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Ohio

Much of Ohio's social and economic development has been and continues to be determined by its natural resources. The effects of natural processes and human activities—floods, water pollution, mining, and urbanization—on Ohio's natural resources are important to understand because these processes and activities, to a large degree, affect the health, safety, and well-being of the people, the economy, and the environment of the State.

For more than 100 years, the U.S. Geological Survey (USGS) has been involved in studies of the geology, water resources, topography, physical features, and, more recently, the biology of Ohio. This long-term effort of data collection and interpretation provides natural-resources managers and policymakers with essential earth-science information needed to make decisions about Ohio's resources.

National Water-Quality Assessment Program

To address the need for consistent and scientifically sound information for managing the Nation's water resources, the USGS began a full-scale National Water-Quality Assessment (NAWQA) Program in 1991. The overall goals of the NAWQA Program are to (1) describe current water-quality conditions for a large part of the Nation's freshwater streams and water-bearing sediments and rocks, (2) describe how water quality is changing over time, and (3) improve our understanding of the principal natural and human factors affecting water quality.

Assessing the quality of water in every location of the Nation would not be practical; therefore, NAWQA studies are planned within a set of areas called study units. These study units are composed of 59 river and aquifer systems that represent the diverse geography, water resources, and land and water uses of the Nation. Two such units, the Lake Erie-Lake St. Clair Basin and the Great and Little Miami River Basins, are being studied by the USGS.

The Lake Erie-Lake St. Clair Basin study unit of NAWQA encompasses an area of about 22,300 square miles that includes northern Ohio, southeastern Michigan, northeastern Indiana, the northwestern tip of Pennsylvania, and southwestern New York. Water resources in the study unit are central to the economy and culture of the region. In a recent assessment, the value of Lake Erie and its tributaries, with respect to sport fishing and related commerce, was estimated to exceed $850 million annually. The study unit contains about 300 public recreational areas and about 90,000 acres of inland waters for public use. Lake Erie supports the largest freshwater fishery in the Great Lakes (an estimated 50–60 million pounds of fish are caught per year) and is widely considered to be the best walleye fishery in the world. Lakes Erie and St. Clair and the St. Clair, Detroit, and Niagara Rivers are vital shipping links that connect the upper Great Lakes to Lake Ontario and the St. Lawrence Seaway.

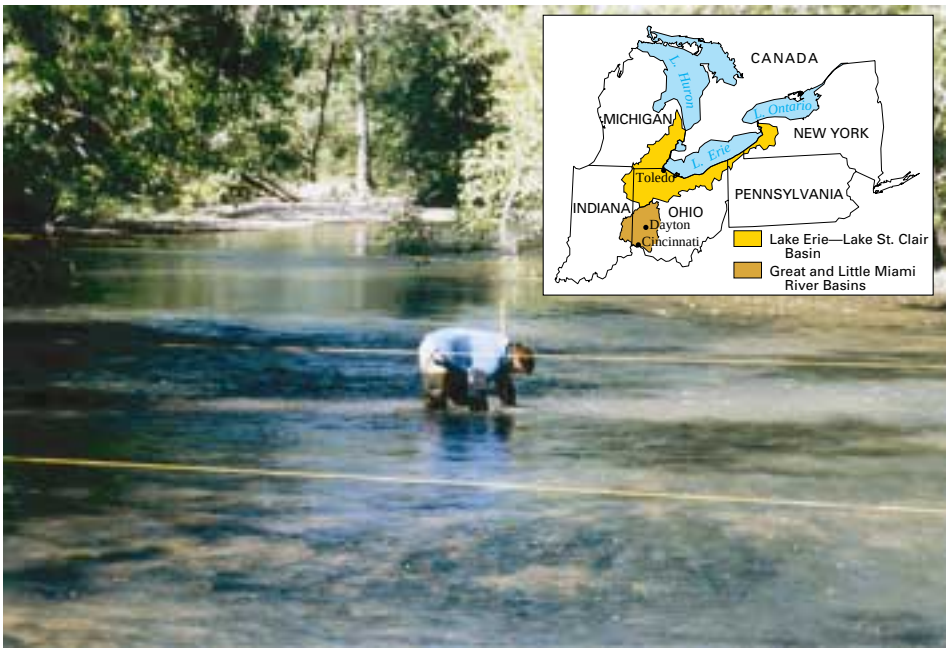

Figure 1. USGS scientist collecting biological data as part of the National Water-Quality Assessment Program.

The Great and Little Miami River Basin NAWQA study unit encompasses an area of about 7,350 square miles that includes southwestern Ohio and southeastern Indiana. The area contains many lakes and small reservoirs that are used for flood control, water supply, and recreation. An estimated 2.8 million people lived in the study area in 1995. Major cities in the study area are Cincinnati and Dayton, Ohio. Approximately 79 percent of the total land area is used for agriculture, primarily row-crop production of corn, soybeans, and alfalfa. Residential, commercial, and industrial land uses comprise 13 percent of the area, whereas the remaining area consists of forests (7 percent) and water bodies or wetlands (1 percent). Major industries are concentrated along the Dayton–Cincinnati corridor. Streams and lakes in the study unit are heavily used by residents for boating, fishing, and other outdoor recreation. The Little Miami River (a State and National Scenic River), the upper Great Miami River and its tributaries, and the Whitewater River in Indiana largely contain high quality warm-water habitats with biologically diverse fish and wildlife populations.

Flood Studies

Millions of dollars of flood damage have been recorded throughout Ohio's history. For example, the flood of March 1997 affected thousands of Ohio residents that live near and around tributaries to the Ohio River. This flood was estimated to have caused nearly $180 million in damage to public and private property, as well as the deaths of five people. To improve the understanding of the patterns of floods, USGS scientists collect and study data before and after these events. These data are collected in the field and through the USGS monitoring network. The monitoring network consists of stations throughout Ohio that collect data on surface-water quantity and quality. Most stations can send data by way of satellites to the USGS office in Columbus. These data then are made available on the Internet as "real-time" data (http://www-oh.er.usgs.gov/rt-cgi/gen_tbl_pg). The National Weather Service, which issues flood warnings, uses USGS real-time data to assist in rapidly determining the conditions of Ohio's streams. The USGS, in cooperation with the Ohio Department of Transportation, evaluates how construction at or near selected stream sites may affect future flooding, as well as documents actual floods at selected highway sites. Additionally, the USGS, in cooperation with the Federal Emergency Management Agency, conducts studies that are used to help establish flood-plain management programs to mitigate flood losses. These studies also are used to develop flood-risk zones within flood-prone areas.

Figure 2. USGS field crew measuring streamflow during the flood of March 1997.

These USGS flood studies and published reports, along with the monitoring-network data and maps, provide water-resources managers and policymakers with information to help them understand how floods affect the lives and property of Ohio residents, as well as provide information that can lead to the mitigation of the loss of lives and property.

Mapping Ohio's Glacial Deposits

Building on present cooperative studies of Lake Erie coastal erosion and glacial geology, the USGS, the Ohio Department of Natural Resources (ODNR)-Division of Geological Survey, and agencies in Indiana, Illinois, and Michigan are developing the Central Great Lakes Geologic Mapping Coalition. The Coalition plans to map at 1:100,000 and 1:24,000-scale the glacial and related deposits in three dimensions in prioritized areas, using modern geophysical and drilling technologies, geologic sedimentation models, and computer-assisted analyses. Partnering with other Federal and State experts, the mapping program will characterize the hydrogeologic and aggregate potential for surface and subsurface units, their geochemical composition, and their roles in

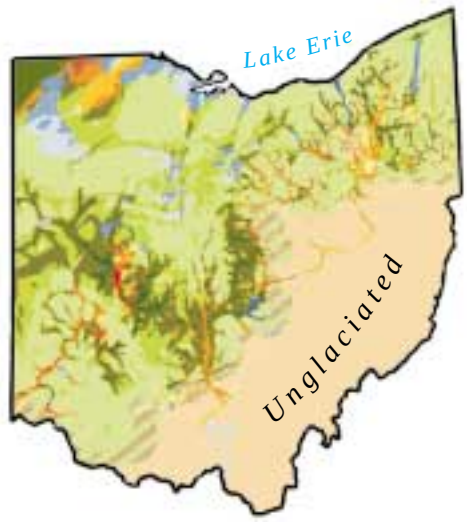

Figure 3. Glacial deposits in Ohio. The map shows surface glacial till deposits in green, sand and gravel deposits in yellow-orange, and silt and clay deposits in blue. Unglaciated areas are light brown. Darker colors, which indicate thicker deposits, can be used to trace old valleys, filled with complex glacial deposits, across the central part of the State.

natural hazards and contamination potential. The Coalition seeks to develop ways to teach local land-use decisionmakers how to use the new, detailed data and software tools in making informed choices for sustainable growth in the region.

A new USGS regional map, which includes Ohio, portrays the character and thickness of glacial deposits in Ohio (fig. 3). The map complements other new State maps of the glacial sediments and the buried bedrock surface. All of these maps are used to assess ground water in glacial aquifers; the susceptibility of aquifers to contamination; the extent of sand and gravel construction aggregates; the potential for coastal-erosion, earthquake, landslide, flood, and radon hazards; and to provide basic information for environmental studies.

Zebra Mussels in Lake Erie Sediments

Zebra mussels originated in Eurasia and were introduced into the Great Lakes in 1988, presumably by ballast water discharges of oceangoing ships. They quickly spread throughout the Great Lakes and into the Mississippi River drainage system, where they have become a nuisance by clogging municipal and industrial water intakes, fouling swimming beaches, and changing lake and river ecology. Zebra mussels are widely known for their conspicuous infestation of rocks and other hard substrates. USGS scientists, in collaboration with The Ohio State University and ODNR-Division of Geological Survey, discovered that zebra mussels are extensively colonizing sand and mud sediments in western and central Lake Erie. A related exotic species, the quagga mussel, also has been found on soft-bottom sediments in eastern Lake Erie and in Lake Ontario. In western and central Lake Erie, the zebra mussel was 10 times more abundant than the quagga mussel on sand and mud sediments. Further investigation is needed into the impact on the Lake Erie ecosystem of the expansion of such vast beds of zebra mussels across sand and mud sediments. These beds of zebra mussels could affect the exchange of nutrients and contaminants between the sediment and the overlying water and within the Lake Erie food web. Another concern is that zebra mussel beds could adversely affect the recovery of the burrowing mayfly—an important food source for many kinds of fish, as well as an indicator of improving water and sediment quality in Lake Erie.

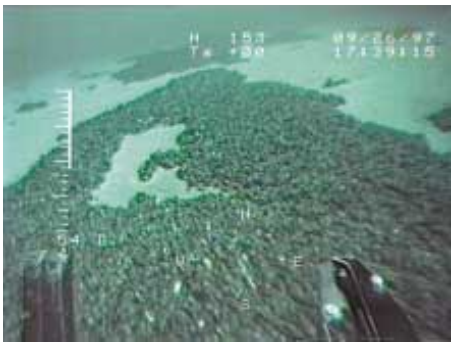

Figure 4. Zebra mussels on fine-grained sediments in western Lake Erie.

Coastal Wetland—Natural Refuge for Native Clams

The recent invasion of zebra mussels into North America has severely threatened native freshwater clams. In the open waters of Lake Erie, where zebra mussels have undergone exponential population growth during the last 10 years, more than 95 percent of certain native clam types have been exterminated. In 1996, however, a population of native clams was discovered in a coastal wetland, Metzger Marsh, just west of Toledo, Ohio. In 1996, as part of a wetlands restoration project, a 1.5-mile stone dike was built across the mouth of the bay to isolate the marsh from Lake Erie. The marsh was then dewatered. During dewatering, 22 species of clams were discovered and relocated by USGS scientists. Although all other hard objects in the marsh were covered with zebra mussels, the clams were not. Less than 1 percent of the 7,000 clams collected showed any evidence of zebra mussel colonization. USGS scientists theorized that native clams are surviving at this site, despite the presence of zebra mussels, because of the specific sediment type and water temperatures characteristic of this wetland habitat. The survival and continuing successful reproduction of native clams in this Lake Erie coastal wetland indicate that such sites may provide a refuge for these at-risk animals. In future years, native clams relocated from this marsh will be returned to it, and the population reestablished. Sites such as Metzger Marsh give promise that at least some clam brood stock from Lake Erie remains available to recolonize the lake if zebra mussel populations ultimately decline.

Restoration of Metzger Marsh

As mentioned, Metzger Marsh is a coastal wetland near Toledo, Ohio. The 900-acre wetland is managed by the U.S. Fish and Wildlife Service and ODNR-Division of Wildlife. The marsh formerly was protected from waves on Lake Erie by a barrier beach that was lost to erosion during

Figure 5. USGS scientist counting and relocating native clams removed from Metzger Marsh.

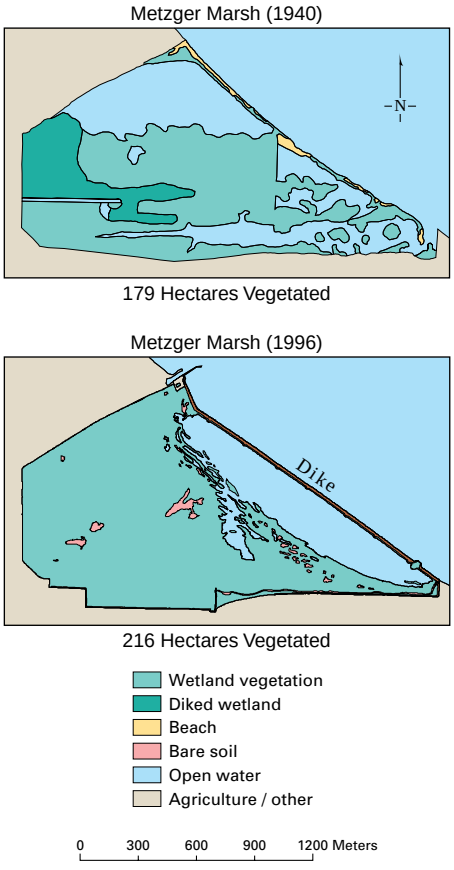

Figure 6. Changes in Metzger Marsh vegetation, 1940 and 1996.

high lake levels in 1973. Progressive loss of vegetated area accompanied erosion of the protective barrier. Therefore, the management agencies chose an active restoration program that incorporated a dike, which mimics the protective function of the lost barrier beach, but includes a water-control structure that can be opened following restoration to allow a hydrologic connection with the lake. Prerestoration studies were completed by USGS scientists in collaboration with the management agencies and academic institutions to measure physical attributes and characterize wetland plant communities and most major groups of fish and wildlife. Followup monitoring will determine the success of this project, which has the potential to provide a model for wetland restoration throughout the Nation.

Gateway to the Earth—The OhioView Project

The OhioView Consortium is a group of universities, colleges, K-12 schools, libraries, and local and State government agencies in the State of Ohio working with the USGS and NASA to provide affordable access to U.S. Government satellite and geospatial data.

Goals of OhioView are to (1) create a prototype of a national public access system for geospatial data from the U.S. Government, (2) promote the use of satellite and geospatial data in education, (3) facilitate the use of satellite data to monitor a wide variety of environmental issues (such as flood risk, crop health, urban sprawl, and loss of wetlands), (4) facilitate cooperation between the education community and State and local governments in remote sensing and digital mapping through data and cost sharing, (5) facilitate research and development in the applications of satellite data, and (6) establish a high-speed network to provide satellite data to the public, educators, scientists, and community leaders in Ohio and the Nation.

These satellite and related geospatial data (such as topographic maps, digital elevation data, aerial photographs, and land-use data) will be transferred over high-speed networks from the USGS EROS Data Center in Sioux Falls, South Dakota, to the NASA Lewis Research Center in Cleveland, Ohio, where they will be distributed to the OhioView Consortium and be viewable by the public over common Internet browsers.

Applications of these data include the following:

- Agriculture: Crop forecasting and crop damage assessments.
- Cartography: Topographic mapping, terrain simulations, and map updating.
- Forestry: Stand density measurement, disease and fire damage assessment.
- Geology: Oil and gas exploration, geologic and structural mapping, and hazards analysis.
- Urban Planning: Land-use mapping and impervious-surface modeling.
- Water and Environment: Wetlands and habitat mapping, pollution monitoring, resource assessment, and hydrologic and coastal studies.

USGS office locations

The USGS has 84 employees in Ohio

USGS State Representative

6480 Doubletree Ave.
Columbus, OH 43229-1111
(614) 430-7700
FAX (614) 430-7777

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http://www.usgs.gov

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