

Kentucky

Black Bear Reintroduction at Big South Fork

Black bears once were present in and around the Big South Fork National River and Recreation Area; however, none remained by the turn of the century. The U.S. Geological Survey (USGS) has embarked on a project to reintroduce black bears into this area along the Tennessee-Kentucky border. In 1996 and 1997, USGS researchers evaluated the effectiveness of different methods for transplanting bears from the Great Smoky Mountain National Park. Eight females and their cubs were removed from winter dens and placed in preselected den sites in Big South Fork. A second set of females and cubs was captured in the summer and released after spending 2 weeks in on-site acclimation pens. Most of the winter transfers resulted in bears establishing home ranges in the new location; summer transfers were less successful. In this group, the bears' powerful homing instincts led several individual bears to attempt returning to the Smokies, placing them at risk and necessitating recapture. The reintroduction pro-



Adult female bears translocated during winter with newborn cubs had significantly higher survival rates and site fidelity than did females released in summer without cubs.



Bear cubs and mothers were removed from winter dens at Great Smoky Mountains National Park and transported as far as 4 miles through the backcountry to vehicles that would take them to Big South Fork National River and Recreation Area, 75 miles away.

gram will continue for 3 years, using the more biologically feasible and cost-effective winter-transfer technique, until a viable population has been established at Big South Fork.

Urban Data-Collection Networks in Kentucky

The USGS, in cooperation with governmental agencies and sanitation districts in three metropolitan areas in Kentucky—Louisville and Jefferson County; Lexington and Fayette County; and the Northern Kentucky

counties of Kenton, Campbell, and Boone—has initiated stream-monitoring programs to obtain hydrologic and water-quality information needed to manage local water resources. Urbanization in these three metropolitan areas is continuing at a steady rate. As land within a watershed is developed, there is, in general, a decrease in the amount of area for the infiltration of precipitation, thus increasing the potential for flooding. Possible consequences include high peak streamflows that occur more often than they might have previously and an increase in the types and amounts of pollutants being transported to the streams.

The objectives of these cooperative stream-monitoring programs are to collect the necessary data, characterize the hydrology and water-quality conditions of streams, assess the effects of point and nonpoint sources of contaminants on streamwater quality, and develop tools needed to formulate strategies for the wise management of the region's water resources. In Jefferson County, the USGS has collaborated with the Louisville and Jefferson County Metropolitan Sewer District to collect rainfall intensity and duration data and continuous streamflow data within selected watersheds to calibrate hydrologic models and verify current model input values. In Lexington, the USGS, in cooperation with the Lexington-Fayette Urban County Government, has established a network of streamgaging stations; data collected from these stations will be used to develop watershed models. The stations also serve as a flood-monitoring network for the Lexington

urban area. The USGS, in cooperation with Sanitation District Number One of Northern Kentucky, has installed four streamgaging stations. Like the networks in Louisville and Lexington, this system of stations will collect the necessary data to support hydrologic and water-quality model calibration and verification requirements.

Environmental Impacts of Coal Use

According to the U.S. Environmental Protection Agency, coal-burning utilities are a major manmade source of mercury in our environment. In addition, the health impacts of arsenic, including arsenic derived from coal combustion, have recently attracted worldwide attention from the biomedical, environmental, and geoscience communities. The USGS Energy Resources Program has been collaborating with State and Federal agencies, universities, and industry to increase the understanding of the distribution of these elements in coal, their behavior during coal cleaning and combustion, and their environmental and health impacts. Future research is intended to address the re-emission into the environment of toxic elements captured on coal combustion products such as flue-gas desulfurization (FGD) sludge. Among the current research activities is a collaborative project with the Kentucky Geological Survey (KGS) to conduct detailed chemical and mineralogical characterization of the feed coal and coal-combustion products (fly ash, bottom ash, and FGD sludge) at a large Kentucky power plant.

FGD is a process that uses limestone, lime, and other industrial minerals to control sulfur dioxide emissions from coal-burning power plants and other facilities. Scientists of the USGS

Mineral Resources Program are initiating work to identify and characterize limestone resources in the Ohio River Valley that are suitable for FGD. Specific activities include determining what characteristics of limestone are most suitable for FGD and the geologic controls necessary to produce this type of limestone, upgrading databases on existing quarry operations, and determining limestone demand by FGD units to meet clean-air standards for the year 2000.

Partnerships of Geospatial Data and Mapping

The USGS has developed a partnership with the U.S. Department of Agriculture and the Kentucky Office of Geographic Information Systems (KYOGIS) to build statewide coverage of digital orthophoto quarter quadrangles (DOQQ's digital, 1-meter, 1:12,000, georectified, black-and-white images produced from National Aerial Photography Program photos). These digital images are the cornerstone of the Kentucky Statewide Digital Basemap initiative, and they are used as the primary ground-truth source for features on the Earth's surface.

An additional partnership supporting the Kentucky Statewide Digital Basemap has been developed between the USGS and the KYOGIS to provide statewide high-resolution coverage of surface-water features. By using geographic information system (GIS) technology, scientists, planners, and government agencies can apply these data to analysis, modeling, forecasting, and problem solving. Issues that may be addressed using GIS technology include environmental concerns, hazard and natural disaster mitigation, and information concerning water as a critical resource.



DOQQ image of Churchill Downs in Louisville.

The Kentucky Statewide Digital Basemap also includes other digital-data themes, such as the digital raster graphics (scanned USGS 7.5-inch quad sheets), digital elevation models, transportation, political boundaries, and geodesy. These datasets are produced using standards compatible with those of the Federal Geographic Data Committee (FGDC). Kentucky is a cooperating partner with the FGDC in building the National Spatial Data Infrastructure. As a consistent, reliable basemap built to known and accepted standards, the Kentucky Statewide Digital Basemap is available to all agencies to use for development of their programmatic applications.

As part of the National Cooperative Geologic Mapping Act of 1992, the STATEMAP Program includes a partnership between the KGS and the USGS to digitize surface geologic information from printed geologic maps. The resulting computer database will be used for spatial analysis of geologic features.

Enhancement of Endangered Mussels in Horse Lick Creek

Freshwater mussel populations in the United States have declined precipitously during this century. Horse Lick Creek, in the Upper Cumberland River drainage basin, is one of the

few remaining streams containing populations of two federally endangered species, the littlewing pearly mussel and the Cumberland bean pearly mussel. The creek also provides a home to four other species of mussel and two species of fish that are considered by the Kentucky State Nature Preserves Commission to be threatened or endangered. Scientists at the Tennessee Cooperative Fishery Research Unit of the USGS in Cookeville, Tenn., have been studying the mussels and fishes of Horse Lick Creek since 1987. The status, distribution, and microhabitat preferences of the two federally listed species and several of the State-listed species have been documented. USGS biologists also have studied the habitat requirements of bottom fishes that serve as hosts for the larval stages of the endangered mussels. The information gathered has helped guide a major effort by the U.S. Forest Service and the Nature Conservancy to preserve and restore the Horse Lick Creek ecosystem. Ongoing USGS studies are directed at developing techniques to culture the endangered mussels in order to enhance local populations. If these efforts are successful, Horse Lick Creek could become a donor source for restoring mussel populations in other streams.

Ground-Water Investigations at Fort Knox

In 1996, the USGS began two investigations in cooperation with the U.S. Army Installation at Fort Knox and with the U.S. Army Corps of Engineers, Louisville District, to provide needed hydrogeologic information and data for the development of wellhead and springhead protection plans. State of Kentucky regulations require that water suppliers develop such plans for the protection of public drinking-water sources. At Fort Knox,



A USGS employee injecting dye into a sinking stream at McCracken Springs.

water managers depend on two sources for their water supplies—the well field in the alluvial aquifer near West Point, Ky., and McCracken Springs in Meade County, Ky.

The alluvial aquifer near West Point is an important water resource, supplying drinking water not only for Fort Knox, but also for Hardin County Water District Number One and the town of West Point. The supply wells for these three systems comprise one of the largest well fields in Kentucky. To provide regional water managers and environmental coordinators the data needed to meet the state regulations, the USGS reviewed published geologic and hydrologic literature pertinent to the area, inventoried and monitored a network of ground-water observation wells, compiled area ground-water pumpage data, conducted a series of aquifer tests, and developed a ground-water-flow model to test hydrogeologic concepts of the flow system. This investigation is intended to provide managers with the information and tools needed to understand the effects of current and future demands on the area's water resources.

At McCracken Springs, the public water supply is potentially vulnerable to natural and induced stresses on the karst aquifer, which is the source of water for the Springs, and to degradation by contaminants introduced by

stormwater entering sinkholes and a large sinking stream in the Springs recharge area. As part of the USGS investigation, ground-water-tracer tests and potentiometric-surface maps were used to identify ground-water basins drained by the major perennial springs and to delineate the approximate boundaries of the recharge area for McCracken Springs. Additional hydrologic data were collected to determine discharge and recharge characteristics of the Springs.

Coal Assessment

The USGS, in cooperation with the KGS, is conducting studies to provide to Federal, State, and local planners information about the distribution and quality of coal, indications of where and when coal reserves will be depleted, and information about how communities, counties, and the State will be affected by the loss of the coal industry. In addition, the USGS and KGS are modeling and developing predictions of coal-quality variations.

The USGS, in cooperation with the KGS, has digitally modeled some of the most productive coalbeds in the Appalachian and Illinois Basins. Five coalbeds (Fire Clay, Pond Creek, Springfield, Herrin, and Baker/Danville) have been modeled. For each coalbed, the original and remaining resources have been estimated, and stratigraphic and geochemical databases and digital maps of the coalbed have been prepared. Potentially hazardous geochemical materials (such as arsenic, mercury, and lead) and ash, sulfur, and calorific values also are being mapped.

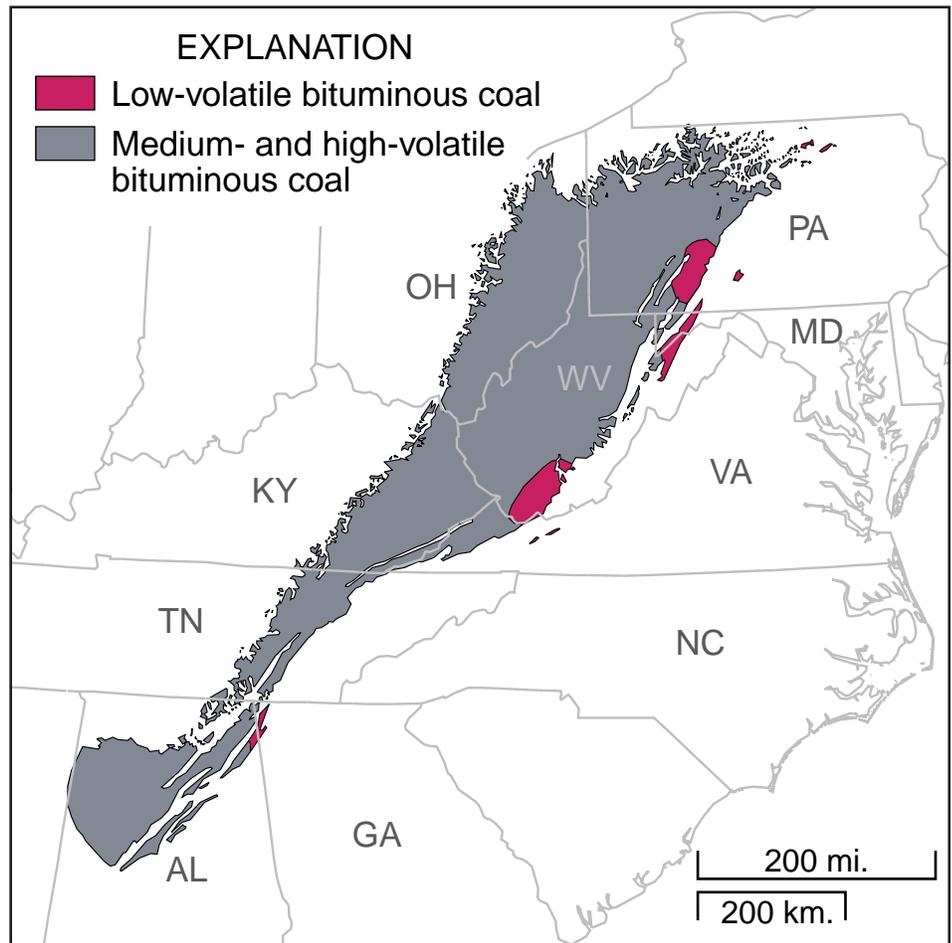
The USGS and 13 cooperating State geological survey offices have developed a systematic national effort, the Coal Availability/Recoverability Studies, to collect, analyze, and depict data that characterize the

relation between restrictions to mining and the potential for development of the Nation's coal resources. The USGS and KGS scientists have collaborated since 1988 to identify restrictions to mining and to determine potential economically recoverable coal. The remaining unrestricted coal in nine study areas in eastern Kentucky that is economically recoverable averages about 8 percent of the original coal in the ground. Initial studies in western Kentucky indicate that there are even smaller amounts of economically recoverable coal in that area.

The USGS, in cooperation with the KGS and the University of Kentucky (Center for Applied Energy Research), is examining coalbeds to document the processes that control coalbed quality. Project personnel do this by examining variations in the organic and inorganic materials of coalbeds. One of the inorganic elements in coal is arsenic. Analyses of arsenic in selected Fire Clay coalbed samples show that arsenic often is present in large pyrite grains. Because the grains are large, they will be removed during coal cleaning, and arsenic will not be released during coal combustion. If the coal-cleaning waste is placed in slurry or spoils ponds, however, it does have the potential to leach arsenic into the environment through the action of the pond water on the pyrite.

Hydrocarbon Exploration in the Appalachian Basin

Most of eastern Kentucky and parts of neighboring States are located in a relatively deep geologic basin in the central and southern Appalachians. The basin has not been tested extensively for hydrocarbons, although it lies within the range of temperatures of oil preservation and is west of potential shale source rocks in the Sevier/Paperville Basin. The USGS is



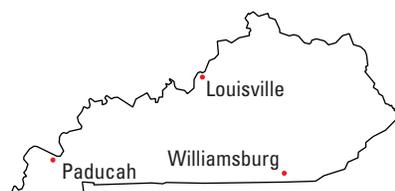
The Appalachian Basin coal region.

investigating the thermal history of the region to estimate the time of fluid generation and migration from the Sevier/Paperville Basin to reservoirs and the geochemistry of potential source rocks. Also, the USGS is

verifying the potential oil and gas possibilities. The goal of the project is to improve the assessment of potential hydrocarbon resources in the deeper, generally unexplored parts of the central Appalachian Basin.

USGS office locations

The USGS has 48 employees in Kentucky



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