



A Guide to Ohio Streams

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Published by

**Streams Committee,
Ohio Chapter of the American Fisheries Society**

in Partnership with

Ohio Environmental Education Fund

Ohio Department of Natural Resources

Ohio Environmental Protection Agency

Columbus, Ohio 2001

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and guide to what, where, and how to find things in this book.



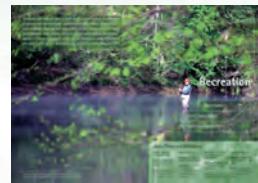
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Section Introduction

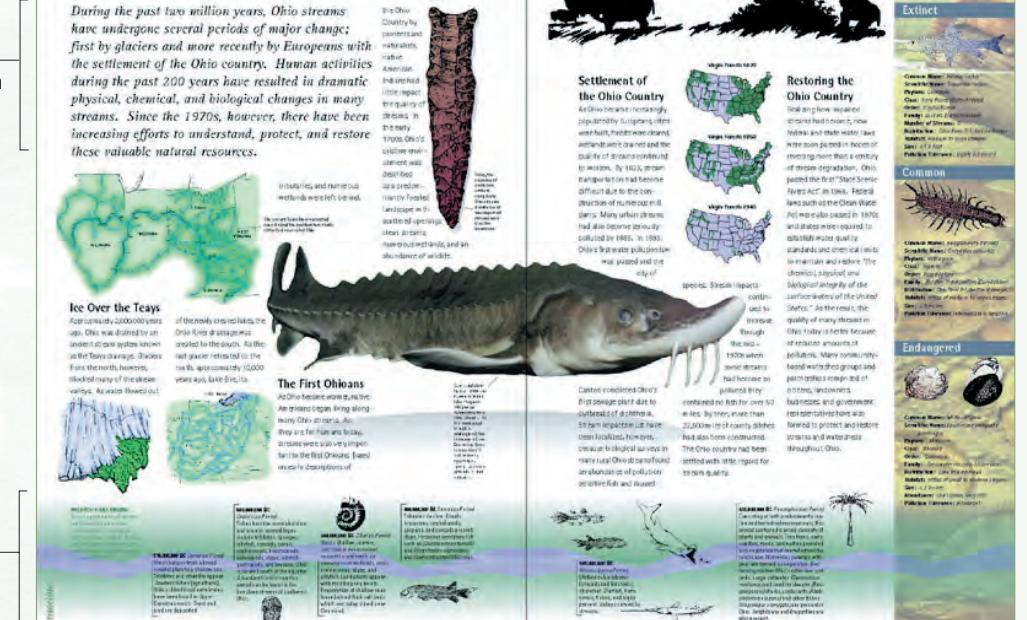
Section Heading

Chapter Section
All information pertaining to a chapter section will be contained in the white area of the page.

Chapter and Section Number
This book is divided into 10 chapters and chapter sections. This number identifies the chapter and section you are in. It also serves as a double page number.

Natural and Human Changes

During the past two million years, Ohio streams have undergone several periods of major change; first by glaciers and more recently by Europeans with the settlement of the Ohio country. Human activities during the past 200 years have resulted in dramatic physical, chemical, and biological changes in many streams. Since the 1970s, however, there have been increasing efforts to understand, protect, and restore these valuable natural resources.



"In Ohio Streams"

In this column you will find an illustration and facts about more than 100 kinds of fish, insects, mollusks, and other aquatic wildlife that live - or lived - in Ohio streams.

Partners in Stream Conservation



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Department of the Interior



Water Management
Association of Ohio



Ohio Division,
Izaak Walton League of America



The Mead Corporation
Paper Division, Woodlands Dept.



Information Design Group

Published by
Streams Committee
Ohio Chapter of the American Fisheries Society
Columbus, Ohio

Cover Art by
Rick Hill, Kentucky Department of Fish and Wildlife Resources

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Ohio Environmental Education Fund Grant 96 G 027.

This book is to be distributed as free educational material. Not for sale.

The materials contained in this guide should not be interpreted as the policies or opinions of the government of Ohio or other agencies, universities, or organizations that supported this project.

For more information contact: ODNR, Division of Wildlife, Fish Management and Research, 1840 Belcher Drive, Columbus, Ohio 43224, USA.

Printed by
The Watkins Printing Company
1401 East 17th Avenue
Columbus, Ohio 43211

First Printing: October 2000
Second Printing: February 2001

Acknowledgements

The Ohio Chapter of the American Fisheries Society (OCAFS) would like to thank and acknowledge the many individuals, agencies, and organizations that made this guide possible through authorship, financial support, review, and the generous use of illustrations, photographs, and other published material. Financial support for this project was provided by the Ohio Environmental Education Fund and in-kind services of the contributing agencies and organizations. OCAFS also thanks the Information Design Group for their graphic design skills and patience, and Dan Armitage, Tim Daniel, Ronald Stuckey, Simeon Kresge Okia, North American Bentholological Society, and *In Fisherman* magazine for the use of their photographs. All other photographs were supplied by the contributing agencies, organizations, and staff listed below and on the facing page. The government agencies that supported this project are equal opportunity providers.

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Illustrations

Rick Hill - *Stream and Big River Ecosystem Posters*, Kentucky Department of Fish and Wildlife Resources
Ronald Zimmerman, Kathryn Paluch - *Information Design Group*
Joseph Tomelleri - *Ichthyologia Scientific Color Fish Illustrations through ODNR, Division of Wildlife*
Milton B. Trautman - *The Fishes of Ohio*, Ohio State University Press
Cynthia Bishop, Gene Whitten - *ODNR, Division of Wildlife*
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Bob Hines - *Ohio Conservation Bulletin*, ODNR, Division of Wildlife
Robert Usinger - *Aquatic Insects of California*, University of California Press
Kenneth Cummins, Margaret Wilzback, Bonnie Hall - *Field Procedures for Analysis of Functional Feeding Groups of Stream Macroinvertebrates*
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From our smallest creeks to largest rivers, streams are one of Ohio's most valuable natural resources. Since the time of native Americans until today, streams have provided Ohioans with many uses and benefits. More than 1,400 species of wildlife also depend on how well Ohioans understand, use, and care for their streams.

Chapter One Streams

Natural and Human Changes

Principal Streams and Watersheds

Uses, Benefits, and Values

Stream Trivia

Useful Terms and Definitions

Brook- a general name for a small sized stream.

Creek- a general name for a small to medium sized stream.

Intermittent- a stream that has no surface flow during dry periods.

Lentic- of still or non-flowing waters.

Lotic- of flowing or running waters.

Perennial- a stream that maintains flow throughout the year.

River- a general name for

a large sized stream; a stream more than 100 miles long.

Stream- a general name for a creek, run, brook, river, ditch, swale, etc.; a body of water that flows down a gradient along a definite path.

Tributary- a stream that flows into another stream, lake or wetland.

Watershed- the land that discharges surface and groundwater to a stream. Also referred to as a stream's drainage area.

View of the Ohio River (Belmont County, Ohio and Marshall County, West Virginia).

Streams

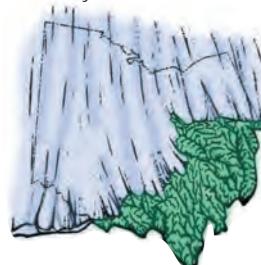
Natural and Human Changes

During the past two million years, Ohio streams have undergone several periods of major change - first by glaciers and more recently by Europeans with the settlement of the Ohio country. Human activities during the past 200 years have resulted in dramatic physical, chemical, and biological changes in many streams. Since the 1970s, however, there have been increasing efforts to understand, protect, and restore these valuable natural resources.



Ice Over the Teays

Approximately 2,000,000 years ago, Ohio was drained by an ancient stream system known as the Teays drainage. Glaciers from the north, however, blocked many of the stream valleys. As water flowed out



PALEOZOIC ERA BEGINS
Ohio's upper bedrock layers are formed by extensive sedimentation throughout seven geologic periods. Fossils indicate both shallow marine and freshwater habitats were present in Ohio.



570,000,000 BC Cambrian Period
Ohio changes from a broad coastal plain to a shallow sea. Trilobites and other life appear. Jawless fishes (agnathans), Ohio's oldest fossil vertebrates, have been found in Upper Cambrian rocks. Deposits of sand and mud form.

500,000,000 BC Ordovician Period
Fishes become more abundant and aquatic assemblages include trilobites, sponges, jellyfish, crinoids, corals, cephalopods, brachiopods, pelecypods, algae, jellyfish, gastropods, and bryozoa. Ohio's location is south of the equator. Abundant fossils from this period can be found in the limestone streams of southwestern Ohio.

440,000,000 BC Silurian Period
Ohio's shallow, marine, subtropical environment supports coral reefs, an abundance of nautiloids, snails, crustaceans, algae, and jellyfish. Land plants appear with receding sea levels. Evaporation of shallow seas leave behind thick salt beds which are today mined near Cleveland.

400,000,000 BC Devonian Period
Trilobites decline. Corals, bryozoans, cephalopods, sponges, and crinoids are present. Huge and ferocious predatory fish such as *Dunkleosteus terrelli*, *Onychodus sigmoides*, and sharks inhabit Ohio seas.



the Ohio country by pioneers and naturalists, native Americans had little impact on the quality of streams. In the early 1700s, Ohio's pristine environment was described as a predominantly forested landscape with scattered openings, clean streams, numerous wetlands, and an abundance of wildlife.

Today, the presence of prehistoric artifacts along many Ohio streams is evidence of how important streams were to native Americans.



The First Ohioans

As Ohio became warmer, native Americans began living along many Ohio streams. As they are for humans today, streams were also very important to the first Ohioans. Based on early descriptions of

Dams and other human influences have eliminated lake sturgeon (*Acipenser fulvescens*) from Ohio streams. As the numbers of this Ohio endangered fish increase in Lake Erie today, there is hope the fish will someday return to its former spawning grounds in Ohio streams.

Canton completed Ohio's first sewage plant due to outbreaks of diphtheria. Stream impacts must have been localized, however, because biological surveys in many rural Ohio streams found an abundance of pollution sensitive fish and mussel

species. Stream impacts continued to increase through the mid-1970s when some streams had become so polluted they contained no fish for over 50 miles. By then, more than 22,500 miles of county ditches had also been constructed. The Ohio country had been settled with little regard for stream quality.

Timeline

A guide to Ohio Streams

In Ohio Streams...

1.1



Virgin Forests 1620



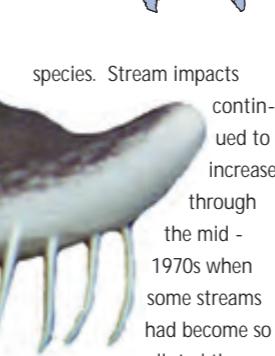
Settlement of the Ohio Country

As Ohio became increasingly populated by Europeans, cities were built, forests were cleared, wetlands were drained and the quality of streams continued to worsen. By 1825, stream transportation had become difficult due to the construction of numerous mill dams. Many urban streams had also become seriously polluted by 1885. In 1893, Ohio's first water pollution law was passed and the city of



Restoring the Ohio Country

Realizing how impaired streams had become, new federal and state water laws were soon passed in hopes of reversing more than a century of stream degradation. Ohio passed the first "State Scenic Rivers Act" in 1968. Federal laws such as the Clean Water Act were also passed in 1970s and states were required to establish water quality standards and chemical limits to maintain and restore "the chemical, physical, and biological integrity of the surface waters of the United States." As a result, the quality of many streams in Ohio today is better because of reduced amounts of pollution. Many community-based watershed groups and partnerships comprised of citizens, landowners, businesses, and government representatives have also formed to protect and restore streams and watersheds throughout Ohio.



Extinct



Common Name: harelip sucker

Scientific Name: *Lagochila lacera*

Phylum: Chordata

Class: bony fishes (Osteichthyes)

Order: Cypriniformes

Family: suckers (Catostomidae)

Number of Streams: 0

Distribution: Ohio River & Lake Erie Basins

Habitat: medium to large streams

Size: < 1.5 feet

Pollution Tolerance: highly intolerant

Locally Common



Common Name: dobsonfly larva; hellgrammite

Scientific Name: *Corydalus cornutus*

Phylum: Arthropoda

Class: Insecta

Order: Megaloptera

Family: fishflies & dobsonflies (Corydalidae)

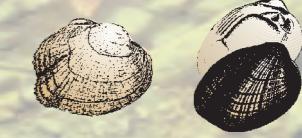
Distribution: Ohio River & Lake Erie drainages

Habitat: riffles of medium to large streams

Size: < 3 inches

Pollution Tolerance: intermediate to sensitive

Endangered



Common Name: white catpaw

Scientific Name: *Epioblasma obliquata perobliqua*

Phylum: Mollusca

Class: Bivalvia

Order: Unionida

Family: freshwater mussels (Unionidae)

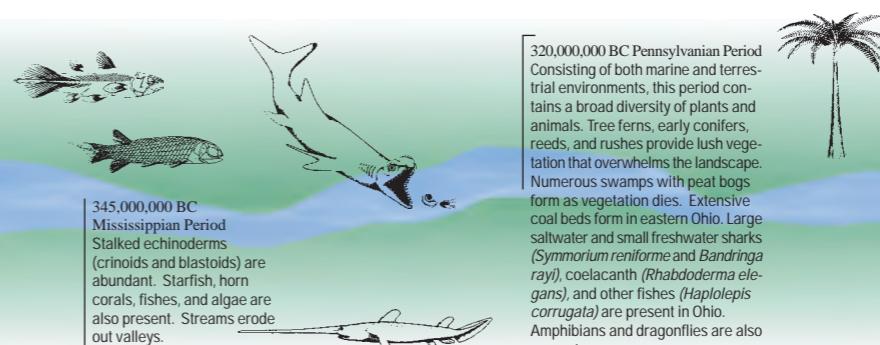
Distribution: Lake Erie drainage

Habitat: riffles of small to medium streams

Size: < 2 inches

Abundance: one stream, very rare

Pollution Tolerance: intolerant



Streams

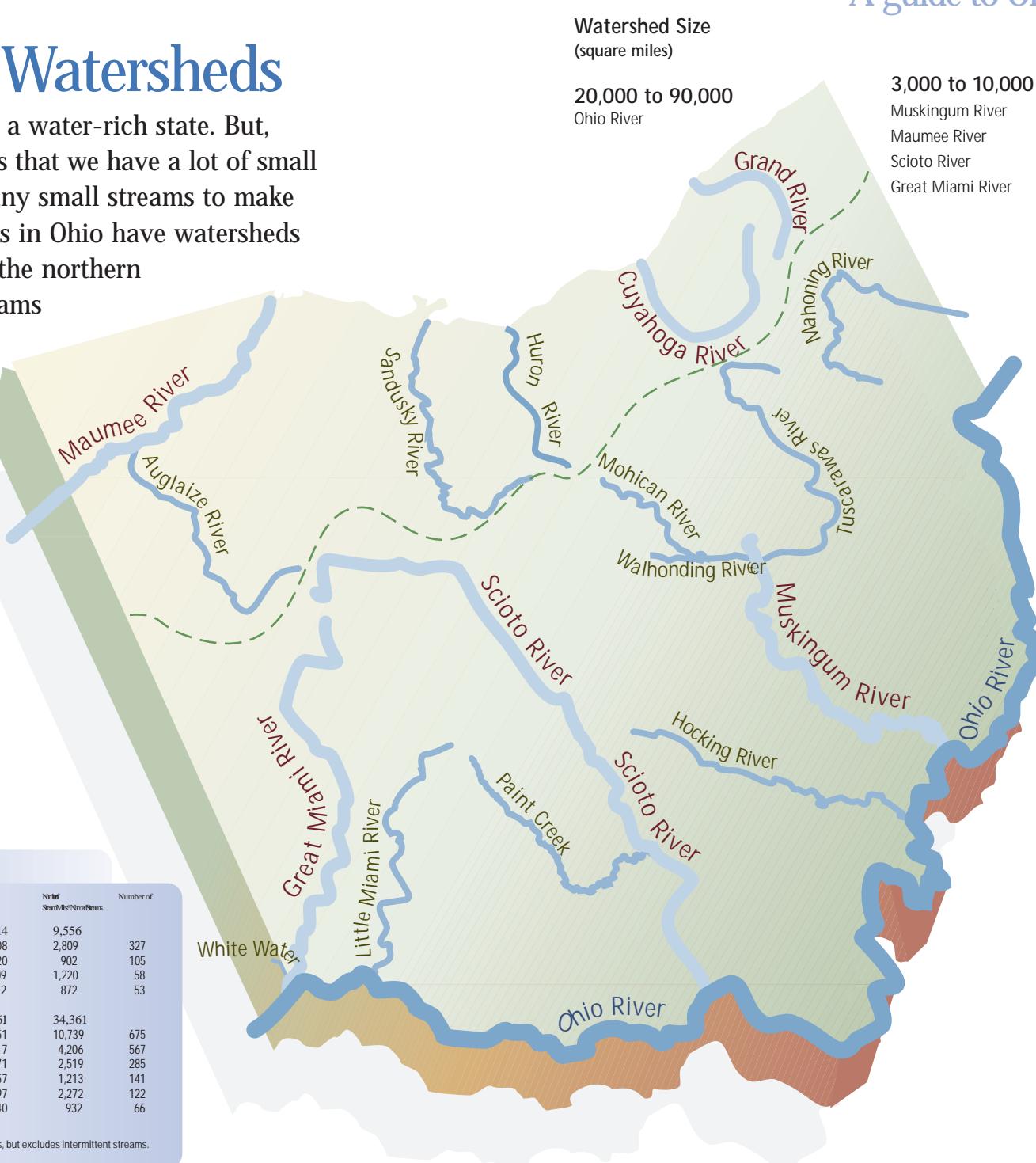
Principal Streams and Watersheds

With more than 60,000 miles of streams, Ohio is a water-rich state. But, if you look at the size of our streams, it is obvious that we have a lot of small creeks and a few large rivers. In fact, it takes many small streams to make a large one. Only 15 of the 3,300 named streams in Ohio have watersheds larger than 1,000 square miles! With streams in the northern third of the state flowing into Lake Erie and streams in the southern two-thirds flowing into the Ohio River, Ohio has two principal watersheds or drainage basins.



Streams and Watersheds

Streams and their watersheds are formed as water flows from higher to lower elevations within specific areas of land. And just like a funnel, streams drain everything that is poured into their watersheds. All streams have watersheds and all streams are tributaries. As small streams merge, larger streams are formed.



timeline

280,000,000 BC
Permian Period Begins
Early habitats include rivers, lakes, deltas with peat swamps, open marine embayments, lagoons, beaches and barrier bars. Fossils include reptile (*Dimetrodon sp.*) and amphibian bones, plants, and freshwater invertebrates.

MESOZOIC ERA BEGINS
A long gap in Ohio's development. No rocks formed during this period occur in Ohio.

PALEOZOIC ERA ENDS
245,000,000 BC
Ohio becomes an exposed continental area as the consecutive periods of extensive sedimentation end.

225,000,000 BC Triassic Period
Conifers appear and reptiles are abundant, but cannot be found in Ohio.



190,000,000 BC
Jurassic Period
Dinosaurs and other reptiles are common, but cannot be found in Ohio.



135,000,000 BC
Cretaceous Period
Dinosaurs present and mollusks are abundant.

CENOZOIC ERA BEGINS
A series of spectacular events end the long break in Ohio's geologic record. The weather turns colder in the northern hemisphere. Enormous Arctic ice caps grow and spread southward. Canada and most northern states are covered in a frozen mass of ice 1,000 to 8,000 feet thick. Seventy of Ohio's 88 counties are affected by glaciers.



Streams

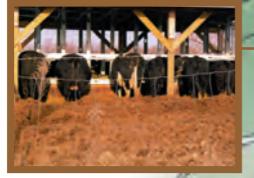
Uses, Benefits, and Values

Used a stream lately? Probably so, and in more than one way. Besides drinking water, they even provide cooling water for the generation of electricity. Streams also provide many recreational opportunities and beautiful scenery. More than 1,400 species of aquatic wildlife also depend on streams and how wisely we use our land and water.

Uses

Streams, lakes, and aquifers are important sources of water for all Ohioans. In 1997, we used approximately 10.8 billion gallons per day for public, industrial, and agricultural purposes. Streams also provide many recreational opportunities such as fishing, boating, and wildlife viewing. Stream corridors are also popular areas for parks, trails, and other greenways.

Agriculture Total surface water withdrawals in 1997 equaled approximately 16 million gallons per day from 535 intakes. The water was used for crop and livestock production, landscaping, fish and waterfowl propagation, and golf course irrigation.



Wildlife Diversity Ohio streams provide habitat for more than 1,400 species of aquatic wildlife. That is a lot considering worldwide there is only one species

of humans, one species of domestic cat, and one species of domestic dog!



Electricity The majority of water withdrawn from streams and lakes in Ohio is used as cooling water to produce electricity. In 1997, forty-two power generating facilities in Ohio used 8,569 million gallons of water per day. Coal mining, quarrying, manufacturing, and other industries also withdrew a total daily average of 449 million gallons per day.



65,000,000 BC Tertiary Period Although evidence of this period has not been found in Ohio, mammals become important and modern plants and animals appear in abundance.



2,000,000 BC Quaternary Period Ohio experiences more than four separate ice ages. Rise and dominance of man and other modern organisms.

25,400 BC The last glacial invasion, the Wisconsin stage, reaches Ohio.



13,000 BC Paleo Indians, the first people to discover the Americas, begin living in Ohio during the last ice age. They hunt now extinct species such as the mammoth and mastodon. They also fish, gather nuts and fruits, and hunt deer and small game.

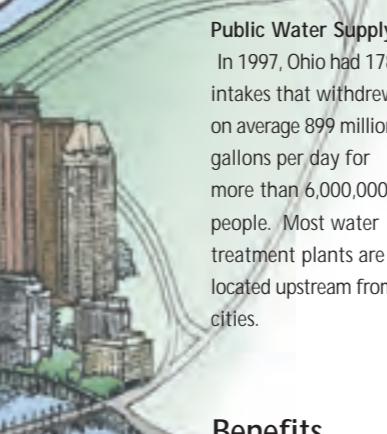


Recreation Streams provide many recreational opportunities such as canoeing and fishing.



Lakes and Reservoirs

Streams and watersheds provide water to more than 60,000 of Ohio's inland lakes, reservoirs and ponds that cover approximately 200,000 acres. Most are manmade and have multiple purposes including water supply, flood control, and recreation.



Public Water Supply

In 1997, Ohio had 178 intakes that withdrew on average 899 million gallons per day for more than 6,000,000 people. Most water treatment plants are located upstream from cities.

Benefits

The economic and social well-being of all Ohioans is closely linked to the quality and quantity of streams and the goods and services they provide.



Wastewater Treatment Plants

After water is used for public and industrial water supply, it is treated and returned to streams. Ohio has more than 3,000 point source discharges - most of which are located downstream from cities.

Values

Why is it so hard to pass over a bridge and not take a look at the stream if there isn't something special about them? Because you might miss a glimpse of wildlife or scenic view? Or is it just a natural instinct that tells us we need them to survive?

In Ohio Streams...

Locally Common



Common Name: longnose gar
Scientific Name: *Lepisosteus osseus*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Lepisosteiformes
Family: gars (Lepisosteidae)
Number of Streams: 46
Distribution: Ohio River & Lake Erie Basins
Habitat: medium to large streams
Size: < 4.5 feet

Common



Common Name: river snail
Scientific Name: *Elminia livescens*
Phylum: Mollusca
Class: snails & limpets (Gastropoda)
Order: Mesogastropoda
Family: river snails (Pleuroceridae)
Size: < 2 inches
Pollution Tolerance: intermediate

Endangered



Common Name: rabbitsfoot
Scientific Name: *Quadrula cylindrica*
Phylum: Mollusca
Class: Bivalvia
Order: Unionida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River & Lake Erie drainages
Habitat: along shore unburied in small to medium size streams
Size: < 6 inches
Abundance: rare
Pollution Tolerance: intolerant

Streams

Stream Trivia

Do you know which state passed the first Scenic Rivers Law? What percent of the earth's water is in freshwater streams? Or do you know about how many miles of streams are in Ohio? What is the largest fish species in Ohio streams? Can you name three streams that were named after birds?

Drainage Facts

- With an average annual precipitation of 38 inches, streams drain away nearly 9.5 trillion gallons of water annually from Ohio.
- 22,500 miles of county ditches have been built in Ohio.
- 4,000 miles of drainage ditches are being maintained in Ohio.
- The drain tiles in northwest Ohio could reach to the moon if stacked on top of each other.

Stream Facts

- There are more than 3,300 named streams in Ohio.
- Ohio has an estimated 61,532 total miles of streams.
- Every stream is a tributary with a watershed.
- Each location in a stream has a drainage area or watershed.
- Ohio passed the first scenic rivers law in 1968.

Water Facts

- About two-thirds of the earth's surface is covered with water.
- About 97.2% of the earth's water is in the oceans.
- Only 2.8% of the earth's water is freshwater of which about three-fourths is frozen.
- Streams and lakes hold less than 0.02% of the earth's water.
- In 1990, each person in Ohio used an estimated 143 gallons of water per day. Annually this amounts to 52,195 gallons!

Inorganic Sediment Facts

Group Name	Particle Name	Diameter Size (mm)
Rocks	Boulder	>255
	Cobble	65 - 255
Gravel	Pebble	4 - 64
	Granule	2.0 - 3.9
Sand	Very Coarse Sand	1.0 - 1.9
	Coarse Sand	0.5 - 0.9
Silt	Medium Sand	0.25 - 0.49
	Fine Sand	0.125 - 0.249
Clay	Very Fine Sand	0.062 - 0.124
	Silt	0.004 - 0.061
	Clay	0.000 - 0.0039

State Facts

- Ohio is about 44,846 square miles in surface area (land 40,469 sq. mi. and water and wetlands 4,377 sq. mi.).

Gradient Facts

- Average stream gradients (or rate of fall) in Ohio ranges from a high of 627.7 ft./mi. (Boland Run, Scioto Co.) to a low of 0.1 ft./mi. (Toussaint River, Ottawa Co.).

Fish Facts

- Ohio's most common stream fish - the creek chub - lives in more than 90% of Ohio's streams.
- Ohio's largest common stream fish - the flathead catfish - can exceed four feet in length and weigh more than 80 pounds.
- Ohio's smallest stream fish - the least darter - is less than two inches long.
- American eels are champion long distance swimmers! One eel swam more than 2,000 miles to reach Salt Lick Creek (Ross Co.) after hatching in the Atlantic Ocean.
- About 153 species of fish live in Ohio streams.

Stream Names

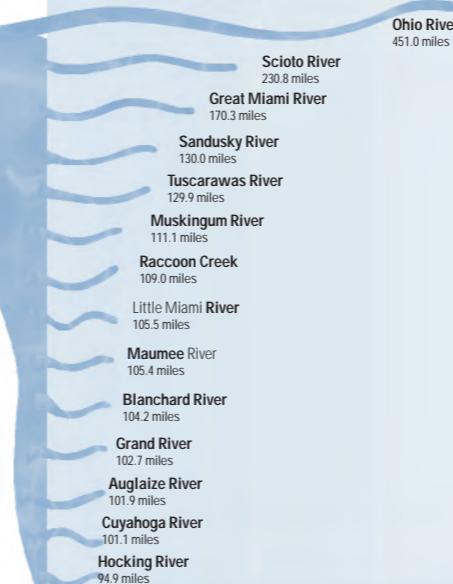
With more than 4,000 different streams in Ohio, names are important! Names can describe a stream's location, size or local history. Most contain two words - a descriptor such as the name of an animal and a second word that usually describes its size. Small-sized streams often end with *run, fork or brook*, medium-sized streams usually end with *creek*, and large-sized streams usually end with *river*. Most rivers are more than 100 miles in length.

Since some streams have the same name, it is also wise to name what stream it flows into and the name of its major watershed.

Name	#
Run	1,589
Creek	1,207
Unnamed	334
Fork	303
Ditch	232
Branch	171
River	52
Brook	20

Descriptors	#	Mammals	#	Birds	#
Dry	53	Wolf	34	Turkey	31
Big	36	Bear	25	Goose	14
Long	26	Beaver	23	Duck	7
Clear	20	Bull	12	Owl	7
Muddy	14	Hog	12		
		Dog	8		
Food				Minerals	
Sugar	37			Mud	30
Plum	22			Rock	13
Salt	18			Sand	10
Honey	16			Coal	9
				Slate	8
Colors					
Black	24			Patriotic	
Yellow	12			Flag	5
Silver	11			Congress	4
				Yankee	2
Trees					
Pine	16				
Cedar	14				
Sycamore	12				
Walnut	8				

Ohio's Longest Streams



Indian Names

Chickamauga Creek
Chickasaw Creek
Cuyahoga River
Kinnikinnick Creek
Macochee Creek
Mississinewa River
Olentangy River
Scioto River
Talawanda Creek
Wakatomika Creek
Ottawa River
Ohio River

In Ohio Streams...

Common



Common Name: creek chub
Scientific Name: *Semotilus atromaculatus*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Cypriniformes
Family: minnows & carps (Cyprinidae)
Number of Streams: 882
Distribution: Ohio River & Lake Erie Basins
Habitat: small to medium streams
Size: < 12 inches
Pollution Tolerance: highly tolerant

Common



Common Name: sow bug
Scientific Name: *Caecidotea sp.*
Phylum: Arthropoda
Class: Crustacea
Order: Isopoda
Family: sow bugs (Asellidae)
Size: < 1 inch
Pollution Tolerance: tolerant

Endangered



Common Name: monkeyface
Scientific Name: *Quadrula metanevra*
Phylum: Mollusca
Class: Bivalvia
Order: Unionoida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River drainage
Habitat: moving water in large streams
Size: < 4 inches
Abundance: rare
Pollution Tolerance: intolerant

Hydrology sediment transport, and other fluvial processes work together to shape stream channels and floodplains. Bedrock, relief, and weather also help determine the physical, chemical, and biological qualities of a stream. Geographical location, human population densities, and land use are equally important.

Chapter Two

Geology and Geography

Bedrock, Ground Water, and Glacial Deposit

Climate and Water Cycle

Precipitation

Relief and Land Use

Useful Terms and Definitions

Alluvium- a general name for sediment deposited on land by streams.

Aquifer- a water-bearing subsurface layer of sand, gravel or rock.

Bedrock- solid rock that is usually beneath the soil or glacial till. It can often be seen exposed in streams or

road cuts along highways.

Erosion- the removal or wearing away of soil or other material by water, wind, glacier or other forces.

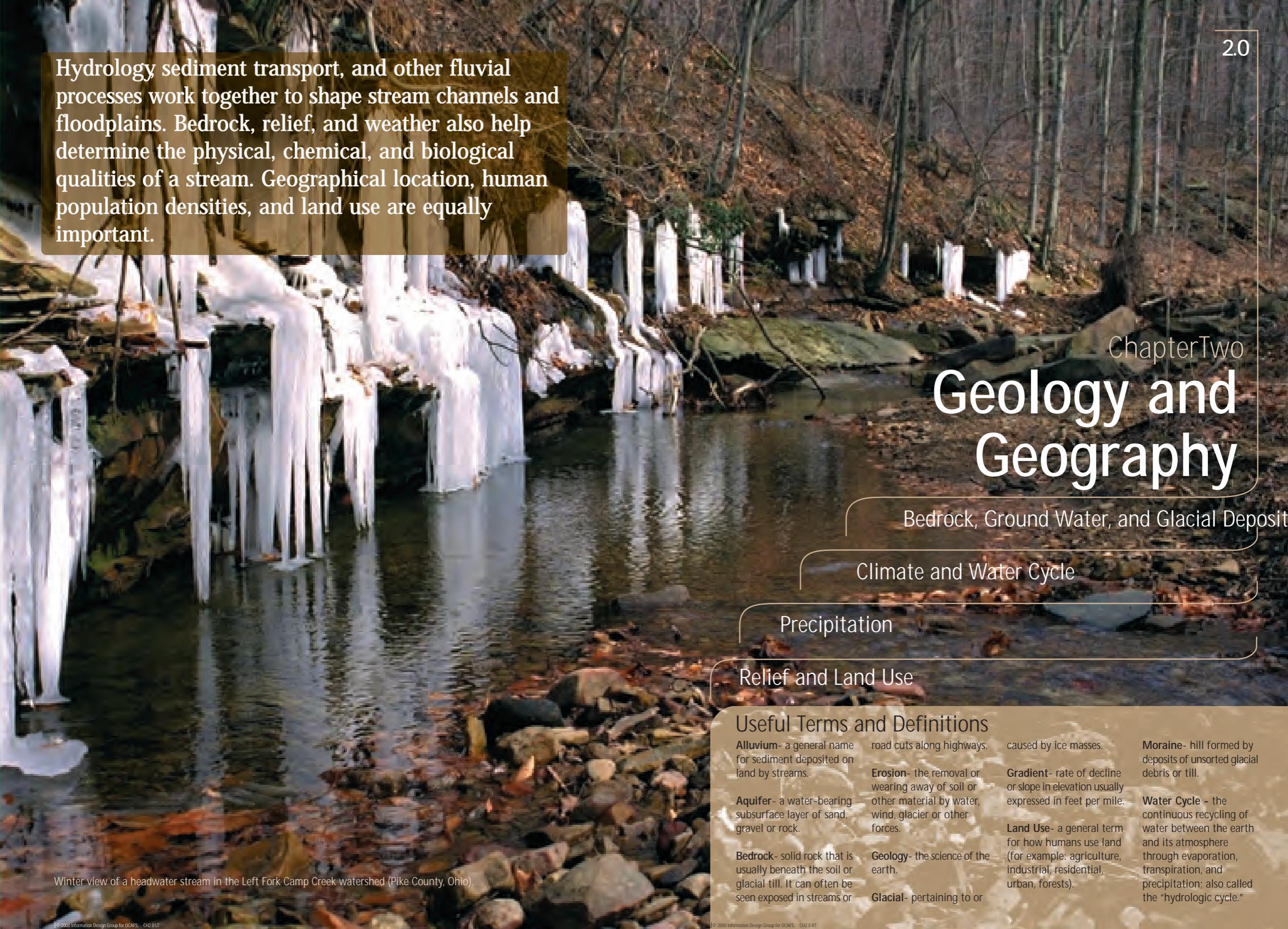
caused by ice masses.

Gradient- rate of decline or slope in elevation usually expressed in feet per mile.

Moraine- hill formed by deposits of unsorted glacial debris or till.

Water Cycle - the continuous recycling of water between the earth and its atmosphere through evaporation, transpiration, and precipitation; also called the "hydrologic cycle."

Winter view of a headwater stream in the Left Fork Camp Creek watershed (Pike County, Ohio).



Geology and Geography

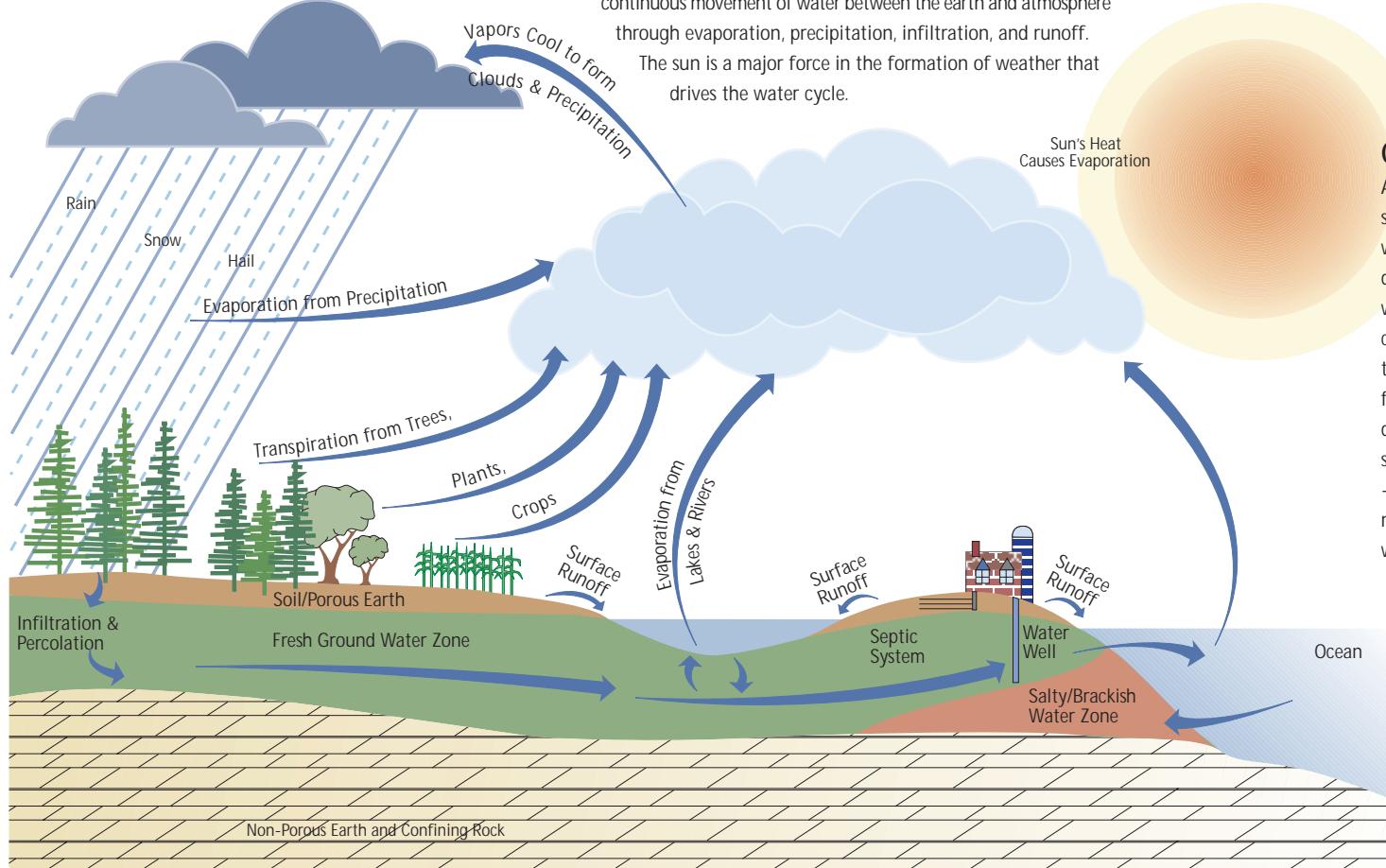
Climate and Water Cycle

Today, Ohio's temperate climate and freshwater streams are primarily determined by geographic location, prevailing air currents, and elevation. As the earth's water is recycled between the land and atmosphere, climate and weather help determine the types and number of streams we have. Weather extremes - blizzards, tornados, floods, and droughts - help to determine which species of wildlife can live in our streams.

Water (Hydrologic) Cycle

As the earth's water is recycled, it appears in many forms - streams, clouds, rain, snow, oceans, fog, ice, groundwater, and lakes to name a few. The hydrologic or water cycle is the continuous movement of water between the earth and atmosphere through evaporation, precipitation, infiltration, and runoff.

The sun is a major force in the formation of weather that drives the water cycle.



1681
King Charles II of England gives William Penn proprietary rights to what becomes the huge colony of Pennsylvania.

1740
Pennsylvania has a population of over 80,000.

1750
Settlers, frontiersmen, and soldiers describe Ohio as densely forested woodlands with huge trees, high quality streams, and abundant wildlife. Streams, with forested banks and floodplains, ran clear with water good enough to drink. Stream substrates were clean with little silt.



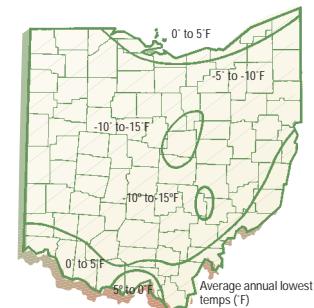
1766
Lt. T. Hutchens surveys the Ohio River. The first accurate report and map of the Ohio River will be published in London in 1778.

Timeline



Climate and Weather

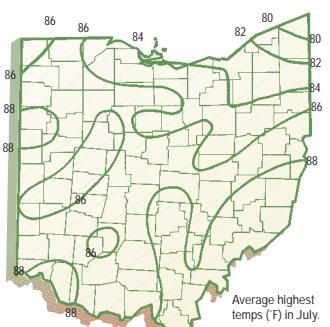
As the earth makes its annual trip around the sun, Ohio experiences four seasons and dramatic weather changes - blizzards, tornados, floods, droughts, hail, wind, sleet, and sweltering heat waves. These seasonal changes are why Ohio's climate is classified as temperate instead of tropical or polar. Ohio's prevailing winds come from the southwest and one or two weather disturbances usually occur each week. Major storms typically come from one of three directions - Canadian and Arctic cold fronts from the northwest, Pacific cold fronts from the west, and warm fronts from the southwest.



Location

Ohio is located approximately 3,000 miles north of the equator between 38 degrees 27 minutes to 41 degrees 57 minutes north latitude and 80 degrees 34 minutes to 84 degrees 49 minutes west longitude. The state covers approximately 44,846 square miles and is nearly square extending 225 miles east to west and 210 miles south to north.

Although two-thirds of the earth's surface is covered with water, less than 3% is freshwater. Most freshwater is stored in glaciers and ice caps and less in ground and surface water. The smallest amounts are stored in the atmosphere, plants, and animals.



A guide to Ohio Streams

In Ohio Streams...

2.2

Endangered



Common Name: speckled chub
Scientific Name: *Macrhybopsis aestivalis*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Cypriniformes
Family: minnows & carps (Cyprinidae)
Number of Streams: 1
Distribution: Ohio River Basin
Habitat: large streams
Size: < 3 inches
Pollution Tolerance: intolerant

Common

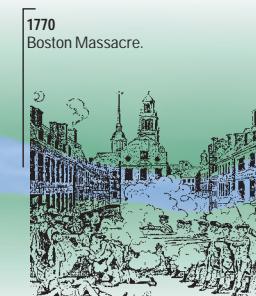


Common Name: caddisfly larva
Scientific Name: *Helicopsyche* sp.
Phylum: Arthropoda
Class: Insecta
Order: caddisflies (Trichoptera)
Family: Helicopsychidae
Distribution: Ohio River & Lake Erie Basins
Size: < 1 inch
Pollution Tolerance: intolerant

Endangered



Common Name: wartyback
Scientific Name: *Quadrula nodulata*
Phylum: Mollusca
Class: Bivalvia
Order: Unionoida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River
Habitat: sand & gravel bars
Size: < 3 inches
Abundance: one stream, rare
Pollution Tolerance: intolerant



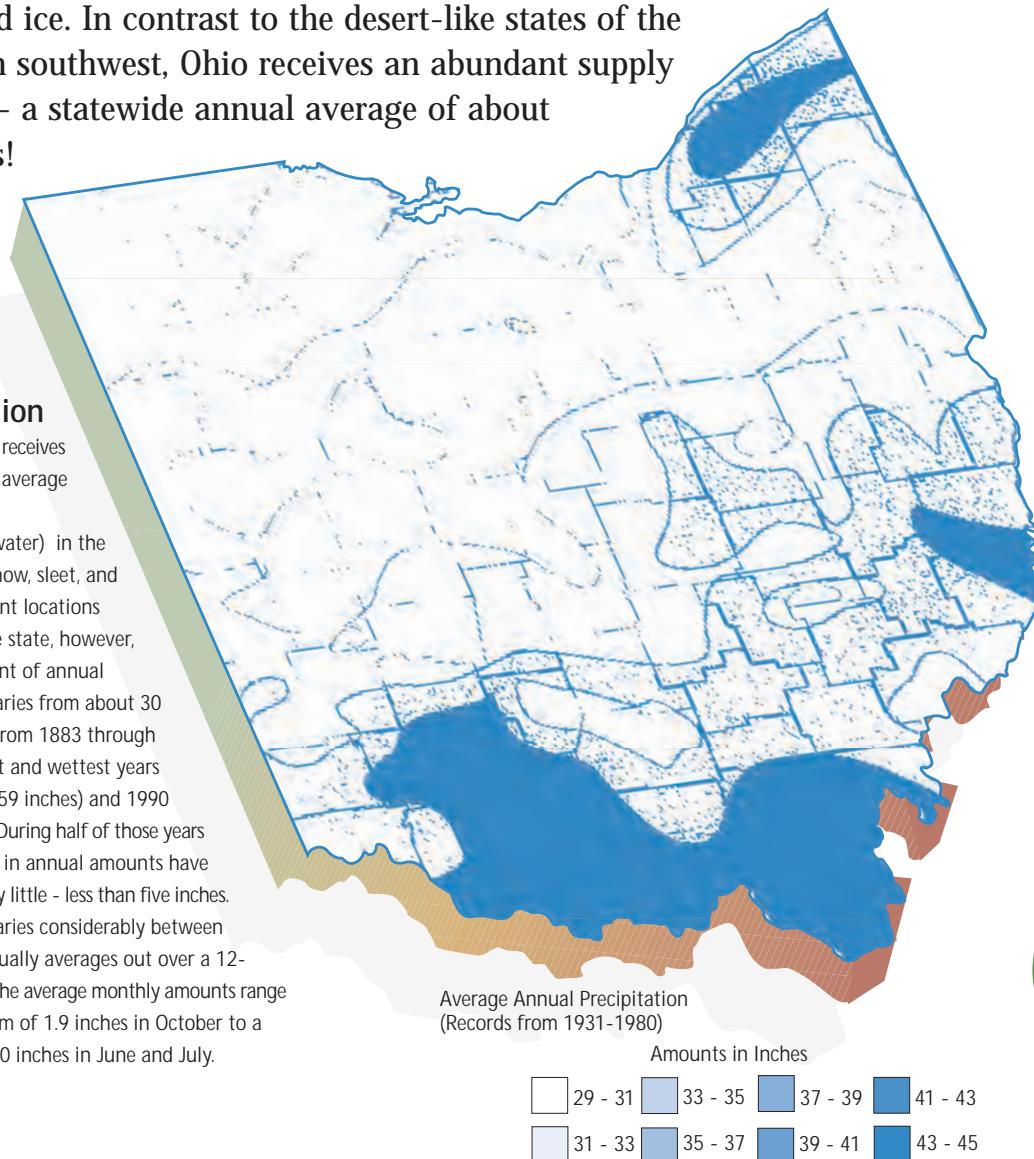
1770
Boston Massacre.

1773
Colonists dump tea into the Boston Harbor. The British retaliate in 1774 with a series of coercive acts. The Revolutionary War is underway.

Geology and Geography

Precipitation

Streams and life in Ohio could not exist without precipitation - water. And Ohio receives it in many forms such as rain, snow, and ice. In contrast to the desert-like states of the American southwest, Ohio receives an abundant supply of water - a statewide annual average of about 38 inches!



1775
As an agent of the Transylvania Company, Daniel Boone leads a group of settlers to Kentucky to establish a fort at Boonesborough.



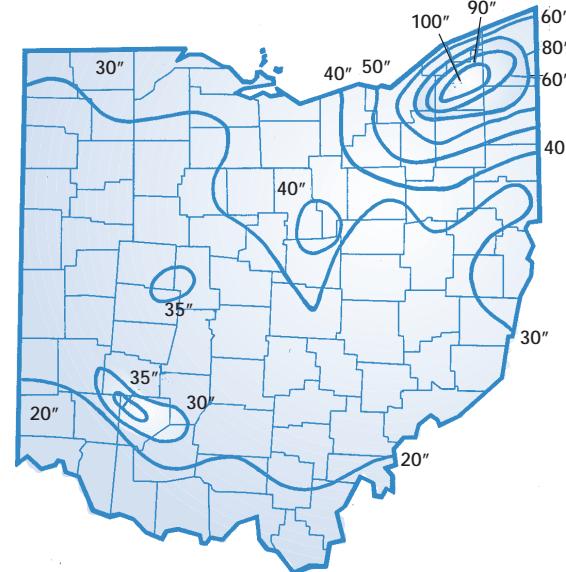
1776
Colonies declare independence from Great Britain with the signing of the Declaration of Independence. The United States begins.

1780
During the Revolutionary War, Captain Byrd is in command of 600 British and Indians as they float down the Great Miami River to conduct raids in Kentucky.

1785
The U.S. Land Ordinance stipulates that the public domain should be surveyed into a rectangular system of townships and sections. The erection of Fort Harmar begins on the northwest bank of the Muskingum and Ohio rivers.

Floods and Droughts

Floods and droughts are natural, reoccurring phenomena that can happen during any month. Flooding can be caused by a number of factors, but is usually associated with heavy rains and above freezing temperatures. A rapid snowmelt on frozen ground coupled with heavy rains is a common formula for flooding during the winter months. During the spring and early summer, flooding is typically caused by prolonged rains or heavy rainfall over a large part of a watershed.



Average Annual Snowfall



View of flooding along the Ohio River.

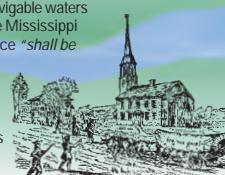


View of late summer drought conditions in Ohio Brush Creek (Adams County, Ohio).

Wet and Dry Years
(Statewide 1883 - 1998)

Wet Years (> 44 inches)	Dry Years (< 32 inches)
1883	45.57
1890	50.37
1913	45.03
1929	45.91
1937	44.50
1945	44.58
1950	47.68
1979	45.17
1990	51.53
1996	47.13
1894	29.72
1895	28.28
1901	31.27
1930	26.59
1934	26.66
1941	31.60
1953	28.57
1963	26.84
1987	31.38
1988	31.51
1991	31.91

1787
The Ordinance of 1787 provides for the orderly development of the states within the Northwest territory. It also includes language that declares the navigable waters leading into the Mississippi and St. Lawrence "shall be common highways and forever free." The First Company starts for the Ohio country.



1788
Frontier settlements appear in Ohio. A village known as The Muskingum becomes the first official American settlement in the Northwest Territory as it locates at the confluence of the Muskingum and Ohio rivers. The first Ohio Company office is built there. Cincinnati begins as a village known as Columbia is built on the north bank of the Ohio River downstream from the Little Miami River.

In Ohio Streams...

2.3

Locally Common



Common Name: brook stickleback
Scientific Name: *Culaea inconstans*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Gasterosteiformes
Family: sticklebacks (Gasterosteidae)
Number of Streams: 69
Distribution: Ohio River & Lake Erie Basins
Habitat: small, cold spring-fed streams
Size: < 2.7 inches

Common



Common Name: caddisfly larva
Scientific Name: *Hydropsyche sp.*
Phylum: Arthropoda
Class: Insecta
Order: caddisflies (Trichoptera)
Family: Hydropsychidae
Distribution: Ohio River & Lake Erie Basins
Size: < 1 inch
Pollution Tolerance: intermediate

Endangered



Common Name: ebonyshell
Scientific Name: *Fusconaia ebena*
Phylum: Mollusca
Class: Bivalvia
Order: Unionoida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River
Habitat: muddy sand or gravel
Size: < 4 inches
Abundance: one stream, rare
Pollution Tolerance: tolerant of impoundment

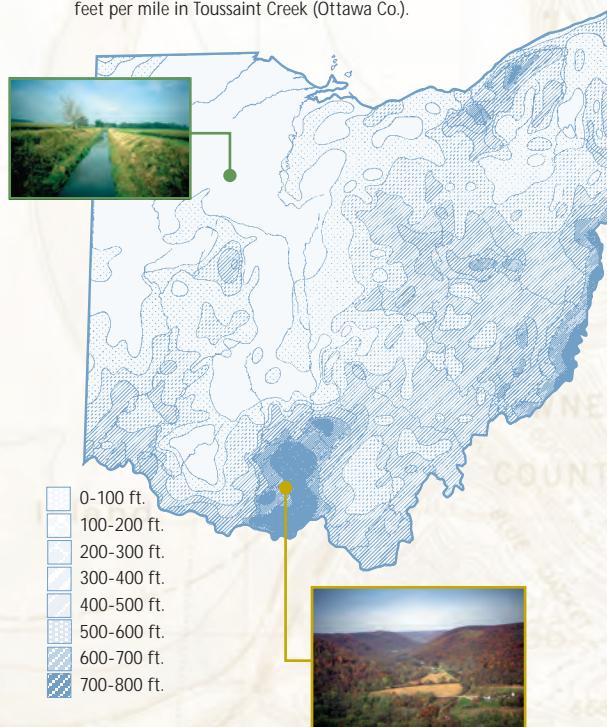
Geology and Geography

Relief and Land Use

From the hill country to the flatlands, the relief of the land influences streams in many ways. It defines each stream's watershed, size, and gradient - how far the water falls from its headwaters to its confluence with another stream. Relief often even defines how we use the land. Within Ohio, there are three principal types of land use. Just look around and you will probably see land that is mostly farmed, forested, or developed.

Relief

Ohio's relief varies a total of 1,120 feet from its lowest elevation (430 feet above sea level at the mouth of the Great Miami River in Hamilton Co.) to the highest point (1550 feet above sea level at Campbell Hill in Logan Co.). The difference in elevation within a watershed determines the gradient or rate of fall for a stream. In Ohio it ranges from a maximum of 627.7 feet per mile in Boland Run (Scioto Co.) to a minimum of 0.1 feet per mile in Toussaint Creek (Ottawa Co.).



Lake Plains

This region lies between the southern shore of Lake Erie and the Glacial Lake Maumee Beach Ridge. The area has little relief and contained numerous wetlands before settlement. Today, most of the area has been cleared and artificially drained through an extensive network of ditches. Land use is predominantly agriculture, but also includes cities, suburbs, and industries. Streams are very low gradient and have been degraded by channelization, development, and agricultural practices.

Till Plains

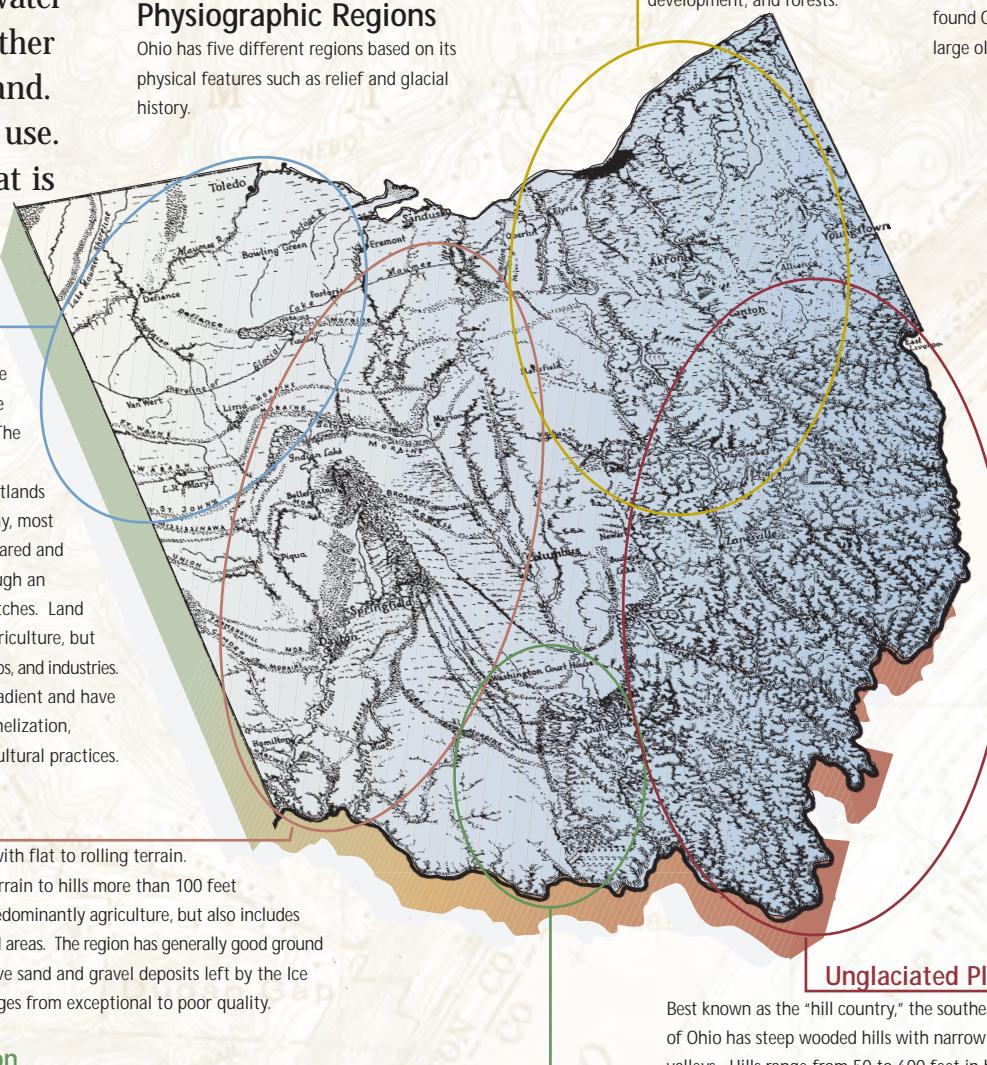
This region is glaciated with flat to rolling terrain. Relief varies from flat terrain to hills more than 100 feet in height. Land use is predominantly agriculture, but also includes large urban and industrial areas. The region has generally good ground water yields and extensive sand and gravel deposits left by the Ice Age. Stream quality ranges from exceptional to poor quality.

Blue Grass Region

This unique region also has deeply dissected and rugged terrain. Most of its streams are high gradient with limestone bedrock substrates. Stream quality is generally good with outstanding sportfisheries.

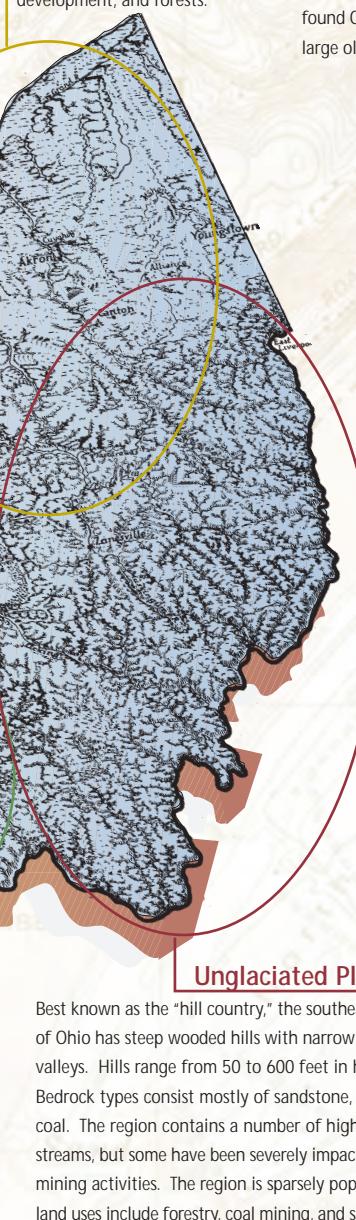
Physiographic Regions

Ohio has five different regions based on its physical features such as relief and glacial history.



Glaciated Plateau

This region has higher relief than the other glaciated regions of Ohio. Most streams have moderate to high gradients with coarse substrates comprised of boulders, bedrock, sand, and gravel. Land use includes a mixture of agriculture, residential development, and forests.



1789 Rufus Putnam, who directed the settlement of Marietta, was appointed a judge of the Supreme Court of the Territory by Washington.



1790 Wolf Creek Mills (Washington Co.) begins operating as both a grist and sawmill. Hamilton becomes the second county established in the Northwestern Territory. Ohio has a population of about 3,000 residents.



1791 The first floating mill on the Ohio was anchored at the mouth of the Hocking River. Powered by water current, it could grind 40 bushels of corn an hour.

1795 In the Treaty of Greenville, Indians ceded most of their land in Ohio to the federal government.

1796 Cleveland, at the mouth of the Cuyahoga River becomes a village. The legal sales of the territory's public land began through a federal land office in Pittsburgh, PA.

1797 Zane's Trace, a crude overland road, has been blazed between Maysville, KY and Wheeling WV. The town of Franklinton, which later becomes part of Columbus, is laid out.

A guide to Ohio Streams

Land Use

The way we use the land within a watershed helps determine the quality of a stream. Watersheds may have a mixture of land uses, but are usually predominated by one of three types - developed, farmed, or wooded. Stream surveys have shown Ohio's highest quality streams have watersheds that are sparsely populated and predominated by forests (with no coal mining) or farmland without channelized ditches. Surveys have also found Ohio's most impacted streams flow through large urban areas with large old industries.

FARMLAND

Cropland, pastures, and other farmland remains the predominant land use in Ohio, but has been steadily declining since 1940. Some of Ohio's highest quality streams have watersheds that are predominantly farmed.

ADVANTAGES: few people; few impervious surfaces
THREATS: channelization; drainage of wetlands; soil erosion; pesticide, fertilizer, and manure runoff; stream encroachment; livestock in streams
TREND: declining, but size of farms is increasing

WOODLANDS

Forested land in Ohio has increased since 1940.
ADVANTAGES: few people; few impervious surfaces; most natural to pre-European settlement conditions
THREATS: soil erosion from clear cutting
TREND: appears stable

CITIES AND SUBURBS

The conversion of farmland and other rural land is the greatest threat to many Ohio streams.
ADVANTAGES: few
THREATS: high water use; dams; destruction of headwater streams; soil erosion during construction; larger sewage treatment plants, sewage overflows after heavy rains; higher percentages of effluent and more nutrients during low flow, more hard surfaces which result in faster stormwater runoff, eroding stream banks, and less groundwater recharge
TREND: increasing

In Ohio Streams...

Common



Common Name: white sucker
Scientific Name: *Catostomus commersoni*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Cypriniformes
Family: suckers (Catostomidae)
Number of Streams: 806
Distribution: Ohio River & Lake Erie Basins
Habitat: small to medium streams
Size: < 25 inches
Pollution Tolerance: highly tolerant

Common

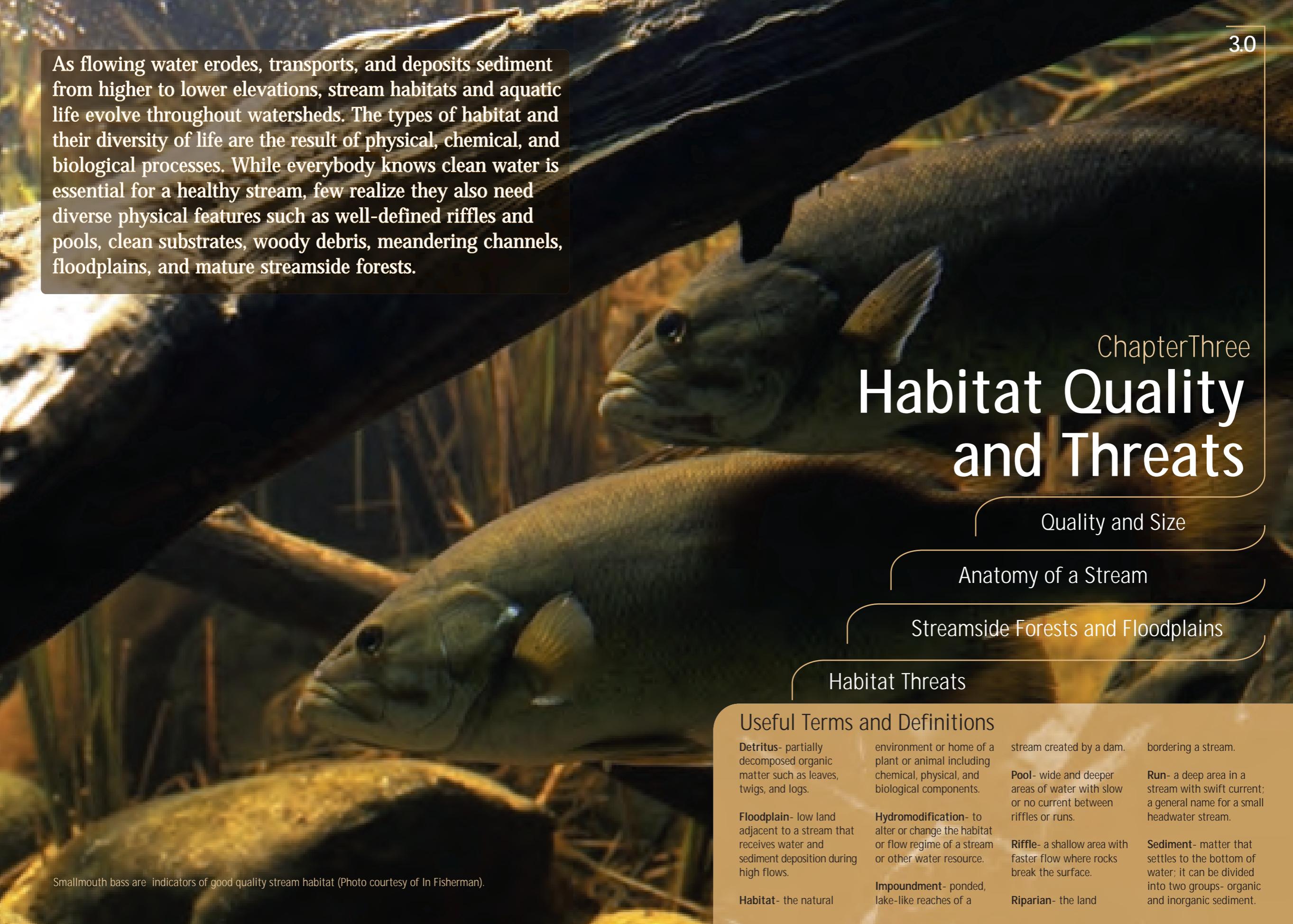


Common Name: crane fly larva
Scientific Name: *Tipula sp.*
Phylum: Arthropoda
Class: Insecta
Order: Diptera
Family: Tipulidae
Distribution: Ohio River & Lake Erie Basins
Size: < 3 inches
Pollution Tolerance: tolerant to intolerant

Common



Common Name: Wabash pigtoe
Scientific Name: *Fusconaia flava*
Phylum: Mollusca
Class: Bivalvia
Order: Unionida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River & Lake Erie Basins
Habitat: small to large streams
Size: < 4 inches
Abundance: common
Pollution Tolerance: tolerant



As flowing water erodes, transports, and deposits sediment from higher to lower elevations, stream habitats and aquatic life evolve throughout watersheds. The types of habitat and their diversity of life are the result of physical, chemical, and biological processes. While everybody knows clean water is essential for a healthy stream, few realize they also need diverse physical features such as well-defined riffles and pools, clean substrates, woody debris, meandering channels, floodplains, and mature streamside forests.

Chapter Three

Habitat Quality and Threats

Quality and Size

Anatomy of a Stream

Streamside Forests and Floodplains

Habitat Threats

Useful Terms and Definitions

Detritus- partially decomposed organic matter such as leaves, twigs, and logs.

Floodplain- low land adjacent to a stream that receives water and sediment deposition during high flows.

Habitat- the natural

environment or home of a plant or animal including chemical, physical, and biological components.

Hydromodification- to alter or change the habitat or flow regime of a stream or other water resource.

Impoundment- ponded, lake-like reaches of a

stream created by a dam.

Pool- wide and deeper areas of water with slow or no current between riffles or runs.

Riffle- a shallow area with faster flow where rocks break the surface.

Riparian- the land

bordering a stream.

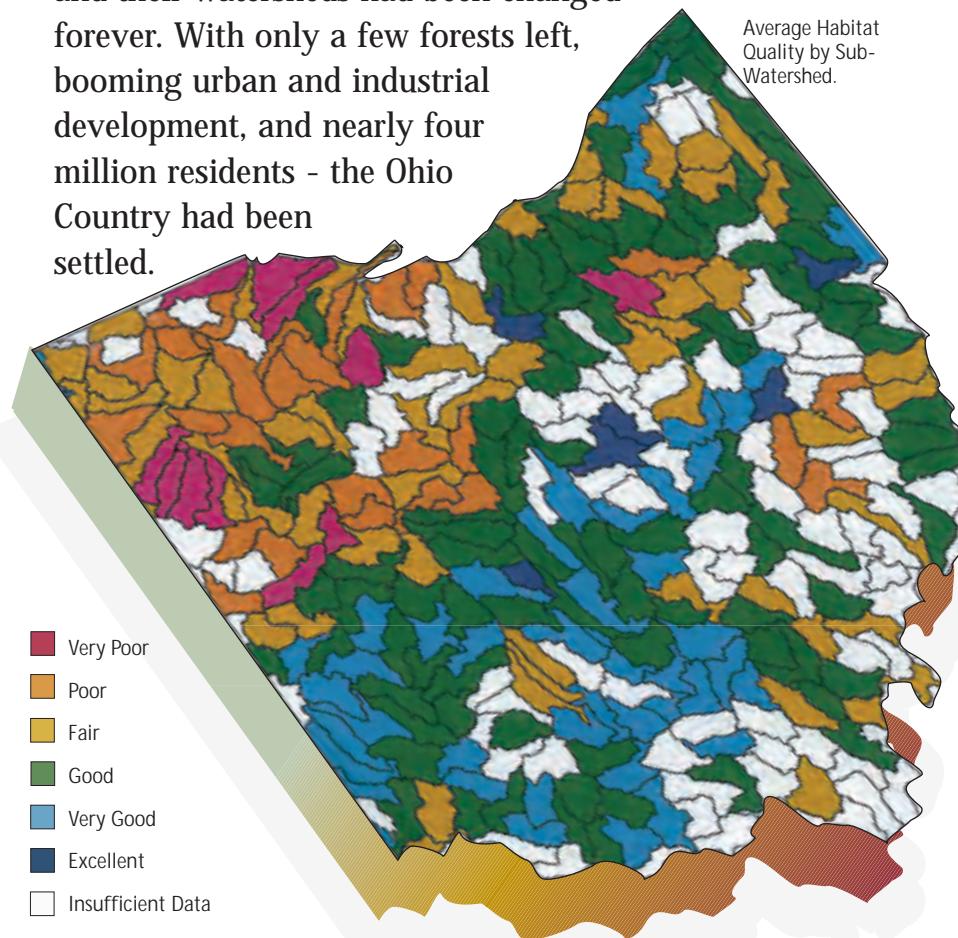
Run- a deep area in a stream with swift current; a general name for a small headwater stream.

Sediment- matter that settles to the bottom of water; it can be divided into two groups- organic and inorganic sediment.

Habitat Quality and Threats

Quality and Size

Accounts by pioneers leave little doubt about the exceptional quality of stream habitats throughout the Ohio Country in the 1700s. Watersheds were densely forested with scattered openings and abundant wildlife. Streams ran clear through deep, narrow channels shaded by leaning trees that crowded their banks. Even small streams flowed throughout the year. By the late 1800s, however, streams and their watersheds had been changed forever. With only a few forests left, booming urban and industrial development, and nearly four million residents - the Ohio Country had been settled.



1799
A law passes that encourages the killing of wolves to promote the raising of sheep in Ohio.



1800
Frontier settlement in Ohio is accelerated when the purchase of public land becomes easier with the opening of land offices in Marietta and Steubenville. Ohio's population increases to 45,365 residents.

Timeline

1801
Thomas Jefferson calls the Ohio River "the most beautiful river in the world." Land offices open in Cincinnati and Chillicothe.

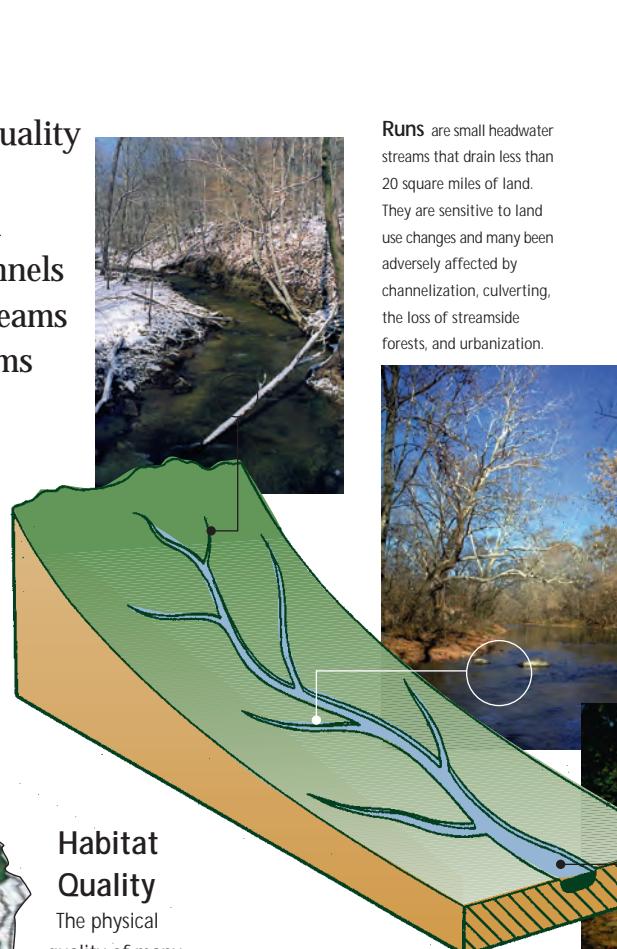


1802
Cincinnati's first chemical plant produces sulfuric acid.



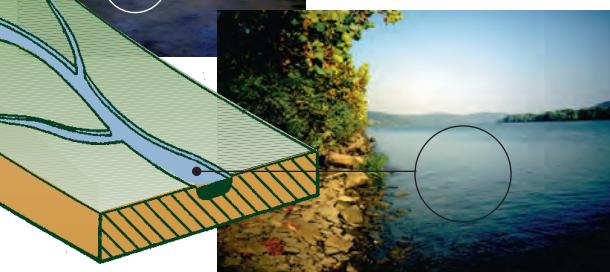
1803
Ohio becomes the first state formed from the Northwest Territory. After leaving Pittsburgh and struggling with their keelboat through low water for 76 days over more than 950 river miles, the Lewis and Clark expedition reaches the Mississippi River.

1804
The Zanesville Land Office opens.



Runs are small headwater streams that drain less than 20 square miles of land. They are sensitive to land use changes and many have been adversely affected by channelization, culverting, the loss of streamside forests, and urbanization.

Creeks are small to medium size streams formed by the confluence of headwater streams. They usually drain less than 700 square miles of land. Most have riffles that can be waded across during low flows.



Rivers are large or long streams. They are usually over 100 miles long with watersheds greater than 700 square miles. Compared to creeks, rivers usually have higher flows, lower gradients, longer pools, and deeper and swifter chutes and rapids. Rivers are usually too deep to wade across except in their headwaters.

Exceptional Quality

Habitat Attributes:

- Predominantly rural watersheds
- Natural meandering channels
- Forested stream corridors with connected floodplains
- Clear water
- Silt-free substrates comprised of sand, gravel, cobble, and boulders or bedrock slabs
- Constricted low flow channels with vegetated islands, high flow channels, and dense patches of water-willow



Poor Quality

Habitat Attributes:

- Predominantly developed watersheds with a high percentage of impervious surfaces
- Modified by channelization or dams
- Straight and uniform shallow channels
- Entrenched channels
- Turbid water
- Predominantly silt or artificial substrates
- No streamside forests

Special Interest

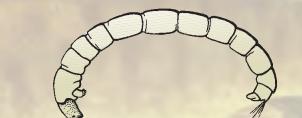


Common Name: purple wartyback
Scientific Name: *Cyclonaias tuberculata*
Phylum: Mollusca
Class: Bivalvia
Order: Unionida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River & Lake Erie Basins
Habitat: medium to large streams
Size: < 5 inches
Abundance: rare to common
Pollution Tolerance: intolerant

Locally Common

Common Name: stonecat
Scientific Name: *Noturus flavus*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Siluriformes
Family: catfishes (Ictaluridae)
Number of Streams: 145
Distribution: Ohio River & Lake Erie Basins
Habitat: medium to large streams
Size: < 12 inches
Pollution Tolerance: intolerant

Common

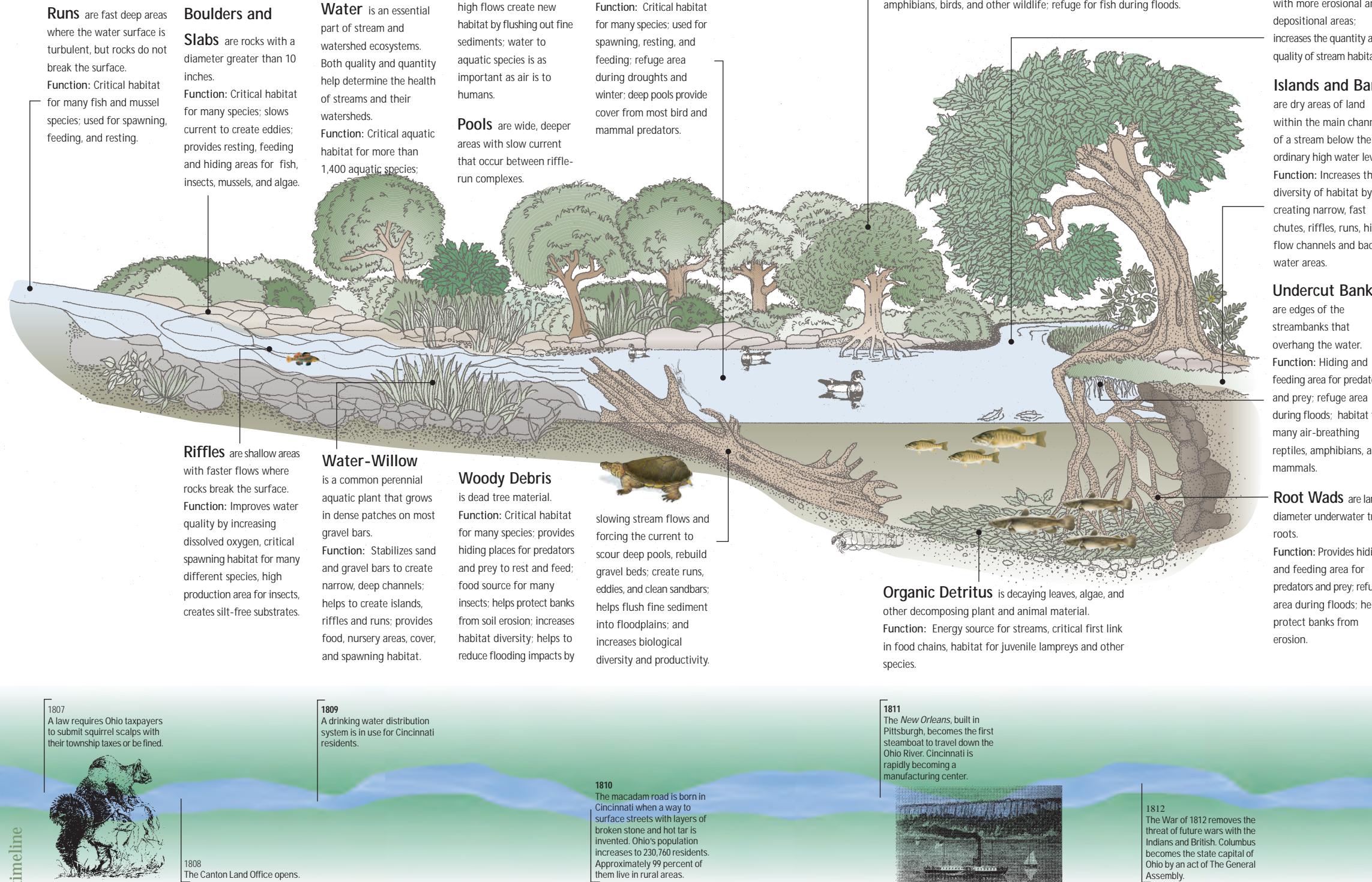


Common Name: midge larva
Scientific Name: *Chironomus sp.*
Phylum: Arthropoda
Class: Insecta
Order: true flies (Diptera)
Family: midges (Chironomidae)
Distribution: Ohio River & Lake Erie Basins
Size: < 1 inch
Pollution Tolerance: tolerant to intolerant

Habitat Quality and Threats

Anatomy of a Stream

Just like a person, streams need many parts to properly function. And the more diverse these parts are - the healthier the stream is. Woody debris, clean water, meanders, riffles, pools, dense patches of water-willow, and streamside forests with huge sycamores are but a few of these essential parts.



A guide to Ohio Streams

In Ohio Streams...

3.2

Endangered



Common Name: pirate perch

Scientific Name: *Aphredoderus sayanus*

Phylum: Chordata

Class: bony fishes (Osteichthyes)

Order: Percopsiformes

Family: pirate perches (Aphredoderidae)

Number of Streams: 1

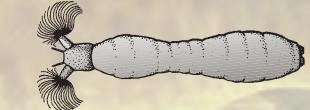
Distribution: Lake Erie Basin

Habitat: small streams

Size: < 4.3 inches

Pollution Tolerance: intolerant

Common



Common Name: black fly larva

Scientific Name: *Simulium* sp.

Phylum: Arthropoda

Class: Insecta

Order: Diptera

Family: Simuliidae

Distribution: Ohio River & Lake Erie Basins

Size: < 1 inch

Pollution Tolerance: tolerant

Extirpated



Common Name: orange-foot pimpleback

Scientific Name: *Plethobasius strigosus*

Phylum: Mollusca

Class: Bivalvia

Order: Unionida

Family: freshwater mussels (Unionidae)

Distribution: Ohio River

Habitat: large streams

Size: < 5 inches

Abundance: none

Pollution Tolerance: intolerant

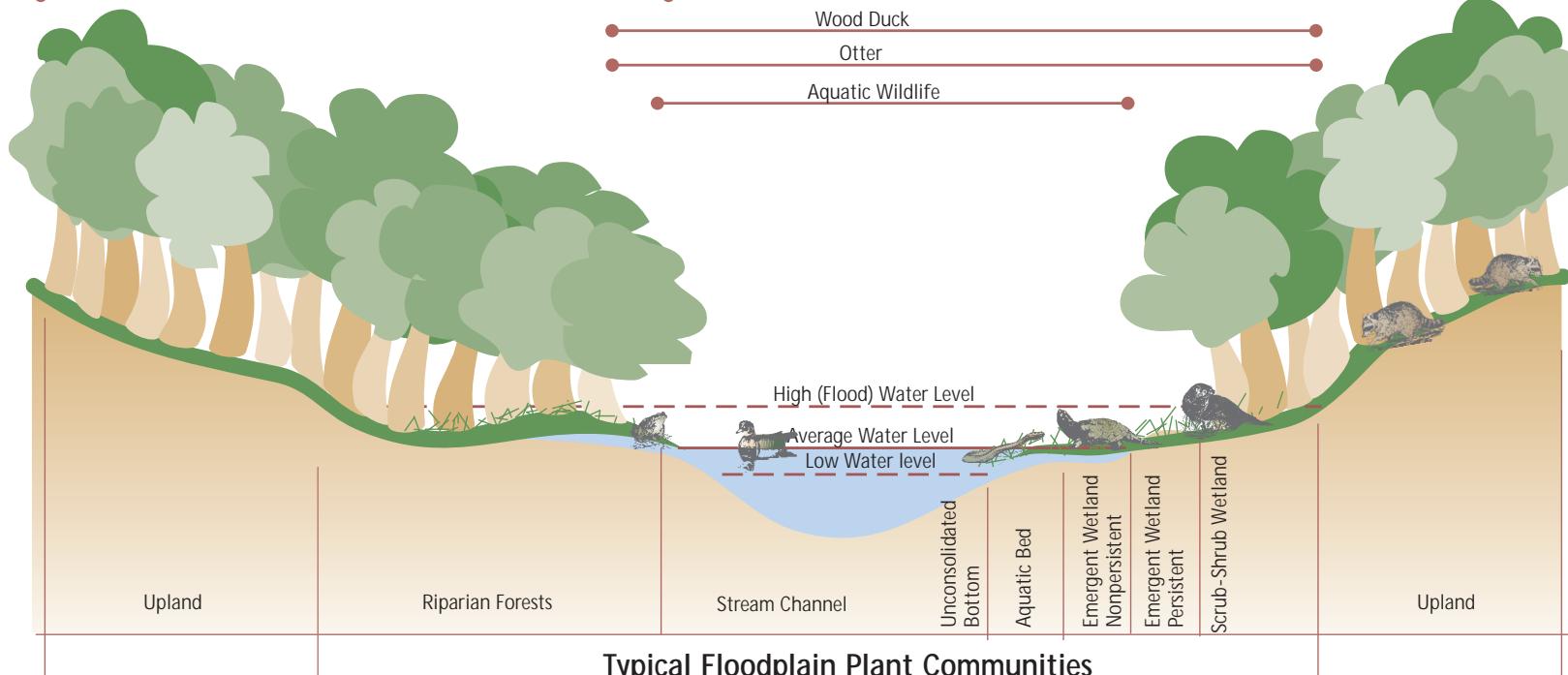
Habitat Quality and Threats

Streamside Forests and Floodplains

Rivers and creeks lined with wide forested buffers in undeveloped floodplains are indicative of healthy stream ecosystems. And in these buffers should be huge sycamore trees - a signature species of Ohio streams. Streamside forests improve water quality and physical habitats, reduce soil erosion and downstream flooding, and serve as important areas for groundwater recharge.

Wildlife

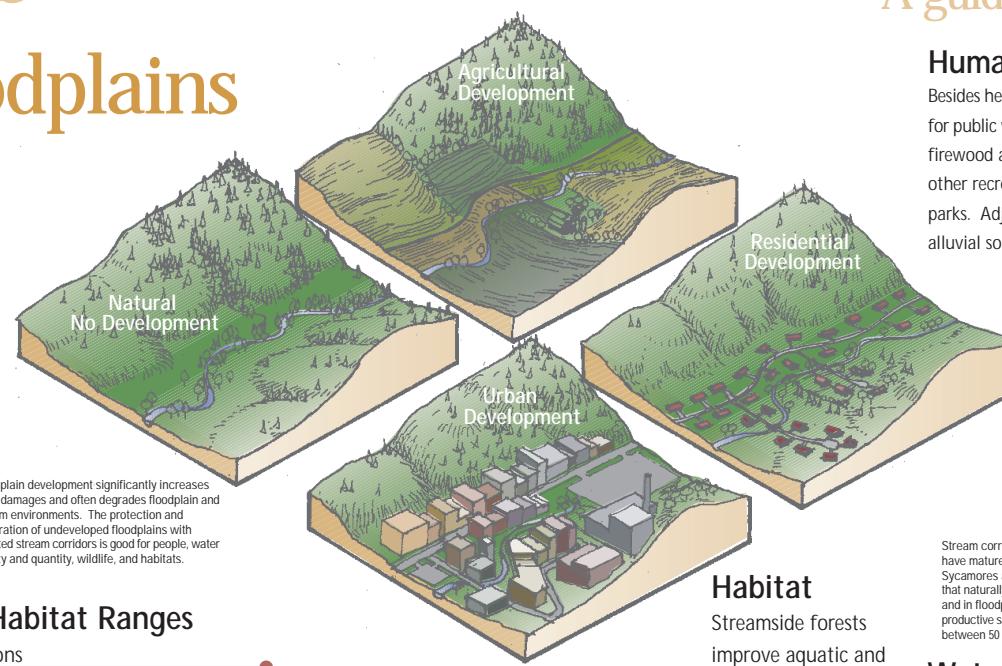
By providing natural habitat, streamside forests increase the biological diversity and productivity both instream and in riparian areas. They serve as a breeding and feeding area for terrestrial wildlife and a refuge area for fishes during floods.



Floodplain development significantly increases flood damages and often degrades floodplain and stream environments. The protection and restoration of undeveloped floodplains with forested stream corridors is good for people, water quality and quantity, wildlife, and habitats.

Typical Floodplain Wildlife Habitat Ranges

- Kingfisher and Herons
- Raccoon
- White-Tailed Deer and Wild Turkey
- Wood Duck
- Otter
- Aquatic Wildlife



A guide to Ohio Streams

Human

Besides helping to reduce flooding and improving water for public water supply, forested buffers can also provide firewood and other timber products, great fishing, and other recreational opportunities such as bike trails and parks. Adjacent connected floodplains maintain rich alluvial soils that are highly productive for agriculture.



Building in floodplains is harmful to people, streams, and wildlife.

Habitat

Streamside forests improve aquatic and riparian habitats in many ways. They stabilize banks, create narrow, deep channels, and increase the diversity of habitats by providing woody debris, undercut banks, deep pools, and other cover. They provide the first link in most aquatic food chains with annual inputs of leaves and other organic material. Forested riparian corridors also provide habitat for many species of terrestrial wildlife such as deer and turkeys. Over time, stream channels will improve if riparian corridors are allowed to naturally reforest.



Water Quantity

Streamside forests and floodplains promote infiltration and aquifer recharge. They also serve important roles in reducing flood peaks and maintaining adequate base flows. As stream flows rise rapidly, water moves into stream banks where it is stored until flows return to normal. It is then released over a period of days or weeks. Floodplains provide flood storage and conveyance and reduce flood velocities, peak flows, and instream sedimentation.



Water Quality

Streamside forests and connected, undeveloped floodplains improve water quality in many ways. They filter out nutrients and sediments, provide shade and groundwater, moderate water temperature fluctuations, and process organic wastes.

In Ohio Streams...

3.3

Exotic Species



Common Name: gold fish
Scientific Name: *Carassius auratus*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Cypriniformes
Family: carps & minnows (Cyprinidae)
Number of Streams: 143
Distribution: Ohio River & Lake Erie Basins
Habitat: small to large streams
Size: < 16 inches
Pollution Tolerance: highly tolerant

Common



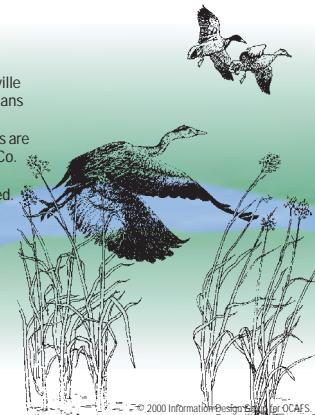
Common Name: snipe fly larva
Scientific Name: *Atherix sp.*
Phylum: Arthropoda
Class: Insecta
Order: true flies (Diptera)
Family: Athericidae
Distribution: Ohio River & Lake Erie Basins
Size: < 1 inch
Pollution Tolerance: intolerant

Endangered



Common Name: Ohio pigtoe
Scientific Name: *Pleurobema cordatum*
Phylum: Mollusca
Class: Bivalvia
Order: Unionoida
Family: freshwater mussels (Unionidae)
Distribution: Muskingum and Ohio Rivers
Habitat: large streams
Size: < 5 inches
Abundance: rare
Pollution Tolerance: intolerant

1814
A second treaty at Greenville begins the removal of Indians from Ohio to reservations elsewhere. As two Ohioans are drilling for brine in Noble Co., OH, the first oil well in the United States is discovered.



1815
There are 150 keelboats carrying Cincinnati-made products both upstream and downstream the Ohio River. Because keelboats could push the heavy iron plated boats upstream using iron-tipped poles, keelboats were safer than flatboats because they no longer required a dangerous overland return trip.

1816
D. Drake, one of Cincinnati's most influential citizens, publishes a 250 page book titled *Natural and Statistical View or Picture of Cincinnati and Miami County*. After becoming a best seller and being circulated overseas, it encourages thousands of Europeans to immigrate to Cincinnati. The Wooster Land Office opens.



1818
C.S. Rafinesque begins publishing papers about Ohio River fishes. Extremely cold temperatures (-22 to -21 degrees F) occur in Marietta and Chillicothe.

1819
Cincinnati becomes a city.

1820
Ohio's population increases to 581,434 residents with 98 percent living in rural areas. Federal water resource programs begin with the U.S. Congress appropriating \$5,000 for a survey to map obstructions in the Ohio River. Rafinesque publishes *Ichthyologia Ohiensis, or Natural History of Fishes Inhabiting the Ohio River*. The Delaware and Piqua Land Offices open.

In Ohio Streams...

A guide to Ohio Streams

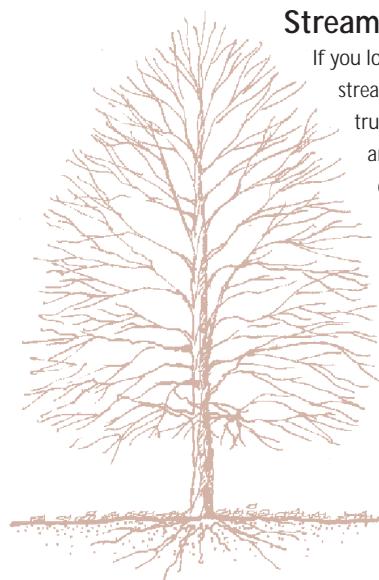
Habitat Quality and Threats

Habitat Threats

Stream wildlife is probably more dependent upon their physical surroundings than any other group of animals. Although it has become more difficult to degrade stream habitats during the past 20 years, Ohio streams continue to be degraded by encroachment, hydromodification, and other human activities.

Streams are Like Trees

If you look at their network of tributaries throughout a watershed, streams are a lot like trees. A healthy tree would have a main trunk, a few large branches, a lot of small branches and twigs, and many underground roots. You could hurt the tree by cutting off many small branches or the big limbs or by building next to it. You could also hurt it by cutting off too much bark or too many roots, or by paving the surrounding land. If you did a little of any of the above, the tree would probably survive, but if you did a lot of the above, the tree's health would be impaired. So would a stream's.



The channelization or straightening of a stream results in a direct loss of aquatic habitat and biological productivity and increases the chance of downstream flooding and bank erosion.

Hydromodification

Hydromodification is the alteration of flow or physical habitats within a stream. Activities that directly modify streams include channel straightening, channel relocation, dam construction, dredging, instream sand and gravel mining, water withdrawal, and the addition of water from point-source discharges. Other activities such as floodplain development, suburban development, and the removal of streamside forests can also cause the alteration of flow or physical habitats within a stream.



Many small streams have been degraded by land development. This small stream was channeled and put in an underground pipe.

1821
John James Audubon, a taxidermist at the Western Museum in Cincinnati, floats down the Ohio River with a group of explorers to look for new birds to draw and describe.

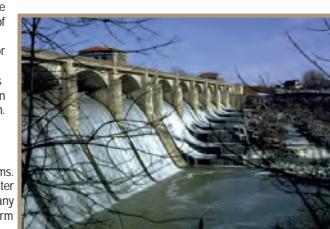
1822
A law passes providing for an engineer and seven commissioners to determine the practicability and expense of various proposed canal routes from Lake Erie to the Ohio River.



Timeline



Blacktop and other impervious surfaces reduce groundwater recharge and increase the rate of runoff. Urban stormwater runoff may go to a sewage plant, a stormwater retention pond, or directly into a stream. It can warm the water and transport metals, oil, and other pollutants into streams. High volumes of urban runoff can also cause increased flooding and bank erosion.



Ohio streams have more than 6,000 dams. Although some dams are needed for water supply, flood control, and recreation, many dams are no longer needed. Dams harm streams by blocking fish passage, reducing the diversity of habitat, and causing increased sedimentation.

1823
As part of a canal study, the first attempt to scientifically measure stream flow in Ohio (and possibly the U.S.) is conducted on the Sandusky River near Upper Sandusky.

Stream Encroachment

Using the land too close to rivers and creeks is harmful to people, physical habitat, and stream wildlife. Stream encroachment includes the removal of riparian forests, floodplain development, and unrestricted stream access by cattle and other livestock.



Building next to streams can be harmful to people, wildlife, and habitat. A landowner will often loose land and buildings if streamside forests are removed or other activities are conducted too close to streams.



Unrestricted access to streams by cattle and other livestock degrade stream banks, instream habitats, and water quality. Cost share programs can provide upland watering devices and fencing to keep livestock out of streams. Conservation easements are another effective tool.

Sedimentation

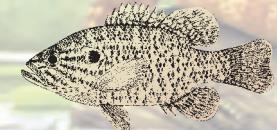
By weight, silt is the most common pollutant in Ohio streams. And the rate of soil loss in many watersheds is measured in tons per acre per year! Although some soil erosion is natural, excessive amounts harm stream habitats and wildlife in many ways. Silt and other fine sediment can bury spawning and feeding areas, disrupt food chains, increase turbidity, and clog the gills of fish, amphibians, insects, and mollusks. Sedimentation also harms recreational activities and increases the cost of water treatment. Unless best management practices are used, excessive amounts of sediment can wash into streams from construction sites, cropland, timbered areas, stream banks, mined lands, gullies, feedlots, pastures and other non vegetated areas.



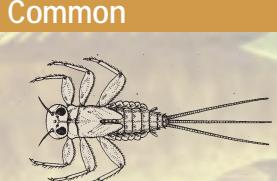
1824
The Federal General Survey Act gives the U.S. Corps of Engineers continuing authority for navigation studies. The Rufus Putnam makes the first steamboat trip up the Muskingum River.



1825, continued
The construction of the Cumberland (National) Road, the first major east to west highway in the U.S., passes through Columbus. The first American steam locomotive is patented.



Common Name: warmouth
Scientific Name: *Lepomis gulosus*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Perciformes
Family: sunfishes (Centrarchidae)
Number of Streams: 114
Distribution: Ohio River & Lake Erie Basins
Habitat: small to large streams
Size: < 11 inches
Pollution Tolerance: intermediate



Common Name: mayfly nymph
Scientific Name: *Stenonema sp.*
Phylum: Arthropoda
Class: Insecta
Order: mayflies (Ephemeroptera)
Family: Heptageniidae
Distribution: Ohio River & Lake Erie Basins
Size: < 1 inch
Pollution Tolerance: intolerant



Common Name: clubshell
Scientific Name: *Pleurobema clava*
Phylum: Mollusca
Class: Bivalvia
Order: Unionoida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River & Lake Erie Basins
Habitat: small to medium streams
Size: < 3 inches
Abundance: rare
Pollution Tolerance: intolerant

With the Cuyahoga River on fire, the Mahoning River nearly boiling, and the Ottawa River without fish for more than 30 miles, it is easy to understand why Public Law 92-500 (1972) established a national goal to "restore and maintain the physical, chemical, and biological integrity of the nation's waters." With the development of water quality standards, new technologies, stricter enforcement, and successful permitting and monitoring programs, the quality of many streams has markedly improved. As point source pollution has been significantly reduced, new abatement efforts are increasingly focused on nonpoint sources such as runoff from urban and agricultural lands.

View of an oil slick in the Ottawa River (Allen County, Ohio).

Chapter Four

Water Quality and Pollution Control

Water Chemistry

Standards and Monitoring

Point Source Pollution

Nonpoint Source Pollution

Useful Terms and Definitions

Concentration - the amount of a substance per unit volume. In water, it is often measured in milligrams per liter (mg/l).

Effluent - the discharged treated wastewater from a municipal sewage plant or industry.

NPDES Permit - a pollution control document issued by Ohio EPA that gives an entity

allowable levels of chemicals or other substances to be discharged into the waters of the state.

Biochemical Oxygen Demand (BOD) - a measure of the amount of oxygen demanding decomposition and respiration required to fully consume the organic matter in a given sample or volume of water.

Dissolved Oxygen (DO) - the amount of oxygen dissolved

in water. Usually measured in milligrams per liter (mg/l).

Nonpoint Pollution - sediment and other pollutants that enter a stream through surface runoff, spills, groundwater or in any other diffuse way.

Toxic - pertaining to poison; can be acute which causes a quick death or chronic which causes harm over time.

Point Source - pollution that enters a stream from a pipe or other distinct location.

Pollute - to make physically

or chemically unclean; the addition of harmful amounts of litter, chemicals, bacteria organic matter, or sediment to water.

Turbidity - a measure of clarity or ability of light to penetrate water.

Water Quality and Pollution Control

Water Chemistry

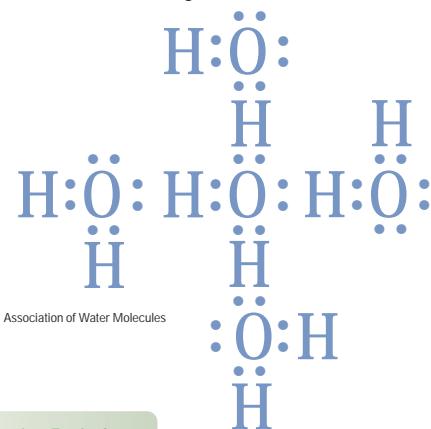
Because water dissolves many substances, chemical testing is conducted on water samples to determine if concentrations of nutrients, metals, and other substances are safe for aquatic life and public water supply.

Values for suspended solids, water temperature, flow, pH, and other parameters are also important.

Standardized field and laboratory methods are used for accurate results.

Concentration

The amount of a substance per unit volume of water is important in determining if a substance is safe or harmful for streams. For example, if a bucket of ammonia is dumped into a small creek, its concentration would be high enough to kill fish because of the small amount of water it has to mix with. But if the same bucket is dumped into a large river, its concentration would be low enough to not kill fish because of the large amount of dilution water.



Concentration Equivalents

Parts per million (ppm)	= milligrams per liter (mg/l) = milligrams per kilogram (mg/kg) = micrograms per gram (ug/g)
Parts per billion (ppb)	= micrograms per liter (ug/l) = micrograms per kilogram (ug/kg) = nanograms per gram (ng/g)



Test Parameters

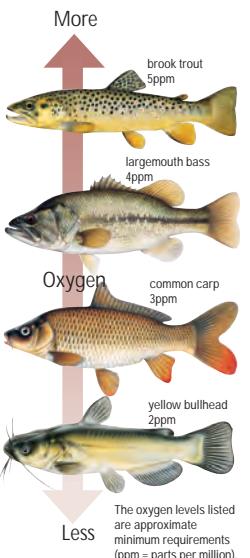
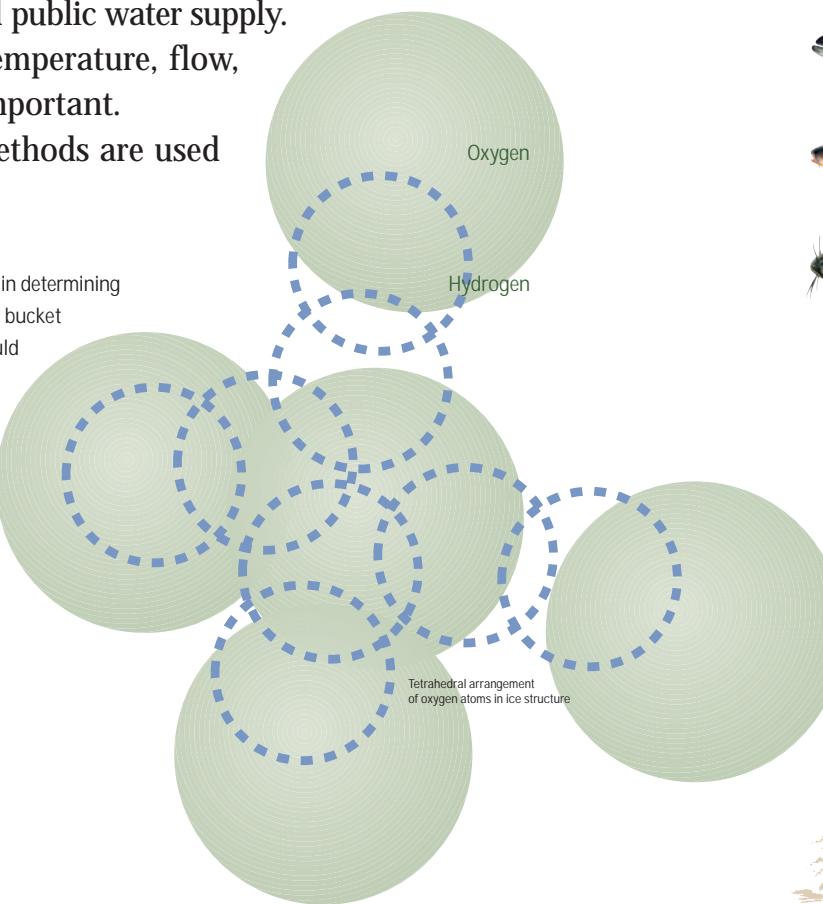
Water testing is usually done to determine the concentration or value of specific parameters. Common parameters include dissolved oxygen, biochemical oxygen demand, nutrients, pH, total hardness, metals, pesticides, temperature, and turbidity.

1826
In the winter of 1825-26, C.A. LeSueur, T. Say, and other principal scientists and educators take a keelboat trip down the icy Ohio River from Pittsburgh, PA to New Harmony, IN. The trip will have far-reaching scientific, cultural, social, and economic benefits for the Midwest and the nation.

1827
LeSueur publishes the descriptions and drawings of some North American fishes. U.S. Congress passes the first Rivers and Harbors Act to authorize federal removal of river obstructions and improve harbors.



Timeline



Dissolved Oxygen (DO) is the amount of oxygen that dissolves in water. All living organisms need oxygen to survive. Levels greater than 5 mg/l are healthy for most aquatic life.



Biochemical Oxygen Demand (BOD) is a measure of how much oxygen is needed to decompose organic matter in water.

Nutrients are inorganic chemicals that include forms of phosphorus and nitrogen commonly found in fertilizers, manure, and sewage. Phosphorus can be measured as ortho, soluble reactive, or total. Nitrogen includes three common forms - nitrate, nitrite, and ammonia. Aquatic life needs nutrients to grow, but excessive amounts are usually harmful.

Total Hardness is a measure of the amount of calcium and magnesium ions dissolved in water.

Temperature is important to all aquatic life, but it can kill if too high or too low. Warm water



Acidic conditions are often found in streams that receive drainage from active or abandoned coal mines. The orange or yellow stain called "yellow-boy" is caused by high concentrations of metals present in the acid mine drainage.

Pesticides are manmade chemicals that include herbicides and insecticides. They are used to control harmful types of vegetation and insects. Some, like DDT and chlordane, have been banned for many years, but can still be found in streams and wildlife tissue. Newer chemicals, such as atrazine - a weed control used in corn production, break down more rapidly.

Metals include arsenic, chromium, copper, lead, mercury, selenium, and zinc. High levels can cause deformities, affect reproduction, and kill. Sources include discharges, highway runoff, landfills, and mining activities.

1830
With nearly 25,000 residents, Cincinnati is the largest city west of the Atlantic seaboard. Many pioneers travel westward along the National Road in white canvas covered wagons. The road will be heavily traveled for the next 20 years. Ohio's population increases to 937,903.



A guide to Ohio Streams

In Ohio Streams...

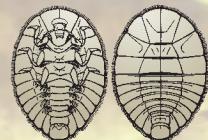
4.1

Common



Common Name: yellow bullhead
Scientific Name: *Ameiurus natalis*
Phylum: Chordata
Class: bony fishes (Ostichthyes)
Order: Siluriformes
Family: catfishes (Ictaluridae)
Number of Streams: 536
Distribution: Ohio River & Lake Erie Basins
Habitat: small to medium streams
Size: < 18 inches
Pollution Tolerance: highly tolerant

Common



Common Name: water penny larva
Scientific Name: *Psephenus sp.*
Phylum: Arthropoda
Class: Insecta
Order: beetles (Coleoptera)
Family: water pennies (Psephenidae)
Distribution: Ohio River & Lake Erie Basins
Size: < 1 inch
Pollution Tolerance: intolerant

Endangered



Common Name: elephant-ear
Scientific Name: *Elliptio crassidens*
Phylum: Mollusca
Class: Bivalvia
Order: Unionoida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River Basin
Habitat: large streams
Size: < 6 inches
Abundance: rare, except in the Ohio River
Pollution Tolerance: tolerant

1832
As Lima becomes the Allen County seat, Shawnees at the Hog Creek Reservations agree to leave Ohio. The state of Ohio begins to canalize the Muskingum River. With Congress lowering the minimum land purchase to 40 acres at \$1.25 per acre, Ohio's Congressional Lands become more affordable to settlers. The Bucyrus Land Office opens.



Water Quality and Pollution Control Standards and Monitoring

Water quality standards are adopted to protect public health and welfare, enhance the quality of water, and meet guidelines established under the Clean Water Act. Although numerical chemical standards were established at the national and state levels soon after the passage of the Act, the development and adoption of numerical standards for biological assemblages did not occur until 1990, when Ohio became the first state to adopt numerical biological criteria.

Use Designations

Use designations are goals that are set for specific surface water bodies in the state. There are four different types:

- Aquatic Life Habitat
- Water Supply
- Recreation
- State Resource Waters

Chemical Criteria

Dissolved oxygen, ammonia, and other water quality parameters all have designated concentrations that set standards to protect public health and welfare, enhance the quality of water, and meet guidelines established under the Clean Water Act.



Chemical data is usually collected by taking water, sediment or fish tissue samples back to an approved laboratory for analysis.

Biological Criteria

Biocriteria were developed to better assess the biological integrity in streams. Although they are used primarily to determine the attainment status of aquatic life use designations, they are also used for water quality based permitting, water quality standards, basic monitoring

and reporting, nonpoint source assessment, natural resource damage assessment and general problem discovery. The criteria consist of numerical values for two fish indices and one macroinvertebrate index which measures structural, functional, and health characteristics of aquatic communities in



Fish and aquatic insects are good indicators of water quality and biological integrity.

timeline



1833
The Wapakoneta Land Office opens.

1837
The Marion Land Office opens. William Procter and James Gamble start a business making soap and candles in Cincinnati.

1835
The Lima Land Office opens

1838
J.P. Kirtland begins publishing lists of the fishes known to occur in Ohio with reference to their distribution and abundance. In Adams County, Ohio J. Locke of the Geological Survey made the first county geologic map. The first federal dam on the Ohio River is built at Browns Island upstream from Steubenville.



1839
Cincinnati becomes the first major municipality in Ohio to have a public water supply. Voters approve a buy out from a private company that pumps water out of the Ohio River.

1840
Ohio's population increases to 1,519,467 residents. During the 1840s, there are about 4,000 flatboats on the Ohio River. The Marietta, Steubenville, Chillicothe, Cincinnati, and Zanesville Land Offices close.

A guide to Ohio Streams

In Ohio Streams...

4.2

Aquatic Life Use Designations

Exceptional Warmwater Habitat (EWH) is assigned to streams that contain unusual and exceptional aquatic assemblages with high biological diversity and value. They often sustain populations of rare and endangered species and include Ohio's highest quality streams and all public lakes and reservoirs. This use represents a protection goal for management efforts. It has the most stringent ammonia and dissolved oxygen criteria.

Warmwater Habitat (WWH) is assigned to streams capable of supporting and maintaining a balanced, integrated, and adaptive (good) community of warmwater aquatic organisms. It is Ohio's most widely applied use designation. Criteria varies by ecoregion.

Modified Warmwater Habitat (MWH) applies to streams with extensive and irretrievable physical habitat modifications that fail to attain criteria for WWH, EWH or other beneficial uses. They contain aquatic assemblages that are tolerant of low dissolved oxygen, silt, nutrient enrichment, and poor habitat quality. There are three subcategories for streams degraded by acid mine waters, extensive channelization, and dams. Criteria are set separately for each subcategory.

Coldwater Habitat (CWH) is assigned to streams that support either native coldwater species (e.g., brook trout and certain invertebrate species) or are coldwater streams managed by the Ohio Department of Natural Resources as stocked trout fisheries.

Seasonal Salmonid Habitat (SSH) is assigned to Lake Erie tributaries and embayments that support significant recreational lake-run salmonid fisheries from October through May.

Limited Resource Water (LRW) is assigned to streams when a scientific assessment concludes they cannot support any degree of aquatic life diversity because of irretrievable factors such as acidic conditions from abandoned mine land or large scale habitat alteration. These designations must be reviewed every three years. The MWH or WWH designation can be assigned if conditions improve.

Limited Warmwater Habitat (LWH) was adopted in 1978 as a temporary variance mechanism for individual stream segments with point source problems that could not meet goals of the Clean Water Act. This designation is being phased out.

Locally Common



Common Name: sauger
Scientific Name: *Stizostedion canadense*
Phylum: Chordata
Class: bony fishes (Ostichthyes)
Order: Perciformes
Family: perches & darters (Percidae)
Number of Streams: 53
Distribution: Ohio River & Lake Erie Basins
Habitat: medium to large streams
Size: < 19 inches
Pollution Tolerance: intermediate

Common



Common Name: mayfly nymph
Scientific Name: *Isonychia* sp.
Phylum: Arthropoda
Class: Insecta
Order: mayflies (Ephemeroptera)
Family: Isonychiidae
Distribution: Ohio River & Lake Erie Basins
Size: < 1 inch
Pollution Tolerance: intolerant

Special Interest



Common Name: flat floater
Scientific Name: *Anodonta suborbicularis*
Phylum: Mollusca
Class: Bivalvia
Order: Unionoida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River Basin
Habitat: muddy slow water in large streams
Size: < 6 inches
Abundance: rare
Pollution Tolerance: tolerant

Water Quality and Pollution Control

Point Source Pollution

Point source pollution enters a stream through a pipe or other distinct location. Wastewater discharges from sewage treatment plants and industries are good examples. Water quality impacts from point source discharges have been markedly reduced with the adoption of state water quality standards, chemical permit limits, stricter enforcement, and successful stream monitoring and assessment programs. Unlike many nonpoint sources of pollution, however, point sources usually discharge 24 hours a day, 365 days a year.

Sources

Sewage Treatment Plants are primarily owned and operated by city and county governments. They receive sanitary and other wastewater from homes, office buildings, and other sources. They also receive stormwater from streets and parking lots. Pollutants entering plants include human organic wastes (nutrients such as ammonia, phosphorus, or nitrate), as well as soaps, detergents, metals and bacteria.



Combined Sewer Overflow (CSO) discharges occur in many of Ohio's older cities that have a mixing of sanitary wastewater and stormwater runoff in single underground pipes. They usually overflow into streams after a heavy rainfall and help prevent house drains from backing up. During overflows they release raw sewage and a variety of pollutants into streams.

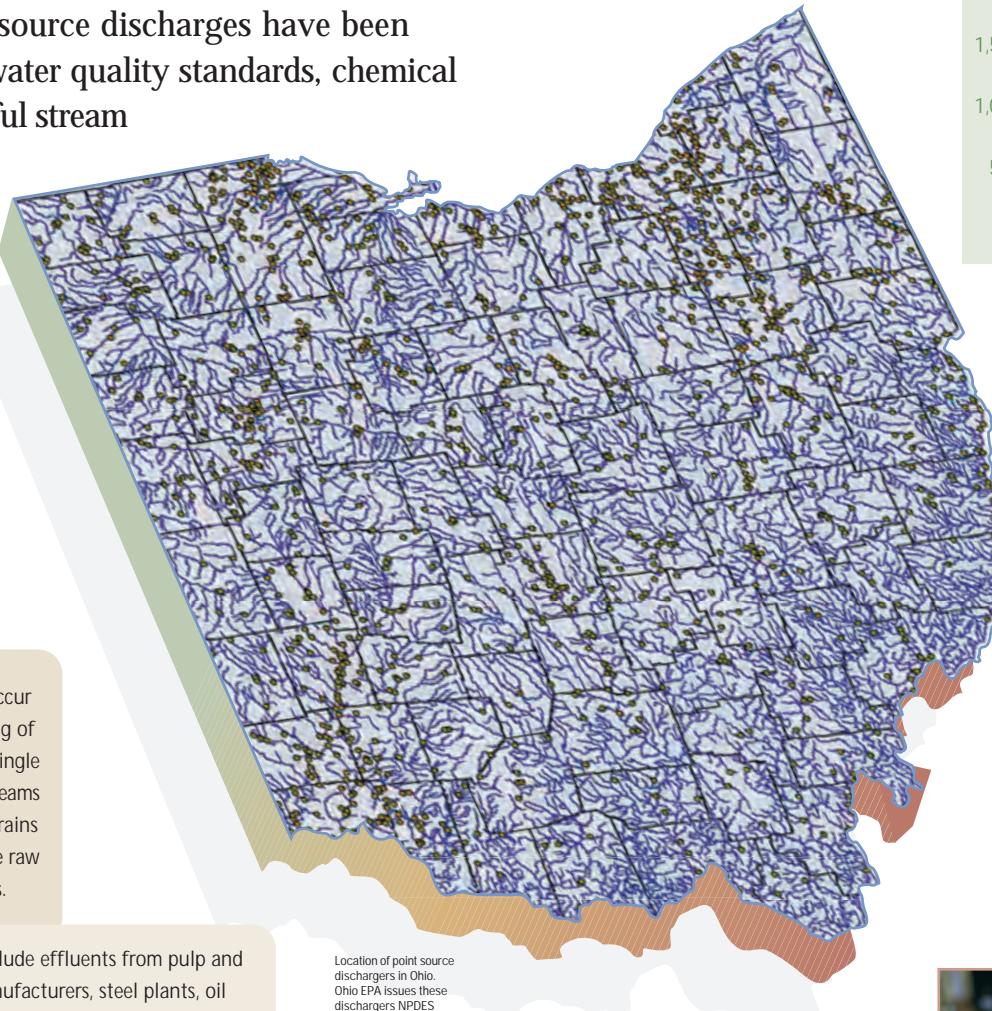


Industrial Discharges include effluents from pulp and paper mills, chemical manufacturers, steel plants, oil refineries, electric generating plants, and food processing plants. Pollutants discharged can include solids, metals, organic chemicals, nutrients, and brine/acidic wastes. Stormwater discharges and combined sewer overflows (which can bypass untreated sewage during large rainfall events) can also contain various quantities of all of the pollutants mentioned above.

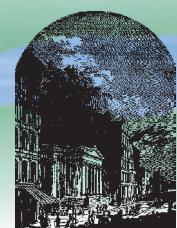
1841
Ohio passes its first drainage law. A new law in 1859 will allow for a system of public ditches.

1843
The Wyandots, Ohio's last native American tribe, leave the Sandusky Reservation for lands in the west. The Upper Sandusky Land Office opens.

Timeline

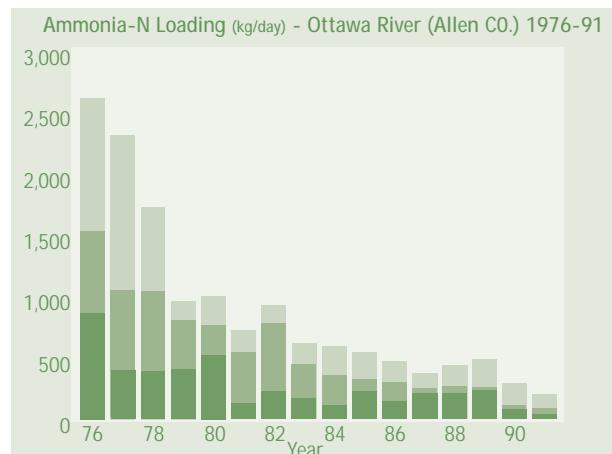


1844
The turnpike system built since 1830 makes shipping to Cincinnati by road, or by road and canal cheaper. Cincinnati is the primary gateway for Ohio products to the rest of the settled United States. During the 1840s, Cincinnati's old wooden water supply pipes are replaced by iron pipes and a reservoir is built to supply untreated river water.



Controls

Almost all point source wastewater is now treated to remove harmful levels of nutrients, toxins, and other pollutants.



Improved treatment of wastewater has significantly lowered the amount of ammonia discharged into the Ottawa River and many other Ohio streams. As a result of less pollution, the quality of many streams has markedly improved since the 1970s.

NPDES Permits

The 1972 Water Pollution Control Act created the *National Pollutant Discharge Elimination System* (NPDES) which required technology-based, chemical discharge limits for all point source dischargers. The permits also imposed monitoring requirements and other conditions. The Act also initiated the Construction Grants Program for upgrading municipal sewage treatment plants. It allowed cities to apply for matching federal funds to improve wastewater treatment facilities. Since 1975, over \$6,000,000,000 has been spent in Ohio to control point source pollution. Since 1988, there has been a 56% decline in point source impacts as a major source of impairment in Ohio streams.

Point Source Impacts

Effluent from dischargers can degrade streams if it contains quantities of oxygen-demanding substances, toxic chemicals, or other pollutants that exceed the natural assimilation capacity of a stream. The severely degraded conditions in Ohio streams prior to the 1980s were caused primarily by inadequately treated

municipal and industrial discharges. Today, evidence of downstream impacts typically include the loss of pollution-sensitive species, a dominance by pollution-tolerant species, a change in biomass, and a high incidence of fish with external DELT anomalies.



A high incidence of fish with external deformity, erosion, lesion or tumor (DELT) anomalies is usually an indication of water quality impacts that are associated with pollutants from point source discharges.

1846
The Little Miami Railroad is operating between Cincinnati and Columbia and up the Little Miami River Valley to Springfield. Most sewers were open ditches or above ground pipes built by property owners to drain stormwater into the nearest ravine or stream.

1847
As a leader in the canal movement, Ohio paves the way for improved trade and had much to do with dooming the Plains Indians and the buffalo they depended upon. Canals provided the supplies and people to overflow the west. More than 250,000 hogs came to Cincinnati slaughtering and packing houses by turnpike, canal, and railroad.

1848
The Defiance Land Office opens.

A guide to Ohio Streams

In Ohio Streams...

4.3

Threatened



Common Name: brook trout
Scientific Name: *Salvelinus fontinalis*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Salmoniformes
Family: trouts (Salmonidae)
Number of Streams: 8
Distribution: Ohio River & Lake Erie Basins
Habitat: small streams
Size: < 21 inches
Pollution Tolerance: intolerant

Common



Common Name: mayfly nymph
Scientific Name: *Ephemerella* sp.
Phylum: Arthropoda
Class: Insecta
Order: mayflies (Ephemeroptera)
Family: Ephemerellidae
Distribution: Ohio River & Lake Erie Basins
Size: < 1 inch
Pollution Tolerance: intolerant

Common



Common Name: giant floater
Scientific Name: *Pyganodon grandis*
Phylum: Mollusca
Class: Bivalvia
Order: Unionida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River & Lake Erie Basins
Habitat: small to large streams
Size: < 6 inches
Abundance: common and widespread
Pollution Tolerance: tolerant

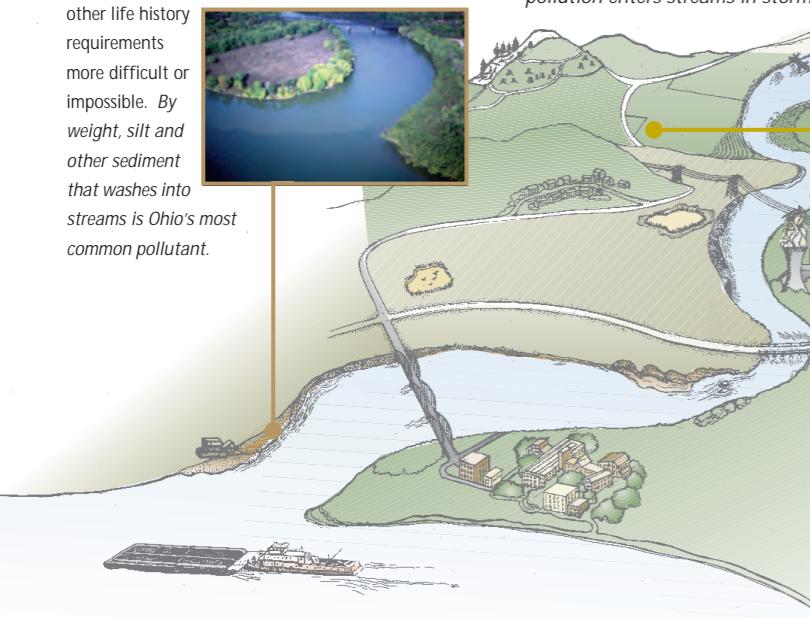
Water Quality and Pollution Control

Nonpoint Source Pollution

Chemicals, sediment and other harmful pollutants that enter streams through surface runoff, spills or ground water is called nonpoint source pollution. It is often more difficult to locate than point sources and usually only pollutes after precipitation falls. It is associated with land use at the watershed level and is more difficult to control than point sources. With lower levels of pollution discharged by point sources today, new pollution abatement programs are increasingly turning to streamside buffers and other "best management practices" on agricultural and urban lands to reduce the amount of soil, nutrients, pesticides, and other pollutants coming from the land.

Sources

Soil Erosion can harm aquatic life in many ways. Excessive amounts of fine sediments can bury critical substrates and increase turbidity which makes feeding, reproduction, and other life history requirements more difficult or impossible. By weight, silt and other sediment that washes into streams is Ohio's most common pollutant.



1850
Ohio's population increases to 1,980,329 residents.

1854
Large flocks of migrating passenger pigeons block out the sun for hours as they pass over Columbus. J. P. Kirtland describes an Ohio muskellunge from the Mahoning River.



1851
With powerful engines to pull passenger trains, the Cincinnati, Hamilton, and Dayton Railroad is responsible for the growth of suburban towns like Clifton and Glendale.

Timeline

1857
Ohio's first fish law passes because so many dams have been constructed on streams. It makes it illegal to prevent the natural transit of fish in navigable streams and lakes.



Spills can contribute a wide range of pollutants and occur almost anywhere - on farms, in cities, at factories, or on a highway.



Agricultural land contributes nonpoint runoff that contains fertilizers, nutrients, soil, and bacteria.



Impacts

Nonpoint source pollution can harm streams and humans in many ways. Ecologically, it can hurt aquatic wildlife by degrading water quality and physical habitats. Economically, it can increase costs for drinking water treatment and impair recreational uses.

Urban areas contribute many pollutants that wash off of highways, parking lots, lawns, and commercial sites.



Streamside forests not only protect physical habitat, but also improve water quality by providing cooler temperatures and filtering out sediment, nutrients and pesticides from upland sources. Fallen leaves are also an important first link in stream food chains.



Controls

Conservation tillage, manure management, stormwater retention basins, and streamside buffers are but a few of the best management practices that can be used to reduce nonpoint source pollutant loads. Funding for monitoring and control of nonpoint pollution comes from state, federal, and local sources.

In Ohio Streams... 4.4

Locally Common



Common Name: slenderhead darter
Scientific Name: *Percina phoxocephala*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Perciformes
Family: perches & darters (Percidae)
Number of Streams: 16
Distribution: Ohio River Basin
Habitat: medium to large streams
Size: < 4 inches
Pollution Tolerance: intolerant

Common



Common Name: stonefly nymph
Scientific Name: *Acronuria* sp.
Phylum: Arthropoda
Class: Insecta
Order: stoneflies (Plecoptera)
Family: Perlidae
Distribution: Ohio River & Lake Erie Basins
Size: < 1 inch
Pollution Tolerance: intolerant

Locally Common



Common Name: elktoe
Scientific Name: *Alasmidonta marginata*
Phylum: Mollusca
Class: Bivalvia
Order: Unionoida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River & Lake Erie Basins
Habitat: medium to large streams
Size: < 4 inches
Abundance: generally uncommon
Pollution Tolerance: intolerant



1860
Trains are becoming an increasingly important method of transportation. There are 3,000 miles of railroad tracks in Ohio. Several tracks are linked directly to the Atlantic coast. Ohio's population increases to 2,339,511 residents. Approximately 83 percent live in rural areas.



1861
The Civil War begins on April 12. Severe flooding in August occurs in Beaver Creek and Elk Run (Columbiana Co.). Homes and bridges in Lisbon and Elkhorn are damaged the same week as the Battle of Bull Run where 481 Union soldiers are killed and 1,011 are wounded.

From how stream life changes as creeks turn into rivers - to how so many different kinds of plants and animals can live together - are just a few of the fascinating relationships that streams have to offer. Ecology is the study of relationships between living organisms and their environment.

Chapter Five Ecology

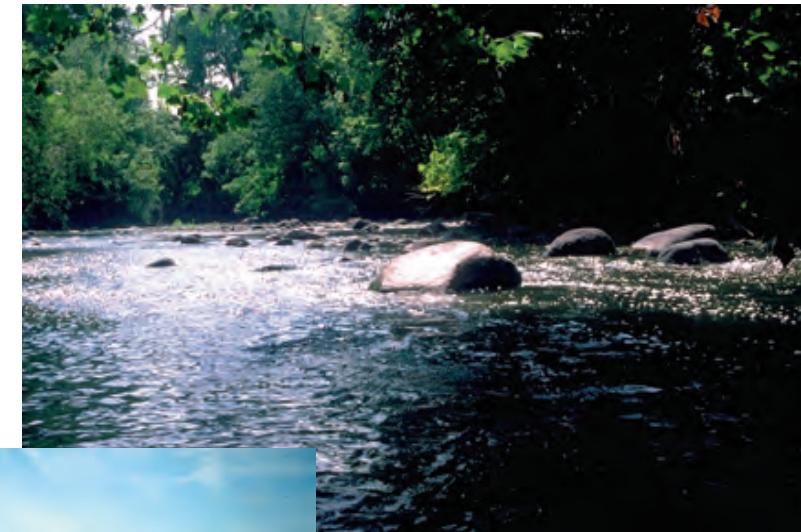
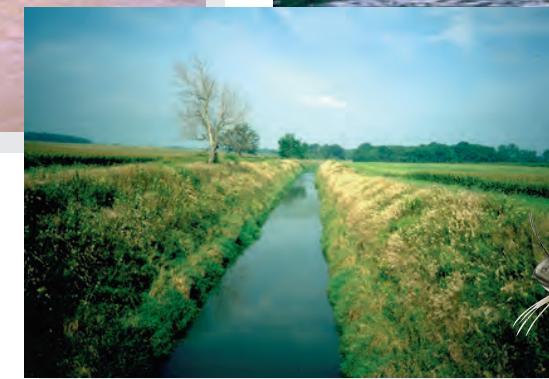
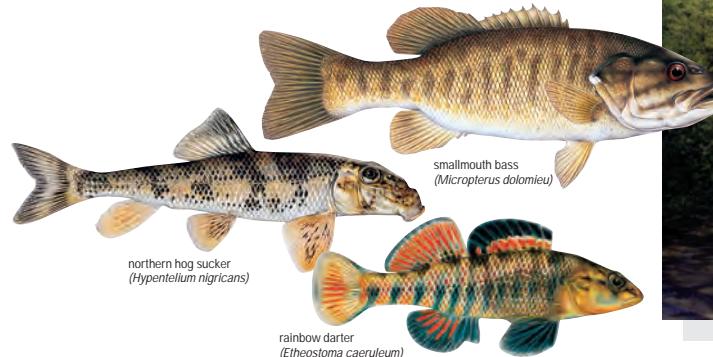


Ecology

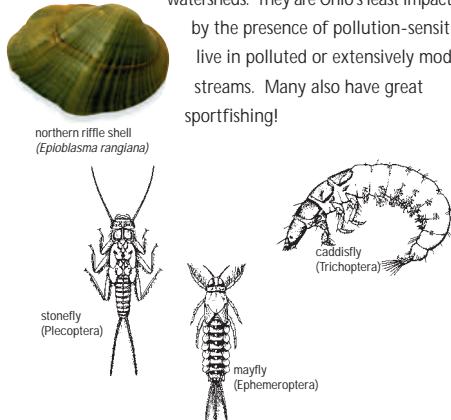
Stream Quality

Why monitor streams? Because looks can be deceiving! The quality of a stream is determined by a combination of factors including physical habitats, water chemistry, and biological diversity. Try and guess the status of the three streams pictured here. Which one is exceptional? Which two are poor quality?

Biological assemblages, chemical water quality, and physical habitats are monitored in many Ohio streams to determine their status.



High Quality streams have clean water, natural habitats, and diverse and abundant biological assemblages that include pollution sensitive, rare, and endangered species. They also have free-flowing, diverse aquatic habitats with forested riparian corridors, islands, associated wetlands and unregulated flow regimes and sparsely populated watersheds. They are Ohio's least impacted streams. They can be identified by the presence of pollution-sensitive species - those that cannot live in polluted or extensively modified streams. Many also have great sportfishing!



Types of Impacts

Biological assemblages are reliable indicators of stream quality. By comparing fish and macroinvertebrate assemblages in a stream upstream and downstream from a suspected source of impact, biologists can tell if a stream is healthy and meeting the goals of the Clean Water Act. Because the types, abundance, and health of aquatic species change in predictable ways, biological monitoring can help determine if impairment is caused by chemical pollution and/or habitat modification.

Chemical impacts are the result of degraded water quality and/or contaminated sediments. They can be caused by excessive amounts of chemicals, other pollutants, and even the modification of habitat. Biological changes due to chemical impacts include few (if any) pollution-sensitive species, more pollution tolerant species, and a high percentage of external DELT anomalies. Chemical impacts are evident when habitats remain similar, but there is a marked decline in species downstream from a pollution source followed by a

downstream recovery. Natural food webs are easily broken by excessive amounts of chemicals and other pollutants.

Habitat impacts are caused by the physical alteration of natural stream channels and other watershed activities. They can be caused by dams, excessive sedimentation, riparian encroachment, flow alterations, and other activities. Biological changes can include a reduction in species and productivity, and shifts from pollution-sensitive to pollution-tolerant assemblages.

1863
Cincinnati allows the public to tap into city sewer lines - a unified, planned sewerage system taking advantage of natural ravines leading to the river to dispose of storm waters.

1867
The Suspension Bridge opens over the Ohio River at Cincinnati. Toledo floods in February after a large ice jam and wall of water breaks loose upstream in the Maumee River.

1866
The Delaware Land Office closes.



1869
The world's first professional baseball team, the Red Stockings, is formed in Cincinnati and wins all of their games.

Stream Monitoring is an excellent way to determine a stream's health. Sampling and assessing biological assemblages, water quality, and physical habitats is a good way to determine not only if a stream is impacted, but the causes and sources of problems as well. Could you determine the quality of the three streams pictured below without data? Possibly so from the middle photo, but not the other two.

The Ottawa River (below photo, Allen Co.) has exceptional habitat, but poor fish assemblages due to degraded chemical water quality.

A guide to Ohio Streams

In Ohio Streams...

5.1

Locally Common



Common Name: central mudminnow
Scientific Name: *Umbra limi*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Salmoniformes
Family: mudminnows (Umbridae)
Number of Streams: 119
Distribution: Ohio River & Lake Erie Basins
Habitat: small to medium streams
Size: < 5.2 inches
Pollution Tolerance: tolerant

Common

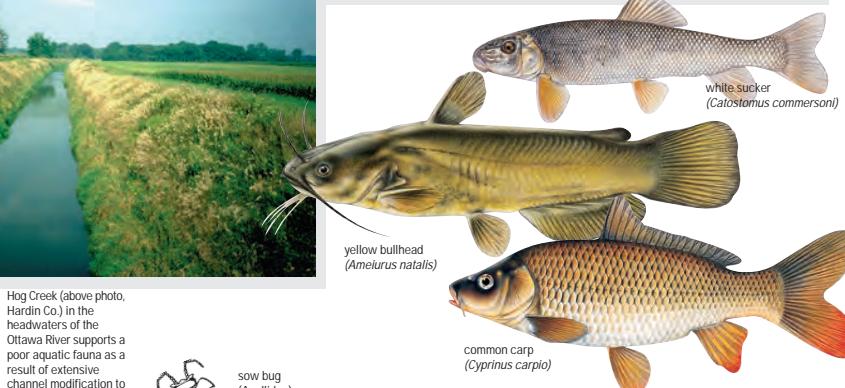


Common Name: predaceous diving beetle
Scientific Name: *Acilius* sp.
Phylum: Arthropoda
Class: Insecta
Order: beetles (Coleoptera)
Family: Dytiscidae
Distribution: Ohio River & Lake Erie Basins
Size: < 1 inch
Pollution Tolerance: moderate

Special Interest



Common Name: salamander mussel
Scientific Name: *Simpsonia ambigua*
Phylum: Mollusca
Class: Bivalvia
Order: Unionida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River & Lake Erie Basins
Habitat: under rocks in medium to large streams
Size: < 2 inches
Abundance: rare
Pollution Tolerance: intolerant



Low Quality streams have degraded chemical water or sediment quality and/or extensively modified physical habitats. They typically have few pollution-sensitive organisms and no rare or endangered species. Most are located in densely populated areas, extensively channelized areas (drained wetlands) with little relief, or extensively mined areas. Low quality streams have biological communities dominated by pollution tolerant species that can live in polluted water and/or modified habitats. Most could be restored to support better aquatic assemblages.

1870
Ohio begins a strong period of industrial growth following the Civil War. Cincinnati's population is 216,239 residents, but only 671 houses are connected to sewers. Most suburban villages dumped their sewage into streams. The American Fish Culturist's Association (now the American Fisheries Society) is formed in New York City.

1871
The U.S. Commission of Fish, the first federal agency concerned with the conservation of a natural resource, is formed to study the decline of several fishes in New England. The U.S. has 11 small state fish commissions.

Ecology

Plants and Predators

Life in every stream begins with plants turning sunlight, water, and carbon dioxide into food through photosynthesis. Then leaves, algae, and other plant material are eaten by mollusks, insects, and other stream animals. These species are then eaten by a series of predators. First a stonefly nymph feeds on a midge larva, then a minnow eats the stonefly, a bass then eats the minnow, and finally a great blue heron, snake, or human eats the bass.

Food Chains, Webs, and Pyramids

Plants and animals in streams are linked together by how they grow, what they eat, and what eats them - a food web. In natural streams, food webs are very complex and formed by hundreds of species. Food webs contain many food chains with links between different trophic levels - plants, plant eaters, predators, and bacteria. Food pyramids - with a large plant base - support only a few large predators. Naturally functioning food chains, webs, and pyramids are one of the reasons so many plants and animals live together. These connections - or links - can be easily broken in streams by the destruction of habitat or excessive levels of pollution.

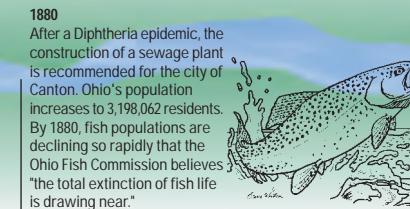
Bacteria

Bacteria are also important in food webs because they process decaying animal and plant matter into nutrients so they can re-enter the food chain through plants. Bacteria are also a source of nutrition for many consumers of detritus.

Plants

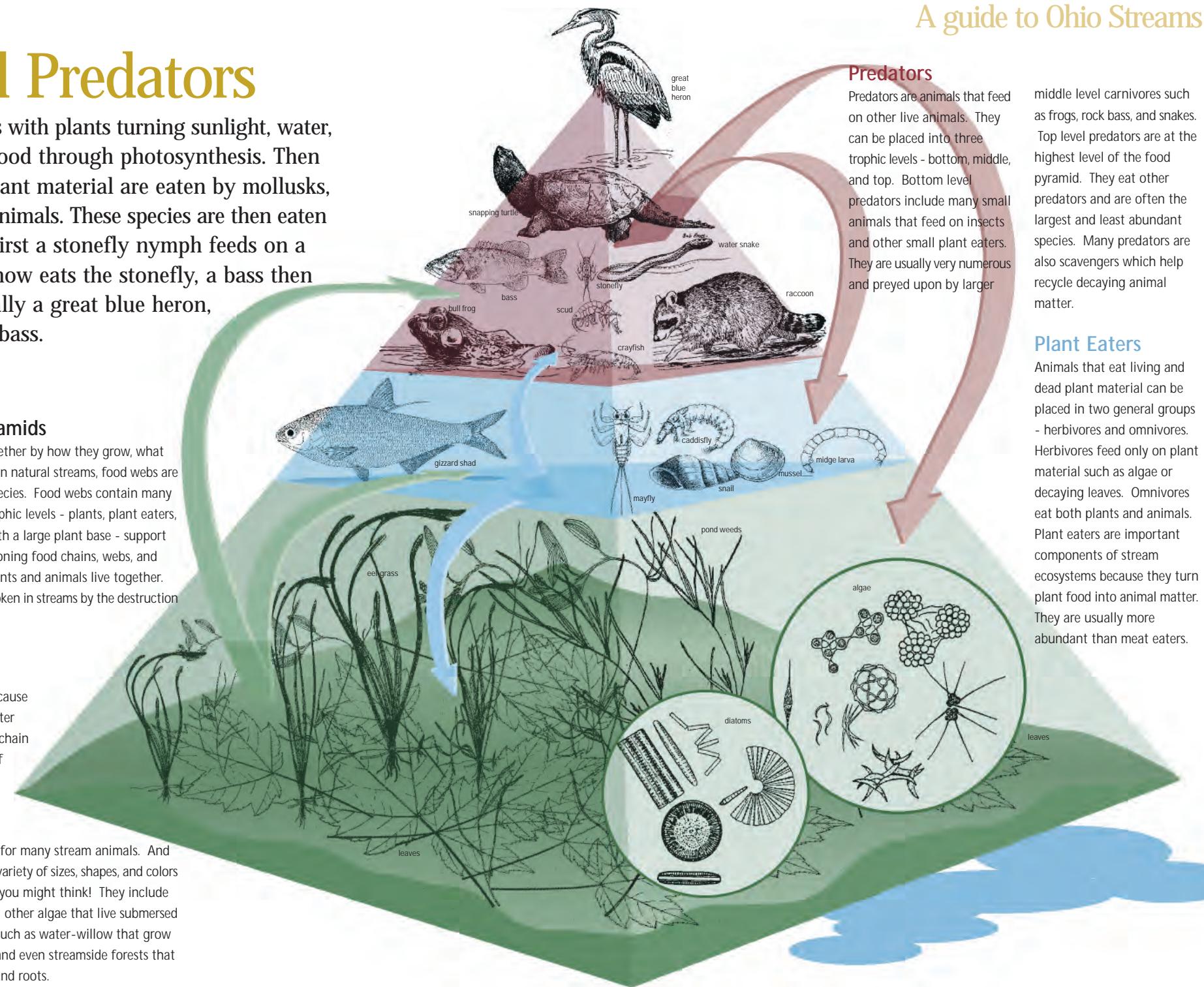
Stream plants are an important food source for many stream animals. And with more than 1,000 species that come in a variety of sizes, shapes, and colors - they are more diverse and important than you might think! They include underwater plants comprised of diatoms and other algae that live submersed on rocks and in the water, emergent plants such as water-willow that grow in dense patches along the banks and bars, and even streamside forests that provide fallen leaves, twigs, branches, logs, and roots.

1879
The Jackson Cut Off project in Wood County drains 30,000 acres of wetlands in the upper Portage River watershed. The water is diverted nine miles to the Maumee River basin. It is Ohio's first cooperative effort on the construction of a drainage ditch.



1880
After a Diphtheria epidemic, the construction of a sewage plant is recommended for the city of Canton. Ohio's population increases to 3,198,062 residents. By 1880, fish populations are declining so rapidly that the Ohio Fish Commission believes "the total extinction of fish life is drawing near."

Timeline



1881
After a very cold winter, Toledo floods when large ice jams and backed-up water breaks loose upstream in the Maumee River.

1882
Jordan publishes the "Report on the Fishes of Ohio" that lists the fish species known to be in Ohio. The development of electric power stations by Edison makes electricity available to cities.



1883
Ohio's first fishing regulations pass making it unlawful to catch fish except by hook and line in specific waters or sell fish caught contrary to law. Major flooding occurs across Ohio after heavy rains fall on frozen ground. A record setting flood stage is recorded in the Ohio River at Cincinnati.



1884
A large winter snowmelt causes flooding in the Ohio River at Cincinnati. Statewide flooding also occurs after heavy rains.

A guide to Ohio Streams

Predators

Predators are animals that feed on other live animals. They can be placed into three trophic levels - bottom, middle, and top. Bottom level predators include many small animals that feed on insects and other small plant eaters. They are usually very numerous and preyed upon by larger

middle level carnivores such as frogs, rock bass, and snakes. Top level predators are at the highest level of the food pyramid. They eat other predators and are often the largest and least abundant species. Many predators are also scavengers which help recycle decaying animal matter.

Plant Eaters

Animals that eat living and dead plant material can be placed in two general groups - herbivores and omnivores. Herbivores feed only on plant material such as algae or decaying leaves. Omnivores eat both plants and animals. Plant eaters are important components of stream ecosystems because they turn plant food into animal matter. They are usually more abundant than meat eaters.

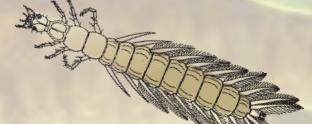
In Ohio Streams...

Threatened



Common Name: American eel
Scientific Name: *Anguilla rostrata*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Anguilliformes
Family: freshwater eels (Anguillidae)
Number of Streams: 8
Distribution: Ohio River & Lake Erie Basins
Habitat: medium to large streams
Size: < 52 inches
Pollution Tolerance: tolerant

Common



Common Name: whirligig beetle larva
Scientific Name: *Dineutus sp.*
Phylum: Arthropoda
Class: Insecta
Order: beetles (Coleoptera)
Family: whirligig beetles (Gyrinidae)
Distribution: Ohio River & Lake Erie Basins
Size: < 1 inch
Pollution Tolerance: tolerant

Common



Common Name: fluted-shell
Scientific Name: *Lasmigona costata*
Phylum: Mollusca
Class: Bivalvia
Order: Unionoida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River & Lake Erie Basins
Habitat: medium to large streams
Size: < 5 inches
Abundance: common
Pollution Tolerance: intolerant

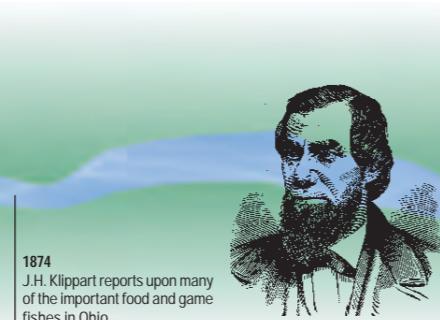
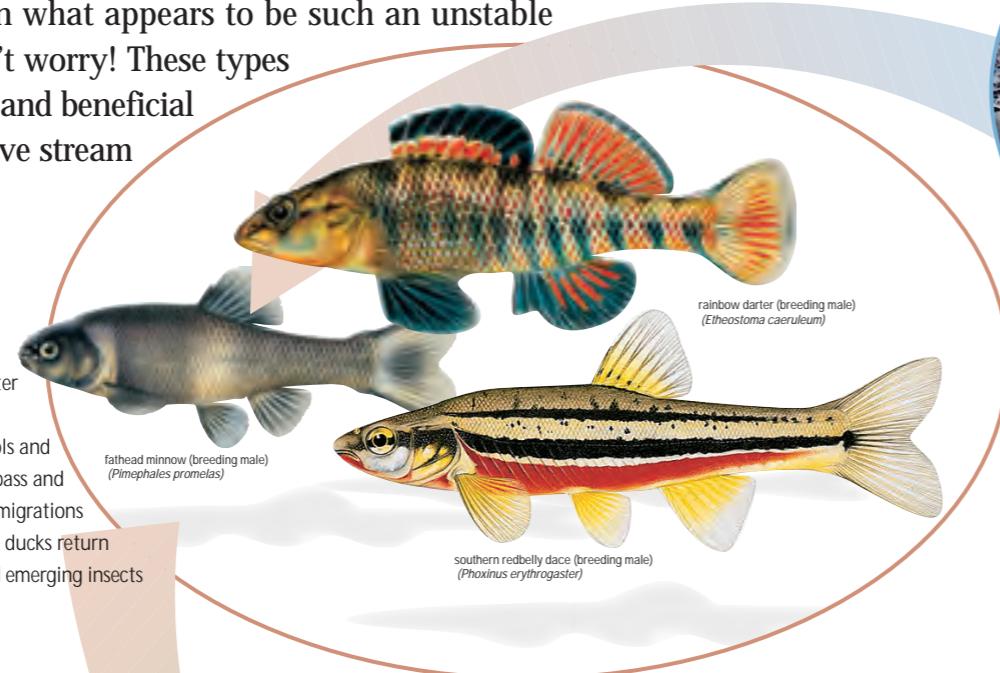
Ecology

Seasonal Changes

When streams are flooding one day and almost dry or frozen on another, it is hard to believe that the fishes and other aquatic life can live in what appears to be such an unstable environment. But don't worry! These types of changes are natural and beneficial to many of Ohio's native stream species.



Summer is a time of warm water temperatures, abundant plant growth, large insect hatches, and high productivity. For many stream species, it is the time for heavy feeding and rapid growth. Because water temperatures in most streams increase to above 75 degrees (F), it is why bass and catfish thrive and coldwater species like brook trout cannot live in most Ohio streams year round. Rapidly growing patches of water-willow stabilize gravel bars and maintain deep runs during low flows.



Winter

is a period of little activity, low

water temperatures and little or no growth for many species. Winter stoneflies hatch and migratory waterfowl - black ducks, mallards and Canada geese - flock to streams for open water to rest and feed on snails and other macroinvertebrates. Cold water temperatures prevent many harmful nonnative species from becoming established in Ohio streams.

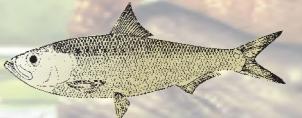


Fall

period of reduced activity as water temperature and plant growth decline.

Smallmouth bass and other species go on a feeding

In
Ohio
Streams...
Locally Common



Common Name: skipjack herring
Scientific Name: *Alosa chrysochloris*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Clupeiformes
Family: herrings (Clupeidae)
Number of Streams: 11
Distribution: Ohio River Basin
Habitat: large streams
Size: < 21 inches
Pollution Tolerance: moderate

Common



Common Name: predaceous diving beetle
Scientific Name: *Deronectes* sp.
Phylum: Arthropoda
Class: Insecta
Order: beetles (Coleoptera)
Family: Dytiscidae
Distribution: Ohio River & Lake Erie Basins
Size: < 1 inch
Pollution Tolerance: moderate

Locally Common



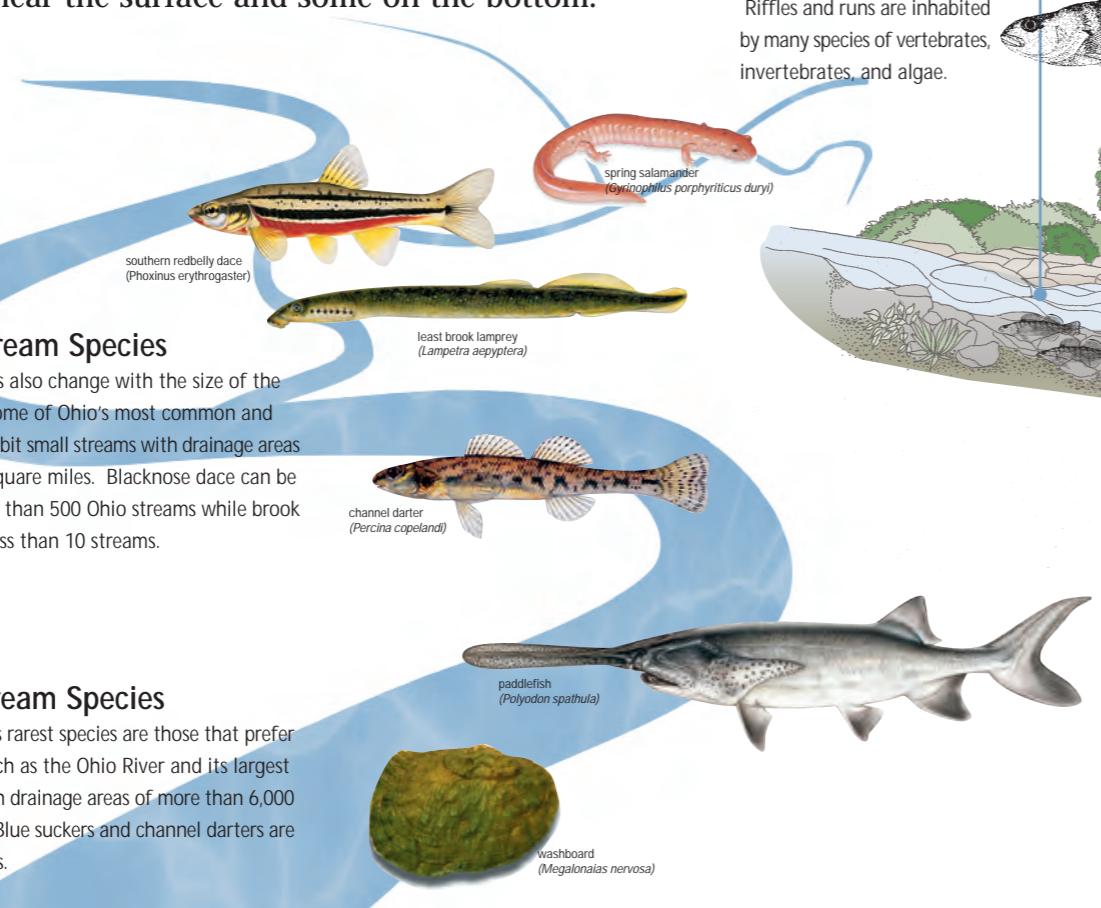
Common Name: white heelsplitter
Scientific Name: *Lasmigona complanata*
Phylum: Mollusca
Class: Bivalvia
Order: Unionida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River & Lake Erie Basins
Habitat: medium to large streams
Size: < 6 inches
Abundance: generally uncommon
Pollution Tolerance: tolerant

5.2

Ecology

Preferred Habitat

How can so many species live in streams? They can live in different sizes of streams such as creeks and rivers. They can live in the same stream, but in different habitats such a pool or riffle. And they can by even eating different types of food such as insects or fishes. Almost all stream species have a preferred habitat and that is where they are most abundant. Some live mostly in fast water and some in mostly slow water. Some live mostly in shallow water while others live mostly in deep water. Some live mostly near the surface and some on the bottom.



Small Stream Species

Stream species also change with the size of the watershed. Some of Ohio's most common and rarest fish inhabit small streams with drainage areas less than 20 square miles. Blacknose dace can be found in more than 500 Ohio streams while brook trout live in less than 10 streams.

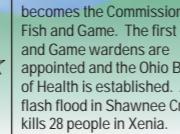
Large Stream Species

Some of Ohio's rarest species are those that prefer large rivers such as the Ohio River and its largest tributaries with drainage areas of more than 6,000 square miles. Blue suckers and channel darters are good examples.

1885
Many urban streams in Ohio are grossly polluted by sewage and industrial wastes. Commercial fishermen harvest more than 530,000 pounds of lake sturgeon from the Ohio waters of Lake Erie and 3,152,400 pounds of blue pike from the U.S. waters of Lake Erie. The first funds are allocated for the enforcement of fish laws.



1886
The Ohio Fish Commission becomes the Commission of Fish and Game. The first Fish and Game wardens are appointed and the Ohio Board of Health is established. A flash flood in Shawnee Creek kills 28 people in Xenia.



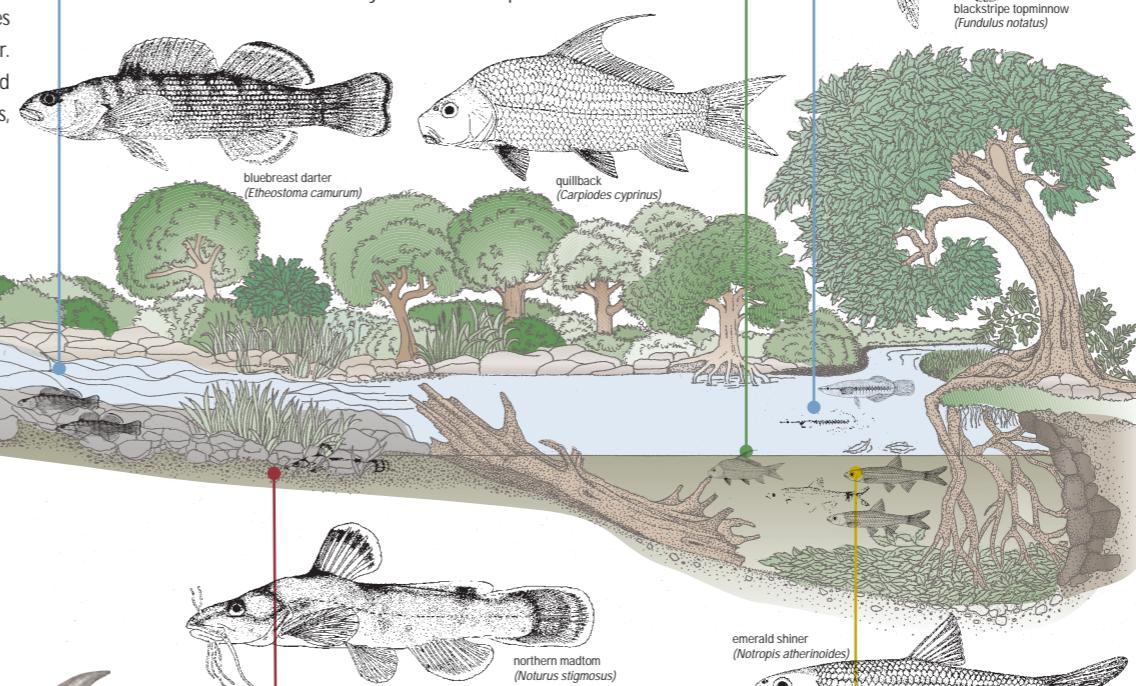
Timeline

Riffle-Run Species

Shallow rocky areas with swift current are often the most biologically diverse and productive habitats in a stream. Riffle-run habitats are where you should find an abundance of pollution-sensitive species of darters, mayflies, stoneflies, and caddisflies. These types of species can only live in these types of habitats because they need clean, silt-free substrates and highly oxygenated water. Riffles and runs are inhabited by many species of vertebrates, invertebrates, and algae.

Pool Species

Pools contain areas with deeper and slower water than riffles and runs. They usually occur in sections with low gradient or little drop in elevation. They may be only a few feet long in a headwater stream to hundreds of feet long in a large river. Large predators such as flathead catfish and smallmouth bass spend the majority of their time in deep pools. Large schools of suckers and minnows also live there. Pools typically have more fine sediment substrates than riffles and runs. Bacteria also live on the bottom of deep pools where they help recycle nutrients and organic matter by helping with the decay of animal and plant material.

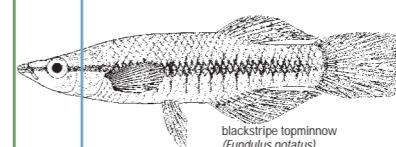


Bottom Species

The number of species that live on the bottom is usually greater than the number of species that live near the surface. Just pick up a rock in a riffle and look at all of the macroinvertebrates living on it. And if you had placed a seine or net downstream from it, there would probably be a few darters, crayfish and hellgrammies in it. Some species of madtoms bury themselves in the gravel during the day and come out only during the night.

Surface Species

If you spend much time along a stream - and watch the surface - you should see at least a few types of insects and fish. Water striders, riffle bugs and whirligigs are just a few of the insects. Blackstripe topminnows and killifish live most of their life just beneath the surface.



In Ohio Streams...

Special Interest



Common Name: river redhorse
Scientific Name: *Moxostoma carinatum*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Cypriniformes
Family: suckers (Catostomidae)
Number of Streams: 29
Distribution: Ohio River & Lake Erie Basins
Habitat: large streams
Size: < 29 inches
Pollution Tolerance: intolerant

Uncommon



Common Name: giant water bug
Scientific Name: *Lethocerus* sp.
Phylum: Arthropoda
Class: Insecta
Order: true bugs (Hemiptera)
Family: giant water bugs (Belostomatidae)
Distribution: Ohio River & Lake Erie Basins
Size: < 2 inches
Pollution Tolerance: moderate

Uncommon



Common Name: creek heelsplitter
Scientific Name: *Lasmigona compressa*
Phylum: Mollusca
Class: Bivalvia
Order: Unionida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River & Lake Erie Basins
Habitat: small to medium streams
Size: < 4 inches
Abundance: widespread, but not common
Pollution Tolerance: intolerant

1888

Several fish species are added to the fishes of Ohio when J. Henshall publishes "Contribution to the Ichthyology of Ohio." Oil pollution is severe in many northwestern Ohio streams as the result of the extensive oil fields. Government snag boats remove more than 1,200 snags from the Ohio River. Electric street cars in Cincinnati help residents migrate to the suburbs.



1891

J. Boepple, a German pearl inlay artist, establishes the first U.S. freshwater mussel button factory in Muscatine, Iowa.



1890

Ohio cities are prosperous and industries continue to expand. Cincinnati is the carriage and wagon center of the world building half of all produced in America. There is rapid suburban growth and many passenger trains.



1893
Canton completes Ohio's first sewage plant adjacent to Nimishillen Creek to help control diphtheria. Ohio passes its first significant water pollution law requiring state approval of plans for public sewerage installations. Harelip suckers and gilt darters are collected from the Maumee River watershed for the last time.

A guide to Ohio Streams

5.4



From their headwaters to confluences, Ohio streams support a remarkable diversity of aquatic wildlife. And based on the presence or absence of a backbone, stream wildlife can be divided into two groups - vertebrates and invertebrates. Vertebrates - those with backbones - include the most well-known and largest animals, such as fishes, reptiles, and amphibians. Invertebrates - those without backbones - include smaller and less well-known animals, such as insects, mollusks, and crustaceans. With more than 1,400 total species, rivers and creeks are "the rain forests of Ohio."

Chapter Six

Wildlife Diversity

Aquatic Insects

Mollusks

Stream Fishes

Reptiles and Amphibians

Useful Terms and Definitions

Benthos- bottom-dwelling organisms.

Endangered Species- in Ohio, a species that is threatened with statewide extirpation or extinction.

Fish- a vertebrate animal with fins, permanent gills adapted to live under-

water, and skin that is commonly covered with scales.

Herps- a general name for reptiles and amphibians.

Insect- an invertebrate animal with three body parts consisting of a head, thorax, and abdomen.

Invertebrate- an animal without a backbone.

Mollusk- an invertebrate animal such as a freshwater mussel or snail with one or two hard shells, no eyes, and a muscular foot for moving about.

Nymph- the intermediate stage between egg and adult for an insect.

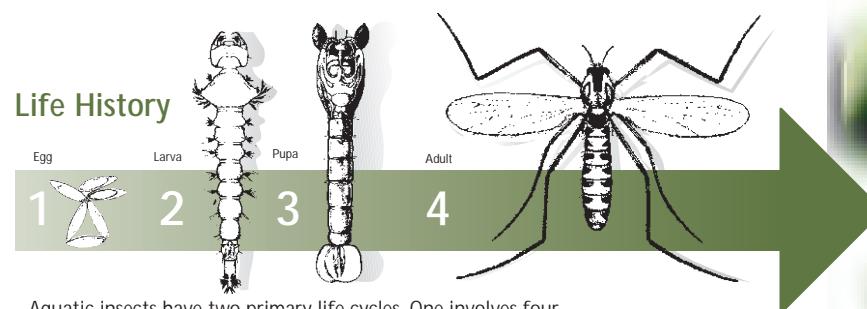
Vertebrate- an animal with a backbone.

Wildlife Diversity- the number and kinds of wild animals including vertebrates and invertebrates.

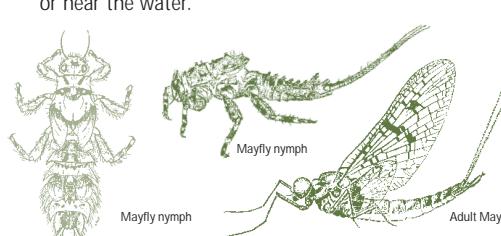
Wildlife Diversity

Aquatic Insects

With more than 1,200 species, aquatic insects are the largest group of Ohio stream wildlife. They can be identified by the presence of three distinct body parts - a head, a thorax with three pairs of legs, and an abdomen. Most grow up under water as larvae, but fly away as adults. Some skate on the surface, some crawl on the bottom, and some even live upside down! Some eat plants, some are predators, and many are eaten by other species of wildlife.



Aquatic insects have two primary life cycles. One involves four stages - egg, larva, pupa, and adult - as in caddisflies and aquatic beetles. The other involves three stages - egg, nymph, and adult - as in mayflies and stoneflies. In both life cycles, the immature stage - larva or nymph - goes through successive growth periods called instars. Most aquatic insects emerge as terrestrial adults, but some stay in the water for their entire lives. All lay eggs in or near the water.



Mayflies (Ephemeroptera) live for only a day after becoming an adult. The immatures - or nymphs - live in a variety of stream habitats from which they emerge as adults in very large numbers. Both nymphs and emerging adults are important food items for many fish and other wildlife. The nymphs are primarily scrapers and collectors that feed on algae and detritus. Together with caddisflies and stoneflies, they are excellent indicators of good water quality.

1895
P.H. Kirsch publishes the results of an extensive fish survey of the Maumee River and its larger tributaries. After several dry years, Ohio experiences an extreme drought from June through October.

1898
Iron furnaces in Cleveland, Canton, and Youngstown are among the world's leading steel producers. The Ohio Fish Commission opens the London Fish Hatchery. More than 60 mussel shell button factories are operating along U.S. streams.

Timeline



Damselfly larva

While perched, adult damselflies hold their wings together tilted upwards above the body.

Dragonflies and Damselflies

(Odonata) are well-known insects because of their beauty and flying ability. Underwater or in the air they are ferocious



predators. Larvae typically go through 10-15 instars over a period of 1-5 years before crawling out of the water. Then they attach to a stick or plant, squeeze through a slit, and dry their wings before flying away as an adult.



The gills of a damselfly larva are located at the tip of the abdomen.

Endangered



Common Name: mountain madtom
Scientific Name: Noturus eleutherus
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Siluriformes
Family: catfishes (Ictaluridae)
Number of Streams: 5
Distribution: Ohio River Basin
Habitat: large streams
Size: < 5 inches
Pollution Tolerance: intolerant

Common



Common Name: damselfly larva
Scientific Name: Argia sp.
Phylum: Arthropoda
Class: Insecta
Order: dragonflies & damselflies (Odonata)
Suborder: damselflies (Zygoptera)
Family: narrow-winged damselflies (Coenagrionidae)
Distribution: Ohio River & Lake Erie Basins
Size: < 2 inches
Pollution Tolerance: moderate

Locally Common



Common Name: kidneyshell
Scientific Name: Ptychobranchus fasciolaris
Phylum: Mollusca
Class: Bivalvia
Order: Unionida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River & Lake Erie Basins
Habitat: medium to large streams
Size: < 6 inches
Abundance: widespread, but sporadic
Pollution Tolerance: intolerant



Adult dragonflies are some of the most colorful insects
(Photo courtesy of Simeon Kresge Oka).



Beetles

(Coleoptera) function not only as predators, but also as herbivores or detritus-feeders depending on the species and life stage.

Most live on the bottom, however, some live in the water column and are good swimmers. Some like parts. Water striders, backswimmers, and water boatmen are but a few of the many hemipterans that live in Ohio streams.



Waterstriders and riffle bugs are considered semi-aquatic because they spend most of their time on top of the water.



True Bugs

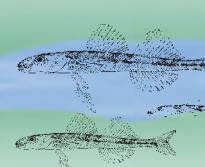
(Hemiptera) are mostly predators with sucking mouth



Hemipterans live in a wide range of stream habitats.



1899
The Rivers and Harbors Act is enacted. Section 10 makes it unlawful to construct any structure (dams, bridges, piers, retaining walls, etc.) in any navigable water or to deposit refuse without federal approval. A crystal darter is collected from the Ohio River for the last time. On February 10, southeastern counties experience Ohio's coldest recorded temperatures ranging from -39 to -30 degrees F.



1900
Ohio's population increases to 4,157,545 residents. Ohio's last wild passenger pigeon is killed in Pike Co. The Lacey Act begins to regulate interstate and international commerce of wild animals, their parts, eggs, and offspring, but excludes migratory birds.

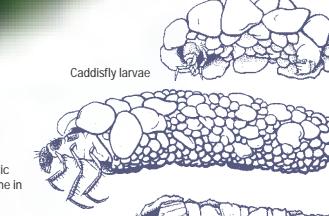
A guide to Ohio Streams

In Ohio Streams...

6.1



Many caddisfly larvae build cases out of rock or plant material while others construct silken retreats.



Caddisfly larva

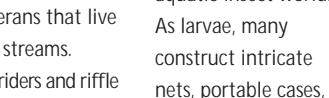


Adult aquatic beetles come in a variety of shapes and sizes.



the whirligig even swirl across the surface in large schools.

Larvae and adults are an important food source for fish and other wildlife. Adult beetles have wings and can fly.



Water striders, backswimmers, and water boatmen are but a few of the many hemipterans that live in Ohio streams.



Larvae and adults are an important food source for fish.



Water striders, backswimmers, and water boatmen are but a few of the many hemipterans that live in Ohio streams.

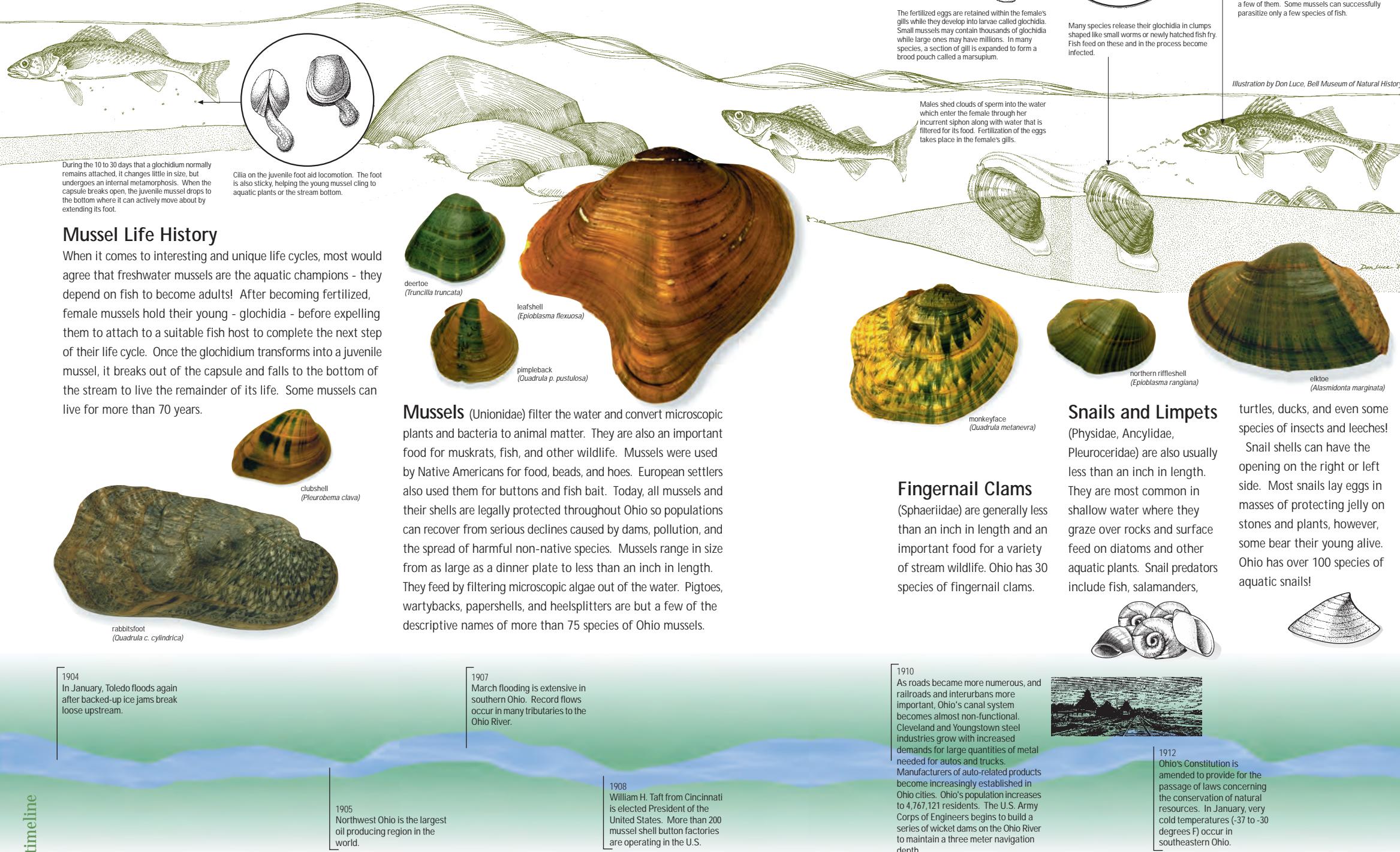
1901
R.C. Osburn publishes *Fishes of Ohio*.

1902
Automobiles are marketed.

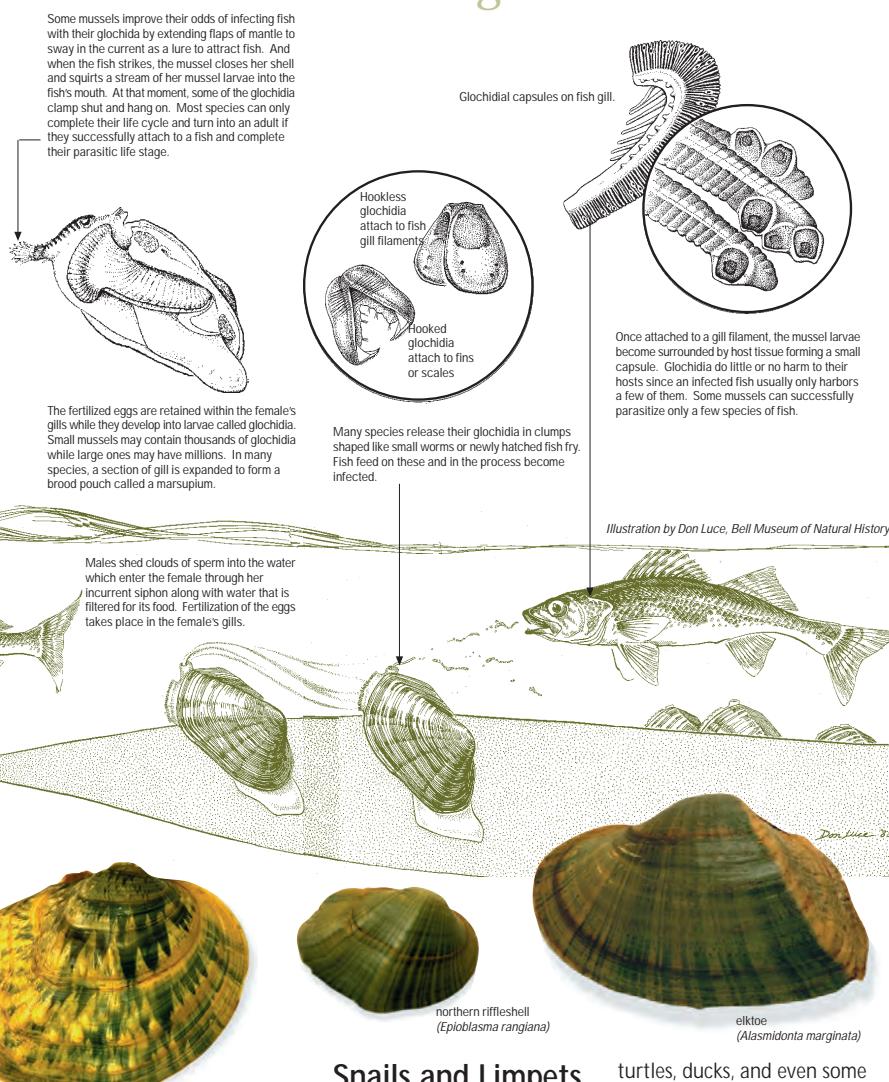
Wildlife Diversity

Mollusks

Based on their shells, mollusks can be divided into two groups - bivalves and univalves. Mussels are bivalves because they have two similar shells. Snails are univalves because they have one large shell that protects most of the animal. Some snails even have a smaller plate that seals the shell when the animal is retracted. Mollusks have no head or eyes and move about by extending a muscular foot.



A guide to Ohio Streams



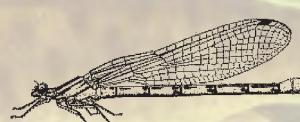
In Ohio Streams...

Special Interest



Common Name: eastern sand darter
Scientific Name: Ammocrypta pellucida
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Perciformes
Family: perch & darters (Percidae)
Number of Streams: 15
Distribution: Ohio River & Lake Erie Basins
Habitat: medium to streams
Size: < 3.2 inches
Pollution Tolerance: intolerant

Common

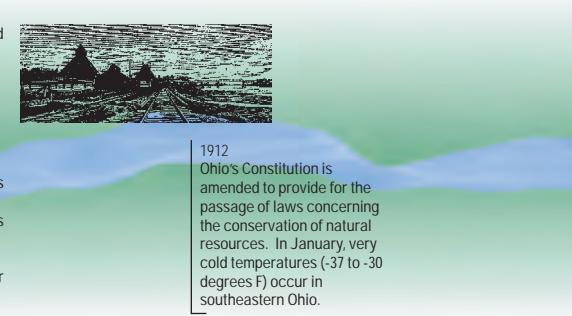


Common Name: narrow-winged damselfly
Scientific Name: Argia sp.
Phylum: Arthropoda
Class: Insecta
Order: dragonflies & damselflies (Odonata)
Suborder: damselflies (Zygoptera)
Family: narrow-winged damselflies (Coenagrionidae)
Distribution: Ohio River & Lake Erie Basins
Size: < 2 inches
Pollution Tolerance: moderate

Threatened



Common Name: threehorn wartyback
Scientific Name: Obliquaria reflexa
Phylum: Mollusca
Class: Bivalvia
Order: Unionida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River & Lake Erie Basins
Habitat: large streams
Size: < 3 inches
Abundance: uncommon, sporadic in rivers
Pollution Tolerance: intolerant



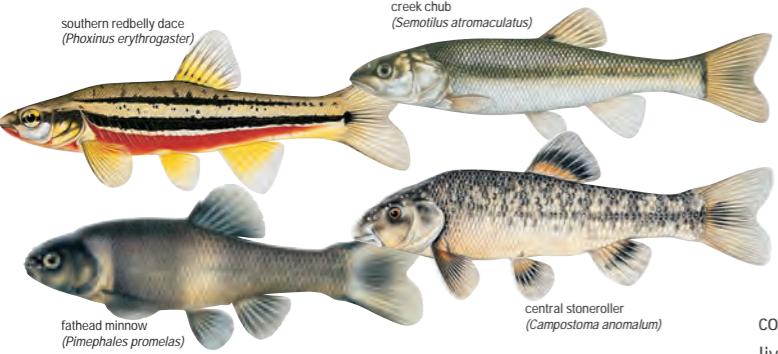
1910
As roads became more numerous, and railroads and interurbans more important, Ohio's canal system becomes almost non-functional. Cleveland and Youngstown steel industries grow with increased demands for large quantities of metal needed for autos and trucks. Manufacturers of auto-related products become increasingly established in Ohio cities. Ohio's population increases to 4,767,121 residents. The U.S. Army Corps of Engineers begins to build a series of wicket dams on the Ohio River to maintain a three meter navigation depth.

1912
Ohio's Constitution is amended to provide for the passage of laws concerning the conservation of natural resources. In January, very cold temperatures (-37 to -30 degrees F) occur in southeastern Ohio.

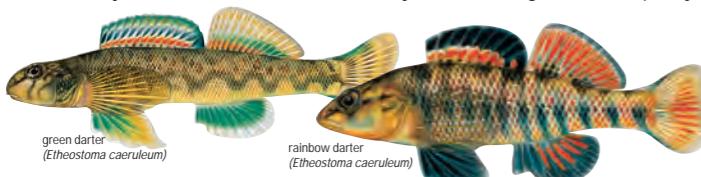
Wildlife Diversity

Stream Fishes

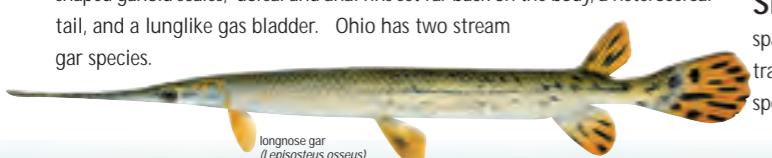
More than 162 species of fish have been captured in Ohio streams - most of which are never caught or seen by anglers. Some are huge, but most are small. Most are minnows, suckers, and darters. Some live only in small brooks while others live in large rivers. Some are gone from Ohio and some are new. But one thing is for certain - they come in a variety of sizes, shapes, and colors! Most are reliable indicators of stream quality and far more abundant than you might think. In just a few hundred yards of most streams, you can expect to find thousands of individual fish of 20 or more species.



Darters and Perch (Percidae) have two dorsal fins - the first with spines and the second without - and ctenoid scales. While most Ohioans are familiar with yellow perch, walleye, and sauger, few have seen the 22 species of small darters that also live in streams. Rainbow, bluebreast, slenderhead, and orangemouth are but a few of the descriptive names given to these brilliantly colored fishes. Darters are usually indicative of good stream quality.



Gars (Lepisosteidae) have long snouts with sharply-toothed jaws, diamond shaped ganoid scales, dorsal and anal fins set far back on the body, a heterocercal tail, and a lunglike gas bladder. Ohio has two stream gar species.

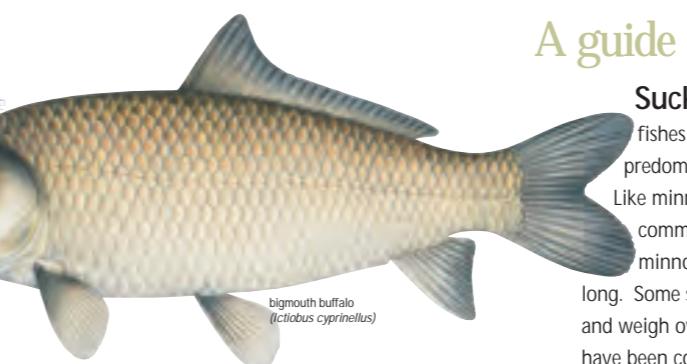


1913
Severe March flooding causes Ohio's greatest weather disaster. Five days of heavy rain on saturated ground kills 467 people. The Ohio River Investigation Station in Cincinnati pioneers the first river basin pollution control concept for the nation. The Ohio Division of Fish and Game is created in the Agriculture Commission. Ohio's first resident hunting license costs one dollar.

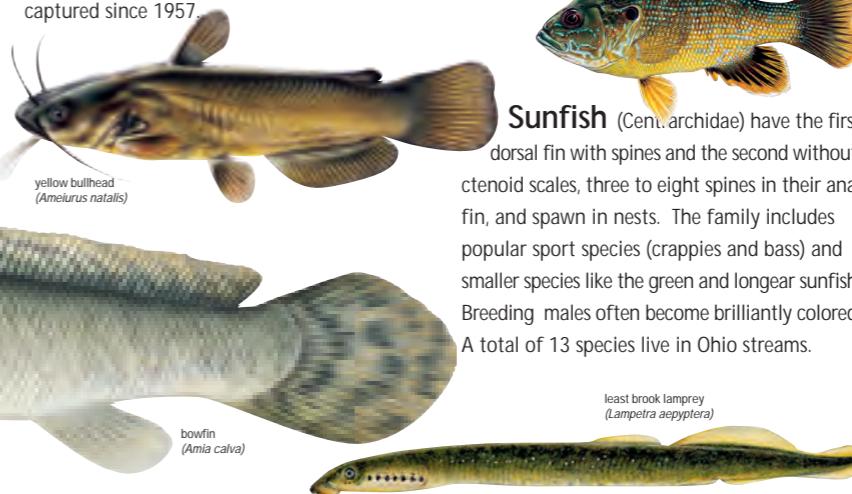
1914
The Conservancy District Act is enacted as the result of the great flood of 1913. The law allows local watershed districts to solve their own flooding and drainage problems. World War I begins in Europe. Ohio industries are major suppliers of war materials.



1915
After a petition is filed in the Hardin Co. Common Pleas Court, the Upper Scioto Conservancy District is created. Its purpose was to prevent flooding by regulating stream channels by changing, widening and deepening, reclaiming, and filling wet and overflow lands; regulating the flows of streams; diverting or in whole or in part eliminating water courses to promote public health, safety, convenience, and welfare. A number of flood control projects follow in the Great Miami and Muskingum watersheds.



Catfish (Ictaluridae) have four pairs of barbels, no scales, and stout spines at the base of their dorsal and pectoral fins. Most Ohioans are familiar with the bullheads, channel catfish, and flatheads, but few are aware of the madtoms that rarely exceed three inches in length. Thirteen species have been collected from Ohio streams, however, the Scioto madtom has not been captured since 1957.

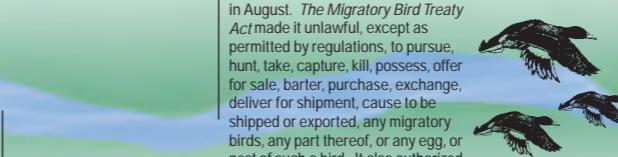


Freshwater Eels (Anguillidae) are a snake-like fish that spawn in the ocean, but migrate into brackish and freshwater to mature into adults. Some female American eels - Ohio's only species - have to swim over 3,000 miles to reach Ohio and return to the sea to spawn. Dams have caused this species to decline in Ohio.



1918
Extremely high temperatures (100 to 110 degrees F) are recorded statewide in August. The Migratory Bird Treaty Act made it unlawful, except as permitted by regulations, to pursue, hunt, take, capture, kill, possess, offer for sale, barter, purchase, exchange, deliver for shipment, cause to be shipped or exported, any migratory birds, any part thereof, or any egg, or nest of such a bird. It also authorized and directed the Secretary of Interior to establish seasons and methods of hunting, shipping etc. World War I comes to an end with armistice on November 11.

1917
The Lake Milton Dam is constructed on the Mahoning River.



A guide to Ohio Streams

Suckers (Catostomidae) are soft rayed fishes with throat teeth that feed predominantly on benthic invertebrates.

Like minnows, suckers are some of the most common stream species. But unlike minnows, most adults are over 12 inches long. Some species are more than two feet long and weigh over 20 pounds. Nineteen species have been collected from Ohio streams. Similar species of suckers include the redhorses, carpsuckers, and buffalos.



Sunfish (Centrarchidae) have the first dorsal fin with spines and the second without, ctenoid scales, three to eight spines in their anal fin, and spawn in nests. The family includes popular sport species (crappies and bass) and smaller species like the green and longear sunfish. Breeding males often become brilliantly colored. A total of 13 species live in Ohio streams.

In Ohio Streams...

Locally Common



Common



Endangered



Wildlife Diversity

Reptiles and Amphibians

Fish are not the only aquatic vertebrates that inhabit streams. Ohio has a number of amphibians (salamanders and frogs) and reptiles (snakes and turtles) as well. Turtles can be seen resting on logs and snakes skimming across the surface. Frogs hide, but give away their presence with calls. Salamanders are secretive and you may not ever see them unless you turn over rocks or catch one while fishing.

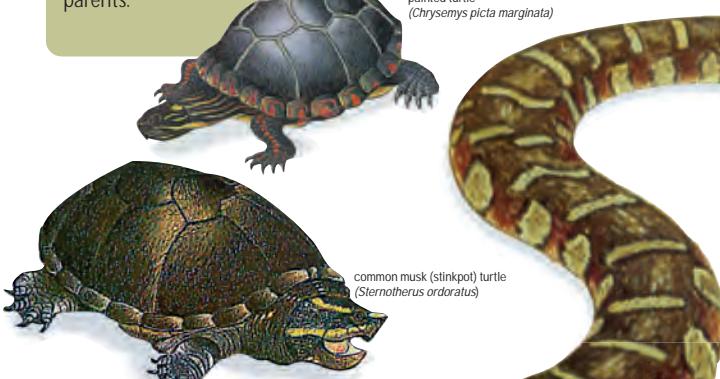
Reptiles (Class Reptilia - Turtles, Snakes, and Lizards) are different from other vertebrates because they are clad in scales, shields or plates and if they have toes - they bear claws. Unlike amphibians, their young have lungs and look like their parents.

Turtles (Order Testudines) are reptiles with sharp bony jaws, but no teeth. Eight of Ohio's eleven turtle species (snapping, common musk, common map, false map, painted, spiny and smooth

softshells, and red-eared slider) inhabit streams. Stream turtles leave the water and can travel long distances to lay and bury their eggs. Most aquatic turtles are omnivorous and eat live or dead frogs, fish,



painted turtle
(*Chrysemys picta marginata*)



common musk (stinkpot) turtle
(*Sternotherus odoratus*)

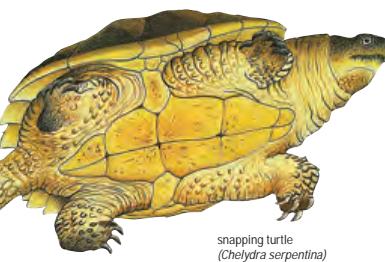


common water snake
(*Nerodia sipedon*)

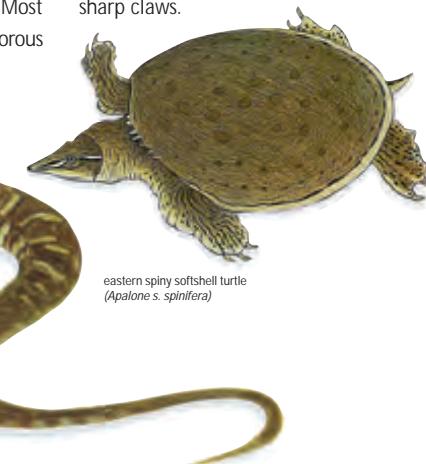
Snakes (Order Squamata) are legless reptiles. Ohio has two stream species, both of which are not venomous. The most common and largest (to 42 inches) is the Northern water snake which is often misidentified as a water moccasin (cottonmouth). Queen snakes are less than 24 inches long and like water snakes will release a foul smelling scent when threatened. Stream snakes primarily eat frogs, fish, salamanders, and crayfish. Female water and queen snakes have litters of live young.



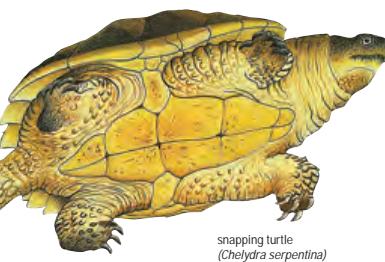
1922
The headwaters of the Scioto River are dredged near Roundhead.



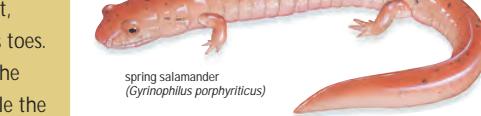
snapping turtle
(*Chelydra serpentina*)



eastern spiny softshell turtle
(*Apalone s. spinifera*)



two-lined salamander
(*Eurycea bislineata*)



spring salamander
(*Gyrinophilus porphyriticus*)



mudpuppy
(*Necturus maculosus*)

Salamanders

(Order Caudata) are amphibians with tails. Twelve of Ohio's 24 salamander species (hellbender, mudpuppy, dusky, mountain dusky, two-lined, spring, streamside, red, northern slimy, mud, cave, and longtail) can be found in or along streams. The prehistoric looking hellbender that can exceed 24 inches in length leaves its underwater hiding crevices only at night to feed on crayfish and other aquatic invertebrates. Their wrinkly skin is believed to help improve oxygen absorption. Mudpuppies - the second largest aquatic species - retain external gills as adults. Their prey includes fish, crayfish, mollusks, insects, and worms. Dusky, two-lined, spring, and most of the other salamanders that live in or along smaller streams are lungless and usually less than five inches long.



Frogs (Order Anura) undergo marked changes as they transform from tadpoles into jumping adults! Usually, their gills turn into lungs, fins develop into legs, and diets shift from plants to animals. Ohio has two common stream species - bull and green frogs. Both can be identified by their call and physical appearance. Bullfrogs have a loud deep call - "JUG-O'-RUM.....JUG-O'-RUM" while a green frog sounds like a plucked banjo string - "TWANG." Green frogs are smaller (usually two to three inches long) and have dorsal ridges that extend straight back behind the eyes. Bullfrogs are usually three to eight inches long and lack the ridges. Sexes of both species of

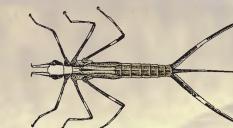


1928
River freight traffic on the Ohio River nearly doubles past Cincinnati with the completion of 49 navigation dams.



Bullfrog
(*Rana catesbeiana*)

Common

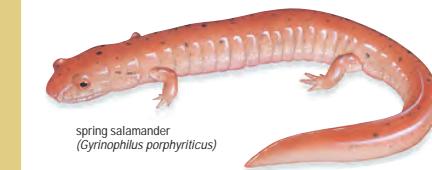


Common Name: damselfly larva
Scientific Name: *Calopteryx* sp.
Phylum: Arthropoda
Class: Insecta
Order: dragonflies & damselflies (Odonata)
Suborder: damselflies (Zygoptera)
Family: broad-winged damselflies (Calopterygidae)
Distribution: Ohio River & Lake Erie Basins
Size: < 3 inches
Pollution Tolerance: moderate

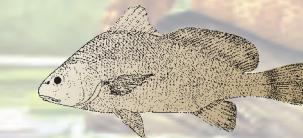
Threatened



Common Name: black sandshell
Scientific Name: *Ligumia recta*
Phylum: Mollusca
Class: Bivalvia
Order: Unionida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River & Lake Erie Basins
Habitat: large streams
Size: < 10 inches
Abundance: uncommon
Pollution Tolerance: intolerant



spring salamander
(*Gyrinophilus porphyriticus*)



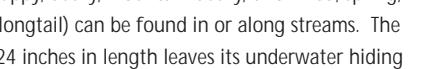
Common Name: freshwater drum
Scientific Name: *Aplodinotus grunniens*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Perciformes
Family: drums (Sciaenidae)
Number of Streams: 114
Distribution: Ohio River & Lake Erie Basins
Habitat: medium to large streams
Size: < 39 inches
Pollution Tolerance: moderate



mudpuppy
(*Necturus maculosus*)



two-lined salamander
(*Eurycea bislineata*)



hellbender
(*Cryptobranchus alleganiensis*)



adult frogs can be identified by comparing the size of their ear drums. It is larger than the eye in males and about the same size as the eye in females. Frogs are an important part of stream food chains. Tadpoles feed mainly on algae, but change to a carnivorous diet as adults when they feed on insects, snails, worms, and crayfish. Tadpoles and frogs are prey for turtles, snakes, fish, birds, and mammals.



green frog
(*Rana clamitans*)



1929
Flooding occurs across Ohio in February as the result of heavy rains, melting snow, and ice jams. Ohio's Division of Fish and Game becomes the Division of Conservation in the Department of Agriculture. Sportsmen still have representation in the Governor's cabinet or authority on stream pollution. The Ohio River is opened to modern navigation by Herbert Hoover. After a decade of economic prosperity, prices on the U.S. stock market plunge signaling the beginning of a severe economic depression.

Streams are one of Ohio's best kept secrets when it comes to a variety of recreational opportunities. Fishing, canoeing, and wildlife viewing are just a few of the many ways to enjoy your leisure time along streams. And what about beautiful scenery? Giant sycamore trees, misty mornings, and reflections are just a few of the breathtaking views streams have to offer.

Chapter Seven Recreation



Gone Fishin'

More Sport Fishes

Recreational Opportunities

Useful Terms and Definitions

Canoe- a light boat propelled by paddles.

Fossil- petrified forms of prehistoric plants and animals.

Kayak- the hunting canoe of arctic America made with sealskins stretched

over a pointed frame.

Recreate- to impart new vigor to; refresh after labor.

Recreation- refreshment of body or mind; amusement as a pleasurable exercise or occupation.

Sport Fish- bass, trout, catfish, and other fishes

River Left- left side of a stream when facing downstream.

River Right - right side of a stream when facing downstream.

sought after by anglers.

Tailwaters- the area in a stream downstream from a dam.

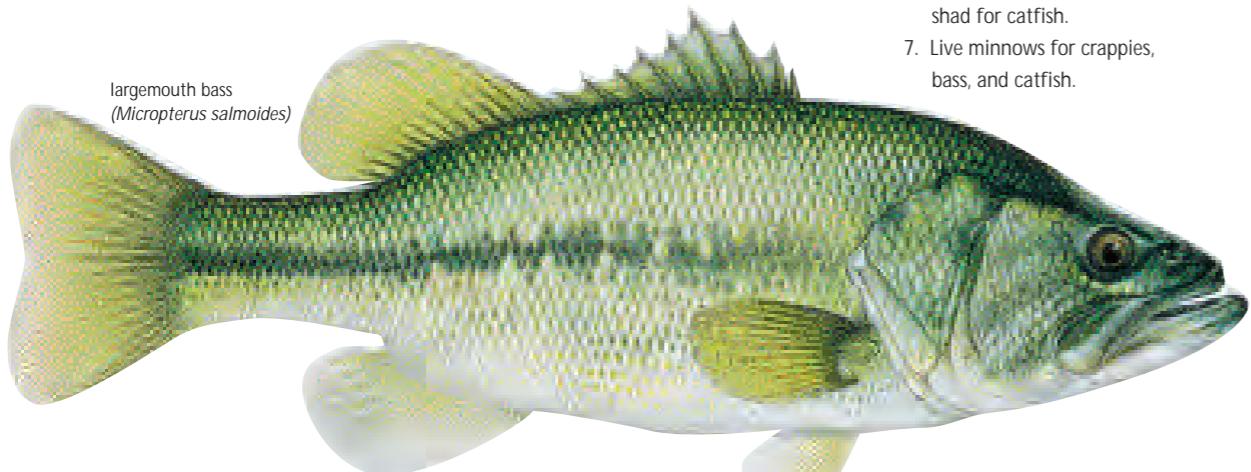
Waders- waterproof boots (chest or hip high) used by anglers and others in streams.

Unequaled in their aesthetic value, streams like Big Darby Creek are a great place to get away from crowds. (Photo courtesy of Dan Armitage).

Recreation

Gone Fishin'

Hook into a feisty smallmouth bass and you will quickly understand why it's Ohio's most sought-after stream bass. No matter where you are in Ohio, there's a good chance that a stream nearby has more than one hungry "smallie." Largemouth and spotted bass – Ohio's two other blackbass species – can also be caught in many streams.



Largemouth Bass

Best Streams: Scioto River, Mill Creek, and Ohio River, but they can be found in most areas as indicated by the dots on the map.



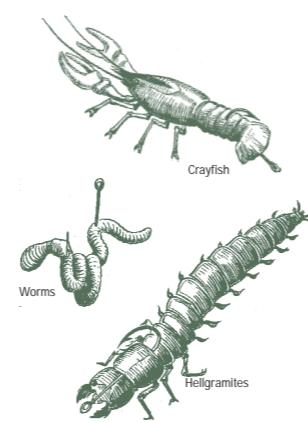
Largemouth bass thrive in medium to large streams with little current, silty bottoms, and numerous snags and dense beds of vegetation. This bass does well in impounded streams, backwater embayments, and canals.

Identification: With mouth closed, the end of the upper jaw extends past the eye. A dark lateral band extends from the head to tail and the dorsal fin is deeply notched between the spines and soft rays. The

color of its sides are usually olive-green with a silvery sheen. This fish has a stronger odor than the other two species of bass. They are normally 12-15 inches long and weigh 1-3 pounds. This is Ohio's largest bass species.

Favorite Foods: Crayfish, frogs, gizzard shad, and other small fish.

Fishing Tips: Flyfishing, baitcasting and spincasting with a variety of lures are all popular ways of catching largemouth bass. Live baits such as hellgrammites, soft craws, and minnows are also popular.



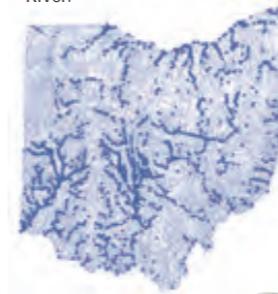
Great Stream Baits

1. Worms threaded on a thin wire hook.
2. "Hairjigs" tipped with a piece of worm.
3. Jig and twister tail tipped with a minnow.
4. Small in-line spinners.
5. Softcraws fished on the bottom.
6. Cutbait - especially gizzard shad for catfish.
7. Live minnows for crappies, bass, and catfish.



Smallmouth Bass

Best Streams: Scioto River, Great Miami River, N. Fork Licking River, Olentangy River, Portage River, Sevenmile Creek, Fourmile Creek, Sandusky River, Big Darby Creek, and Ohio River.



Smallmouth bass thrive in medium to large streams with good water quality, current, and gravel or rock bottoms. Stream banks and gravel bars lined with dense patches of waterwillow are also an indication of a good "smallie" stream.

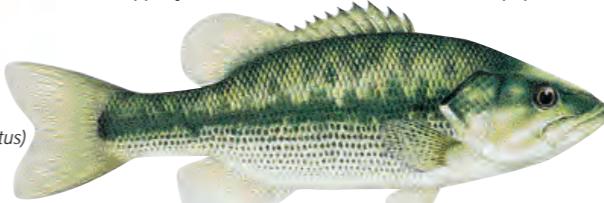
Identification: With mouth closed, the end of the upper jaw does not

extend past the eye. Its color varies from yellow-green to olive-green with bronze iridescence. They are normally 10-15 inches long and weigh less than two pounds.

Favorite Foods: Crayfish, minnows, and aquatic insects.

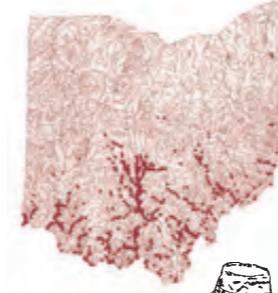
Fishing Tips: Flyfishing, baitcasting, and spincasting with lures are all popular ways of catching smallmouth bass.

Live baits such as hellgrammites, soft craws, and minnows are also popular.



Spotted Bass

Best Streams: Muskingum River, Scioto River, Big Darby Creek, Ohio River, Hocking River, E. Fork Little Miami River, Salt Creek, Raccoon Creek.



Spotted bass thrive in medium to large streams in southern Ohio with good water quality, slow current, and rocky substrates.

Identification: When the mouth is closed, the end of the upper jaw does not extend past the eye. A patch of teeth on the tongue, rows of spots below the lateral band, and a shallow notch in the dorsal fin distinguishes it from a largemouth bass. Young have a tri-colored tail. They are

normally 8-12 inches long and weigh less than one pound. This is Ohio's smallest bass species.

Favorite Foods: Crayfish, minnows, and aquatic insects.

Fishing Tips: Spotted bass can be caught on a wide variety of natural and artificial baits using spin-casting, baitcasting and flyfishing gear. Live baits such as hellgrammites, and minnows are popular baits.

In Ohio Streams...

Common



Common Name: green sunfish
Scientific Name: *Lepomis cyanellus*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Perciformes
Family: sunfishes (Centrarchidae)
Number of Streams: 724
Distribution: Ohio River & Lake Erie Basins
Habitat: small to medium streams
Size: < 10.8 inches
Pollution Tolerance: highly tolerant

Common



Common Name: crawling water beetle
Scientific Name: *Peltodytes sp.*
Phylum: Arthropoda
Class: Insecta
Order: beetles (Coleoptera)
Family: Haliplidae
Distribution: Ohio River & Lake Erie Basins
Size: < 1 inch
Pollution Tolerance: moderate

Extirpated



Common Name: ring pink
Scientific Name: *Obovaria retusa*
Phylum: Mollusca
Class: Bivalvia
Order: Unionoida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River
Habitat: large streams
Size: < 4 inches
Abundance: none
Pollution Tolerance: intolerant



1930 Ohio's population increases to 6,646,697 residents. July is the driest month in Ohio history with temperatures exceeding 108 degrees F and a statewide average rainfall of only 1.52 inches. From April to the following March will become the driest 12 months in Ohio's history with an average of only 21.9 inches of precipitation.

1931 With its upper watershed protected by a water district, the Meander Creek Reservoir creates a potable water supply for residents in the Mahoning River valley.

1933 Ohio River floods Cincinnati and other cities in March after several periods of heavy rain. President F. Roosevelt signs into law Senate Bill 598 which creates the federal Civilian Conservation Corps (CCC). The CCC gives young men land and forest restoration jobs. Projects include dam construction, tree planting, wildlife habitat development, and soil conservation projects. The program ignites a public consciousness for responsible stewardship of natural resources.

1934 The Migratory Bird Hunting Stamp Act provides funds for the acquisition of habitat for wild ducks, geese, brant, and swans. Waterfowl hunters 16 years of age and older are now required to purchase an annual duck stamp. Drought conditions develop again during the hot summer. Extremely high temperatures (96 to 113 degrees F) are recorded statewide in July.

1936 An extreme statewide heat wave - with record-setting high temperatures of 104 to 110 degrees F - occurs in several cities during July.

1937 All cities along the Ohio River experience record-setting flows during January flooding. A statewide monthly average of 9.57 inches makes January the wettest month since September 1866. The Pittman-Robertson Act places a federal tax on guns, ammunition and other hunting equipment.

Timeline

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Recreation

More Sport Fishes

Rock bass, sauger, and huge flathead catfish are but a few of the many other game fishes that can be caught in many Ohio streams. No matter where you are in Ohio, there is some great stream fishing nearby.

channel catfish

(Ictalurus punctatus)

Best Streams: Muskingum River, Great Miami River, Ohio River, Scioto River, Whiteoak Creek, Paint Creek, E. Fork Little Miami River, Licking River, and Whitewater River.



northern pike

(Esox lucius)

Best Streams: Breakneck Creek, Killbuck Creek, Portage River, Scioto River, Maumee River, Cuyahoga River, Stillwater Creek, Tenmile Creek, and Tiffin River.



timeline

1938
The U.S. Army Corps of Engineers builds the first high-lift roller dam on the Ohio River.

1939
The Division of Conservation and Natural Resources is formed. New stream programs are initiated including stream habitat improvement and pollution abatement. Shovelnose sturgeon will be collected for the last time in the Ohio River along the Ohio shoreline. The longhead darter will be collected for the last time in the Walhonding River.

1940
Eagle Act passes to protect bald eagles. Prohibits the taking, possession, sale, purchase, barter, transportation, export and import of bald and golden eagles, their parts, nests, and eggs without a permit. Ohio's population increases to 6,907,612 residents. Reaching a historic low, Ohio woodlands cover an estimated 10 percent of the state's land.

rock bass
(Ambloplites rupestris)

Best Streams: Chagrin River, Lost Creek, Buck Creek, Scioto River, Mill Creek, Auglaize River, and Big Darby Creek, and Sandusky River.

white crappie
(Pomoxis annularis)

Best Streams: Scioto River, Portage River, Fourmile Creek, Alum Creek, and Mahoning River.

black crappie
(Pomoxis nigromaculatus)

Best Streams: Huron River, Great Miami River, Black Fork Mohican River, Mosquito Creek, Sandusky River, Pymatuning Creek, Cuyahoga River, and Ohio River.

bluegill
(Lepomis macrochirus)

Best Streams: Ohio River, Leith Run, Muskingum River, Nimisila Creek, Turtle Creek, Scioto River, Tuscarawas River, Portage River, Mosquito Creek, Still Fork, and Big Darby Creek.

flathead catfish
(Pylodictis olivaris)

Best Streams: Muskingum River, Scioto River, Ohio River, Great Miami River, Little Miami River, and Hocking River.

sauger
(Stizostedion canadense)

Best Streams: Ohio River, Scioto River, Beaver Creek, and Little Miami River.

saugeye
(S. canadense x S. vitreum)

Best Streams: Deer Creek, Scioto River, Muskingum River, Great Miami River, and Olentangy River.

walleye
(Stizostedion vitreum)

Best Streams: Maumee River, Sandusky River, Muskingum River, Mahoning River, and Ohio River.



In Ohio Streams...

7.2

Locally Common



Common Name: brook silverside

Scientific Name: *Labidesthes sicculus*

Phylum: Chordata

Class: bony fishes (Osteichthyes)

Order: Atheriniformes

Family: silversides (Atherinidae)

Number of Streams: 117

Distribution: Ohio River & Lake Erie Basins

Habitat: medium to large streams

Size: < 4.2 inches

Pollution Tolerance: moderate

Common



Common Name: predaceous diving beetle

Scientific Name: *Deronectes sp.*

Phylum: Arthropoda

Class: Insecta

Order: beetles (Coleoptera)

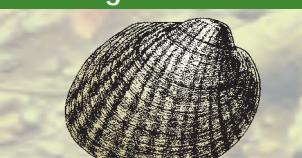
Family: Dytiscidae

Distribution: Ohio River & Lake Erie Basins

Size: < 1 inch

Pollution Tolerance: moderate

Endangered



Common Name: hickorynut

Scientific Name: *Obovaria olivaria*

Phylum: Mollusca

Class: Bivalvia

Order: Unionoida

Family: freshwater mussels (Unionidae)

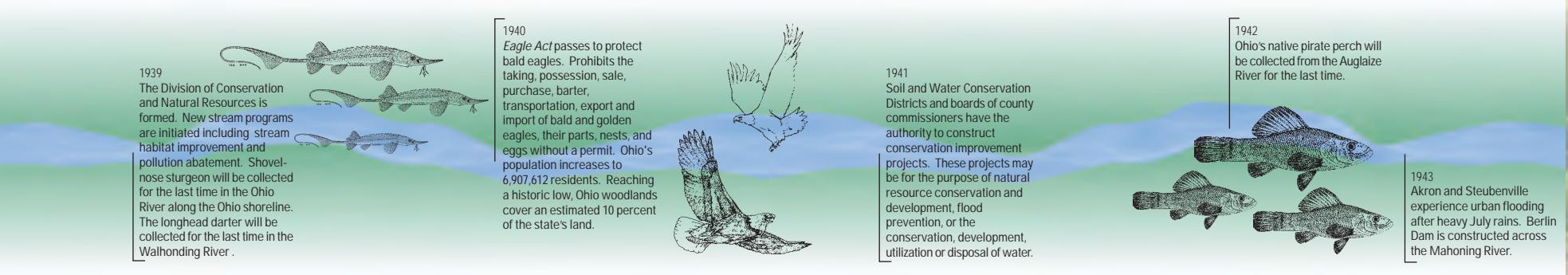
Distribution: Ohio River

Habitat: large streams

Size: < 4 inches

Abundance: very rare

Pollution Tolerance: intolerant



Recreation

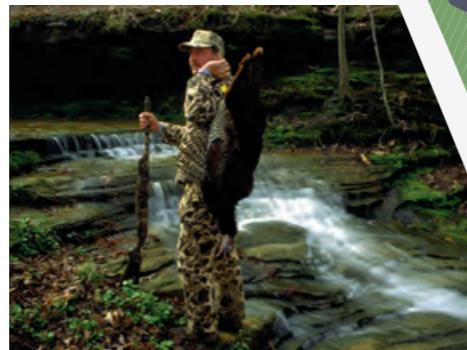
Recreational Opportunities

Hiking, biking, canoeing, and wildlife viewing are but a few of the other recreational opportunities that streams and their corridors have to offer. Don't know where to go? Try one of Ohio's Scenic, Wild, or Recreational Rivers. Just taking a walk, having a picnic, or just skipping rocks can be an enjoyable stream adventure. Have you visited a stream lately?



Canoeing

Canoeing is one of Ohio's most popular types of stream recreation. Two popular streams for float trips are the Little Miami and the Mohican rivers.



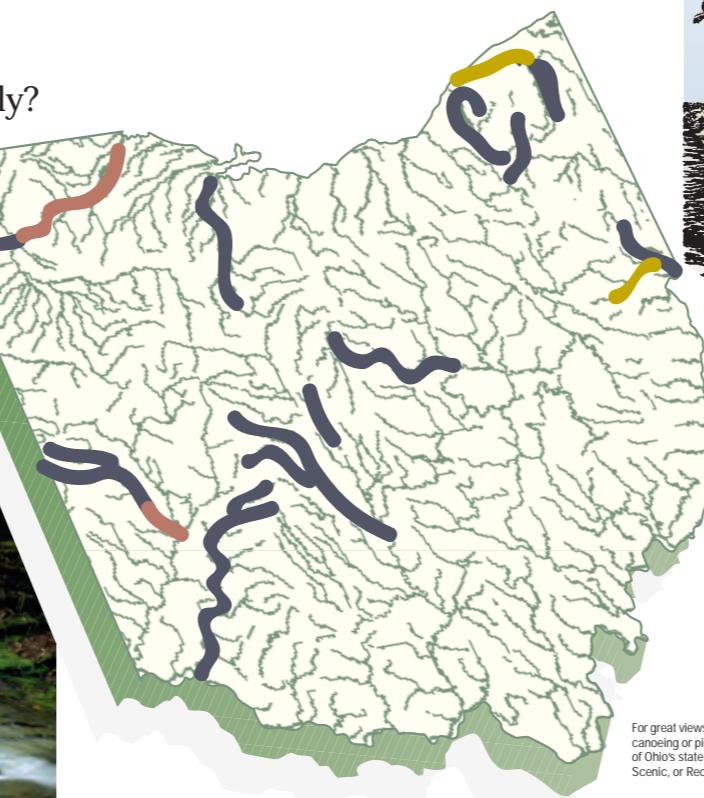
Hunting

Streams and riparian corridors are great places to hunt waterfowl, deer, wild turkeys, and squirrels. Waterfowl hunting is best in the early season when wood ducks are abundant and during the late winter after lakes and marshes are covered with ice.



Trapping

Trapping muskrats, beaver, mink, and raccoon not only provides beautiful fur coats, but is also an effective wildlife management tool and source of extra income for many Ohioans.



Hiking, Biking, and

Photography

Stream corridors are great places to hike or bike for beautiful views, natural sounds, and great wildlife viewing opportunities. Stream corridors are becoming increasingly popular recreational areas in many cities.



1944
The Mosquito Creek Reservoir is constructed within the Mahoning River watershed. Mussel shell button factories begin to close as plastic buttons become increasingly popular.

1946
Fish kill investigations upheld. Ohio's Attorney General rules that the Commission has the authority to bring an action against the introduction of a substance into a stream that injures or destroys wild animals. An \$18,000 settlement is made for aquatic life killed by pollution discharges into the Little Miami River.



1947
Flash floods in June tear through Adams, Scioto, and Lawrence counties.



Wildlife Viewing
Streams are great places to view a variety of birds, mammals, fish, reptiles, amphibians, and invertebrates.



Locally Common
Common Name: trout-perch
Scientific Name: *Percopsis omiscomaycus*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Percopsiformes
Family: trout-perches (Percopsidae)
Number of Streams: 90
Distribution: Ohio River & Lake Erie Basins
Habitat: small to large streams
Size: < 5 inches
Pollution Tolerance: moderate

Common



Common
Common Name: water strider
Scientific Name: *Gerris sp.*
Phylum: Arthropoda
Class: Insecta
Order: true bugs (Hemiptera)
Family: water striders (Gerridae)
Distribution: Ohio River & Lake Erie Basins
Size: < 2 inches
Pollution Tolerance: tolerant



Fossil Collecting

The warm shallow seas of the Paleozoic Era left many fossils in Ohio's sedimentary rocks. For some great collecting try small streams in southwestern Ohio where the limestone bedrock (formed during the Ordovician period) contains numerous brachiopods, corals, crinoids, trilobites, and other fossils.

River Classifications:

Wild 100% Free Flowing, 75% Forrested Banks.	
Scenic Natural Setting, 25% Forrested Banks.	
Recreational Historically or Culturally Significant; Some Development.	

For great views and relaxation, try canoeing or picnicking along one of Ohio's state designated Wild, Scenic, or Recreational Rivers.

The large trilobite, *Isotelus maximus*, is the official Invertebrate fossil of Ohio.

Stream Safety

Canoeing, fishing, and other activities in or along streams can be very dangerous - especially near dams or during flooding or cold weather. Children should never be near a stream without the supervision of an adult. For more information about stream safety contact your district office of the Ohio Department of Natural Resources, Division of Watercraft.



Extinct
Common Name: leafshell
Scientific Name: *Epioblasma flexuosa*
Phylum: Mollusca
Class: Bivalvia
Order: Unionida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River
Habitat: large streams
Size: < 4 inches
Abundance: none
Pollution Tolerance: very intolerant

1948
Water Pollution Control Act passes and is signed by president Truman. This is the first comprehensive federal initiative on water quality. It authorizes assistance to states in creating uniform laws to control pollution and provide low interest loans for the construction of sewage plants and grants for pollution studies. This federal act will be amended many times. The Ohio River Valley Water Sanitation Commission, an interstate compact, is formed to control and abate water pollution in the Ohio River valley. Northern Ohio streams experience heavy flooding in March.

1949
The Ohio Department of Natural Resources (ODNR) is created. A number of state agencies engaged in the conservation of natural resources are brought together to avoid duplication of effort. The Division of Wildlife is formed. The Water Pollution Control Act "Reagan Act" makes it unlawful to discharge untreated sewage and industrial wastes into state waterways. Violations are made criminal offenses, but procedures for administration are lacking and enforceability is questioned.

What do point source dischargers, anglers, and many other stream users have in common? They are regulated by a variety of environmental and conservation laws, permits, and other regulations. We usually do not like laws, but they are needed to protect our health, environment, and natural resources in a variety of ways. Most have been developed to permit the balanced and reasonable uses of resources for multiple activities.

Chapter Eight Stream Laws

U.S. Environmental Laws

U.S. Wildlife *and* Conservation Laws

Ohio Environmental Laws

Ohio Wildlife *and* Conservation Laws

Useful Terms and Definitions

Act- a document formally stating what has to be done, made into law, etc.

Law- all of the rules of conduct established and enforced by the authority, legislation, or custom of a given community, state, country, or other group.

Ordinance- a local, generally municipal law.

organization, or individual.

direction or enactment.

Permit- a document granting permission to do something.

Regulation- a rule of a group or organization enforced by authority by which conduct, etc. is regulated.

Policy - a principle, plan, or course of action, pursued by a government,

Standard- something established for use as a rule or basis of comparison in measuring or judging capacity, quantity, etc.

Rule- a legal principle or maxim; an authoritative

Statute- a law enacted by a legislative body.

Stream Laws

U.S. Environmental Laws

Historically, federal initiatives have been the crucial first step in the establishment of dedicated government programs to address complex environmental and natural resource problems throughout the United States. Federal laws - common to all states - have provided legal guidance and funding to protect and restore water quality, habitat, and wildlife.

1899 Rivers and Harbors Act

Section 10 makes it unlawful to construct any structure (dams, bridges, piers, retaining walls, etc.) in any navigable water or to deposit refuse without federal approval. In combination with Section 404 of the 1972 WPCA and other federal regulations, this law establishes a permit system for building, dredging, and filling navigable waterways. Special emphasis is to be placed on water quality and other environmental values in issuing any permits for such activities. It is administered by the U.S. Army Corps of Engineers in consultation with the U.S. EPA and other federal and state agencies.

1948 Water Pollution Control Act (WPCA)

This was the first comprehensive federal initiative on water quality. It authorized assistance to states in creating uniform laws to control pollution, provided low interest loans for construction of sewage plants and grants for pollution studies. This is the primary federal act that has had subsequent amendments. Since 1977, it has been known as the *Clean Water Act*.

1956 WPCA Amendments

Provided permanent authorization of WPCA and grants to help states prepare pollution control plans and build new wastewater treatment plants.

1961 WPCA Amendments

Provided more grants for construction of treatment plants and broadened the provisions for abatement and enforcement.

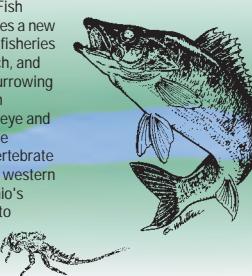
1965 WPCA Amendments "Federal Water Quality Act"

Mandated states to develop water quality criteria along with a plan for implementation and enforcement of the criteria. States had to consider uses and values for public water supplies, propagation of fish, recreation, agriculture, industrial water supplies and other uses. If a state failed to adopt interstate standards, the federal government could take action to establish them.

1966 WPCA Amendments "Clean Water Restoration Act"

Authorized a significant increase in grants for the construction of wastewater treatment plants.

1950
Passage of the Sport Fish Restoration Act provides a new source of revenue for fisheries management, research, and public access. The burrowing mayfly *Hexagenia* - an important food of walleye and other game fish are the dominant benthic invertebrate in the substrate of the western basin of Lake Erie. Ohio's population increases to 7,946,627 residents.



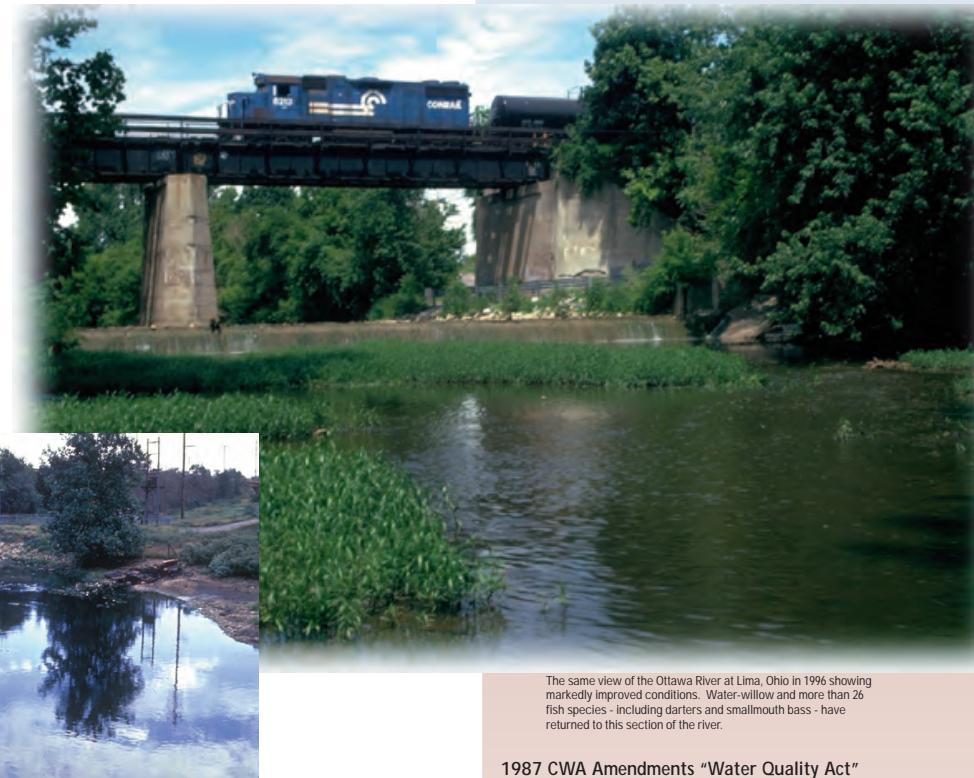
1951
The Water Pollution Control Act is amended to create a Water Pollution Control Board in the Ohio Dept. of Health. This law represents the first real effort to establish a comprehensive program for pollution control.

1952
The Wildlife Council liberalizes fishing in all public waters with no seasons or size limits. Ohio experiences very dry weather during the summer and autumn months.

1953
The Little Miami Sewage Treatment Plant is one of two municipal wastewater treatment plants operating along the Ohio River. All municipalities had previously discharged untreated sewage into the river. The Ohio County Ditch Law is revised. Extreme heat and dry conditions during the autumn is the beginning of a severe drought.

1972 WPCA Amendments

As one of the most famous Acts, it established a national goal to "restore and maintain the chemical, physical, and biological integrity of the nation's surface waters." Wherever attainable, water quality that provides for the



A 1969 view of the Ottawa River at Lima, Ohio. The stream was so polluted it supported few aquatic organisms (Photo courtesy of Ronald Stuckey and Allen Wentz).



The same view of the Ottawa River at Lima, Ohio in 1996 showing markedly improved conditions. Water-willow and more than 26 fish species - including darters and smallmouth bass - have returned to this section of the river.

1987 CWA Amendments "Water Quality Act"

The control of nonpoint pollution is addressed in Section 319 which allowed for financial assistance to states with approved nonpoint source pollution control programs. The 1987 amendments also created a revolving funding program for wastewater treatment plants and control strategies for industries contributing toxic pollution. More than \$30 million has been spent on local projects across Ohio.

Greater redhorse - a pollution sensitive fish species - now inhabit the lower Ottawa River as a result of improved water quality from upstream point source discharges.



1990 CWA Amendments "Great Lakes Critical Programs Act"

This law established the Great Lakes Water Quality Guidance Initiative (GLI) to set minimum uniform water quality standards for all of the Great Lakes to protect human health, aquatic life, and wildlife. The Act also required the development of local, community led remedial action plans to restore the most degraded tributaries to the Great Lakes.

In Ohio Streams...

8.1

Locally Common



Common Name: brindled madtom
Scientific Name: *Noturus mirus*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Siluriformes
Family: catfishes (Ictaluridae)
Number of Streams: 71
Distribution: Ohio River & Lake Erie Basins
Habitat: medium to large streams
Size: < 5.2 inches
Pollution Tolerance: intolerant

Common



Common Name: riffle bug
Scientific Name: *Rhagovelia* sp.
Phylum: Arthropoda
Class: Insecta
Order: true bugs (Hemiptera)
Family: broad-shouldered water striders (Veliidae)
Number of Streams: 71
Distribution: Ohio River & Lake Erie Basins
Size: < 1 inch
Pollution Tolerance: moderately tolerant

Extirpated



Common Name: tubercled blossom
Scientific Name: *Epioblasma t. torulosa*
Phylum: Mollusca
Class: Bivalvia
Order: Unionida
Family: freshwater mussels (Unionidae)
Number of Streams: 71
Distribution: Ohio River
Habitat: large streams
Size: < 3 inches
Abundance: none
Pollution Tolerance: very intolerant

Stream Laws

U.S. Wildlife and Conservation Laws

Many stream related federal

laws have also been enacted to protect and restore wildlife and other natural resources as well as the environment. Landowners, the general public, and other Ohioans have benefited from many of the federal, state, and local programs that have evolved from these statutes. U.S. laws are passed in Washington DC by Congress and usually signed by the President.

1900 Lacey Act

This Act for the first time regulated the interstate and international commerce of wild animals, birds, amphibians, reptiles, mollusks, and crustaceans, or their dead bodies, parts, eggs, and offspring.

1918 Migratory Bird Treaty Act (MBTA)

Except as permitted by regulations, this law made it unlawful, to pursue, hunt, take, capture, kill, possess, offer for sale, barter, purchase, exchange, deliver for shipment, cause to be shipped or exported any migratory bird, or part thereof, or any egg, or nest of such a bird. It also authorized and directed the Secretary of Interior to establish seasons and methods of hunting and shipping.



1926 Black Bass Act

Originally covered only black bass, but amendments have extended it to cover all fresh and saltwater fish, shellfish, and foreign commerce. The Act provides that fish caught, killed, taken, sold, purchased, possessed, or transported contrary to the law of a state or foreign country and transported across a state line or U.S. boundary set up a violation of the Act.

1934 Migratory Bird



Hunting Stamp Act

Was created to supplement the 1918 MBTA by providing funds for the acquisition of habitat for wild ducks, geese, brant and swans. Waterfowl hunters 16 years of age and older were now required to purchase the

1957
Milt Trautman publishes the first edition of *The Fishes of Ohio*. Scioto madtoms (*Noturus trautmani*) are collected in Big Darby Creek for the last time.

1959
Heavy rainfall on frozen ground produces severe statewide flooding. Approximately 200 pounds of blue pike are harvested from the waters of Lake Erie.



1937 Wildlife Restoration Act

Also known as the Pittman-Robertson Act, this well-known Act placed a federal tax on guns, ammunition, and other hunting equipment for wildlife restoration. Since 1939, Ohio has received more than \$85 million of federal aid to purchase wildlife habitat and manage game species.

1940 Eagle Act

Protected bald eagles, but was amended in 1962 to also include golden eagles. Prohibited the taking, possession, sale, purchase, barter, transportation, export and import of bald and golden eagles, their parts, nests, and eggs without a permit.



1950 Sport Fish Restoration Act

Also known as the Dingell-Johnson Act, this legislation did for sport fishing what the Wildlife Restoration Act did for hunters. Under this measure, the monies from a 10 percent excise tax on fishing tackle were set aside and apportioned to states for approved fisheries projects at a 75 percent federal to 25 percent state match. It was expanded as the 1984 Wallop-Breaux Act to items such as tackle boxes, other types of fishing equipment, and motorboat fuel. Since 1950, Ohio has received more than \$81 million for sport fish restoration.

1954 Watershed Protection and Flood Prevention Act

The Act allowed for technical and financial help to local groups wishing to carry out small watershed projects. It allowed for land treatment for watershed protection and structural measures for flood prevention, drainage, irrigation, fish and wildlife, recreation, and water supply.

1960
Increased amounts of industrial pollution kill fish in more than 50 river miles of the Ottawa and Auglaize rivers downstream from the city of Lima. Ohio's population increases to 9,706,397 residents.

1962
Drought conditions - that will last over two years - begin.

1958 Fish and Wildlife Coordination Act

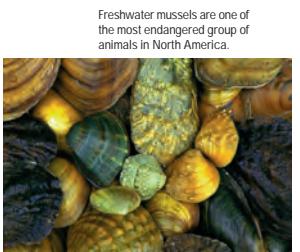
This act ensured that wildlife conservation should receive equal consideration with other factors in water-resource development projects. Whenever fish and wildlife habitat is altered in any way by a federal agency, the responsible agency must consult with the U.S. Fish and Wildlife Service and State fish and wildlife agency to consider steps to protect, conserve, and restore fish and wildlife resources.

1964 Land and Water Conservation Fund Act (LWCF)

Established a program using revenues from offshore oil and gas receipts for the purchase of property to support the creation of national and community parks, forests, wildlife refuges, and open spaces to guarantee outdoor recreation opportunities and a clean environment. From parks to playgrounds, wilderness to wetlands, and trails to greenways, this fund has been an American success story.

1968 Wild and Scenic River Act

Established official stream designations of Scenic, Wild, and Recreational to preserve vestiges of vanishing wild, scenic, and historic areas adjacent to river systems to provide greater enjoyment, beauty, and conservation for present and future generations. Included sections of the Little Miami River in Ohio.



1973 Endangered Species Act (ESA)

Required all federal agencies to take whatever action is necessary to ensure that their activities do not jeopardize endangered species, or habitat critical to their survival. Administered by the U.S. Fish and Wildlife Service within the Department of the Interior.

1977 Surface Mining Control and Reclamation Act (SMCRA)

Based in part on Ohio's law, this federal law set strict uniform standards for coal mining throughout the U.S. It required any state that wished to administer its own regulatory program adopt regulations that are as effective as federal regulations.

1964

The U.S. Congress creates the Land and Water Conservation Fund (LWCF). It establishes a program that uses revenues from offshore oil and gas receipts for the purchase of land and water to create national and local parks, forests, wildlife refuges, and open spaces for outdoor recreation and a clean environment. Heavy rainfall in March causes flooding across Ohio. Pollution investigations become a new responsibility for the Division of Wildlife Enforcement Section.



A guide to Ohio Streams

In Ohio Streams...

Locally Common



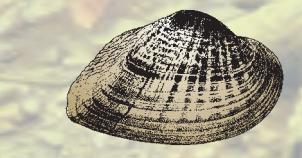
Common Name: silver chub
Scientific Name: *Macrhybopsis storriiana*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Cypriniformes
Family: minnows & carps (Cyprinidae)
Number of Streams: 15
Distribution: Ohio River & Lake Erie Basins
Habitat: very large streams
Size: < 9.1 inches
Pollution Tolerance: intolerant

Common



Common Name: water scorpion
Scientific Name: *Ranatra* sp.
Phylum: Arthropoda
Class: Insecta
Order: true bugs (Hemiptera)
Family: water scorpions (Nepidae)
Distribution: Ohio River & Lake Erie Basins
Size: < 3 inch
Pollution Tolerance: moderately tolerant

Endangered



Common Name: snuffbox
Scientific Name: *Epioblasma triquetra*
Phylum: Mollusca
Class: Bivalvia
Order: Unionida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River & Lake Erie Basins
Habitat: medium to large streams
Size: < 3 inches
Abundance: rare and sporadic
Pollution Tolerance: intolerant

Stream Laws

Ohio Environmental Laws

After a state law is passed by the Ohio General Assembly and signed by the governor, it becomes part of the Ohio Revised Code (ORC). The ORC is comprised of 31 Titles of which most state environmental laws can be found in Chapter 3745 of Title 37 (Environmental Protection Agency) and Chapter 6111 of Title 61 (Water Pollution Control). The ORC also gives state agencies and departments authority to adopt rules which become part of the Ohio Administrative Code (OAC).

1841 Ohio Drainage Law

Ohio's first drainage law was amended in 1852 and repealed in 1853. A new law in 1859 provided for a system of public ditches for farming, development, and public health purposes.

1893 Ohio's First Water Pollution Law

Municipalities were required to submit plans of proposed sewerage treatment works to the Ohio Department of Health (ODH). In 1925, it was clarified and amended to address water pollution control and industrial waste disposal. It also gave ODH general supervision over the operation of treatment plants, imposed obligations upon ODH to study lakes and streams and determine uses. ODH was authorized to adopt and enforce regulations relative to water pollution control.

1914 Conservancy District Act

Due to the great flood of 1913, this law was passed to allow local watershed districts to solve their own flood and drainage problems. In 1915, the Upper Scioto Conservancy District was formed as a result of a petition filed in the Hardin County Common Pleas Court. Its purpose was to establish ways of preventing floods; regulate stream channels by changing, widening, and deepening; reclaim and fill wet and overflow lands; regulate the flow of streams; and divert or in whole or in part eliminate water courses for public health, safety, convenience, and welfare. A number of flood control projects followed in the Great Miami River and Muskingum River watersheds.

1965
The U.S. Water Quality Act mandates states to develop water quality criteria along with a plan for implementation and enforcement of the criteria. The U.S. Water Resources Planning Act combined federal and state efforts in creating river basin commissions to do comprehensive planning. Pollution sensitive burrowing mayflies have virtually disappeared from the western basin of Lake Erie due to poor water quality.

1966
The state of Ohio sues the Commonwealth of Kentucky requesting a declaration establishing the state boundary line in regards to the northerly side of the Ohio River in 1792. The U.S. Clean Water Restoration Act authorizes a significant increase in grants for construction of wastewater treatment plants. Ohio's commercial mussel industry begins to revive as freshwater shell material is being increasingly used by the Japanese pearl industry.

1941 Soil and Water Conservation Districts (SWCDs)

Under the authority of Sections 1515.01 - 1515.29 ORC, SWCD boards of supervisors work voluntarily with landowners on natural resource management. District boards determine priority conservation needs for their county and have the authority to inventory, plan, design, construct, and maintain group projects for public benefit. Projects may be for the purpose of natural resource conservation and development, flood prevention, utilization, and disposal of water. Past projects include construction of retention basins, wetlands, erosion control structures, riparian buffers, and drainage improvements.

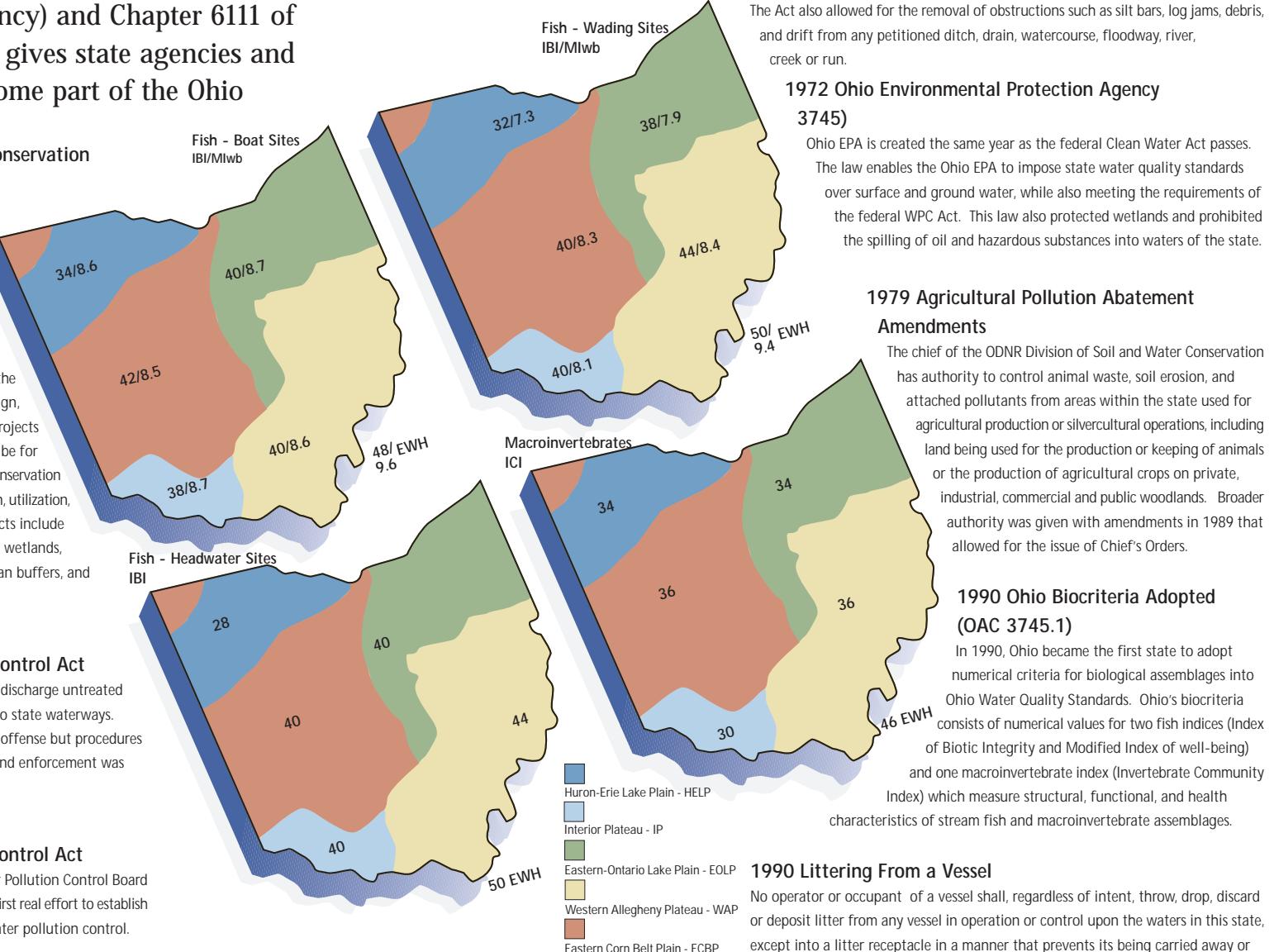
1949 Water Pollution Control Act

Reagan Act made it unlawful to discharge untreated sewage and industrial wastes into state waterways. Violations were made a criminal offense but procedures for administering were lacking and enforcement was questioned.

1951 Water Pollution Control Act

The Deddens Act created a Water Pollution Control Board in ODH. This law represented the first real effort to establish a comprehensive program for water pollution control.

1968
Ohio becomes a pioneer in stream preservation with the passage of the nation's first scenic rivers law - the Ohio Scenic Rivers Act. The official designation of Scenic Rivers is to identify and preserve vestiges of vanishing wild, scenic, and historic areas adjacent to river systems to provide greater enjoyment, beauty, and usefulness to Ohio's citizens. The program is first administered by the Ohio Water Commission. The federal act is passed six months after the Ohio law. Central and southern Ohio streams flow out of their banks after heavy rains in May. Ohio has 640 recognized dumps and landfills.



A guide to Ohio Streams

1953 Ohio County Ditch Law

(ORC 6131, 6133, 6135, and 6137)

Ohio drainage laws are very broad in scope and apply to a wide variety of activities that are administered by the boards of county commissioners. Permanent maintenance of the practices is provided. The activities possible under the drainage laws include: the location, construction, reconstruction, reconditioning, widening, deepening, straightening, altering, boxing, tiling, filling, walling, arching, or any change in the course, location or terminus of any petitioned ditch, drain, water course or floodway. The Act also allowed for the removal of obstructions such as silt bars, log jams, debris, and drift from any petitioned ditch, drain, watercourse, floodway, river, creek or run.

1972 Ohio Environmental Protection Agency 3745

Ohio EPA is created the same year as the federal Clean Water Act passes. The law enables the Ohio EPA to impose state water quality standards over surface and ground water, while also meeting the requirements of the federal WPC Act. This law also protected wetlands and prohibited the spilling of oil and hazardous substances into waters of the state.

1979 Agricultural Pollution Abatement Amendments

The chief of the ODNR Division of Soil and Water Conservation has authority to control animal waste, soil erosion, and attached pollutants from areas within the state used for agricultural production or silvicultural operations, including land being used for the production or keeping of animals or the production of agricultural crops on private, industrial, commercial and public woodlands. Broader authority was given with amendments in 1989 that allowed for the issue of Chief's Orders.

1990 Ohio Biocriteria Adopted (OAC 3745.1)

In 1990, Ohio became the first state to adopt numerical criteria for biological assemblages into Ohio Water Quality Standards. Ohio's biocriteria consists of numerical values for two fish indices (Index of Biotic Integrity and Modified Index of well-being) and one macroinvertebrate index (Invertebrate Community Index) which measure structural, functional, and health characteristics of stream fish and macroinvertebrate assemblages.

1990 Littering From a Vessel

No operator or occupant of a vessel shall, regardless of intent, throw, drop, discard or deposit litter from any vessel in operation or control upon the waters in this state, except into a litter receptacle in a manner that prevents its being carried away or deposited by the elements.

1969
The Ohio Stream Litter Law becomes effective with game protectors given the responsibility as a public service. The law and its enforcement is well received in Ohio courts. The passage of the National Environmental Policy Act (NEPA) requires all proposed federal actions be objectively examined to determine the effects of such actions upon the environment. The Little Miami River is designated State Scenic from the East Fork to its headwaters, including the North Fork. Some community drinking water systems suffer considerable damage from summer flooding after severe storms drop six to 14 inches of rain in northcentral Ohio. The Cuyahoga River experiences another fire.

1970
The Ohio Scenic Rivers Program transfers to the Division of Natural Areas in ODNR. Ohio's population increases to 10,652,017 residents. Approximately 25 percent live in rural areas. The Sandusky River is designated State Scenic from the Roger Young Memorial Park in Fremont to U.S. Route 30 in Upper Sandusky. Steel industries in the Mahoning River Valley use 1.5 billion gallons of river water per day - about four times the normal river flow.



In Ohio Streams...

8.3

Common



Common Name: channel catfish
Scientific Name: Ictalurus punctatus
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Siluriformes
Family: catfishes (Ictaluridae)
Number of Streams: 164
Distribution: Ohio River & Lake Erie Basins
Habitat: medium to large streams
Size: < 46 inches
Pollution Tolerance: moderately tolerant

Locally Common



Common Name: alderfly
Scientific Name: Sialis sp.
Phylum: Arthropoda
Class: Insecta
Order: fishflies & alderflies (Megaloptera)
Family: alderflies (Sialidae)
Distribution: Ohio River & Lake Erie Basins
Size: < 2 inch
Pollution Tolerance: moderately tolerant

Special Interest



Common Name: deertoe
Scientific Name: Truncilla truncata
Phylum: Mollusca
Class: Bivalvia
Order: Unionoida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River & Lake Erie Basins
Habitat: large streams
Size: < 3 inches
Abundance: locally common
Pollution Tolerance: moderately intolerant

Stream Laws

Ohio Wildlife and Conservation Laws

Ohio was the first state to pass a

Scenic Rivers Act and adopt Biological Criteria into State Water Quality Regulations. There are a number of stream-related state wildlife and conservation laws in Chapters 1501 to 1571 of Title 15 (Conservation of Natural Resources). They range from the protection of endangered animals and plants to water withdrawal. Although the water in all streams is "waters of the state" - the right to use the water is closely tied to a "riparian system of rights" or the ownership of the land beside or within which the water flows.

1829 Ohio's First Wildlife Law

The first conservation-related law in Ohio was passed to "protect the fur trade." It established a season for the legal taking of muskrats.



1837 Ohio Geological Survey

In addition to geologic studies, Ohio's first natural resource agency was responsible for investigation of the flora, fauna, soils, and agriculture of Ohio.

1857 Ohio's First Fish Law

Because so many dams had been constructed on streams, a law was passed making it illegal to prevent the natural transit of fish in navigable streams and lakes.

1873 Ohio Fish Commission (OFC)

With an annual budget of \$1000, a commission was formed to examine ways to improve fish populations. It promoted stocking and approved the introduction of the exotic German carp. By 1880, fish populations were declining so rapidly that they believed the total extinction of fish life was drawing near. In 1886, the OFC became the Commission of Fish and Game and the first fish and game wardens were appointed.

1972 U.S. Water Pollution Control Act Amendments require National Pollutant Discharge Elimination System (NPDES) permits and establishes national water quality goals to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Ohio Senate Bill 397 creates Ohio EPA. About 50 commercial mussel harvesters are operating on the Muskingum River.

1973 President Nixon signs the U.S. Endangered Species Act. All federal agencies are now required to take whatever action is necessary to ensure their activities do not jeopardize endangered species, or habitat critical to their survival. NPDES permits are issued jointly with the U.S. EPA. The Little Miami River is designated National Scenic from Clifton Gorge to Foster. The Olentangy River is designated State Scenic from the Old Wilson Bridge Road to the Delaware Dam.

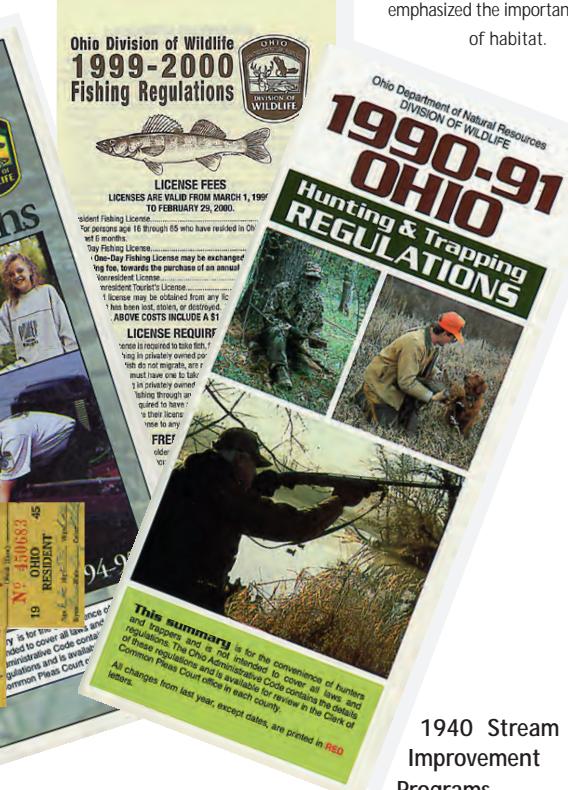


1974 The passage of the Ohio Endangered Species Act restricts possession of native species threatened with statewide extinction. Ohio EPA is given authority to operate the NPDES program. An Ohio ban is put on the commercial harvesting of mussels in the Muskingum River due to large mussel kills downstream from the Gould Engine Parts and Foli Plant in Morgan Co. Sections of Little Beaver Creek, W. Fork, M. Fork, and N. Fork are designated State Wild and Scenic. The Grand River is designated State Wild from the

Norfolk and Western Railroad trestle south of Painesville to the Harpersfield covered bridge and State Scenic from the Harpersfield covered bridge to the SR 322 bridge in Ashtabula Co. The Cuyahoga River is designated Scenic from U.S. Rt. 14 to the Troy-Burton Township line in Geauga Co. The Maumee River from the state line to the SR 24 bridge west of Defiance is designated State Scenic and from the SR 24 to the U.S. Rt. 25 bridge near Perryburg is designated State Recreational. The U.S. Safe Drinking Water Act is enacted.

1929 Division of Conservation

Division of Fish and Game becomes the Division of Conservation in the Department of Agriculture. Sportsmen still had no representation in the Governor's cabinet and there was no legal authority for stream pollution. New wildlife employees begin actively working on the survey and inventory of wildlife and habitat restoration. In the late 1930s, Dr. Aldo Leopold of Wisconsin was at the height of his career as the pioneer of science-based wildlife management that emphasized the importance of habitat.



1940 Stream Improvement Programs

In 1939, the Division of Conservation and Natural Resources was formed and new stream programs are initiated including stream habitat improvement and pollution abatement.

1946 Fish Kill Investigations Upheld

Ohio's Attorney General ruled that the Commission had the authority to bring an action against the introduction of a substance into a stream that injures or destroys wild animals. An \$18,000 settlement was made for aquatic life killed by pollution discharged into the Little Miami River.



1975 Gould, Inc. is fined \$260,000 for toxic pollution that killed more than 43 million mussels in the Muskingum River between 1971 through 1974. For the year, 1,061 spills are reported to the Ohio EPA. Sections of Little Beaver Creek and its W. Fork, M. Fork, and N. Fork are designated National Scenic. The Stillwater River from the Englewood Dam to the Great Miami River is designated State Recreational. The Ohio Division of Wildlife begins a nongame program. Benthic assemblages in western Lake Erie are dominated by pollution tolerant sludge worms.

A guide to Ohio Streams

1949 Ohio Department of Natural Resources (ODNR)

State agencies engaged in the conservation of natural resources are brought together as a department to avoid duplication of effort.

1964 Pollution Investigations

Pollution investigations became a new responsibility of the Division of Wildlife's Enforcement Section which was directed to investigate every instance where pollution killed wild animals.

1968 Ohio Scenic Rivers Act

Ohio became a pioneer in stream preservation with the nation's first scenic river law. It established official designations to identify and preserve vestiges of vanishing wild, scenic, and historic areas adjacent to Ohio streams.

1969 Stream Litter Law

The new stream litter law became effective and game protectors were given the responsibility as a public service. The enforcement of this law has been well received in Ohio courts.

1972 Ohio Strip Mine Law

New methods of reclamation that were stricter than neighboring states were required. It contained a severance tax to be used for reclamation of abandoned mine lands. Impacts from coal mining in Ohio have been markedly reduced by this law.

1974 Ohio Endangered Species Act

This law provided protection to species in Ohio that were in danger of being extirpated from the state. It restricted possession of native species threatened with statewide extinction.

1993 NatureWorks Bond Issue

Ohio voters approved a permanent source of funding for the maintenance and improvement of Ohio's parks and natural resources including habitat protection.

1999 Ohio Farmland Preservation Act

This law allows state and local governments to hold deed restrictions on farmland that prohibits certain land uses such as suburban development.

In Ohio Streams...

Locally Common



Common Name: silver lamprey

Scientific Name: *Ichthyomyzon unicuspis*

Phylum: Chordata

Class: lampreys (Cephalaspidomorphi)

Order: Petromyzontiformes

Family: lampreys (Petromyzontidae)

Number of Streams: 14

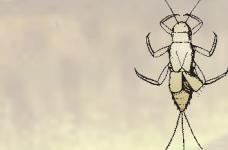
Distribution: Ohio River & Lake Erie Basins

Habitat: large streams

Size: < 14 inches

Pollution Tolerance: intolerant

Common



Common Name: mayfly nymph

Scientific Name: *Caenis sp.*

Phylum: Arthropoda

Class: Insecta

Order: mayflies (Ephemeroptera)

Family: mayflies (Caenidae)

Distribution: Ohio River & Lake Erie Basins

Size: < 1 inch

Pollution Tolerance: moderate

Threatened



Common Name: fawnshell

Scientific Name: *Truncilla donaciformis*

Phylum: Mollusca

Class: Bivalvia

Order: Unionoida

Family: freshwater mussels (Unionidae)

Distribution: Ohio River & Lake Erie Basins

Habitat: large streams

Size: < 2 inches

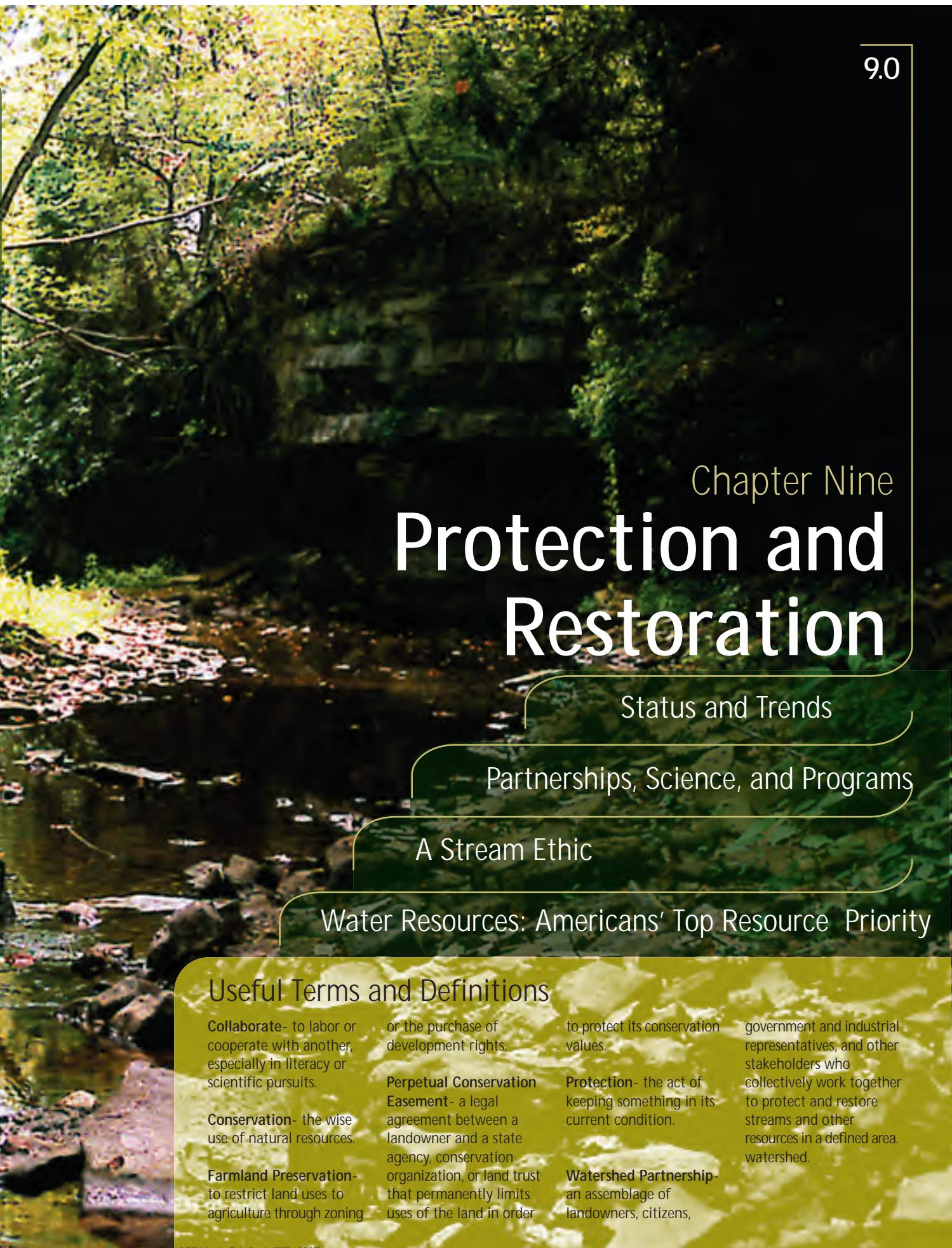
Abundance: rarely common

Pollution Tolerance: intolerant

In 1938, stream improvement included building dams, rescuing fish during droughts, and stocking Lake Erie fish throughout Ohio. Today, stream protection and restoration include dam removal, watershed-based partnerships, monitoring and assessment, point source and nonpoint pollution control, education, land use planning, mitigation, and the conservation of stream habitats, riparian forests, floodplains, and water resources.



Preservation of our streams ensures continued benefits for future generations.



Chapter Nine Protection and Restoration

Status and Trends

Partnerships, Science, and Programs

A Stream Ethic

Water Resources: Americans' Top Resource Priority

Useful Terms and Definitions

Collaborate- to labor or cooperate with another, especially in literary or scientific pursuits.

Conservation- the wise use of natural resources.

Farmland Preservation- to restrict land uses to agriculture through zoning

or the purchase of development rights.

Perpetual Conservation Easement- a legal agreement between a landowner and a state agency, conservation organization, or land trust that permanently limits uses of the land in order

to protect its conservation values.

Protection- the act of keeping something in its current condition.

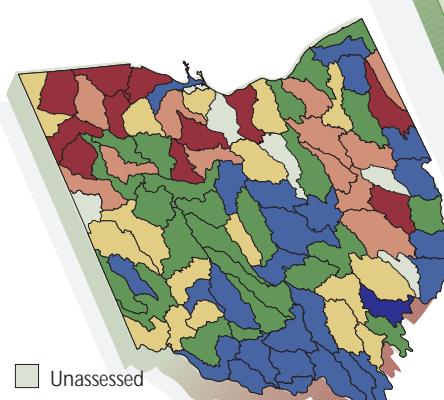
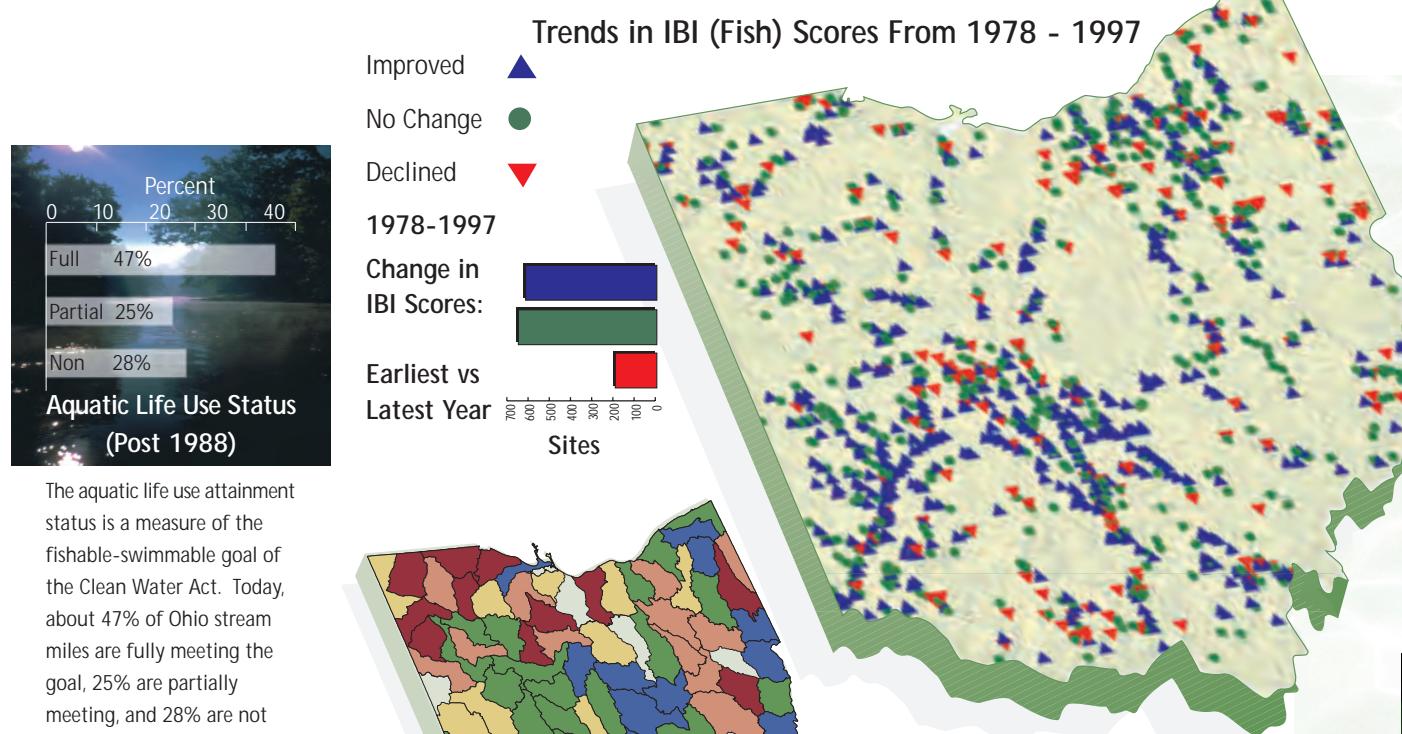
government and industrial representatives, and other stakeholders who collectively work together to protect and restore streams and other resources in a defined area watershed.

Watershed Partnership- an assemblage of landowners, citizens,

Protection and Restoration

Status and Trends

With more than \$6 billion spent on the control of point sources of pollution, it is not surprising that the quality of many Ohio streams has improved during the past 25 years. Since 1988, there has been a 48% decline in point sources as a major source of impairment. Today, impacts from habitat and hydrologic modifications, the loss of streamside forests, urban and agricultural stormwater, and excessive sedimentation are becoming increasingly evident.



1978
Blizzard conditions strike Ohio in January. Snow cover ranges from 70 to 110 inches throughout Ohio. Ohio EPA performs the first priority pollution determination for organic contaminants of ground waters serving public water systems.

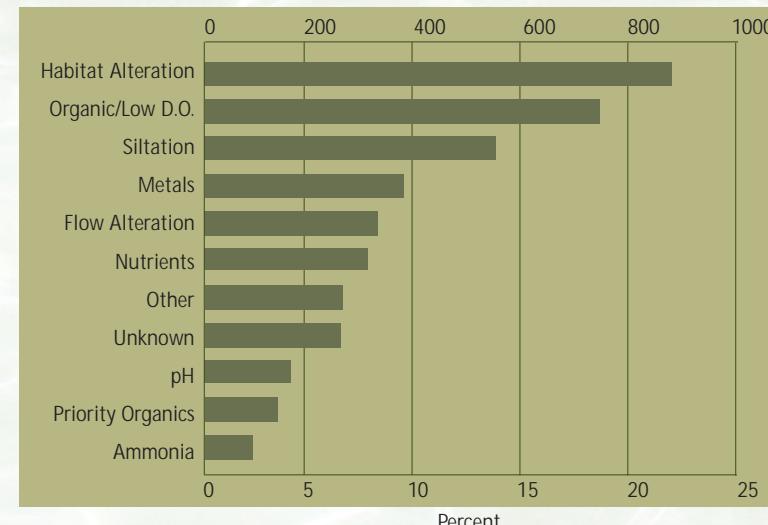
1979
Using fish and aquatic macroinvertebrates as indicators of water quality, Ohio EPA begins an intensive stream monitoring program to assess point source pollution. The Chagrin River from the confluence of Aurora Branch to the St. Rt. 6 bridge, the Aurora Branch from SR 82 to the mainstem, and the East Branch from Heath Road to the mainstem are designated State Scenic. A September hurricane causes severe flooding in Ohio from Cincinnati to Cleveland.

1980
The U.S. Supreme Court supports Ohio's claim against Kentucky that the state boundary extends into the impounded Ohio River to the low water mark of 1792. Ohio's population increases to 10,797,630 residents. The Little Miami River is designated National Recreational from Foster to the Ohio River. The Stillwater River from the Riffle Rd. bridge in Darke County to the Englewood Dam, and Greenville Creek in Ohio are designated State Scenic.



In 1938, Ohio Division of Conservation crews built dams on small headwater streams. Today, more dams are being removed than built. Stream protection and restoration today include the formation of community-based watershed partnerships, land use planning, pollution control, education, and the protection and restoration of stream channels, riparian forests, floodplains, and wetlands.

Number of Monitored Stream Miles Impaired in Ohio (1998)



The increasing presence of blue suckers - an Ohio endangered species - is a good environmental indicator for the Little Miami River and other large tributaries to the Ohio River.



Habitat alteration and siltation from excessive erosion are two of the three leading causes of non-attainment of aquatic life use in Ohio streams. The removal of streamside forests along many streams has caused severely eroding banks - a source of siltation - in many streams.

In Ohio Streams... 9.1

Endangered



Common Name: blue sucker
Scientific Name: *Cyclopterus elongatus*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Cypriniformes
Family: suckers (Catostomidae)
Number of Streams: 4
Distribution: Ohio River Basin
Habitat: large streams
Size: < 40 inches
Pollution Tolerance: intolerant

Common



Common Name: riffle beetle
Scientific Name: *Ancyronyx sp.*
Phylum: Arthropoda
Class: Insecta
Order: beetles (Coleoptera)
Family: riffle beetles (Elmidae)
Distribution: Ohio River & Lake Erie Basins
Size: < 1 inch
Pollution Tolerance: moderate

Common



Common Name: fragile papershell
Scientific Name: *Leptodea fragilis*
Phylum: Mollusca
Class: Bivalvia
Order: Unionoida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River & Lake Erie Basins
Habitat: small to large streams
Size: < 6 inches
Abundance: common
Pollution Tolerance: intolerant

Protection and Restoration

Partnerships, Science, and Programs

Partnerships, science, and programs are but a few of the many things needed to protect, manage, and restore Ohio streams and their watersheds. And just like a mathematical equation or a jigsaw puzzle, the pieces all add up and fit together to make a difference.



1984
U.S. Wallop-Breaux Act expands the 1950 Sport Fish Restoration Act. New provisions extend the excise tax to items such as tackle boxes and other fishing equipment. A portion of the motorboat fuel tax is also devoted. Sections of Big Darby Creek from the Champaign-Union County line to the Conrail railroad trestle crossing and from Little Darby Creek to the Scioto River, and Little Darby from the Lafayette-Plain City Rd. bridge downstream to 0.8 miles upstream from the confluence with Big Darby Creek are designated State Scenic.



1985
Statewide low temperatures in January range from -15 to -30 degrees F. The number of spills reported to the Ohio EPA continues to rise - 4,423 are reported. Publicly-owned treatment works discharging to the Lake Erie basin must comply with a one mg/liter phosphorus limit to prevent excessive algae blooms in the lake.

Timeline

1987
Ohio EPA publishes *Biological Criteria for the Protection of Aquatic Life* - a three volume set of manuals developed for consideration of adoption into state water quality standards. U.S. Clean Water Quality Act amendments provide financial assistance to states with approved nonpoint source pollution control programs. There have been no major outbreaks of waterborne disease from public water systems for 30 years. Due to their success and popularity, Ohio's General Assembly makes ODNR's tax return check-off programs permanent law.

1988
By June, a severe drought with extremely hot temperatures (95 to 105 degrees F) occurs throughout Ohio. Large fish kills occur downstream from electric generating plants in the Muskingum and Great Miami rivers. The Ohio Department of Health issues a swimming, wading, and fish consumption advisory for the lower 30 miles of the Mahoning River in Ohio. Zebra mussels invade Lake Erie.

1990
Lakes Critical Programs Act establishes the Great Lakes Water Quality Initiative to develop uniform water quality standards for all of the Great Lakes. The U.S. Nonindigenous Aquatic Nuisance Prevention and Control Act is created to prevent and control the spread of zebra mussels and other harmful nonnative aquatic species. Extensive flooding occurs on New Year's Eve. A statewide average of 51.38 inches is recorded for the year - the highest amount since records began in 1854.

1991
Four Tennessee mussel poachers are arrested along the Muskingum River near Beverly for possessing 4,529 live mussels - including 29 individuals of three endangered species. Ohio's population increases to 10,932,000 residents.

A guide to Ohio Streams

In Ohio Streams...

9.2

Uncommon



Common Name: bowfin
Scientific Name: Amia calva
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Amiiformes
Family: bowfins (Amidae)
Number of Streams: 28
Distribution: Ohio River & Lake Erie Basins
Habitat: medium to large streams
Size: < 31 inches
Pollution Tolerance: tolerant

Locally Common



Common Name: back swimmer
Scientific Name: Notonecta sp.
Phylum: Arthropoda
Class: Insecta
Order: true bugs (Hemiptera)
Family: back swimmers (Notonectidae)
Distribution: Ohio River & Lake Erie Basins
Size: < 1 inch
Pollution Tolerance: moderate

Extirpated

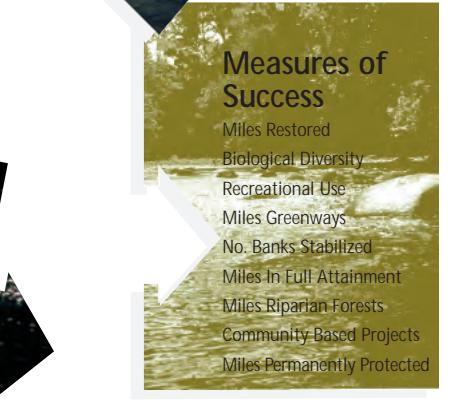


Common Name: scaleshell
Scientific Name: Leptodea leptodon
Phylum: Mollusca
Class: Bivalvia
Order: Unionoida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River Basin
Habitat: large streams
Size: < 4 inches
Abundance: none
Pollution Tolerance: intolerant



A variety of strategies are often needed to conserve Ohio. While it may be difficult to understand how each effort makes a difference, they all cumulatively add up at the watershed level. Science-based assessments of streams and watersheds are important to determine the status of aquatic life and causes and sources of impairment.

A variety of cost-share programs for landowners are available to help establish stream buffers.



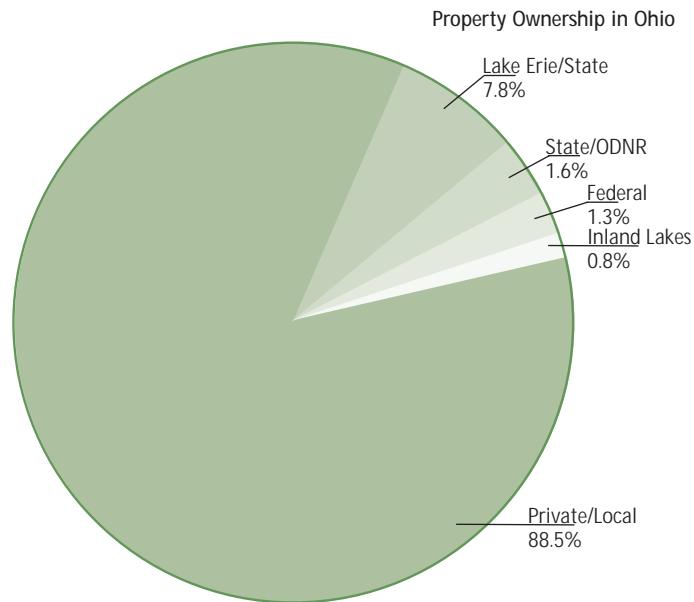
Protection and Restoration

A Stream Ethic

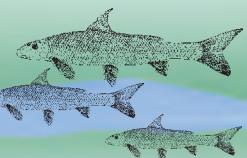
Streamside landowners are one of the most important parts of a stream ecosystem. The water and wildlife belong to the people of Ohio, but the quality of habitat it flows through is determined by the conservation stewardship of local landowners. And the ability to distinguish between right and wrong as it relates to preserving the integrity, sustainability, and beauty of flowing waters and its aquatic life is as important as any law.

Streams and Watersheds

Since more than 88 percent of Ohio is privately or locally owned, the well-being of Ohio's streams and watersheds is very dependent upon the attitudes and conservation stewardship of landowners and local communities. Increasingly, community-based watershed groups and partnerships comprised of many stakeholders are collectively working to protect and restore their local streams and watersheds. As water resources become increasingly important, it will be the willingness of private landowners and these groups to practice voluntary conservation on private and local lands that will determine the need for future regulations related to the health of streams and watersheds throughout Ohio.



1993
Blue suckers are captured in the Little Miami River for the first time. In September, a pipeline ruptures and spills an estimated 30,000 gallons of diesel fuel into an Indiana field within the Fish Creek watershed. The fuel flows through a small drainage ditch and contaminates seven miles of Fish Creek - a high quality tributary of the St. Joseph River. Fish Creek is the last known stream with the endangered white castjaw mussel.



1994
Statewide low temperatures in January range from -18 to -37 degrees F. The 1984 State Scenic segments of Big Darby and Little Darby creeks are designated as National Scenic. The State Scenic designated segments are extended in Big Darby Creek from Little Darby upstream to the northern boundary of Battelle-Darby Metro Park and from the U.S. Rt. 40 bridge upstream to the Conrail Railroad trestle. The lower 0.8 miles of Little Darby Creek are also designated. Sport fishing regulations are unified for the Ohio River between the bordering states.

Timeline

Stream Principles

- 1) Natural is best.
- 2) If you protect water quality and habitat, streams and their wildlife will take care of themselves.
- 3) It is easier and more economical to protect a healthy stream than to restore it later.
- 4) The fewer pollutants, the better.
- 5) Watersheds are not only the drainage area of a stream - it's where we live, work, and send our children to school.
- 6) What we do to streams, we do to ourselves - everything is connected and we all live downstream.
- 7) The more we learn about streams, the better we will care for them.
- 8) Large streams are formed by many small ones, every stream is a tributary, and every stream location has a watershed.
- 9) Healthy resources are the ones we put more into than we take from.
- 10) We must recognize existing stream uses where they provide important community functions.

Ways You Can Help

There are many ways you can help conserve Ohio's streams and watersheds.

Aquatic Life

- Join a local watershed group.
- Learn more about the fish and other species that live in your watershed.
- Support stream monitoring and assessment programs that assess the biological and chemical conditions of Ohio streams.
- Direct efforts and funds to the biggest problem(s) within your watershed.



Habitat

- Protect natural stream channels.
- Protect and restore riparian forests, floodplains, and wetlands.
- Control soil erosion and stabilize stream banks.
- Support the removal of nonessential dams.
- Minimize blacktop, rooftops, and other impervious surfaces.
- Use Best Management Practices (BMPs).
- Support farmland preservation, parks, greenways, and other conservation and open space programs.
- Support agencies and organizations that protect streamside property through acquisition and conservation easements.

Water Quality

- Make sure your pollution is properly treated and not harming aquatic life in a stream. Check your septic system or call your wastewater treatment plant and ask if they are meeting their NPDES permit limits.
- Minimize the amounts of fertilizer, pesticides, and other chemicals you use.
- Protect and restore streamside forests, floodplains, and wetlands.
- Control soil erosion.
- Dispose of all chemicals and petroleum products properly.
- Attend workshops and read books to learn more about the conservation of streams and watersheds.
- Use Best Management Practices (BMPs).

State Government
Ohio DNR
Ohio EPA
Ohio DOT
State Universities

U.S. Government
Department of the Interior
Department of Agriculture

Local Government
Soil and Water Conservation Districts
Park Districts
Wastewater Treatment Plants
Water Treatment Plants

Private Companies
Consultants
Industries and Businesses

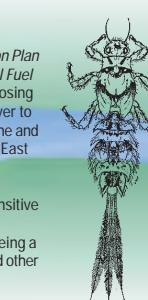
Nongovernment Organizations
Conservation Organizations
Watershed Groups
Sportsmen's Groups
Land Trusts



Careers and Opportunities

Ever consider a stream related career or voluntary work? Compared to the 1970s, there are many more opportunities today as a result of new laws and more concern for the environment. Some examples include aquatic biologists, water quality chemists, wildlife officers, environmental scientists, and sanitary engineers. For more information or technical assistance contact the following and learn more about their stream-related programs.

1996
Ohio and Indiana natural resource trustees settle claims for damages to Fish Creek caused by the 1993 diesel fuel spill. A \$2.5 million court registry account is established to be used exclusively for the restoration of Fish Creek. The U.S. National Invasive Species Act reauthorizes the 1990 Aquatic Nuisance Species (ANS) Act, but on a national level. It also allows for regional ANS panels.



1997
The Joint Environmental Assessment and Restoration Plan for the Fish Creek #2 Diesel Fuel Spill is published. The Kokosing River from the Mohican River to the Knox-Morrow County line and the North Branch from the East Branch to the mainstem is designated State Scenic. Populations of pollution sensitive burrowing mayflies have recovered to the point of being a nuisance to Port Clinton and other Lake Erie cities.



1998
The Tennessee Shell Company pleads guilty to a felony for purchasing illegally taken mussels from streams in Ohio, Michigan, Kentucky, and West Virginia. The Japanese-owned business is fined \$1 million.

A guide to Ohio Streams

In Ohio Streams...

9.3

Locally Common



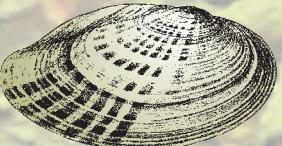
Common Name: orangespotted sunfish
Scientific Name: Lepomis humilis
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Perciformes
Family: sunfishes (Centrarchidae)
Number of Streams: 155
Distribution: Ohio River & Lake Erie Basins
Habitat: medium to large streams
Size: < 4 inches
Pollution Tolerance: moderately tolerant

Locally Common



Common Name: water boatmen
Scientific Name: Sigara sp.
Phylum: Arthropoda
Class: Insecta
Order: true bugs (Hemiptera)
Family: water boatmen (Corixidae)
Distribution: Ohio River & Lake Erie Basins
Size: < 1 inch
Pollution Tolerance: moderate

Uncommon

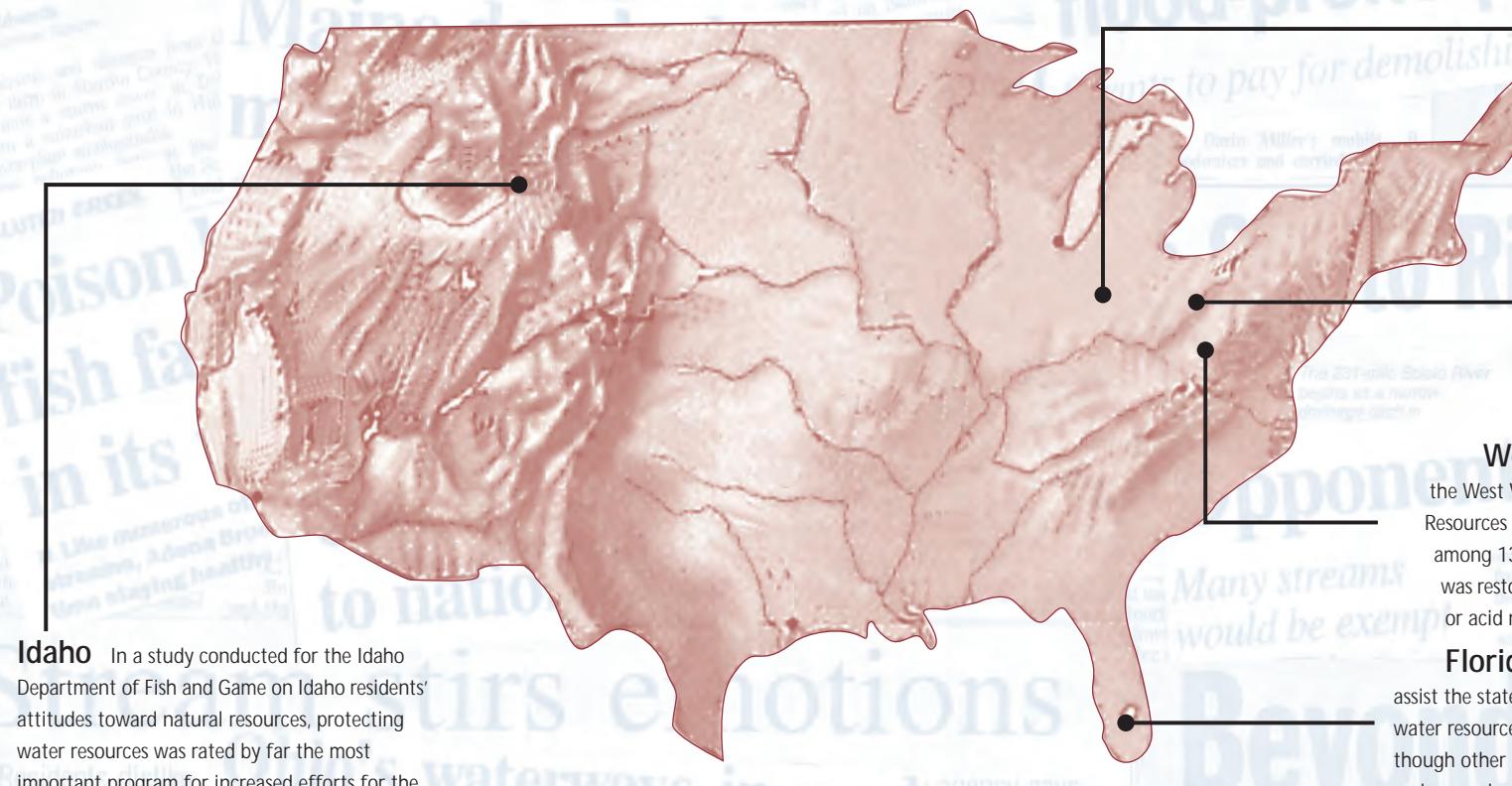


Common Name: rainbow
Scientific Name: Villosa iris
Phylum: Mollusca
Class: Bivalvia
Order: Unionoida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River & Lake Erie Basins
Habitat: medium to large streams
Size: < 3 inches
Abundance: uncommon and sporadic
Pollution Tolerance: intolerant

Protection and Restoration

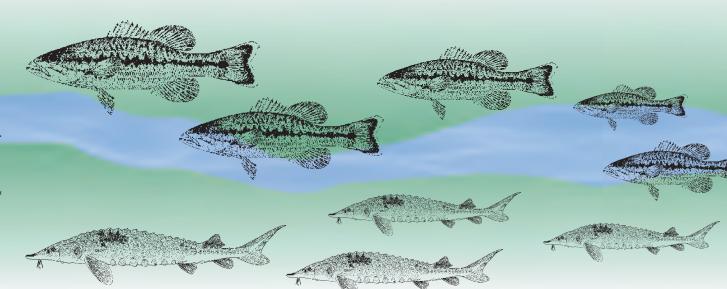
Water Resources: Americans' Top Natural Resource Priority

By far, one of the most important natural resource and environmental issues for Americans in the new millennium will be related to water - clean water, water resource protection, and the clean-up of our waterways. Resource managers that fully comprehend the magnitude of the public's concern over the nation's water resources will be many steps closer to putting programs into action for the benefit of people and wildlife resources (Responsive Management 1999).



1999 Governor Hollister signs the Ohio Farmland Preservation Act into law. Severe droughts occur throughout much of Ohio.

2000 The new Millennium begins. Black bass limits are reduced statewide from a daily possession limit of eight to five. Ohio woodlands cover 33 percent of the land. For the first time in more than 28 years, an adult lake sturgeon (*Acipenser fulvescens*) is captured and released in an Ohio stream - the lower Maumee River during May.



A guide to Ohio Streams

In Ohio Streams...

9.4

Survey Results

Numerous surveys conducted during the past 10 years show that water quality and water resource protection consistently rise to the surface among the most important natural resource issues for Americans. Rarely does an issue come along that crosses so many boundaries it unites the public with conservation and environmental efforts. Americans' health depends on a clean water supply as does the health of our stream resources. Any future programs that are linked directly to clean water will inevitably touch upon the most prominent resource concern within the hearts and minds of the American public. Water and the protection of waterways is one of those rare issues that will be the resource and environmental issue of the new millennium (Responsive Management 1999).

Indiana In a study of Indiana residents' attitudes toward fish and wildlife management conducted for the Indiana Division of Fish and Wildlife, residents were asked to rate the importance of 12 fish and wildlife management programs. Of the 12 presented, improving water quality was by far the most important. Several other studies conducted by Responsive Management show similar results (Responsive Management 1999).

Ohio Similar results have also been found in Ohio. When the development of this book began, a questionnaire was mailed to 200 streamside landowners in Ohio. A part of the survey asked them to rank the importance of this book's chapters. Not surprisingly, Chapter 4 *Water Quality and Pollution Control* and Chapter 9 *Protection and Restoration* were scored as the most important (Ohio Chapter of AFS 1996).

West Virginia In a survey conducted for the West Virginia Division of Natural Resources Wildlife Resources Section, the top program for increased effort, among 13 programs presented to West Virginia residents, was restoring streams that have been damaged by acid rain or acid mine drainage (Responsive Management 1999).

Florida In a major needs assessment conducted to assist the state of Florida's environmental education programs, water resources completely dominated the entire study, even though other important issues were covered as well, including endangered species, growth and development, habitat loss, and air pollution, to name a few (Responsive Management 1999).

Endangered



Common Name: goldeye
Scientific Name: *Hiodon alosoides*
Phylum: Chordata
Class: bony fishes (Osteichthyes)
Order: Osteoglossiformes
Family: mooneyes (Hiodontidae)
Number of Streams: 2
Distribution: Ohio River Basin
Habitat: large streams
Size: < 20 inches
Pollution Tolerance: intolerant

Common



Common Name: water strider
Scientific Name: *Metabates sp.*
Phylum: Arthropoda
Class: Insecta
Order: true bugs (Hemiptera)
Family: water striders (Gerridae)
Distribution: Ohio River & Lake Erie Basins
Size: < 1 inch
Pollution Tolerance: moderate

Endangered



Common Name: little spectacledace
Scientific Name: *Villosa villosa*
Phylum: Mollusca
Class: Bivalvia
Order: Unionida
Family: freshwater mussels (Unionidae)
Distribution: Ohio River Basin
Habitat: small streams
Size: < 2 inches
Abundance: very rare
Pollution Tolerance: intolerant

Watersheds are best viewed from high above - that's where precipitation, relief, principal streams, land use, flora, and fauna all become one. Since the first Ohioans arrived to the twenty-first century streams and their watersheds continue to be an integral part of life for both humans and wildlife.

Chapter Ten

Major Ohio Watersheds

Lake Erie Basin

Maumee River

Sandusky River

Cuyahoga River

Grand River

Ohio River Basin

Great Miami River

Little Miami River

Scioto River

Hocking River

Muskingum River

Mahoning River

View of the lower Scioto River valley near Portsmouth (Scioto County, Ohio, Photo by Tim Daniel).

Major Ohio Watersheds

Maumee River

State Scenic and Recreational River

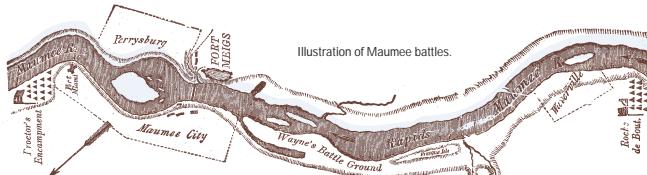
After Europeans settled Marietta and Cincinnati, Ohio's last frontier was still almost entirely covered by unbroken forests and the Great Black Swamp - a huge wetland approximately 40 miles wide by 120 miles long. The Battle of Fallen Timbers in 1794 followed by the Treaty of Greenville the next year, however, would change the landscape forever. Although the Defiance Land Office did not open until 1848, Lima and Findlay became the world's largest producers of oil by 1900. With more than 16,000 miles of drainage ditches and few remaining forests today, the largest Great Lakes watershed is one of Ohio's most agriculturally productive and intensively farmed landscapes. Formed at the confluence of the St. Joseph and St. Marys rivers in Indiana, the Maumee River flows northeasterly into Maumee Bay and Lake Erie at Toledo.



View of the lower Maumee River (Wood County, Ohio).

Stream Habitat (in Ohio)

Throughout most of its length, the Maumee River flows slowly through large pools within an intensively farmed ancient lake bed with little relief and clay soils. Three long sections of the river are impounded by the backwaters of Lake Erie and two dams located at Grand Rapids and Independence. Free-flowing sections of river contain long pools interspersed by swifter flowing rocky riffles, runs, and rapids.

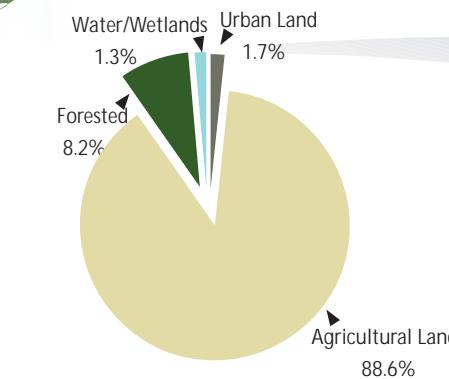


Principal Streams

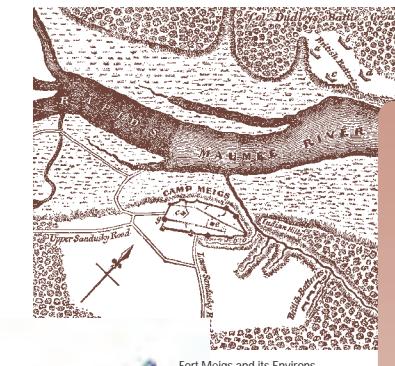
Stream Name	Length (miles)	Drainage Area (sq. mi.)
Maumee River (in OH)	105.4	4862
Auglaize River (in OH)	101.9	2337
St. Joseph River (in OH)	44.3	238
St. Marys River (in OH)	59.1	458
Tiffin River (in OH)	59.2	557
Blanchard River	91.0	771
Ottawa River	52.7	365
Little Auglaize River	45.5	405
Flatrock Creek (in OH)	34.0	98
Swan Creek	38.5	204
Beaver Creek	26.0	186
E. Br. St. Joseph (in OH)	5.8	25
S. Turkeyfoot Creek	20.9	149



white cat's paw (*Epioblasma obliquata perobliqua*)



View of Maumee River valley at Perrysburg in 1846 (Henry Howe).



Fort Meigs and its Environs.

Maumee River (in Ohio)

Watershed Facts

Named Streams: 327
Endangered Stream Species: 10
Clean Water Act Goals (miles)
Meeting: 156 (21.6%)
Partially Meeting: 266 (36.9%)
Not Meeting: 299 (41.5%)
Population Estimate
Total: 654,413
People/Square Mile: 134

Mainstem Facts

Average Gradient: 1.3 feet/ mile
Fish Species: 94
Mussel Species: 42
Aquatic Macroinvertebrate Taxa: 231
State Scenic River Designations (miles)
Scenic River: 43
Recreational River: 53
Stream Flow (cfs)
Maximum: 180,000
Average: 5,040
Minimum: 17
Dams: 2
Aquatic Life Use Designations (miles)
Warmwater Habitat: 105.4



white bass (*Morone chrysops*)

Major Ohio Watersheds

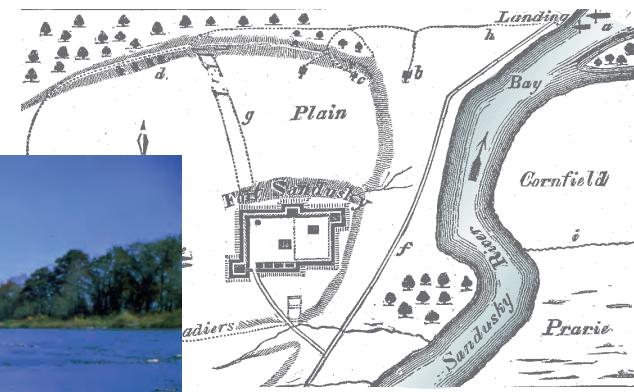
Sandusky River

State Scenic River

San,doos,tee “at the cold water”, Sa,un,dos,tee “water within water-pools”, and Po,ta,ke,sepe “a rapid river” are reported native American names and meanings for the Sandusky River. The watershed has a rich historical past that includes the Wyandots, early French fur trade, Fort Stephenson, and Ohio’s last native American reservation. Today, large spawning runs of Lake Erie fishes, all six species of Ohio redhorse, nesting bald eagles, and large flights of migrating waterfowl are but a few of the Sandusky’s natural features. The Sandusky River originates near Bucyrus, flows west to Upper Sandusky and then north through Tiffin and Fremont to its confluence with Sandusky Bay and Lake Erie. Water supply, sport fishing, canoeing, and wildlife viewing are but a few of the important attributes this State Scenic River has to offer.



Dolomite cliffs are common along the lower Sandusky River (Sandusky County, Ohio).



Fort Sandusky and environs (Henry Howe).

Stream Habitat

As it flows from its headwaters to Sandusky Bay, the Sandusky River changes from a small headwater stream into a large river. The stream contains an outstanding reach of natural fish spawning habitat downstream from Tiffin, but migratory walleye, white bass, and other lake-run fishes can not reach it due to a barrier dam located at Ballville. Like many agricultural streams, excessive levels of siltation can be found in many of its larger pools.

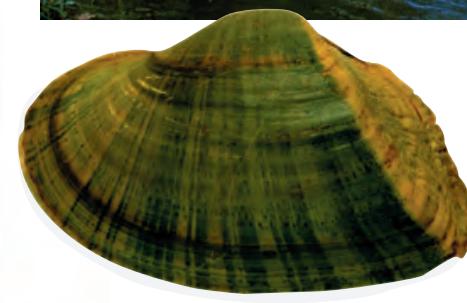


Principal Streams

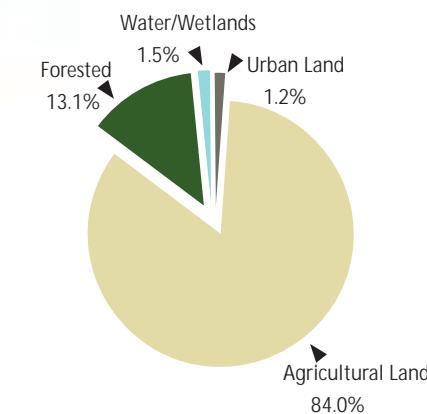
Stream Name	Length (miles)	Drainage Area (sq. mi.)
Sandusky River	130.0	1421
Tymochtee Creek	54.8	299
Honey Creek	39.3	177
Wolf Creek	23.9	153
Broken Sword Creek	32.0	91
East Branch	18.2	83
Green Creek	22.9	83
Sycamore Creek	20.0	68



walleye
(*Stizostedion vitreum*)



elktoe
(*Alasmidonta marginata*)



Sandusky River

Watershed Facts

Named Streams: 105
Endangered Stream Species: 5
Clean Water Act Goals (miles)
Meeting: 10 (9.3%)
Partially Meeting: 22 (20.6%)
Not Meeting: 75 (70.1%)
Population Estimate
Total: 135,722
People/Square Mile: 96

Mainstem Facts

Average Gradient: 3.9 feet/ mile
Fish Species: 85
Mussel Species: 29
Aquatic Macroinvertebrate Taxa: 228
State Scenic River Designations (miles)
Scenic River: 65
Stream Flow (cfs)
Maximum: 36,500
Average: 1,031
Minimum: 4.4
Dams: 5
Aquatic Life Use Designations (miles)
Warmwater Habitat: 130

Major Ohio Watersheds

Cuyahoga River

State Scenic River

Ya,sha,hia “the place at the wing” and “crooked” are two interpretations for its native American name. Although famous for its 1969 fire, the Cuyahoga’s pollution helped establish the nation’s first “earth day” a few years later. A national water quality goal “to restore the chemical, physical, and biological integrity of our nation’s surface water” was also established by the U.S. Congress. During the last 15 years, pollution controls have significantly improved the middle and lower reaches of the river. While it remains one of our most densely populated and industrialized watersheds, the upper Cuyahoga still contains some of Ohio’s highest quality stream habitat and aquatic assemblages. The scenic river - an important source for drinking water - flows through waterfalls, gorges, and Ohio’s only National Recreational Area.



A guide to Ohio Streams

10.3

Stream Habitat

Aquatic habitats in the Cuyahoga River markedly change between its headwaters and Cleveland. The mainstem begins as slow flowing wetlands, but changes into more diverse stream habitats consisting of

alternating series of high gradient riffles, runs, and pools at Hiram Rapids.

Downstream, sections of the mainstem are impounded by a series of dams. The lower river's navigation channel contains poor quality habitats as the result of extensive hydro-modification and ongoing maintenance.

View of the upper Cuyahoga River near Mantua (Portage County, Ohio).



Cuyahoga River

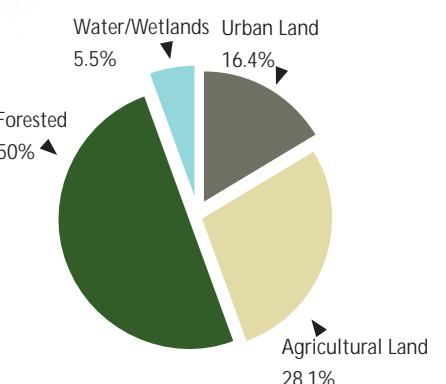
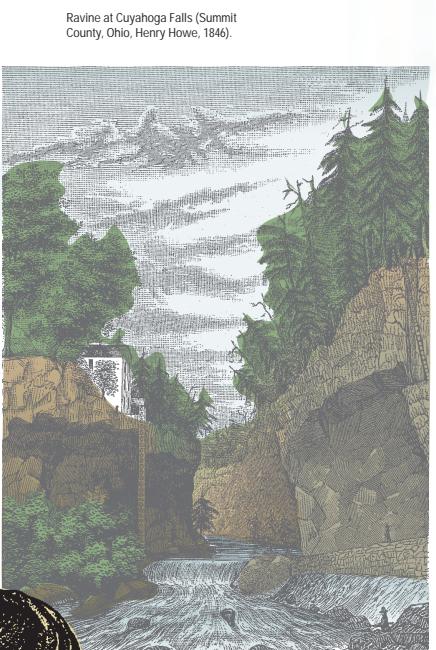
Watershed Facts

- Named Streams: 58
- Endangered Stream Species: 2
- Clean Water Act Goals (miles)
 - Meeting: 56 (22.3%)
 - Partially Meeting: 59 (23.5%)
 - Not Meeting: 136 (54.2%)
- Population Estimate
 - Total: 1,009,737
 - People/Square Mile: 1,248

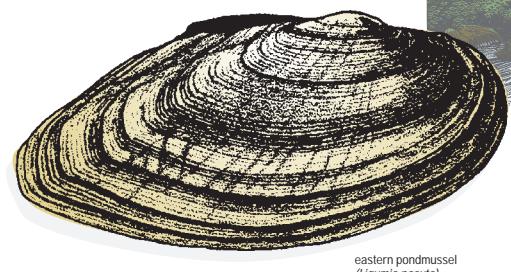
Mainstem Facts

- Average Gradient: 7.1 feet/ mile
- Fish Species: 87
- Mussel Species: 12
- Aquatic Macroinvertebrate Taxa: 342
- State Scenic River Designations (miles)
 - Scenic River Miles: 25
- Stream Flow (cfs)
 - Maximum: 16,700
 - Average: 860
 - Minimum: 21
- Dams: 7
- Aquatic Life Use Designations (miles)
 - Exceptional Warmwater Habitat: 4.0
 - Warmwater Habitat: 91.5
 - Limited Resource Water: 5.6

Principal Streams		
Stream Name	Length (miles)	Drainage Area (sq. mi.)
Cuyahoga River	101.1	813
Tinkers Creek	28.2	96
Congress Lake Outlet	26.4	79
Little Cuyahoga River	17.4	69



northern pike
(*Esox lucius*)



eastern pondmussel
(*Ligumia nasuta*)

Major Ohio Watersheds

Grand River

State Wild and Scenic River

In native American language, it was called "Sheauga sepe" meaning the Raccoon River. And with large beaver swamps, northern brook lampreys, black bears, river otters, bald eagles, and wild turkeys present today, the Grand River watershed is one of Ohio's most wild and scenic regions. From its marshy headwaters in the Grand River Wildlife Area, the river meanders north through an ancient lake bed to Mechanicsville where it turns west and cascades through a deep and picturesque valley before entering Lake Erie. With urban sprawl occurring throughout much of northeastern Ohio, there are increasing partnership efforts to protect and restore the watershed's unique stream and riparian habitats, biological diversity, recreational opportunities, and rural qualities.



Fishing for steelhead - lake-run rainbow trout - is becoming increasingly popular in the lower Grand River and tributaries (Photo courtesy of Dan Armitage).



rainbow trout
(*Oncorhynchus mykiss*)



In 1986, the Ohio Division of Wildlife began reintroducing river otters (*Lutra canadensis*), a state endangered species, into the Grand River watershed.



salamander mussel
(*Simpsoniarobusta*)

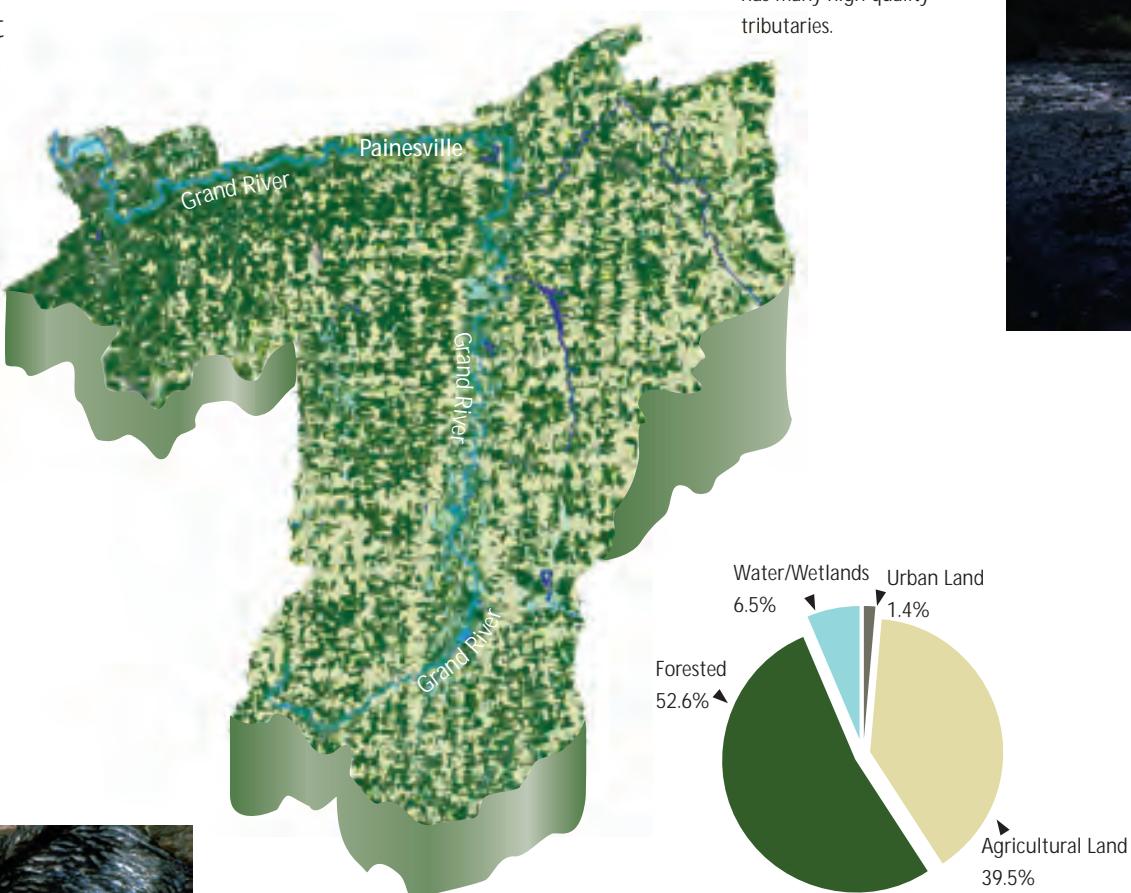


Illustration of an Ohio log cabin (Henry Howe).

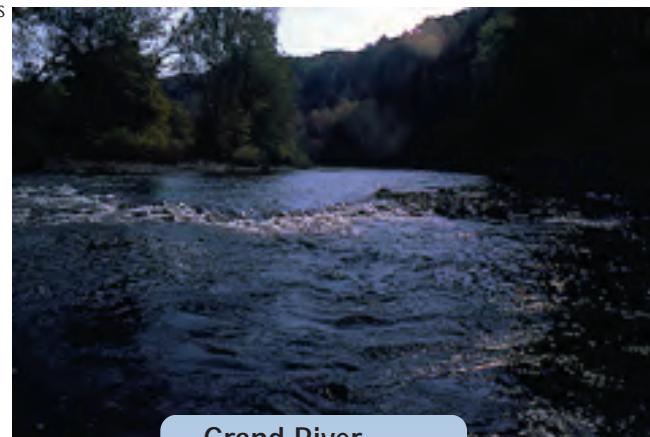
A guide to Ohio Streams

10.4

Stream Habitat

Habitats in the Grand River markedly change as it flows from its headwaters to its confluence with Lake Erie. Located in an ancient lake bed with extensive wetlands, the upper river flows slowly through long pools with soft sediments. The lower river has more diverse, high gradient rocky habitats comprised of alternating series of well-defined pools and riffle-run complexes. Because the Grand River is mostly underlain by a shallow, low yielding, shale bedrock aquifer, it typically experiences low flows in the late summer and early fall. The mainstem has many high quality tributaries.

View of the Grand River downstream from Harpersfield (Ashtabula County, Ohio).



Grand River

Watershed Facts

Named Streams:	53
Endangered Stream Species:	3
Clean Water Act Goals (miles)	
Meeting:	151 (84.8%)
Partially Meeting:	25 (14.0%)
Not Meeting:	2 (1.1%)
Population Estimate	
Total:	96,437
People/Square Mile:	137

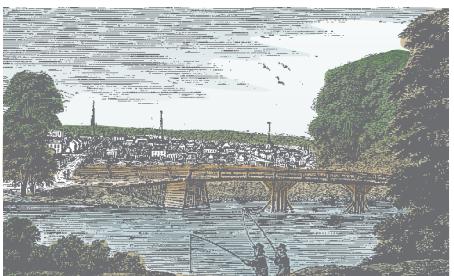
Mainstem Facts

Average Gradient:	5.6 feet / mile
Fish Species:	87
Mussel Species:	26
Aquatic Macroinvertebrate Taxa:	291
State Scenic River Designations (miles)	
Scenic River:	33
Wild River:	23
Stream Flow (cfs)	
Maximum:	18,700
Average:	1,047
Minimum:	5.1
Dams:	1
Aquatic Life Use Designations (miles)	
Exceptional Habitat:	42.9
Warmwater Habitat:	55.6
Seasonal Salmonid Habitat:	30.9

Major Ohio Watersheds

Great Miami River

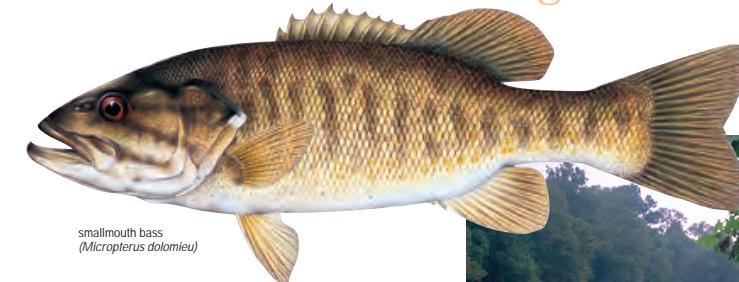
The name Miami was originally the designation of the tribe who bore the name of "Tewightewee." In the Ottawa language, it signified "mother" and the Shawanoese called the river Shi,me,a,mee,sepe or "Big Miamie River." The settlers who constructed flatboats in Piqua knew the dangerously swift and crooked channels downstream from Troy as the "Ninety-nine Islands." The Miami Valley was also known for its lush vegetation, abundant water resources, Ohio-Erie canal, and rich archeological past. Today, the valley is known for its water supply, recreation, industries, productive farmland, and high quality tributaries. Frequented by trout clubs and canoeists, the Mad River is Ohio's longest coldwater stream. The Stillwater River supports an exceptional diversity of aquatic wildlife and great sport fishing. Originating upstream from Indian Lake, the Great Miami River flows southwest to its confluence with the Ohio River west of Cincinnati. The middle and upper mainstem contains some of Ohio's best smallmouth bass fishing.



View of the Great Miami River at Piqua in 1886, Miami County, Ohio



fawnfoot
(*Truncilla donaciformis*)



smallmouth bass
(*Micropterus dolomieu*)

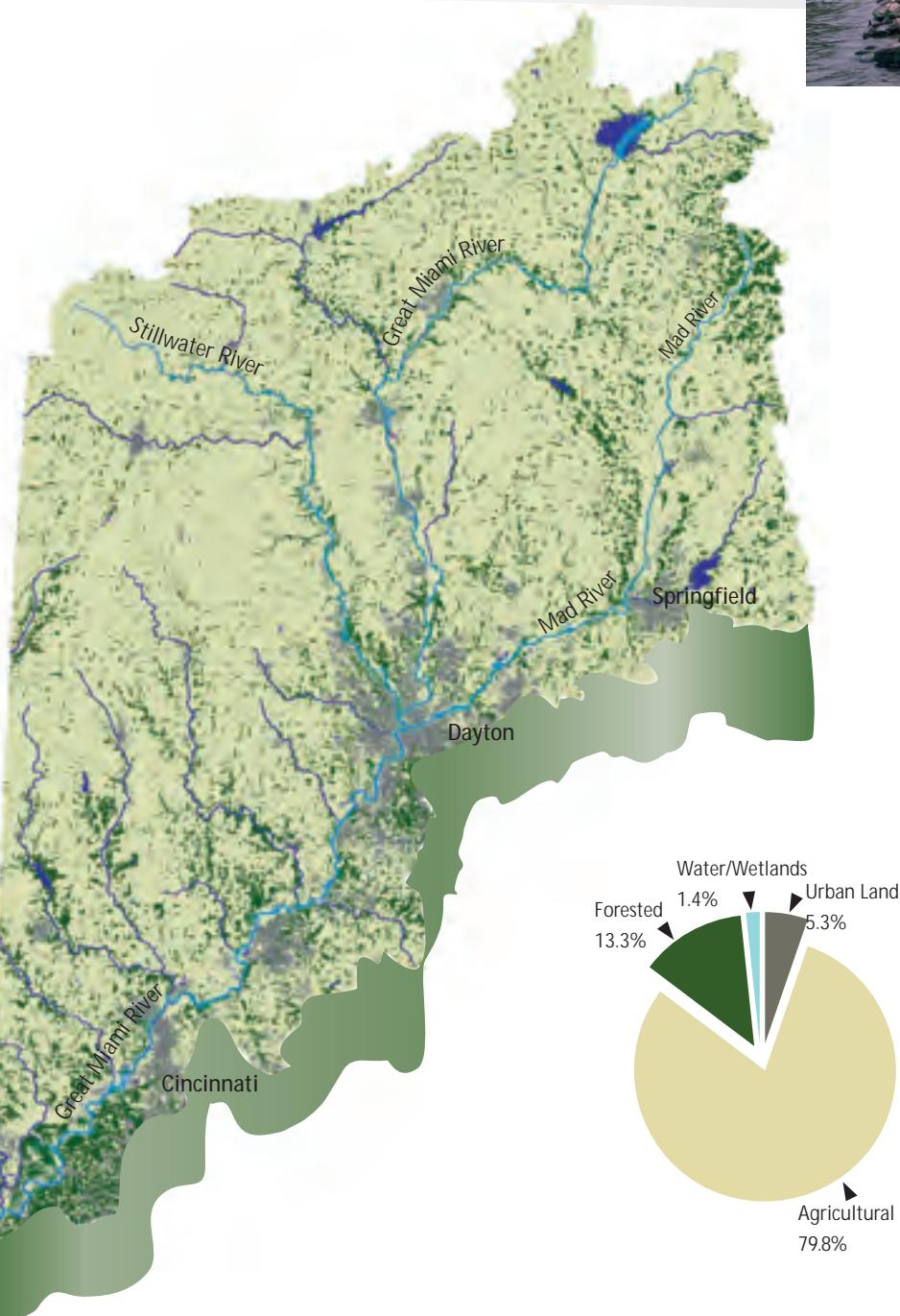


View of the Great Miami River upstream from Hamilton (Butler County, Ohio).

Stream Habitat

As a result of the watershed's glacial deposits, the Great Miami River flows over a buried aquifer with thick deposits of sand, gravel, cobble, and boulders. Habitat modifications include channelization in the upper reach, numerous low-head dams, and some gravel

mining. Its large watershed and abundant groundwater helps to maintain good base flows throughout the year.



Great Miami River (in Ohio)

Watershed Facts

Named Streams:	285
Endangered Stream Species:	14
Clean Water Act Goals (miles)	
Meeting:	613 (58.8%)
Partially Meeting:	206 (19.8%)
Not Meeting:	223 (21.4%)

Population Estimate

Total:	1,334,930
People/Square Mile:	338

Mainstem Facts

Average Gradient:	3.9 feet/mile
Fish Species:	114
Mussel Species:	37
Aquatic Macroinvertebrate Taxa:	297
Scenic River Designations (miles)	
Scenic River:	Stillwater River & Greenville Creek: 83
Recreational River:	Stillwater River: 10
Stream Flow (cfs)	
Maximum:	352,000
Average:	3,367
Minimum:	155
Dams:	15
Aquatic Life Use Designations (miles)	
Warmwater Habitat:	170.3

Major Ohio Watersheds

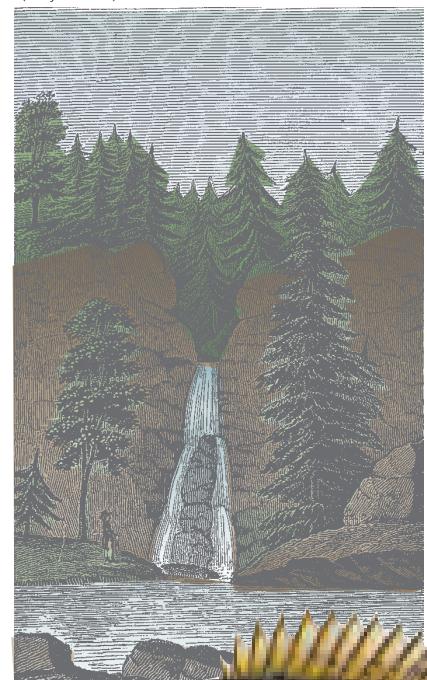
Little Miami River

State and National Scenic River

The Shawanoese called it Che,ke,me,a,mee,sepe “the Little Miamie River.” Ohio’s first State and National Scenic River is our longest reach of Exceptional Warmwater Habitat.

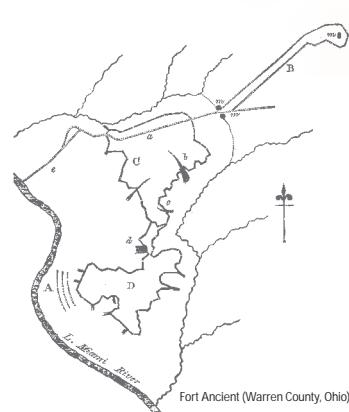
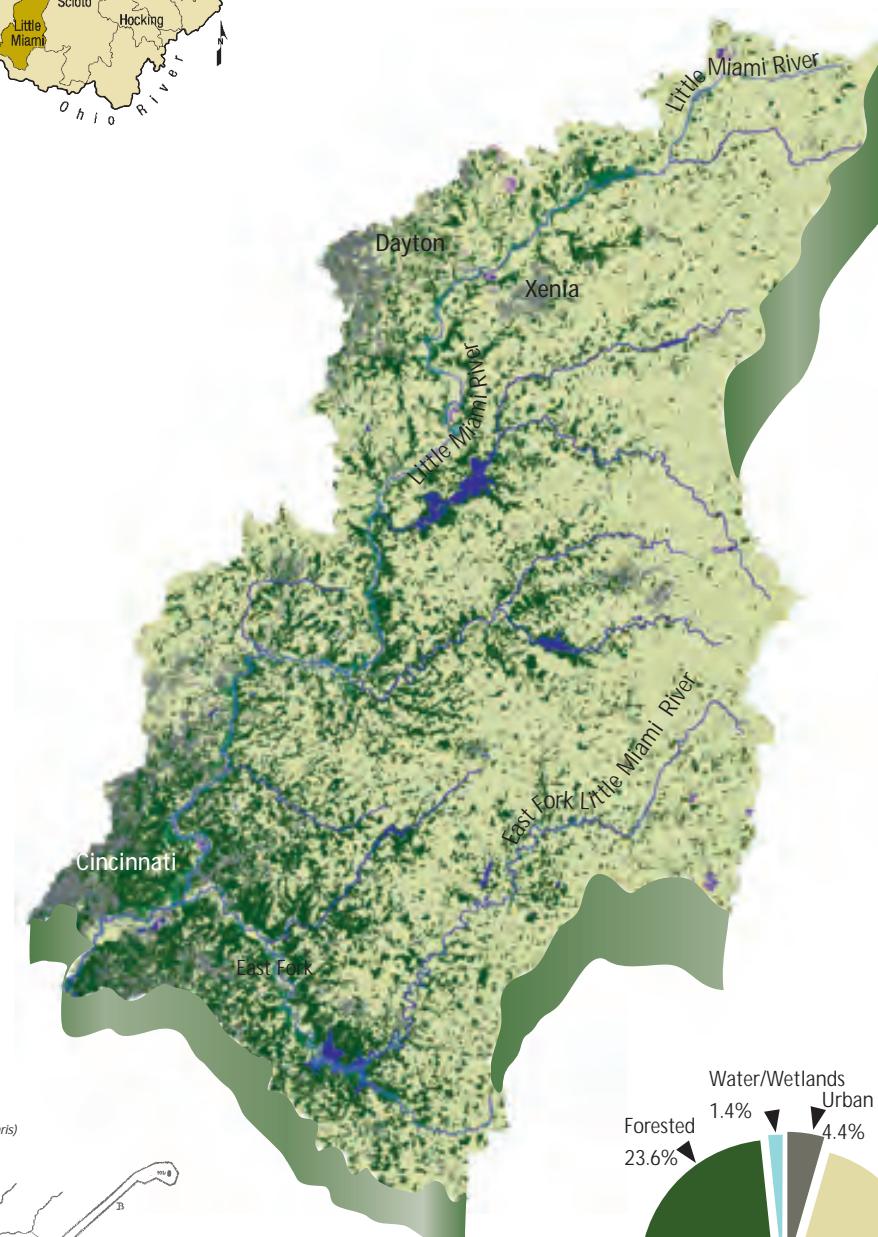
Endangered stream species, a high biological diversity, and one of Ohio’s oldest river groups are but a few of the many attributes of the Little Miami River watershed. Originating near South Charleston, the river flows in a southwesterly direction to its confluence with the Ohio River east of Cincinnati. With great sport fishing, beautiful scenery, canoe liveries, parks, and trails it is easy to understand why the Little Miami River is a popular recreational retreat for many Ohioans.

Cascade at Clifton, Greene County, Ohio
(Henry Howe 1846).

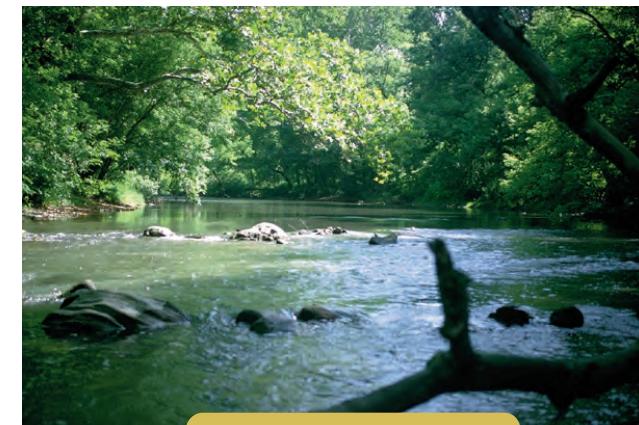


Principal Streams

Stream Name	Length (miles)	Drainage Area (sq. mi.)
Little Miami River	105.5	1755
East Fork	81.7	501
Todd Fork	35.0	261
Caesar Creek	33.9	239
Anderson Fork	28.3	93
Massie Creek	9.5	87
Stonelick Creek	22.9	78



View of the upper Little Miami River upstream from Xenia (Greene County, Ohio).



A guide to Ohio Streams

10.6

Stream Habitat

With predominantly natural stream channels, good quality riparian forests, and high-gradient substrates comprised of sand, gravel, rubble, and bedrock slabs, the Little Miami River and its tributaries contain some of the highest quality stream habitat in Ohio.

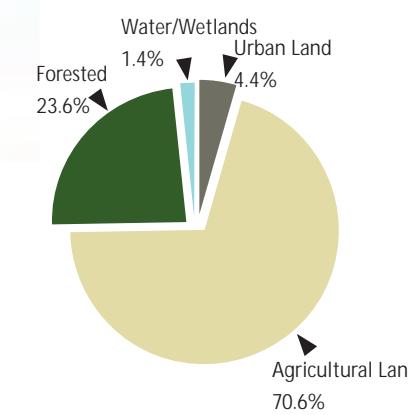
Little Miami River

Watershed Facts

Named Streams: 141
Endangered Stream Species: 12
Clean Water Act Goals (miles)
Meeting: 118 (48.4%)
Partially Meeting: 77 (31.6%)
Not Meeting: 49 (20.0%)
Population Estimate
Total: 610,777
People/Square Mile: 348

Mainstem Facts

Average Gradient: 6.5 feet/ mile
Fish Species: 106
Mussel Species: 44
Aquatic Macroinvertebrate Taxa: 311
State Scenic River Designations (miles)
Scenic River: 105
Stream Flow (cfs)
Maximum: 84,100
Average: 1,280
Minimum: 27
Dams: 2
Aquatic Life Use Designations (miles)
Exceptional Warmwater Habitat: 102.5
Warmwater Habitat: 3.0



Major Ohio Watersheds

Scioto River

The Wyandotts named it the “Sci,o,to”, but its meaning is not known. An archeological past that spans more than 10,000 years is evidence of its importance to native Americans. A high biological diversity, high quality tributaries, large State parks and forests, and a diverse array of landforms are but a few of the watershed’s attributes. As it flows south through central Ohio, the mainstem transforms into a large river as it cuts through the edge of Appalachia into the rugged hill country between Chillicothe and Portsmouth. The Scioto River remains important today for its water supplies, recreational opportunities, rich farmland, abundant groundwater, and extensive deposits of sand and gravel. The river south of Columbus is Ohio’s longest free-flowing stream.

Stream Habitat

Throughout its length, the Scioto River contains a wide diversity of aquatic and riparian habitats. The upper river has been extensively channelized, but the middle and lower reaches contain predominantly natural habitats comprised of alternating series of pools, riffles, and runs. Although its banks are severely eroding in many sections, the river maintains great island habitats, fast deep chutes, numerous snags, and extensive sand and gravel bars.



View of the lower Scioto River near Portsmouth (Scioto County, Ohio).



paddlefish
(*Polyodon spathula*)

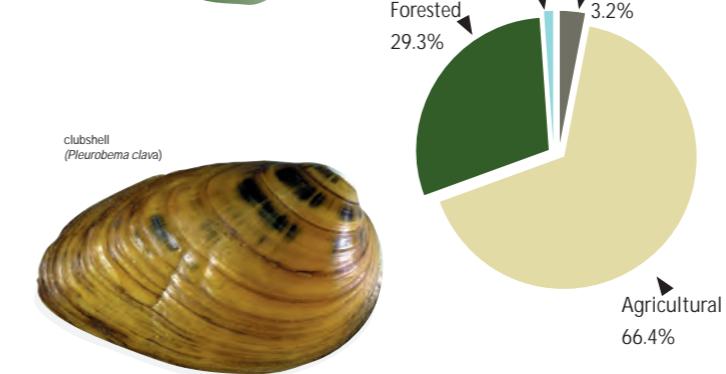


The landing at Portsmouth (Scioto County, Ohio, Henry Howe 1846).



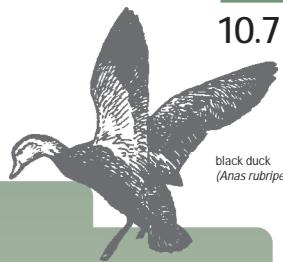
Principal Streams

Stream Name	Length (miles)	Drainage Area (sq. mi.)
Scioto River	230.8	6510
Paint Creek	94.7	1143
Big Darby Creek	78.7	557
Big Walnut Creek	74.2	557
Salt Creek	45.4	553
Olentangy River	88.5	536
Deer Creek	67.1	408
Little Walnut Creek	49.8	281
Rattlesnake Creek	42.3	277
Scioto Brush Creek	36.0	273
Little Salt Creek	28.6	247
North Fk. Paint Creek	46.6	236
Alum Creek	55.8	201
Mill Creek	37.8	185
Little Darby	69.1	176
Sunfish Creek	26.5	145
Rocky Fork	27.5	145
Whetstone Creek	35.0	114
S. Fork Scioto Brush	18.2	113
Little Scioto River	27.2	111
M. Fork Salt Creek	21.2	108
Rush Creek	40.1	107



A guide to Ohio Streams

10.7



Scioto River

Watershed Facts

Named Streams: 567
Endangered Stream Species: 36
Clean Water Act Goals (miles)
Meeting: 863 (71.7%)
Partially Meeting: 199 (16.5%)
Not Meeting: 142 (11.8%)
Population Estimate
Total: 1,521,367
People/Square Mile: 233

Mainstem Facts

Average Gradient: 2.3 feet/ mile
Fish Species: 116
Mussel Species: 67
Aquatic Macroinvertebrate Taxa: 372
State Scenic River Designations (miles)
Scenic River:
Olentangy River: 22
Big and Little Darby Creeks: 84
Stream Flow (cfs)
Maximum: 177,000
Average: 4,749
Minimum: 244
Dams: 6
Aquatic Life Use Designations (miles)
Warmwater Habitat: 228.1
Modified Warmwater Habitat: 2.7



Plan of the purchase of the Ohio and Scioto Land Companies in 1787.

Major Ohio Watersheds

Hocking River

Hock,hock,ing “a bottle” and Wea,tha,kagh,qua sepe “bottle river” are two native American words and meanings for the Hocking River. The name came from a waterfall area 6 - 7 miles northwest of Lancaster where the stream was narrow and straight above the fall, but wide below and from above - resembled a bottle. Rich coal deposits, rugged wooded hills, canal lands, and abundant wildlife are but a few of the watershed’s attributes. Originating near Lancaster, the Hocking flows southeasterly to the Ohio River at Hockingport. With an abundance of public lands, the watershed provides Ohioans many recreational opportunities such as great stream fishing, canoeing, hiking, wildlife viewing, and hunting.



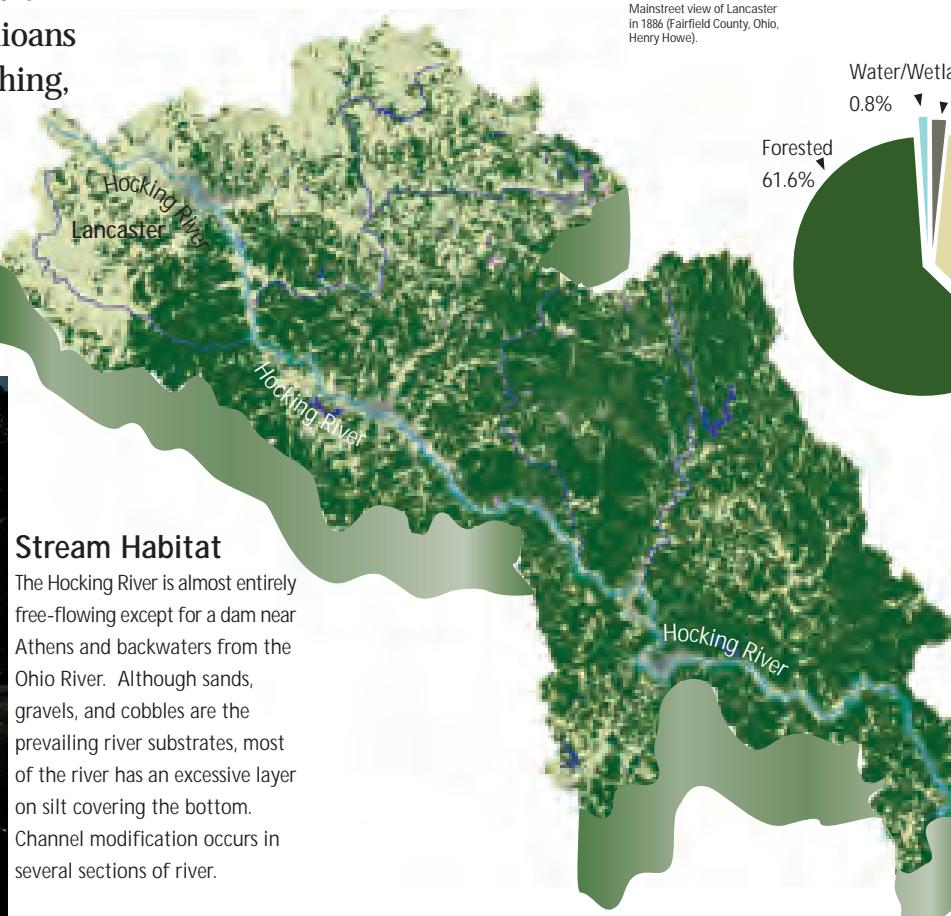
Principal Streams		
Stream Name	Length (miles)	Drainage Area (sq. mi.)
Hocking River	94.9	1200
Rush Creek	37.2	236
Federal Creek	23.8	145
Sunday Creek	27.2	139
Monday Creek	27.0	116
Little Rush Creek	18.0	98
Clear Creek	23.0	91



View of the Hocking River downstream from Logan



flathead catfish
(*Pylodictis olivaris*)



Stream Habitat

The Hocking River is almost entirely free-flowing except for a dam near Athens and backwaters from the Ohio River. Although sands, gravels, and cobbles are the prevailing river substrates, most of the river has an excessive layer on silt covering the bottom. Channel modification occurs in several sections of river.



Mainstreet view of Lancaster in 1886 (Fairfield County, Ohio, Henry Howe).



pink papershell
(*Potamilus ohioensis*)

Hocking River

Watershed Facts

- Named Streams: 122
- Endangered Stream Species: 3
- Clean Water Act Goals (miles)

 - Meeting: 160 (56.1%)
 - Partially Meeting: 49 (17.2%)
 - Not Meeting: 76 (26.7%)

- Population Estimate
 - Total: 153,314
 - People/Square Mile: 128

Mainstem Facts

- Average Gradient: 4.6 feet/ mile
- Fish Species: 97
- Mussel Species: 27
- Aquatic Macroinvertebrate Taxa: 266
- State Scenic River Designations (miles)
 - none
- Stream Flow (cfs)
 - Maximum: 50,000
 - Average: 1,023
 - Minimum: 10
- Dams: 4
- Aquatic Life Use Designations (miles)
 - Warmwater Habitat: 89.0
 - Modified Warmwater Habitat: 5.9

Major Ohio Watersheds

Muskingum River

Da,righ,quay “a town or place of residence”, Mus,king,um and Wa,ka,tal,mo “a town on the river side”, and Mus,king,um “the glare of an elk’s eye” are all reported native American words and meanings for the Muskingum River. And with ancient earthworks, the Legend of Duncan Falls, the shell button industry, the Y bridge, the Muskingum River Parkway, and large public lands, Ohio's largest inland watershed is rich with history, tradition, and public recreation. Originating at the confluence of the Walhonding and Tuscarawas rivers in Coshocton, the Muskingum flows south into the Ohio River at Marietta. The Muskingum River has an outstanding sport fishery - especially for spotted bass and huge flatheads.

View of the Muskingum River and Philo Dam at Duncan Falls (Muskingum County, Ohio).

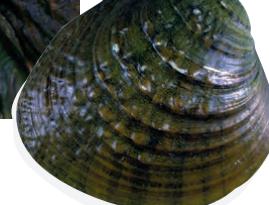


spotted bass
(*Micropterus punctulatus*)

Fort Harmar (1786) was the second military post erected by Americans in Ohio (Washington County, Ohio, Henry Howe).



The Muskingum River contains some of the largest and most diverse mussel beds in Ohio (Photo by Tim Daniel, ODNR, Division of Wildlife).

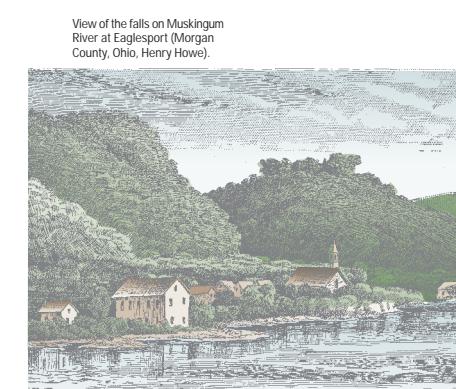


fanshell
(*Cyprogenia stegaria*)

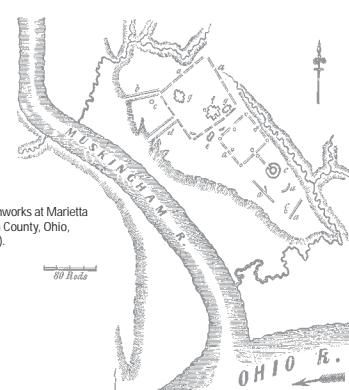
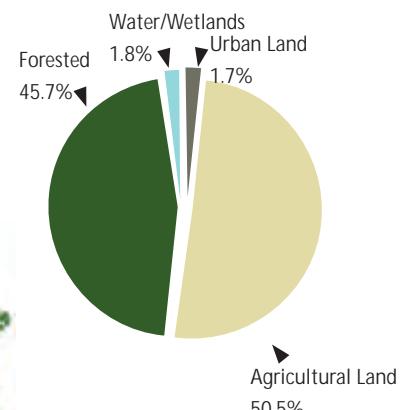


Principal Streams

Stream Name	Length (miles)	Drainage Area (sq. mi.)
Muskingum River	111.9	8038
Tuscarawas River	129.9	2590
Walhonding River	23.5	2252
Mohican River	64.2	999
Wills Creek	92.2	853
Licking River	67.5	781
Killbuck Creek	81.7	613
Sandy Creek	41.3	503
Stillwater Creek	63.5	485
Kokosing River	57.2	482
Sugar Creek	45.0	356
Black Fork	58.4	351
Lake Fork	14.7	344
Moxahala Creek	29.2	301
S. Fork Licking River	33.9	288
Conotton Creek	38.7	286
N. Fork Licking River	38.4	239
Wakatomika Creek	42.6	234
Wolf Creek	47.4	231
Clear Fork	36.6	219
Jonathan Creek	26.1	193
Chippewa Creek	26.7	188
Nimishillen	24.5	187
Salt Fork	32.0	161
Jerome Fork	24.5	159
Seneca Fork	30.3	151



View of the falls on Muskingum River at Eaglesport (Morgan County, Ohio, Henry Howe).



Muskingum River

Watershed Facts

- Named Streams: 675
- Endangered Stream Species: 31
- Clean Water Act Goals (miles)
 - Meeting: 441 (56.9%)
 - Partially Meeting: 150 (19.4%)
 - Not Meeting: 184 (23.7%)
- Population Estimate
 - Total: 1,392,980
 - People/Square Mile: 173

Mainstem Facts

- Average Gradient: 1.3 feet/ mile
- Fish Species: 108
- Mussel Species: 67
- Aquatic Macroinvertebrate Taxa: 202
- State Scenic River Designations (miles)
 - Scenic River:
 - Kokosing River: 48
 - Stream Flow (cfs)
 - Maximum: 270,000
 - Average: 7,646
 - Minimum: 325
 - Dams: 10
 - Aquatic Life Use Designations (miles)
 - Warmwater Habitat: 111.9

Major Ohio Watersheds

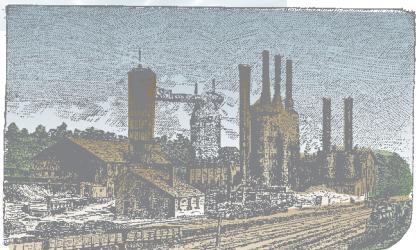
Mahoning River

Mahoni "a lick" and Mahonink "at the lick" are two native American words and meanings from which the name was derived. Located halfway between Cleveland and Pittsburgh with abundant coal and iron ore deposits and good railroads, Youngstown and the Mahoning valley were destined to become one of Ohio's leading steel producers. Originating in Columbiana County, the mainstem flows in a horseshoe direction to its confluence with the Shenango River in Pennsylvania to form the Beaver River. With good smallmouth bass and muskellunge fishing in upper mainstem, several canoe liveries, and four large state park reservoirs, the watershed offers a diversity of recreational opportunities. Although the water quality of the Mahoning River has improved, the protection of headwater habitat and removal of contaminated sediments and lowhead dams remain challenges for future restoration efforts for the



A headwater view of the Mahoning River (Columbiana County, Ohio).

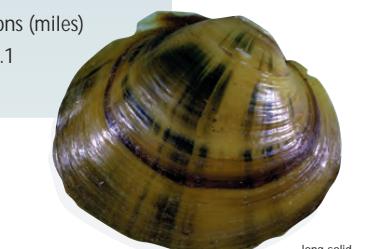
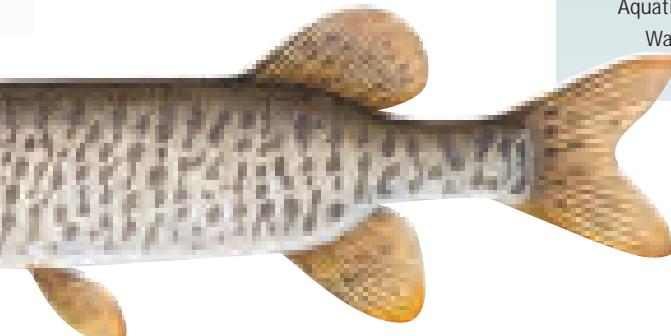
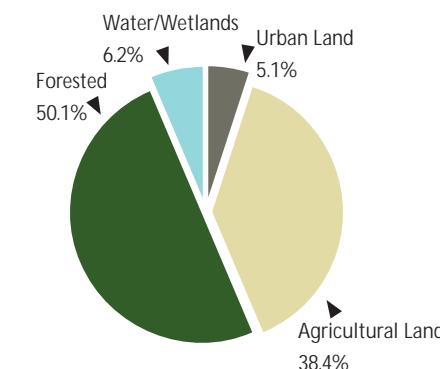
Principal Streams		
Stream Name	Length (miles)	Drainage Area (sq. mi.)
Mahoning River (in OH)	97.1	1075
Mosquito Creek	33.7	139
West Branch	29.2	109
Eagle Creek	21.5	109



In the summer of 1890, Youngstown extended the city limits to include the Brier Hill Furnaces which were erected by Governor Tod. They had what was called a wash-metal plant where pig-iron was remelted (Mahoning County, Ohio, Henry Howe).



muskellunge (*Esox masquinongy*)



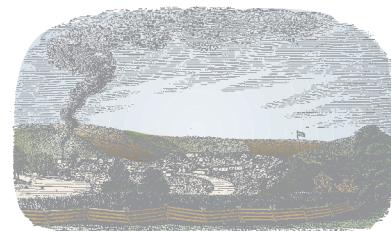
long-solid (*Fusconaia maculata*)

A guide to Ohio Streams

10.10

Stream Habitat

A substantial length of the Mahoning River in Ohio is impounded by two large reservoirs and 12 lowhead dams. Free-flowing sections, however, have diverse habitats comprised of deep pools interspersed by riffles and runs. Typical of glaciated watersheds, most riffle-run complexes have swift flows over a mixture of sand, gravel, cobble, and boulder substrates. Streamside forests are present along much of the river's length - even in urban areas.



Youngstown was the first settlement in the Western Reserve (Mahoning County, Ohio, Henry Howe, 1846).

Mahoning River

Watershed Facts

- Named Streams: 66
- Endangered Stream Species: 5
- Clean Water Act Goals (miles)
 - Meeting: 32 (25.2%)
 - Partially Meeting: 11 (8.7%)
 - Not Meeting: 84 (66.1%)
- Population Estimate
 - Total: 514,219
 - People/Square Mile: 478

Mainstem Facts

- Average Gradient: 4.0 feet/ mile
- Fish Species: 72
- Mussel Species: 14
- Aquatic Macroinvertebrate Taxa: 200
- State Scenic River Designations (miles)
 - none
- Stream Flow (cfs)
 - Maximum: 21,000
 - Average: 1,129
 - Minimum: 155
- Dams: 15
- Aquatic Life Use Designations (miles)
 - Warmwater Habitat: 97.1