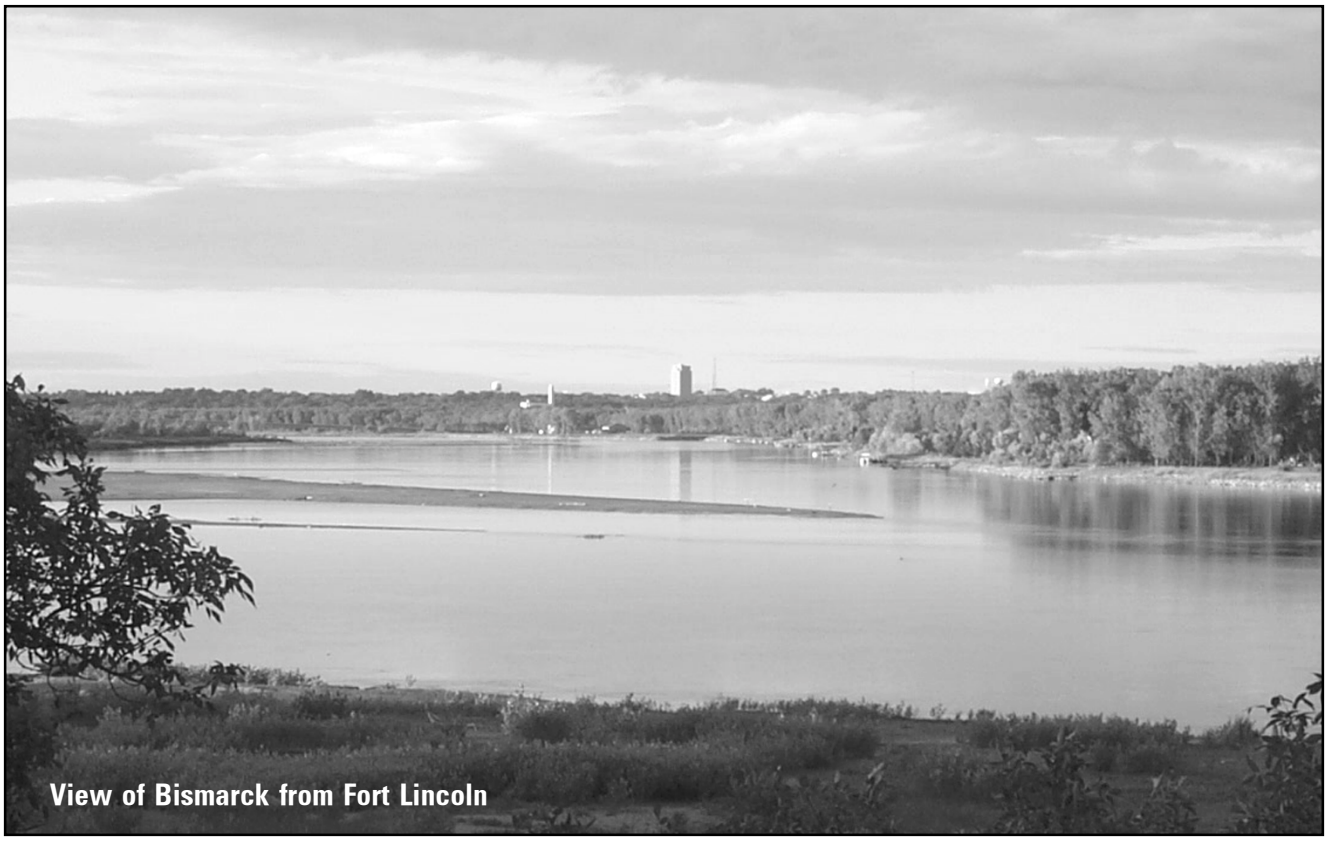
Missouri River Management: It's Everybody's Business

May 21-24, 2000
Radisson Inn
Bismarck, North Dakota

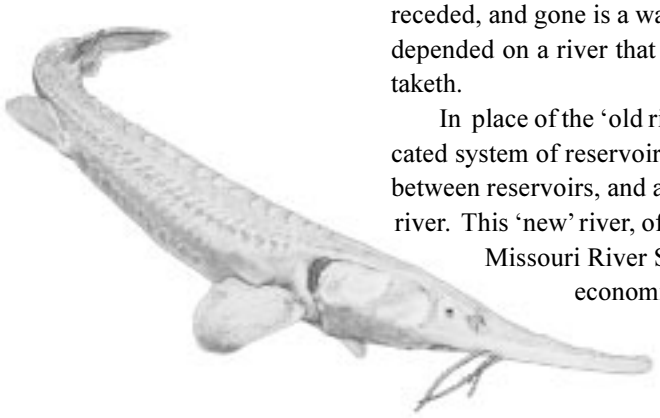


View of Bismarck from Fort Lincoln

The Missouri River represents many different things to different people. To some it is a link to the past, to others, a conduit to the future. Despite differing perspectives, most of us value it for both its history and promise.

There are two stories of the Missouri River: one, a rich past before channelization and impoundment, the other a reflection of our society fitting the river to benefit the needs of a growing population. The characteristics of the river are a far cry from what once dubbed the Mighty Mo, the Big Muddy, and the Old Missury. Gone is the highly unpredictable nature of a dynamic river, gone are the murky waters that coated the flood plain with mud when spring flows receded, and gone is a way of life that depended on a river that both giveth and taketh.

In place of the 'old river' is a complicated system of reservoirs, river reaches between reservoirs, and a highly channelized river. This 'new' river, often termed the Missouri River System, has been an economic windfall for the citizens of the United States. With an annual worth of approximately $1.7 billion, the Missouri River System now provides flood control protection for millions of people, cheap hydropower for residents of the northern and central plains, a thriving water-based recreation industry, and a dependable water supply to serve the fancy of a thirsty society. Conversion to a 'new' river was costly, however. Over a million acres of former river valley were permanently inundated with the creation of the 6 mainstem dams. Furthermore, some native species lost the attributes of a river in which they evolved and thus have become increasingly rare.



PROGRAM CONTENTS

CREDITS:
Nebraska Game and Fish Department: photos/graphics page 1, 10, 13, 38, 50. USGS: all others.

As it is throughout the basin, the form and function of the Missouri River changed dramatically in North Dakota during the 20th century. Lake Sakakawea, 80 miles north of Bismarck, captures a vast expanse of water as the river exits Montana. Most years, there is enough water stored in Lake Sakakawea to flood all of North Dakota with six inches of water. There are enough miles of shoreline surrounding Lake Sakakawea to equal the perimeter of North Dakota plus 200 miles to spare.

For the most part, the Missouri River has surrendered its muddy waters and in its place are clear, cool waters that support exceptional fisheries. For example, over 5,000 hours of fishing per river mile occur on the Missouri with a harvest of more than 2 tons of walleye per river mile in certain areas. Strangely, despite these changes to the river, North Dakota still has some of the best natural river habitat left throughout the entire Missouri River System. The Missouri and Yellowstone Rivers above Williston still function to a large degree as wild rivers and are home to some of the largest populations of pallid sturgeon and paddlefish found anywhere.

The debate to 'do right' by the Missouri River will never go away; controversy concerning the future of the river predates the time when Pick met Sloan. Conflicting interests will continue to fuel the controversy surrounding the management and operations of the Missouri River. Regardless of where the debate takes us, one thing is for sure: "Missouri River Management: It's Everyone's Business."

Only through listening and conversing with individuals of different backgrounds will we be able to move forward and meet both present and future challenges. On behalf of the Conference's Steering Committee, welcome to North Dakota and welcome to Bismarck. We hope you enjoy the Conference and leave understanding a little more about the different perspectives than when you arrived. Please feel free to contact person wearing a "Host" or "Steering Committee" ribbon with any question that may arise.

Greg Power
Steering Committee Chair

Conference Overview

Noon - 6:00 p.m.	Registration - *Radisson Courtyard*	**SUNDAY, MAY 21**
	Exhibit and poster set-up - *Patterson/Lamborn Ballrooms*	
	Self-guided tours - *maps available at registration*	
5:15 p.m.	Moderators meeting - *Radisson Courtyard*	
6:00 - 9:00 p.m.	**Social** - *aboard the Lewis and Clark Riverboat* and *at Meriwether's Restaurant*	
7:00 a.m. - 5:00 p.m.	Registration - *Conference Center in front of Ballrooms*	**MONDAY, MAY 22**
7:00 a.m. - 8:00 p.m.	Posters and exhibits displayed - *Patterson/Lamborn Ballrooms*	
8:00 a.m. - 11:50 a.m.	**Missouri River in North Dakota** - *Grand Pacific Ballroom*	
Noon - 1:30 p.m.	Lunch (on your own)	
1:30 - 4:40 p.m.	**Basinwide Perspectives** session - *Grand Pacific Ballroom*	
2:00 - 5:00 p.m.	MRNRC Wildlife Technical Committee - Governor's Room	
5:30 - 8:00 p.m.	**Poster session and social** featuring Native American singers and dancers and a flute performance by Keith Bear - *Patterson/ Lamborn Ballrooms*	
8:00 - ?	Dinner - on your own	
8:00 - 10:00 a.m.	**Flood Plain Management** session - *Grand Pacific Ballroom*	**TUESDAY, MAY 23**
10:30 - Noon	**Local Flood Plain Development** session - *Grand Pacific Ballroom*	
Noon - 1:15 p.m.	Lunch with Robert Schneiders, author of *Unruly River,*	
	Courtyard	
1:15 - 2:35 p.m	**Concurrent paper presentations** - *Heart (Session A) and Sheyenne/Cannonball Rooms (Session B)*	
Afternoon	Main Stem Missouri Ecosystem Team - *Room 3160*	
2:00 - 5:00 p.m.	MRNRC Tern/Plover Technical Committee - *Room 2160*	
2:45 - 6:00 p.m.	**Field trips** - *Meet at Door #4*	
6:00 - 9:00 p.m.	**Pitchfork Fondue** - "The Post" north of Fort Lincoln on Route 1806	
8:00 a.m. - Noon	**Concurrent paper presentations** - *Heart (Session A)* and *Sheyenne/Cannonball Rooms (Session B)*	**WEDNESDAY, MAY 24**
Noon	Conference adjourns	
Noon - 5:00 p.m.	Missouri River Roundtable - *Cannonball Room*	
1:30 - 5:00 p.m.	Missouri River Benthic Fishes Study - *Room 2160*	
8:00 a.m. - Noon	Missouri River Roundtable - *Cannonball Room*	**THURSDAY, MAY 25**

SCHEDULE

SUNDAY, MAY 21

Noon - 6:00 p.m. **Registration -** *Radisson Courtyard*

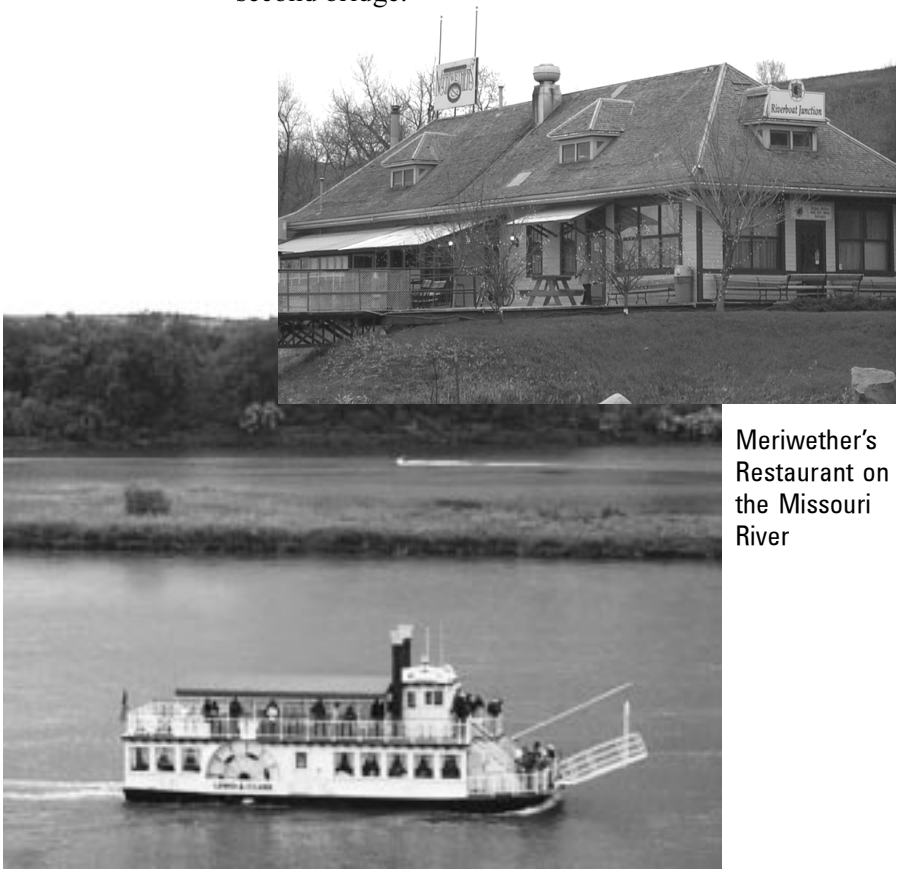
Posters and Exhibits Set-up
Patterson/Lamborn Ballroom

5:15 p.m. **Moderators Meeting -** *Radisson Courtyard*

All day **Self-Guided Tours**
Maps will be available at registration desk.
(Descriptions on page 5)

6:00 to 9:00 p.m. **Social -** *aboard the Lewis and Clark Riverboat* and at *Meriwethers' Restaurant*

Directions to the Social: Go south from the Radisson on 3rd to Bismarck Expressway, turn right. Go about 3/10 mile, turn right at light onto Washington Street. Go 3/10 mile, turn left at next light onto West Arbor Ave. West Arbor will turn into Riverside Park Road, continue for 2.10 miles passing under one bridge. The Port and Meriwether's is under the second bridge.



Meriwether's Restaurant on the Missouri River

Self-Guided Tours

Bird's Eye View of Bismarck

From the *University of Mary* see a view of the Missouri River including the cities of Mandan and Bismarck and the riparian areas along the river corridor.

Double Ditch affords a view atop a historic Indian village to see homes in the flood plain, irrigation activities, and sandbars. Complex management issues abound.

Development

Fox Island Housing Development is built on a former island-slough in the flood plain. This development and plans for others along the river affect options for managing the river.

Petroleum Refinery

Located next to the river, the *BP Amoco Refinery* was built in 1954 and refines up to 60,000 barrels of crude oil a day (roughly half of all North Dakota's crude oil production). One third of the refinery's 960 acres are used for storage tanks; the remaining 640 acres are dedicated to wastewater treatment and wildlife conservation.

Municipal Water

The Missouri River flows pass the *Bismarck-Mandan* city intake pumps at an average of 22,000 cubic feet per second. Bismarck removes 9.6 million gallons per day on average, peaking at 25 million gallons. Winter rates average 6.5 million gallons per day and, during the summer, 16 million gallons. Average use in Mandan is 3.5 million gallons per day with 2 million gallons in winter and 6.5 million gallons in summer.

Conservation Properties

The 3000 acre *Cross Ranch,* 29 miles north of Mandan on scenic Highway 1806, was purchased by The Nature Conservancy to address the loss of bottom land forests.

Fort Lincoln, just south of Tuesday night's Pitchfork Fondue at "The Post," is managed for historical preservation and recreation. It includes On-A-Slant reconstructed Mandan earthlodge village, Fort McKean infantry post, and George Armstrong Custer's calvary post.

Lewis and Clark Interpretive Center

Located 35 miles north of Bismarck at Washburn on the Missouri River, the Center chronicles the entire Corps of Discovery journey. Artwork by Karl Bodmer depicts Plains Indian life and landscapes along the Missouri River. A mile and a half west of the Interpretive Center is the reconstructed Fort Mandan which replicates the quarters of the Expedition in 1804-5.

North Dakota Heritage Center

Located on the Capitol grounds, the Center features outstanding museum exhibits on North Dakota history and prehistory, videos, archives, and a gift store. The Center houses one of the largest collections of Plains Indian artifacts in the Nation.

SCHEDULE

MONDAY MAY 22

REGISTRATION
7:00 a.m. to 5:00 p.m.

EXHIBITS & POSTERS
Patterson/Lamborn Ballrooms
7:00 a.m. - 8:00 p.m

Paper Descriptions pages 14-22

THE MISSOURI RIVER IN NORTH DAKOTA

Grand Pacific Room 8:00 a.m. - Noon

Moderator: Greg Power, North Dakota Game and Fish Department

8:00 **Welcome.** Bill Sorenson, Mayor of Bismarck

Dean Hildebrand, Director, North Dakota Game and Fish Department, Bismarck, ND

8:30 **Geology and Paleontology Along the Missouri River Corridor in North Dakota.** John W. Hoganson, North Dakota Geological Survey, Bismarck, ND

9:00 **Prehistoric Archaeology of the Missouri River in North Dakota.** J. Signe Snortland, U.S. Bureau of Reclamation, Bismarck, ND

9:30 **The Damming of the River: A Cultural Change.** Gerard Baker, National Park Service, Sulphur, OK

10:00 **BREAK**

Moderator: Jeanne Heuser, U.S. Geological Survey

10:30 **The Missouri River and the Environmental Movement: Some Notes on History.** Mark Harvey, North Dakota State University, Fargo, ND

11:00 **Wildlife Resources Along the Mighty Missouri: Then and Now.** Randy Kreil, North Dakota Game and Fish Department, Bismarck, ND

11:30 **Missouri River in North Dakota, Current Uses and Issues.** Todd Sando, North Dakota State Water Commission, Bismarck, ND

Noon - 1:30 p.m. **LUNCH on your own**

BASINWIDE PERSPECTIVES

Grand Pacific Room 1:30 p.m. - 4:40 p.m.

Moderator: Mike Olson, U.S. Fish and Wildlife Service

1:30 *The Corps of Engineers: Ever-Changing Role with the Missouri River.* Marie Vanderpool, Army Corps of Engineers, Kansas City, MO

1:50 *Mni Sose Intertribal Water Rights Coalition's Role in the Management of the Missouri River.* Richard Bad Moccasin, Mni Sose Intertribal Water Rights Coalition, Rapid City, SD

2:10 *Missouri River InfoLINK: Making Science Available to the Public.* Jeanne Heuser, U.S. Geological Survey, Columbia, MO

2:30 *Restoring the Natural Range of Missouri River Flow Variability to Benefit Declining Species.* David L. Galat, USGS Cooperative Fish and Wildlife Research Unit, Columbia, MO

MONDAY MAY 22

2:50 **BREAK**

Moderator: Peter Ismert, U.S. Environmental Protection Agency

3:20 *Discover a Watershed: The Missouri Project, A Watershed-wide Approach to Public Education.* Dennis Nelson, Montana State University, Bozeman, MT

3:40 *Consortium of Missouri River Institutes: An Intercollegiate Research and Educational Initiative for the Missouri River Basin.* Tony Prato, University of Missouri, Columbia, MO

4:00 *Endangered Species Issues of the Missouri River.* Mike Olson, U.S. Fish and Wildlife Service, Bismarck, ND

4:20 *The Conversion of Missouri River Reservoirs to Sustainable Systems.* Howard Coker, University of South Dakota, Vermillion, SD

Poster Session and Social

5:30 p.m. - 8:00 p.m.

Dinner on your own

Posters will be presented by their authors starting at 5:30 Monday evening. Exhibits will also be available for viewing.

Following the poster session, performances are planned from Three Affiliated Tribes singers and dancers and Keith Bear, a Mandan Hidatsa Sioux flutist, storyteller, actor, flutemaker, and dancer.

Mr. Bear tells stories that were passed down and collected from friends and relatives. Many of the stories and songs he performs are more than 300 years old. He plays hand-carved Native American flutes, many of which he carved himself using simple tools. Mr. Bear's CD, *Echoes of the Upper Missouri,* will be available for purchase.

SCHEDULE

TUESDAY, MAY 23

REGISTRATION
7:00 a.m. to 3:00 p.m.

EXHIBITS & POSTERS
Patterson/Lamborn Ballrooms
7:00 a.m. - 3:00 p.m.

Paper Descriptions page 22-26

Flood Plain Management Perspectives

Grand Pacific Ballroom 8:00 - 10:00 a.m.

Moderator: Roger Collins, U.S. Fish and Wildlife Service

8:00 **Responsibilities in Flood Plain Management.** Simon Cardenas, Federal Emergency Management Agency, Denver, CO

8:30 **Flood Plain Management and the Operation of the Missouri River Mainstem Reservoir System.** Larry Cieslik, U.S. Army Corps of Engineers, Omaha, NE

9:00 **The Austin Experience, Flooding 1945 to the Present.** Kermit E. Mahan, Housing and Redevelopment Authority of Austin, Austin, MN

9:30 **Flood Plain Management: A City/County Perspective.** Bill Delmore, Attorney and Burleigh County Commission, Bismarck, ND

10:00 **BREAK**

Local Flood Plain Development

Grand Pacific Ballroom 10:30 -11:50 a.m.

Moderator: Mike Ell, North Dakota Department of Health

10:30 *Flood Insurance and Flood Plain Management Study of the Missouri River through Bismarck-Mandan.* John Liou, Federal Emergency Management Administration, Denver, CO

10:50 *The Missouri River Coordinated Resource Management Program: Building a Consensus for the Future.* Mike Dwyer, North Dakota Water Education Foundation, Bismarck, ND

11:10 *Garrison to Oahe, the Most Improved River in the Nation.* Andy Mork, BOMMM Joint Water Resource Board, Mandan, ND

11:30 *Protection of Public Values Provided by the Garrison Reach of the Missouri River.* Gary Raedeke, North Dakota Chapter of the Sierra Club, Bismarck, ND

Luncheon in the Courtyard

Noon - 1:15 p.m.
Presentation by Robert Schneiders,
author of *Unruly River*

Book signing at Pitchfork Fondue

TUESDAY MAY 23

Concurrent Paper Sessions
1:15 - 2:35 p.m.

Session A - Heart Room (Paper descriptions, pages 27-29)

Moderator: Felicia Felix, Three Affiliated Tribes

1:15 *Living Along the River: A Mandan, Hidatsa, Arikara Cultural Perspective.* Tillie Walker, Malcolm Wolf, and Amy Mossett, Fort Berthold Community College, New Town, ND

1:35 *This Land I Am Standing On.* Marilyn C. Hudson, Three Affiliated Tribes Museum, New Town, ND

1:55 *The 1944 Flood Control Act as an Educational Tool for Teaching Natural Resources Policy.* Robert D. Kuzelka, University of Nebraska-Lincoln, Lincoln, NE

2:15 *NATIVE WATERS - An American Indian Water Resources Education Project (Missouri River Basin Pilot Project).* Dennis Nelson, Montana State University, Bozeman, MT; Ronald Eggers, Bureau of Reclamation, Billings, MT; and Richard Bad Moccasin, Mni Sose Intertribal Water Rights Coalition, Rapid City, SD

Session B - Sheyenne/Cannonball Room (Paper descriptions, pages 29-31)

Moderator: Nick Stas, Western Area Power Administration

1:15 *Changes in Fish Species Abundance in a Missouri River Main Stem Reservoir During Its First 45 Years.* Jeff Hendrickson, North Dakota Game and Fish Department, Riverdale, ND

1:35 *Distribution, Abundance, and Habitat Use of the Sturgeon Chub and Sicklefin Chub in the Missouri and Yellowstone Rivers, North Dakota.* Dennis L. Scarnecchia, University of Idaho, Moscow, ID

1:55 *The Yellowstone River: How Has It Managed to Remain So Good For So Long?* Fred Ryckman, North Dakota Game and Fish Department, Williston, ND

2:15 *Warmwater Release at Fort Peck Dam.* Mike Ruggles, Montana Department of Fish, Wildlife and Parks, Fort Peck, MT

Field Trips and Pitchfork Fondue
2:45 - 9:00 p.m.

2:45 FIELD TRIPS: See descriptions on side - meet at Door #4; your field trip reservation number is on your registration invoice.

6:00 PITCHFORK FONDUE at "The Post" north of Fort Lincoln on Highway 1806.

FIELD TRIPS

#1 History

Walter Bailey (Historian), State Historical Society of North Dakota, and Mike McCormick (Historian), Bismarck State College, take visitors to a site noted by Lewis and Clark (On-A-Slant Village), an early military outpost (Fort Rice), an Infantry Post (Fort McKean), and the place where George Armstrong Custer should have stayed (Fort Abraham Lincoln).

#2 Paleontology/Archaeology

John Hoganson (Paleontologist), North Dakota Geological Survey, will lead a 2-mile hike through the Stumph Natural Area. Vertebrate dinosaur fossils and a prehistoric Bison Kill Site are some of the significant discoveries in the area. A strenuous hike; need to wear hiking boots and carry water.

#3 Archaeology/Cultural Resources Management

Signe Snortland (Archaeologist), U.S. Bureau of Reclamation, guides a tour of the National Landmark Huff State Historic Site, the reconstructed Mandan earthlodge village at On-A-Slant Village, and prehistoric archaeological sites along the Missouri River endangered by erosion.

#4 Water Issues-Sites

A trip north of Bismarck with a variety of speakers and stops at Double Ditch development, Painted Woods Lake Wildlife Development Area, Lewis and Clark Interpretive Center, Price and Square Butte cattle operation, and Amoco Refinery Wildlife Refuge Tour with talks presented on Missouri River usage including the Garrison Diversion Project. *Tour provided by the North Dakota Water Education Foundation.*

SCHEDULE

WEDNESDAY MAY 24

Concurrent Paper Presentatons - Session A

Heart Room 8:00 a.m - Noon

Paper Descriptions page 32-37

Moderator: Pamela Haverland, U.S. Geological Survey

8:00 *Lisbon Bottom - The Balance Between Navigation and Environment.* Mike Chapman, Army Corps of Engineers, Kansas City, MO

8:20 *Aquatic Habitat Rehabilitation Assessment, Lower Missouri River.* Robert B. Jacobson, U.S. Geological Survey, Columbia, MO

8:40 *Pallid Sturgeon in the Lower Missouri and Middle Mississippi Rivers.* Joanne M. Grady, U.S. Fish and Wildlife Service, Columbia, MO

9:00 *An Evaluation of Missouri River "In Channel" Restoration Alternatives, Lower Decatur Bend Example.* Doug Latka, Army Corps of Engineers, Omaha, NE

9:20 *Applicability of Hydrologic Models for Assessing Aquatic Habitat Improvements - Lower Decatur Bend Example.* John I. Remus, Army Corps of Engineers, Omaha, NE

9:40 **BREAK**

Moderator: Chad Smith, American Rivers

10:10 *Improving the Missouri River: Our Role as Government Agencies.* Mimi Garstang, Missouri Department of Natural Resources, Jefferson City, MO

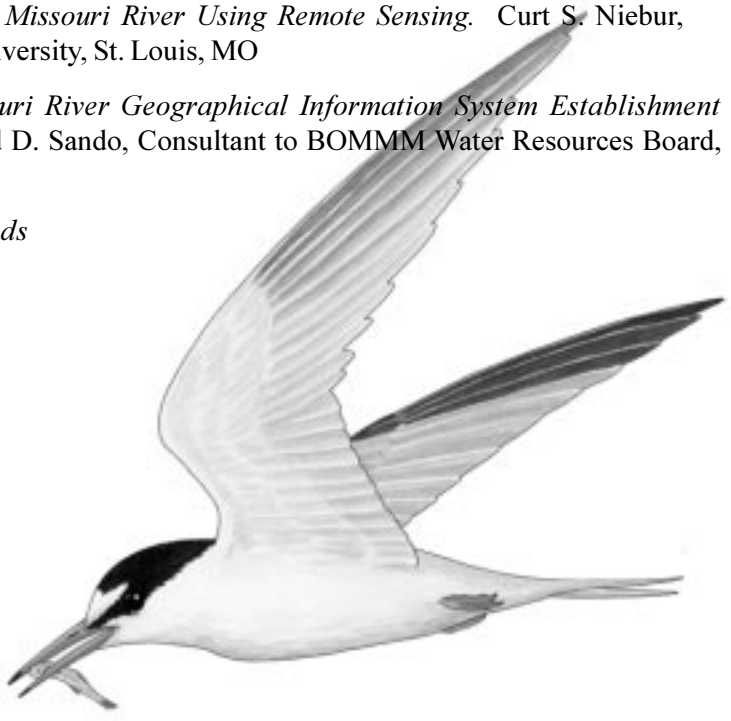
10:30 *Working Successfully with Missouri River Partners and Programs.* Kristie McKinley, Natural Resources Conservation Service, Sidney, IA

10:50 *Permitting Agencies, Are There No Guidelines?* Dan D. Carda, Missouri River Corridor Partnership, Pierre, SD

11:10 *Monitoring the Missouri River Using Remote Sensing.* Curt S. Niebur, Washington University, St. Louis, MO

11: 30 *CRMP - Missouri River Geographical Information System Establishment Efforts.* Ronald D. Sando, Consultant to BOMMM Water Resources Board, Bismarck, ND

Noon *Conference Ends*



WEDNESDAY MAY 24

Concurrent Paper Presentations - Session B

Sheyenne/Cannonball Rooms 8:00 a.m. - Noon

Paper Descriptions pages 37-43

Moderator: Mark Laustrup, U.S. Geological Survey

8:00 *Effects of Alternative Missouri River Management Plans on Ground Water in the Lower Missouri River Flood Plain.* Brian P. Kelly, U.S. Geological Survey, Independence, MO

8:20 *Status of Benthic Fish Communities in the Missouri River.* Charles R. Berry, South Dakota State University, Brookings, SD

8:40 *Overview of the Middle Missouri River Historical Database.* Mike LeValley, Missouri River Natural Resources Committee, Iowa Valley, IA

9:00 *Sediment Transport in the Missouri River Downstream from Garrison Dam, North Dakota.* Wayne R. Berkas, U.S. Geological Survey, Bismarck, ND

9:20 *Suspended-Sediment Loads in Selected Tributaries to the Missouri River, Garrison Dam to Lake Oahe, North Dakota.* Kathleen M. Macek-Rowland, U.S. Geological Survey, Bismarck, ND

9:40 **BREAK**

Moderator: Larry Shepard, U.S. Environmental Protection Agency

10:10 *Sandbar Habitat Dynamics Following an Unusual High Water Event on the Missouri River.* Casey Kruse, Army Corps of Engineers, Yankton, SD

10:30 *Site-Scale Characteristics of Piping Plover and Least Tern Sandbar Habitat on the Missouri River.* Bruce A. Vander Lee, South Dakota State University, Brookings, SD

10:50 *Wildlife Management Challenges Along Lake Sakakawea and the Missouri River in NW North Dakota.* Kent A. Luttschwager, North Dakota Game and Fish Department, Williston, ND

11:10 *Methodologies and Outcomes of Biodiversity Monitoring for the Benedictine Bottoms Flood Plain on the Lower Missouri River, 1994-1999.* Martin Simon, Benedictine College, Atchison, KS

11:30 *To be announced.*

Noon *Conference Ends*

EXHIBITS

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PAPERS

MONDAY, MAY 22

MISSOURI RIVER IN NORTH DAKOTA SESSION
8:00 a.m. - Noon

8:30 a.m.
Geology and Paleontology along the Missouri River Corridor in North Dakota

John W. Hoganson
North Dakota Geological Survey, 600 East Boulevard Ave., Bismarck, ND 58505

The present position of the Missouri River results mostly from the alteration of drainage patterns in North Dakota by glaciers at the end of the last Ice Age. Erosion caused by this river has exposed rock formations and fossils entombed in those rocks throughout the entire Missouri River corridor. Cretaceous age rocks, primarily shales and sandstones, of the Pierre and Fox Hills Formation were deposited in shallow marine environments between about 75 and 68 million years ago and occur along the southern stretch of the river in North Dakota. These rocks contain the remains of animals that lived in marine habitats including cephalopods, gastropods, bivalves, crustaceans, sharks, bony fish, and reptiles. The dinosaur fossil-bearing Hell Creek Formation exposed in parts of Sioux, Emmons, and Morton Counties was deposited in a delta environment and consists mostly of sandstones, siltstones, and mudstones. This formation contains the remains of several kinds of dinosaurs, including *Tyrannosaurus rex* and *Triceratops*, and many other vertebrate and invertebrate animals and plants that resided in North Dakota 65 million years ago.

From Morton and Emmons Counties to the Montana border the primary rock formations exposed along the Missouri River corridor are the Paleocene age (deposited between about 65 and 58 million years ago), Ludlow and Cannonball Formations in the south and the Slope, Bullion Creek, and Sentinel Butte Formations in the north. All of these formations consist of sandstones, siltstones, mudstones, and lignites deposited in fluvial and lacustrine settings except for the Cannonball Formation that documents the last marine advance into North Dakota. The nonmarine formations contain the remains of crocodiles, turtles, fish, mammals, and exotic, subtropical plants. The Cannonball Formation contains fossils of marine animals including many invertebrate taxa and sharks, rays, ratfish, and bony fish.

Sediments, including glacial till, outwash gravels, etc., deposited at the end of the Ice Age, about 12,000 years ago, veneer the upland areas along the Missouri River especially in central and northwestern North Dakota. Fossils of animals that lived in North Dakota at that time, including woolly mammoths and the giant *Bison latifrons,* have been recovered from these deposits.

-- John Hoganson is a native North Dakotan from West Fargo. After receiving a Bachelor's degree in Earth Science from North Dakota State University in 1970 he enrolled in a graduate program at the University of Florida. He received a Master's degree in Geology with a Paleontology emphasis from that university in 1972. John was employed as a paleontologist with Union Oil Company of California in Houston, Texas from 1972 to 1976. In 1985, he received a Doctorate degree in Geology with a Paleontology emphasis from the University of North Dakota. John has been the paleontologist for the North Dakota Geological Survey from 1981 to the present. John administers North Dakota's Fossil Resource Management Program and is the curator of the State fossil collection at the North Dakota Heritage Center. He is the author of many technical and nontechnical articles about the paleontology of North Dakota. In 1993, John was honored by Governor Schaefer with the North Dakota Governor's Award for Excellence in Public Service. The U.S. Forest Service presented its Service Award to John in 1996 for his work with fossil resource management issues.

9:00 a.m.
Prehistoric Archaeology of the Missouri River in North Dakota

J. Signe Snortland, Area Archaeologist
U.S. Bureau of Reclamation, P.O. Box 1017, Bismarck, ND 58501

-- Signe Snortland holds a B.A. from the University of North Dakota and an M.A. from the University of Manitoba in Anthropology. She is currently the Area Archaeologist for the U.S. Bureau of Reclamation in Bismarck, North Dakota, and was formerly the Chief Archeologist for the State Historical Society of North Dakota. She has also worked as an archaeologist for the Natural Resources Conservation Service, University of North Dakota, U.S. Bureau of Land Management, and Historic Resources Branch of the Province of Manitoba. Her research interests are Northern Plains prehistory, mortuary practices, and cultural resources management. She has published papers in the *Smithsonian Institution Press, Plains Anthropologist*, *North Dakota History*, *Journal of the Archaeological Society of Southwestern Manitoba*, *Papers in Manitoba Archaeology*, and *University of North Dakota Anthropological Papers*. One of her most recent publications is a book she edited for the public, *A Traveler?s Companion to North Dakota State Historic Sites.*

9:30 a.m.
The Damming of the River: A Cultural Change

Gerard A. Baker, Mandan-Hidatsa
Chickasaw National Recreation Area, National Park Service, P.O. Box 201, Sulphur, OK 73086

In this session, I will discuss the changes that occurred as the result of the Garrison Dam. I am among the first generation to be born as the Garrison Dam stopped the flow of the Missouri River in the middle of Mandan, Hidatsa and Arikara traditional lands. As a child and on into my adulthood, I have lived with the people, heard their stories about the way of life before and after the Garrison Dam. Even today, we still feel the effects, not only culturally, but also politically and socially as well. I will share some of the stories I heard as I was growing up on the Fort Berthold Indian Reservation. I will also discuss what is happening today and how the Three Affiliated Tribes exist since the removal from the “home lands” and what we as Indian people hope to accomplish in the generations to come.

-- I grew up on our family ranch on the western side of the Reservation. After spending all of my early years on the ranch, learning many of the traditional ways from my parents and my clan relatives, I went to boarding school, graduating from St. Mary’s of New England. I then attended Mary College in Bismarck, College of the Redwoods, Eureka, CA, and graduated from Southern Oregon University with Bachelor degrees in Criminology and Sociology. I have worked for the National Park Service for 24 years. I am currently the Superintendent at Chickasaw National Recreation Area in Sulphur, Oklahoma. Prior to my current position, I was Superintendent at Little Bighorn Battlefield National Monument, Crow Agency, Montana.

PAPERS

MONDAY, MAY 22

INTRODUCTORY SESSION
8:00 a.m. - Noon

10:30 a.m.
The Missouri River and the Environmental Movement: Some Notes on History

Mark Harvey, Department of History
North Dakota State University, P.O. Box 5075, SU Station, Fargo, ND 58l05

The Missouri River has long been a subject of interest among historians who have published a number of important works within the last 50 years. Yet until very recently most historians ignored the environmental aspects of the river's history, preferring to study the economic and political interests behind the advent of dams, channelization, and diversion. Moreover, historians generally assumed that there was little awareness in the environmental aspects of the river and its "development" prior to the 1970s and the environmental revolution. Yet the evidence reveals that as early as the 1940s there was concern about how the huge dams and channelization plans would transform the river and about the possible environmental shortcomings of the Flood Control Act of 1944. My paper will examine these early environmental observations and reveal that the interest in safeguarding the river's beauty and biodiversity has a deeper history than is commonly assumed.

--- Mark Harvey is an associate professor of history at North Dakota State University in Fargo, where he has taught classes on the American West and U.S. environmental history since 1986. He holds a Ph.D. in history from the Univ. of Wyoming. He is the author of the book *A Symbol of Wilderness: Echo Park and the American Conservation Movement* (Seattle: Univ. of Washington Press, 2000).

11:00 a.m.
Wildlife Resources Along the Mighty Missouri: Then and Now

Randy Kreil
North Dakota Game and Fish Department, 100 North Bismarck Expressway, Bismarck, ND 58501

Beginning in the early days of European exploration, travelers through the northern Great Plains recognized the Missouri River corridor was home to a tremendous abundance of wildlife. Lewis and Clark, George Caitlin, and Alexander McKenzie all noted in colorful detail the amazing numbers and diversity of wild animals inhabiting the forests, plains, and bluffs along the Missouri and Yellowstone Rivers. As they followed the great river that bisected the Plains and led the way westward to the Rocky Mountains, these explorers hunted, collected, and artistically depicted the region's fauna.

Today, these same explorers would not recognize the rivers they once traversed. Neither would they find the numbers and types of wildlife encountered with regularity on their journeys. They would notice dramatic alterations in natural habitats and subsequent changes in the types of wildlife species associated with the Missouri River of today. Some would argue the current assemblage of wildlife species in the Missouri River corridor pales in comparison to what the early explorers experienced. Others would disagree and point to the incredible recreational values associated with today's Missouri River fish and wildlife species. They would further argue that many of the former wild inhabitants of the region are precluded from existing in the area today because of man's presence. This paper examines these changes and focuses on the current biological resources of North Dakota's Missouri River corridor.

--- Randy Kreil is a native North Dakotan and has a degree in Fisheries and Wildlife Biology from the University of North Dakota. He has been employed with

the North Dakota Game and Fish Department since 1985. After 9 years as a natural resource biologist and coordinator of the agency's nongame and endangered species program he accepted the position of Wildlife Division Chief. Experience in these two distinct, yet interfacing areas of wildlife management provides him with a broad-based perspective on the wildlife resources of the Missouri River system. Randy lives in Bismarck (above the flood plain - unlike many of his south Bismarck colleagues).

11:30 a.m.
Missouri River in North Dakota, Current Uses and Issues

Todd Sando
North Dakota State Water Commission, 900 East Boulevard, Bismarck, ND 58505

The Missouri River is no longer a natural river. Rather, it is a controlled water system providing hydropower, water supply, flood control, recreation and navigation benefits to the entire Nation. This system has divided the river into four distinct reaches in North Dakota, each with its own uses and issues. To provide the benefits of the dams the upper basin states have accepted the permanent flooding of 1.6 million acres of prime farmland. North Dakota alone has 550,000 acres flooded by Lake Sakakawea and Lake Oahe. The system is operated by the Corps of Engineers under the guidelines provided in the Master Manual. Releases from the dams for various uses have impacts on the other authorized uses as well as on landowners, fish and wildlife habitat, historical properties and irrigators. Although the dams have provided benefits that exceed their negative impacts, the negative impacts, including delta formation, bank erosion, and environmental impacts still need to be addressed.

--- Todd Sando, a native of Bismarck, North Dakota, is the Director of the Water Development of North Dakota State Water Commission (SWC). Todd, a registered Professional Engineer, has worked with the SWC since 1985. Todd has a Bachelors degree in Civil Engineering from the University of North Dakota. Todd has 14 years of water resource engineering experience in hydrology and hydraulics. During this time, Todd has been actively involved with the Missouri River Basin Association and the Corps of Engineer's *Master Manual* Review Process and Update.

MONDAY, MAY 22

BASINWIDE PERSPECTIVES
1:30 - 4:40 p.m.

1:30 p.m.
The Corps of Engineers' Ever-Changing Role with the Missouri River

Marie J. Vanderpool
U.S. Army Corps of Engineers, Kansas City District, 601 East 12th Street, Kansas City, Missouri 64106-2896

CO-AUTHOR
Christine T. Altendorf, U.S. Army Corps of Engineers, Kansas City District, 601 East 12th Street, Kansas City, MO 64106-2896

The Missouri River has a long and dynamic history and the Corps of Engineers has played an integral part in the changes that have occurred over the past 200 years. This presentation will provide a chronological history of the river. It will include the responsibilities of the Corps of Engineers as related to authorizations by Congress, special interest groups, and the public. The changing role of the Corps will be discussed including the past modifications made to the river, current construction, environmental balance and what is expected over the next decade.

PAPERS

MONDAY, MAY 22

BASINWIDE PERSPECTIVES
1:30 - 4:40 p.m.

1:50 p.m.
Mni Sose Intertribal Water Rights Coalition's Role in the Management of the Missouri River

Richard Bad Moccasin
Mni Sose Intertribal Water Rights Coalition, P.O. Box 2890, Rapid City, SD 57709

The Mni Sose Intertribal Water Rights Coalition is the first tribal membership organization devoted to assisting Tribes in the protection of Indian water rights to the Missouri River and the development of viable economies that rely upon the Tribes' water rights to the Missouri River.

Mni Sose assists the member Tribes in the following high-priority issues:

Low-cost Hydropower: When the Federal government constructed massive water projects including dams and hydroelectric facilities in the 1940s and 1950s, approximately 25 % of the land acquired was Indian land. In return, the Tribes were to receive direct hydropower benefits. Through the efforts of the Coalition, the Tribes will finally receive low-cost hydropower beginning in 2001.

Missouri River Master Water Control Manual: The Coalition's membership in the Missouri River Basin Association has resulted in the States' recognition of Indian water rights in the Missouri River Basin. On behalf of the Tribes, Mni Sose has submitted documents to the Army Corps of Engineers that document the effects the Master Manual has on the Tribes.

Technical Assistance: The Coalition provides legal, technical, and educational assistance to tribal leaders and natural resource staff members in order to enhance their capabilities to manage their water resources.

Environmental Protection Training: The Coalition has launched a training effort in environmental protection directed toward tribal leaders and natural resource staff members. This training includes analysis of existing environmental laws, pending environmental legislation, and training in environmental protection strategies.

2:10 p.m.
Missouri River InfoLINK: Making Science Available to the Public

Jeanne Heuser
U.S. Geological Survey, Columbia Environmental Research Center, 4200 New Haven Road, Columbia, MO 65201

The InfoLINK was created for resource managers, policy makers, and citizens to enhance understanding of the Missouri River through information, partnerships, maps, and science. It endeavors to make data easily accessible and understandable so this broad group of stakeholders can apply scientific and other information to Missouri River land and water management decisions. The *InfoLINK* provides:

- An Internet web page featuring maps on a basin and regional scale (http://infolink.cr.usgs.gov/);
- Collaborative meetings including the annual Missouri River Natural Resources Conference
- Partnerships for support, technical assistance, data management, and community place-based planning
- Packaging of complex river science into easily understood concepts

The InfoLINK is a project of the USGS Columbia Environmental Research Center located in Columbia, Missouri. It began in 1998 as an extension of the Lower Missouri River Ecosystem Initiative (LMREI), one of 12 ecosystem initiatives selected through a competitive process in 1994. Funding for LMREI ended in 1998 and the Environmental Protection Agency (EPA)-Region 7 partnered with the USGS to continue the program as the InfoLINK and to begin distributing Internet-based maps that provide stakeholders a sense of place. Other Federal agencies that share a similar goal to make scientific information readily available to the public joined the partnership: the National Biological Information Infrastructure (NBII), USGS-Biological Resources Division Office of Biological Informatics and Outreach, EPA-Region 8, and U.S. Fish and Wildlife Service-Region 6,

The NBII funds were targeted to develop a map interface for viewing summary statistics from the Missouri River Benthic Fishes Study. The study is the first of its kind to gather biological data over the entire length of a river as large as the Missouri. Displaying the data in a spatial format on the Internet is also a first for Missouri River biological data. The InfoLINK is working in cooperation with the USGS Cooperative Fish and Wildlife Research Units; the USGS Mid-Continent Mapping Center, Rolla, Missouri; and ESRI software company, St. Charles, Missouri to design the prototype.

2:30 p.m.
Restoring the Natural Range of Missouri River Flow Variability to Benefit Declining Species

David L. Galat
U.S. Geological Survey, Cooperative Fish and Wildlife Research Unit, 302 ABNR, University of Missouri, Columbia, MO 65211-7240

Re-establishing a semblance of the natural flow regime through controlled reservoir releases is becoming a successful management tool to restore ecological integrity of regulated rivers. Reregulation of river flows requires defining a reference condition based upon the full range of hydrologic variability present in the pre-regulation system. The Current Water Control Plan (CWCP) for the Missouri River, including multipurpose regulation of storage releases for downstream uses, is being revised. Below Gavins Point Dam, SD, two competing water uses are navigation (i.e., CWCP) and fish and wildlife.

A split navigation season (SNS) and three fish and wildlife (FW10, FW15, FW20) alternatives to the CWCP were evaluated to determine how closely they simulated the magnitude, timing, and duration of preregulation flows. The four alternatives were applied to 1967-1996 50th percentile discharge at Omaha, NE. Resulting flow patterns were compared with a range of percentile discharges before (1929-1948) and after (1967-1996) flow regulation. All alternatives, and especially SNS, were clear improvements over CWCP because they yielded a more natural hydrograph for the :ower Missouri River. However, declining native species can be further recovered if greater consideration is given to managing reservoir flow releases to simulate the natural variability inherent in preregulation hydrology. Incorporating a broader range of historical flow variability into managing reservoir releases provides an ecological reference condition for decision makers to evaluate among other beneficial uses. Over the long term, integrating ecological and human values and needs into river management can yield a greater overall societal benefit than considering them independently.

PAPERS

MONDAY, MAY 22

BASINWIDE PERSPECTIVES
1:30 - 4:40 p.m.

3:20 p.m.
Discover a Watershed: The Missouri Project, A Watershed-wide Approach to Public Education

Dennis Nelson, Executive Director
The Watercourse Program and International Project WET, 201 Culbertson Hall, Montana State University, Bozeman, MT 59717

CO-AUTHOR
Sandra DeYonge, DirectorProject WET U.S.A,. 201 Culbertson Hall, Montana State University, Bozeman, Montana 59717

The *Discover a Watershed: The Missouri* is a multidisciplinary water resources education project for formal and nonformal educators and their students. This project will address a wide range of Missouri River and basin management topics through the publication of creative, engaging, and relevant materials. The project was formally launched in March 2000 at the Discover a Watershed: The Missouri Writing Workshop. Peer-nominated formal and nonformal educators and a small group of resource managers representing each state in the Missouri basin assisted The Watercourse in the creation of original lessons and activities all focused on the Missouri River and watershed. The result of the writing workshop and associated research activities will be published in the *Discover a Watershed: The Missouri Reference and Activity Guide* for Educators, a complimentary *Student Workbook*, and in a Lewis and Clark Bicentennial Kit. The release of the Discover a Watershed: The Missouri project materials and the implementation of a basin-wide education program are planned to coincide with the Lewis and Clark Bicentennial. The Watercourse, in cooperation with State Project WET sponsors and other organizations that are interested in becoming involved in water resources education, will deliver the materials to citizens throughout the basin at locally sponsored community education events (e.g., workshops, seminars, and festivals) and in school programs and classroom units. The Discover a Watershed: The Missouri is part of The Watercourse Program's Discover a Watershed series. Other basins in the series include the Everglades, the Rio Grande/Rio Bravo, and the Columbia.

3:40 p.m.
Consortium of Missouri River Institutes: An Intercollegiate Research and Educational Initiative for the Missouri River Basin

Tony Prato
University of Missouri – CARES, 130 Mumford Hall, University of Missouri-Columbia, Columbia, MO 65211

CO-AUTHOR
J. Michael Jess, 121B Nebraska Hall, University of Nebraska-Lincoln, Lincoln, NB 68588

The proposed Missouri River Institute (MRI) is a consortium of 4-year academic institutions within the Missouri River Basin that engages in interdisciplinary research, educational, and outreach programs to advance knowledge and understanding of the

cultural, ecological, economic, geophysical, historical, and social issues influencing the use, management, sustainability, and appreciation of the Missouri River and its tributaries. The MRI will undertake wide-ranging, science-based studies designed to improve public understanding of the impacts of river management on social, economic, natural resources and other values. Studies will be used to guide engineering design and facilitate regulatory decisions.

A primary factor motivating creation of the MRI is the desire to alleviate impasses resulting from State and Federal regulatory actions/requirements, such as those associated with the debate over flows in the Missouri River and revision of the Corps of Engineers' Master Operations Manual. The Corps' attempt to revise the Master Manual in the early 1990s became bogged down and confidence in its analysis eroded due to incomplete analysis. Criticisms of "advocacy research" were directed at certain conclusions that Federal decisionmakers intended to use in support of proposed changes. Regrettably, more than $12 million were spent on this unsuccessful effort.

The MRI's basinwide programs will emphasize monitoring, research and educational activities that support watershed planning, sustainable development and environmental quality, and will encompass scholarly work in environmental and engineering sciences, law, public policy, ethics, social sciences and humanities. MRI affiliated faculty will be drawn from 4-year colleges and universities in the basin.

4:00 p.m.
Endangered Species Issues of the Missouri River

Michael M. Olson
U.S. Fish and Wildlife Service, 3425 Miriam, Bismarck, ND 58501

CO-AUTHOR
Dave Ponganis, U.S. Army Corps of Engineers, Northwest Division, P. O. Box 2870, Portland, OR 97208-2870

Awareness of the Missouri River and its natural resources has reached an all-time high during the last few years due to a number of factors, including, but not limited to, the following: a 6-year drought followed by several years of high water and immense floods, the Corps' *Master Water Control Manual* Study and its Annual Operating Plans, the upcoming Lewis and Clark Bicentennial commemoration, American Rivers listing of the Missouri River as the most endangered river in the United States, and listing and recovery actions related to several threatened and endangered species. An example of the local, regional and national interest in endangered species recovery on the Missouri was the more than 100 media inquires to our office surrounding the stocking of pallid sturgeon in the summer of 1998. Recovery of the threatened and endangered species dependent upon the Missouri River is a complicated topic with many facets. The many interests in the Missouri River make recovery a greater possibility in some reaches and may complicate the task in other reaches. We are at a crossroad in Missouri River management. This crossroad was epitomized by recent discussions surrounding a biological opinion on three major actions on the Missouri River. Recommendations from the opinion will move agencies who work on the Missouri River in new directions toward species recovery.

PAPERS

MONDAY, MAY 22

BASINWIDE PERSPECTIVES
1:30-4:40 p.m.

4:20 p.m.
The Conversion of Missouri River Mainstem Reservoirs to Sustainable Systems

Howard Coker
University of South Dakota, 414 East Clark Street, Vermillion, SD 57069

The Missouri River reservoirs will eventually fill. All flood control will be lost, as will most other benefits of the Pick-Sloan system. The three lower reservoirs are the most endangered. Delta formation is causing local flooding throughout the system. In all but Lewis and Clark Lake, the smallest of the six reservoirs, more than 95% of the reservoir sediment is silt and clay. In a previous paper, it was shown that the silt and clay components can be transported at modest cost by pipeline to the channel at Gavins Point. The cost of construction and operation of a system to render the three lower reservoirs sustainable has been estimated.

The capital cost of the pipeline and dredges will be matched by the net benefits in about 2 years. The annual value of the flood damage prevented, as allocated by the Corps of Engineers to the three reservoirs, is $120 million. The Master Manual gives $25 million annually for the recreation benefit. To these may be added $55 million for the operational cost of hydroelectric vs. coal-fired generators for a total annual benefit of $200 million. The pipeline construction cost is about $300 million. The cost of the dredges and other capital items is estimated to be $30 million. The annual cost of returning the sediments to the channel will be less than $35 million. Wear rates are not well defined, but the system lifetime should exceed 50 years. The cost-benefit ratio is quite favorable and justifies a thorough feasibility study.

TUESDAY, MAY 23

FLOOD PLAIN MANAGEMENT PERSPECTIVES
8:00 - 10:00 a.m.

8:00 a.m.
Responsibilities in Flood Plain Management

Simon Cardenas, Hazard Program Specialist
Federal Emergency Management Agency, FEMA Building 710-A, P.O. Box 25267, Denver Federal Center, Denver, CO 80225-0267

Individual citizens alone cannot regulate building or establish construction priorities for communities unless the community as a whole practices and enforces adequate flood plain hazard mitigation. Then we can reduce future flood losses.

--- Simon Cardenas is employed with the Federal Emergency Management Agency, Mitigation Division and serves as a Hazard Program Specialist and Regional Flood Insurance Liaison. His principal assignment for the last 7 years has been North and South Dakota, assisting local governments implement their local flood plain management ordinance.

8:30 a.m.
Flood Plain Management and the Operation of the Missouri River Mainstem Reservoir System

Lawrence J. Cieslik, Professional Engineer, Chief
Missouri River Reservoir Control Center, Northwestern Division, U.S. Army Corps of Engineers, 12565 West Center Road, Omaha, NE 68144

Construction of the Missouri River Mainstem System (System) began in the 1930's with Fort Peck Dam. Construction of the other five dams in the System was authorized by the 1944 Flood Control Act (Pick-Sloan Act). The Act also authorized the operation of all six main stem dams as a system. The System is authorized for flood control, irrigation, hydropower, navigation, recreation, water supply, water quality, and fish and wildlife. The System has prevented nearly $23 billion of flood damage (1997 dollars), but the System cannot prevent all flooding. Residual flooding can occur due to runoff that is not captured by the System or by high releases from the System as a result of rare, high-magnitude runoff events. The ability of the System to prevent flood damage can be compromised by additional development in flood plains along the main stem. The Federal government does not hold the power to control land use. That right and responsibility is vested in State and local governments. The Federal government has two major tools at its disposal to reduce unwise flood plain development along the main stem of the Missouri River. The first is the ability to purchase land or flowage easements in areas adjacent to System reservoirs. This can include relocation or flood-proofing of existing flood plain development to allow operation of the System as authorized, e.g. - Niobrara, NE / Pierre/Fort Pierre, SD. The second is the Flood Insurance Program administered by the Federal Emergency Management Administration, e.g. - Bismarck, ND.

9:00 a.m.
The Austin Experience, Flooding 1945 to the Present

Kermit E. Mahan, Executive Director
Housing and Redevelopment Authority of Austin, 308 2nd Ave. NE, Austin, MN 55912

The presenter will disclose historical data on Austin's flood experience commencing 1945 to the present. Not only will occurrences be discussed but contributing factors will be reviewed, e.g., farming practices, urbanization, and code enforcement. The Austin experience will depict how the city became a leader in flood plain enforcement and seeker of nonstructural solutions. Finally, strategic issues will be examined on how to conduct a flood clearance program: "What to do" and "What not to do."

--- Mr. Mahan has served the City of Austin, Minnesota, as its Executive Director for the Housing and Redevelopment Authority for the past 28 years. During this time, Mr. Mahan has administered a broad range of community development activities exceeding $130 million in project expenditures. Mr. Mahan has served on a number of boards and commissions addressing community-wide issues. He holds a Masters degree in Political Science and is a past Ford Foundation Research Fellow. Mr. Mahan has had the "good fortune" in dealing with three major floods in his tenure and will share both technical and behavioral experiences in flood management. His community was one of the first in the Nation to embrace nonstructural solutions to flooding.

9:30 a.m.
Flood Plain Management: A City/County Perspective

William J. Delmore, Attorney and Burleigh County Commission
Kelsch, Kelsch, Ruff and Kranda PLLP, Collins and Main, P.O. Box 785, Mandan, ND 58554

PAPERS

This presentation examines the resolution of City and County zoning conflicts including a Joint Planning Agency and preparation for jurisdiction transition; groundwater and surface water protection, wastewater systems, agriculture processing; setbacks and buffer zones; and areas with no zoning jurisdiction.

--- William Delmore is an attorney with Kelsch Kelsche Ruff and Kranda and is the past Director of Environmental Enforcement for the North Dakota Health Department.

TUESDAY, MAY 23

LOCAL FLOOD PLAIN DEVELOPMENT
10:30 - Noon

10:30 a.m.
Flood Insurance and Flood Plain Management Study of the Missouri River Through Bismarck-Mandan, North Dakota

Dr. John Liou, Professional Engineer
Federal Emergency Management Agency Region 8, Building 710, Denver Federal Center, Denver, CO 80225-0267

CO-AUTHORS
Dr. Lawrence Woodbury, Professional Engineer, Houston Engineering, Inc., P.O. Box 5054, Fargo, ND 58105-5054
Gregg Thielman, Professional Engineer, Houston Engineering, Inc., P.O. Box 5054, Fargo, ND 58105-5054

In February 1997, FEMA Region 8 initiated a Detailed Flood Insurance Restudy (FIS) of the Missouri River through the communities of Bismarck and Mandan, North Dakota. The FIS was initiated at the request of State and local agencies that felt the existing FIS was inaccurate and not representative of changing conditions within the Missouri River. A particular concern was in regards to a sediment delta buildup within the upper reaches of Lake Oahe in the South Bismarck area of the Missouri River. Ice-affected flooding within the study area was also a concern.

Flow on the Missouri River through the study area is regulated by Garrison Dam. In addition, tributaries such as the Knife River and Heart River enter the Missouri River upstream of the study area. The hydrology for this reach of the Missouri River was updated as part of the FIS. Ice jam potential in the study reach was also analyzed. As part of the FIS, 45 channel cross sections on the Missouri River were resurveyed using GPS and sounding survey equipment. These new channel cross sectional data, along with existing overbank cross sectional data were used for the hydraulic analysis. Hydraulic profiles were run through the study reach for the 10-, 50-, 100-, and 500-year floods along with the floodway using the Corps of Engineers' HEC-RAS water surface profile computer program. Digital mapping of the flood plain and floodway was performed using existing 2-foot contour maps and USGS 7.5-minute quadrangle maps. GIS data obtained from the communities of Bismarck and Mandan were also incorporated into the work maps.

The results of the FIS show an increase in the base flood elevation of up to 1 foot through the Bismarck-Mandan area. This increase can be largely attributed to the changing channel geometry as a result of sediment deposition in the upper reaches of Lake Oahe. The results of the ice jam analysis showed that ice jams are primarily a concern for lower frequency events such as the 10-year flood.

The changing channel conditions through the Bismarck-Mandan area as a result of the Oahe delta formation have an impact on existing and future development. These impacts will continue to occur until an equilibrium sediment level is reached in the Oahe Delta at which point increased velocities through this reach of the Missouri River will push the sediment further downstream into Lake Oahe.

10:50 a.m.
The Missouri River Coordinated Resource Management Program: Building a Consensus for the Future

Mike Dwyer, Executive Director
North Dakota Water Education Foundation, 1830 N. 11th St., Bismarck, ND 58501

The Missouri River in North Dakota has many stakeholders. They include Federal and State agencies, agriculture, industry, landowners, environmentalists, and other private constituencies. They each have different perspectives about how the river should be used and managed — perspectives which often clash. However, they do seem to agree on one paramount point: that is the need for a consensus on how to manage the river in the future. To bring these stakeholders toward a consensus, the Missouri River Coordinated Resource Management Program (CRMP) has been established. Sponsored by the Burleigh, Oliver, McLean, Mercer and Morton Joint Resource Board, CRMP is a two-part effort intended to address these river issues.

Its two main groups are a vision group and an assessment program technical group. The Vision Group is working to develop a long-range strategic plan for the Garrison Reach of the Missouri River. The Missouri Assessment Program Technical Group is working to secure technical data on sediment, river channel conditions, impacts based on certain river flows, land use patterns and other related issues. It is also developing a Geographic Information System for the river.

Because these diverse groups of stakeholders are talking together and working through these issues together, we are hopeful for a unified resolution to many common and long-time controversial issues.

11:10 a.m.
Garrison to Oahe, the Most Improved River in the Nation

Andy Mork, Chairman
BOMMM Joint Water Resource Board, 2816 37th Street N.W., Box 176, Mandan, ND 58554

The American Rivers Association has declared the Missouri River the most ruined and now the second most ruined river in America. I reject this classification. First, the Missouri River was and is too large and too variable to be put into one category; and secondly, it certainly does not apply to the Garrison to Oahe Reach.

To make an evaluation one must know how it was before Pick Sloan and compare it to now. I am uniquely qualified to make this comparison since I have lived with the river since 1931. Garrison Dam was closed in 1953 so I learned to know it well then and all the years since.

The old river was correctly named the Old Muddy since it carried a full load of sediment. It did erode its banks although much slower than we are led to believe, but being an honest river it always built back as much as it took—there was no net loss of land. Ice jam flooding was common in the spring, making any use of the land other than limited agricultural and recreational impossible. The mountain snow melt water and the June rise came through the summer months. Although not flooding the high bottomland, it made nesting of plovers, terns, and geese difficult to impossible. The fishery was catfish, carp, bullheads, sturgeon, and other muddy water lovers.

In contrast our modern river now has clear, cold water controlled by the Garrison

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TUESDAY, MAY 23

LOCAL FLOOD PLAIN DEVELOPMENT
10:30 - Noon

Dam releases. Flooding has ceased as was proven in 1997 when a 200-year water flow was safely passed through without flooding the high bottomlands. Agricultural, commercial, and residential development of the former flood plain has flourished. With the exception of years like 1997, the summer river now has bare and vegetated sand bars and islands that provide excellent nesting for the plovers, terns, geese, and other birds. The carp, bullheads, and sturgeon, no longer compatible with the clear, cold water, are gone. In their place is a world-class walleye, sauger and northern pike fishery. The most improved river title is obviously deserved.

Is the river perfect? No, there are problems with accelerated bank erosion caused by the clear water and a delta formation in Oahe's headwaters. Fortunately, three-fourths of the needed bank protection is already in place and our BOMMM group is promoting completion of the remaining needed protection. At that time 60% of the bank will still remain natural. Our reach will then become the gem of our Nation!

11:30 a.m.
Protection of Public Values Provided by the Garrison Reach of the Missouri River

Gary Raedeke
North Dakota Chapter of the Sierra Club, 1106 W. Capitol Ave. #7,Bismarck, ND 58501

The Garrison Reach is a unique natural resource. However, the public's interest in the fish, wildlife, recreational, historic, and scenic values of the river are threatened by bank stabilization and accompanying development on the river's immediate edge.

The public has ownership interests in the river to the high water mark. See *State ex. rel. Sprynczynatyk v. Mills, 523 N.W. 2d 537 (N.D. 1994)*. The Public Trust Doctrine requires the State as trustee to protect those ownership interests. See *United Plainsmen v. N.D. State Water Cons., 247 N.W. 2d 457 (N.D. 1976).*

To date, the primary focus has been on maximization of private property values and usage through flood control and bank stabilization. Little consideration has been given to the impacts bank stabilization and riparian land development have on public's ownership values in the Garrison Reach.

As a result of construction of Garrison Dam and the controlled flows, private landowners along the river have already reaped substantial benefits from the government. With the subsequent increase in land values, bank stabilization has become desirable to some landowners.

The public's interest in the dynamic free-flowing characteristics of the Garrison Reach has precedence over the continued furtherance of private economic gain. Instead of further constricting the river and promoting private riverfront development through bank stabilization, government is responsible for preservation of the public's ownership values in the Garrison Reach.

1:15 p.m.
Living Along the River: A Mandan, Hidatsa, Arikara Cultural Perspective

Tillie Walker, Malcolm Wolf, Amy Mossett
Ft. Berthold Community College, P.O. Box 490, Newton, ND 58763

For hundreds of years, the Mandan, Hidatsa, and Arikara people have survived on the plains-along the river. The people of these tribes lived in permanent earthlodge villages - along the river. They farmed the land -along the river - their fall harvest consisting of corn, squash, beans, and sunflowers helped to sustain them throughout the long and often severe northern plains winters. Each spring brought new life, renewal, and reawakening as the people continued their journey through the cycle of life - along the river.

The Mandan, Hidatsa, and Arikara were the first people to build permanent homes along the upper Missouri River. The people have always been connected to the river in proximity and in spirit. For hundreds of years, the river has been the source of fertile farmlands, irrigation, water supply, food supply, navigation, recreation, and beauty to the people of the Mandan, Hidatsa, and Arikara tribes. There is a spiritual connection to the river that has existed since time immemorial. But for decades, this relationship has been compromised by environmental, social, political, and economic challenges, however, the Mandan, Hidatsa, and Arikara people,the Three Affiliated Tribes, have survived and will continue to live - along the river.

1:35 p.m.
This Land I Am Standing On*

Marilyn C. Hudson, Administrator
Three Affiliated Tribes Museum, P.O. Box 147, New Town, ND 58763

Most North Dakotans and others associated with Missouri River management are familiar with the 1944 Flood Control Act and how it "tamed" the Big Muddy. The displacement of the Fort Berthold Indians by the Garrison Project has for the past 50 years been a topic of great interest to historians, sociologists, environmentalists, writers, and students at all levels of study.

Fort Berthold Indians today identify the relocation period as the most traumatic event in their centuries-old history, ranking second only to the small-pox epidemic of 1837. The records of the Garrison Dam and the resultant removal of 90% of the reservation population to higher ground show the tremendous attachment to the land and the river. Tribal leaders again and again asserted their belief that their land titles were secure and implored the Government to honor the treaties.

The statements of the Indian people made in opposition to the Garrison Dam will be the topic of this presentation. This is a good time to go back and listen to the Indian voices from a "50-years-later" perspective. Statements of Indian people will be read with a slide to give the viewer an image of the land. The results of this research have made proud the tribal leaders who were faced with the terrible reality of trying to convince the U.S. Government to halt the construction of the Garrison Dam. Without exception, their protests relate back to the Indian people's attachment to their land and their wishes to remain as a tribal group.

*Statement by James Driver, Sr., from a speech made on May 27, 1946

PAPERS

TUESDAY, MAY 23

SESSION A
CONCURRENT PAPER PRESENTATIONS
1:30 - 2:35 p.m.

1:55 p.m.
The 1944 Flood Control Act as a Educational Tool for Teaching Natural Resources Policy

Robert D. Kuzelka, Associate Professor
School of Natural Resource Sciences, University of Nebraska-Lincoln, 103 Natural Resources Hall, Lincoln, NE 68583-0844

Since 1988 I have taught an undergraduate course in natural resources policy. Rather than have the students learn a "cookbook" of existing policies I try to show them what policies are, how they are developed, and how they are implemented. I do this through a variety of Federal, State, and local case studies. With one exception, in all 15 sessions that I have taught of the course, the case studies have varied due to current issues. The exception is my presentation of two case studies that I use to demonstrate Federal natural resources policy and the difference between structural and nonstructural polices.

To do this I contrast the 1944 Flood Control Act (FCA) with the 1969 National Environmental Policy Act. My presentation discusses how and why I use this approach. More important, I present student reactions to the cases studies. In particular, each year I ask students to rate the success of the FCA as to dams, flood control, irrigation, navigation, power, fish and wildlife, sedimentation, and the project overall. I am able to display and discuss the reactions and thoughts of about 600 students to the project based upon class presentations and readings.

Required reading for the course related to FCA include John P. Guhin, "The Law of the Missouri," in the *South Dakota Law Review,* Vol. 3, No. 2, Spring 1985, pp. 347-487 and John R. Ferrell, *Big Dam Era,* published in 1993 by the U.S. Army Corps of Engineers, Omaha, NE.

2:15 p.m.
NATIVE WATERS - An American Indian Water Resources Education Project (Missouri River Basin Pilot Project)

Dennis Nelson, Executive Director
The Watercourse Program and International Project WET, 201 Culbertson Hall, Montana State University Bozeman, MT 59717
Ronald J. Eggers, Special Assistant
Native American Affairs, Great Plains Region, Bureau of Reclamation, P.O. Box 36900, Billings, MT 59107-6900
Richard Bad Moccasin, Executive Director
Mni Sose Intertribal Water Rights Coalition, Inc., P.O. Box 2890514 Mt. Rushmore Road, Rapid City, SD 57709-2890

Native Waters is an American Indian water resources education project. This multifaceted education initiative will focus on water and related management topics from an American Indian perspective. The Native Waters project will include materials, professional development courses, network development, and a wide range of support services for tribal educators and resources managers. The goal of Native Waters is to provide tribal and nontribal leaders, managers, educators, students, and community leaders with contemporary, unbiased, scientifically accurate, educationally sound teaching resources, and creative programming entirely focused on water. A diverse and talented team of researchers, writers, scientists, and cultural reviewers

will be assembled to develop and implement the Native Waters project. One key element to the successful development of Native Waters is extensive tribal involvement and buy-in. The Watercourse Program will facilitate the development of Native Waters with guidance and input from American Indian tribal leaders, resource managers, and educators. The research and development phase of the Native Waters project will be launched in spring 2000 and implementation will begin in 2001 following the publication of the *Native Waters Educators Guide.* Anticipated project outcomes include increased tribal member awareness and understanding of basic water science topics (hydrology, water quality and quantity); the integration of water information and education into tribal schools; and increased nontribal member awareness and understanding of tribal water issues, challenges, and opportunities. The Watercourse Program will establish an official project division completely dedicated to the Native Waters initiative. The presenters will highlight key features of the 10-year plan for the Native Waters project.

1:15 p.m.
Changes in Fish Species Abundance in a Missouri River Main Stem Reservoir During Its First 45 Years

Jeff C. Hendrickson
North Dakota Game and Fish Department, P.O. Box 506, Riverdale, ND 58565

CO-AUTHOR
Greg J. Power, North Dakota Game and Fish Department, Bismarck, ND 58501

The objective of our study was to characterize trends in fish abundance within the reservoir. We also assessed these changes in relation to expected changes in abundance under a typical trophic upsurge pattern.

Standard netting surveys have been ongoing since 1956 in Lake Sakakawea, a Missouri River main stem reservoir, and have identified 58 different species of fish. Regression analyses were performed for the total catch rate (CPUE), total weight catch rate, and the CPUE for 20 common fish species to determine trends in fish abundance over time. Significant ($P<0.05$) positive trends in abundance were found for walleye *(Stizostedion vitreum*), white bass (*Morone chrysops*), spottail shiner (*Notropis hudsonius*), and johnny darter (*Etheostoma nigrum*). Significant negative trends in abundance were found for crappie (*Pomoxis annularis* and *P. nigromaculatus*), yellow perch (*Perca flavescens*), common carp (*Cyprinus carpio*), and goldeye (*Hiodon alosoides*).

Lake Sakakawea is relatively young as the estimated life of the reservoir is over 400 years. Information in the literature concerning long-term trends in fish populations of large reservoirs is generally lacking. This analysis of the long-term data for Lake Sakakawea should contribute to this body of knowledge about large reservoirs.

1:35 p.m.
Distribution, Abundance, and Habitat Use of the Sturgeon Chub and Sicklefin Chub in the Missouri and Yellowstone Rivers, North Dakota

Dr. Dennis L. Scarnecchia
Department of Fish and Wildlife Resources, University of Idaho, P.O. Box 441136
Moscow, ID 83844-1136

PAPERS

CO-AUTHOR
Scott R. Everett, Department of Fish and Wildlife Resources, University of Idaho, P.O. Box 441136, Moscow, ID 83844-1136

TUESDAY, MAY 23

SESSION B CONCURRENT PAPER PRESENTATIONS 1:15-2:35 p.m.

The distribution, abundance, and habitat use of sturgeon chub (*Macrhybopsis gelida*) and sicklefin chub (*M. meeki*), two declining benthic fish species (Family Cyprinidae) native to the Missouri River basin were investigated in three distinct river segments. The study area consisted of the Missouri River near Williston (the Williston segment), a moderately altered segment, the Missouri River near Bismarck (the Bismarck segment), and impounded, much altered segment, and the Yellowstone River near its confluence with the Missouri River (the Yellowstone segment), a quasi-natural segment. Both species of chub were collected throughout 94% of the range sampled in the Williston and Yellowstone segments, but none were collected from the Bismarck segment. Sicklefin and sturgeon chubs were the second and third most abundant cyprinids, respectively, collected from the Williston and Yellowstone segments. Best-fit regression models indicated that the presence of sturgeon chubs increased with decreasing depth, increasing velocity and decreasing water clarity, and that the presence of sicklefin chubs increased with increasing depth, decreasing velocity and decreasing water clarity. The Bismarck segment had significantly deeper, faster, and clearer water than both the Williston and Yellowstone segments. The absence of both chubs in the Bismarck segment may be associated with these habitat differences.

1:55 p.m.
The Yellowstone River:How Has It Managed to Remain So Good for So Long?

Fred Ryckman
North Dakota Game and Fish Department, 2007 8th Avenue East, Williston, ND 58801

The Yellowstone is a big river, coursing 678 miles from its headwaters within Yellowstone National Park to its confluence with the Missouri River in extreme western North Dakota. The Yellowstone is simply unique among the Nation's major rivers. It is the longest undammed river in the contiguous United States. The Yellowstone River discharges an average of 9.4 million acre-feet annually into the Missouri River at their confluence, which is considerably more than the 7.3 million acre-feet average annual discharge of the Missouri River itself at the confluence. From its headwaters in Wyoming to its mouth in North Dakota, the Yellowstone changes from an alpine, cold-water, salmonid-type fishery to a diverse, warm-water aquatic ecosystem. Much of the upper Yellowstone is classified as a blue ribbon trout stream, whereas the river downstream of the mouth of the Bighorn River represents what is probably the most pristine large prairie river in North America. As a result, the Yellowstone provides a diversity of aquatic habitats seldom found in any river system.

This habitat diversity supports over 50 species of fish, some of which are uniquely adapted to the river. Sturgeon, sicklefin, and flathead chubs, shovelnose sturgeon, and blue suckers are but a few of these native species with a preference for large, turbid river environments. Although populations of several of these species are in serious decline in many parts of their historic range, populations of these species appear to be much more stable in the Yellowstone. The pallid sturgeon is the only fish species in the Yellowstone River that has been federally listed (as endangered) under the Endangered Species Act. The recovery plan for this species

recognizes that some of the best remaining habitat for this species is found in the lower Yellowstone River. Since the Yellowstone River still retains many of its original habitat characteristics, it will likely become even more important as one of the last strongholds for many of these native, big river fishes. Fortunately Montana recognized the need to maintain flows in the Yellowstone for fish, wildlife, and nonconsumptive purposes. Through the water appropriation process, Montana has dedicated slightly more than half of the historic river flows as protected instream flows.

Despite the unique and apparently critical nature of the aquatic habitats that the Yellowstone River still contains, the river is certainly not without its share of problems. Unfortunately, flows in the lower Yellowstone have undergone considerable alteration. The instream flow appropriation only appropriated 5.5 million acre-feet of the 8.2 million acre-feet of water that the Montana Department of Fish, Wildlife and Parks sought to be protected. Although no large dams have been built on the river, several low head dams have been constructed on the lower river to facilitate the diversion of irrigation waters. These dams have been found to not only impede fish passage, but may also be impinging and entraining hundreds of thousands of fish each year. Tributary dams, the largest of which is Yellowtail Dam on the Bighorn River, at least partially regulate flows from 31% of the drainage basin. In total, water depletions and diversions have reduced historic flows of the Yellowstone by roughly 25%. Bank stabilization projects have impacted a considerable amount of river bank; stabilization has become an extremely contentious issue in the past few years. Irrigation return flows, oil and gas industry activities, and other developments provide additional threats to the natural resource values of this unique river. River protection efforts must be greatly improved if the Yellowstone River is to continue to be billed as the most pristine large prairie river in North America.

2:15 p.m.
Warmwater Release at Fort Peck Dam

Mike Ruggles
Montana Fish, Wildlife, and Parks, P.O. Box 165, Fort Peck, MT 59223

A decline of warm water species in the Missouri River below Fort Peck, in particular pallid sturgeon, has occurred since the operation of Fort Peck Dam. The dam altered the river's hydrograph, sediment transport, and temperature functions. Due to high runoff expected in 1997, it was anticipated the spillway would be used. Several temperature monitors were placed in the river to document the spill's influence. Temperature profiles made by the Corps of Engineers were used to determine if surface water temperatures in the reservoir would be suitable for increasing river temperatures. Average daily temperatures were calculated from hourly readings taken by the loggers and compared to other location results. Reservoir surface water reached adequate fish spawning temperatures for many spring spawners by early to mid-June. Spillway discharges had higher temperatures than the powerhouse discharges, and the effects were immediate for several miles below the spill. As the water mixed further downriver, it became cooler again. By adjusting discharges from the powerhouse and spillway it would be possible to increase river temperatures to improve habitat for many existing warm water species. Many species such as pallid and shovelnose sturgeon, blue sucker, flathead, sicklefin, and sturgeon chub, paddlefish, smallmouth and bigmouth buffalo, freshwater drum, goldeye, and other warm water species could potentially benefit from warm spring inflow from the spillway.

PAPERS

WEDNESDAY, MAY 24

SESSION A
CONCURRENT PAPER PRESENTATIONS
8:00 - 9:40 a.m.

8:00 a.m.
Lisbon Bottom – The Balance Between Navigation and Environment

Mike Chapman
U.S. Army Corps of Engineers, Kansas City District 601 East 12th Street, Kansas City, MO 64106-2896

CO-AUTHOR
Marie J. Vanderpool , U.S. Army Corps of Engineers, Kansas City District, 601 East 12th Street Kansas City, MO 64106-2896

The Flood of 1993 brought with it the beginnings of a chute on the Missouri River located at river mile 214-210 known as Lisbon Bottoms. In 1995, more flooding caused the chute to become fully connected. Flows through the chute reached values up to 30% of the entire river flow, causing concern over the stability of the navigation channel. The design to regain control of the navigation channel while maintaining newly developed aquatic habitat in the chute will be discussed. A synopsis of the coordination of these efforts and construction progress will be presented.

8:20 a.m.
Aquatic Habitat Rehabilitation Assessment, Lower Missouri River

Robert B. Jacobson
U.S. Geological Survey, Columbia Environmental Research Center, 4200 New Haven Road, Columbia, MO 65201

CO-AUTHOR
Mark S. Laustrup, U.S. Geological Survey, Columbia Environmental Research Center, 4200 New Haven Road, Columbia, MO 65201

Aquatic habitat rehabilitation projects on the Lower Missouri River can be classified into two general categories: side-channel projects and within-channel projects. Both categories generally seek to increase hydraulic diversity in the river corridor while maintaining traditional river-corridor uses, including agriculture and navigation. Adaptive management of rehabilitation projects requires monitoring and evaluating project performance, which in turn allow improved understanding to be used in the design process. Objective evaluation also requires quantifying the value of aquatic habitats that exist under present management conditions. We have been developing methods to monitor and evaluate physical habitats (depth, velocity, and substrate) at scales appropriate for aquatic habitat projects in the Lower Missouri River. Our study consists of habitats associated with a variety of navigation structures and those associated with two opportunistic habitat rehabilitation projects: a side-channel chute at Lisbon Bottom (RM 214-218) and a within-channel experiment adjacent to Jameson Island (near RM 213). Results of these case studies indicate that existing navigation structures can create complex habitats with high hydraulic diversity. Habitats forming at the rehabilitation sites are somewhat less diverse, more dynamic, and generally more like habitats that existed in the late 1800s.

8:40 a.m.
Pallid Sturgeon in the Lower Missouri and Middle Mississippi Rivers

Joanne M. Grady
U.S. Fish and Wildlife Service, Columbia Fishery Resources Office, 608 E. Cherry St., Room 200, Columbia, MO 65201

CO-AUTHORS
Jim Milligan, U.S. Fish and Wildlife Service, Columbia Fishery Resources Office, 608 E. Cherry St., Room 200, Columbia, MO 65201
Gerald Mestl, Nebraska Game and Parks Commission, 2200 N. 33rd Street, Lincoln, NE 68503
Lannie Miller, Iowa Department of Natural Resources, Blackhawk District Office, Box 619, Lakeview, IA 51450
Mike Peterson, Missouri Department of Conservation, Long-Term Research Monitoring Program, 3815 E. Jackson Blvd., Jackson, MO 63775
Robert Sheehan, Cooperative Fisheries Research Laboratory, Southern Illinois University, Carbondale, IL 62901-6511

The pallid sturgeon was listed as an endangered species on September 6, 1990. Information on the distribution and habitat requirements of this species is scarce, particularly in the center of its historic range on the Lower Missouri and Middle Mississippi Rivers. The Iowa Department of Natural Resources, Missouri Department of Conservation (MDC), Long-Term Research Monitoring Program Open River Station, Nebraska Game and Parks Commission, Southern Illinois University, and U.S. Fish and Wildlife Service's Columbia Fishery Resources Office contributed in a cooperative effort to meet Pallid Sturgeon Recovery Plan tasks on the Lower Missouri and Middle Mississippi Rivers. Project objectives included documenting relative abundance, distribution, and habitat association characteristics of pallid sturgeon and associated fish species. Agencies used standardized gears similar to those used for other large river programs; gears included gill nets, hoop nets, and set lines. Four thousand fish of 39 species were collected. Six pallid sturgeons and six pallid sturgeon hybrids were collected in the lower Missouri River in deep holes behind wing dikes. Two of the pallid sturgeon were stocked by the MDC and four were presumed of wild origin. Seven pallids, all stocked by MDC, were collected in the Middle Mississippi River. Morphometric measurements were collected on all pallid sturgeon, pallid sturgeon hybrids, and subsamples of shovelnose sturgeon collected. Measurements were used to solve the Dryer and Sheehan Character Indices and to compare index results with biologist identifications. Biologists correctly identified all of the sturgeon species measured.

9:00 a.m.
An Evaluation of Missouri River "In-Channel" Restoration Alternatives, Lower Decatur Bend Example

Doug C. Latka
U.S. Army Corps of Engineers, 12565 West Center Road, Omaha, NE 68144

CO-AUTHOR
John I. Remus, Professional Engineer, U.S. Army Corps of Engineers, 215 N. 17th St., Omaha, NE 68102-4978

PAPERS

WEDNESDAY, MAY 24

SESSION A CONCURRENT PAPER PRESENTATIONS 8:00 - 9:40 a.m.

Current restoration efforts in the channelized Missouri River involve removing/modifying river training structures. These efforts have proven costly and incur a level of risk to the maintenance of the original navigation channel. Under these circumstances it is necessary to be able to measure the value of various alternatives so that the ultimate restoration project reduces the risk while obtaining the desired restoration. The evaluation requires a standard to which the alternatives can be compared and a method to compare the alternatives to the standard to derive a "value" for the alternatives. This paper discusses the use of historic Missouri River hydrographic surveys and 2-dimensional hydraulic modeling to assess the value of various restoration alternatives at Lower Decatur Bend near Decatur, NE.

9:20 a.m.
Applicability of Hydrologic Models for Assessing Aquatic Habitat Improvements – Lower Decatur Bend Example

John I. Remus, Professional Engineer
U.S. Army Corps of Engineers – Omaha, 215 North 17th Street, Omaha, NE 68102-4978

Restoration, development, and maintenance of aquatic habitat along major rivers have proven to be both costly and risky. Per-acre construction costs can be as high as $25,000, and the potential risk to existing water resources projects can be unacceptable. However, as more emphasis is placed on the value of aquatic habitat, particularly that associated with endangered species, the pressure to develop lower cost projects and accurately assess the risk has increased. The Omaha District has designed a number of projects using existing computer models. This paper provides a general synopsis of the lessons learned to date, as well as detailed discussion of the 2-dimensional modeling that was completed as part of the Lower Decatur Bend Project.

WEDNESDAY, MAY 24

SESSION A CONCURRENT PAPER PRESENTATIONS 10:10 - Noon

10:10 a.m.
Improving the Missouri River: Our Role as Government Agencies

Mimi Garstang, Chief of Water Resources
Missouri Department of Natural Resources, P. O. Box 176, Jefferson City, MO 65102

CO-AUTHORS
John Drew, Missouri Department of Natural Resources, P. O. Box 176, Jefferson City, MO 65102
Robert Bacon, Missouri Department of Natural Resources, P. O. Box 176, Jefferson City, MO 65102

There are many changes occurring on the Missouri River. The Corps is developing a new water control plan for the main stem reservoirs. The endangered species recovery process is ongoing, and many other things happening (expansion of the Big Muddy National Fish and Wildlife Refuge, transfer of land from the Corps to the State of South Dakota, etc.). The Missouri Department of Natural Resources, as well as many other agencies, are involved in these changes.

Government agencies play a role in these changes. As the conference title indicates, "Its Everybody's Business" and has to be that way if we are going to make it work. This paper will explore some of government's responsibilities and why they are so important. These include making sure that our processes are open and inclusive, and using good science.

10:30 a.m.
Working Successfully with Missouri River Partners and Programs

Kristie McKinley
Natural Resources Conservation Service, P.O. Box 490, Sidney IA 51653

Fifty percent of the Missouri flood plain has been inundated 5 of the past 6 years. Farmers have been asking for help on the bottoms. The Army Corps of Engineers (COE), the Iowa Department of Natural Resources (DNR), and the Natural Resources Conservation Service (NRCS) all have programs that can work on the Missouri River, but they had never tried working together to solve the problem.

The NRCS, COE, and DNR agreed to work together to enroll as many acres in this area through either the NCRS Wetlands Reserve Program (WRP) or COE Mitigation Program. By having both programs available, landowners now have a choice. They can own an easement for wildlife or if they want to get out of it they can sell to the COE. By the COE enlarging its mitigation area, the landowners now have the option to sell the residual value of the WRP easements to the COE. This involved enlarging the COE mitigation area in Iowa from 2,000 to 10,000 acres, by NRCS giving Special Project status to the Missouri River for the Wetlands Reserve Program and by the DNR dedicating more staff time toward managing larger mitigation areas along the Missouri River. To date, the NRCS has spent over $1.5 million in easements to place permanent easements on 1,156.3 acres in this area.

By working together on projects, we can stretch our agency funds further and give our customers more options. Partnerships across agency boundaries can be a win-win situation.

10:50 a.m.
Permitting Agencies - Are There No Guidelines?

Dan D. Carda
Missouri River Corridor Partnership, P.O. Box 9283

This paper represents part of the watershed planning program that the Missouri River Corridor Partnership (MRCP), Inc., was charged to perform under an EPA grant. This paper will show some of the problems that have developed over the past 10 years in the building boom along the river.

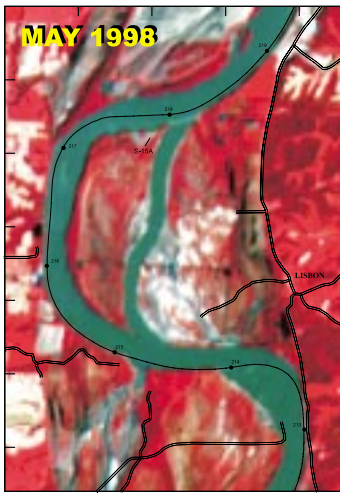
The MRCP had adopted 10 projects along the river that involved working with communities and discussing problems. This in turn led to comments about the various problems that MRCP had seen in and around its areas. During the past year these "reported problems" were investigated and photographed to try to resolve and prevent future problems.

There are cases of soil slumping in South Dakota that have caused homeowners to abandon their homes. Photo #1 is in the Pierre area and has devastated the owner and contractors in a series of accusations as to who is to blame. Photo #2 is taken on

PAPERS

WEDNESDAY, MAY 24

SESSION A CONCURRENT PAPER PRESENTATIONS 10:10 - Noon



the west side of the river in a development that has seen continual shifting of the soils over the past 10 years with associated broken water and sewer lines. One house in this development is now in danger of dropping off the cliff. Photo #3 shows a nature park that has experienced major slumping of the soil across some of the marked trails. Here is a situation in which the unsuspecting visitor could fall down a 4-foot slide, catch an arm or leg in the crevass, and get seriously injured.

Below Yankton a property owner has seen the river chew away at the riverbank until his home is now in danger of being drawn into the waters. An agricultural operator in the Mobridge area has seen the Corps of Engineers take line slowly disappear into the river and start to consume his property to the extent that his costly irrigation pivot can no longer be used as intended, thereby decreasing his crop yield.

This careless platting of land and issuance of building permits for buildings on known unstable soils are reckless abandon in performing as stewards of the land. It is clear that greed has taken a greater role than concern for the quality of the water and preservation of this natural resource. It may also come back to haunt these same agencies in the form of litigation for failing to permit properly, set realistic building codes, and inspect each building site for compliance. Broken sewer lines along with soil transport, and non-point sources of pollution are some of the penalties that will have to be paid if things do not improve.

11:10 a.m.
Monitoring the Missouri River Using Remote Sensing

Curt S. Niebur
Washington University, Campus Box 1169, One Brookings Drive, St. Louis, MO 63130

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The large number of users of the Lower Missouri River and its flood plain make management a difficult and complex problem. Regular monitoring of the river system is necessary to help assess the impact of the practices adopted by managers. However, an extensive monitoring program for the Missouri River can be difficult and expensive due to the large areas that need to be studied, frequency of observations, and the cost and effort required by field investigation. Remote sensing is a natural solution to decreasing the cost and complexity of periodic river system monitoring. Remote sensing is the technique of interpreting data collected by instruments, such as satellites, that are not in contact with the observation targets. As new sensors such as Landsat 7 become operational, the availability and quality of satellite remote sensing data increase and costs decrease. We have been developing straightforward tools based on remote sensing data that can provide valuable information about the Missouri River and its flood plain to managing agencies. These tools have been developed as part of our study of the Lisbon Bottom/Jameson Island Fish and Wildlife Refuge near Columbia, MO. This area was heavily damaged by the 1993 flood and converted into a wetlands refuge after it was abandoned. Using Landsat thematic mapper multispectral data and radar data, we have produced maps of soil moisture, NDVI (a measure of vegetation extent) and surface cover for the refuge with only a modest amount of fieldwork. Soil moisture maps of the Refuge show sand areas dry

out quickly after flood events, whereas flood plain chutes retain their moisture for long periods. Surface cover maps track the rapid vegetation succession since the 1993 Flood from xeric species to mesic cottonwood and willow saplings. Using remote sensing-derived datasets such as these allows quantitative monitoring of the condition of the Missouri River and its flood plain.

11:30 a.m.
CRMP - Missouri River Geographical Information System Establishment Efforts

Ronald D. Sando
Consultant to the North Dakota Water Education Foundation and the BOMMM Joint Board, 200 Telstar Drive, Bismarck, ND 58501

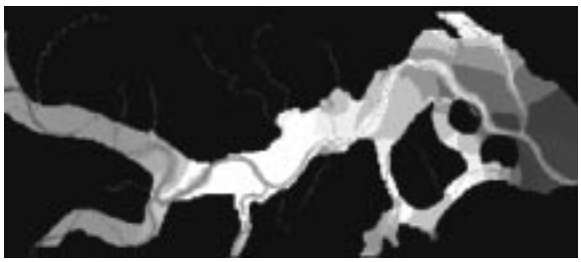
The paper explains how the North Dakota Water Education Foundation and the BOMMM (Burleigh, Oliver, McLean, Mercer, and Morton) Joint Board are attempting to establish a North Dakota Geographical Information System (GIS) for the Missouri River corridor. The GIS would provide a quantitative framework for resource information and also a baseline for assessing effects on the system's ecosystem from any past, present, or future corridor modifications. The work to date has been to identify assessment needs, establish the GIS committee, and negotiate with a state agency to house a staff and provide an archive for all digitized data. The final results are yet to be achieved. The value to the state, counties, and cities is limitless. Managers, planners, developers, regulators, and others will utilize the data to manage and monitor the riparian corridor ecosystem.

WEDNESDAY, MAY 24

SESSION B
CONCURRENT PAPER PRESENTATIONS
8:00 - 9:40 a.m.

8:00 a.m.
Effects of Alternative Missouri River Management Plans on Groundwater in the Lower Missouri River Flood Plain

Brian P. Kelly
U.S. Geological Survey, Water Resources Division, Room 223, 301 W. Lexington, Independence, MO 64050



Changes in the magnitude and timing of groundwater level fluctuations for eight alternative Missouri River management plans (ARMPs) proposed in 1998 could impact agriculture, urban development, and wetlands along the lower Missouri River flood plain. A ground-water flow model of the flood plain in the Kansas City area was used to compare ground-water depth for each ARMP with the current water control plan (CWCP), determine the groundwater response to known flood pulses, and compare simulated to measured groundwater responses at three sites along the Lower Missouri River flood plain.

The daily change in model area with depth to groundwater less than 1 foot (shallow groundwater area) is similar for each ARMP. The three conservation and the navigation ARMPs cause small increases or decreases in shallow groundwater areas compared to the CWCP. The three fish and wildlfe ARMPs cause a spring increase and summer or fall decrease in shallow groundwater areas compared to the

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SESSION B CONCURRENT PAPER PRESENTATIONS 8:00 - 9:40 a.m.

CWCP.

The groundwater response factor (GWRF), the change in groundwater level divided by the magnitude of the flood pulse at a specified distance from the river, was determined to provide estimates of groundwater response in the absence of data. GWRFs were determined from simulated flood pulses of known magnitude and duration. The GWRF is directly proportional to the length and magnitude of the flood pulse and inversely proportional to distance from the river. Results indicate that simulated GWRFs can provide a reasonable estimate of groundwater responses to stage changes for the lower Missouri River flood plain. The GWRFs indicate a small effect on groundwater levels during periods of small stage changes of daily or weekly duration. A larger effect on groundwater levels occurs from larger stage changes of longer duration. This indicates the significance of long duration releases and seasonal stage changes on groundwater levels of the Lower Missouri River flood plain.

8:20 a.m.
Status of the Benthic Fish Community in the Missouri River

Charles R. Berry, Jr.
South Dakota Cooperative Fish and Wildlife Research Unit, South Dakota State University, P.O. Box 2206, Brookings, SD 57007

CO-AUTHORS
Bradley Young, Department of Wildlife and Fisheries Science, South Dakota State University, Brookings, SD 57007
David Galat, U.S. Geological Survey, Cooperative Fish and Wildlife Research Unit, 302 ABR, University of Missouri, Columbia, MO 65211

The "benthic fish study" (1995-1999) was a joint study between five of the U.S. Geological Survey's Cooperative Research Units and the Montana Department of Fish, Wildlife, and Parks to evaluate the status of 26 benthic fishes (includes recreational species, declining species, rare species, and keystone species). Objectives of the study are to describe recruitment, growth, size structure, body condition, and relative abundance of selected benthic fishes and to measure physical and water quality features where fishes are collected. Sampling was done in late summer and fall of 1996, 1997, and 1998. Fish sampling was stratified among six macrohabitats (main channel cross-over, outside bend, inside bend, tributary mouth, connected secondary channel, nonconnected secondary channel (i.e., backwater). About 100,000 fishes representing at least 93 taxa were collected. Species richness was highest (54) at the mouth and lowest in the Montana segments where the dominant taxa were flathead chub and *Hybognathus* species. In downstream sections, dominant species were gizzard shad and channel and flathead catfish. Fish growth for some species improved downstream from tributaries (e.g., Platte River). For

each benthic species, habitat associations are being analyzed for depth, turbidity, velocity, and temperature. Spawning success is being indirectly determined by length-frequency histograms for each species throughout the river. Catch-per-effort data show (1) six gear types differ in efficiency depending on macrohabitat and (2) macrohabitats where benthic species are likely to be found. Annual reports can be found at www.cerc.cr.usgs.gov/pubs/pubs.html.

8:40 a.m.
Overview of the Middle Missouri River Historical Database

Mike LeValley
Missouri River Natural Resources Committee, 1434 316th Lane, Missouri Valley, IA 51555

The Missouri River Historical Database (MRHD) is currently under development by Rivers Corporation. The area of coverage is about Fort Randall Dam tailwaters to Rulo, NE, which encompasses two unchannelized sections of the middle Missouri River and about 480 km of channelized Missouri River. MRHD incorporates biological data extending back from the present time to 1963. Available biological data vary by year but icthyoplankton and other fish samples, and benthic and drift invertebrates are represented. Hydrological data include stage and discharge dating from the present back to the late 1800s. Information is included from most USGS gages located between Fort Randall Dam and Rulo, NE. Physicochemical data complement the biological and hydrological data but are available for limited time periods. Water chemistry, depth, velocity, substrate type, cover type, latitude, longitude, and elevation are included in the physicochemical data. This paper will describe, in greater detail, the attributes and information available for incorporation into the MRHD, those data currently in the database, and the data format.

9:00 a.m.
Sediment Transport in the Missouri River Downstream from Garrison Dam, North Dakota

Wayne R. Berkas
U.S. Geological Survey, WRD, 821 East Interstate Avenue, Bismarck, ND 58501

Sediment data were collected on and along the Missouri River downstream from Garrison Dam during May 1988, May 1989, and April 1991 to characterize sediment transport in the river. Specific study objectives were to (1) identify erosional and depositional reaches during two steady-state low-flow periods and one steady-state high-flow period; (2) determine if the reaches are consistently eroding or depositing, regardless of streamflow; and (3) determine the sources of suspended sediment in the river.

Erosional and depositional reaches differed between the two low-flow periods, indicating that slight changes in the channel configuration between the two periods caused changes in erosional and depositional patterns. Erosional and depositional reaches also differed between the low-flow periods and the high-flow period, indicating that channel changes and increased streamflow velocities affect erosional and depositional reaches.

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The significant sources of suspended sediment in the Missouri River are the riverbed and riverbanks. The riverbed contributes to the silt and sand load in the river, and the riverbanks contribute to the clay, silt, and sand load. The contribution from tributaries to the suspended-sediment load in the Missouri River usually is small. Occasionally, during low-flow periods on the Missouri River, the Knife River can contribute significantly to the suspended-sediment load in the Missouri River.

9:20 a.m.
Suspended-Sediment Loads in Selected Tributaries to the Missouri River, Garrison Dam to Lake Oahe, North Dakota

Kathleen M. Macek-Rowland
U.S. Geological Survey, WRD, 821 East Interstate Avenue, Bismarck, ND 58501

The Missouri River plays an important part in the development of the region through which it flows. Of concern to most people in the region is maintaining the integrity of the river while promoting its use. A major factor affecting the use of the Missouri River in North Dakota is the amount of sediment transport. Sources of sediment in the river are the riverbed, riverbanks, and tributaries. Although the sources of sediment are readily identifiable, the amount of sediment contributed by each source is less known. The purpose of this study was to estimate the annual suspended-sediment loads in selected tributaries to the Missouri River below Garrison Dam and in the Missouri River at Bismarck. The selected tributaries are the Knife River, Turtle Creek, Painted Woods Creek, Square Butte Creek, Burnt Creek, Apple Creek, and Heart River.

Estimates of the annual suspended-sediment loads since 1953 were derived using regression equations based on daily discharge and suspended-sediment loads for each of the tributaries and for the Missouri River at Bismarck. When too few data existed to determine a regression equation for a tributary, data from a tributary with similar characteristics were used. The annual suspended-sediment loads in the tributaries were compared to the annual suspended-sediment loads in the river to determine the relative contributions of each of the tributaries to the total sediment load in the river.

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SESSION B2 CONCURRENT PAPER PRESENTATIONS 10:10 - Noon.

10:10 a.m.
Sandbar Habitat Dynamics Following an Unusual High Water Event on the Missouri River

Casey D. Kruse
U. S. Army Corps of Engineers, P.O. Box 710, Yankton, SD 57078

CO-AUTHORS
Gregory A. Pavelka, U.S. Army Corps of Engineers, P.O. Box 710, Yankton, SD 57078
Bruce A. Vander Lee, South Dakota State University, C/O USACE, P.O. Box 710 Yankton, SD 57078

Record high flows on the Missouri below Gavins Point Dam from 1995 to1997 created large areas of high elevation sandbar habitat that became exposed when flows returned to near normal conditions in 1998. These events provided a unique opportunity to study the instream habitat alteration that occurred as a result of the high flows and to evaluate methods to extend the longevity of improved habitat

conditions. We used land cover maps produced by classifying large-scale (1:1000) color-infrared digital orthophotos of the Gavins Point reach from 1996, 1998, and 1999 to evaluate habitat changes during and following the high-flow events. Sandbar habitat increased dramatically from 1996 to 1998, with specific areas increasing as much as 5-fold in the amount of exposed sand. High flows increased sandbar habitat both by depositing sand to create new bars and by scouring vegetation from existing bars. The abundance of sandbar habitat decreased from 1998 to 1999, both from erosion and encroaching vegetation. Continued monitoring of sandbar habitat on this reach will provide important information on the longevity of the sandbars and the importance of flows in sandbar maintenance.

10:30 a.m.
Site-Scale Characteristics of Piping Plover and Least Tern Sandbar Habitat on the Missouri River

Bruce A. Vander Lee
South Dakota State University, C/O USACE, P.O. Box 710 Yankton, SD 57078

CO-AUTHORS
Casey D. Kruse, U.S. Army Corps of Engineers, P.O. Box 710 Yankton, SD 57078
Gregory A. Pavelka, U S. Army Corps of Engineers, P.O. Box 710 Yankton, SD 57078

Management and recovery activities for piping plovers (*Charadrius melodus*) and least terns (*Sterna antillarum*) on the Upper Missouri River often include creation and maintenance of sandbar nesting habitat as objectives. However, little information is available about site-scale characteristics of nesting areas to guide these actions. We are using remote sensing technologies to evaluate sandbar habitat on a larger scale than is currently available to provide information on important habitat components to direct habitat management activities. We used large-scale (1:1000) color-infrared digital orthophotos to create land cover maps of five river reaches for 1998 and integrated piping plover and least tern nest location information collected with a Global Positioning System. We used a geographic information system to summarize and compare characteristics of sandbar habitat areas, such as size, shape, degree of fragmentation, distance from shore, proximity to foraging areas, amount of vegetation, and length of shoreline. Our preliminary results suggest that site-scale characteristics may differ between used and unused habitat areas and between successful and unsuccessful nesting sites. These results can be used to evaluate current habitat conditions and identify priority areas for habitat creation or maintenance activities. Site-scale habitat characteristics should be considered in planning and implementing habitat management projects on the Upper Missouri River.

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SESSION B CONCURRENT PAPER PRESENTATIONS 10:10 - Noon

10:50 a.m.
Wildlife Management Challenges Along Lake Sakakawea and the Missouri River in NW North Dakota

Kent A. Luttschwager, Wildlife Resource Supervisor
North Dakota Game And Fish Department, 13932 West Front Street, Williston, ND 58801

The ND Game and Fish Department (NDGF) has a license grant agreement from the Corps of Engineers (COE) to manage 45,395 acres on 14 Wildlife Management Areas (WMAs) along the shores of Lake Sakakawea. Reservoir WMAs present a number of challenges, but with proper management of shoreline area on large reservoirs, many types of wildlife habitat and wildlife-based recreation are provided. Management challenges include noxious weed control, oil and gas development, annual cropping, and herbaceous cover manipulation.

Examples of challenges will be presented for the Lewis and Clark WMA (LCWMA) that is located at the upper end of the headwaters of Lake Sakakawea. The WMA consists of 8,139 acres of Missouri River bottomlands including braided channels, wetlands, cottonwoods, willows, farm and hay fields. The WMA provides habitat for several species including white-tailed deer, pheasants, turkeys, waterfowl, neotropical migrants, bald eagles, and occasionally moose and bobcats. A portion of the property was a former irrigation district that was leased from the COE to a Mutual Aid Corporation from 1957 to1977. The NDGF assumed management responsibilities in 1977 to present. Farming by permittees has continued on the WMA since 1977. The NDGF's desire to convert cropland to wildlife habitat and change farm practices has been a contentious issue since.

Silt deposition at the headwaters of Lake Sakakawea, fluctuating lake elevations, and Missouri River flows affect the LCWMA. The dramatic fluctuations can cause flooding in the spring and during the "June Rise" that results from increased flow from the Yellowstone River as a result of melting mountain snowpack in the upper reaches of the Yellowstone drainage. The dynamic water regime and its effects on wildlife habitat management will be discussed.

11:10 a.m.
Methodology and Outcomes of Biodiversity Monitoring for the Benedictine Bottoms Flood Plain on the Lower Missouri River, 1994 -1999

Martin Simon
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Lawrence Bradford, Department of Biology, Benedictine College, 020 N. 2nd Street, Atchison, KS 66002

The U.S. Army Corps of Engineers has purchased 943 hectares of land on the western shore of the Missouri River just east of Atchison, Kansas, known as the

Benedictine Bottoms (the Bottoms). The Corps revegetated the Bottoms with native tree and grass species and installed various systems to regulate the inundation of the site. The Bottoms is now being managed by the Kansas Department of Wildlife and Parks. The goal of our research has been to (1) measure the temporal changes in biodiversity of the Bottoms, (2) compare biodiversity patterns on the Bottoms with that of a nearby flood plain community at Ft. Leavenworth, Kansas, as well as historical records of biota occurring near the Bottoms, (3) to determine the population structure of selected species and, (4) determine the effect of management practices on changes in biodiversity. Permanent transects have been established at seven locations within the Bottoms. Specific methodologies are being used to quantify biodiversity patterns for the following biotypes: soil bacteria, terrestrial plants, Corps-planted tree species, terrestrial and aquatic macroinvertebrates, amphibians, reptiles, birds, and mammals. Since 1994 Benedictine Biology Department students and faculty have conducted over 8,500 hours of field and laboratory work on this program.

Baseline data collected from 1994 to 1999 indicated a movement from agricultural-based plant and animal species to those found in wetland areas. This project has been supported in part by the Kansas Department of Wildlife and Parks and the U.S. Army Corps of Engineers.

11:30 a.m.
To be announced ....

POSTERS

A GIS Model of Waterbird Distribution within a Wetland Complex

Ellen Ehrhardt
Missouri Department of Conservation, 1110 South College Avenue, Columbia, MO 65201

CO-AUTHORS
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Barry Poulton, U.S. Geological Survey, Columbia Environmental Research Center, 4200 New Haven Road, Columbia, MO 65201
Duane Chapman, U.S. Geological Survey, Columbia Environmental Research Center, 4200 New Haven Road, Columbia, MO 65201

The phenology of waterbird use of the flooding and drying of a localized complex of wetlands fed by the Missouri River and intermittent tributaries was studied in order to begin to assess the influence of the spring flood hydrology on habitat dynamics. Field surveys of waterbirds were conducted to document spatial and temporal distributions in relation to hydrology, amount of shallow water habitat, and water quality from mid-March to May 1999. Surveys were conducted on three flood plain habitats (temporary, seasonal, and semipermanent - four representative wetlands each) in order to provide samples representing a continuum of shallow habitat in three hydrologic systems: tributary, crevasse, and chute. Waterbird abundance, species diversity, and density were assessed among habitats. Waterbird location on habitats was recorded in relation to GPS locations. In conjunction with waterbird counts, sites were sampled twice weekly for water quality monitoring as an index to pond productivity (two samples per site) and sites were sampled weekly for invertebrates, providing a measurement of relative abundance of prey in shallow habitats (<24 cm) in the four habitat types and three systems.

A working model of the distribution of shallow water habitat on the flood plain during the spring hydrologic regime was developed and used to visually reproduce the distribution of shallow water and waterbird sightings and to estimate shallow habitat.

Archeological Dig at Tobacco Gardens

Ruth Hall
Fort Berthold Community College, P.O. Box 490, New Town, ND 58763

This initial dig on June 19-23 in northwestern North Dakota, McKenzie county at Tobacco Gardens was to determine the amount of artifacts located in the Danielson site. Working with various members of the U.S. Forest Service and U.S. Forest Service archeologists, the project excavated many objects, including pennies, buttons, glass, wire, a knife handle, and other objects of the time period - circa 1915-1940. A prehistorical gunflint was located to include a time period of early interaction between Native American and non-Native American culturals. Also excavated were many prehistorical objects of Native American origin: numerous arrowheads, flint flakes, ceramics (pottery), bone, and a well-defined fire pit.

The methodology included establishing reference points and excavating with trowels, picks, and brushes in 1-m by 1-m areas up to a depth of 80-cm in 10-cm increments to sterile subsoil that contained no artifacts. To date, the results are pending with the Forest Service who are carbon dating and documenting the artifacts

and will forward the results at a later date.

Major conclusions include placing the tentative time period of occupation and interaction in the Tobacco Gardens area that include both historical and prehistorical from 1050 B.C. to A.D. 100.

The project was a joint venture between the Ft. Berthold Community College and the U.S. Forest Service. Support for the project was provided by the Ah'Jo'Gun program and the U.S. Forest Service from Billings, Montana, and Watford City, North Dakota.

Bioavailability and Toxicity of Metals in Groundwater, Sediment, and Surface Waters of the Missouri River near a Lead Refinery

Duane Chapman
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T. W. May, U.S. Geological Survey, Columbia Environmental Research Center, 4200 New Haven Road, Columbia, Missouri, MO 65201
C. J. Schmitt, U.S. Geological Survey, Columbia Environmental Research Center, 4200 New Haven Road, Columbia, Missouri, MO 65201
E. V. Callahan, Environmental Statistics, Fountain City, WI
J. A. DeLashnit, U.S. Environmental Protection Agency, Kansas City, KS

Surface waters, sediments, and sediment pore waters were collected from the ASARCO Omaha facility and from the Missouri River adjacent to it. Groundwater was also collected from the facility. Inorganic contaminants were analyzed by ICP-MS (waters and sediments) and AVS/SEM (sediments). The toxicity of the waters was evaluated with the *Ceriodaphnia dubia* 7-day test. Concentrations of several elemental contaminants of concern were highly elevated in the groundwater, but not in sediment pore waters. Lead concentrations were elevated in whole sediment at one site, but the porewater concentration was only marginally elevated due to apparent sequestration by acid volatile sulfides. The groundwater sample was highly toxic to *Ceriodaphnia dubia,* causing 100% mortality. Survival and reproduction were reduced at concentrations higher than 6.25%. *C. dubia* reproduction in pore water was high except at one downstream site. This difference was significantly different from one upstream reference but not from the other. Reduced reproduction at this site could not be attributed to measured elemental contaminants in pore water.

POSTERS

Biodiversity Patterns of Terrestrial and Aquatic Macroinvertebrates on the Benedictine Bottoms Flood Plain

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In 1994 the U.S. Army Corps of Engineers initiated a mitigation project to restore 943 hectares of flood plain habitat. This flood plain site is known as the Benedictine Bottoms. The Benedictine Bottoms are located approximately 1.5 km northeast of Atchison, KS in the area known as the Rushville Bend of the Missouri River. The purpose of this study is to monitor the biodiversity of invertebrates inhabiting the Benedictine Bottoms Mitigation Site. To assess the biodiversity of the terrestrial invertebrates, sticky traps were set 1-1.3 m off the ground with 96 cm^2 covered with Tanglefoot. Pitfall traps, with a diameter of 179 cm^2, were set in the ground and filled with 2.5 cm of preservative. Although both nonflying and flying insects occurred in both trap types, we found distinct differences in the biodiversity of macroinvertebrates collected depending on the collecting method. In the study of the aquatic invertebrates, a D-shaped net was used to collect the specimens from the water and the first few inches of the substratum. Initial findings seem to suggest that abundance and size of organisms collected are related to the duration of flooding. Aquatic and terrestrial invertebrates that were collected were identified to order. Results indicate that as the mitigation process continues, the taxonomic biodiversity of invertebrates on the Benedictine Bottoms is increasing.

Bird Biodiversity on the Benedictine Bottoms Mitigation Site from 1994 to 2000

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Martin Simon, Benedictine College, Biology Department, Atchison, KS 66002

Documentation of increasing bird diversity is part of a larger study of biodiversity taking place on the Benedictine Bottoms, a site developed by the Corps of Engineers. The transition of the Benedictine Bottoms from agricultural land to a riparian hardwood forest-grassland-wetland complex is managed by Kansas Department of Wildlife and Parks. The Kansas Breeding Bird Atlas Project (KBBAT) methods are used to assess the breeding status of all species. The interior roads are driven and we sample the species and numbers of individuals seen. Changes in habitat have already attracted over 130 bird species, many associated with wetlands, the most common nonpasserine birds including: great blue heron, american coot, american white pelican, northern pintail, cattle egret, least tern, and great egret. The most common passerine birds include: red-winged blackbird, American tree sparrow, common grackle, eastern meadowlark, song sparrow, dark-eyed junco, and dickcissel. The species new to the Bottoms in 1999 is the Tennessee warbler. Funding came from Benedictine College and the Kansas Department of Wildlife and Parks.

Comparison of Pre- and Post-Impoundment Daily Flows Along the Missouri River

Mark A. Pegg
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CO-AUTHORS
Clay L. Pierce, Iowa State University, 11 Science II, Ames, IA 50011
Anindya Roy, Iowa State University, 11 Science II, Ames, IA 50011

Regulation of large rivers for human needs has become a common occurrence over the last century. The Missouri River is no exception as construction of both impoundments and channel restrictions occurred in the early to mid-1900s. One potential outcome of this regulation is an altered hydrograph. Altered hydrologic conditions can have detrimental effects on both aquatic and terrestrial organisms that have historically relied upon the natural flow regime throughout their life cycle. The goal of this study was to statistically test for differences in the pre-impoundment (1925- 1948) and post-impoundment (1966-1996) flow conditions at several points along the Missouri River. We present a quantitative analysis using time series modeling to describe the intrinsic nature of the daily mean flows at two different temporal scales: annual and spring only. We then tested for differences between the two flow periods using parameters from these time series models. Analysis of 10-gage stations, located throughout the warmwater portion of the Missouri River, indicate that daily mean flows do differ at all locations for the annual scale. However, flows at the upper and lower extremes of the river were similar at the spring scale. Gages directly influenced by impoundments in the mid-reaches were statistically different. Factors that have influenced these differences and their potential biological impacts are discussed.

POSTERS

Diurnal Variations in Suspended-Sediment Concentrations in the Missouri River at Bismarck, North Dakota

Wayne R. Berkas
U.S. Geological Survey, WRD, 821 East Interstate Avenue, Bismarck, ND 58501

Daily mean suspended-sediment concentrations in a river generally are computed using suspended-sediment samples collected once daily from one to three locations in a river cross section at about the same time. This method of computing daily mean concentrations generally is adequate for most rivers because the diurnal variations of flow in most rivers are small. However, the method may not be appropriate for the Missouri River at Bismarck. During most of the summer in any given year, discharge in the Missouri River at Bismarck can vary substantially during the day because of changes in power generation at Garrison Dam. Therefore, a study was conducted by the U.S. Geological Survey in cooperation with the U.S. Army Corps of Engineers to determine (1) the temporal variability of suspended-sediment concentrations during a 60-hour period and (2) the spatial variability of suspended-sediment concentrations within a cross section of the Missouri River at Bismarck.

Suspended-sediment samples were collected from August 19 to August 21, 1991, using the equal discharge increment method. Samples were collected every 2 hours for 60 hours from each of the 10 equal discharge locations in the river cross section. The cross section mean concentrations ranged from 69 to 157 milligrams per liter during the 60-hour period. Samples collected from the centroid or thirds of flow were poor predictors of the mean concentration for the entire river cross section. Samples collected about halfway between the high and the low of the diurnal discharge cycle were good predictors of the daily mean concentration in the river.

Effective Strategies for the Prevention of Streambed Degradation and Streambank Widening in Western Iowa Hungry Canyons Alliance

Pam Neenan
Hungry Canyons Alliance, 406 South Highway, Oakland, IA 51560

In 1992, Hungry Canyons Alliance, a nonprofit corporation, was formed to research and implement solutions to the problem of stream channel erosion in the deep loess soils region of western Iowa. Members of the Alliance represent 22 counties in the region and receives financial support from State, Federal, and county funds.

In 1999, eight three-streambed stabilization structures have been included in the Hungry Canyons cost share program. The majority of projects include hydraulic control structures. The structures generally have a raised weir section that creates an upstream backwater condition, trapping sediments upstream and reducing downstream sediment flow. The most commonly used structures are sheet pile, h-pile, rock sills, and concrete block weirs.

In 1996, Hungry Canyons Alliance received a grant from the Iowa Department of Transportation to determine what factors increased the effectiveness of the stream stabilization structures. The results of that study are included in the *Design Manual-Streambed Degradation and Streambank Widening in Western Iowa.*

The *Design Manual* describes the six stages of stream degradation and includes recommendations for when a structure would be effective in preventing further

degradation. Predictors for the amount and rate of future degradation and methods to determine cost benefits are included. The *Design Manual* explores streambed and streambank characteristics, channel conditions, and drainage features. Results of field evaluations are combined with an analysis of structure characteristics (design discharge, riprap specifications, construction, and maintenance costs) and site conditions (maximum flow rate, channel characteristics) to determine the relationship between these variables and the effectiveness of stabilization structures.

A site evaluation procedure and a site evaluation checklist were developed to help determine ongoing effectiveness of the structures. Finally, the *Design Manual* describes circumstances and design strategies for use of logs, boards, and channel debris, natural rock and beaver dams, and combination hard and soft structures such as k-dams, log and debris-catcher dams.

Fish Use and Productivity of Permanent and Temporary Wetlands at Lisbon Bottom, Missouri

Duane C. Chapman
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CO-AUTHOR
James Fairchild, U.S. Geological Survey, Columbia Environmental Research Center, Columbia, Missouri 65201

This study examined Lisbon Bottom, which lies within a sharp bend of the Lower Missouri River. This bend was heavily inundated in the 1993 flood. Sand deposition and scouring damaged its suitability as cropland and created a number of wetlands. Lisbon Bottom became part of the newly created Big Muddy National Fish and Wildlife Refuge in 1994. The levees were not maintained after the creation of the refuge and subsequent floods have further influenced the bottoms. We examined fish assemblages from temporary and permanent wetlands on the bottoms.

We also examined age and growth of selected species in permanent wetlands and documented spawning of flood plain-spawning fishes during flood events. Results indicated distinct differences in fish assemblage of various wetland types.

Formation of an Alliance to Govern the Loess Hills

Shirley Frederiksen
Golden Hills RC&D, 406 Highway 6 South, Oakland, Iowa 51560

Flanking Iowa's western border is a unique land formation that spans seven counties. Although deposits of loess soil are found across the world, nowhere else but China do they reach as high as here, where some hills are more than 200 feet above the Missouri River Valley.

The major threats to the Loess Hills are indiscriminant housing development, fill dirt removal, and woody shrub and cedar tree invasion of the few remaining prairies. A regional management team was needed to coordinate and balance the variety of interests and activities in the Hills. There was excellent media coverage and political support. Western Iowa Tourism Region and Golden Hills Resource Conservation and Development (RC&D) coordinated a Loess Hills Public Forum seeking the balance between conservation and development. The idea of a Loess Hills Alliance was

suggested and some broad vision concepts were established. The Secretary of Interior invited a delegation to Washington, DC, to discuss this unique resource. At the same time, the Iowa General Assembly drafted legislation as a vehicle for State funding. The Loess Hills Alliance is governed by a 28-member board of directors from the 22 counties that drain into the Missouri River. The work committees consist of Information and Education, Protection, Economic Development, and Stewardship.

The Loess Hills Alliance has a broad scope of work ranging from tourism and development to preservation and prairies. Maintaining the enthusiasm and local volunteers while continuing the effort to sustain the Loess Hills for the next generation is our challenge.

Fort Berthold Indian Reservation Watersheds and Pour Points

Paul Danks, Water Resources Director
Three Affiliated Tribes, HC 3 Box 2, New Town, ND 58763

This project was developed to show the location of watersheds and the different types of land uses on the Fort Berthold Indian Reservation utilizing Three Affiliated Tribes Geographic Information System program.

The background is satellite imagery taken in 1993 by EROS Data Center in South Dakota. The colors represent different types of vegetation listed on the legend. The watershed boundaries, pour points, and reservation boundaries are placed on the imagery. Soils data were clipped by the watersheds coverage. Each soils type is listed showing the amount of each soil type per watershed.

It was determined that land east of Lake Sakakawea is primarily farm land and the land west of the lake is primarily gazing lands. This project demonstrates types of land uses, soils classifications, watershed boundaries, and it identifies pour points for monitoring purposes.

Hamburg Bend Mitigation Site

Gerald Mestl., Missouri River Program Manager
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Hamburg Bend is Nebraska's first habitat restoration project as part of the Missouri River Bank Stabilization and Navigation Fish and Wildlife Mitigation Project. This mitigation site encompasses 1,630 acres of terrestrial flood plain habitat surrounding a free-flowing chute approximately 2.5 miles in length. Construction of the

chute began in January 1996 and was completed by May 1996. The chute and adjacent river fishery is sampled seasonally with a variety of techniques (e.g. seines, benthic trawls, hoop nets) as part of an ongoing monitoring program. In four years of collections we sampled 15,692 fish representing 41 species within the chute's various habitats. Seining collections were dominated by plains minnows, river carpsuckers, emerald shiners, and river shiners. We have observed that the catch per seine haul of speckled chub and silver chub is three times higher than the number of chubs found in the adjacent river in the late 1980s and early 1990s, and nearly as high as in the early 1970s. Flathead chub that were seldom seen in the adjacent river from 1986 to1993 have been regularly sampled. Plains minnow were sampled at twice the abundance seen in the early 1970s. In addition, several species of concern not previously collected or rarely collected including the sturgeon chub, sicklefin chub and blue sucker have been documented in the chute and or the adjacent river.

Hydroacoustic Remote Sensing of Sturgeon Habitat, Lower Missouri River

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The USGS Columbia Environmental Research Center (CERC), River Studies Unit is developing procedures that will allow researchers to integrate habitat measures in the context of large river fisheries studies. To test the procedures developed to date, CERC is working with the U.S Fish and Wildlife Service, Columbia Fishery Resources Office on a Mississippi Interstate Cooperative Resource Association (MICRA)-funded project to characterize overwintering sturgeon habitat on the Lower Missouri River. To ensure that the data collected on habitat conditions are reflective of fish use, fish sampling and mapping occur at the same discharge and if not at the same time, within a day or two of each other. Habitat is characterized at pairs of dikes for historical pallid sturgeon capture locations. Each dike pair includes the dike where a pallid sturgeon was netted and another dike, in the same dike field, where sturgeon were not captured. River depth, velocity, and substrate are mapped simultaneously in real time (submeter planimetric accuracy) with hydroacoustic remote sensing instruments. Point data are collected in a checkerboard pattern along transects spaced 20 meters apart. The density of the data collected approaches 3 points per square meter. Continuous surfaces (grids) representing bathymetric and bed material characteristics are calculated. Velocity profiles are collected at each site with acoustic Doppler velocimetry and analyzed for means and variance. Metrics developed from these data are compared between sites producing fish and the adjoining sites that did not.

POSTERS

Influence of Wetland Chronology/Hydrology on Aquatic Invertebrate Communities of the Lower Missouri River Flood Plain

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Flooding in the 1990s had dramatic effects in altering flood plain habitats of the Lower Missouri River. Breached levees resulted in significant scouring, sediment deposition, and changes in vegetation. Many of these altered habitats have been purchased by State and Federal agencies as rehabilitation areas where flood plain landscapes can be directly or indirectly shaped by natural riverine processes. One such parcel is Lisbon Bottom (river miles 213-218), now part of the Big Muddy National Fish and Wildlife Refuge. In 1995, additional flooding cut a new chute across the flood plain at this location and greatly increased the hydrologic and habitat diversity of permanent and ephemeral wetlands. However, little information exists concerning the ecological significance and aquatic diversity in these newly formed wetland habitats. We studied the response of benthic invertebrate communities in various aquatic habitats at Lisbon Bottom in relation to the source, frequency, and duration of spring flooding. A series of eight wetland basins representing a variety of habitat conditions were sampled every 2 weeks to compare and contrast community differences and the effects of these variables. Results indicated that there are distinct benthic community differences between the main river, the chute, permanent scours, and seasonal wetlands. A total of 92 aquatic macroinvertebrate species have been collected from the wetlands within this river reach, over one-third of which are unique to temporary wetlands. Results indicate that the creation of diverse new aquatic habitats by flooding has resulted in a continuum of wetland types and subsequent increased biodiversity. This information should provide refuge managers with valuable insight concerning habitat management and rehabilitation within the Missouri River flood plain.

Instream Flow Rights for the Platte River - A Major Tributary of the Missouri River

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The Platte River is the largest interior river in Nebraska but diversions of nearly 70% of its natural flow have created problems for fish and wildlife. For instance, the central Platte has had fish kills in 13 of the years between 1974 and 1996. In addition, whooping crane, least tern, and piping plover habitat has been lost or degraded. Even so, six major diversion applications were filed with the Nebraska Department of Water Resources (NDWR) between 1976 and 1990 although none were approved.

In 1982, the Nebraska Game and Parks Commission (NGPC) initiated State and Federal cooperative efforts to determine instream flow needs for fish and wildlife. Habitat and hydraulic data were collected in three river reaches. Suitability criteria were developed for fish species and for whooping crane roosting habitat. Additional studies included: flow versus water temperature, temperature tolerances of native fish, sociology and economics, and the relationship of river stage to wet meadow groundwater. Using this information, NGPC filed five instream flow applications with the NDWR on November 30, 1993. These requests were for protection of flows for whooping crane roosting habitat, wet meadow maintenance and fish habitat.

A contested hearing conducted by the NDWR began on September 25, 1996, and ended on April 8, 1997. In a decision issued on June 26, 1998, NDWR denied the wet meadow habitat application and affirmed many of the whooping crane roosting and fish habitat flows. These instream flow rights substantially protect habitat for fish and wildlife in the lower 250 miles of the Platte River, which discharges to the Missouri River below Omaha.

Land Use Survey

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The purpose of the study was to determine availability, usage level, and status of water on Fort Berthold Indian Reservation. The importance of this survey is to help determine the worth of land being returned to the Three Affiliated Tribes and for optimally ecologically sound land use planning. This survey was taken during the months of June and July 1995. A pencil and paper survey was administered via telephone and personal interview. Results were tabulated and are in the process of being utilized by the T.A.T. Tribal Council. The survey was a joint venture between the Three Affiliated Tribes and Fort Berthold Community College. Support for the project was received from the Ah'Jo'Gun Project at the University of North Dakota. The project is sponsored by the National Science Foundation.

Larval Fish Drift in the Lower Platte River, Nebraska

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Changes in discharge in the Platte River, whether caused by climatic conditions or water diversions, likely have an effect on fish reproduction. To evaluate the relationship between larval fish densities and discharge, we sampled the drift of fish eggs and larvae at four sites along the lower Platte River between Columbus, Ne-

braska and the mouth. Drift nets having a 0.5 by 1.0 meter opening with 0.6 mm mesh were set in pairs at 3-hour intervals for 24-hour period every other week from May through August in 1998 and 1999. In 1998, overall drift densities increased with temperature through late June and then declined. No consistent relationship could be established between drift and other physical and chemical factors, such as total discharge, suspended solids or dissolved oxygen concentrations. Cyprinids comprised 87% of the larvae sampled with catostomids, clupeids, sciaenidae and centrarchids comprising 6.2, 2.5, 1.9 and 1.4% by number, respectively. Ictalurids, athernids, and percids, combined, comprised about 1% of the drift. Analysis of 1999 samples is proceeding and we plan to continue sampling through 2003. These data will form the baseline upon which proposed water withdrawals and mitigation activities can be evaluated.

Limnology of Flood Plain Wetlands at Lisbon Bottom, MO

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This study examined Lisbon Bottoms, which lies within a sharp bend of the Lower Missouri River. This bend was heavily inundated in the 1993 flood. Sand deposition and scouring damaged its suitability as cropland and created a number of wetlands. Lisbon Bottoms became part of the newly created Big Muddy Fish and Wildlife Refuge in 1994. The levees were not maintained after the creation of the refuge and subsequent floods have further influenced the bottoms, including the creation of a chute. We examined water quality, productivity (in terms of in situ fish growth, zooplankton density and diversity, chlorophyll a, and nutrient availability) in temporary and permanent wetlands on the bottoms. Wetlands primarily influenced by river flooding were compared to those influenced by streams originating in the bluffs outside the flood plain. Results indicated differences in productivity among wetlands according to water source. In topflooding, scour ponds stratification was intermittently destroyed during flooding but was quickly reestablished. In backflooding ponds, which flood less violently, this relationship was less obvious.

Missouri River Institute: An Intercollegiate Research and Educational Initiative for the Missouri River Basin

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The proposed Missouri River Institute (MRI) is a consortium of four-year academic Institutions within the Missouri River Basin whose mission is to conduct interdisciplinary research, educational, and outreach programs that advance knowledge and understanding of cultural, ecological, economic, geophysical, historical, and social issues influencing use, management, sustainability, and appreciation of the Missouri River and its tributaries.

The MRI will develop a broad range of research and educational programs and activities dealing with the use, management, restoration, and appreciation of natural resources in the Missouri River Basin. MRI tasks will include:

- Periodically conduct and/or sponsor surveys of resource managers, basin stakeholders, scholars, and scientists for the purpose of identifying needs for research, education, and policy analysis.
- Compile, synthesize, and publish surveys and studies.
- Act as a clearinghouse for information and point of contact for basin stakeholders, scientists, and scholars conducting research and policy analysis.
- Provide forums in which scientists and scholars from a variety of disciplines can use to discuss research and educational programs and to develop funding proposals.
- Offer competitive funding or matching institutional support for external funding for integrated research and educational programs that deal with critical research and educational needs.
- Maintain and distribute a directory of institutions, scholars, and scientists conducting research and educational programs.
- Distribute the findings of scientific and scholarly research via a web page, newsletter/MRI bulletin, MRI journal/working paper series, extension/outreach media, conferences and news releases.

MRI will be a nonpartisan entity that serves to facilitate communication and the exchange of ideas between the various interest groups along the Missouri River.

Monitoring Fishes in the Lisbon Bottom Unit, Big Muddy National Fish and Wildlife Refuge

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Lisbon Bottom is a 2,200-acre unit of the Big Muddy National Fish and Wildlife Refuge. A 2-mile chute began forming from a levee breech scour hole during the flood of 1993. The chute continued to develop through the 1995 flood and became a flowing side channel in 1996. The U.S. Army Corps of Engineers is in the process of constructing river control structures to maintain the integrity of the navigation channel. The Columbia Fishery Resources Office of the U.S. Fish and Wildlife Service initiated fishery survey and monitoring work in 1997 to evaluate the impacts of the control structure project on fishes and their habitats in the Lisbon Bottom Unit. Fish sampling was conducted at 12 stations in the chute and adjacent Missouri River from

1997 to1999. Fish were collected by seine, benthic trawl, mini-fyke nets and hoop nets. Depth, velocity, substrate, turbidity, and other water quality parameters were also measured at the sampling stations. A total of 8,000 fish comprising 34 species have been collected in Lisbon Chute. Federally listed candidate species, the sicklefin chub and sturgeon chub were collected as well as species of concern, the plains minnow and blue sucker. A 28-inch-long pallid sturgeon hybrid weighing 2.75 pounds was also collected. Hybrid pallid sturgeon receive the same protection under the endangered species listing as pure stock relatives. Monitoring will continue for several years following completion of project construction.

Movements and Habitat Selection of Pallid Sturgeon in the Lower Platte River

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Pallid sturgeon (*Scaphirhynchus albus*) are classified as an endangered species and are infrequently collected in the Platte River in Nebraska. In 1998, 10 age 6 hatchery-reared pallid sturgeon were implanted with radio transmitters. The process was duplicated in 1999 with 15 age 7 hatchery-reared pallid sturgeon. Summer and early fall movements and habitat use were assessed using water and aerial surveys. Movement upstream to a distance of 20 km was observed. However, the majority of fish remained between the stocking site and the mouth of the Platte River, a distance of approximately 65 km downstream. Observations usually occurred in areas downstream of sandbars where currents converge. Eighty-eight percent of observations occurred in depths of 0.3 to 1.0 m. Mean column velocities of 0.30 to 1.00 m/sec and bottom velocities less than 0.70 m/sec were used at frequencies of 86% and 92%, respectively. Pallid sturgeon in the Platte River occupy habitats that are similar to yet shallower than those used in other rivers.

Natural Plant Recolonization and Survivorship of Cultivars on the Benedictine Bottoms:1995-2000

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The transition of the Benedictine Bottoms from agricultural land back to its native flood plain habitat was begun by the Army Corps of Engineers (Corps) at the end of the 1993 growing season. Since then the Corps has planted 176,100 tree and shrub seedlings on 550 acres and 750 acres with native grass species and legumes. Plant diversity is being monitored through a floristics study conducted by the Benedictine College Biology Department. This study is done by pressing and mounting the collected blooming plants. These mountings are then identified by using Gray's *Manual of Botany* and placed in the Benedictine Bottoms Herbarium. The progress of the Corps' tree planting is monitored by using maps and planting data. Beginning the fall of 1997 various plots were surveyed for the abundance of surviving Corps' planted trees.

The Benedictine Bottoms Herbarium has grown to include over 48 families, 111 genera, and 144 species. The results of this study are being compared to a relatively undisturbed wetland complex located 20 miles south of the Bottoms in Fort Leavenworth. The overall survivorship of the Corps' plantings was 9% from the 1994 plantings and 25% indicated in the 1995 plantings. An examination of the planting techniques, microhabitats, weather, and flooding conditions of the past 4 years reveals why certain species were successful and why others were not. This study has been supported in part by the Kansas Department of Wildlife and Parks and the US Army Corps of Engineers.

Reconciling Conflicting Management Goals: Proposed Alternatives from an Undergraduate Human Dimensions of Natural Resources Class

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Management of the Missouri River entails a labyrinth of social, economic, political, cultural, and ecological issues. Students entering natural resource professions are well grounded in ecological theory and application but often have less exposure to the social and cultural dynamics that influence natural resource management. This poster is the end-product of a class project for upper-level undergraduate students at the University of Missouri-Columbia, which is designed to expose them through hands-on experience to the challenges of addressing diverse management goals in the Missouri River Basin. They will collaborate with the Manitou Bluffs Project. The Manitou Bluffs Project was initiated to promote public participation in completing a sustainable development plan for the region, coordinating the development of a demonstration eco-tourism infrastructure, and managing newly acquired public wetlands in the Missouri River flood plain. The Manitou Bluff region consists of four counties in central Missouri. The poster will include student qualitative interview results with key stakeholders in the Manitou Bluff's region along with student analyses on how to effectively include diverse interest groups when making management decisions.

POSTERS

Reptile and Amphibian Colonization of the Benedictine Bottoms, 1995-2000

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Biodiversity of reptiles and amphibians on the Benedictine Bottoms is being studied during the transition from agricultural land to managed flood plain habitats. Throughout spring and summer, the presence of these animals is determined by weekly observations and measurements of calls (when appropriate). Nocturnal surveys are conducted by auditory sampling of chorus. Population dynamics of selected species of amphibians are also investigated by application of mark and recapture techniques (nocturnal). Specimens captured in pit fall traps are examined and identified. Relative abundance of various species is estimated. Eight species of amphibians have been identified. However, this number may be modified to 9 or 10 due to the difficulty encountered in distinguishing between the species of *H. chrysoscelis*/*H. versicolor* and *P. maculata*/*P. triseriata*. Resident species include the southern leopard frog and woodhouse's toad. These species are new distributional records for this area. Seven species of reptiles have been identified. These include four species of turtles and three species of snakes. Analysis of the data collected will be compared with the data attained from previous years to determine trends of the reptiles and amphibians.

Soil Microbial Biodiversity and Abundance on the Benedictine Bottoms

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In 1994 the U.S. Army Corps of Engineers initiated a program to mitigate the wetland habitats along the Missouri River that had been converted to agricultural use. An important function of this mitigation is to restore the disturbed habitat to previous

"natural" conditions. The Biology Department at Benedictine College has established a research program on the Benedictine Bottoms Mitigation Site in Northeast Kansas. The goal of this study is to monitor the changes in biodiversity accompanying the mitigation process. Beginning in winter 1999, soil samples were taken at depths of 5 and 10 centimeters and analyzed for the number of taxa, abundance of microorganisms, temperature, and pH.

The initial results of our investigation show a mean of 58.2 X 105 colony-forming units, with a range from 853 X 105 to 1.6 X 105, and a mean of 4.2 different taxa of bacteria occurring in a 5-g soil sample. The average soil temperature was 17.8° C , ranging from 2° C to 25.8° C, and the average pH level was 7.73. Thirty different types of bacteria were isolated.

The significance of temperature and pH levels on microbial biodiversity in the soil was analyzed and will be discussed, as well as the relationship of the depth of the soil to the abundance of microorganisms.

Study of Populations and Habitat Variables of Endangered Species on Fort Berthold

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The purpose of this study was to determine what impact the rising water levels of Lake Sakakawea would have on the reproduction rate of the least tern and piping plover, the only two endangered bird species on Ft. Berthold. The plan was to locate nests using land and water transportation and GPS technology then observe nesting sites, count the number of eggs found, and determine fledgling success rate. Due to rapidly rising lake levels, all nests were destroyed. One conclusion of the study was that if similar studies are undertaken in the future, more advanced planning is necessary. The high water levels of Lake Sakakawea pose a severe threat to the two endangered species' future experiences on Ft. Berthold. The survey was a joint venture between the Three Affiliated Tribes and Ft. Berthold Community College. Support for the project was provided by the Ah'Jo'Gun Program, the Three Affiliated Tribes, and FBCC.

Surface Water Study on Fort Berthold

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Water is the key element for survival. The quality of water determines its usability. Knowing what is in our water and what we are putting in our body is a concern to everyone. The purpose of my study was to determine the presence and quantities of certain parameters that indicate water problems in each segment of the Fort Berthold Reservation. The methodology was to get copies of chemical analysis of well test results of people who live in rural areas of the Reservation and compare the results to those from past North Dakota geological surveys. Results showed that each segment of the Reservation has problems with groundwater. Each segment has its own soils and mineral compositions due to their location, so the problems with groundwater differ but the vast majority of each household will need proper home water treatment systems. The results of my research will be used by TAT Water Resources Personnel to get assistance in purchasing water treatment system for these rural homes to protect our quality of life.

POSTERS

The Biodiversity of Mammals on the Benedictine Bottoms: 1995-2000

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One goal of our research is to quantify changes in the biodiversity of mammals living on the Benedictine Bottoms as the mitigation efforts proceed. On average, 50 to 60 standard small mammal live traps were distributed among five transect sampling sites on a monthly basis from 1995 to 2000. The traps were checked for 3 consecutive days following placement. Specimens were identified to species. The mammal traps revealed that the deer mouse (*Peromyscus maniculatus*), Hispid cotton rat (*Sigmodon hispidus*), and house mouse (*Mus musculus*) were most common. Other mammals trapped or seen in the study area included the opossum (D*idelphis marsupialis*), the badger (*Taxidea taxus*), and the coyote (C*anis latrans*). Monthly deer spotlight surveys were also conducted on a 6-km portion of elevated road surrounding a 3.5-km tract of land adjacent to the Bottoms. An average of 30 whitetail deer (*Odocoileus virginianus*) were seen during each survey. Sixty-eight percent of those deer classified were does; the remaining 32% were classified as immature bucks, mature bucks, fawns, or unclassified individuals. Comparisons with a nearby undisturbed flood plain habitat in Leavenworth, Kansas, revealed a high percentage of common mammals.

The Missouri River and Lake Sakakawea: Heart of the Fort Berthold Reservation

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The Fort Berthold Reservation was established for the Mandan, Hidatsa, and Arikara Tribes by the Fort Laramie Treaty of 1851. The original major Indian communities on the Reservation were inundated with the construction of the Garrison Dam on the Missouri River in the 1950s. Lake Sakakawea now occupies 155,000 acres of land within the Reservation boundaries and bisects it from northwest to southeast with only one bridge located west of the city of New Town. Current Reservation boundaries consist of 986,000 acres of land.

There are several recreation areas on Lake Sakakawea within the boundaries of the Reservation. Many of these are managed by the Three Affiliated Tribes either

through license or lease agreements with the Army Corps of Engineers. There are several professional-fishing tournaments held on Lake Sakakawea each summer. Recreationalists and Sportsmen/women are important to the economy of the Reservation. There are five intakes for water treatment plants on Lake Sakakawea. These support the communities of Mandaree, Twin Buttes, White Shield, Four Bears, and the incorporated town of Parshall.

For these reasons and several more, the quality of water in the Missouri River and Lake Sakakawea is of the utmost importance to the people of the Fort Berthold Reservation. The Environmental Division of the Three Affiliated Tribes has been monitoring water quality and managing the Clean Water Act, Section 106 program with grants from U.S. Environmental Protection Agency for the past 5 years.

Projects relating to water quality:

Section 106 Surface Water Quality monitoring: Currently, nine watersheds are being monitored for selected physical and chemical parameters. This year an additional six bays on Lake Sakakawea were added to the monitoring plan.

104 (b) (3) projects: Two completed, one in the process of being completed. Moved winter animal feeding areas off of riparian areas to improve and protect water quality.

Summer of 1997: In coordination with the U.S. Fish and Wildlife Service's Lostwood Wetland District, six wetlands were created to provide livestock with a water source away from the lake's shoreline, and provide additional habitat for wildlife.

Summer of 1998: Survey of 130 miles of stream/riparian in the nine selected watershed was completed. A riparian health assessment of these areas was completed that will allow for future management decisions along these areas that feed into Lake Sakakawea.

Work has also been done with the U.S. Army Corps of Engineers and the Fish and Wildlife Service to assist with monitoring piping plovers and least terns within the Reservation boundaries.

The Natural Resources office of the Three Affiliated Tribes is responsible for four water treatment facilities that use water from the Missouri River. Operators are trained and certified through several different programs.

Several irrigation projects are also being considered at this time.

The members of the Mandan, Hidatsa, and Arikara Tribes have strong spiritual ties with the Missouri River that date back thousands of years. Historically, the tribes have shown great respect and strong spiritual feelings towards the River, for without water there is little chance for life. The Missouri River is a part of their culture, their history, and their future.

The Missouri River Institute at the University of South Dakota

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The University of South Dakota (USD) established the Missouri River Institute (MRI) in 1999 to develop and promote scholarly research, education, and public awareness related to the natural and cultural resources of the Missouri River basin. Major goals are to (1) generate scientific and humanities research on the Missouri

River basin, (2) develop educational opportunities at all levels on Missouri River-related subjects, (3) create outreach initiatives devoted to the Missouri River's resources for the public, (4) support and promote the ethnic heritage of the past and present native inhabitants and Euroamerican settlers along the river and, (5) participate in the Lewis and Clark Bicentennial. Recent MRI activities include a special lecture series featuring prominent guest speakers on topics relating to the history, natural resources, and present-day concerns of the Missouri River. MRI is also developing an interdisciplinary undergraduate and graduate course for summer 2000 on the Missouri River. In the future, we intend to offer a Missouri River studies curriculum that will lead to a Master of Integrated Studies or provide a graduate or undergraduate interdisciplinary minor. Other recent projects at USD related directly to the Missouri River include water quality monitoring by high school and university students, on-going research on pallid sturgeon and paddlefish, archaeological studies of prehistoric sites and steamboat wrecks near Vermillion, a special topics course at USD on the Lewis and Clark Expedition, and a unique undergraduate research program on contemporary aspects of culture and environment along the Missouri River funded by the NCUR Lancey Program.

Upper Missouri River Environmental Monitoring and Assessment Program (EMAP-UMR) in Montana and North and South Dakota

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The EPA Office of Research Development's Mid-Continent Ecology Division, in cooperation with EPA Region 8, North and South Dakota and Montana, has begun an EMAP effort to assess selected resources of the UMR mainstem, flood plain and reservoirs. The objective is to contribute to the scientific underpinning for adaptive management of the UMR via improved ecological assessment and monitoring. Products will include recommended biological indicators, identification of potential stressors, stressor-condition associations, delineation of important sources of variation, development of appropriate sample designs for assessments, and ultimately an ecological assessment of the UMR. Sample sites will be located using a stratified random sample design that produces unbiased estimates of resource condition with known statistical confidence. In 2000, pilot studies will focus on the Garrison Reach of the UMR (ND) and Lake Oahe (ND and SD). Initial efforts will include (1) a synoptic survey of water chemistry and sediment in the river and reservoir, (2) an assessment of the trophic status of Lake Oahe, (3) quantification of longitudinal and interhabitat variation in the riverine and reservoir macrobenthos, and (4) analysis and classification of

flood plain riparian condition, including the functional significance of woody debris habitat in the mainstem.

Where Has All the Water Gone? Depletions and Water Transfers on the Missouri River

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Water availability is a growing issue, whether water is needed to irrigate agricultural lands, supply our domestic and industrial needs, maintain a healthy environment, or provide a long list of other uses. As river basins become more and more depleted, competition for water increases. Many river basins have already reached a point where almost every drop of water is consumed and we are paying the price.

This paper will explore what we know about depletions and water transfers, make comparisons with other river basins and explore what we know about the impacts that a growth in depletions might cause. The Missouri Department of Natural Resources has been involved in the issue of Missouri River depletions for a long time and played a role in the last major effort to quantify depletions done in the 1980s.

There are several points that make the discussion of depletions a timely topic. These include (1) recovery of endangered species, (2) recent debates over the management of water in the Missouri River Main Stem Reservoir System, (3) ongoing proposals to divert water out of the basin, and (4) new insights of the impacts caused by a growth in depletions aided by the Corps Master Manual analysis. On many rivers, water rights are at the heart of the debate on the recovery of endangered species. A heightened awareness about depletions may help us avoid problems experienced in other river basins. The Missouri River Basin may have options that are no longer feasible in other river basins.

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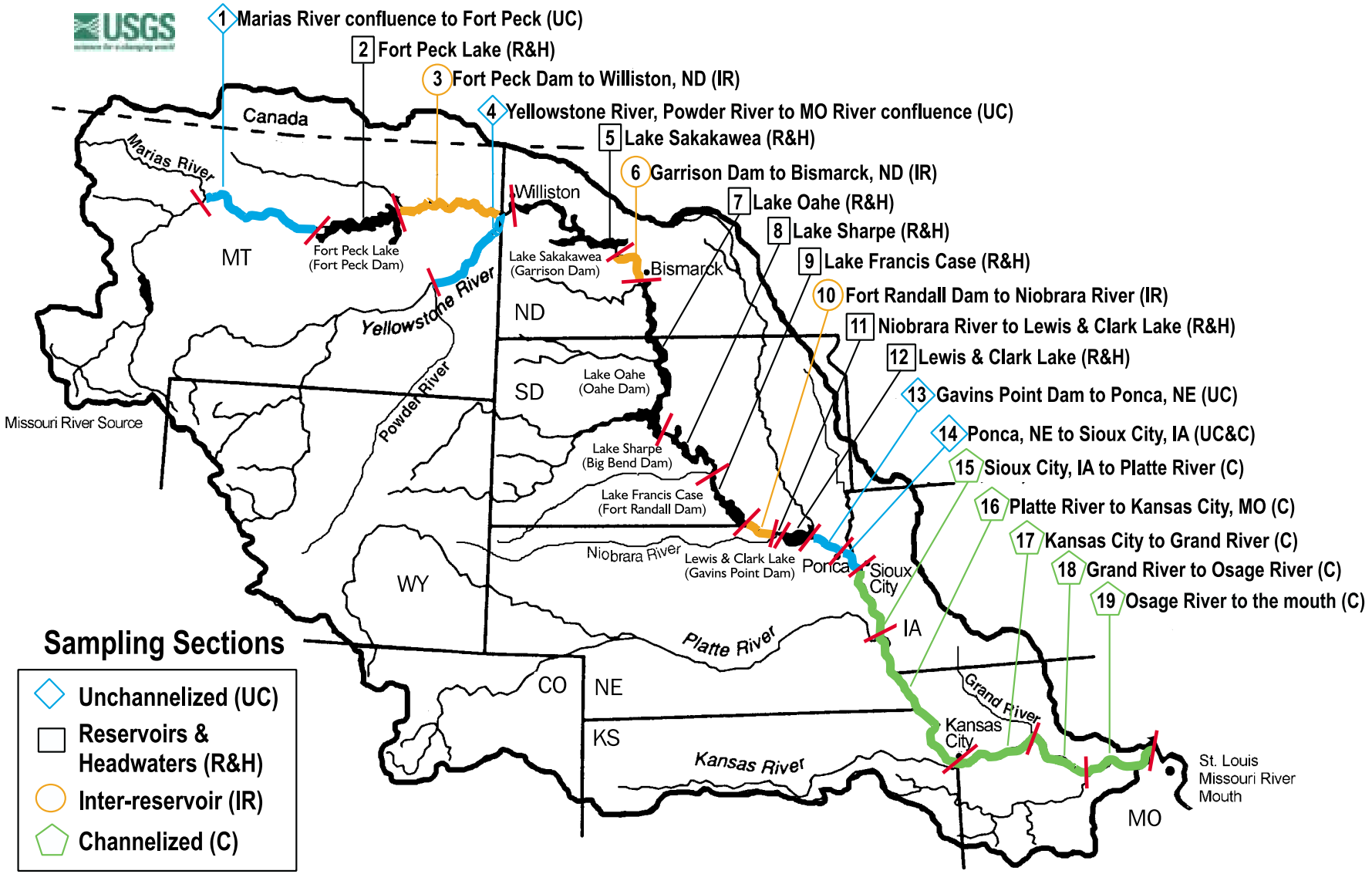

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