U.S. Geological Survey Programs in Florida

U.S. Department of the Interior ■ U.S. Geological Survey

The safety, health, and economic well-being of citizens in Florida are important to the U.S. Geological Survey (USGS), which is involved in water-related, geologic, biological, land use, and mapping issues in many parts of the State. The Florida District Office in Tallahassee acts as the liaison for all studies conducted by USGS scientists in Florida. Water-resources activities are conducted from the District Office and Subdistrict Offices in Miami, Tampa, and Altamonte Springs (Orlando). Scientists in these offices investigate surface and ground water and water quality, working in cooperation with other Federal, State and local agencies and organizations.

The USGS Center for Coastal Geology and Regional Marine Studies was established in St. Petersburg in 1988 in cooperation with the University of South Florida. The Center conducts a wide variety of research on mineral resources and on coastal and regional marine problems, which include coastal erosion, climate change, wetlands deterioration, and coastal pollution. This research is leading to more accurate predictions of future coastal erosion, the evolution of wetlands, the fate of contaminated sediments, and the location of economically valuable sand and gravel and minerals.

An Earth Science Information Center (ESIC) was established in Tallahassee in 1985 under a cooperative agreement with the Florida Resources and Environmental Analysis Center of Florida State University. As part of the National ESIC network, this office provides information and directs inquiries to the USGS or the appropriate State agency on such earth science topics as cartography, geography, digital data, remote sensing, geology, geophysics, geochemistry, hydrology, geohydrology, aerial photography, and land use in Florida. It is supported by the USGS with reference materials, technical assistance, outreach activities, and data base access.

Hydrologic and Geologic Issues

Widespread population growth and land-use modification in Florida threaten the quantity and quality of drinking water, alter natural wetlands, and increase human exposure to geologic hazards, such as flooding, sinkholes, and erosion. Major problems with water quantity and quality can result from saltwater intrusion, aquifer dewatering, ditch excavation, water withdrawal, domestic and industrial solid and liquid wastes, atmospheric deposition, contaminated soils and sediments, and varying lengths of wet and dry periods. Other hazards, such as sinkhole development, radon, coastal erosion, and hurricane effects are additional environmental concerns. These concerns are being addressed by several USGS programs that are being conducted in cooperation with other Federal, State, and local agencies.

National Water-Quality Assessment Program

In 1991, the USGS began a full-scale National Water-Quality Assessment (NAWQA) Program to improve the understanding of environmental stresses to the Nation's water supply by using a regional approach. Two NAWQA studies cover most of peninsular Florida (fig. 1). These studies provide a basis for evaluating the effectiveness of water-quality management programs and predicting the likely effects of changes in land- and water-management practices. A third, which is mostly in Georgia, includes the Appalachicola River Basin in the western panhandle of Florida.

South Florida

The South Florida NAWQA Program study, which began in 1993, encompasses a large regional ecosystem (fig. 1) that covers about 19,500 square miles. The study area, which includes the Kissimmee–Okeechobee–Everglades Basin, is characterized by dense urban development near the coast, intensive agricultural development in the northern Everglades, Native American lands in the interior, and vast regions of rangeland and wetlands throughout. The southern part of the study area is mostly under public control as parks, preserves, sanctuaries, conservation areas, and refuges; it contains most of the remaining Everglades and adjacent South Florida wetlands.

The South Florida study addresses unique environmental issues by using a multiscale, interdisciplinary approach. The study design includes analysis of historical data, surface- and ground-water assessments, and ecological studies. Streambed sediment and tissue studies are ongoing. Largemouth bass, or Florida gar, have been collected at 15 sites to assess organic and trace-metal contamination. A surface-water-quality sampling program at 7 sites within the study area and a ground-water sampling program of 30 shallow wells completed in the Biscayne aquifer and which are within a residential area in southeast Florida have been initiated.

Index of Subjects

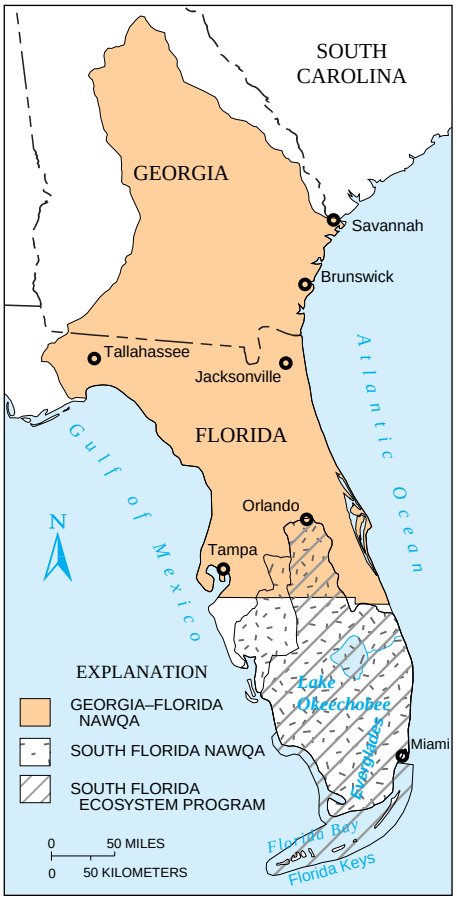

Figure 1. Study areas of the Georgia–Florida Coastal Plain and the Southern Florida National Water-Quality Assessments (NAWQA) and the South Florida Ecosystem Program.

Agricultural, industrial, and urban areas are sources of water-quality degradation. Agricultural production uses numerous chemicals, which include fertilizers, insecticides, herbicides, and fungicides, that can leak into ground water or nearby surface waters. Water drained into canals from farms and cattle lands contains high concentrations of nutrients and numerous chemicals that enter Lake Okeechobee and the Everglades. Nutrients in water are necessary for productive aquatic ecosystems, but in high concentrations they can adversely affect aquatic life and human health. The Everglades is the largest continuous area in Florida from which fish are banned for consumption because of mercury contamination, the source of which is still under investigation. Altered water quality and high concentrations of nutrients also may be impacting coastal waters such as Florida Bay, where large areas of seagrasses have died, algal blooms have increased, and fisheries have declined over the past 10 years.

The Biscayne aquifer is the principal source of potable water for southeastern Florida and has been designated as a "sole-source" drinking water supply by the U.S. Environmental Protection Agency (USEPA). However, the permeable Biscayne aquifer is at or near land surface, which could increase the potential for contamination from surface sources in this highly urban area.

Georgia–Florida Coastal Plain

The Georgia–Florida Coastal Plain NAWQA Program study area covers nearly 62,000 square miles and is divided almost equally between the States of Georgia and Florida (fig. 1). Seven hydrologic subregions are located within the study area, which includes the Altamaha and the Suwannee Rivers. The Floridan aquifer system is the major ground-water system.

The Georgia–Florida Coastal Plain study area is populated by 9.3 million people who rely primarily on the Upper Floridan aquifer for drinking water. More than 5 billion gallons of freshwater are used daily; more than 90 percent of the public supply is derived from the Upper Floridan aquifer.

Nutrient data, which have been collected over the past 20 years by the Florida Department of Environmental Protection's (FDEP) Ambient Ground Water Monitoring Program, the USGS, and the Georgia Geologic Survey, were evaluated early in the study. In September 1995, the 3-year phase of intensive data collection was completed. During that phase, more than 800 samples were collected and analyzed for pesticides, nutrients, and major water-quality constituents.

Preliminary analyses of surface-water samples show very low values of 25 pesticides that have been detected in urban and agricultural basins. Concentrations of pesticides display seasonal variations that generally follow usage patterns. Among the intensively studied sites, more insecticides occurred in an urban basin than in two agricultural basins. In the Suwannee River Basin, preliminary analysis of streambed sediment samples and tissue samples collected from clams has identified the presence of elevated mercury and arsenic concentrations.

Ground-water samples collected from a predominantly agricultural eight-county area in Georgia showed elevated concentrations of nitrate; 7 of the 23 samples collected showed concentrations above the 10-milligram-per-liter USEPA drinking-water standard. Elevated nitrate concentrations in agricultural areas in Florida also have been observed, but statistics are not yet available.

Ecosystem Studies

The USGS is conducting a number of ecosystem studies to provide scientific data to Federal and State management and regulatory agencies for the maintenance and restoration of the South Florida ecosystem. A major multidisciplinary effort is currently directed toward South Florida.

South Florida Ecosystem

The South Florida ecosystem, which includes the Everglades, has been dramatically altered during the past century by human activities. It is assumed that restoration of the South Florida ecosystem will follow restoration of natural hydrologic conditions, although this assumption is difficult or impossible to prove. Competing demands for water for household use, agriculture, fisheries, and ecosystem protection and restoration, as well as the construction of numerous canal systems, complicate the issues in South Florida and Florida Bay. The USGS has initiated the South Florida Ecosystem Program to provide scientific insight on the hydrology, geology, and ecology, which are inextricably linked in the Everglades and Florida Bay and along the South Florida coast (fig. 1). The Program complements ongoing and planned USGS activities such as the NAWQA Program, cooperative water-resources studies, the geologic and topographic mapping programs, and the work of the Center for Coastal Geology.

The Program focuses on developing key scientific information on hydrologic conditions to assist Federal, State, and local resource-management agencies and the private sector in their restoration efforts. Ongoing work includes the following:

- Measurement of the quantity of water discharging from the ecosystem to coastal waters and measurement and modeling of the movement of water through the various internal components of the ecosystem to assess the availability of water for competing requirements
- Identification of the processes that transform and transport nutrients and mercury through the ecosystem to assess water quality within South Florida, Florida Bay, and the Keys and fringing reefs and to provide the data needed by responsible agencies to design remediation facilities
- Reconstruction of freshwater and saltwater distribution, the frequency of fires, and the accumulation rates of nutrients and trace metals over the past 150 years, to determine the ecosystem history and the natural hydrologic conditions of South Florida and Florida Bay
- Preparation of bimonthly salinity maps of Florida Bay
- Description of the sediment dynamics of Florida Bay; these include interpretation of turbidity from satellite images
- Production of topographic maps and the related data needed to support scientific investigations and the design of ecosystem restoration alternatives.

One of the Program's first products is a satellite image map of South Florida that was based on 1992 and 1993 Landsat thematic mapper images. Satellite imagery shows subtle land elevation changes in the flat terrain of the Everglades, which do not appear on standard topographic maps. The satellite image map provides recent information on distribution of vegetation types and other land-cover features and serves as a baseline from which to plan restoration efforts in South Florida.

The Program is a collaborative effort by the USGS with a large number of other Federal and State agencies. Coordination is being conducted through USGS participation in the working group and subgroups of the South Florida Ecosystem Restoration Task Force, which includes 12 Federal agencies, 6 State agencies, and the Miccosukee and the Seminole Indian Tribes.

Biological Studies

The USGS Biological Resources Division (formerly the National Biological Service) conducts research in Florida, Puerto Rico, and the Virgin Islands from its Florida Caribbean Science Center (FCSC) in Gainesville. The FCSC's research includes studies of the endangered Florida manatee by means of its Sirenia Project, life-history studies of the threatened Gulf sturgeon and impacts of nonindigenous species on native ecosystems, studies on the threatened Kemp's Ridley sea turtles, studies related to restoration of the South Florida ecosystem, and helping the J.N. Ding Darling National Wildlife Refuge identify the cause of recent aquatic fauna die-offs.

The National Wetlands Research Center in Lafayette, Louisiana, documents the ecological effects of hurricanes, fire, and hydrological changes in Big Cypress National Preserve and Everglades National Park. Its Gulf Breeze office develops digital data bases on water quality and contaminants in Gulf of Mexico estuaries. The Center also helps assess potential impacts of Outer Continental Shelf oil and gas development and identifies the effects of increasing temperature, sea level, and atmospheric carbon dioxide on wetland plants in St. Marks National Wildlife Refuge.

The Florida Cooperative Fish and Wildlife Research Unit in Gainesville works with the University of Florida to conduct research on invasive plants, threatened and endangered species, fish community dynamics, and landscape ecology issues.

Hydrologic Monitoring

The USGS, in cooperation with Florida resource-management agencies, is studying major hydrologic issues, which include floodplain ecosystem water needs, integrated ground- and surface-water management, water-supply availability, surface and subsurface ground-water recharge with treated wastewaters, development of brackish ground-water resources, evapotranspiration/natural groundwater recharge relations, interaction of lakes and wetlands with ground water, and increased water withdrawal to supply users' needs. Programs are reviewed regularly and future needs for data collection and hydrologic investigations are developed jointly with cooperating State and local agencies. Typically, USGS investigations are of the following major types: data collection, problem-oriented appraisals, applied research, and hydrologic system definition.

The historical and current data-collection programs in Florida consist of monitoring networks for streamflow, ground-water levels, and surface- and ground-water quality. One unique surveillance program is the USGS's streamflow program, which is the primary source of long-term discharge data in the State (fig. 2). Information from various USGS networks is combined for all the States to establish a national computerized data base.

In 1995, the USGS conducted about 50 hydrologic studies, most of which can be categorized as problem-oriented appraisals and applied research. These include, by broad categories, 21 studies to determine the availability of regional water resources for population growth management planning, 17 studies for assessment of water-quality degradation, and 13 research studies on such topics as loss of water to the atmosphere by evaporation and plants, hydrodynamics and chemical modeling of ground- and surface-water flow, and wetland processes—all of which are important to water-resources management.

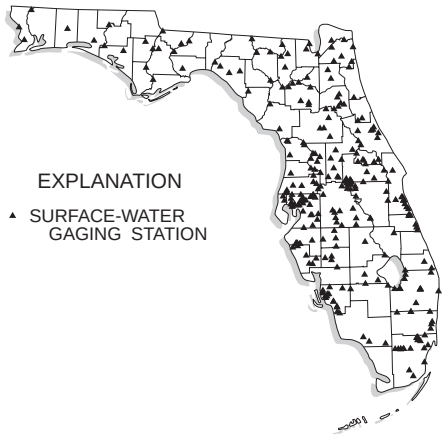

Figure 2. The locations of active long-term daily streamflow-monitoring stations in Florida.

These studies were done cooperatively with the five Florida Water Management Districts, the Florida Department of Environmental Protection (FDEP), the Florida Department of Transportation, and a number of county and local agencies.

Coastal Erosion

The west-central coast of the Florida peninsula is characterized by sandy barrier islands with numerous inlets and a low wave and tidal energy regime. Despite the low average energy, this coast is highly dynamic, changeable, and subject to erosion. In fact, the FDEP has classified about 60 percent of the beaches along the west-central Florida coast as "critical erosion areas." Many have required beach replenishment that has cost tens of millions of dollars. The USGS, in cooperation with researchers from the University of South Florida and Eckerd College, initiated a 5-year program in October 1994 to study these problems. Results of the study are intended to provide information for long-term management and protection of the barrier island and inlet system. The research is divided into studies of the geologic framework of the coast, the oceanographic processes related to sea-level change and coastal sediment transport, and the changes in size, shape, and position of barrier islands and sand bodies on the inner shelf.

By using high-resolution seismic profiling, side-scan sonar surveying, and surficial sediment samples and sediment cores, the USGS and its collaborators are mapping the distribution of sediment on the inner shelf in an attempt to understand the relation between the sediment on the beaches and in adjacent shallow waters offshore. Side-scan sonar mosaics reveal a complex pattern of bottom characteristics and suggest an irregular distribution of sediments. Maps of beach-quality sand north of Tampa Bay have been produced for the U.S. Army Corps of Engineers to help identify potential borrow sites for beach replenishment projects.

Geologic Mapping

The STATEMAP component of the National Cooperative Geologic Mapping Program is a funding vehicle whereby the USGS coordinates a 50:50 (Federal:State) dollar match that, through a competitive proposal process, supports mapping projects by individual State geological surveys. The geologic mapping project products are designed to help resolve issues of ground-water protection, waste-disposal siting, metallic and (or) nonmetallic mineral-resource identification, and land-use planning.

Current projects in Florida involve mapping of near-surface geology in the southern Everglades to assist with future planning decisions regarding the flow and interactions of ground and surface waters.

Topographic Mapping, Digital Coverage, and Earth Observation Data

Among the most popular and versatile products of the USGS are its 1:24,000-scale topographic maps (1 inch on the map represents 2,000 feet on the ground). These maps depict basic natural and cultural features of the landscape, such as lakes and streams, highways and railroads, boundaries, and geographic names; contour lines are used to depict the elevation and shape of terrain. Florida is covered by 1,041 maps at this scale, which are useful for a multitude of technical and recreational applications.

Statewide digital line graph coverages of Public Land Surveys, boundaries, hydrography, and transportation have been prepared under a joint agreement with the FDEP and are available for computer applications. Digitized contour data are available for about one-quarter of the State, and digital elevation models are available for about one-half of the State. In 1996, the USGS and the State of Florida initiated a statewide digital revision program that begins in the panhandle and works eastward.

A statewide coverage of digital orthophotoquads (DOQ's) is the result of agreements with the FDEP, several Water Management Districts, and the National Park Service (NPS). DOQ's are derived from digitized aerial photographs that are corrected for displacement caused by camera tilt and terrain relief. They are becoming increasingly popular as a geographic information systems component, where they are used in combination with vector data. In cooperation with the NPS, the FDEP, St. John's Water Management District and the South Florida Water Management District, the USGS is producing digital raster graphics (DRG's) for the State. A DRG is a scanned image of a topographic map that

retains the positional accuracy of the map in raster format. Recently acquired DOQ images can overlay DRG's to provide new information for revising base maps.

Through its Earth Resources Observation System Data Center near Sioux Falls, South Dakota, the USGS distributes a variety of aerial photographs and satellite image data products that cover the entire State of Florida. Satellite images, which date from 1972, can be used to study changes in regional landscapes.

Hurricane Studies

The destructive forces of hurricanes cause loss of life and property, particularly in coastal areas. USGS scientists currently are developing a new method of forecasting the size and number of national disasters and their attendant losses. The magnitude of future hurricanes is being forecast in terms of fatalities and dollars, as well as by traditional scientific characteristics. Probabilistic estimates of hurricanes in Florida, which were based upon 106 years of observations, indicate that hurricanes with winds equal to or greater than 100 knots occur more frequently in South Florida and gradually decrease toward northern Florida (fig. 3).

Other USGS hurricane-related studies include storm-surge measurements and damage assessment. On October 4, 1995, Hurricane Opal came ashore in the Florida panhandle and caused major coastal damage to a 100-mile stretch of beachfront. This was the second most damaging storm in Florida's history after Hurricane Andrew. In a cooperative effort between the USACE (Mobile, Alabama office) and the USGS (Tallahassee office), storm surges of from 12 to 15 feet above sea level were measured. Although winds reached 117 knots (135 miles per hour), aerial photographs and videos taken by the USGS indicate that most damage was due to surge, rather than to wind.

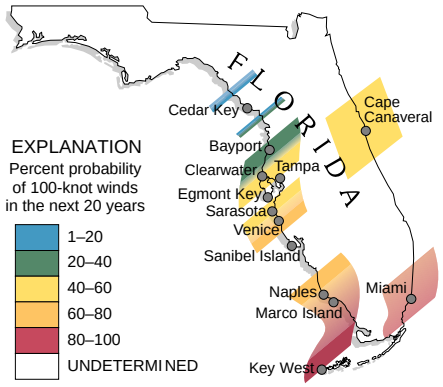

Figure 3. Frequency of hurricanes with wind speeds greater than or equal to 100 knots, mapped in terms of the probability of occurrence during a 20-year period. Areas for which estimates have not yet been calculated are shown in white.

Big Bend Coastal Wetlands

The Big Bend region of Florida includes more than 120,000 acres of undisturbed coastal wetlands (20 percent of all estuarine wetlands along the U.S. coastline facing the Gulf of Mexico). The region includes coastal counties north of Tampa from Pasco to Wakulla Counties, where the population has increased 250 percent in the last 20 years. These wetlands are very sensitive to environmental stresses. For example, sabal palms in these wetlands have been dying, and recent freezes have killed mangroves in the area, which has caused significant alterations of environments. The USGS, in cooperation with the Florida Geological Survey, the University of South Florida, and the University of Florida, is conducting a 5-year study to document the changes of wetlands in this region and to identify the factors that are contributing to losses in wetland area. These cooperative efforts are leading to an understanding and potential prediction of the response of wetlands to sea-level fluctuations and the migration of marshes into upland areas. Wetland areas that have experienced critical change are being identified. Results help in the management of public lands, such as national wildlife refuges and State parks (fig.4).

Figure 4. Typical South Florida Wetland

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Additional earth science information can be found by accessing the USGS Home Page on the World Wide Web at **http://www.usgs.gov/**

For more information on all USGS reports and products (including maps, images, and computerized data), call **1-800-USA-MAPS**

The **USGS** provides maps, reports, and information to help others meet their needs to manage, develop, and protect America's water, energy, mineral, biological, and land resources. We help find the natural resources needed to build tomorrow and supply the scientific understanding needed to help minimize or mitigate the effects of natural hazards and environmental damage caused by natural and human activities. The results of our efforts touch the daily life of almost every American.

U.S. Geological Survey
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