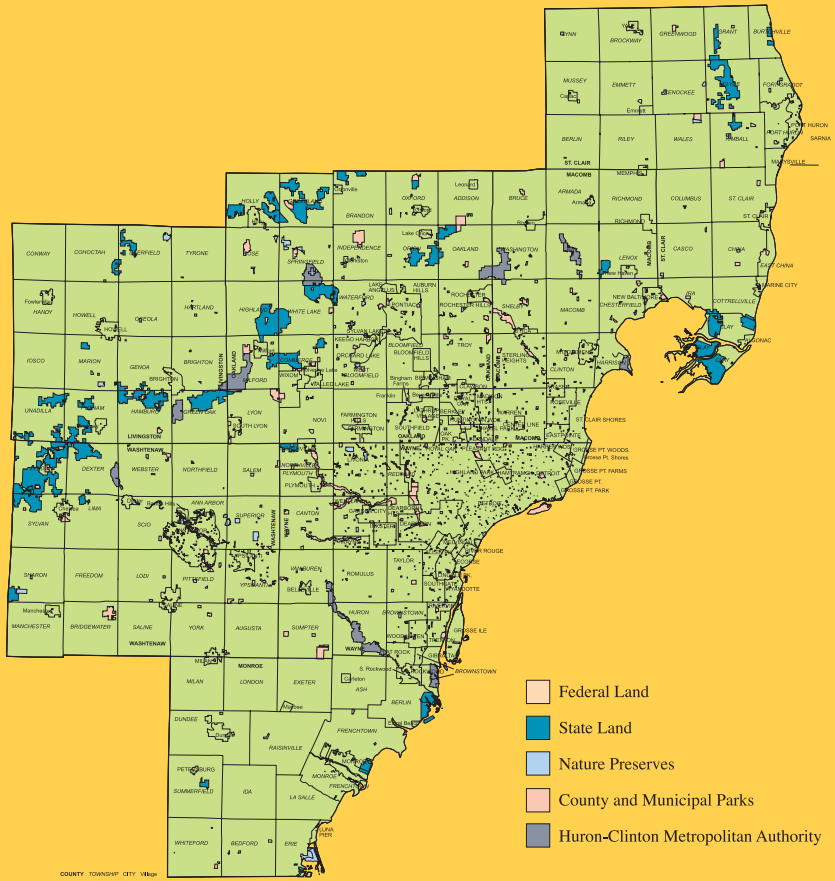
Since then, this project has continued to grow in many ways – in acreage protected, in membership and in geographic scope. And it has fostered other successful international environmental partnerships. The designation of the Detroit River as both a United States and Canadian Heritage River, and the creation of the International Wildlife Refuge in the lower Detroit River, are examples of the growing spirit of international environmental stewardship linking business, industry and our communities. This book is the latest reflection of that spirit, and will contribute to furthering its growth.

DTE Energy is grateful for the opportunity to participate in the creation of this book. My hope is that publication of *Explore our Natural World: A Biodiversity Atlas of the Lake Huron to Lake Erie Corridor* will inspire all of us to regard this region as our own "backyard," deserving of preservation and protection now and for generations to come.

Afterward by Anthony F. Earley, Jr.,
Chairman and Chief Executive Officer of DTE Energy

Appendix A: Protected Lands

Proctected Lands in Southeast Michigan, 2003



SEMCOG
Southeast Michigan Council of Governments
535 Griswold, Suite 300, Detroit, MI 48226-3602
313-961-4266 • *Fax 313-961-4869*
www.semcog.org

Appendix A: Protected Lands

Appendix B: Species at Risk

Species at risk are plants and animals whose populations have been declining in response to a variety of factors. Government agencies periodically review species known to be rare and assign them a status that reflects the security of their future. The determination of a species' status is based upon the best available scientific information.

The following are universal terms assigned to species at risk:

Extinct–a native species that no longer exists anywhere.

Endangered–a native species at risk of extinction imminently throughout all, or a significant portion of its range.

Threatened–a native species at risk of becoming endangered throughout all, or a significant portion of its range if declining factors are not reversed.

Special Concern–A species whose population is in decline, and whose characteristics make it particularly sensitive to human or natural disturbances.

Extirpated–A native species no longer existing in the wild within its natural habitat in a given region, but existing elsewhere in the wild.

A species is protected by law if it is designated as endangered or threatened. It is not legally protected if designated as special concern. Species listed as special concern signal potential losses of biodiversity in the future. This designation gives an opportunity to implement conservation planning and land protection efforts before a species' situation becomes critical.

Factors that Contribute to the Decline of Native Species

- Habitat loss and degradation
- Environmental contamination
- Genetic and reproductive isolation
- Human interference with natural events, such as fire
- Climate change or severe weather
- Disease
- Invasive species

Several government agencies at the state/provincial and federal levels, as well as non-government organizations, play a role in identifying plants and animals for protection as well as developing conservation plans.

Conservation efforts to protect endangered and threatened species from extinction are critical to preserving biodiversity.

For the most current information about endangered, threatened and special concern species, contact the following organizations.

CANADA

COSEWIC Secretariat
Canadian Wildlife Service
Environment Canada
Ottawa, ON K1A 0H3
Http://www.speciesatrisk.gc.ca
Http://www.cosewic.gc.ca

Species at Risk Project
Ontario Parks
300 Water Street
Peterborough, ON K9J 8M5
Http://www.mnr.gov.ca

Natural Heritage Information Centre
Science and Information Branch
Ontario Ministry of Natural Resources
P.O. Box 7000
Peterborough, Ontario
K9J 8M5 Canada
www.mnr.gov.on.ca/MNR/nhic/nhic.cfm

UNITED STATES

U.S. Fish and Wildlife Service
Bisphop Henry Federal Building
One Federal Drive
Ft. Snelling, MN 55111-4056
http://midwest.fws.gov/endangered

Michigan Department of Natural Resources
Wildlife Division
P.O. Box 30444
Lansing MI 48909-7944
http://www.michigan.gov/dnr

Michigan Natural Features Inventory
PO Box 30444
Lansing, MI 48909-7944
www.msue.msu.edu/mnfi/

NORTH AMERICA

NatureServe is a non-profit conservation organization that provides the scientific information and tools needed to help guide effective conservation action. NatureServe and its network of natural heritage programs are the leading source for information about rare and endangered species and threatened ecosystems.
Http://natureserve.org/

Appendix B: Species at Risk

Federal and State/Provincial Designations

E Endangered
T Threatened
SC Special Concern

Subnational Ranks (SRanks)
The SRank indicates the relative abundance of a species on a state or provincial scale. It is used by natural heritage programs to set protection priorities for rare species and natural communities. These ranks are not legal designations.

S1 Critically Imperiled (0 to 5 occurrences)

S2 Imperiled (6 to 20 occurrences)

S3 Rare, or vulnerable to extirpation (21 to 100 occurrences)

S4 Apparently secure (usually with 101 to 1000 occurrences)

S5 Very common (usually with greater than 1000 occurrences)

SX Extirpated from the state or province

SH Historically known from a given area, but not reported recently; there is a reasonable expectation that the species may be rediscovered.

SU Unranked, unrankable because of a lack of or conflict in information.

B Breeding, refers to the breeding population of the species.

? Following a rank indicates some degree of uncertainty

Rank Ranges–When ranks are combined, it indicates a range, but there is insufficient information to determine which exact rank applies; for instance, G1G2.

Global Rank (GRank)
The GRank indicates the relative abundance of a species on a worldwide scale. Global ranks are determined by a consensus among natural heritage programs, scientific experts and The Nature Conservancy. These ranks are not legal designations.

G1 Critically Imperiled (0 to 5 known occurrences)

G2 Imperiled (6 to 20 known occurrences)

G3 Rare, or vulnerable to extinction (20 to 100 known occurrences)

G4 Apparently secure (more than 100 known occurrences)

G5 Very common, the species is demonstrably secure under present conditions

GU Status uncertain, more data needed

G? Unranked, or if following a ranking, the rank is tentatively assigned

T Denotes the rank applies to a subspecies or variety

Endangered, Threatened and Special Cocern Species known to occur in the Lake Huron to Lake Erie Corridor, Winter 2002

COMMON NAME	SCIENTIFIC NAME	MI	ON	US	CA	SRANK MI	SRANK ON	GRANK
Mollusks								
Purple wartyback	*Cyclonaias tuberculata*	SC				S2S3	S3	G5
White catspaw	*Epioblasma obliquata*							
	perobliqua	EN	EN	EN		SH		G1T1
Northern riffleshell	*Epioblasma torulosa*							
	rangiana	EN	EN	EN	EN	S1	S1	G2T2
Snuffbox	*Epioblasma triquetra*	EN	EN		EN	S1	S1	G3
Wavy-rayed lamp mussel	*Lampsilis fasciola*	T	EN		EN	S2	S1	G4
Hickorynut	*Obovaria olivaria*	SC				S2	S1	G4
Round hickorynut	*Obovaria subrotunda*	EN	EN			S1	S1	G4
Round pigtoe	*Pleurobema sintoxia*	SC				S2S3	S2S3	G4
Mudpuppy mussel	*Simpsonaias ambigua*	EN	EN		EN	S1	S1	G3
Purple lilliput	*Toxolasma lividus*	EN				S1		G2
Rayed bean	*Villosa fabalis*	EN	EN		EN	S1	S1	G1G2
Rainbow	*Villosa iris*	SC				S2S3	S2S3	G5
Fish								
Lake sturgeon	*Acipenser fulvescens*	T				S2	S3	G3G4
Eastern sand darter	*Ammocrypta pellucida*	T	T		T	S1S2	S2	G3
Redside dace	*Clinostomus elongatus*	EN	SC		SC	S1S2	S3	G4
Lake herring	*Coregonus artedi*	T				S3	S5	G5
Creek chubsucker	*Erimyzon oblongus*	EN				S1S2		G5
Lake chubsucker	*Erimyzon sucetta*		T		T	S4	S2	G5
Greenside darter	*Etheostoma blennioides*		SC		SC	S4	S4	G5
Mooneye	*Hiodon tergisus*	T				S2	S4	G5
Silver chub	*Hybopsis storeiana*	SC	SC		SC	S2S3	S2	G5
Northern brook lamprey	*Ichthyomyzon fossor*		SC		SC	S4	S3	G4
Bigmouth buffalo	*Ictiobus cyprinellus*		SC		SC	S3	SU	G5
Spotted gar	*Lepisosteus oculatus*	SC	T		T	S2S3	S2	G5
Spotted sucker	*Minytrema melanops*		SC		SC	S3	S2	G5
River redhorse	*Moxostoma carinatum*	T	SC		SC	S1	S2	G4
Black redhorse	*Moxostoma duquesnei*		T		T	S3	S2	G5
Pugnose shiner	*Notropis anogenus*	SC	SC		SC	S3	S2	G3
Bridle shiner	*Notropis bifrenatus*		SC		SC		S2	G5
Pugnose minnow	*Notropis emiliae*	EN	SC		SC	S1	S2	G5
Silver shiner	*Notropis photogenis*	EN	SC		SC	S1	S2S3	G5
Brindled madtom	*Noturus miurus*	SC				S2S3	S2	G5
Northern madtom	*Noturus stigmosus*	EN	SC		SC	S1	S1S2	G3
Channel darter	*Percina copelandi*	EN	T		T	S1S2	S2	G4
River darter	*Percina shumardi*	EN				S1	S3	G5
Southern redbelly dace	*Phoxinus erthyrogaster*	EN				S1		G5
Sauger	*Stizostedion canadense*	T				S1	S4	G5
Insects								
Dusted skipper	*Atrytonopsis hianna*	T				S2S3	S1	G4G5
Pipevine swallowtail	*Battus philenor*	SC				S1S2	S2B	G5
Swamp metalmark	*Calephelis mutica*	SC				S1S2		G3G4
Frosted Elfin	*Callophrys irus*	T				S2S3	SX	G3
Monarch butterfly	*Danaus plexippus*		SC		SC	S5	S5	G4
Wild indigo duskywing	*Erynnis baptisiae*	SC				S2S3	S1	G5
Persius duskywing	*Erynnis persius persius*	T	EXT			S3	SX	G5T2T3
Duke's skipper	*Euphyes dukesi*	T				S1	S2	G3
Leafhopper	*Flexamia delongi*	SC				S1S2		G?
Huron river leafhopper	*Flexamia huroni*	SC				S1		G?
Leafhopper	*Flexamia reflexa*	SC				S1		G?
Russet-tipped clubtail	*Gomphus plagiatus*	SC				S1S2	SH	G5
Barrens buckmoth	*Hemileuca maia*	SC				S2S3		G5
Karner blue butterfly	*Lycaeides melissa samuelis*	T		EN		S2	SX	G5T2
Mitchell's satyr butterfly	*Neonympha mitchelli*	EN				S1		G1G2
American burying beetle	*Nicrophorus americanus*	EN		EN		SH	SH	G2G3
Powesheik skipperling	*Oarisma powesheik*	T				S1S2		G2
Tamarack tree cricket	*Oecanthus laricis*	SC				S1S2		G1G2
Pine tree cricket	*Oecanthus pini*	SC				S1S2	S1	G?
Blazing star borer moth	*Papaipema beeriana*	SC				S1S2		G3
Maritime sunflower borer	*Papaipema maritima*	SC				S1S2		G4
Culver's root borer moth	*Papaipema sciata*	SC				S2S3		G3G4
Silphium borer moth	*Papaipema silphii*	T				S1S2		G3G4

COMMON NAME	SCIENTIFIC NAME	MI	ON	US	CA	SRANK MI	SRANK ON	GRANK
Regal fern borer	Papaipema speciosissima	SC				S2S3		G4
Red-legged spittlebug	Prosapia ignipectus	SC				S2S3	S1?	G4
Regal fritillary	Speyeria idalia	EN	EXT			SH		G3
Amphibians								
Smallmouth salamander	*Ambystoma texanum*	EN	SC		SC	S1	S1	G5
Blanchard's cricket frog	*Acris crepitans*							
	blanchardii	SC	EN			S2S3	SH	G5T5
Fowler's toad	*Bufo fowleri*		T		T	S5	S2	G5
Five-lined skink	*Eumeces fasciatus*		SC		SC	S4	S3	G5
Reptiles								
Eastern spiny-softshell	*Apalone spinifera*							
	spinifera		T		T		S3	G5T5
Spotted turtle	*Clemmys guttata*	T	SC		SC	S2	S3	G5
Kirtland's snake	*Clonophis kirtlandii*	EN				S1		G2
Blue racer	*Coluber constrictor*		EN		EN	S5	S1	G5
Black rat snake	*Elaphe obsoleta obsoleta*	SC	T		T	S3	S3	G5T5
Eastern fox snake	*Elaphe vulpina gloydi*	T	T		T	S2		G5T3
Blanding's turtle	*Emydoidea blandingii*	SC			T	S3	S3?	G4
Northern map turtle	*Graptemys geographica*	SC	S5	S4				G5
Milk snake	*Lampropeltis triangulum*		SC			S5	S4	G5
Copperbelly water snake	*Nerodia erthyrogaster*							
	neglecta	EN		T		S1		G5T2T3
Lake Erie water snake	*Nerodia sipedon insularum*		EN		EN		S2	G5T2
Queen snake	*Regina septemvittata*		T		T	S4	S2	G5
Eastern massasauga	*Sistrurus catenatus*							
	catenatus	SC	T		T	S3S4	S3	G3G4T3T4
Eastern box turtle	*Terrapenne carolina*							
	carolina	SC				S2S3	SE1	G5T5
Butler's garter Snake	*Thamnophis butleri*		T		T	S4	S2	G4
Birds								
Cooper's hawk	*Accipiter cooperii*	SC				S3S4	S4B	G5
Northern goshawk	*Accipiter gentilis*	SC			T	S3	S4	G5
Henslow's sparrow	*Ammodramus henslowii*	T	EN		EN	S2S3	S1B	G4
Short-eared owl	*Asio flammeus*	EN	SC		SC	S1	S3S4B	G5
Long-eared owl	*Asio otus*	T				S2	S4	G5
American bittern	*Botaurus lentiginosus*	SC				S3S4	S4B	G4
Red-shouldered hawk	*Buteo lineatus*	T	SC		SC	S3S4	S4B	G5
Black tern	*Chlidonias niger*	SC				S3	S3B	G4
Northern harrier	*Circus cyaneus*	SC				S3	S4B	G5
Marsh Wren	*Cistothorus palustris*	SC				S3S4	S5B	G5
Northern bobwhite quail	*Colinus virginianus*		EN		EN	S4	S1S2	G5
Yellow rail	*Coturnicops noveboracensis*	T	SC		SC	S1S2	S4B	G4
Cerulean warbler	*Dendroica cerulea*	SC	SC		SC	S3	S3B	G4
Acadian flycatcher	*Empidonax virescens*		EN		EN	S3S4	S2B	G5
Merlin	*Falco columbarius*	T				S1S2	S4B	G5
Peregrine falcon	*Falco peregrinus*	EN	T		T	S1	S2S3B	G4
Common moorhen	*Gallinula chloropus*	SC				S3	S4B	G5
Common loon	*Gavia immer*	T				S3S4	S4B	G5
Bald eagle	*Haliaeetus leucophalus*	T	EN	T		S4	S4B	G4
Eastern yellow-breasted chat	*Icteria virens virens*		SC		SC	S3	S2S3B	G5
Least bittern	*Ixobrychus exilis*	T	T		T	S2	S3B	G5
Loggerhead shrike	*Lanius ludovicianus*	EN	EN		EN	S?	S2B	G4
Red-headed woodpecker	*Melanerpes erythrocephalus*		SC		SC	S5	S3B	G5
Black-crowned night heron	*Nycticorax nycticorax*	SC				S2S3	S3B	G5
Osprey	*Pandion haliaetus*	T				S4	S4B	G5
Wilson's phalarope	*Phalaropus tricolor*	SC				(N)	S3B	G5
Prothonotary warbler	*Protonotaria citrea*		EN		EN	S3	S1S2B	G5
King rail	*Rallus elegans*	EN	EN		EN	S1	S2B	G4G5
Louisiana waterthrush	*Seiurus motacilla*		SC		SC	S2S3	S3B	G5
Caspian tern	*Sterna caspia*	T				S2	S3B	G5
Forster's tern	*Sterna forsteri*	SC				S2	S2S3B	G5
Common tern	*Sterna hirundo*	T				S2	S4B	G5
Western Meadowlark	*Sturnella neglecta*	SC				S4	S4B	G5
Barn Owl	*Tyto alba*	EN	EN		EN	S1	S1	G5
Hooded warbler	*Wilsonia citrina*	SC	T		T	S3	S3B	G5
Mammals								
Least shrew	*Cryptotis parva*	T	EXT			S1S2	SH	G5
Southern flying squirrel	*Glaucomys volans*		SC		SC	S5	S3	G5
Woodland vole	*Microtus pinetorum*	SC	SC		SC	S3S4	S3	G5
Indiana bat	*Myotis sodalis*	EN		EN		S1		G2
Eastern mole	*Scalopus aquaticus*		SC		SC	S5	S2	G5
American badger	*Taxidea taxus*		EN		EN	S4	S2	G5
Plants								
Climbing fumitory	*Adlumia fungosa*	SC				S3	S4	G4
Gattinger's agalinis	*Agalinis gattingeri*	EN	EN		EN	S1	S2	G4
Skinner's agalinis	*Agalinis skinneriana*	EN	EN		EN	S1	S1	G3
Colic root	*Aletris farinosa*		T		T	?	S2	G5
Lake cress	*Armoracia lacustris*	T				S2	S3	G4
Leadplant	*Amorpha canescens*	SC				S3	SH	G5
Hairy angelica	*Angelica venenosa*	SC				S3	SR	G5
Missouri rock cress	*Arabis missouriensis*							
	var deamii	SC				S2		G5
Three-awned grass	*Aristida longespica*	T				S2	S2	G5
Virginia snakeroot	*Aristolochia serpentaria*	T				S2		G4
Sullivants milkweed	*Asclepias sullivantii*	T				S2	S2	G5
Purple milkweed	*Asclepias purpurascens*	SC				S3	S2	G5
Tall green milkweed	*Asclepias hirtella*	T				S2	S1	G5
Crooked stem aster	*Aster prenanthoides*	T	T			?	S2	G4G5
White wood aster	*Aster divaricatus*		T			SR	S1	G5
Canadian milk-vetch	*Astragalus canadensis*	T				S1S2	S4	G5
Cooper's milk-vetch	*Astragalus neglectus*	SC				S3	S3	G4
Prairie indigo	*Baptisia alba*	SC				SR	SR	G5
Slough grass	*Beckmannia syzigachne*	T				S2	S4	G5
Murray birch	*Betula murrayana*	SC				S1		G1Q
Side-oats grama grass	*Bouteloua curtipendula*	T				S1S2	S2	G5
Bluehearts	*Buchnera americana*		EN		EN	SX	S1	G5
Large water-starwort	*Callitriche heterophylla*	T				S1	S2	G5
Wild-hyacinth	*Camassia scilloides*	T	T		T	S2	S2	G4G5
Raven's foot sedge	*Carex crus-corvi*	T				SH	S1	G5
Davis's sedge	*Carex davisii*	SC				S3	S2	G4
Fescue sedge	*Carex festucacea*	SC				S1	S1	G5
Frank's sedge	*Carex frankii*	SC				S2S3	S2	G5
False hop sedge	*Carex lupuliformis*	T	EN		EN	S2	S1	G4
Broad-leaved sedge	*Carex platyphylla*	T				S1	S5	G5
Richardson's sedge	*Carex richardsonii*	SC				S3S4	S4	G4
Weak stellate sedge	Carex seorsa	T				S2	S2	G4
Squarrose sedge	*Carex squarrosa*	SC				S1	S2	G4G5
Hairy-fruited sedge	*Carex trichocarpa*	SC				S2	S3	G4
American chestnut	*Castanea dentata*	E	T		T	S1S2	S3	G4
Dwarf hackberry	*Celtis tenuifolia*	SC			SC	S3	S2	G5
Purple turtlehead	*Chelone obliqua*	E				S1		G4
Hill's thistle	*Cirsium hillii*	SC				S3	S3	G3
Dodder	*Cuscuta indecora*	SC				SH		G5
Knotweed dodder	*Cuscuta polygonorum*	SC				S2	SH	G5
Yellow nut-grass	*Cyperus flavescens*	SC				S2S3	S2	G5
Small white flowered lady's slipper	*Cypripedium candidum*	T	EN			S2	S1	G4
Ram's head lady slipper	*Cypripedium arietinum*	SC				S3	S3	G3
Large toothwort	*Dentaria maxima*	T				S1S2	SSYN	G5Q
Beak grass	*Diarrhena americana*	T				S2		G4
Creeping whitlow grass	*Draba reptans*	T				S1	S2	G5
English sundew	*Drosera anglica*	SC				S3	S5	G5

COMMON NAME	SCIENTIFIC NAME	MI	ON	US	CA	SRANK MI	SRANK ON	GRANK
Purple coneflower	*Echinacea purpurea*	EXT				SX	SE1	G4
Spike-rush	*Eleocharis geniculata*	T				S?	S1	G5
Engelmann's spike rush	*Eleocharis engelmannii*	SC				S2S3	S1	G4G5Q
Horsetail spikerush	*Eleocharis equisetoides*	SC	EN		EN	S3	S1	G4
Spike-rush	*Eleocharis radicans*	EXT				SX		G5
Love grass	*Eragrostis capillaris*	SC				SH	S1	G5
Small love grass	*Eragrostis pilosa*	SC				SH	SE1	G4
Wahoo	*Euonymous atropurpureus*		SC				S3	S3 G5
Upland boneset	*Eupatorium sessilifolium*	T				S1		G5
Tinted spurge	*Euphorbia commutata*	T				S1	S1	G5
Chestnut sedge	*Fimbristylis puberula*	EXT				SX	S1	G5
Blue ash	*Fraxinus quadrangulata*		SC		SC	S?	S3	G5
Umbrella-grass	*Fuirena squarrosa*	T				S2		G4G5
Showy orchis	*Galearis spectabilis*	T				S2	S4	G5
Downy gentian	*Gentiana puberulenta*	EN				S1	SX	G4G5
Stiff gentian	*Gentianella quinquefolia*	T				S2	S2	G5
White prairie gentian	*Gentiana alba*	EN	EN		EN	S1	S1	G4
Pale avens	*Geum virginianum*	SC				S1S2	S1	G5
Limestone oak fern	*Gymnocarpium*							
	robertianum	T				S2	S2	G5
Kentucky coffee-tree	*Gymnocladus dioicus*	SC	T			S3S4	S2	G5
Whiskered sunflower	*Helianthus hirsutus*	SC				S3	SE1	G5
Downy sunflower	*Helianthus mollis*	T				S2	SE1	G4G5
Dwarf bulrush	*Hemicarpha micrantha*	SC				S3	S1	G5
Smooth rose mallow	*Hibiscus laevis*	SC				SH	SX	G5
Swamp rose mallow	*Hibiscus moscheutos*	SC				S3S4	S3	G5
Panicled hawkweed	*Hieracium paniculatum*	SC				S2	S2	G5
Green violet	*Hybanthus concolor*	SC				S3	S2	G5
Goldenseal	*Hydrastis canadensis*	T	T		T	S2	S2	G4
Gentian-leaved								
St. John's wort	*Hypericum gentianoides*	SC				S3	S1	G5
Round-fruited								
St. John's wort	*Hypericum sphaerocarpum*					S1	S1	G5
Small whorled pogonia	*Isotria medeoloides*		EN	T	EN	S1	S1	G2
Whorled pogonia	*Isotria verticillata*	T	EN		EN	S2	S1	G5
Twinleaf	*Jeffersonia diphylla*	SC				S3	S4	G5
Short fruited rush	*Juncus brachycarpus*	T				S1S2	S1	G4G5
Vasey's rush	*Juncus vaseyi*	T				S1S2	S3	G5?
Water-willow	*Justicia americana*	T	T		T	S2	S1	G5
False boneset	*Kuhnia eupatorioides*	SC				S2		G5
Woodland lettuce	*Lactuca floridana*	T				S2	S2	G5
Legget's pinweed	*Lechea pulchella*	T				S1S2	S1	G5
Least pinweed	*Lechea minor*	SC				SH	SX	G5
Slender bush clover	*Lespedeza virginica*		EN		EN	S?	S1	G5
Cliff conobea	*Leucospora multifida*	SC				S?	S1	G5
Blazing-star	*Liatris squarrosa*	EXT				SX		G5
Dense blazing star	*Liatris spicata*		T		T	S?	S2	G5
Furrowed flax	*Linum sulcatum*	SC				S2S3	S3	G5
Virginia flax	*Linum virginianum*	T				S2	S2	G4G5
Purple twayblade	*Liparis liliifolia*	SC	EN		EN	S3	S2	G5
Narrow-leaved puccon	*Lithospermum incisum*	EXT				SX	S1	G5
Broad-leaved puccon	*Lithospermum latifolium*	SC				S2	S3	G4
Seedbox	*Ludwigia alternifolia*	SC				S3	S1	G5
Northern appressed								
clubmoss	*Lycopodiella subappressa*	SC				S2		G2
Swamp candles	*Lysimachia hybrida*	SC				S2	S1	G5
Cucumber tree	*Magnolia acuminata*		EN		EN		S2	G5
Wing-stemmed								
monkeyflower	*Mimulus alatus*	EXT				SX	S2	G5
Bee balm	*Monarda didyma*	EXT				SX	S3	G5
Red mulberry	*Morus rubra*	T	EN		EN	S2	S2	G5
Mat muhly	*Muhlenbergia*							
	richardsonis	T				S2	S2	G5
American lotus	*Nelumbo lutea*	T				S2	S2	G4
Eastern prickly pear cactus	*Opuntia humifusa*		EN		EN	S?	S1	G5
Violet wood-sorrel	*Oxalis violacea*	T				S1		G5
Ginseng	*Panax quinquefolius*	T	EN		EN	S2S3	S2	G3G4
Leiberg's panic grass	*Panicum leibergii*	T				S2	S2	G5
Panicum microcarpon	*Panicum microcarpon*	SC				S2	S2	G5T5
Low-forked chickweed	*Paronychia fastigiata*	SC				SH	S1	G5T5
Smooth beardtongue	*Penstemon calycosus*	T				S2	SE1	G5
Pale beard tongue	*Penstemon pallidus*	SC				S3	SE1	G5
Wild bean	*Phaseolus polystachios*	SC				SH		G4
Heart-leaved plantain	*Plantago cordata*	EN	EN		EN	S1	S1	G4
Orange fringed orchid	*Platanthera ciliaris*	T				S2	SX	G5
Eastern prairie fringed								
orchid	*Platanthera leucophaea*	EN	SC	T	EN	S1	S2	G2
Bog bluegrass	*Poa paludigena*	T				S2		G3
Jacob's ladder	*Polemonium reptans*	T				S2	SEH	G5
Cross-leaved milkwort	*Polygala cruciata*	SC				S3	SX	G5
Pink milkwort	*Polygala incarnata*	EXT	EN		EN	SX	S1	G5
Honey-flowered	*Polygonatum*							
Solomon's seal	*biflorum var melleum*	EXT				SX	SH	G5TH
Carey's smartweed	*Polygonum careyi*	T				S1S2	S3S4	G4
Swamp cottonwood	*Populus heterophylla*	EN				S1		G5
Vasey's pondweed	*Potamogeton vaseyi*	T				SH	S4	G4
Sand cinquefoil	*Potentilla paradoxa*					SU	S3	G5
Bald rush	Psilocarya scirpoides	T				S2		G4
Pinedrops	*Pterospora andromedea*	T				S2	S2	G5
Hoary mountian mint	*Pycnanthemum incanum*		EN		EN		S1	G5
Hairy mountian mint	*Pycnanthemum pilosum*	T				S2	S1	G5T5
Shumard oak	*Quercus shumardii*	SC	SC		SC	S2	S3	G5
Spearwort	*Ranunculus ambigens*	T				SH	SR	G4
Prairie buttercup	*Ranunculus rhomboideus*	T				S2	S3	G5
Meadow-beauty	*Rhexia virginica*	SC				S3	S3S4	G5
Climbing prairie rose	*Rosa setigera*		T		SC	S2S3	S3	G5
Tooth-cup	*Rotala ramosior*	SC	EN		EN	S3	S1	G5
Hairy ruellia	*Ruellia humilis*	T				S1		G5
Arrowhead	*Sagittaria montevidensis*	T				S1S2		G4G5
Canadian burnet	*Sanguisorba canadensis*	T				S1		G5
Clinton's bulrush	*Scirpus clintonii*	SC				S3	S2	G4
Tall nut-rush	*Scleria triglomerata*	SC				S3	S1	G5
Few-flowered nut-rush	*Scleria pauciflora*	EN				S1	S1	G5
Fire pink	*Silene virginica*	T				S1	SX	G5
Compass plant	*Silphium laciniatum*	T				S1S2	S1	G5
Cup plant	*Silphium perfoliatum*	T				S2	S2	G5
White goldenrod	*Solidago bicolor*	SC				S3	S4?	G5
Riddell's goldenrod	*Solidago riddellii*		SC		SC	S?	S3	G5
Showy goldenrod	*Solidago speciosa*		EN		EN	S?	S1	G5
Prairie dropseed	*Sporobolus heterolepis*	SC				S3	S3	G5
Blue-eyed grass	*Sisyrinchium hastile*	EXT				S?	S1	G5?
Smooth carrion flower	*Smilax herbacea*	SC				S3	S4	G5
Round-leaved greenbrier	*Smilax rotundifolia*		T		T	S?	S2	G5
Trailing wild bean	*Strophostyles helvula*	SC				S3	S3	G5
Wood poppy	*Stylophorum diphyllum*		EN		EN	S?	S1	G5
Virginia goat's rue	*Tephrosia virginiana*		EN		EN	S?	S1	G5
Bastard pennyroyal	*Tradescantia virginiana*	SC				S2	SE1	G5
Dropping trillium	*Trichostema dichotomum*	T				S2	S1	G5
	Trillium flexipes		EN		EN	S?	S1	G5
Prairie trillium	*Trillium recurvatum*	T				S2S3		G5
Toadshade	*Trillium sessile*	T				S2S3		G4G5
Painted trillium	*Trillium undulatum*	EN				S1S2	S5?	G5
Nodding pogonia	*Triphora trianthophora*		EN		EN	S1	S1	G3G4
Sand grass	*Triplasis purpurea*	SC				S2	S4?	G4G5
Prairie birdfoot violet	*Viola pedatifida*	T	EN			S1	S1	G5
Frost grape	*Vitis vulpina*	T				S1S2	S1	G5
Wild rice	*Zizania aquatica*							
	var aquatica	T				S2S3	S4	G5T5

Appendix C: Recommended Reading

A Checklist of Ontario Freshwater Fishes. 1992. Royal Ontario Museum, Toronto

A Guide to Michigan's Endangered Wildlife. 1992. David C. Evers. University of Michigan Press, Ann Arbor, Michigan.

Amphibians and Reptiles of the Great Lakes Region. 1997. James H. Harding. University of Michigan Press, Ann Arbor, Michigan.

Amphibians and Reptiles of Ontario. 2002. Ross D. MacCulloch. Royal Ontario Museum and McClelland & Stewart Ltd. Toronto, Ontario.

At*las of Breeding Birds in Ontario.* 1987. Federation of Ontario Naturalists and Long Point Bird Observatory.

Atlas of the Mammals of Ontario. 1994. Federation of Ontario Naturalists

Atlas of Rare Vascular Plants of Ontario. 1982-87. National Museum of Sciences, Ottawa.

Birds of Southeast Michigan: Dearborn Wayne County. 1996. Julie A. Craves. Cranbrook Institute of Science Bulletin 62. Cranbrook Institute of Science, Bloomfield, Hills, Michigan.

Insects of the Great Lakes Region. 1996. Gary A. Dunn. University of Michigan, Ann Arbor, Michigan.

Lake Erie and Lake St. Clair Handbook. 1993. Edited by Stanley J. Bolsenga and Charles E. Herdendorf. Wayne State University Press, Detroit, Michigan.

Mammals of the Great Lakes Region. 1997. Allen Kurta. University of Michigan Press, Ann Arbor, Michigan.

Michigan Trees. 1981. Burton V. Barnes. University of Michigan Press, Ann Arbor, MI.

Newcomb's Wildflower Guide. 1977. Lawrence Newcomb. Little, Brown and Company, Boston, Massachusetts.

Ontario Birds at Risk. 1994. Federation of Ontario Naturalists and Long Point Bird Observatory.

Orchids of the Western Great Lakes Region. 1987. Frederick W. Case, Jr. Cranbrook Institute of Science Bulletin 48. Cranbrook Institute of Science, Bloomfield, Hills, MI.

The Geology of Michigan. 1970. John A. Door and Donald F. Eschman. The University of Michigan Press, Ann Arbor, Michigan.

The Ontario Butterfly Atlas. 1991. Toronto Entomologists' Association, Toronto.

The Tallgrass Restoration Handbook. 1997. Society of Ecological Restoration. Island Press, Washington, D.C.

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All non-credited photographs taken by Lisa M. Appel

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Appendix E:
Resources and Organizations

Below is a list of organizations involved with environmental education and protection in the Lake Huron to Lake Erie Corridor

First Nations

Walpole Island Heritage Center
(519) 627-1475
www.bkejwanong.com

Government – Binational

International Joint Commission
(519) 257-6710
www.ijc.org

Government – United States

Army Corps of Engineers
Detroit District
(313) 226-6767

Belle Isle Aquarium
(313) 852-4075
www.ci.detroit.mi.us/recreation/centers/M/belle_isle/belleM.htm

Dossin Great Lakes Museum
(313) 852-4050
www.ci.detroit.mi.us/recreation/centers/M/belle_isle/belleM.htm

Huron-Clinton Metropolitan Authority
1-800-477-2757
www.metroparks.com

Michigan Department
of Agriculture
Environmental Stewardship Division
(517) 241-0236
www.mda.state.mi.us
/environm/index.html

Michigan Department of
Environmental Quality
1-800-662-9278
www.michigan.gov/deq

Michigan Department of Natural
Resources
(517) 373-1207
www.michigan.gov/dnr

Natural Area Preservation
City of Ann Arbor
Department of Parks and Recreation
(734) 996-3266
www.ci.ann-
arbor.mi.us/framed/parks/nap.htm

National Oceanographic and
Atmospheric Administration (NOAA)
Great Lakes Environmental
Research Laboratory (GLERL)
(734) 741-2235
http://www.glerl.noaa.gov

Oakland County Planning &
Economic Development Services
(248)858-0720
http://www.co.oakland.mi.us/peds/
Southeast Michigan Council
of Governments
(313) 961-4266
www.semcog.org

St. Clair County Planning Commission
(810) 989-6950
www.stclaircounty.org/offices/metro/

U.S. Department of Agriculture
Natural Resources Conservation
Service
(517) 324-5270

United States Environmental
Protection Agency
Great Lakes National Program Office
(312) 353-2117
www.epa.gov/glnpo

U.S. Fish and Wildlife Service
Great Lakes-Big Rivers Region 3
1-800-657-3775
http://midwest.fws.gov

U.S. Geological Survey
Biological Resources Division
Great Lakes Science Center
(734) 994-3331
www.glsc.usgs.gov

Government – Canada

Canadian Wildlife Service
(819) 997-1095
www.cws.ec.gc.ca

Environment Canada
Inquiry Centre
1-800-668-6767
www.ec.gc.ca

Essex Region Conservation Authority
(519) 776-5209
www.erca.org

Essex County Stewardship Network
Ontario Ministry of Natural Resources
(519) 354-6274
www.ontariostewardship.org/
Essex/essex.htm

Lower Thames Valley Conservation
Authority
(519) 354-7310
www.lowerthames-
conservation.on.ca

Ontario Ministry of Natural Resources
Main Office – Peterborough
(705) 755-2000
www.mnr.gov.on.ca/MNR/

Ontario Parks
1-800-ONTARIO
www.ontarioparks.com

Rural Lambton Stewardship Network
(519) 354-5013
www.ontariostewardship.org/
LAMBTON/lambton.htm
St. Clair Region
Conservation Authority
(519) 245-3710
www.scrca.on.ca

Upper Thames River
Conservation Authority
(519) 451-2800
www.thamesriver.on.ca

Non-government Organizations – United States

Cranbrook Institute of Science
(248) 645-3200
www.cranbrook.edu/institute/

Detroit Audubon Society
(810) 545-2929
www.detroitaudubon.expage.com

The Detroit Zoological Society
(248) 541-5717
www.detroitzoo.org

Ducks Unlimited, Inc.
Great Lakes/Atlantic Region Office
(734) 623-2000
www.ducks.org

East Michigan Environmental
Action Council
(248) 258-5188
www.emeac.org/

Great Lakes Commission
(734) 971-9135
www.glc.org

Greening of Detroit
(313) 237-8733
www.greeningofdetroit.com

Michigan Odonata Survey
Insect Division, Museum
of Zoology
http://insects.ummz.lsa.umich.edu/
michodo/mos.html

National Wildlife Federation
(734) 769-3351
www.nwf.org

Rouge River Bird Observatory
Environmental Interpretive Center
University of Michigan-Dearborn
(313) 593-5338
www.umd.umich.edu/dept/
rouge_river

Southeast Michigan Greenways
Initiative
Community Foundation for
Southeast Michigan
(313) 961-6675
http://greenways.cfsem.org

Southeastern Michigan Raptor
Research
(734) 379-5020 x 5736
www.smrr.net

Southeast Michigan Resource
Conservation and Development
Council
www.semircd.org

Southeast Michigan Stewardship
Network
www.snre.umich.edu/
stewardshipnetwork

Southwest Detroit
Environmental Vision
(313)842-1961
comnet.org/local/orgs/sdev

White Lake C.A.R.E.
www.wlrcare.com

Wildlife Habitat Council
(301) 588-8994
www.wildlifehc.org

Watershed Councils

Clinton River Watershed Council
(810) 853-9580
www.crwc.org

Friends of the Rouge
(313) 792-9627
www.therouge.org

Huron River Watershed Council
(734) 769-5123
www.hrwc.org

Friends of St. Clair River
www.friendsofstclair.com

Johnson Creek Protection Group
(734) 761-1010
www.jcpg.org

River Raisin Watershed Council
(517) 263-5614
www.riverraisin.org

Detroit American Heritage River
(313) 568-9594
www.tellusnews.com/ahr

Land Protection

Bluewater Land Conservancy
P.O. Box 611424
Port Huron, MI 48061-1424

Grosse Ile Nature and Land
Conservancy
(734) 676-6657
www.ginlc.org

Holly Land Trust
304 S. Broad Street, Suite A
Holly, MI 48442

Independence Land Conservancy
8062 Ortonville Road
Clarkston, MI 48016

Livingston Land Conservancy
(810) 229-3290
www.livingstonland
conservancy.org

Macomb Land Conservancy
(586) 784-5848
www.savingplaces.org

Michigan Nature Association
(517) 655-5655
www.michigannature.org

Monroe County Land Conservancy
(734) 279-2149
www.bendor.org/mlc.shtml

North Oakland Headwaters
Land Conservancy
(248) 846-6547
www.nohlc.org

Oakland Land Conservancy
(248) 601-2816
www.oaklandlandconservancy.org

Raisin Valley Land Trust
(734) 428-8108
www.rvlt.org

Southeast Michigan Land
Conservancy
(734) 997-0942
www.bendor.org/smlc.html

Superior Land Conservancy
(734) 482-7414
www.bendor.org/slc.shtml

The Nature Conservancy
Michigan Chapter
(517) 316-0300
http://nature.otg/wherewework/
northamerica/states/michigan

Washtenaw Land Trust
(734) 302-LAND
www.washtenawlandtrust.org

West Bloomfield Land
Conservancy
7299 Verona Drive
West Bloomfield, MI 48322
(248) 788-3940

Non-government Organizations – Canada

Carolinian Canada
(519) 873-4631
www.carolinian.org

Ducks Unlimited Canada
(705) 721-4444
www.ducks.ca

Essex County Field Naturalists'
Club
(519) 733-9972
www.ojibway.ca/ECFN.htm

Federation of Ontario Naturalists
(416) 444-8419
www.ontarionature.org

Holiday Beach Migration
Observatory
Essex Region Conservation
Authority
(519) 736-3772
www.hbmo.org

Lambton Wildlife Incorporated
www.sarnia.com/groups/
lwi/lwi.html

Little River Enhancement Group
(519) 735-0418
www.lilreg.com/
Ontario Federation of Anglers
and Hunters
(705) 748-6324
www.ofah.org

Sarnia-Lambton Environmental
Association
(519) 332-2010
www.sarniaenvironment.com

Sarnia Urban Wildlife Committee
www.suwc.org

Sydenham Field Naturalists
P.O. Box 22008
Dufferin Ave.
Wallaceberg, ON N8A 5G4

Tallgrass Ontario
(519) 873-4631
www.tallgrassontario.org

Wetland Habitat Fund
(613) 722-2090
www.wetlandfund.com

Land Protection

Thames Talbot Land Trust
(519) 652-2189

Nature Conservancy of Canada
(416) 932-3202

Nature Centers -U.S. and Canada

Ojibway Nature Centre
(519) 966-5852
www.ojibway-ca/index.htm

Longwoods Road Conservation
Area, Resource Centre and
Ska-Nah-Doht Iroquoian Village
and Museum
(519) 264-2420
www.lowerthames-
conservation.on.ca/Longwoods
RoadCA.htm

Pinery Provincial Park Visitor
Centre
(519) 243-8574
www.pinerypark.on.ca

Point Pelle National Park Nature
Centre
(519) 322-2365
www.pc.gc.ca/pn-
np/on/pelee/index_E.asp

Rondeau Provincial Park
Visitor Centre
(519) 674-1768
www.rondeauprovincialpark.ca

Wawanosh Wetlands Conservation
Area Education Centre
www.mvca.on.ca/wawa.html

A.W. Campbell Conservation Area
Nature House
(519) 847-5357

University of Michigan-Dearborn
Environmental Interpretive Center
(313) 593-5338
www.umd.umich.edu/dept/na

Dinosaur Hill Nature Preserve
City of Rochester and Rochester
Community Schools
(248) 656-0999
www.livinglibrary.com/dinohill

Drayton Plains Nature Center
(248) 647-2119
www.draytonplainsnaturecenter.org
Howell Interpretive Nature Center
(517) 546-0249
www.ismi.net/howellnature

James D. Reader, Jr. Urban
Environmental Education Center
Nichols Arboretum
University of Michigan
(734) 998-9540
www.umich.edu/~wwwarb/about

Kensington Metropark
Nature Center
Huron-Clinton Metropolitan
Authority
(248) 685-1561
www.metroparks.com

Matthaei Botanical Gardens
University of Michigan
(734) 998-7061
www.lsa.umich.edu/mbg

Nankin Mills Nature Center
Wayne County Road Commission
(734) 261-1850
www.waynecounty.com/parks/nank
in_ic.htm

Oakwoods Metropark
Nature Center
Huron-Clinton Metropolitan
Authority
(734) 782-3956
www.metroparks.com

Pine River Nature Center
St. Clair County Regional Education
Service Agency
(810) 325-9106
www.sccresa.org

Seven Ponds Nature Center
Michigan Audubon Society
(810) 796-3200
www.geocities.com/sevenponds/

Sterling Heights Nature Center
(586) 446-2711

Stony Creek Metropark
Nature Center
Huron-Clinton Metropolitan
Authority
(586) 781-4242
www.metroparks.com

Metro Beach Metropark
Nature Center
Huron-Clinton Metropolitan
Authority
(586) 463-4581
www.metroparks.com

Indian Springs Metropark
Nature Center
Huron-Clinton
Metropolitan Authority
(248) 625-7280
www.metroparks.com

Lewis E. Wint Nature Center
Oakland County Parks
and Recreation
(248) 625-6473
www.co.oakland.mi.us/parksrec/
ppark/wint_center.html

Lloyd A. Stage
Outdoor Education Center
City of Troy
(248) 524-3567
www.ci.troy.mi.us/parks/OEC/
NatureCenter.asp

Lake Erie Metropark Museum
and Nature Center
Huron-Clinton
Metropolitan Authority
(734) 379-5020
www.metroparks.com

The Madison Heights Nature
Center at Friendship Woods
City of Madison Heights
(248) 585-0100

Gerald E. Eddy Geology Center
Michigan Department
of Natural Resources
Waterloo Recreation Area
(734) 261-1900

Leslie Science Center
Ann Arbor Parks and Recreation
(734) 997-1553
www.ci.ann-
arbor.mi.us/Parks/LeslieScience/le
slie.htm

Holliday Forest
and Wildlife Preserve
(734) 261-1900
www.waynecounty.com/parks/
william_p_holliday.htm

Private

DTE Energy
(313) 235-4000
www.dteenergy.com

Ontario Power Generation
(416) 592-2555
www.opg.com

Ford Motor Company
1-800-392-3673
www.ford.com

Smith Group JJR
1-866-SMITHGROUP
www.smithgroup.jjr.com

Glossary

A

abiotic–a nonliving factor in an environment (e.g. light, water, temperature.)

acid–substance with a pH value less than 7.

acidophiles–plants that live in acidic soils.

alkaline–substance with a pH value greater than 7.

anaerobic–lacking oxygen.

aquifer–an underground geological formation or group of formations containing water. Aquifers are sources of groundwater for wells and springs.

autotroph–an organism capable of self-nourishment by using inorganic materials as a source of nutrients and using photosynthesis or chemosynthesis as a source of energy (e.g. plants.)

B

backfill–material, often dirt or broken concrete, used to fill the space behind a retaining wall or other shoreline hardening structure.

barrens–level or slightly rolling land, usually with relatively infertile sandy soil and few trees.

bedrock–the rock underlying soils ranging from zero (when exposed by erosion) to several hundred feet in elevation.

benthic–relating to the bottom of a body of water.

benthic macroinvertebrate–an aquatic invertebrate animal large enough to be seen with the human eye. Macroinvetebrates include insects, clams, crayfish, snails and worms. An analysis of the types and numbers of macroinvertebrates present in a stream is a very useful indicator of water quality and habitat conditions.

benthos–the bottom of a river, lake, sea, or ocean.

biodiversity–the variety of organisms living in a particular area or region. This can include diversity within species (genetic), and diversity of ecosystems.

biomass–the total mass of a living material in a given environment.

biome–a large geographic area with somewhat uniform climatic conditions; a complex of communities characterized by a distinctive type of vegetation and maintained under the climatic conditions of the region.

biota–animal and plant life of a region.

biotic–the living organisms in a community, including all of the plant and animal life in a community.

bog–peat-accumulating wetland with precipitation as the dominant water source, typically acidic and normally dominated by Sphagnum spp. mosses.

buffer–areas or strips of land in permanent vegetation, designed to intercept pollutants and sediment. Buffers include riparian buffers, filter strips, windbreaks, and living snow fences.

bulkhead–a retaining structure of timber, steel, or reinforced concrete used for shoreline protection or harbors.

C

calcareous–chalkiness due to the presence of calcium carbonate.

canopy–the cover formed by the tallest, leafy upper branches of trees in a forest.

carnivorous–animals that eat meat; a plant that eats insects.

channelization–human engineering of river channels to enlarge, straighten, embank, or protect existing channels, create new channels, or protect adjacent structures.

clay–a sediment type, consisting of particles less than 0.002 mm in diameter. A soil type consisting of greater than 40% clay, less than 45% sand, and less than 40% silt.

climate–general prevailing weather patterns of a region, based on temperature, air pressure, humidity, precipitation, sunshine, cloudiness, and winds.

climax community–a stage in ecological succession in which a community of organisms, especially plants, is stable and capable of perpetuating itself.

community–a group of plants and animals living and interacting with one another in a specific region under relatively similar conditions.

conifer–a plant that bears its seeds in cones; mostly needle-leafed or scale-leafed; mainly evergreen.

connecting channel–a waterway or long strait between two lakes (e.g. the St. Clair River, Lake St. Clair, and Detroit River are a connecting channel between Lake Huron and Lake Erie.)

conservation easement–legal agreement that restricts landowners to uses that are compatible with conservation and environmental values.

consumer–an organism that eats plants or animals for its food.

contaminant–something that makes water, soil, or air unsuitable, unclean, or toxic; a pollutant.

cover–the vegetation, debris, and irregularities of the land that provide concealment, sleeping, feeding, and breeding areas for wildlife.

D

deciduous plant–a plant that sheds all its leaves every year during a certain season.

decomposer–microorganisms, fungus, or insects that convert dead organic materials into inorganic materials.

decomposition–chemical breakdown of a compound into simpler compounds, often accomplished through the aid of microorganisms.

delist–a term used by the International Joint Commission (IJC) to indicate when water and habitat quality standards within an Area of Concern have improved to the point of no longer being a concern.

delta–a geological formation that occurs where a stream or river deposits sediment into a receiving basin or lake.

deposition–the act or process of being deposited (e.g. the placement of excavated soils or dredged materials in a new location; sediments transported by water current to a new place.)

dike–a human-made barrier built around a wetland designed to control water levels within an enclosed area.

diversity–variety.

dredging–the process of using machinery to remove sediments from the bottom of a waterway.

dune–a sand hill or sand ridge formed by the wind, usually in deserts or near lake and ocean shorelines.

E

ecology–the study of relationships between organisms and their environments.

ecosystem–a system defined by the interaction of a community of organisms with their physical environment.

ecotone–the transition zone between two different plant communities, such as between a forest and a prairie.

embayment–a bay.

ericaceous–plants of the heath family, such as bog rosemary and leatherleaf, which usually prefer to grown in acid substrates.

erosion–the process by which the surface of the earth is worn away by water, glaciers, winds, and waves, which is often intensified by land-clearing practices related to farming, residential, industrial development, road building, or logging.

erosional features–topography and landforms shaped by flowing water and glacial ice.

eutrophication–describes a phenomenon in water bodies that occurs when waters are rich in mineral and organic nutrients. It results in a proliferation of plant life, especially algae, that reduce the dissolved oxygen content and often causes the death of other organisms in the water.

exotic species–organisms (plant or animal) introduced to a habitat where they are non-native. They are often severe agents of habitat alteration and degradation and are a major cause of the loss of biological diversity; often referred to as introduced, alien, or non-indigenous species.

F

fauna–animals, collectively.

fen–peat-accumulating wetlands with groundwater as the dominant water source, and a variety of plant species, including grasses and sedges.

floodplain–the land bordering a river or stream that is subject to flooding. The floodplain is built up of sediments from overflow of the stream.

flora–plants, collectively.

food chain–the transfer of food energy from one organism to another as each consumes a lower member and in turn is preyed upon a higher member.

food web–the totality of interacting food chains within an ecological community.

forb–a broad-leaved flowering plant, such as black-eyed susan and wild bergamot; a wildflower; does not include grasses, sedges, trees and shrubs.

fossils–any remains, impression, or trace of a living thing from a former geologic age.

fragmentation–the process, usually the result of development or agriculture, in which natural areas, such as a forests or wetlands, are cut away or changed so that only small, isolated remnants of the original community remain.

G

game fish–fish large enough to be caught by recreational sport fishermen; sport fish.

genetic diversity–the chromosomal diversity available within a species.

geology–the science that deals with the dynamics and physical history of the earth, rocks, and the earth's physical, chemical, and biological changes.

grassland–an area in which grasses and wildflowers are the dominant vegetation.

gravel–a sediment type, consisting of small stones and cobble.

Great Lakes Basin–the five Great Lakes plus the watershed land that surrounds them; the largest freshwater system in the world.

Great Lakes coastal marsh–a freshwater wetland ecosystem that occurs along the coast of the Great Lakes, which is highly influenced by fluctuating water levels.

ground water–water beneath the earth's surface that supplies wells and springs. Precipitation that is absorbed into the ground replenishes groundwater.

H

habitat–the arrangement of food, water, shelter or cover, and space suitable to animals' needs.

headwaters–the origin or upper tributaries of a river.

herb layer–the layer of soft-stemmed (non-woody) plants growing close to the forest floor.

herbaceous vegetation–non-woody vegetation, including ferns, sedges, emergent, submerged, and floating plants.

heterotroph–an organism requiring organic compounds for its principal source of food.

hydrology–the study of the occurrence, circulation, distribution, and property of the natural waters on Earth.

hypsithermal–elevated temperature.

I

impervious surfaces–hard surfaces within a watershed including rooftops, parking lots, streets, sidewalks, and driveways that do not allow water to infiltrate soils.

indicator species–plant or animal communities whose presence indicates good habitat or water quality; species that offer a signal of the biological condition of a given area.

invasive species–a species of animal or plant that is moved, usually by intentional or unintentional human intervention, from its native location to a new location; without natural predators or consumers in the new location, an invasive species can become a nuisance species that threatens or eliminates native species; also known as non-native species, exotic species, or nuisance species.

invertebrates–organisms without a backbone.

J

K

L

lacustrine–of, or pertaining to, a lake.

lakeplain–old lake bottom of the ancestral Great Lakes.

land use planning–the process of deciding appropriate uses of land.

landforms–hills, valleys, low areas, and lakes that comprise the topography of an area; a natural feature of a land surface.

larva–the immature, wingless, feeding stage of an insect.

life history–the developmental history of an individual or group.

litter layer–the forest floor characterized by fallen, decomposing leaves, decaying stumps, mosses and lichens.

loam–a soil type, consisting of a moderate amount of sand, silt, and clay; a soil composed of 7-27% clay, 28-50% silt, and 23-52% sand.

lowland–land that is low or level in comparison to adjacent terrain.

M

macrophyte–a plant, especially an aquatic plant, large enough to be visible to the naked eye.

marsh–low, wet land, often treeless with open water, generally characterized by grasses, sedges, cattails, and rushes.

mesic–moderately moist.

microclimate–climates of small specific areas as contrasted with the general climate of the area.

migrate–to pass seasonally from one region or climate to another.

mitigation (of wetlands)–restoration, creation, enhancement, or preservation of wetlands that expressly compensates for unavoidable wetland losses due to development actions.

moraine–an accumulation of gravel, and stone carried and deposited by glaciers, often forming mounds or hills.

N

naiad–the juvenile form of the dragonfly, damselfly, or mayfly.

nearshore waters–a band of varying width around the perimeter of a lake between the land and the deeper offshore waters, as determined by the thermocline; the part of a large lake in which fish spawn, waterfowl feed, and mammals prey.

native species–an animal or plant that originated in a particular place or region.

non-native–in conservation terms, an organism that has been introduced to an area in which it did not originate.

nonpoint source pollution–pollution that comes from many different sources over a broad area. It usually caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up pollutants, finally depositing them into lakes, rivers, streams, and wetlands. Farm fields and parking lots, or from an unseen location, such as an underground storage tanks or failing septic systems are sources of nonpoint source pollution.

nuisance species–see invasive species.

O

organic matter–plant and animal matter that is in the process of decomposing.

organism–a living thing; a form of life composed of parts that work together to carry on the various processes of life.

P

PAH–Polyaromatic hydrocarbon.

PCB–Polychlorinated biphenyl.

parent material–rock or glacial sediment from which soils originate.

periphyton–benthic algae that grow attached to surfaces, such as rocks or larger plants.

pesticide–a chemical preparation used to control populations of organisms. pioneer species – plants that are typically shade-intolerant, short-lived, and the first to grow in land that has been disturbed by fire, agriculture, or other events.

plankton–small, passively floating or weakly mobile aquatic organisms.

point source pollution–pollution that originates from a specific, identifiable location. Point source pollution can be discharged from any pipe, ditch, channel, tunnel, conduit, well, concentrated feeding operation, sewage discharge pipe, landfill leachate collection system, vessel, or other floating craft.

pollinator–a creature, often an insect, bird, bat, moth or butterfly that conveys a flower's pollen from the anther to the stigma.

pollution–the introduction of harmful substances or products into an environment.

population–the quantity of a certain species living in a certain location.

predator–an animal that kills and eats other animals.

prey–animals that are killed and eaten by other animals.

producer–a green plant or bacterium that uses photosynthesis or chemosynthesis; constitutes the first trophic level in a food chain.

Q

R

relict–a plant, animal, or geological feature that has survived in a considerably changed environment.

remnant–a small, fragmented piece of a previously large, intact natural community.

revetment–a wall, often constructed of masonry or concrete, to protect an embankment from water erosion.

rhizome–a horizontal underground stem, usually rooting at the nodes.

riparian–of, situated, or dwelling on the bank of a river or stream.

riverine–of, or pertaining to, a river.

river mouth–the lower end of a river or stream where water is discharged into a larger body of water, such as a lake.

Glossary

riverine system–rivers, streams, ditches, and drains as well as the adjacent buffers that border them along with the fringe of adjacent upland areas.

runoff–precipitation, snow melt, or irrigation water that runs-off the land into surface water. Runoff can carry pollutants from the air and land into receiving waters.

S

sand–a soil type, consisting of particles between 0.05 and 2.0 mm in diameter.

savanna–a grassland with scattered trees, either as individuals or clumps. A transitional community between prairie and forest.

sediment–fragmented material that originates from weathering of rocks and is transported by, suspended in, or deposited by water or air.

shoreline–the line where shore and water meet.

shoreline hardening–the installation of artificial shoreline structures such as concrete docks, steel breakwalls, berms, and concrete revetments designed to prevent erosion and protect properties from being washed away. In the process, natural vegetation and habitat is eliminated.

shrub layer–the part of a forest floor characterized by shrub growth or young trees (woody vegetation.)

siltation–the deposit of or accumulation of very tiny soil particles (silt.)

silt–a soil particle between 0.05 and 0.002 mm in diameter; a soil type.

snags–dead trees that are still standing or have partially fallen.

slough–a hollow filled with mud and water (e.g. an inlet from a river.)

soil–a dynamic natural body composed of mineral and organic materials and living forms in which plants grow.

spawn–to deposit eggs or sperm directly into water, as fish do.

species at risk–plant and animal species in which populations are declining to low levels; species that are listed as special concern, threatened, or in danger of extinction.

spring ephemerals–forest wildflowers that flower in the spring before nearby trees can produce leaves and block sunlight.

stormwater or stormwater runoff–water that flows over the ground after a rainstorm; water that quickly runs off paved surfaces and into storm sewers.

submergent–plants that grow under water; submerged.

subwatershed–the drainage area of a small creek or stream, which flows into a larger river; a component of larger watershed.

succession–the replacement of plant species in an orderly sequence of development.

surface water–water on the surface of the earth.

swamp–a wetland dominated by trees and shrubs, with standing water, limited drainage, and often neutral or slightly acidic soils.

T

temperate zone–the part of the Earth's surface lying between the Tropics and the Arctic, characterized by warm summers, cold winters, and moderate springs and falls.

terminus–the southernmost edge of a glacier.

terrestrial–of, or pertaining to land.

topography–the elevational pattern of the soil surface, including its relief and the position of natural and manmade features.

toxic–a poison or something that has been poisoned.

tributary–any river or stream that connects with a larger river or stream before reaching its final outflow.

trophic level–a group of living things that share the same level in the food chain.

U

understory–part of a forest where tall shrubs and shade-tolerant trees grow beneath the main canopy.

upland–land above the level where water flows or flooding occurs.

V

vegetation–all the plants that grow in a region or area.

vernal pool–ponds or small lakes that occur only in springtime. [vernal = springtime]

vertebrate–organism having a backbone.

W

wastewater–water that has been used within homes, businesses, factories, or outdoor activities and discharged back into the environment.

watershed–the land area that drains into a single body of water such as a lake, river, or stream.

waterway – a lake, river, or stream.

wetlands – an area that is inundated or saturated by surface water or ground-water with a frequency and duration sufficient to support vegetation adapted for life under those soil conditions. Swamps, marshes, fens, and bogs are examples of wetlands.

wildlife–undomesticated animals living in the wild.

woodland–land having a cover of trees and shrubs (less densely than a forest.)

X

xeric–dry

Y

Z

zone of saturation–point at which groundwater totally saturates the soil. Water in the zone of saturation will flow into a well and is called ground water; an aquifer.

MANDY DUNLAP

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