Lower Missouri River Ecosystem Initiative FINAL REPORT 1994-1998

Missouri River Manitou Bluffs Region, river mile 142-198, Jefferson City to Boonville, MO

The Lower Missouri River Ecosystem Initiative (LMREI) began in 1994 at the U.S. Geological Survey Columbia Environmental Research Center in Columbia, Missouri. The goal of the LMREI was to partner with others to facilitate the transfer of Missouri River scientific data and other information needed by river management agencies and local, state, and Federal decision makers.

Objectives were to:

1) develop partnerships to facilitate communication and cooperation among agencies and the public,
2) create an information clearinghouse to serve as an access point for data and information,
3) house a geographic information system (GIS) lab to transform data into maps for landscape-scale resource analysis,
4) assist in river monitoring and research projects.

In 1998, the original LMREI ended. Through additional partners, LMREI expanded its focus and was transformed into the Missouri River InfoLINK.

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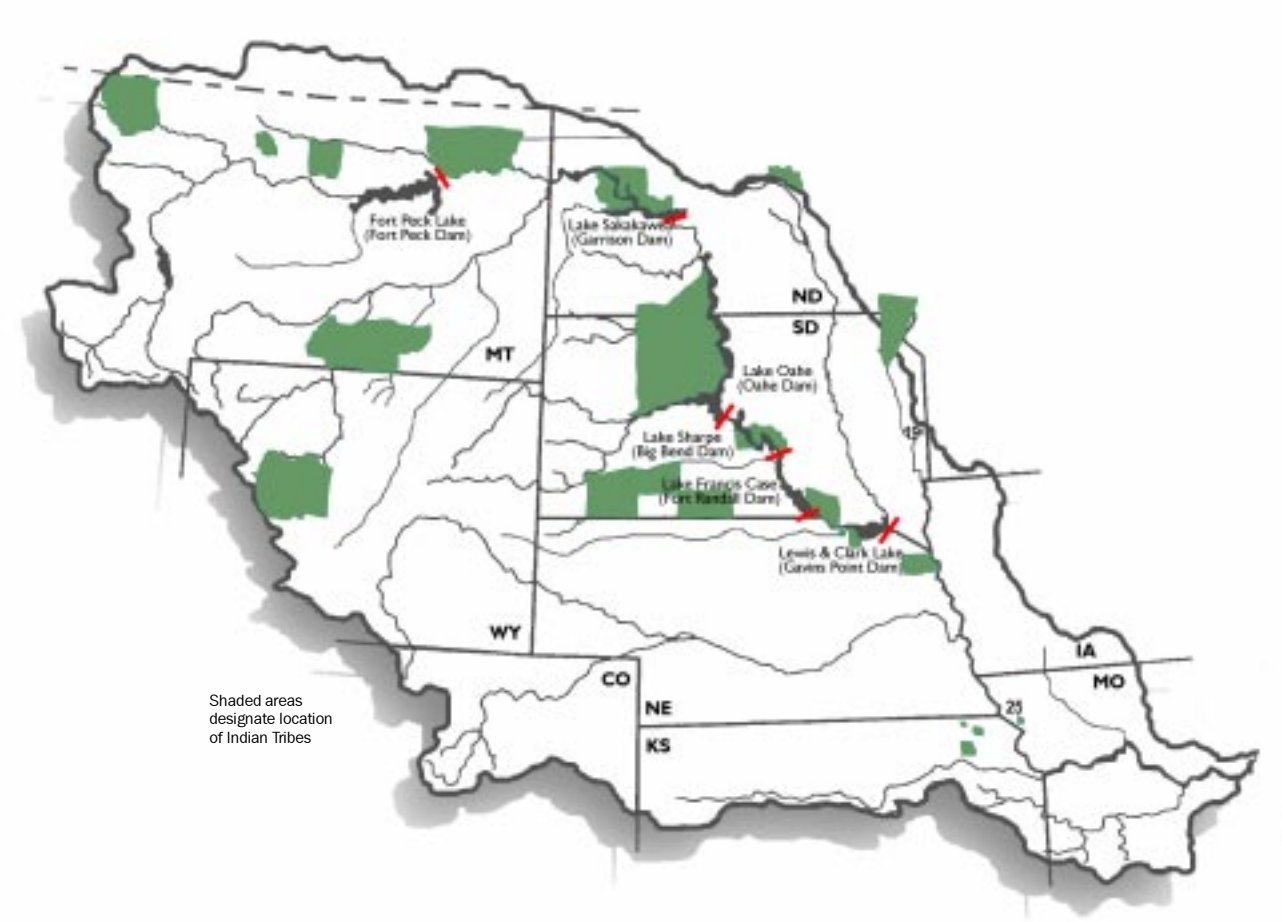
Missouri River Basin



The Missouri River basin drains one-sixth of the United States and encompasses 529,350 square miles with 9,700 square miles in Canada. It flows 2,341 miles from its headwaters at the confluence of the Gallatin, Madison, and Jefferson Rivers in the mountains above Three Forks, Montana, to its confluence with the Mississippi River just north of St. Louis, Missouri.

The basin is home to a total population of 10 million people from 28 Native American tribes, 10 states (Colorado, Iowa, Kansas, Minnesota, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming), and a small part of Canada.

Precipitation in the basin varies from an annual mean of 40 inches in the southeast interior highlands of the Missouri Ozarks to 10 inches in areas of the dry upland plains of North and South Dakota, Wyoming, and Montana. Precipitation deviates widely within each of the physiographic divisions of the basin.

History

Elevation drops from 4,050 feet above sea level in the Rocky Mountains to 380 feet at the confluence with the Mississippi in St. Louis, Missouri.

A century ago, the Missouri River supported one of North America's most diverse ecosystems with abundant braided channels, riparian lands, chutes, sloughs, islands, sandbars, backwater areas and natural flood plain communities. These riverine and flood plain habitats were maintained by a dynamic equilibrium of continuous bank erosion and deposition, which constantly reshaped the channel and flood plain.[9]

The river carried a high sediment load, thus earning the nickname "Big Muddy," and had a propensity for flooding and changing the location of its channel. Typical river flows rose throughout the spring from rain and melting snow runoff, first from the Great Plains and in late June from the Rocky Mountains. Flows declined throughout the summer and fall, reaching their low point in late December.[9]

As European settlement of the Missouri River basin increased in the 19th century, people began attempts to control the river's unpredictable nature and its rich alluvial flood plain for transportation, farming, and urban development. In the 1940's the Pick/Sloan Plan (1944 Flood Control Act) and the Missouri River Bank Stabilization and Navigation Project were created by the U.S. Army Corps of Engineers and the Bureau of Reclamation. The two programs transformed the free-flowing river into a system of main stem reservoirs and highly altered riverine reaches influenced by regulated flows, self-channelization, and bank stabilization.

In addition to the main stem modifications, the river is influenced by an extensive reservoir system in the large tributary basins of the Platte, Kansas, and Osage Rivers; channelization of flood plain tributaries; and levees along the lower river and major tributaries. Not until the late 20th century were these actions recognized as having damaged the river's ecosystem.

The Missouri River is 2,341 miles long and flows through 7 states and a portion of Canada. Its watershed drains one-sixth of the United States.

Lower River Channelization

Indian Cave Bend, Nebraska

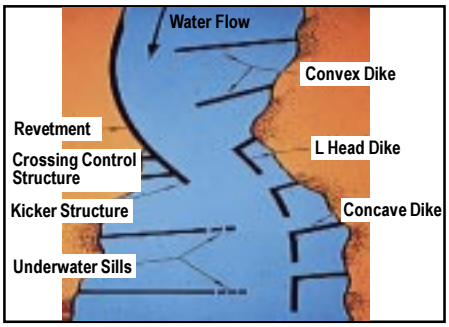
The wide natural river channel before channelization with sandbars, shallow water, and riparian vegetation.

Sediment collects behind wing dikes. The constricted river washes away sandbars and eliminates shallow water habitat.

Land accreted behind the wing dikes is colonized by forest communities.

Forests are removed and accreted land is farmed.

Plans began by the late 1800's to solve the problems associated with bank erosion and sediment transport while increasing viability of navigation on the river. The goal of the *Missouri River Bank Stabilization and Navigation Project* was to create one stabilized channel from the numerous small channels of the natural river. The plan entailed concentrating the water flow and shaping it in smooth easy bends so that the energy of the flowing water scoured out a deeper, more efficient channel.[1]

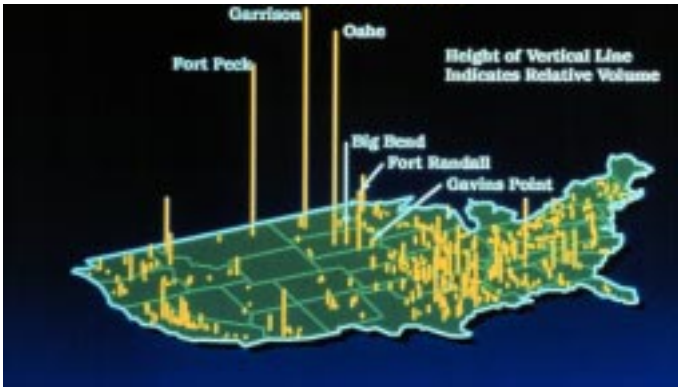


The Rivers and Harbors Acts of 1912, 1917, 1925, 1927, 1930, 1935, and 1945 each affirmed the desire of the flood plain occupants, the basin's elected officials, and the Federal government to harness the natural river for navigation and flood control.[1] Officially completed in 1981, 735 miles of the Missouri River from Sioux City, Iowa, to St. Louis, Missouri were channelized or stabilized.[5]

Upper River Dams

The Missouri River main stem reservoir system, completed in 1967, is the largest system of reservoirs in the United States with a storage capacity of 74 million acre-feet and a surface area of one million acres. The ratio of reservoir storage to annual runoff in this drainage is 3.1 acre-feet of storage for each acre-foot of natural runoff. Six dams were built in the upper basin states of Montana, North Dakota, and South Dakota, submerging about a third of the former river under permanent pools.

The original plan was to collect and store snow runoff and spring rains in the reservoirs to prevent flooding and to provide water for irrigation in the dry upper basin states. Though the irrigation use was never fulfilled, the reservoirs became a source of recreational income for the upper states. Consistent water flow from the dams provides hydropower, navigation, and water supply for municipal and industrial uses downstream.

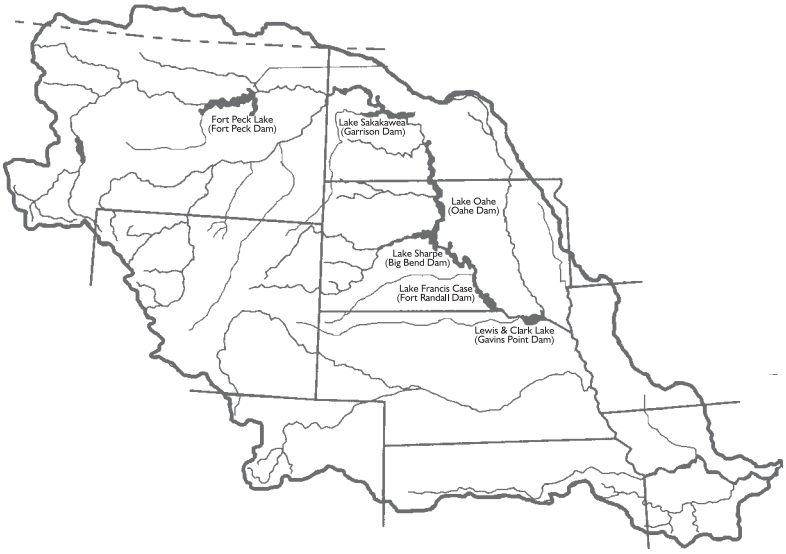


The Missouri River reservoirs are the largest in the United States. This graph demonstrates the relative water storage capacity of all Corps dams.

Fort Randall Dam on Lake Francis Case in South Dakota.

Between 1933 and 1967 six dams were built on the upper river:

- Fort Peck
- Garrison
- Oahe
- Big Bend
- Fort Randall
- Gavins Point



Ecological Results of

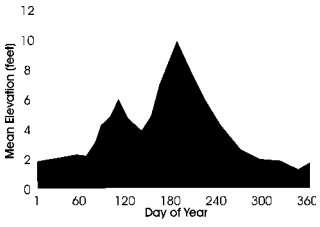
The Missouri River is now considered one of the most highly engineered rivers in the country. Damage to the ecosystem has occurred as a result of changes made by flow regulation, dams and reservoirs, and channelization.

RIVER FLOW

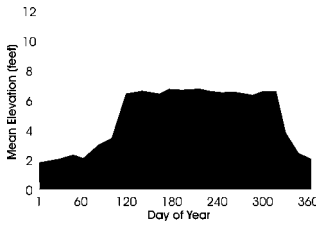
Changes to water flow, especially the suppression of the spring flood pulse, has:

- Caused loss of spawning cues (i.e., warmwater coupled with river stage increases) that triggered spawning activity in native river fish.
- Reduced productivity in the upper river reaches due to altered nutrient transport and cycling. The historical flows introduced detritus and other carbon sources produced on the flood plain and in off-channel wetlands to the river. Such materials are the basis of the food chain and energy flow in large, temperate rivers.
- Prevented seasonal fish and wildlife access to remaining off-channel backwaters and wetlands. Seasonally inundated backwaters and wetlands provide spawning, nursery, and feeding areas for fish and important feeding and breeding habitat for migratory birds and furbearers.[9]

Flow Regime at Omaha, Nebraska



Natural Missouri River Hydrograph



Altered Missouri River Hydrograph

DAMS and RESERVOIRS

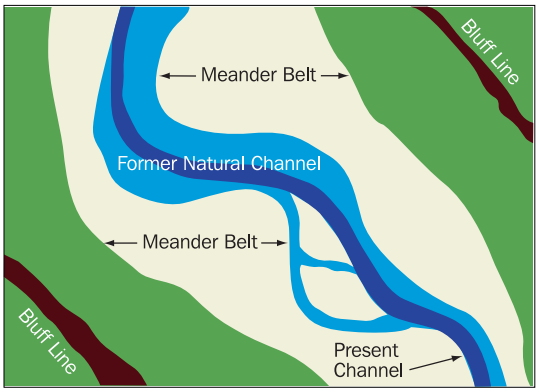
- Converted riverine and flood plain aquatic and wetland habitats to deep water habitats.
- Interrupted sediment and organic material transport, resulting in reduced turbidity, increased bed degradation, and reduced sandbar formation downstream of dams.
- Blocked upstream and downstream fish movements to spawning or foraging areas.
- Created unsuitable temperatures for native warmwater fish spawning and development due to bottom releases from some dams.
- Degraded the river bed in the tailwaters below dams compounding the effects of the loss of high spring flows for recharging wetlands and other off-channel habitats.
- Reduced formation of high elevation sandbar habitat in unchannelized reaches below dams. Vegetation encroachment of remaining high elevation bars has resulted from loss of sediment and scouring flows association with the natural spring flood pulse.[9]

River Control

CHANNELIZATION

From bluff to bluff, the river flood plain below Sioux City, Iowa, covers 1.9 million acres. Historically, the river meandered across more than one-fourth of this flood plain acreage. This "meander belt" contained a variety of fish and wildlife habitats including wetlands, sandbars, wet prairies, and bottomland forests. Seasonal floods provided the water needed to replenish shallow-water habitats used for fish and wildlife breeding and growth. Channelizing and stabilizing the river:

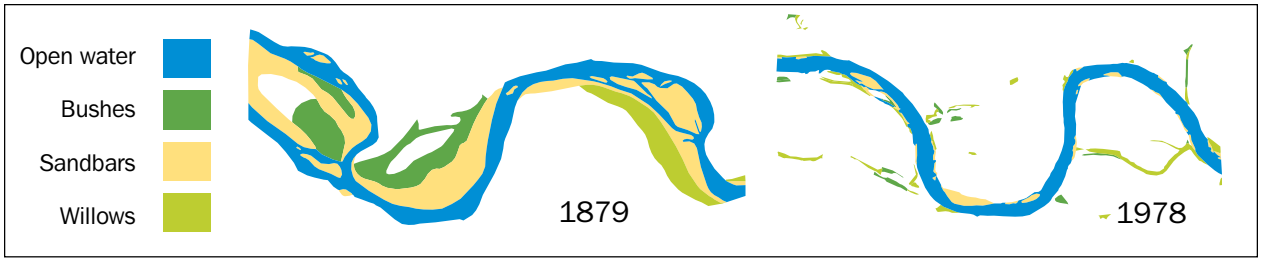
- Resulted in the loss of roughly 168,000 acres of natural channel, 354,000 acres of meander belt habitat, and 50% of the river's surface area.[9]
- Resulted in the loss of shallow-water habitat (0-5-foot depths) by up to 90% in some river reaches and virtually eliminated sandbars and islands, oxbows and backwaters.[9]
- Reduced flood plain forest coverage from 76% in the 19th century to 13% by 1972, while increasing cultivated lands from 18% to 83%.[4]



- Converted nearly 67,000 acres of riverine habitat into primarily privately owned and leveed agricultural land.[9]
- Isolated any remaining wetlands from the river and reduced organic matter inputs needed for fish and wildlife by building levees adjacent to the river for protection from floods.

The damage to fish and wildlife habitat was acknowledged in 1986 when the Corps was authorized to implement the *Missouri River Fish and Wildlife Mitigation Project*. The goal of the project is to acquire and restore 28,000 acres in Iowa, Kansas, Missouri, and Nebraska. This equals approximately 5% of the habitat lost as a result of the Missouri River Bank Stabilization and Navigation Project.

More than half of the historical natural channel and meander belt have been lost as a result of channelization. This is the area most crucial for fish and wildlife habitat.



Loss of habitat over 100 years at Lisbon Bottom, river mile 211-219.

The 1993 Midwest Flood

Jefferson City, Missouri's state capital, during the cresting waters of the 1993 Midwest Flood.

The 1993 Midwest Flood was a hydrometeorological event without precedence in modern times. In terms of precipitation amounts, record river levels, flood duration, area of flooding, and economic losses, it surpassed all previous floods in the United States. During the period from June to

September 1993, record precipitation fell on soil already saturated by previous seasonal rainfall and spring snowmelt, resulting in flooding along major rivers and tributaries in the upper Mississippi River basin.[4]

Following the flood, the President's Executive Office created a Federal Interagency Flood Plain Management Review Committee to assess the causes and consequences of the flood and to evaluate the performance of existing flood plain watershed management programs.[4] The Review Committee published *Sharing the Challenge: Floodplain Management into the 21st Century (Sharing the Challenge)* in June 1994.

Because it had been clear for many years that incomplete and inconsistent collection of data is a severe handicap to developing policy for flood plain management,[5] the Scientific Assessment and Strategy Team (SAST) was established as part of the Review Committee. The SAST developed a major database of flood and basin information at the USGS Earth Resources Observation Systems (EROS) Data Center in Sioux Falls, South Dakota.[4]

Sharing the Challenge recommended establishing a clearinghouse to provide Federal, state, and local decision makers the information gathered as a result of the flood.[4] It also suggested "exploiting science and technology to support monitoring, analysis, modeling, and the development of decision support systems and geographic information systems (GIS) for flood plain activities." The pioneering nature of the SAST effort, and the subsequent use of its products, initiated a scientific foundation for Missouri River management decisions.[5]

National Ecosystem Initiatives

The **Lower Missouri River Ecosystem Initiative (LMREI)** provided a vehicle for fulfilling the scientific information exchange recommended in *Sharing the Challenge* (see previous page). The LMREI was one of 12 ecosystem initiatives selected through a competitive process by the National Biological Service (now the U.S. Geological Survey, Biological Resources Division, USGS-BRD).

The initiatives were created in response to the critical need of assessing the condition of important ecosystems. The overall goal was to provide information, oversight, and coordination that promote a scientifically broad understanding of the biological condition in an ecosystem.

Sharing the Challenge confirmed the need for understanding natural resources as ecosystems: "Ecosystem information is critical for setting resource management objectives, examining alternatives within multiple-use planning, and implementing solutions. Additional uses of this information include scientifically sound input to ongoing flood damage reduction, navigation, private lands, water quality, and watershed programs of other agencies."[4]

The LMREI is located at the Columbia Environmental Research Center (CERC) in Columbia, Missouri, one of four research centers in the central region of the USGS-BRD. The CERC has a national mission of conducting environmental contaminants research and a regional mission of conducting ecosystem science for large rivers and other ecosystems. The LMREI is administered by the CERC Ecogeography Branch and is located in the Environmental Technology Center.

The CERC's 33-acre facility includes a 26,000 sq. ft. building with a wet laboratory; 37,000 sq. ft. of peripheral buildings devoted to aquatic ecology, toxicology, analytical chemistry, landscape analysis, fish culture, library sciences, and conference facilities; 36 small ponds used for investigating relationships between organisms in freshwater habitats; and 3 artificial streams for studying plant and animal communities in flowing waters.

USGS
science for a changing world

The mission of the USGS-Biological Resources Division is to work with others to provide scientific understanding and technologies needed to support the sound management and conservation of our Nation's biological resources and to make the data and information easily accessible to all people.

USGS Columbia Environmental Research Center, Columbia, Missouri, home to the Lower Missouri River Ecosystem Initiative.

Lower Missouri River Ecosystem Initiative

The goal of the Lower Missouri River Ecosystem Initiative (LMREI) is to partner with others to facilitate the transfer of Missouri River scientific data and other information needed by river management agencies and local, state, and Federal decision makers.

The Lower Missouri River was selected because of the:

- Extent of environmental alteration from channelization and resulting effects on ecological processes.
- National importance of the Missouri River ecosystem.
- Impact of flooding on citizens, wildlife, and the economy.
- Need to integrate interstate management efforts.
- Desire to view ecological processes at landscape scales as demonstrated in the products generated by the Scientific Assessment and Strategy Team.

For the past 4 years, the LMREI has provided the following services:

Information Clearinghouse

Serving as a collator of and access point for data and information.

Partnerships

Facilitating communication and cooperation among agencies and the public.

Spatial Analysis

Providing geographic information system (GIS) data for landscape-scale resource analysis.

Monitoring and Research

Assisting with the identification of biological monitoring needs and providing supplemental funding in support of research projects related to the river.

Interior Least Tern

INFORMATION CLEARINGHOUSE

Serving as a collator of and access point for data and information on the Missouri River.

The Missouri River Natural Resources Bibliography

The LMREI identified and listed biological information on the river in a comprehensive *Missouri River Natural Resources Bibliography* with a keyword index. It contains over 2200 basinwide listings.

Missouri River Homepage

To serve as an information clearinghouse for biological information on the Missouri River, the LMREI created a Missouri River homepage located at the Columbia Environmental Research Center:

Missouri River InfoLINK
Internet homepage:

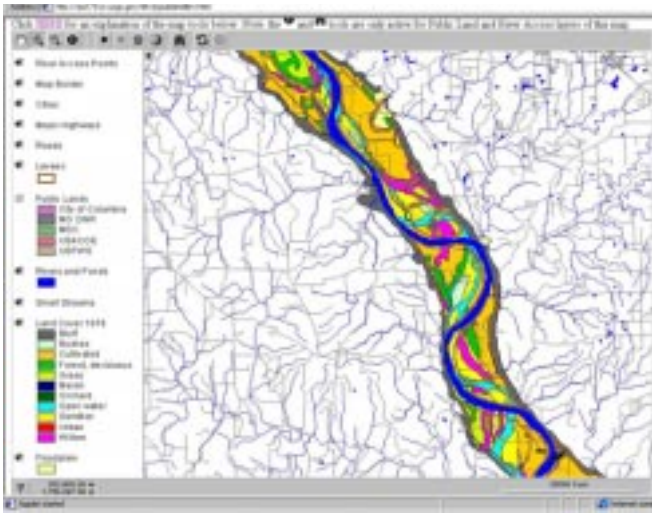
http://infolink.cr.usgs.gov

Homepage Links

- State, Federal and local partners involved in Missouri River natural resource issues.
- Biological data including fish and bird listings, a benthic invertebrate database, and the *Missouri River Natural Resources Bibliography*.
- Maps of spatial data including data collected by the SAST on the 1993 Midwest Flood, an 1879 land cover map from Yankton, South Dakota to St. Louis, Missouri, and Missouri River levees.
- Real time hydrographs of water stages from the Corps of Engineers and USGS.
- CERC's Global Positioning System (GPS) Base Station for use in accurately mapping and determining locations along the river.
- Missouri River events and related points of interest.

Proposed Future Activities: Information Clearinghouse

- Continue and expand information on the Missouri River homepage and the bibliography through the Missouri River InfoLINK.
- Publish a comprehensive *State of the Missouri River* report to be updated periodically and provide the most current scientific information available on the river for use by Federal, state, and local decision makers.



The InfoLINK web page interactive maps provide a visual perspective of Missouri River basin information.

PARTNERSHIPS

Facilitating communication & cooperation among agencies & the public to share information about the river.

The Lower Missouri River Ecosystem Initiative (LMREI) cooperates with other agencies and the public to integrate scientific information with coordinated management of the Missouri River. It provides expertise, funds, and equipment to help a variety of river projects and fosters communication among all river interests.

Missouri River Conference

Over 200 people attended the *1st Annual Conference on the Natural Resources of the Missouri River Basin* held January 14-16, 1997 in Columbia, Missouri. This basinwide conference was organized by the LMREI to bring together diverse public and private river interests to share new scientific research on the Missouri River and discuss management concerns. Co-hosts of the conference were the Missouri River Natural Resources Committee, Missouri River Basin Association, Columbia Environmental Research Center, and Missouri Department of Conservation). Other cooperators in the conference included the U.S. Environmental Protection Agency, Missouri Department of Natural Resources, Natural Resources Conservation Service, and the Missouri Chapter of the American Fisheries Society.

Missouri Resource Assessment Partnership

The Missouri Resource Assessment Partnership (MoRAP) is a collaborative initiative involving nine state and Federal agencies and the University of Missouri-Columbia. Its goal is to develop, analyze, and disseminate high-quality natural resource information at the lowest cost so each partner agency can meet its own goals for natural resource management. MoRAP is co-located at the CERC.

The LMREI coordinates with MoRAP by sharing equipment in the CERC Environmental Technology Center's GIS lab, serving on MoRAP technical committees, and developing and sharing GIS layers such as land cover, stream networks, and historical vegetation of the Missouri River.

Missouri River Natural Resources Committee

The Missouri River Natural Resources Committee (MRNRC) was established in 1988 to seek a system approach to managing the natural resources of the Missouri River; to promote preservation, conservation, and enhancement of the natural and recreational resources of the Missouri River and its flood plain; and to provide coordinated recommendations to appropriate agencies. It consists of representatives from the seven state fish and wildlife management agencies along the Missouri River (Iowa, Kansas, Missouri, Montana, Nebraska, North Dakota, and South Dakota) and ex-officio members from the Corps of Engineers, Fish and Wildlife Service, Western Area Power Administration, and the Bureau of Reclamation.[8] The LMREI coordinated and assisted in the development of the *Missouri River Environmental Assessment Program,* a comprehensive monitoring plan for the river (page 17).

Big Muddy National Fish and Wildlife Refuge

Of the over 500 national U.S. Fish and Wildlife Service (USFWS) refuges, one of the newest is the Big Muddy National Fish and Wildlife Refuge which was established on September 9, 1994. Its purpose is to address the public need to preserve and restore the river flood plain, manage fish and wildlife habitats, and provide for wildlife-dependent recreation. The Big Muddy headquarters is co-located at the CERC.

The LMREI provided GIS analysis and support by creating land cover maps for the Big Muddy Refuge's *Environmental Impact Statement,* digitizing Big Muddy Refuge lands into a public land ownership layer and researching the biological significance of a new chute at Lisbon Bottom, the first such occurrence in the Kansas City to St. Louis reach in several decades (see p. 18).

Environmental Management Technical Center (EMTC) & Midcontinent Ecological Science Center (MESC)

LMREI helped fund EMTC and MESC's development of *Metamaker,* a software application designed to capture information about metadata. Metadata consists of the data, processes, and quality controls used in the development of scientific research, monitoring, or mapping. It provides a history of the process and helps evaluate the usefulness of the information. The Federal Geographic Data Committee implemented standards for metadata and required Federal agencies to follow the standards.

Other Cooperators

The LMREI also coordinates activities with the U.S. Army Corps of Engineers; U.S. Fish and Wildlife Service, Regions 3 and 6; U.S. Environmental Protection Agency, Regions 7 and 8; and U.S. Natural Resources Conservation Service.

Proposed Future Activities: Partnerships

- Continued co-sponsorship of the *Annual Conferences on the Natural Resources of the Missouri River* with the Missouri River Natural Resources Committee and other organizations.
- Continuation and expansion of partnerships including those with the USFWS Big Muddy National Fish and Wildlife Refuge and the Missouri Resource Assessment Partnerships.
- Official designation of the Ecosystem Initiative as a basinwide effort by recognizing that information generated and partnerships developed already include the upper basin.

SPATIAL ANALYSIS

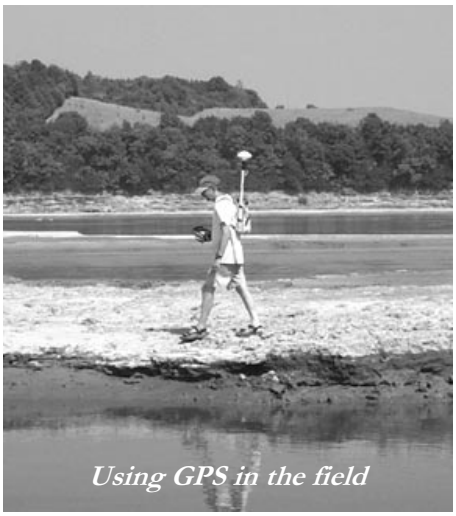
Providing geographic information system (GIS) support for landscape-scale resource analysis.

Geographic Information Systems

Research and management of the Missouri River require an ability to examine patterns and processes over large areas through time. Historically, interpreting these patterns and predicting outcomes were done through a tedious analysis of maps with plastic overlays or analyzing data that had little association to the actual space it represented.

A geographic information system (GIS) is a system of hardware and software, procedures, and data that can be related to a place on the earth and with which analysis can be conducted. A GIS database typically consists of a set of layers, coverages, or themes of data, each of which describes the spatial distribution of some feature or attribute.[5]

The Lower Missouri River Ecosystem Initiative (LMREI) coordinates mapping needs with a variety of partners and works in the CERC's Environmental Technology Center's GIS lab, which has five Unix-based workstations, an E-size color plotter for making large maps, and a digitizer for converting hard copy maps to GIS layers.



Using GPS in the field

Global Positioning System (GPS) base station antenna

GPS field unit

Global Positioning System

To verify map accuracy, Global Positioning System (GPS) technology is used to determine map features and locations in the field. The LMREI established a GPS base station at the CERC to serve as a known reference point. Rover units are used in the field to determine coordinates and the base station is used for differential corrections of field readings. Data from the GPS base station are available on the CERC homepage.

Map Production and Analysis

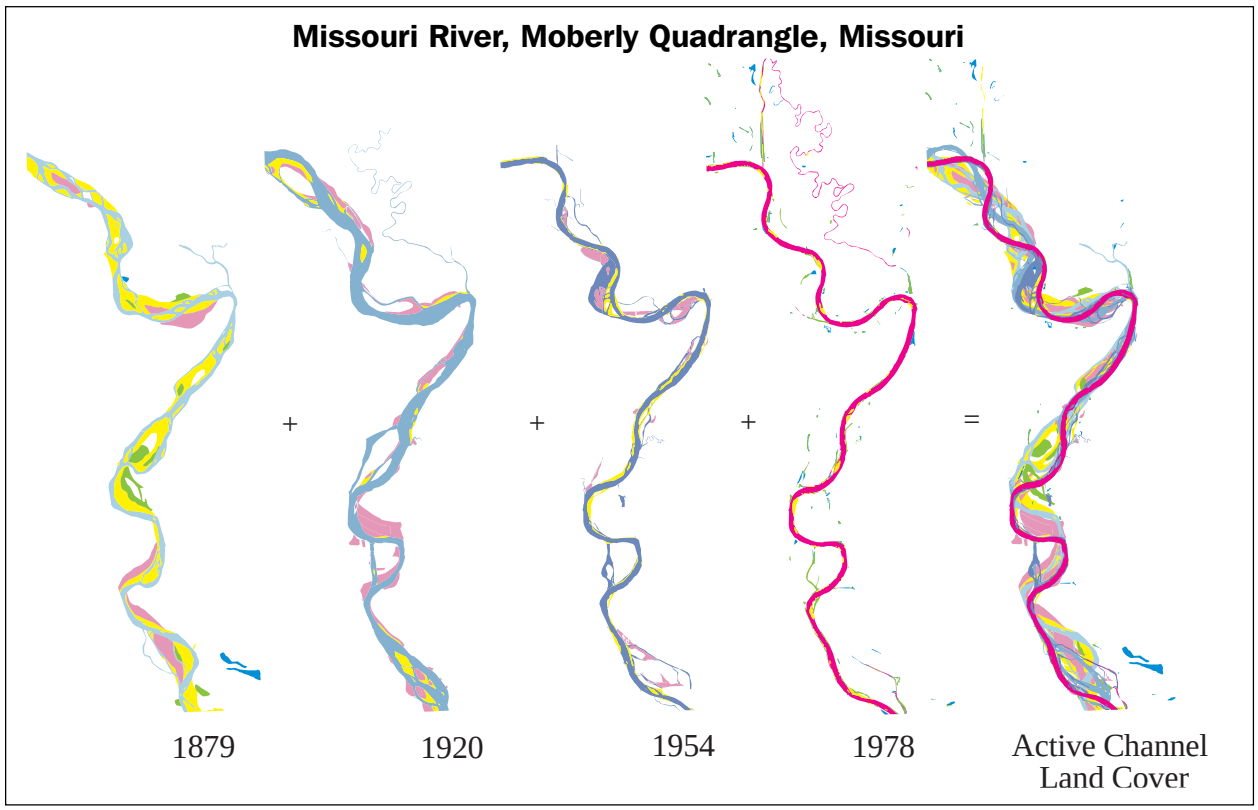
The LMREI added to databases developed by the SAST and continues to convert Missouri River maps into digital representations, including:

HISTORICAL CHANNELS: Maps of the river from 1879, 1920, 1954, and 1980 were individually digitized for the Moberly, Marshall, and Jefferson City quadrangles in Missouri. When the four time periods are overlaid, an "active channel zone" is identified that demonstrates the natural meander belt of the river. By placing the levee coverage over the active channel zone, it becomes apparent which areas may be prone to flooding and channel movement (see below). Development of these maps is a cooperative effort with the Missouri Fish and Wildlife Cooperative Research Unit at the University of Missouri-Columbia.

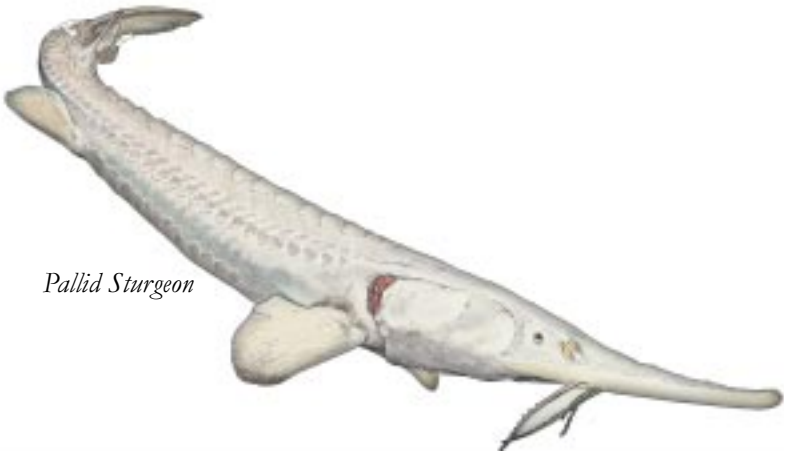
LAND COVER: Land cover for Missouri counties adjacent to the river from Kansas City to St. Louis was developed for the *Environmental Impact Statement* of the USFWS Big Muddy National Fish and Wildlife Refuge. The maps show the current land cover of forest, agriculture, water, wetland, and urban area with the highways and flood plain delineated.

Proposed Future Activities: Landscape Analysis

- Expand upon the LMREI's ability to produce GIS maps for clients, develop new maps, and make the maps available to the public through InfoLINK.
- Model and predict flood plain changes and link the physical and chemical changes to biological responses.



Historical channels overlaid to define an Active Channel Zone, visually demonstrating which areas may be prone to flooding



Pallid Sturgeon

Historical Pallid Sturgeon Distribution

Knowing where pallid sturgeon have been found in the past is important in restoration efforts and implementing a recovery plan. Using Missouri River Division, Corps of Engineers data, the LMREI prepared a map showing the historical distribution of this endangered fish that is being used in the CERC's current research on pallid sturgeon movement, distribution, and habitat requirements (see page 18).

Publicly Owned Land

After the Flood of 1993 and *Sharing the Challenge* was published, it became apparent that purchasing some highly damaged flood plain lands from willing sellers would save taxpayers' money while providing needed fish and wildlife habitat. For example, in Missouri, three Federal agencies, the Corps of Engineers (COE), U.S. Fish and Wildlife Service (USFWS), and Natural Resources Conservation Service (NRCS), and one state agency, Missouri Department of Conservation (MDC) are cooperating to purchase various parcels from willing sellers. A GIS map of public lands was created to facilitate the tracking of purchases and to provide a base map for future management activities. Development of this map was in collaboration with Lincoln University, Jefferson City, Missouri, and with the cooperation of the MDC, COE, and USFWS.

Hydrographic Survey

The LMREI is converting the COE 1994 Missouri River Hydrographic survey from CAD to GIS format. The data cover the river from Rulo, Nebraska, to St. Louis, Missouri. The data will be used by MDC to evaluate catfish sampling design using wing dam and revetment information and as a base for the collection of Missouri River bathymetry supporting the CERC pallid sturgeon research (see page 18).

Flood plain Geomorphology

The LMREI is converting 1993 post-flood Missouri River scour hole (blue hole) bathymetry collected by the NRCS from CAD to GIS format. The data will be used by MDC and the Missouri Cooperative Fish and Wildlife Research Unit to evaluate the longevity of these off-channel habitats as part of a multiyear investigation into the benefits of habitats created as the result of the 1993 flood.

Hydrography

The LMREI is developing a hydrography layer (stream network) covering the Missouri River and the major tributaries from Yankton, South Dakota to St. Louis, Missouri for use by the USFWS.

MONITORING & RESEARCH

Assisting with the identification of biological monitoring needs and providing supplemental funding in support of research projects.

Research and monitoring provides information used to make complex management decisions on the river. The LMREI was involved in determining future monitoring needs and conducting specific research projects.

The need for a comprehensive environmental monitoring plan for the Missouri River was recommended in *Sharing the Challenge,* by the Missouri River Natural Resources Committee (MRNRC) in its 1995 Annual Report and by the Missouri River Basin Association, a quasi-governmental policy body represented by the states of Iowa, Kansas, Missouri, Montana, Nebraska, North Dakota, South Dakota, and the Mni Sose Intertribal Water Rights Coalition representing 26 Indian tribes.

In 1996, the USGS-BRD State Partnership Program provided financial assistance to the CERC and MRNRC to develop the blueprint for such a monitoring plan, referred to as the *Missouri River Environmental Assessment Program.* A series of meetings began in late 1996 with a representative group of resource managers from the entire basin, many of whom are members of the MRNRC.

The *Missouri River Environmental Assessment Program* will be especially useful for recovered flood plain lands that are managed for the benefit of the overall Missouri River ecosystem. It will take careful observation of the natural processes at work to determine how to manage these areas within the confines of the modern world. This multiyear proposal was completed in 1998.

Missouri River Environmental Assessment Program

GOAL - To provide the scientific basis for optimum management of the Missouri River's mainstem and flood plain fish and wildlife resources while avoiding or minimizing conflicts with other river uses.

Characteristics

- Focus on operation and maintenance (O&M) of the river.
- Assess biological, chemical, and physical responses to changes in O&M.
- Inventory biological, physical, and chemical habitat.
- Use and build upon existing data, studies, and sampling protocols.
- Develop (or adopt) and apply standard methods.
- Conduct sound scientific studies designed to meet the Program's objectives.

Objectives - *to understand and predict:*

- Species, community, habitat, and water quality response to different flow regimes, including intrasystem regulation.
- Biological response to structure addition, modification, or removal.
- Impact of physical changes due to aggradation (sedimentation) in the upper reaches of reservoirs and degradation (incision) below the dams on biota and habitat.

Proposed Future Activities: Monitoring & Research

- Conduct and support basinwide research that leads to a better understanding of the impacts of river modification on native biota.
- Integrate the *Missouri River Environmental Assessment Program* process into research capabilities at the CERC.

Pallid Sturgeon Research Project

The pallid sturgeon was listed as endangered in 1990, but management of recovery efforts has been hindered by the lack of information on its habitat needs. The CERC is conducting a three-part research project to facilitate management decisions by conducting early life history, juvenile behavior, and food habits lab studies; studying movement and habitat use with telemetry and bathymetric equipment in the river reach between Jefferson City and Glasgow, Missouri; and assessing fish populations and reproduction status.

The LMREI contributed to the project by providing a historical map of pallid sturgeon distribution and funds to purchase bathymetric equipment for mapping and sonar transmitters to track fish movement.

Field investigations into the naturally formed chute at Lisbon Bottom, a unit of the Big Muddy National Fish and Wildlife Refuge south of Glasgow, Missouri, help researchers understand the physical, biological, and chemical relationships in the complex Missouri River ecosystem.

Lisbon Bottom Chute Research

Almost 2,400 acres of the Lisbon Bottom have been purchased for the USFWS Big Muddy National Fish and Wildlife Refuge. The CERC scientists are evaluating a newly formed chute on Lisbon Bottom and its effect on aquatic and terrestrial biota. The LMREI partnered with the USFWS by providing funds for the study and mapping the area.

Other related research

Benthic Invertebrate Study

The CERC is currently conducting a study to characterize critical habitats for aquatic macroinvertebrates in the lower Missouri River. This research will also evaluate sampling methodologies for macroinvertebrates in large rivers and was initiated as a component of the Biomonitoring Environmental Status and Trends (BEST) program. The LMREI provided funding to complete the work.

Post Flood Evaluation

The MDC and NRCS coordinated a major research effort on the lower Missouri River after the 1993 flood. Many agencies are involved in collecting data associated with the new wetlands and scour holes created from that event. The LMREI provided staff to complete basin morphometry mapping for this project.

The Future


View from Jefferson City, Missouri

The Lower Missouri River Ecosystem Initiative (LMREI) started the process recommended in *Sharing the Challenge: Floodplain Management into the 21st Century* of using science and technology to its full advantage in gathering and disseminating critical resource management information.[4]

The LMREI served as a clearinghouse, making available scientific information for resource managers and policy makers. It is appropriate for the LMREI to be housed in the USGS, which has provided valuable information about earth sciences to guide resource management decisions in the United States for over a hundred years.

There is still much to be done. The *Annual Conferences on the Natural Resources of the Missouri River* are an initiation for many people who are unfamiliar with viewing the river in a broad scientific context. People need additional opportunities through workshops and information to understand the river system and how individual river interests can all find a place in future river management.

The partnerships developed in the past 4 years are an excellent start in communication; additional people from both the public and private sectors need to be included. The geographic information system (GIS) data being collected and analyzed are crucial to the river management community for use in decision making. The *Missouri River Environmental Assessment Program* will ultimately provide many of the scientific answers needed to restore the ecosystem in balance with human uses.

The unique timing of the LMREI's creation positioned it to begin implementing recommendations in *Sharing the Challenge*. It is hoped the LMREI can continue to support research and information dissemination on Missouri River ecosystem problems and issues related to the operation and maintenance of the system. The research will provide local, state and Federal entities the information needed to make informed management decisions about the future of Missouri River.

Acronyms

BRD: Biological Resources Division
CERC: Columbia Environmental Research Center
COE: U.S. Corps of Engineers
EROS: Earth Resources Observation Systems
LMREI: Lower Missouri River Ecosystem Initiative
MDC: Missouri Department of Conservation
MoRAP: Missouri Resource Assessment Partnership
MRBA: Missouri River Basin Association
MRNRC: Missouri River Natural Resources Committee
NRCS: Natural Resources Conservation Service
SAST: Scientific Assessment and Strategy Team
USFWS: U.S. Fish and Wildlife Service
USGS: U.S. Geological Survey
USGS-BRD: U.S. Geological Survey - Biological Resources Division

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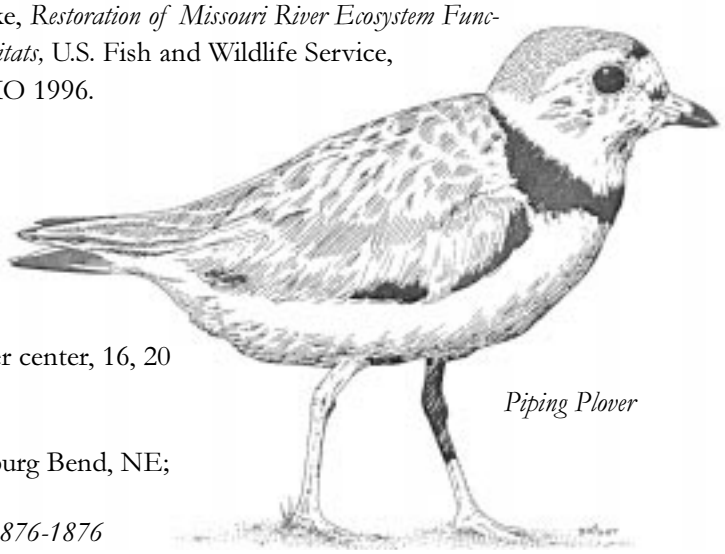

Piping Plover