USGS
science for a changing world

Integrated Science

Providing a More Complete Understanding of Complex Problems

Integration among sciences is critical in order to address some of our most pressing problems. Because of the inherent complexity of natural systems, and the increasing complexity of human demands on them, narrowly-focused approaches are no longer sufficient.

USGS Workshop on Enhancing Integrated Science, November 1998.

The Mid-Continent Geographic Science Center is actively participating in several integrated science studies that include research partners from the other disciplines of the U.S. Geological Survey (USGS), other Federal and State agencies, universities, and private non-government organizations. The following three examples illustrate the diversity of these studies.

Science to support Adaptive Ecosystem Management in Rehabilitation Projects, Lower Missouri River

The construction of levees, bank revetments, and wing dikes along the lower Missouri River has resulted in a reduction in the quantity (spatial and temporal extent) and quality (species diversity) of its terrestrial and aquatic habitats. Recent efforts to return the river corridor to a more natural condition have included modifications of existing channel control structures, rehabilitation of floodplain wetlands, and construction of side-channel chutes. The success of these and other rehabilitation efforts along the lower Missouri River are dependent on an understanding of the inherent complexity of riverine ecosystems. Questions regarding the interdependence of floodplain hydrology, geology, and ecosystem structure and function are at the cutting edge of ecological research interests, and critically important to refuge managers practicing adaptive management at several sites along the river.

The objective of this project is to evaluate the response of floodplain vegetation to the construction of a side-channel chute by the U.S. Army Corps of Engineers at Overton Bottoms, a unit of the U.S. Fish and Wildlife Service Big Muddy National Fish and Wildlife Refuge. Five interrelated tasks were defined, which included mapping floodplain land cover, evaluating the effects of the chute on ground-water flow patterns, quantifying the response of vegetation to ground-water gradients, and synthesizing the science into adaptive ecosystem management. Scientists at the Mid-Continent Geographic Science Center mapped and analyzed multi-year trends in land cover to determine how vegetation communities have been affected by hydrologic alteration of the Missouri River floodplain at Overton Bottoms. Their results suggested a strong relation between surficial floodplain stratigraphy and the distribution of specific types of floodplain land cover. They also demonstrated that land cover change can be used to monitor land use management strategies and practices, or combined with geologic and hydrologic data to identify sites that are suitable for habitat restoration or rehabilitation.

Lower Missouri River at Overton Bottoms.

USGS scientist collecting data aboard the USGS R/V Slim Funk.

Geohydrological and Biological Investigations Associated with Lead-Zinc Exploration and Mining in Southeastern Missouri

Lead-zinc mining in the Viburnum Trend began in the mid-1960's around Viburnum, Missouri. During the next two decades, 10 mines were opened along the south-trending ore deposit. In response to declining economical ore reserves in the trend, mining companies began to explore for new ore bodies in an area south of Winona, Missouri, and north of the Eleven Point River. This area is in a region highly valued for its scenic beauty and recreational opportunities. It includes two federally designated scenic rivers, the Ozark Scenic Riverways administered by the National Park Service, and the Eleven Point National Scenic River administered by the U.S. Forest Service.

Because of the many environmental concerns associated with lead-zinc mining, the USGS initiated a 5-year integrated study of the possible effects of mining in the area south of Winona and the Viburnum Trend. The Viburnum Trend offers an ideal laboratory for assessing potential environmental effects of mining in the new exploration area because geologic conditions and mining practices in the Viburnum Trend are similar to the conditions and practices in the new area being explored. The investigation includes onsite studies of stream, spring, and aquifer hydrology, field geologic mapping, geochemical research on trace element mobility from mined ore bodies, surveys of stream biological quality and lead accumulation by aquatic biota, and research on the toxicity of lead and other heavy metals to aquatic biota. Scientists at the Mid-Continent Geographic Science Center have conducted a study of the spatial and temporal distribution of trace elements in the sediments of Clearwater Lake. Temporal trends in lead concentrations show relatively little change where no mining has taken place and increasing concentrations where active mining occurs. Analysis of pre- and post-mining concentrations in deep lacustrine sediments shows a doubling of lead concentrations and a nearly 50 percent increase in zinc concentration values from anthropogenic sources. Lead isotopic ratios suggest mixing between lead from surface sedimentary rocks and lead from the mined ore with an increase in the ore lead component over time.

Buick Lead Mine, Viburnum Trend, Missouri

USGS scientists collecting fish using backpack electrofishing gear.

Platte River Priority Ecosystem Study, Nebraska

The central Platte River Valley in Nebraska is an internationally significant staging area for the migratory water birds of the Central Flyway, and is best known for the one-half million Sandhill Cranes and several million other water fowl that migrate annually through the valley. Nine endangered species use the central Platte River Valley, including the Whooping Crane, Piping Plover, and Least Tern. Changes in water and land use have transformed the river channel and altered adjacent wet meadows. With changes in the hydrology of the river and the structure of riparian habitats, the sustainability of migratory and resident birds and other biota have been brought into question. Of central concern is how the ecosystem has adjusted to changes in streamflow. Developing successful strategies to sustain or rehabilitate the riparian ecosystem of the central Platte River requires an understanding of the linkages between hydrology, river morphology, biological communities, and ecosystem processes.

In 1995, a memorandum of agreement was signed by the Secretary of the Interior and the governors of Colorado, Wyoming, and Nebraska to begin developing a basin-wide habitat recovery program for the Platte River. This agreement was implemented by the Platte River Endangered Species Partnership begining in 1997. Major aspects of the program call for the acquisition and restoration of habitat areas, design and implementation of water augmentation and conservation measures, and development of an overall monitoring and research plan to determine the effectiveness of an adaptive management plan. The USGS Platte River Priority Ecosystem Study supports the recovery program by building an

interdisciplinary team to address the overall objectives of 1) providing a better understanding of the migratory and resident birds and other biota and the ecology of their habitats, 2) providing a better understanding of the physical processes that affect the habitats, and 3) using this knowledge to evaluate the effects of different management strategies on individual species and their habitats. Scientists at the Mid-Continent Geographic Science Center have assisted other discipline scientists with the collection and analysis of geographic data and are investigating the geographic linkage of migratory bird energy requirements in the Platte River region. This information will facilitate development of better models that predict the ability of migratory birds to build the energy reserves they require to have a successful breeding season.

Sandhill Cranes in a cornfield, central Platte River Valley, Nebraska.

Aerial view of a portion of the Platte River, Nebraska.

Information

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For additional information, visit the ask.usgs.gov Web site or the USGS home page at www.usgs.gov.

Additional Information

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