Montana

Montana has a wide variety of natural resources. Conflicting demands to develop or preserve these resources result in considerable controversy over resource management policies and decisions. For more than 100 years, the U.S. Geological Survey (USGS) has worked closely with Federal, State, Tribal, and local interests to provide scientific knowledge and understanding of the natural resources of Montana. This information is vital for wise development, management, and protection of those resources.

Abandoned Mine Lands

Many abandoned or inactive mines are on or adjacent to public lands. Wastes from many of these abandoned mine lands (AML) affect resources on public lands. In 1995, an interdepartmental strategy was developed to address the remediation of affected areas on public lands. The strategy uses a watershed approach, and it is focused on developing methods to understand the processes that release and transport acid and metals to streams and the subsequent response of biological communities. The USGS is working closely with the U.S. Forest Service and the Bureau of Land Management to develop efficient and cost-effective methods to evaluate effects and to formulate plans for remediation. A pilot AML study was initiated in 1997 in the Boulder River watershed in southwestern Montana. This watershed was selected by a consensus of State and Federal interests based on existing information from various sources, including the Montana

Figure 1. Tailings deposited in the valley of High Ore Creek in the Boulder River watershed, Montana.

Bureau of Mines and Geology. Premining environmental conditions, current contamination and environmental conditions, and the natural processes that control contaminant transport and fate are being assessed through integrated application of geology, geochemistry, geophysics, hydrology, water chemistry, biology, geospatial analysis, and digital-data collection and management. The assessments are using existing data and new data acquired using traditional and recently developed technologies. Interdisciplinary scientific expertise combined with experience working with organizations at Federal, State, and local levels enables the USGS to make a unique contribution toward remediation of adverse effects of abandoned mines.

In the Boulder River watershed, concentrations of cadmium, copper, lead, and zinc in water and sediment commonly are elevated downstream from three large inactive mines (fig. 1). Although the granitic rocks in the basin contain substantial buffering capacity to neutralize much of the acid generated, metals released from adit drainage and episodic runoff from mine wastes adversely affect water quality, aquatic habitat, and aquatic life within the watershed.

Effects of Whirling Disease on Trout in the Northern Rockies

Whirling disease has severely affected trout populations in Montana. The disease is caused by a parasite that devours the cartilage in the skulls of young trout, causing them to swim erratically and, eventually, die or succumb to predation. Recently, several studies were initiated by USGS scientists with the Montana Cooperative Fishery Research Unit in cooperation with Montana State University, Montana Fish, Wildlife and Parks, and the U.S. Fish and Wildlife Service.

Studies of the effects of whirling disease on brown trout in the Ruby River and Poindexter Slough and on rainbow trout in the Missouri River and its tributaries near Helena are providing key information needed by resource managers to help maintain fish populations. Laboratory studies of whirling disease at the Wild Trout Research Laboratory at Montana State University are analyzing the effects of trout age and parasite dose on development of whirling disease. Young trout, especially those less than 9 weeks old, are most affected by whirling disease, and the severity of disease is directly related to dosage. Thus, increasing the age of the trout at first exposure to the disease, or reducing the number of disease spores, will lessen the disease's impacts.

National Water-Quality Assessment

In 1991, the USGS began a program to assess the water-quality conditions for a large part of the Nation's freshwater streams and aquifers. The overall goal of this National Water-Quality Assessment Program (NAWQA) is to increase the scientific understanding of surface-water and ground-water quality and the effects of human activities and natural factors on water-quality conditions, and to provide information on how those conditions are changing with time. Two studies that include parts of Montana were initiated in 1997 as part of this program. The Northern Rockies Intermontane Basins study includes the Clark Fork-Pend Oreille and Spokane River basins in northwestern Montana, northern Idaho, and eastern Washington. The Yellowstone River Basin study includes the entire basin of the Yellowstone River in Montana and Wyoming.

Water-quality issues for the Northern Rockies Intermontane Basins NAWQA study are trace metals and nutrients in surface and ground water, degradation of water quality in urban and suburban areas, sedimentation, and the effects of these factors on aquatic biota. Water-quality issues for the Yellowstone River Basin NAWQA study are trace elements and toxic compounds in surface and ground water, salinity, sedimentation, and the effects of these factors on aquatic biota. For both studies, a high-intensity phase of data collection will be conducted through 2001 to describe existing conditions, followed by a low-intensity phase to determine trends in water-quality conditions.

Geographic Data Programs and Partnerships

The USGS cooperates with Federal, State, and local agencies to coordinate and share the cost of geographic data production in Montana. In one such agreement with the Bureau of Reclamation, the USGS completed digital scanning of topographic maps statewide. To supplement the scanned topographic maps, the USGS also produced Digital Orthophoto Quadrangles (DOQ's) (fig. 2). DOQ's are scanned aerial photographs that can be loaded into a Geographic Information System (GIS) and used with other data layers for analysis and geographic applications. These data will enable Federal, State, and local agencies to accomplish joint land-management responsibilities.

Figure 2. Digital Orthophoto Quadrangle image.

The USGS will support the Blackfoot Challenge and Missouri Basin projects. Both projects will involve the production of DOQ's and 10-meter Digital Elevation Models (DEM's). DEM's show topographic relief of the landscape. These data will become part of a regionwide assessment that may contribute to a better understanding of the unique recreational, ecological, and historical characteristics of Montana.

The USGS is cooperating with the Confederated Salish & Kootenai Tribes of the Flathead Nation to produce 10-meter DEM's that will aid the Tribes' forestry department in providing timber-sale-contract maps and in determining numerous land-form features.

Sharing Information Resources

The USGS is using advances in technology to obtain scientific information and to share it with a wide audience. Streamflow data are collected by the USGS at more than 200 sites in Montana in cooperation with Federal, State, Tribal, and local agencies. Real-time data for more than 100 of these sites are available on the Internet (fig. 3). Historical streamflow data, some dating back to 1890, for more than 800 sites also are available on the Internet. The real-time and historical data are used by recreationists, resource managers, emergency personnel, and the general public for numerous purposes.

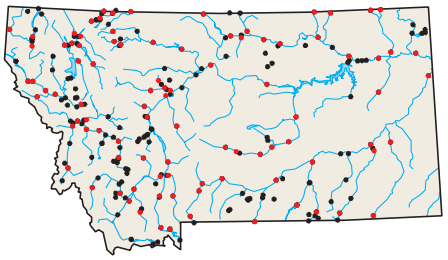


Figure 3. Streamflow monitoring sites in Montana. Sites with real-time data are shown in red.

In partnership with the Montana Geographic Information Council, the Montana GIS Interagency Technical Working Group, the Montana Local Government GIS Coalition, and the Montana Natural Resource Information System, the USGS shares spatial data, provides technical assistance, and helps develop directions for GIS in the future. The USGS also is working with the Greater Yellowstone Area Data Clearinghouse to develop consistent data layers across the region, allow sharing of information, avoid duplication, and focus on common missing data sets. The clearinghouse is at Montana State University, Mountain Research Center.

Greater Yellowstone Ecosystem

The natural resources of the Greater Yellowstone Ecosystem are being threatened by residential growth, commercial development, and recreational activities. Of immediate concern are the unique hot springs of the central plateau, the quality of headwater streams and lakes, and the integrity of regional wildlife populations and biological communities.

USGS scientists, in cooperation with Federal and State biologists of the Interagency Grizzly Bear Study Team, are studying grizzly bears, a threatened species, in the Greater Yellowstone Ecosystem. Scientists are monitoring grizzly survival, reproduction, and habitats using modern techniques and tools, such as global positioning systems, radio telemetry, and DNA fingerprinting, and are studying important foods such as whitebark pine seeds, army cutworm moths, cutthroat trout, and elk and other large animals. Researchers also are evaluating the impacts of human activities on grizzly bears. Research results are important to park managers, State and Federal land managers, the U.S. Fish and Wildlife Service, and the Interagency Grizzly Bear Committee, a coordinating group of State and Federal resource managers. Grizzly bear research and information are essential components of the recovery process.

USGS scientists are coordinating a 5-year program to study the ecology of bison and the role of brucellosis in the Greater Yellowstone Ecosystem. Ecological studies are intended to provide information for the long-term management of bison (fig. 4). Brucellosis research provides key information on the disease, including the methods of transmission between bison, the risk of transmission to cattle, and the safety of livestock vaccines for wildlife species. Updated findings are provided regularly to the Greater Yellowstone Interagency Brucellosis Committee.

Figure 4. Bison in Yellowstone National Park. (Photograph courtesy of the National Park Service.)

The USGS is building a pilot National Geologic Map database at the scale of 1:100,000 for the Greater Yellowstone Area. This is a cooperative effort among the USGS, the National Park Service, the U.S. Forest Service, the States of Idaho, Montana, and Wyoming, and county and local agencies. Geologic map data are being compiled with the aid and cooperation of the Montana Bureau of Mines and Geology. These data will be combined with other spatial databases for wildlife habitat, geologic hazards, and the effect of the rocks, geochemistry, and sources of water upon the fauna of the region and the flora on which many animal species feed. The research will help Federal, State, and local land managers make informed decisions about the environment in their charge.

Natural Resources of Developing Areas

The availability, utilization, and protection of natural resources are of concern in rapidly developing areas of Montana such as Ravalli, Missoula, Lewis and Clark, Gallatin, and Park Counties. In particular, local residents and resource managers are concerned about the availability, quality, and sustainability of the water resource. The USGS is involved in cooperative studies with city, county, and State officials and citizens groups in several of these areas to describe surface-water and ground-water resources and to determine the current and potential effects of development on those resources. State-of-the-art hydrologic techniques are being used to determine ground-water flow paths, interactions between ground water and surface water, ground-water age, and the sources and transport characteristics of potentially toxic chemicals. These studies provide residents and resource managers with the scientific information necessary to make water-development and land-use decisions.

Detailed geologic mapping, conducted by the USGS and the Montana Bureau of Mines and Geology through the National Cooperative Geologic Mapping Program, provides information vital for assessing the potential for, and possible consequences of, mineral- and energy-resource development and the potential for geologic hazards, such as earthquakes and landslides. The geologic mapping also provides information complementary to the hydrologic studies, particularly in Lewis and Clark County. USGS scientists work closely with residents and local groups and agencies to provide data for specific needs or concerns.

The USGS Minerals Program Headwaters Project will provide mineralization, alteration, and geoenvironmental data and interpretations that are essential for effective land stewardship. The project will develop digital geoscience databases applicable to local and regional questions, advance the understanding of mineral resources in a geologic and environmental context, establish geologic context for ecosystem structure and function, and forecast the types and locations of mineral exploration and development.

The USGS, in partnership with the University of Montana, is determining the baseline geochemical characteristics of the Upper Blackfoot River watershed as part of a regional and national geochemical assessment program. The watershed includes the area of a proposed gold mine about 8 miles east of Lincoln near the confluence of the Blackfoot River and Landers Fork. The information will describe the hydrology and geochemistry of surface water, ground water, and sediment. Results to date indicate a significant interaction between surface water and ground water in some reaches of both the Blackfoot River and Landers Fork, which subsequently affects water quality. The chemistry of water in Landers Fork appears to be affected by the ore body, although concentrations of all constituents are relatively small compared to most water-quality standards.

Upper Clark Fork Basin

Water quality in the Clark Fork basin above Missoula has been adversely affected by the mining, milling, and smelting of copper, gold, silver, and lead ores. The waste materials, or tailings, are rich in heavy metals, and have been distributed over extensive areas of the flood plain by several large floods in the 1890's and early 1900's. The tailings are dispersed throughout the channel and flood-plain sediments, and are a source of continued metal loading to the river. As a result, metal concentrations in the river are elevated, have periodically caused fish kills, and have contaminated a public water supply at Milltown. The U.S. Environmental Protection Agency (EPA) and the State of Montana are evaluating remedial alternatives for the entire basin above Missoula. The USGS, in cooperation with the EPA, has monitored water quality in the Clark Fork basin since 1985 and has quantified annual suspended-sediment and trace-metal loads at various locations in the basin in order to identify the most important source areas. Metals in bed sediment and biota also have been monitored since 1986. An investigation of geomorphology, flood-plain tailings (fig. 5), channel migration, and metals transport rates was completed in 1998. Scientific studies of this large, complex hydrologic system provide an understanding of past and present conditions and the knowledge to enable resource managers to make informed decisions regarding large-scale remediation.

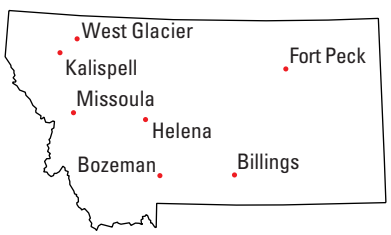
Growth and Survival Temperature Criteria for Bull Trout

Bull trout, in decline throughout the Northern Rockies and Pacific Northwest, recently were listed as a threatened species. The bull trout requires very cold water for survival and growth, but its precise temperature requirements are not known. USGS scientists at the Montana Cooperative Fishery Research Unit recently initiated studies in cooperation with Montana State University and the U.S. Fish and Wildlife Service to determine the water-temperature requirements for bull trout. Laboratory trials at the Bozeman Fish Technology Center will examine the effects of a range of water temperatures—particularly those that might occur during late summer—on the growth rate and growth efficiency of bull trout. The information is important to resource managers involved in bull trout restoration efforts and to industries involved in natural-resource development, such as the timber industry.

Figure 5. Tailings deposit on the Clark Fork flood plain.

USGS office locations

The USGS has 101 employees in Montana



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