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.

e Land and Water Connection

ile waterways and land may seem connect only at shorelines, the erconnectedness of water and land s far beyond a simple beach.

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

arly everything that takes place land, especially human

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.

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.

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.

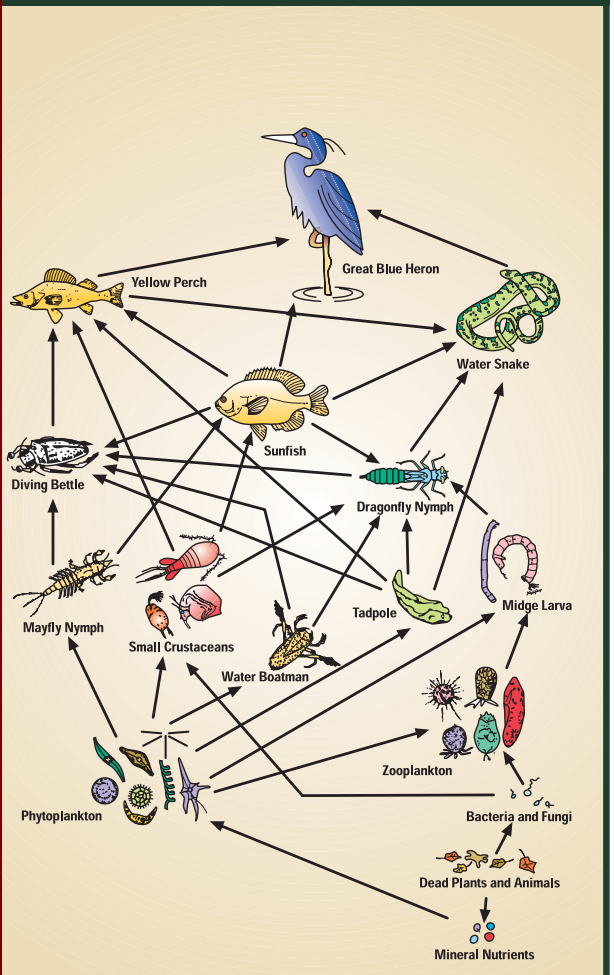
These shallow water areas are known as nearshore waters. They are home to nearly all species of Great Lakes fish, as well as many types of birds and mammals at some point in their life cycles. The water in these areas has the warmth and shallowness to support warm-water fish and other aquatic organisms.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



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

s diagram shows the complicated relationships within the food chain of the great blue heron. ndreds of organisms may be involved in any single aquatic food chain. A disturbance in one level 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.

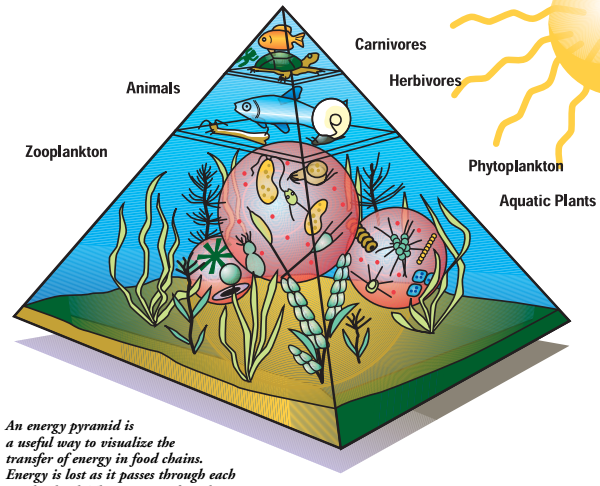
Benthic macroinvertebrates are spineless creatures that live in the bottom of a waterway for at least part of their lives. These creatures include mussels, snails, crayfish, leeches, worms, sow bugs, mayfly and stonefly nymphs. Some feed on dead organic matter (detrius) or filter feed. Other species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

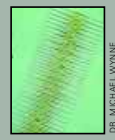
The top, or quarternary consumers, in the aquatic food chain are fish eaters–humans, mammals and birds, such as cormorants and bald eagles.

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.

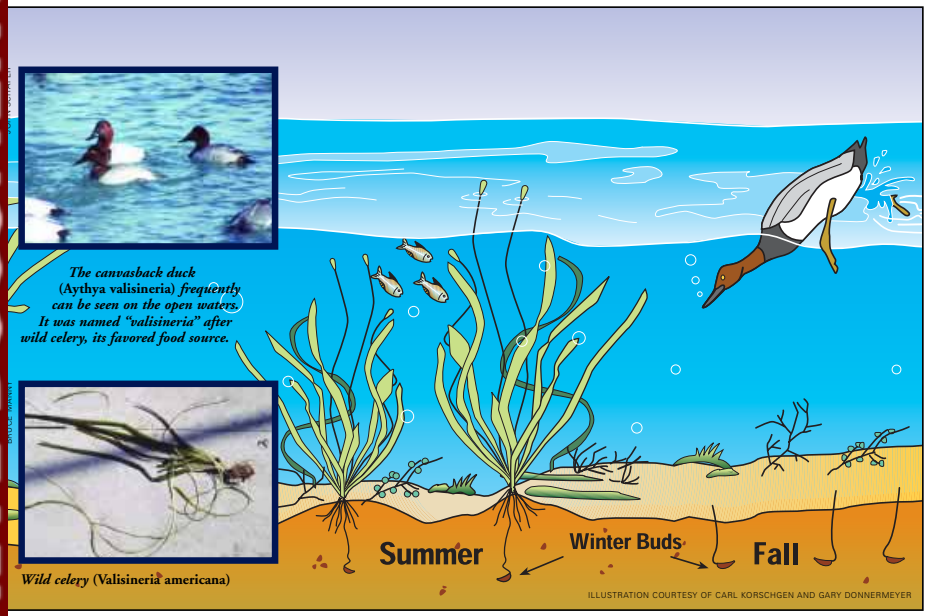
Primary Producers	Tertiary Consumers
phytoplankton, periphyton and aquatic macrophytes	muskellunge, white bass, walleye and northern pike
Primary Consumers	**Quaternary Consumers**
zooplankton, mussels, snails, crayfish and aquatic insects	osprey, tern, bald eagle, great blue heron, raccoons and humans
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.



d celery* (Valisineria americana) *populations declined by 72 percent from the 1950s to the 1980s in the Detroit River. They have since rebounded and 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 ssel, a non-native, invasive aquatic species. Wild celery is the preferred food of diving ducks such as canvasbacks, redheads and scaup.

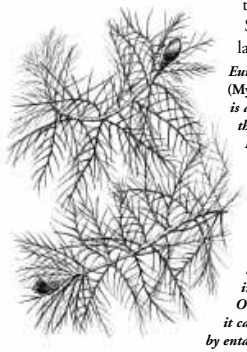
bmersed Aquatic Plants

re than 20 species of submersed nts occur in the St. Clair River, e St. Clair and Detroit River system. e most common species are listed he chart below.

one time, the shoreline of the Lake ron 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

mmon Name	Scientific Name
ld celery	*Valisineria americana*
dhead grass	*Potamogeton richardsonii*
rasian watermilfoil	*Myriophyllum spicatum*
aterweed	*Elodea canadensis*
ater stargrass	*Heterantha dubia*
ndweeds	*Potamogeton spp.*
shy pondweed	*Najas flexilis*
ontail	*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 rifleshell* (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 rifleshell 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.

e Biology of Freshwater Mussels

shwater mussels may appear to be a
ple lifeform, but they actually have
omplex lifecycle. Most species spend
ir time buried in sand or gravel at the
tom of rivers and streams. Some
ssels live to be 100 years old. Only
w species make their home in the still
ers of lakes and ponds. They usually
ain in one place, although they do
e a "foot" that helps them to burrow
l move limited distances if disturbed
drought or floods. This foot also helps
anchor them against strong currents
l predators such as muskrats that dig
p in the sand for their dinner.
shwater mussels draw water into their
lls so their gills can absorb oxygen
l filter plankton, their food source.

DOUG SWEET

***snuffbox* (Epioblasma triquetra)**
small freshwater mussel with unique
rkings that look like dripping paint.
ives deep within the sediment of small- to
lium-sized rivers and streams, preferring
n sand, gravel or cobble substrate with
ily flowing water. The banded sculpin
l logperch are fish hosts. Distribution
he snuffbox has been reduced significantly
ughout North America; most populations
e become small and isolated. It is listed as
ngered 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	*Lampiis 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.

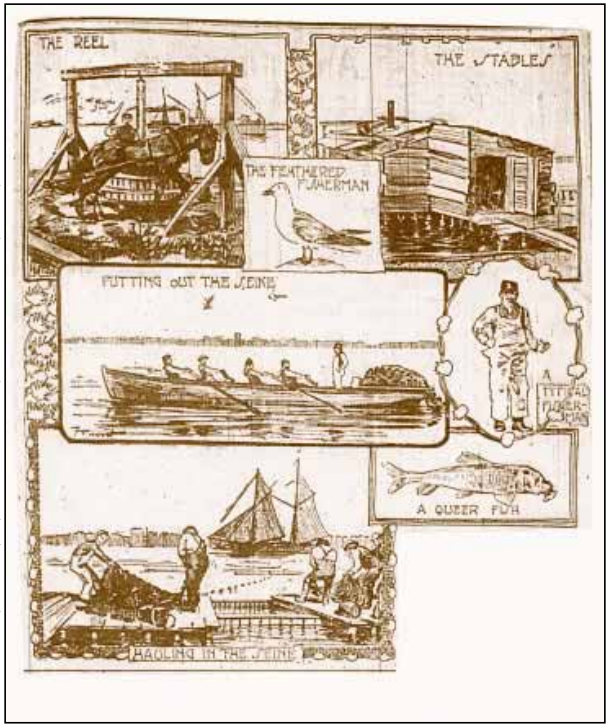
The Lake Huron to Lake Erie Corridor is a Migration Route and Spawning Area for Great Lakes Fish

h are the most numerous animals of the
en water in the Corridor. Of the 174
cies of fish recorded in the Great Lakes
in, 116 are known to occur in the St.
ir and Detroit River systems and their
utaries. This incredibly large and
erse fish fauna is due to a wide variety
quatic habitats, as well as the fact that
e species found here are at the north-
or southern limits of their range.

ce the arrival of European settlers, there
e been significant changes in the fish
mmunity, particularly during the past
tury. Exploitation by commercial and
reational fisheries, extensive shoreline
dification, pollution and introduction
exotic species have changed the abun-
nce and distribution of fish species.
ese dramatic changes become apparent
en current conditions are compared
h this account, written by Bela
bbard, who lived near the Detroit River
the late-19th Century:

*All the world is now familiar with this
rous and exquisite fish (lake whitefish),
h which our strait and lakes abound, and
ich has become an important article of
merce. In our river they are only taken
h seine and dragnets, in the spring and
. The latter is the season of the great run,
l commences with the approaching of cold
ther in October, lasting until nearly win-
…many a time I have watched the boats
hey pull upstream – a song keeping time
he oars—drop the net, and row rapidly
k to shore. Here both ends are drawn by
se windlass, the bag of the net soon
earing, distended with the shining cap-
s. They are thrown into a pile, from
ich the finest and largest may be selected
ive to ten cents a piece…..The seine of
rse catches all kinds of fish that come
hin its sweep, and are not too small to
pe its two and half inch meshes. Among
se occasionally a huge sturgeon, often
orty pounds weight. And more rarely that
nce of a fish and delicate bonne bouche,
muskellunge. The latter is also taken by
k and line in our river and in Lake Ste.
ire."*

– 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.

(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.

DOROTHY L. FRANCIS

(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

common carp **(Cyprinus carpio),** ***which is ught to have originated in Eastern Asia, was ught here as a potential food fish in the 0s. It adversely affects coastal wetlands use it uproots aquatic plants as it feeds, roying valuable submergent beds.***

otic Fish in the Lake Huron Lake Erie Corridor

re than 15 species of exotic fish in the Lake Huron to Lake Erie rridor. Of these, alewife, rainbow elt, coho salmon, chinook salmon, nbow 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.

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.***

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.

ish at Risk

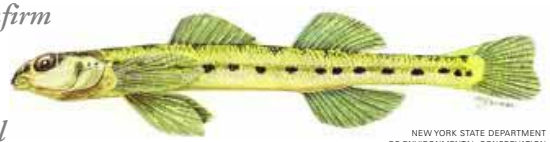
Many fish species found in the St. Clair River, Lake St. Clair and Detroit River are considered to be at risk in either Michigan or Ontario due to declining populations. Decreases in the abundance and diversity of fish are caused by various factors, including water pollution and invasive species. The 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.

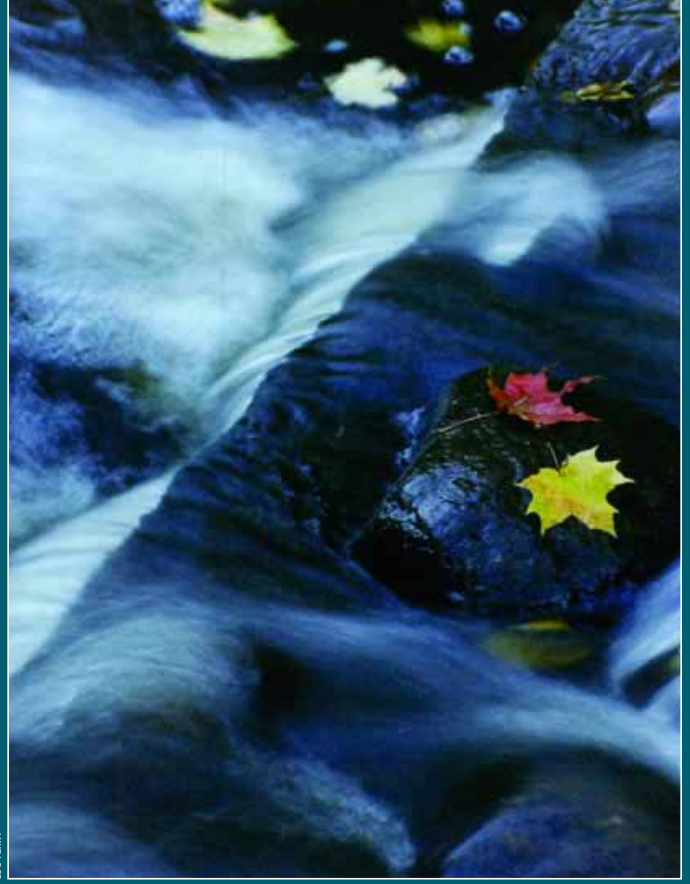
RIVERS & STREAMS

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.

ish Diversity in the Tributaries

e tributaries that flow into the
ke Huron to Lake Erie Corridor are
erally too small for large fish but
y provide habitat for smaller fish
cies such as darters and minnows.
storically, the Corridor's watersheds
e supported a diverse fish fauna.

fortunately, changes in riparian
es, such as the clearing of streamside
etation, have altered the habitat and
lted in siltation, pollution and
reased water temperatures lowering
suitability of rivers and streams to
port 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.

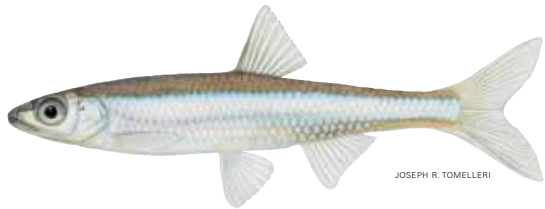
River systems in southwestern Ontario also support a great diversity of fish. The Thames River supports nearly two-thirds of Ontario's known fish fauna. The Sydenham River supports eight fish species at risk. Twenty-three species of minnows, such as the pugnose, have been identified in Essex County's 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.

annual leaf fall into rivers and creeks supplies organic matter to the stream system. It is a first link in the food chain, ling 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.