Proceedings

1997
GOVERNOR'S CONFERENCE ON THE MANAGEMENT OF THE ILLINOIS RIVER SYSTEM

Sixth Biennial Conference
October 7-9, 1997
Holiday Inn City Centre
Peoria, Illinois

My Experiences and Perspectives on the Illinois River
Frank C. Bellrose
9 October 1997

Introductory Remarks by Stephen P. Havera:

Frank C. Bellrose has spent over 60 years studying the various aspects of the river including its wildlife, plants, hydrology, and sedimentation. He has traveled extensively observing rivers and wetlands throughout North America and has used those experiences to apply to his insights of the Illinois River system. He is known as "Mr. Waterfowl" throughout the world. We are fortunate to have such a distinguished scientist among us and also an activist in this area. We are also fortunate to have one who is so devoted to the Illinois River and its natural resources. I take great pride in presenting my colleague, Frank Bellrose.

Thanks, Steve. Ladies and gentlemen, it's a privilege to be able to share with you some of my experiences along the Illinois River. Starting back in 1933, I made my first canoe trip down the river from Ottawa to Peoria. My companion, Robert Wagner, was the top student from the Ottawa High School and was responsible for getting me through 8 years of elementary school. Robert was a great writer and kept a daily record of his thoughts as we canoed down the river. He wrote how pristine the river was after we left LaSalle because houses became infrequent until we arrived at Henry and then more numerous as we approached Peoria. The placid nature of the river amazed us because we had been used to canoeing on the Fox River where the current is much faster. Sometimes when we stopped paddling, the west wind blew us upstream; it motivated us to keep paddling against the southwest winds.

We marveled at the lakes that we saw after Hennepin as the river changed direction from straight west to almost straight south, and we couldn't believe when the valley broadened from being a mile wide to four miles wide. We wondered why the drastic change, both in the direction of the river and the width of the valley. Then we came upon the lakes that were adjacent to the channel of the river. We were amazed at the shallow depth of these backwater lakes as we paddled through them. Lake Senachwine, over a mile wide and 5 miles long, in particular, impressed us with its shallowness—only a foot or two in depth even far from shore. We wondered about the acres of dead snags we found in some of the lakes. Why were these former forested areas submerged?

Years later, due to the work of scientists of the Geological Survey, the Water Survey, and our own work in the Illinois Natural History Survey, we answered some of these questions. But first we had to go way back to the geology of the river to understand why this big change had come in the river from west to south, and why the valley changed and why the velocity of the water decreases to just a mile or two per hour. And we learned, of course, that the Wisconsin Glacier was responsible. Previous to the Wisconsin glaciation, this was the valley of the Mississippi River extending from Hennepin to Grafton. That section of the channel from the Quad Cities to Hennepin was buried under glacial till. With the melting of the Wisconsin Glacier some ten thousand years ago, a new drainage system evolved. Waters from the rivers we now call Kankakee, Des Plaines, and Fox coalesced to form the Illinois, the waters of which formed a new channel as it coursed westward. In the region of Bureau, the outwash from the melting glacier spilled into the valley of the ancient Mississippi River with its mature valley. Thus, the unique Illinois River valley was formed with an unusually wide floodplain and an unusually low rate of fall.

Because of the ancient valley below Hennepin, the Illinois River falls at about one inch per mile. This low rate of fall resulted in the establishment of floodplain lakes, separated from the channel for the most part by a natural levee. These low, flat earthen ridges were formed by a sheer in the water velocity between the faster paced waters of the channel and the slower moving flood waters inundating the floodplain. Over thousands of years the continually building natural levees increasingly isolated adjacent water areas except at flood times when the natural levees were overwhelmed.

The bottomland lakes make the Illinois Valley what it was in historical times and what it is today. These lakes now cover about 70,000 acres at normal water level in addition to the 30,000 acres that are in the river channel. The natural lakes, shallow as they are, became very important for early commercial fishing. At one time, more fish were shipped out of the Illinois Valley to eastern markets from Chicago than any other place, except for the Columbia River. As early as the 1890s, the Illinois Valley became important for waterfowl hunting; I found scores of duck clubs were well established when I came to Havana in 1938. In fact, the duck clubs covered about 100,000 acres of the 400,000 acres in the floodplain. Most of the wetlands were owned by duck clubs; only a few thousand acres at that time were in federal or state ownership. The Chautauqua National Wildlife Refuge was just being established and the state had two small public hunting areas, one at Sparland and the other at Woodford County. Today, we find that the state and federal agencies have about 50,000 acres for waterfowl recreation, and about 60,000 acres are still in ownership of private duck clubs.

Duck hunting has always been an important source of recreation for people in central Illinois, and indeed, many come from other states to hunt here. Especially, during the first quarter century the Illinois Valley was one of the most famous waterfowl hunting areas in the nation. Superlative hunting declined after the mid-1930s with the outlawing of baiting and live decoys. Baiting by corn and other grains was employed in the early 1900s to replace the loss of mast, the result of increase in diversion from Lake Michigan—diversion which started in the early 1900s and proceeded for many years thereafter and of course still goes on today in a more limited fashion. The earliest volumes of water diverted from Lake Michigan were much greater than are currently added to the river flow. Early in the 1900s diversion raised minimum levels 3 to 6 feet depending on the particular part of the river area. This rise in water level resulted in the loss of much of the high quality bottomland hardwood forest partly made up of pecans and pin oak; they are more sensitive to the water table than willows, cottonwoods, and soft maples. The mast from oaks and pecans was a primary motivating factor for populations of mallards to migrate this far east from the prairies of Canada and the Dakotas. Acorns were the basic food for mallards and wood ducks. Thus, the loss of acorns from the decrease in high quality timber in the Illinois Valley adversely affected mallard hunting. To compensate, duck clubs resorted to corn and to some other grain to enhance waterfowl food resources. With the introduction of baiting, duck harvest became excessive—too many were killed in local areas. Therefore, the Biological Survey, the forerunner of the present Fish and Wildlife Service (Ding Darling, a well known cartoonist and conservationist was the director at that time) made baiting illegal in 1934. The loss of artificial food resources dramatically reduced mallard populations and harvest in the Illinois Valley. Providentially, farmers began using mechanical pickers for harvesting corn. One of our early studies showed that about 10 percent of the yield—about 6 bushels per acre in the early 1940s—was left after harvest. This waste corn was a bonanza for mallards who required energy to migrate to wintering grounds in Arkansas and Louisiana.

This idyllic situation lasted only through World War II. Agricultural practices changed dramatically shortly afterwards. Farmers began changing from pickers to combines to harvest corn and other crops. They were more efficient, leaving much less waste grain. In addition, fall plowing of the corn stubble became increasingly prevalent, turning under the waste corn before the ducks had an opportunity to feed on it. Hence to provide food resources for mallards and other ducks, our research suggested the moist-soil plants developing on mud flats during the summer and flooded during the fall would provide excellent food. Water levels in Illinois Valley lakes traditionally underwent a seasonal cycle: very high spring floods followed by low mid-summer levels, and a slight rise during the fall. This resulted in mud flats being exposed in mid-summer and moist-soil food plants developing on mudflats—millets, smartweeds, nutgrasses and pigweed, sawgrass or rice cutgrass, to name a few. We found that these plants provided palatable and nutritious seeds for many species of ducks. When the seeds of moist-soil seed plants are made available by flooding during the fall months they provide more nutrition for waterfowl than the natural aquatic plants that formerly grew in abundance. The principal aquatic and marsh plants characteristic of the floodplain lakes were sago and longleaf pondweeds, coontail, American lotus, and river bulrush.

Beginning in 1938, we made vegetation maps of selected Illinois Valley lakes to determine their plant communities. We found that the farther the lakes were removed from the river, the more aquatic vegetation they contained. A lake that was entirely separate from the river, like Spring Lake near Manito, which is behind an agricultural levee, had an abundance of aquatic plant beds. However, on other lakes aquatic conditions worsened from increasing turbidity and fluctuating water levels. Even the tolerant American lotus and river bulrush declined in abundance to almost extinction. The reduction in these two species, that had through thousands of years adapted to the conditions of the river environment, could not persist in their former abundance—good evidence that the Illinois River lakes were in bad shape biologically.

We found that activities on the river were changing from my early days in Ottawa. Increasingly, there was more boating on the river as urban pollution steadily abated. At one time in the 1920s, pollution was so great in the Illinois River from Chicago and other cities downstream that the river was declared a dead river biologically. Oxidation of the sludge in Peoria Lake resulted in improved conditions downstream.

We found in our first canoe trip in 1933 that water quality had really improved from that earlier period prior to the establishment of the Chicago Sanitary District in the early 1920s and before the building of navigation dams from Starved Rock eastward. The navigation dams aided pollution abatement by increasing the oxidation of sludge at it moved downstream from the Dresden Pool. Below that point, we found that there was a great improvement in water quality because of both the improved operation of the Chicago Sanitary District (which became the Metropolitan Sanitary District when they took in the suburbs) and because of the navigation dams. While urban pollution abated in the Illinois River, sedimentation increased. From our studies, we found that bottomland lakes were filling in at the rate of 1 inch per year. In a deep lake this would be relatively minor, but in the shallower-basined lakes of the Illinois Valley, it is critical to their survival. We know that 20 years ago the average depth of water in reaches north of Peoria was only 1.5 feet at normal water levels. The lakes south of Peoria were nearly 2 feet in depth and Peoria Lake was 3 feet on the average. It is apparent that sedimentation is rapidly shortening the existence of Illinois Valley lakes. It has an even greater impact on water depth. When we related sedimentation rate to water depth, trend lines disclosed a close relationship between the two; deeper waters were filling much more rapidly than shallow areas. Consequently, we can be misled at viewing the surface of lakes without realizing the amount of sediment being deposited below.

Indeed, we wondered about this years ago when we found stumps of trees that had not been covered up to any great degree by sedimentation even though they had been there 40 or 50 years. We didn't realize that deposition was going on at a faster rate in deeper waters. The upshot is that most of our lakes are pan-shaped without any great depth, except for parts of Peoria Lake. Unless some drastic action is taken, Peoria Lake will become several bodies of water separated from the river channel by natural levees; now the river enters and exits the lake continually.

All the other bottomland lakes became separated from the river channel hundreds of years ago. As the outwash from the Wisconsin Glacier receded, the immersed floodplain of the Illinois Valley contained extensive bodies of water through which the river flowed. Slowly over time, natural levees formed as the faster moving water of the channel clashed with the slow-moving flooplain water accelerating the deposition of sediments. Along this gradient natural levees were built separating lower acres of the floodplain from the river channel.

This appears to be in the process of development on Upper Peoria Lake where cross-sections of the lake near Rome reveal a raised level of bottom muds adjacent to the channel. In time, it will appear at low water stages as muddy banks marking the channel as it courses toward Spring Bay. Eventually, as the low banks become natural levees, bottomland trees will grow. As a result of sedimentation marking the river channel, we might conceive that several lateral, shallow lakes would be formed, great for ducks but not for boating or recreation.

Most central Illinois residents would like to see Peoria Lake as it is, an attractive landscape providing excellent boating and other water activities. Whether it can be done or not depends on how bad we want to do it. We're faced with a dilemma much as the world is faced with global warming. Most everyone knows that global warming is developing as the result of greenhouse gases, particularly carbon dioxide. But how much do we want to stress our economy to reduce global warming? So I think it comes right back to the situation of how much do we want to stress our economy to keep Peoria Lake intact. It's a big problem because the Illinois River drains half of the state of Illinois. There are about 12 million acres that are in row crops. This leads to a lot of sheet erosion, and then as we look at the network of tributaries with eroding banks we realize the magnitude of the problem. Many farmers cultivate within a foot or two of the stream banks which readily erode with high water; temporary greed results in long term loss. We need a green belt along these streams to reduce bank erosion. How many land owners are willing to do this? There are a lot of good farmers—and I'm one of them. I own 400 acres of erodible land that is either in woods or grass. But unfortunately, not everyone is a caring farmer. Too many people, perhaps, are absentee land owners and care only about the immediate; they don't care about the future. They only care about the bottom line this year. The problem we face, is that this watershed is so vast covering the big prairie area and there are so many millions of acres that are in farms, that to me, even with minimum tillage and the best of agricultural equipment, there is going to continue to be this problem with erosion. As long as we have this problem with silt coming into the river at the rate of 1–2 inches per acre, I think it will take more action than we've seen in the past, and indeed, we have seen some favorable action in the past. The CRP program is an example, which makes it possible for me to have my land in grass. There is hope that perhaps we'll take more seriously the ownership of land because, after all, we're only stewards for a short time. We die, we give it on to other people who will become stewards. It's how well we take this task of stewardship that will affect the future welfare of the Illinois Valley. Because the future welfare of the Illinois Valley, as I see it now, is tied up entirely in how to alleviate the rate of siltation. If we don't reduce soil erosion, it's obvious that many of these bottomland lakes, including Peoria Lake, will in 50–100 years become bottomland forests. Is that what we want? I don't think so. And we're lulled, perhaps, into a sense of complacency when we look out and see extensive tracts of water, not realizing that below the surface the bottom is getting ever closer. It would be nice to assume that our lakes are alright. It's the easiest way out for our conscience, but it's not the answer.

"AT THE HEART OF SAVING THE PEORIA LAKES"

HEARTLAND WATER RESOURCES COUNCIL OF CENTRAL ILLINOIS

416 Main Street Suite 828, Peoria, Illinois 61602-1116 (309) 637 - LAKE (5253)

Thank you for participating in the 1997 Governor's Conference on the Management of the Illinois River System that was held on October 7-9 at the Holiday Inn City Centre in Peoria, IL. Enclosed is your copy of the Conference Proceedings that contains the papers that were presented by the speakers. We hope you found this conference to be educational and provided an opportunity to network with individuals from other agencies and organizations.

Plans are already underway for the 1999 Governor's Conference on the Management of the Illinois River System. Please reserve the dates of October 5-7, 1999 to attend the next Illinois River Conference that will again be held at the Holiday Inn City Centre in Peoria. We welcome any suggestions you may have for speakers, topics, tours, exhibits, riverfront activities, and other events. We hope you will be able to join us.

Sincerely,

Bob
Bob Frazee
Conference Co-Chair

Sincerely,

Steve
Steve Havera
Conference Co-Chair

Proceedings

1997
Governor's Conference on the Management of the Illinois River System

Sixth Biennial Conference
October 7-9, 1997
Holiday Inn City Centre
Peoria, Illinois

Alesia M. Strawn, Editor
Water Resources Center

Photographs by Bob Anstine and Lynn Morford
Illinois Department of Commerce and Community Affairs

Issued as Special Report No. 24
Water Resources Center
University of Illinois at Urbana-Champaign
1101 W. Peabody Drive
Urbana, Illinois 61801
(217) 333-0536

Printed with financial support from the Illinois Department of Natural Resources.

Contents

Hydrology & Hydraulics

Economic Development

Local Initiatives

Natural Resources I

Natural Resources II

Conference Closing/Adjourn

Appendices

Planning Committee

Bob Anstine
IL Dept. of Commerce & Community Affairs
Springfield, IL

Nani Bhowmik
IL State Water Survey
Champaign, IL

Gretchen Bonfert
Green Strategies
Springfield, IL

John Braden
U of I Water Resources Center
Urbana, IL

Gary Clark
IDNR Division of Water Resources
Springfield, IL

Bob Dean
Natural Resources Conservation Service
Galesburg, IL

Mike Demissie
IL State Water Survey
Champaign, IL

Michael Eppley
IL Environmental Protection Agency
Springfield, IL

Nancy Erickson
IL Farm Bureau
Bloomington, IL

Rick Farnsworth
University of Illinois
Urbana, IL

Bob Frazee*
U of I East Peoria Center
East Peoria, IL

Lisa Haderlein
The Nature Conservancy
Peoria, IL

Anna Barnes
U of I Water Resources Center
Urbana, IL

Steve Havera*
IL Natural History Survey
Havana, IL

Jon Hubbert
Natural Resources Conservation Service
Peoria, IL

Martin Hudson
US Army Corp of Engineers
Rock Island, IL

Marilyn Leyland
Caterpillar Inc.
Peoria, IL

Jim Mick
IDNR Division of Fisheries
Springfield, IL

Thixton "T" Miller
US Army Corp of Engineers
St. Louis, MO

Lynn Morford
IL Dept. Commerce & Community Affairs
Springfield, IL

Michael Platt
Heartland Water Resources Council
Peoria, IL

Wendy Russell
Heartland Water Resources Council
Peoria, IL

David Soong
IL State Water Survey
Champaign, IL

Steve Stalcup
Association of Soil & Water Conservation Districts
Springfield, IL

Mark Werth
IL Dept. of Agriculture
Springfield, IL

***Co-Chairman**

Conference Co-Sponsors

Federal
U.S. Senator Dick Durbin
U.S. Senator Carol Moseley - Braun
U.S. Representative Lane Evans IL 17
U.S. Representative Ray LaHood IL 18
U.S. Representative John Shimkus IL 20
U.S. Representative Gerald Weller IL 11
U.S. Army Corps of Engineers
  Rock Island District
  St. Louis District
*U.S. Department of Agriculture
  Natural Resources Conservation Service
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service, Rock Island

State of Illinois
Governor Jim Edgar
Lt. Governor Bob Kustra
*Illinois Dept of Agriculture
*Illinois Dept of Commerce and Community Affairs
*Illinois Dept of Natural Resources
Illinois Environmental Protection Agency
University of Illinois
  College of ACES
  Cooperative Extension Service
  Illinois - Indiana Sea Grant
  Illinois Water Resources Center

Organizations
Association of Illinois Soil and Water Conservation Districts
Caterpillar Inc.
City of Pekin
City of Peoria
Committee on the Middle Fork of the Vermilion River
Conservation Technology Information Center
DuPage River Coalition
Foundation for Agronomic Research
Friends of the Chicago River
*Green Strategies
Heartland Water Resources Council
Heart of Illinois Sierra Club
Illinois - American Water Company
Illinois Association of Park Districts
*Illinois Chapter of the American Fisheries Society
Illinois Eco Watch Network
Illinois Environmental Council
Illinois Farm Bureau
Illinois Paddling Council
*Illinois River Carriers Association
Illinois Rivers Project
Illinois Valley Yacht & Canoe Club
Izaak Walton League
Jim Agles Chevrolet/Geo
*MTCO - Metamora Telephone Company
Marshall - Putnam Farm Bureau
Openlands Project
Pekin Energy Company
Peoria Area Chamber of Commerce
*Peoria Area Convention & Visitors Bureau
Peoria County Farm Bureau
Peoria County Soil & Water Conservation District
Peoria County Soil & Water Conservation District
Peoria Park District
Potash & Phosphate Institute
Prairie Rivers RC & D
*SeniorNet (Sponsored by Illinois Eye Center & Bradley University)
Soil & Water Conservation Society - IL Chapter
Tazewell County Farm Bureau
The Nature Conservancy
Tri - County Regional Planning Commission
Tri - County Riverfront Action Forum, Inc.
Upper Mississippi River Basin Association
Wildlife Prairie Park

***Designates Conference Underwriter**

Conference Organizers

Heartland Water Resources Council of Central Illinois
Association of Illinois Soil and Water Conservation Districts
Caterpillar Inc.
Green Strategies
Illinois Dept of Agriculture
Illinois Dept Commerce and Community Affairs
Illinois Dept of Natural Resources
- Natural History Survey
- Office of Resource Conservation
- Office of Water Resources
- State Water Survey

Illinois Environmental Protection Agency
Illinois Farm Bureau
The Nature Conservancy
U.S. Department of Agriculture
- Natural Resources Conservation Service

U.S. Army Corps of Engineers
- Rock Island District
- St. Louis District

University of Illinois
- Cooperative Extension Service
- Water Resources Center

State of Illinois

EXECUTIVE DEPARTMENT

Proclamation

WHEREAS, the Illinois River System is an integral part of our state's geography, history, economy and ecology; and

WHEREAS, these values are threatened as a result of the cumulative effects of human activities that have significantly altered the natural hydrological and biological systems of the Illinois River ecosystem; and

WHEREAS, our state should embrace an integrated approach to large river management for our river; and

WHEREAS, the implementation of the Illinois River Partnership and Conservation 2000 are important milestones in efforts to protect the resources of the Illinois River; and

WHEREAS, the 1997 Conference on the Management of the Illinois River System is October 7-9, 1997, at the Holiday Inn City Centre in Peoria;

THEREFORE, I, Jim Edgar, Governor of the State of Illinois, proclaim October 1997 as ILLINOIS RIVER SYSTEM MANAGEMENT MONTH in Illinois and urge all citizens to recognize the economic, recreational, social and environmental responsibilities we have to conserve and properly utilize the resources of the Illinois River Basin.

In Witness Whereof, *I have hereunto set my hand and caused the Great Seal of the State of Illinois to be affixed.*

Done at the Capitol in the City of Springfield this THIRTEENTH *day of* FEBRUARY*, in the Year of Our Lord one thousand nine hundred and* NINETY-SEVEN*, and of the State of Illinois the one hundred and* SEVENTY-NINTH

SECRETARY OF STATE

GOVERNOR

Proceedings

OPENING ADDRESS

Robert W. Frazee

Extension Educator, Natural Resources Management
University of Illinois Cooperative Extension Service
727 Sabrina Drive, East Peoria, IL 61611

Good Morning and Welcome! At this time I would like to convene this Opening Session of the 1997 Governor's Conference on the Management of the Illinois River System. I am Bob Frazee, a Natural Resources Educator for the University of Illinois and am serving as Co-Chair for this conference. This morning as I mingled with people in the hallways, it was exciting to be a part of the interest and enthusiasm that is being generated by holding this sixth biennial conference on the Illinois River System. I am very pleased to report, that as of a few minutes ago, we now have over 300 individuals registered for this conference. This is our largest conference ever - a true indication of the growing interest that is concerned about protecting our Illinois River System for the future! In looking over the registration list, we have a very diverse group of participants in terms of their backgrounds and the groups and agencies they represent. This is tremendous! With this diversity in mind, I would like to encourage each of you throughout the conference to actively seek out individuals with *different* opinions and viewpoints on river management. Share your thoughts and concerns with each other, open your minds to new perspectives, and explore the opportunity for compromise. A tremendous opportunity for networking will occur this evening during our conference barbecue and social at the Peoria Riverfront.

The Illinois River has been a river of extremes throughout the 20th century. It has flourished as one of the country's best fresh-water fisheries; and it has also been given up as dead, the victim of severe pollution. However, the Illinois River has been making a comeback in the past decade, and this is the focus for our 1997 Governor's Conference on the Management of the Illinois River System.

The theme, appropriately enough, is: "The Illinois River System: Examining the Opportunities." During the next two days, our conference speakers will be focusing on the six major components of the newly-developed Integrated Management Plan for the Illinois River that was developed through leadership by our Lieutenant Governor Bob Kustra. The speakers will be addressing water-quality issues, progress that has occurred, and highlight future plans that will influence the river and its watershed as we move into the 21st century.

The Illinois River System is indeed our state's most important inland water resource. It is part of the seventh largest river system in the world, draining nearly 18.5 million acres in three states. As each of us in this room must acknowledge, the Illinois River System is in jeopardy. Only through efforts like this conference, will solutions to the river's problems be found.

The Governor of Illinois, Mr. Jim Edgar, recognizes the tremendous importance of the Illinois River System to our state and further realizes that it also provides Illinois with a key environmental challenge. Consequently, the 1997 Conference on the Management of the

Illinois River System has been designated a Governor's Conference. A special Governor's proclamation has been issued to emphasize our state's commitment to conscientiously manage this important natural resource for the benefit of future generations. This Proclamation reads as follows:

WHEREAS, the Illinois River System is an integral part of our state's geography, history, economy and ecology; and

WHEREAS, these values are threatened as a result of the cumulative effects of human activities that have significantly altered the natural hydrological and biological systems of the Illinois River Ecosystem; and

WHEREAS, our state should embrace an integrated approach to large river management for our river; and

WHEREAS, the implementation of the Illinois River Partnership and Conservation 2000 are important milestones in efforts to protect the resources of the Illinois River; and

WHEREAS, the 1997 Conference on the Management of the Illinois River System is October 7-9, 1997 at the Holiday Inn City Centre in Peoria;

THEREFORE, I, Jim Edgar, Governor of the State of Illinois, proclaim October 1997 as ILLINOIS RIVER SYSTEM MANAGEMENT MONTH in Illinois and urge all citizens to recognize the economic, recreational, social and environmental responsibilities we have to conserve and properly utilize the resources of the Illinois River Basin.

This Proclamation will be on display in the foyer throughout the conference and will also be printed in the Conference Proceedings. Unfortunately, Governor Jim Edgar is unable to attend this Illinois River conference as he is in western Europe leading a two-week business trade mission.

Two years ago, following the 1995 Illinois River Conference, a statewide planning committee was formed to begin making plans for the conference convening here today. These committee members, who are listed on the blue insert in your Registration Folder, can be identified by the blue committee ribbon on their name tags. These individuals have done an outstanding job of developing the program and making the necessary arrangements. Would these planning committee members please stand and be recognized.

I am also pleased to announce that we have over 70 co-sponsoring agencies and organizations who have assisted in promoting this conference and are committed to protecting and preserving the Illinois River System. They are listed on page 36 of the Abstracts and Speaker Information Booklet. We welcome each of you and thank you for helping to make this conference a success!

This year, we are especially indebted to several agencies and organizations for providing significant financial contributions to enhance the quality of this conference. These Conference Underwriters are designated with an asterisk on page 36 of the Speaker & Abstract Booklet. They include: the Illinois Department of Natural Resources, the Illinois Department of Agriculture, the Illinois Department of Commerce and Community Affairs, the U.S. Department of Agriculture Natural Resources Conservation Service, Green Strategies, the Illinois Chapter of the American Fisheries Society, the Illinois River Carriers Association, Ameritech, MTCO-Metamora Telephone Company, SeniorNet, and the University of Illinois Illinet Training Center. For the first time ever, these donations have enabled our Conference Planning Committee to waive the registration fees for our speakers - a gesture that I'm sure is greatly appreciated by our speakers. Following our conference, each registered participant will receive a copy of the Conference Proceedings through the mail in approximately 3 months.

At this time, I would like to specifically recognize the efforts of several individuals who have made significant contributions to the organization of this conference. First is the co-chair of this conference, Dr. Steve Havera. Steve is an Animal Ecologist with the Illinois Natural History Survey and serves as Director of the Forbes Biological Station and the Frank C. Bellrose Waterfowl Research Center at Havana. Steve will be chairing the conference sessions tomorrow. Steve, thank you for the excellent leadership you have provided to this conference.

Next, I would like to recognize the Heartland Water Resources Council of Central Illinois, which has been serving as the local administrative entity for handling the many arrangements necessary to make this a successful conference. Mike Platt is the Executive Director and Wendy Russell is the Office Manager for the Heartland Water Resources Council. Please join me in thanking Mike and Wendy for their efforts in organizing this conference. While you are at this conference, if you should have questions or need local information, the members of the Heartland Water Resources Council will be pleased to help you, and they can be identified by the special ribbon on their name tags.

At this time I would like to recognize Jon Hubbert, District Conservationist for the Peoria County Natural Resources Conservation Service, who was responsible for organizing the Conference Conservation Tour that was held yesterday afternoon. This tour provided an excellent opportunity for participants to see, first-hand, the many conservation practices which are being applied to agricultural and urban land throughout the Illinois River Watershed. Thank you, Jon, for an outstanding tour.

Another individual I would like to recognize is Dr. David Soong, Hydrology and River Mechanics Leader for the Illinois State Water Survey, who has chaired our Exhibits Committee. I would like to encourage each of you to meet with the Exhibitors and to learn about the many diverse projects that are occurring throughout the Illinois River System. The Exhibit Room is located down the hallway in Conference Rooms A & B and will be the site for the refreshment breaks and tomorrow's continental breakfast. On pages 27 - 34 of your program booklet is a listing of the Exhibitor Abstracts.

A new feature to this year's conference is "Technology Showcase" where conference participants will have the opportunity to access information sites on the Internet related to river and watershed resources. The Technology Showcase will officially open at this morning's break in the Exhibit Hall and will run concurrently with the conference sessions. At this time I would like to recognize three individuals who have provided the creativity and leadership for organizing our Technology Showcase. Please join me in recognizing Dr. John Braden, Director of the Water Resources Center; Gretchen Bonfert, Lt. Governor Bob Kustra's Illinois River Liaison; and Lynn Morford, Communications Manager with the Illinois Department of Commerce and Community Affairs.

Throughout our two-day conference, please refer to the Abstract and Speaker Information Booklet for the agenda and for more complete information regarding the speaker's topic and personal background. On behalf of the planning committee, I hope that you will find this conference to be exciting, informative, stimulating, and enjoyable.

At this time, it is my pleasure to introduce to you, Dr. Ed Glover, Councilman At-Large for the City of Peoria. Dr. Glover will officially welcome you to the friendly City of Peoria, situated midway on the Illinois River between Chicago and Grafton.

Thank you, Dr. Glover, for this cordial welcome and for sharing the Proclamation that was issued for our conference from Mayor Bud Grieves that designates October 1997 as ILLINOIS RIVER MONTH for the City of Peoria. It is now my pleasure to introduce the Moderator for our Opening Session, Wayne Zimmerman. Wayne is Vice President of the Human Services Division, Caterpillar Inc. and is also a very knowledgeable and influential member of the Illinois River Strategy Team. Mr. Zimmerman will introduce our Keynote Speakers for our Opening Session.

WELCOME

Dr. Ed Glover

Councilman-At-Large, City of Peoria
Peoria, IL

Office of the Mayor

Proclamation

WHEREAS, the City of Peoria took root and grew to international fame along the shores of the Illinois River; and

WHEREAS, the Peoria Lakes represent this community's most valuable natural asset; and

WHEREAS, the City of Peoria has been a full partner in the effort to protect the Peoria Lakes and the Illinois River from the damaging effects of sedimentation; and

WHEREAS, the City of Peoria is fully committed to pursuing actions that lead to the rehabilitation of the Peoria Lakes and the Illinois River; and

WHEREAS, the City of Peoria supports the designation of the Illinois River as an American Heritage River; and

WHEREAS, the City of Peoria recognizes the importance of convening this Sixth Governor's Conference on the Management of the Illinois River System here in Peoria;

NOW, THEREFORE, I, Lowell G. Grieves, Mayor of the City of Peoria, Illinois, do hereby proclaim October, 1997 as

ILLINOIS RIVER AWARENESS MONTH

and furthermore, urge all governmental bodies adjacent to the Peoria Lakes to support measures that can restore this water body to the magnificence God created for our pleasure.

Dated this 7th day of October, 1997 A.D.

MAYOR

THE INTEGRATED MANAGEMENT PLAN FOR THE ILLINOIS RIVER WATERSHED

Lt. Governor Bob Kustra

State of Illinois
Springfield, IL

Thank you very much, Wayne, for that nice introduction. But Wayne deserves a lot of that credit too because if the fact be known when the going got tough and this small group of folks had to find a way to take the hundreds of recommendations we had for how to improve the River and bring it down to 34 that you find in that Integrated Management Plan, Wayne Zimmerman was also at that table, that's why he's so familiar with just what it took to get the job done. But, thank you, Wayne for the help that you gave us and the leadership as well.

First of all, ladies and gentlemen, thank you for having me today. This is a real privilege for me to come before you this morning. In a way it is somewhat of a personal journey. Wayne referred to that 1991 speech. It's interesting my staff has never done this before but they literally gave me the verbatim transcript of everything I said in 1991. I don't know whether that's a reminder to make sure I live up to whatever I promised back in that year or what but I think it's the first time I've ever awakened in the morning to look to see where I'm going and to find six-year old remarks that I gave at the very same conference. I also remember similar remarks to the Heartland Water Resources group where I was first educated you might say on the problems of the Illinois and the potential solutions. All along the way I've been able to count as friends and colleagues, the people who you know have been there for you and for this River and this great state. Dr. Glover (representing Mayor Peoria Bud Grieves) of course mentioned the support that Peoria's specific leadership has provided. There is just no question about that. The City of Peoria is civic and business leadership has been there for the Illinois. Bud Grieves today and his predecessor before him, the city councils then and now have all been willing to jump in and work on behalf of this great resource that they more than anyone else realizes we simply can't not let go.

My colleagues in Illinois state government starting, of course, with the Governor who needless to say I derived my authority from and he has been a tremendous partner in showing his concern for the River. But of course today the Governor is off today in western Europe; last month doing something else that is of incredible demand on his schedule and left on the day to day basis to administer to the affairs of this state are the directors of agencies. And in this particular case, the case of the Illinois River, we are blessed indeed to have working alongside of us Becky Doyle and Brent Manning. I feel like Becky and Brent are personal friends in addition to colleagues. We've worked together long and hard on this issue and on many issues confronting the Illinois River and conservation and natural resources across the state. They each have their own constituencies and when they stand before you on days like this and they talk about what they're doing, hidden in their comments are the hours upon hours it takes to sort through very difficult issues, wrestling with their own constituencies and trying to come up with some common denominator and move forward; in Becky's case, for agriculture in Illinois; in Brent's case, for natural resources in Illinois and I just want to give them extra credit for the partnership that they provided and how easy they've made it for me as we've worked our way through these series of 34 recommendations.

Along the way I've had the opportunity to visit in Washington and I tell you in a minute about my meeting with the President; that was a first of my career in state government. But it didn't start in Washington, the support that we received from the federal government. That started of course right here in central Illinois with a Congressman for whom I have the utmost respect, someone who is also willing to sit down at the table and actually roll up his sleeves and work on behalf of the Illinois River and the people who care about it. That of course is Ray LaHood. Ray has always been there for this River and for this cause and he will continue to be. Early this morning I read the latest letter that Ray had sent to the President in support of the Illinois River when it comes to the Heritage River Project and I will get to that in a moment.

When I look back on this journey that I referred to earlier, I can't help but have tremendous optimism about the future. I don't think there's any question we are going to really move into this next century having recognized how long it's taken to make progress but only cognizant of the fact that we now have a plan in front of us that can be implemented and will be implemented. When I stop and think of all the people that served on that strategy team, all the folks that sat down and put us together, especially Gretchen Bonfert who was the glue that held us all together. I'm not so sure Gretchen's ever been called glue before but the fact is that she was there and she was the coordinator and she was the person who provided the expertise in so many ways to help us move our agenda forward. In the end there were 34 recommendations. And I said from the beginning as I say today the last thing I wanted to do was leave some legacy of another report on another shelf collecting more dust. We've heard all about those reports; we know there's a few of them on shelves regarding the Illinois River and in 1991 when I gave that speech to the Governor's Conference on the Illinois River, I tried to point out how important it was for us to move forward and get something done instead of constantly talking about what we were going to do. And one of the things I'm here today to report to you is that we have already begun the implementation of the 34 recommendations in the Integrated Management Plan. And that, I think, is very good news. On the legislative side we had two bills pass the legislature. They were signed by the Governor. One provides more flexibility with filter strips and the other creates the Illinois River Coordinating Council to further the work of the plan. It is composed of citizens and government agency representatives. If I could take a moment to focus on why I think that is so important. I know that most of you are all aware that we are in the midst of a four to eight year reshuffling of state government that is supposed to occur under our democratic form of government and your Governor and I will not be in state government in January 1999 and someone else will be in our place. It is our job and your job over the course of the next year to make sure that whoever is in that new place, in the Office of Governor and Lt. Governor, the rest of the offices and the rest of the Illinois General Assembly, that they remain as committed as you are to your goals.

By creating an Illinois River Coordinating Council we first of all institutionalize the importance of this River in the Illinois scheme of priorities. Secondly, if you'll forgive me for a personal observation, since my colleagues in the legislature, and I believe this was really their idea, not mine, chose to make the chair of the coordinating council the Lt. Governor who sits there right next to the Governor and has the ear of the Governor, it seems to me that we have elevated the importance of the Illinois River project in a way that has never been done for any river in the State of Illinois in a way that, quite frankly, any number of organizations and institutions around the state would like to be as closely identified with the Governor's Office as this coordinating council will be. So our job then over the course of this next year will be to make sure that all who are interested in the political process, all who aspire to sit in the seat that I sit in, the seat that the Governor sits in, are as knowledgeable as possible and as supportive as possible of the Illinois River and everything we do.

The Conservation Congress voted overwhelmingly last month to support the implementation of the Integrated Management Plan. The Illinois River Watershed Speakers Bureau has been established in Champaign. In the next few weeks, the Governor will be making a major announcement, a press conference. That announcement will involve a private philanthropist who has stepped forward to make a substantial donation for wetland restoration. We believed from the beginning that this had to be a private public partnership. We in the public sector took the lead. We wanted our private sector partners to be right alongside of us as Wayne Zimmerman was alongside of us at that table a few months ago.

Well, we now have the very first evidence that our message was received by the private sector, by private individuals who have the resources to come to the table and help us in wetland restoration. I am truly excited about that announcement which is soon coming.

We have federal grant applications pending for analysis of silt, to find other uses for it. A federal grant application pending with the US Department of Agriculture that would advance and recommend a variety of conservation and restoration activities.

I went to Washington just recently and put in my bid for the application sitting in the USDA right now for four hundred million dollars. It's absolutely critical that Illinois be out front on that. Your entire Congressional delegation is united on that front and we intend to move it forward.

Caterpillar is investing in the development of silt removal technology. The Corps of Engineers has received funding this year and next year to work with a local task force and the Illinois Department of Natural Resources who has committed to be a cost-share partner in addressing the sediment in the Peoria lakes. A one-hundred thousand dollar appropriation for the US Army Corps to initiate activities next year for five of the recommendations. Federal and state agencies are cooperating to determine how to improve our water and sediment monitoring ability.

Ladies and gentlemen, I think my point has been made. We have taken 34 recommendations and over half of those are right now in the process of being implemented. We'd like to see to it that each and every one of those are implemented as we move through this year and into the next few years. I am absolutely confident that we can do that.

It was indeed a remarkable coincidence that not more than a few days after we announced the Integrated Management Plan right here in Peoria in January, President Clinton gave his State of the Union message and it called for the identification of ten heritage rivers. Later we learned that incorporated in that plan would be a provision for a river navigator. Someone who would be given to a state like Illinois and a river like the Illinois. And that river navigator would work with federal, state, local agencies to move forward the agenda of yours and mine. I felt so strongly about the need for the Illinois River to be one of those ten rivers that a few weeks ago, as I said earlier, I traveled to the President's press conference and his announcement of this project. It was interesting because among all the 50 governors and lieutenant governors, I wound up being the only one there of any of those folks. So, needless to say, the White House staff was taking a little more of a look at Illinois and a little more look at me. I was getting praised for being out there by everybody that President Clinton and the Council on Environmental Quality had working for him that day. It was just a good time to be there speaking up for Illinois. There were a few mayors there from the east coast who were there to speak for their rivers, but the other thing I learned about this particular effort is that some of the states in this country have already divided up. Some of the small eastern seaboard states where you have three or four or five rivers running through them, the congressmen from the northern end of the state are thinking about putting in an application for their little old river and the congressmen from the southern end of the state are looking to put an application in for their little old river. They're divided. When I returned to Illinois after receiving so much support it seemed from the Administration on our efforts here, number one, they were aware of what we were doing here on the Illinois; number two, they were thankful for some of the support that we gave them publicly for the Heritage River Project and I might add that Congressman Ray LaHood has been very vocal in his support of that program as well.. That were cognizant of that and it was clear to me that they wanted to move this forward. I am absolutely confident we are going to do very well if we can all come together here in Illinois on an application that speaks for our statewide problems and for the Illinois River and all its watersheds. To that end in mind, I sat down two weeks ago with Mayor Daley to talk about the fact that there was some rumblings about the Chicago River being a separate application and how if we did that we frankly looked just as ineffective as our friends out in those eastern seaboard states by dividing up the power and influence of this great congressional delegation and the work that must be done in Washington to get on that list of ten. Mayor Daley agreed with me that since the Chicago River is part of the Illinois River watershed we all ought to be in this together. And there ought to be one application going to Washington for the Illinois River watershed, that will include of course the Des Plaines, and the Fox, and the Kankakee, and most importantly from the standpoint of the Mayor, the Chicago River and I might add that Friends of the Chicago River have done wonderful things with the Chicago River. I have friends who are working on that river and it is just absolutely unbelievable to think that you can make that kind of progress given what they were up against just a few years ago.

So, the good news is that we are all working together. We certainly have our work cut out for us but I am absolutely confident that with conferences like yours, with the support and enthusiasm you bring to this conference that we will indeed get the job done. So once again have a great conference. I truly hope you realize that we in my office are here to help in any way that you think we can and when that day comes that you need help, please call us up over in Springfield and we will be by your side and I have tried to be over these last few years. It's been great working with you. Thank you very much.

USING T BY 2000, THE 1996 FARM BILL, AND CONSERVATION 2000 TO PROTECT THE ILLINOIS RIVER AND ITS WATERSHED

Becky Doyle

Director, Illinois Department of Agriculture
Springfield, IL

Throughout most of this administration, the Illinois Department of Agriculture has had the privilege of working with Governor Edgar and the Lieutenant Governor's office on strategies to protect and enhance the Illinois River.

The farm community's participation in this effort is central to its success considering roughly eight of every 10 acres in this state is involved in agricultural production.

Implementing the necessary practices is a challenge for farmers, who it seems each year have to squeeze their bottom line. It's a continuous struggle to hold costs down while making the most of market opportunities. Farmers pay whatever it costs to produce a crop and take whatever price others decide to pay them for that crop.

Despite these market pressures, Illinois farmers have taken to heart contemporary emphasis on environmental stewardship. They are taking steps to better target pesticide application, conserve soil and protect water quality. In the process, they are finding ways to farm more efficiently and better maintain their financial bottom line.

Shakespeare said "One touch of nature makes the whole world kin." Certainly our efforts to protect the Illinois River have conceived a family of concerned leaders and doers from every social, economic and political background.

Nowhere is the commitment to protect and enhance our natural resource base more apparent than on farms across Illinois.

Fifteen years ago, the Illinois Department of Agriculture together with the state's 98 county soil and water conservation districts, initiated the Illinois Erosion and Sediment Control Program, more often called T by 2000.

The primary objective is to help Illinois meet the legislatively mandated goal of T, or tolerable soil loss levels, statewide by century's end. Reducing soil loss to T is essential to maintain the long-term agricultural productivity of the soil and to protect water supplies from sedimentation.

T by 2000 is a voluntary approach to erosion and sediment control, using education and financial assistance to benefit urban and rural citizens.

Illinois was the first Midwestern state to initiate a T by 2000 program for reducing soil erosion. Other states, including Missouri, Indiana, Iowa and Wisconsin, have since adopted similar programs.

Similarly, Illinois was the first state to complete a comprehensive, county-by-county soil conservation survey to measure progress in this effort. Each year since 1994, soil and water conservation districts, together with the Illinois Department of Agriculture and farm organizations, have worked in partnership to conduct the survey. The survey is important not only as a measure of our success but also as a means of identifying areas in which we need to focus our resources and as an aid in developing conservation strategies.

Survey results show steady progress toward our statewide goal of achieving tolerable soil loss levels, or T, by the year 2000.

In 1997, expanded use of conservation tillage on soybeans fueled a 2 percent increase in the amount of Illinois cropland below T. Now, more than 78 percent, or 18.1 million acres, are within tolerable levels. That compares to only 59.4 percent of cropland acres at T in 1982, the year before our T by 2000 program began.

Soil loss on another 3.1 million acres – or 15 percent of cropland– this year was only slightly higher than T. Slight changes in management practices could easily bring these acres to tolerable levels. The number of acres with soil loss at T or below continues to grow and the number of acres for which soil loss is unknown continues to shrink as the survey system improves.

Most of our best protected acreage is within the Illinois River watershed. Still we're in no position to rest on our laurels. Fulton, Schuyler, Brown, Pike, Scott, Greene and Jersey counties, in particular, have considerable conservation needs. But we have made considerable progress with a wholly voluntary system, and I am confident increased state investment and increased local commitment will speed our progress toward our goal.

In terms of tillage systems, the survey reported 43.7 percent of the state's cropland is farmed using conservation tillage methods, a 4.7 percent increase from 1996. The increase stems from a 10.6 percent jump in conservation tillage soybean acres, which offset slight decreases in this category for corn and small grains. Conservation tillage practices, which include both no-till and mulch-till techniques, were used on 61.6 percent of total soybean acres, 26.7 percent of all corn acres and 52.8 percent of acres devoted to small grains.

In addition to tracking tillage practices and progress toward T, surveyors record the amount of crop residue left on fields after spring planting.

This year, residue levels on 43.3 percent of the state's cropland, or 9.2 million acres, measured greater than 30 percent. This represents a 6 percent increase from 1996.

As technology has changed and improved, so has our capability to measure cropland soil loss. In keeping with that, Illinois will employ the Revised Universal Soil Loss Equation, known as RUSLE [RUSSEL], when calculating future survey data. I believe this more accurate measure of soil loss will show we have made even much better progress than past measurements have shown.

Much of the work remaining will likely involve investment in conservation structures. Toward that end, we are very fortunate in Illinois to have Conservation 2000.

As you know, Governor Edgar proposed Conservation 2000 to protect natural resources, provide wildlife habitat and enhance outdoor recreational opportunities. Several state agencies share responsibility for administering the program. The Agriculture Department is charged with program initiatives aimed at enhancing the long-term viability of environmentally compatible agricultural systems.

Conservation 2000 provides increased funding for soil and water conservation district programs and for three major initiatives: cost-share, streambank stabilization and sustainable agriculture.

In Fiscal Year 1998, Illinois soil and water conservation districts will receive $4.2 million in Conservation 2000 operations grants from the Illinois Department of Agriculture, plus an additional $1 million in capital cost-share monies. That compares to $1.8 million in operations dollars with *no* capital contributions in Fiscal Year 1996, the year Conservation 2000 funding began.

This year, $3 million is available for the Conservation Practices Program, which helps defray the cost for landowners to implement soil-saving structures. That's three times the state's investment just two years ago. And roughly half that expenditure is targeted toward districts in the Illinois River watershed.

Conservation practices, such as terraces, filter strips and grass waterways, are aimed at reducing soil loss on Illinois cropland to tolerable levels by the year 2000. The Agriculture Department distributes funding for the cost-share program to Illinois' soil and water conservation districts, which prioritize and select projects.

Cost-share initiatives are an effective way to focus on sites with the greatest potential for erosion and to concentrate resources there. With that goal in mind, to qualify for the program, land upon which the owner plans to install a conservation practice must be experiencing erosion at rates greater than one and one-half times the tolerable soil loss level. Landowners must also be cooperators with their local district and have on file a district-approved conservation plan.

Selection of cost-share projects is made at the district level, using local experience and knowledge. Districts many also set maximum cost-share rates for each practice, up to a maximum of 60 percent. Maximum cost-share payments may also be established for each project. Cost-share payments are based on locally established average costs for similar conservation practices.

Assistance is targeted toward projects that save the most soil or benefit the most acres per dollar spent. In Fiscal Year 1998, we are specifically targeting land exceeding 1½ times the tolerable soil loss level. Recipients of cost-share monies must agree to continue or maintain structural conservation practices and possibly some management practices for at least 10 years.

Last year, the state funded 891 conservation cost-share practices, up from 592 the year before. We expect to fund as many as 1,400 projects this fiscal year.

Clearly, through the efforts of our conservation partners, the districts and the Natural Resources Conservation Service, we are identifying the most vulnerable areas and taking steps to protect them.

We have also been very active demonstrating and expanding efforts to reinforce eroding streambanks. A major source of sediment buildup in bodies of water like the Illinois River, streambank erosion also threatens soil, plant and animal resources. It decreases depth and holding capacity of lakes and reservoirs and reduces stream channel capacity, which increases the likelihood of flooding and additional streambank erosion. Of course, excessive flooding degrades water quality and damages fish and wildlife habitat.

The streambank stabilization and restoration program is designed to demonstrate effective, inexpensive vegetative and bioengineering techniques for limiting streambank erosion. Program monies fund demonstration projects at suitable locations statewide and provide cost-share assistance to landowners with severely eroding streambanks.

Originally focused on the inexpensive willow-post method of streambank stabilization, the program has since been expanded to include other cost effective techniques as well, including longitudinal peaked stone toe protection (a stone dike that creates a windrow along the toe of the eroding bank), bendway weirs (angled rock sills that project from the outer bank and extend across the deepest portion of the stream), rock riffles (small stone grade control structures constructed across a stream channel to halt degradation and break the water flow), and willow curtains (use of a single dormant willow stem placed horizontally in a shallow trench and anchored in place. A new growth emerges along the entire length from the top of the stem, and a row of new roots sprouts from the bottom).

Illinois' Agriculture Department, soil and water conservation districts and the USDA's Natural Resources Conservation Service serve as partners in implementing the program, bringing federal, state and local resources to bear in diffusing a major threat to water quality.

This year, we are dedicating nearly half-a-million dollars to streambank stabilization efforts, up from $125,000 two years ago, when Conservation 2000 funding began. So far this year, we have targeted about half our total allocation, $224,000, for 38 projects within the Illinois River watershed.

As important as protecting our water resources is to Illinois, Conservation 2000 also has another purpose: to safeguard and enhance our agricultural potential for generations to come. Hence state funding for sustainable agriculture.

Sustainable agriculture is a system of farming designed to balance environmental and economic concerns. Practices are aimed at maintaining producers' profitability while conserving soil, protecting water resources and controlling pests through means that are not harmful to natural systems, farmers or the general public. The Conservation 2000 grant program funds sustainable agriculture research, education and demonstration through conferences, training, on-farm research and educational outreach.

The state's Sustainable Agriculture program has gone from no funding before Conservation 2000 to $600,000 this fiscal year, helping to maintain a fertile base for agriculture's future.

Over the last two years, the department has funded 47 sustainable agriculture projects, of which 35 or so were located in the Illinois River basin.

Not officially part of Conservation 2000 but nonetheless an important adjunct to it is the Illinois FarmAsyst Program.

Illinois FarmAsyst helps rural residents identify potential sources of pollution on their farmsteads. It is a voluntary self-assessment program that provides information and step-by-step worksheets people can use to measure risks for contamination and take corrective action. The department administers the program in conjunction with soil and water conservation district offices.

Since the program began in 1996, nearly 500 assessments have been conducted. Almost all these assessments were for farmsteads in the Illinois River basin.

Finally, today, I'd like to say a few words about how the 1996 Farm Bill fits into our efforts to conserve soil and protect water quality, particularly along the Illinois River.

While the farm bill has little impact on the initiatives I have outlined thus far, it does assist our efforts by providing ancillary assistance.

Conservation compliance remains a requirement for receiving federal agricultural payments. In keeping with this requirement, the USDA's Natural Resources Conservation Service continues to conduct status reviews to ensure farmers administer acceptable conservation systems.

As I mentioned earlier, many farmers already have conservation systems in place that reduce soil loss to tolerable levels. Others are actively working towards soil loss reductions by applying reduced tillage systems or structural conservation practices. Farmers found out of compliance risk forfeiting their right to a federal payment.

The farm bill continues the Conservation Reserve Program, which offers farmers an economically viable opportunity for removing environmentally sensitive land from crop production.

Last spring, more than 346,000 acres were offered for the program. More than 174,000 acres – or 1.1 percent of Illinois' cropland acres – were ultimately accepted.

We would like to see Illinois' share of program participation be much higher. To help achieve this goal, we are proposing establishment of additional CRP conservation priority areas in some of the most environmentally vulnerable parts of Illinois. If the Farm Service Agency accepts our proposal, landowners within the designated area who submit bids will receive additional points in the national selection competition.

Currently, Illinois' conservation priority area stretches along the mid and lower Illinois River basin. In all, 691,409 cropland acres, or about 2.8 percent of the state's cropland acres, are included in this designation.

The farm bill allows for up to 10 percent of cropland acres to be designated as priority areas.

Using information from the recent CRP sign up and other data gathered by state natural resource agencies, we are proposing adding areas where there is a fairly high level of landowner interest in CRP but a low acceptance rate.

Of these areas, we are only including acreage considered natural resource priorities by the state: namely, counties that have a high number of cropland acres exceeding 2T or that are rich in wildlife, wetland or ecosystem resources. Proposed priority areas include several counties in the Illinois River watershed

Additionally, of course, the farm bill created the Environmental Quality Incentives Program, called EQIP. That program helps target financial assistance to high priority areas of the state.

Together, state, federal and local efforts are making a real difference in Illinois. I believe they are a testament to what we can achieve through voluntary means if we provide the technical, programmatic and financial assistance farmers and landowners need to be the best environmental stewards possible.

There is still a lot of work to do. But we are headed in the right direction. Moreover, we are getting where we need to be without shackling farmers with an unbearable burden of expensive and cumbersome regulation. That is quite an achievement, and one in which I think everyone involved can take pride.

Thank you.

WHAT CONSERVATION 2000 WILL MEAN FOR THE ILLINOIS RIVER SYSTEM

Brent Manning

Director, Illinois Department of Natural Resources
Springfield, IL

Good morning.

I would like to begin by thanking Lieutenant Governor Bob Kustra for his outstanding efforts regarding the Illinois River system. He and his staff have worked tirelessly on this effort. The Lieutenant Governor has done a tremendous job in pulling everyone together to develop the management plan.... and following up to ensure the plan is implemented. I know he also has been in Washington urging the President to designate the Illinois as an American Heritage River and to obtain funding for the needed work on the system. Illinois government will be losing a champion of the natural resources next year when Bob returns to the private sector.

I've been asked to speak with you today about Conservation 2000 and what it is doing and can do for the Illinois River system.

Conservation 2000 has resulted in the creation of partnerships throughout the state and the number is growing. Together, state agency partnerships, in conjunction with the ecosystem partnerships, have the ability to implement strategies for watershed remediation, flood control, economic development, research and education projects. Those strategies encompass many of the recommendations that the Lieutenant Governor's integrated management plan is trying to achieve.

The integrated management plan calls for the implementation of regional strategies to protect, restore and expand critical habitats.... particularly in key high-quality tributaries through the watershed and the headwaters of tributaries in northeastern Illinois.

Conservation 2000 is providing a way to preserve, restore, and enhance the Illinois River watershed through its flexibility to create innovative, effective partnerships to implement action plans and put together funding sources.

Conservation 2000 is accomplishing several things:

1. It is redirecting resource management to a more broad based holistic approach;

2. It is allowing D-N-R to develop new, better and stronger partnerships with local groups, communities, and agencies than ever before;

3. It is providing a mechanism for local communities to leverage more dollars for watershed management than ever before.

The Illinois River system is one of the most important natural resources shared by the citizens of our state. It is vital to the economy and the environment of Illinois, and the nation.

Historically, the Illinois River was one of the most productive rivers in North America – its fish and wildlife population virtually unequaled. Today, even after experiencing drastic changes brought about by human intervention, the Illinois River remains our state's most important river system.

Its basin and tributaries total 32-thousand-81 square miles... touches over 50 counties... and includes over half of the area of Illinois. Accordingly, the Illinois River is affected by and affects the majority of our state's citizens. Half of Conservation 2000's ecosystem partnerships are in the Illinois River watershed. All or part of the eleven of 22 partnerships reside there.

Many worthwhile Conservation 2000 projects are being undertaken within the Illinois watershed. For example.... the Mackinaw River partnership is undertaking 15 habitat improvement projects from stabilizing streambanks to prairie restorations to wetland creation.

Within D-N-R, the Ecosystems Program is the largest program funded by Conservation 2000. This voluntary, incentive-based program specifically encourages participation by private landowners and local coalitions of stakeholders to form ecosystem partnerships throughout Illinois.

Funds are provided to the partnerships for projects that preserve and enhance the watershed's natural resources while addressing local economic and recreational concerns.

Last year more than one-point-six million dollars was provided to 60 ecosystem projects. This year, we have received applications for 255 projects totaling nearly 8-million dollars. We have nearly three-million dollars to award... but clearly you can see the popularity of the program continues to outpace the funds available.

The ecosystem partnerships are not relying solely on the grant funds from state government. I'm pleased to say in the last round of grants, the partnerships provided nearly two-point-three million dollars of their own either through cash or in-kind contributions. Those contributions from private sources will need to continue.... and to strengthen... for this program to make a lasting difference.

Truly, Conservation 2000 and the ecosystem partnerships are changing the ways D-N-R manages natural resources. We are moving away form traditional, single species... or discipline oriented management... to strategies for communities and ecosystems.

It just makes good sense to use watersheds as the geographical units for implementing this new resource management strategy.

This watershed approach for Conservation 2000 and the ecosystem partnerships is the driving force of our natural resource management for several reasons:

- it encompasses the interests of all stakeholders within a defined geographic area;

- it addresses all components of the watershed area, such as hydrological, habitat, economic and social.

- and it links together many different agencies and partners, funding sources, and resource users.

Ninety percent of the land in Illinois is in the hands of private landowners. The criteria for ecosystem partnership designation include requirements that the organization be built around a watershed and involve both public and private landowners. You have to have landowner participation to make this program work... and clearly it is working.

The ecosystem program provides support to the partnerships in three ways. It provides background assessments and scientific data to make sound management decisions. It provides funding for the ecosystem improvement projects the partnerships want to undertake... and it provides D-N-R program support.

Background assessments and scientific data are provided through the critical trends assessment program. Critical trends is an on-going process to evaluate the state of the Illinois environment.

Continued environmental monitoring is also a part of conservation 2000 through the Ecowatch Network. The network is a collection of volunteers, high school science teachers and students who have been trained to monitor Illinois' rivers, forests and wetlands.

We also are ever expanding the environmental information we are able to bring into people's homes through the Internet. The program also provides natural resource, cultural resource, soci-economic, and presettlement vegetation assessments for the ecosystem partnerships to help them develop a strategic action plan for their watershed.

Not only are we changing the way we are managing the natural resources. We are changing the way we manage ourselves. Changes have been made within the d-n-r organizational structure to provide for a team approach to the development of integrated natural resource management plans for landowners and state sites. D-N-R field staff work closely with the ecosystem partnerships, and other state, federal and local agencies to address watershed resource restoration, stabilization and enhancement.

D-N-R field staff are involved in all of the ecosystem partnerships in the Illinois river watershed and are participating in the development of regional strategies for resource management, restoration, and protection.

The department is using the expertise of its scientific surveys and its field management staff to work with other agencies to develop models to help with watershed planning activities and to develop an applied watershed remediation technology that will work for the Illinois as well as statewide.

The department is working with E-P-A and agriculture on an inter-agency watershed committee to provide coordination of watershed-based activities and programs among state, federal and local agencies. Partnerships among these agencies provide the most cost-effective and efficient watershed management.... while providing the maximum natural resource and environmental benefits.

The Spoon River watershed is among the first areas being considered for an inter-agency pilot program.

The Spoon River watershed encompasses natural areas in Bureau, Fulton, Henry, Knox, Marshall, McDonough, Peoria, Stark and Warren Counties in the western Illinois River watershed.

This area contains nearly 14-hundred miles of streams, 90 percent of which the Illinois Environmental Protection Agency rates only as "fair." A survey of landowners in this highly agricultural area reveals the intimate connection in Illinois between crop production and resource conservation. Survey results show a high level of concern for water quality protection, groundwater recharge, wildlife habitat and streambank stabilization.

Although the Spoon River watershed holds the dubious distinction of being the largest contributor of siltation to the Illinois River, the efforts and focus on the watershed through the partnership provides the local constituents a means of enhancing the area's resources and extending those positive effects to all who live downstream.

The pilot programs will include monitoring of the river resources and an assessment of the benefits of various land practices such as riparian strips, wetland restoration, streambank and streambed stabilization.

The cornerstone of the Ecosystems Program is the involvement of the people in the watershed who are most likely to be concerned about the resources in that watershed.... and who are most able to take action to protect those resources.

The Ecosystems Program has seen significant growth in the interest and initiative of local groups to combine forces. This focus on locally driven, volunteer efforts will ensure its success.

This was the vision of the Illinois Conservation Congress and Governor Edgar's Water Resources and Land Use Priorities Rask Force in 1995. Through the ecosystem partnerships and Conservation 2000, that ideal is being translated into long-term benefits for the citizens of Illinois.

The Conservation 2000 program clearly provides an opportunity to implement the Illinois river system management plan. Together they are helping to shape Illinois' landscape for future generations. And together.... they serve as a national model for environmental management.

APPLYING NEW TECHNOLOGY TO MANAGE THE ILLINOIS RIVER SYSTEM (INFORMATION TECHNOLOGY FOR NATURAL RESOURCE MANAGEMENT: PRESENT AND FUTURE)

Doug Johnston

National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign
101 Temple Buell Hall, 611 E. Lorado Taft Drive, Champaign, IL 61820

ABSTRACT

The availability of, and demand for, information resources continues to grow at rapid pace. Evolving methods of data collection, generation, and analysis, along with technologies for reporting and disseminating information have seen dramatic growth in the very near past. We ca obtain current weather images and forecasts, current market trading activity, real-time traffic congestion reports, and access to vast amounts of archival information ranging from war records to gardening tips. The growth of public access to the Internet has spawned another round of prognostication for everything from the reconstruction of a democratic society to yet-another-way of invading privacy.

This paper outlines a range of research and development activities that focus on the application of information technology for natural resource management. It addresses two aspects of access.

First, it describes the types of technologies under development that permit the management and use of increasingly vast and diverse sources of data. Technologies include data mining: searching for content and relationships in an unorganized information world, as well as digital libraries' efforts at organizing and making available to users this information. Visualization tools can be used as a mechanism for condensing information and finding relevant information from a sea of numbers; and collaboration tools to assist the diverse groups involved in natural resource management to share information.

Second, the growth of information resources and user expectations is not without its costs in terms of demands on the technology. There is an increasing requirement that data management and analysis tools be scalable across a wide range of geographic, temporal and feature scales. Also, there is the requirement that information resources be interactive and real-time, or that the data and applications are portable across a wide range of hardware, software, and human environments.

Through example and demonstration, this paper will illustrate these emerging technologies in river systems applications including information systems for streams and fisheries resources, and modeling of hydrologic processes at various scales for planning and analysis.

Information Technology for Natural Resource Management: Present and Future

Doug Johnston
University of Illinois@Urbana-Champaign
dmj@ncsa.uiuc.edu
http://www.gis.uiuc.edu

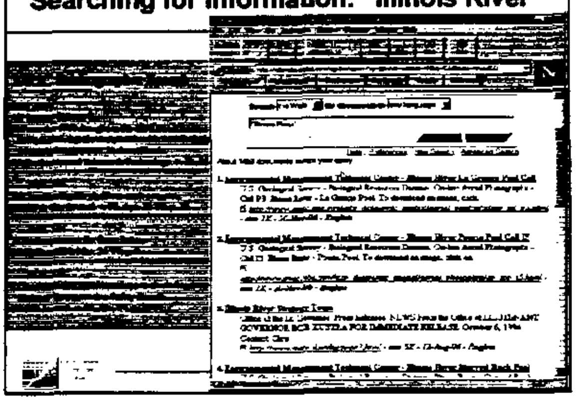
NCSA

Information Technology: A (R)evolution in the Making?

- What is the current state of information technology?
  How many of you can find all the information you really need, at the time you need it, in the form you need?

NCSA

Searching for Information: "Illinois River"



Safe Predictions:

- Information will be both more accessible and more complex.
- Computing and communications will continue to expand in power and "bandwidth".
- Participation in public decision making will increase.
- Natural Resources Management is not a problem that is to be "solved".

NCSA

Information Technology Directions

- More Types of Data: Multi and Mixed Data
- More Data: Data Repositories, Data Mining
- More Complex Problems Attempted: Modeling and Simulation
- More Information "Horsepower" Required: High performance computing

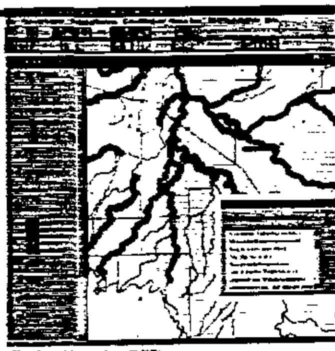
NCSA

Multi- and Mixed Media

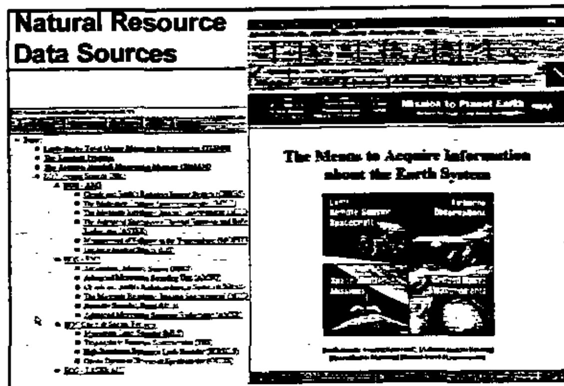
- Text
- Graphics 
- Sound 
- Video 

NCSA

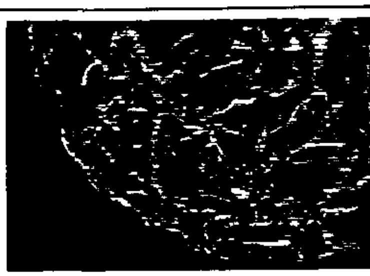
Mixed Databases



Natural Resource Data Sources



Analysis of Very Large Datasets



- Rotating Turbulent Gas Ball Model of the Sun
- Nine Day Run on NCSA Origin (128-processors)
- Generated 2 Terabytes of Data, LCSE Visualized in 3 Days

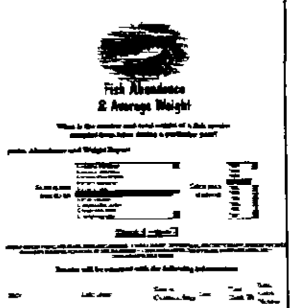
Paul Woodward, et al., LCSE, Univ of Minnesota, June 1997

Federated Databases and Digital Libraries

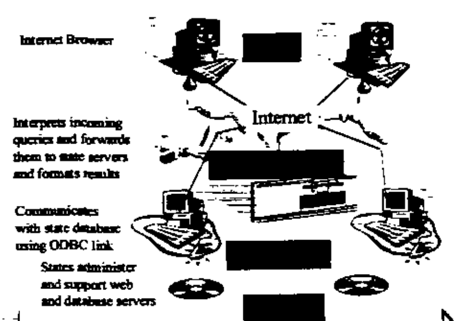
- How to access related data that are maintained by different organizations in different places?
- How to search for data in text, numbers, equations, sounds, and images?

Internet Access to Aquatic Resources: The MARIS Project

http://www.gis.uiuc.edu/maris

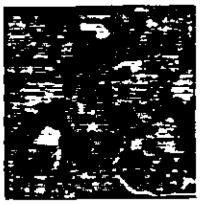


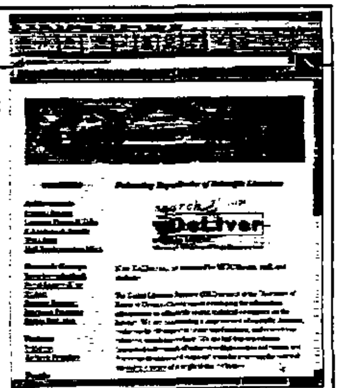
How it works



Data search and retrieval

- Digital Library Project
- Air Photo Project





NCSA

Data analysis and reduction: JP Morgan Risk Visualization

NCSA

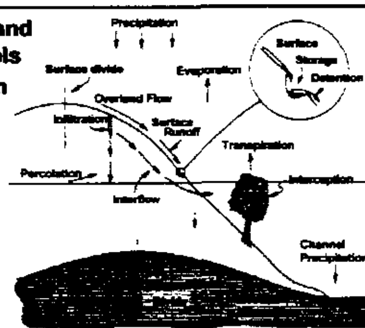
Modeling and Simulation

- Use models to gain better understanding and to predict outcomes of decisions.
- Most models focused on disciplinary efforts (e.g. weather, fish, plant growth).
- Most management problems are multi-disciplinary.

NCSA

Model Trends

- Collaborative and dynamic models
- Process-driven models



NCSA

Watershed Models

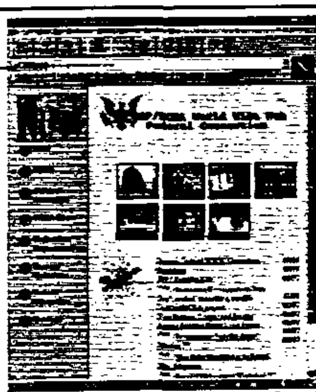
NCSA

Visualization

NCSA

Collaboration

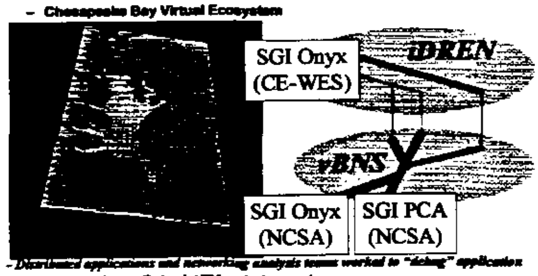
- Cooperating at different times from different places
  - newsgroups
  - interactive communication
  - network-based computing



NCSA

Collaboration in Virtual Space

- Environmental Modeling in Shared VR-space
  - Chesapeake Bay Virtual Ecosystem

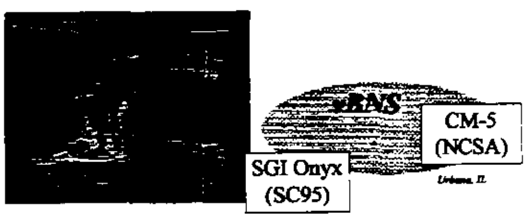


– Distributed applications and networking analysis teams worked to "debug" application and bottlenecks in two Federal ATM testbed networks

NCSA

Remote Steering with Virtual Environments

- Atmospheric Sciences (UIUC/NCSA)
  - Tornado Simulation



NCSA

Prospects

- Technology sometimes changes the way we live, mostly changes the way we do it.
  - More Types of Data: Multi and Mixed Data
  - More Data: Data Repositories, Data Mining
  - More Complex Problems Attempted: Modeling and Simulation
  - More Information "Horsepower" Required: High performance computing

NCSA

THE UPPER MISSISSIPPI RIVER COALITION

Chester S. Boruff

Deputy Director, Illinois Department of Agriculture
Springfield, IL

As we meet here today in Peoria to discuss the Illinois River, its importance to our state, and what actions we might take to protect and preserve it, just outside of town Illinois farmers are harvesting this year's crop at a record pace.

When they are finished, Illinois producers will contribute to what appears to be our nation's largest soybean crop ever and perhaps our third largest corn crop, based upon early estimates. Producers around the world have also experienced good yields this year, but even though world supplies of grains and oil seeds are high, so is the demand for these commodities. Growing populations, improving economies, and new industrial uses for grains have put added strains on the world's production system to provide our most basic commodities.

At the same time, forecasters around the world are keeping a weary eye on the impact that the largest El Nino ever recorded will have on world food supplies. Now, maybe more than ever, the line between feast and famine is becoming even thinner.

Illinois has been uniquely positioned to take advantage of world markets due to our access to river transportation for our grain on the Illinois and Mississippi Rivers. Our state's economy has greatly benefitted and we will continue to rely on world market access to keep our state's ag industry strong.

However, the United States is not alone in its reliance upon world trade of our commodities. Other nations around the globe, some of which at one time felt starvation and were dependent upon our aid, are now our competitors in the world market. Many countries are making huge investments in their transportation and infrastructure systems. These long term investments may give them a long term advantage over our ag industry, if our country fails to recognize the benefit of maintaining and improving our river systems for transportation and trade.

For too long, many have mistakenly believed that the need for an efficient river transportation system and the need to maintain the delicate environmental balance within the river itself, were incompatible and presented competing demands for the rivers we depend upon.

Fortunately, this is not the case and in the past two years meaningful dialogues have occurred in which the stakeholders of the Upper Mississippi River, of which the Illinois River is a major component, have met to explore ways that new concepts in river management might work for the benefit of all stakeholders and the rivers themselves.

In Minneapolis in early 1996, and again in early 1997 in St. Louis, stakeholders met at the Upper Mississippi River Summit to hold meaningful discussions on how this national treasure, the Mississippi River System, might be managed for the benefit of all. Another summit is planned for early 1998. Participants have included representatives of the Army Corps of Engineers, state and federal government agencies, environmental interests, agriculture, and a transportation industry. During the discussions, not all parties necessarily agreed about all of the issues at hand, but did agree on one key point. The Mississippi River System will continue to deserve our best efforts to protect it.

In early 1997, the participants held a conference in Davenport, Iowa to highlight the economic benefits of the Mississippi River System.

In April, 1997, the five Governors of the states bordering the Upper Mississippi River offered a proclamation committed to managing the River in a way that will be conducive to a healthy economy and a healthy environment within the river system.

Clearly, attention is shifting towards the rivers in our country.

The growing and genuine commitment of both the public and private sectors is showing benefits already. The commitment of decision makers to work for the benefit of the river system has pointed out that, too often in the past, programs which were limited by the virtue of their restrictions also limited how effective efforts could be. Today, we are learning that creativity and the courage to implement flexible efforts will lead to success.

Following are some examples of the activities resulting from the dialogue at these two river summits:

1. Studies are being initiated to determine how effective the modification of existing levee systems will be in order to allow for flood protection and navigation benefits, while providing flood pressure relief during times of the most severe flooding. Examples of these efforts include the notching of existing levees to provide for flood inflow and working with landowners to provide for floodplain use easements.

2. The U.S. Army Corps of Engineers is considering the impact that minor drawdown techniques will have in certain pools of the river and to determine whether or not habitat improvements will occur while allowing for recreational and transportation uses of the river.

3. Regional dialogues are beginning on how to best implement floodplain use and flood control strategies on a system approach.

4. Working with, and coordinating the efforts of a number of watershed groups within the Upper Mississippi River Basin, local stakeholders are encouraged to implement floodplain and upland land management and to protect and reestablish wetland areas.

Later today, other speakers will be reporting to you about the upcoming navigational study to be prepared and released by the Army Corps of Engineers. Our state is looking forward to its role in formulating this plan. When completed, the navigational study will provide a vision of how best to manage the Mississippi River System for all its users.

In closing, it is important to remember the role the Mississippi River System and its tributaries have played in the development and history of our nation. Our future, and the future of our children to come, will depend upon this national treasure. They should expect no less than our best efforts to preserve and enhance it for their benefit.

ASPECTS OF THE 1996 FARM BILL AND EQIP AS THEY RELATE TO ILLINOIS RIVER WATERSHED MANAGEMENT

William J. Gradle

State Conservationist, United States Department of Agriculture
Natural Resources Conservation Service
1902 Fox Drive, Champaign, IL 61820

Good Morning, I'm glad to be with you this morning, and I would like to thank the organizers of this conference for including me as a presenter. I want to tell you about the programs and partnerships that my agency, the Natural Resources Conservation Service, is involved with along the Illinois River and on its watershed.

The Illinois River flows from just southeast of Chicago to join with the Mississippi River at Grafton. In Lieutenant Governor Kustra's *Integrated Management Plan for the Illinois River Watershed,* it says that eighty percent of that watershed is in fifty-five counties in Illinois. More than ninety percent of Illinois' population lives within the watershed. A lot of land and a lot of people are potentially affected by the Illinois River! Much of the land that Illinois River waters flow through is used to grow crops, and *most* is in private ownership.

Our agency takes an inventory of our nation's natural resources every 5 years. According to the 1992 National Resources Inventory, about 34.6 million acres of Illinois land were in private ownership, compared to 520 thousand acres of federal land.

The inventory also showed that 88 percent of the state's land was in rural areas; 24 million acres were used to grow crops; 3.4 million acres were forested; 2.7 million acres were in pasture and 1.3 million acres were in other categories.

It's important to know that fewer than 2 percent of Illinois' population is taking care of 88 percent of her land! We and our partners, Illinois' Soil and Water Conservation Districts and others, are working with the private landowners to offer technical assistance and cost-sharing for conservation practices on their land. These practices will help protect the Illinois River and other Illinois waters from further sedimentation, reduce erosion, stabilize streambanks, and provide wildlife with habitat, while increasing wetland and woodland areas.

Now let's take a look at how we accomplish our work.

The 1985 Food Security Act was the *first* Farm Bill to include a Conservation Title. Its provisions included mandatory conservation on highly erodible land and wetlands if a farmer wanted to participate in federal farm programs. To receive farm payments, farmers had to have a conservation plan before January 1, 1990, and they had to have their plan in place before January 1, 1995. This was the first "conservation compliance" provision.

If the '85 Farm Bill was memorable for its restrictions on cropping HEL and draining wetlands, the 1990 Farm Bill was known for its penalties and further restrictions.

These two farm bills were good for the country though, and most people saw the benefits in them. We have achieved a great amount of conservation because of them. By 1992, there were over 100,000 approved conservation plans on 5.3 million acres of land in Illinois. By the end of 1994, when conservation plans needed to be in place on the land, approximately 80-85 percent of Illinois farmers were in compliance. And year after year, our status reviews show that this many remain in compliance.

From 1982 to 1992, soil erosion in the state dropped from an average annual rate of 6.4 tons to 4.4 tons per acre. Many factors besides the Farm Bills helped. Illinois has the T by 2000 goal that Soil and Water Conservation Districts have promoted and worked toward since April, 1980. With agribusiness' help, crop residue management has become easier and more acceptable to do.

By 1992, over 500,000 acres of wetlands had been identified by NRCS. Almost a thousand acres of wildlife food plots and ponds were in place due to the Conservation Reserve Program, and over 31 thousand acres of trees on CRP had been planted.

The 1997 NRI is in progress now, and its results should be available in about a year.

By 1992, we had gained a lot of conservation on Illinois' private lands, but there were still several more years before the farm bill conservation compliance plans kicked in and eight more years before the T by 2000 deadline.

Last year, Congress passed the 1996 Farm Bill. With it came many changes.

- The Agriculture Conservation Program and 3 other programs not used in Illinois were rolled into the Environmental Quality Incentives Program.
- Swampbuster provisions were modified for flexibility.
- Conservation Compliance was changed to give farmers a year to take corrective action on HEL plans.
- The Wetlands Reserve Program and the Conservation Reserve Program were extended through 2002.
- The Emergency Watershed Protection Program now allows for the purchase of Floodplain Easements.
- The new Wildlife Habitat Incentives Program provides for help establishing and managing food plots and other habitat.
- The Conservation of Grazing Land Initiative provides for technical assistance with pasture, forage, and other aspects of managing grazing lands.

These are the 1996 Farm Bill programs currently in use on the Illinois River Watershed: EQIP, CRP, WRP, and WHIP.

The '96 Farm Bill also brought us some additional strategies to use:

- An expansion of the State Technical Committee to include wider representation and participation. This committee functions as a technical advisory board to me on farm bill issues and standards.
- Encouragement to partner with others, especially with sharing resources.
- Prioritizing, or choosing priority areas.

- A reemphasis on the locally led approach to conservation – community involvement.

Locally led conservation means local people...with the leadership of county soil and water conservation districts. The local work group is formed and led by the soil and water conservation district board. The work group: assesses their county's natural resource conditions and needs, identifies solutions to resource problems, sets goals, identifies programs and other resources to solve those needs, develops proposals and recommendations to solve problems, implements solutions, and measures success.

Locally led conservation is: voluntary; it's sharing vision and goals; it's using federal, state and local programs as tools to solve concerns; is responsible for dealing with local concerns; is based on finding common ground, and is based on assessing conservation needs and assistance available.

Locally led conservation is also ... helping community leaders identify and prioritize natural resource concerns. The people who might be in the local work group include Soil and Water Conservation District officials, who work with the FSA County Committee, USDA personnel, people from state agencies and organizations, producers' groups, agribusiness, environmental groups and others in the community who are interested and want to contribute their expertise.

Locally led conservation is ... getting things done by working together; talking together; listening to and understanding each other's viewpoints; partnering and sharing responsibilities and resources.

Locally led conservation is ...

Involving the community by forming an advisory or steering committee with wide representation; holding public meetings and inviting all stakeholders; holding focus group meetings to learn what perspectives exist on certain issues in the community; widely publicizing your activities, goals and successes in the community.

Locally led conservation ... emphasizes the local work group. The local work group is crucial to the success of this approach. The local committee: analyzes conservation needs and priorities; develops a resource assessment; identifies, agrees on and documents community objectives; identifies geographic areas and potential priority areas.

What does resource assessment mean? We ask several questions: What are the present conditions of the natural resources in the area? Which natural resources need improvement? How can the conditions be improved? Where should we begin? How can we measure success?

We use many tools to achieve the natural resources goals of the communities. Local, state and federal programs, private sector programs, and new programs. We seek all available financial and technical assistance and we combine resources with others when possible.

Let's look at the 1996 Farm Bill programs that we're using in the Illinois River watershed. As always, all USDA programs are available to all landowners and managers, without discrimination.

The Wetlands Reserve Program (WRP) is a voluntary program to restore and protect wetlands on private property. WRP is an opportunity for landowners to receive financial incentives to enhance wetlands in exchange for retiring marginal agricultural land. Landowners can choose from several types of easements and receive technical and cost-sharing help to restore or manage existing wetlands.

The Wildlife Habitat Incentives Program (WHIP) helps landowners improve and manage wildlife habitat on their land. The program provides cost-sharing and technical help to develop and carry out habitat plans for upland and wetland wildlife, endangered species, and fisheries. Agreements generally last from 5 to 10 years. The final rule has been published. We will probably start taking applications in January, 1998.

The Conservation Reserve Program (CRP) protects highly erodible and environmentally sensitive lands with grass, trees, and other vegetative cover. There are two kinds of CRP sign-up. One is continuous and is used to reduce erosion and protect water quality through use of practices like filter strips, riparian buffers, field windbreaks, grassed waterways, and contour grass strips. Producers may sign up anytime, and the offers are automatically accepted, if all eligibility requirements are met.

The other sign-up takes place during designated periods. The next period will be October 14, to November 14, this year. These bids are competitive. The Environmental Benefits Index (EBI) is used to figure the points for different conservation practices and other factors. The bids that offer the most environmental benefits for the dollar are accepted into 10 to 15 year contracts.

The Environmental Quality Incentives Program (EQIP) is a voluntary program that will help crop and livestock producers deal with environmental and conservation improvements on the farm. It provides technical, financial, and educational assistance primarily in designated priority areas. On a national basis, half the funding is targeted to livestock-related natural resource concerns and the remainder to other significant conservation priorities. This program is intended to maximize environmental benefits per dollar spent.

In Fiscal Year 1997, there are eight designated Conservation Priority Areas. There are also five Statewide Natural Resource Priority concerns for EQIP funding. Three of the Conservation Priority Areas are in the Illinois River Watershed, the Fox River Watershed, the Mackinaw River Watershed, and the Middle Illinois River Resource Rich Conservation Priority Areas.

We also have the Mid and Lower Illinois River Priority Area for the Conservation Reserve Program. In February '97, the State Technical Committee supported submitting a proposal for a CRP Priority Area. The Area was approved this year. A producer within the area receives 25 extra points on the Environmental Benefits Index for CRP competition. This Priority Area includes subwatersheds in Brown, Calhoun, Cass, Fulton, Greene, Jersey, Mason, Morgan, Peoria, Pike, Schulyer, Scott, and Tazewell Counties.

The Illinois State Technical Committee helps develop technical standards for conservation programs. It makes recommendations to me for prioritizing the EQIP Conservation Priority Areas and the statewide Natural Resources Priority Concerns, and offers help and suggestions when there are decisions to be made about Farm Bill implementation. We meet on a quarterly basis and our meetings are open to the public.

Membership on the committee has been expanded through the '96 Farm Bill. We have representatives from federal, state and local government, organizations, producers groups, and ag industry. We have individuals who are on the committee because they have special expertise. The committee is invaluable to me in its advisory capacity.

I'd like to explain next, the process that NRCS, the local work groups and the State Technical Committee go through to get areas designated as Conservation Priority Areas for the EQIP.

Delivery of conservation programs is done at the local level. For over 60 years, NRCS and the soil and water conservation districts have worked in Illinois to offer expert technical help to landowners.

(1) The local work group makes all the local decisions and nominates areas for the next year's funding to the state level.

(2) The State Technical Committee reviews nominations and makes recommendations to me. With their advice, and concurrence of FSA, I make recommendations to the Regional Office.

(3) The Regional and National Offices integrate this information into regional and national strategic plans.

(4) Funds are allocated to regions and states based on resource needs described in the National Strategic Plan, with FSA concurrence.

(5) NRCS determines allocations for the local level with State Technical Committee advice and FSA concurence. FSA issues the allocations.

(6) The SWCDs and NRCS deliver technical assistance and approve conservation plans. FSA approves and pays, based on the needs and priorities that the local work group identified.

(7) Continuous evaluation of achievements leads to improvement.

Many people are working with NRCS and with *their* organization's programs on Illinois rivers. We are all working with the same goals in mind that are enumerated in the Lieutenant Governor's *Technical Report on the Illinois River Watershed.*

Many resources are flowing into the work on the Illinois River Watershed. In addition to federal funding and assistance, state and local agencies and organizations, local Farm Bureaus, conservation groups and agribusinesses are making contributions toward achieving conservation on the watershed.

In Fiscal Year 1998, we will continue to focus on the local work groups and their priorities, we will encourage participation of all stakeholders, and we will be sharing resources from the different federal, state, local and private organizations and their programs. I'll look forward to the next conference on the Illinois River so that I can report on our successes with the various new programs from the 1996 Farm Bill. I really appreciate being invited to be here with you today.

REFERENCES

Kustra, Bob. 1997. Integrated Management Plan for the Illinois River Watershed Technical Report. p. 1. Springfield: State of Illinois.

THE PERSONAL SIDE OF CONSERVATION ISSUES

Leon Wendte

District Conservationist, United States Department of Agriculture
Natural Resources Conservation Service
2110 W. Park Ct., Champaign, IL 61821

INTRODUCTION

Over the past ten years, citizens of Champaign County watersheds have initiated planning activities at the headwaters of four different river basins. With coordination provided by the Champaign County Soil and Water Conservation District (SWCD) and the Natural Resources Conservation Service (NRCS), watershed steering committees have formed for the headwaters of the Vermilion, the Little Vermilion, the Embarras, and the Sangamon Rivers. Each committee is currently in a different stage of planning and implementation, but all are making tremendous progress in reaching their established goals.

One reason that these committees are working well and that these watershed activities are being implemented so successfully is that the 'Personal side of conservation issues' is being considered in each step of the process. Another way of thinking about this "personal side" of conservation is reminding ourselves that we are doing watershed planning for people not to the people.

You can assemble all the technical experts in and around a community or watershed, prepare elaborate inventories, analyses and alternative scenarios, and recommend the best or preferred plan for conservation of natural resources, but if the plan does not solve the problems and meet the needs and goals of the people in living and working and raising their families in the watershed, the plan will sit on a shelf, collect dust, and never be implemented.

Every step of the conservation problem solving process must involve and be led by local people or by local groups of people with common interests.

ORGANIZING AND ANALYZING - THE PERSONAL SIDE

I'd like to share a few of the lessons NRCS has learned about this "personal side" of conservation starting with organizing and analyzing problems of a watershed. No State or Federal agency or program can generate the necessary long-term commitment required from a watershed steering committee to form and successfully implement a comprehensive watershed management plan. In fact, it is usually a natural resource problem or disaster that personally affects people in a watershed that provides the catalyst to organize a watershed committee in the first place. At the Natural Resources Conservation Service, it has been our experience that it is almost impossible to simply generate interest in a local watershed and that a hope a steering committee organizes and continues to operate. In fact two of our current committees were formed because of high nitrates in drinking water supplies and the other two formed as a result of devastating flood events. Once people are called to action, it is then and only then that the experts and agencies outside the watershed can most successfully provide technical and financial assistance with their programs. Unless you follow this recipe, you run the risk of doing watershed planning to people not for people.

Once the incentive to organize is present, another "personal side" of conservation becomes important. That is making sure that all interest groups are included in the watershed steering committee. This may involve a few members who don't necessarily agree on all the goals and objectives for natural resources in the watershed. Rest assured, if you don't include these individuals and groups in the beginning, you most certainly will have to answer to them in the end. Locally, each of our four steering committees were appointed by the local Soil and Water Conservation District. Committees were limited to about 12 individuals usually representing multiple interest groups. Absolutely no "agency" or "technical" personnel from outside the watershed were appointed to the committees and it was required that members had to live within the boundaries of the watershed. Agency and resource professionals, on the other hand, were invited to serve on subcommittees appointed to work on various aspects of planning and implementation in the watershed but only at the request of the steering committee. Again, we organized to plan for people not to people.

Another lesson we learned in addressing conservation from the "personal side" is how important it is to ask the people in the watershed what are their concerns for the watershed. Here again, it is important to record problems exactly as stated by the people and not to try to get them to identify concerns as provided by individuals outside the watershed. This is all a little scary at first, especially for outside groups—they are afraid that the watershed committee may set goals and objects that may not mesh with their own. However, as members of steering committees begin to examine and analyze their problems with the help of agencies and resource professionals, they begin to see how the initial resource problem is connected to a host of other resource issues. Alternative solutions begin to evolve that not only address the initial crisis problem but also begin to address natural resource problems that are more watershed-oriented, or larger in scope. In most instances, these are exactly in line with missions and goals of outside agencies trying to assist the watershed group.

ALTERNATIVES AND PLANS - THE PERSONAL SIDE

Let's move now to the "personal side" of conservation as it involves developing alternative solutions and preparing a final plan. Assembling the alternatives at the direction of the steering committee is crucial. This is where resource professionals can truly shine. They can really use their technical expertise to serve the watershed customer. Once alternatives are prepared, however, it is imperative that the citizens of the watershed be allowed to pick or vote for the recommended plan. When a solution is recommended to them instead of developed for them, implementation is rarely successful. People in a watershed area who know the problems and help craft solutions to the problems will share the responsibility of solving the problems.

IMPLEMENTATION - THE PERSONAL SIDE

Implementation is the last stage of the process and perhaps the most important step to include in the "personal side" of conservation. Since most of the land in Illinois watersheds is privately owned, implementing watershed plans must also be done for individual people and not to people just like the watershed planning process. Implementing watershed plans starts with individual people, voluntarily changing their management practices with the help of programs and resource professionals. Just as watershed planning starts by asking people what they see as problems, planning with landowners starts by asking them to identify their goals and objectives for their property. While most resource concerns start out as single issue problems, most solutions end up with multiple benefits for both the individual and for the watershed.

SUMMARY

Considering the "personal side" of conservation means that watershed planning is done for people not to people. With the help of conservation districts, agencies, or other resource professionals, individuals with diverse interests proceed forward in the planning process with a shared vision of goals, even though they may not necessarily agree on every issue. Citizens of the watershed who know the problems best share the responsibility of solving those problems as they seek out the advice of technical experts from local, state, or federal agencies. They use these outside individuals as their consultants and their diverse range of programs as tools to solve natural resource concerns. Implementation of the watershed plan is completely voluntary and starts on individual property. Properly considering the "personal side" of conservation on individual property leads to resource conservation not only on that property but eventually for the entire watershed.

BREAKING THE MOLD, UPLAND TREATMENT OF THE SWAN LAKE AREA

Martha Sheppard

United States Department of Agriculture, Natural Resources Conservation Service
P.O. Box 516, Hardin, IL 62047

1) Swan Lake Breaking the Mold. This slide show will get you aquatinted with the Swan Lake Watershed Area. I'll show you the problems identified, the partners involved, the solutions being used, and some new challenges that have come up.

2) Calhoun County location in the state.

3) Distinctive features of Calhoun County. Located western edge of state, between Illinois and Mississippi Rivers.

4) Calhoun County. The southern part of the county is less than 25 miles from downtown St. Louis, however the county remains rural and agricultural because the only bridge out is located at Hardin.

5) Calhoun County Watersheds. The Swan Lake Watershed Area is shown in red.

6) Calhoun County Landcover from IDNR's maps. Swan Lake shows up as blue along the inside of the fishhook. Cropland makes up most of the south part of the watershed, and woodland the north part.

THE PROBLEMS

7) This is the southern part of Swan Lake, a 2,500 acre backwater of the Illinois River, less than 5 miles from its confluence with the Mississippi River. Swan Lake was once an important natural fishery and waterfowl habitat. However, siltation has reduced the depth and surface acres of the lake. Studies show two sediment sources.

8) 65% of the sediment is coming from the Illinois River, primarily during seasonally high flows.

9) 35% of the sediment is coming from the 20,000 acres of the local Swan Lake Watershed.

10) Sediment from the local watershed shows up on this slide as bulges or deltas in the lake. Aerial photos from the past 50 years document this growth.

THE PARTNERS

The US Army Corps of Engineers owns Swan Lake and the adjacent land. The US

Fish and Wildlife Service manage the south part through the Brussels District of the Mark Twain Refuge. The north part is managed by Illinois Department of Natural Resources.

11) These partners are cooperating on Habitat Enhancement Projects through the Environmental Management Program (EMP) on federal and state owned lands in Illinois.

PARTIAL SOLUTION

12) To control sedimentation from the river, a levee is being constructed that will protect the lake from seasonal high flows. The levees and other habitat features such as islands, plantings, etc., is being done on the federally owned land.

MORE SOLUTIONS

13) To work on a solution for the sediment coming from private property, local partners were added. The USDA Natural Resources Conservation Service, Two Rivers RC & D, and the Calhoun County Soil and Water Conservation District worked with local landowners in the watershed to develop their first resource plan in 1991. This plan was included as the Hillside Sediment Control component of the Swan Lake Master Plan.

14) In 1995 agreements were signed between the partners so that the Corps of Engineers can provide 75% of the funding for erosion control practices in the watershed up to $750,000.

15) Technical Assistance to landowners is provided by NRCS, IDNR, and the Soil and Water Conservation Service. The Soil and Water Conservation District also serves as the local sponsor. Landowners work directly with the Technical Agencies and do the work themselves or hire their own contractor.

16) The resource plan identified these key points for project success: Voluntary, 75% Cost Share, Conservation Planning.

17) Voluntary Participation includes these provisions: No public access to private land; no $$ limit, like some programs; no Farm Service Agency ties or compliance; landowner can veto any plan.

18) 75% Cost-Share. Landowner has contractor build a $10,000 pond, SWCD pays landowner $7500, Landowner pays contractor $10,000. Most landowners have worked with cost-share programs in the past and are comfortable with this way.

19) Conservation Planning. Identify problems, offer solutions with and without cost-share. Target area gives landowners higher priority with technical specialist. Coordinate with IDNR: Forester, Fisheries Biologist, Private Lands Biologist, and Natural Heritage Biologist. Previous Conservation Plans only address soil erosion. This gives the landowner to prepare a plan to address additional resources.

20) The resource plan was updated in 1995 by a group of local landowners. The

Conservation Practices agreed on were: Farm Pond, Grade Control Structure, Diversion, Grassed Waterway, Stream Protection, Sediment Trapping Wetland, Water and Sediment Control Basin, Terrace, Filterstrip, Field Border, Critical Area Planting, Livestock Exclusion, Tree Planting, and Contour Orchard Planting.

21) No-till is the most common cropping method used in the watershed area. However, with an average cropland slope of 12%, soil losses average 10 tons per acre.

Following are slides of some of the practices.

22) Farm Pond
23) Grade Control Structure, Cable concrete lined chute
24) Grassed Waterway
25) Small 3 ac. Sediment Trapping Wetland
26) Water and Sediment Control Basin
27) Orchard Planting

ADDITIONAL CHALLENGES FOR THIS PROJECT

28) The county is rich in cultural resources. Federal money can not be used on public or private land if it is determined that a significant cultural resource will be damaged.

29) A NRCS Archaeologist evaluates the potential for cultural resources in cooperation with the Center For American Archaeology, located in Kampsville. The CAA has a large database of known sights within the county.

30) Migratory Waterfowl hunters are concerned that current plans for the federally owned land may not fully meet their expectations for the project.

31) Sediment reduction projections in the original resource plan were based on the construction of 55 ponds. So far only 10 have been built. NRCS Engineers determined that sediment trapping wetlands can provide an alternative to help us meet our goal. 5 small wetlands have been built and the first large one is under construction.

32) This stream that flows into Swan Lake has a 3000 acre drainage area. A structure is going in this channel to divert the stream through 4 cells, allowing it to drop most of its sediment.

33) These pipes are all part of the water control for the wetland.

34) Gabion baskets and in-line water control valves will be part of the project and allow the landowners to manage for waterfowl and other wildlife.

35) EEO statement.

36) Swans on a lake.

SITE-SPECIFIC FARMING'S IMPACT ON LAND AND WATER MANAGEMENT

Harold F. Reetz, Jr.

Midwest Director, Potash & Phosphate Institute
111 E. Washington Street, Monticello, IL

Application of satellite and computer technology in site-specific crop and soil management offers some new opportunities to lessen agriculture's impact on the environment. These new systems will help farmers more efficiently use nutrients and pesticides, and produce higher and more profitable yields.

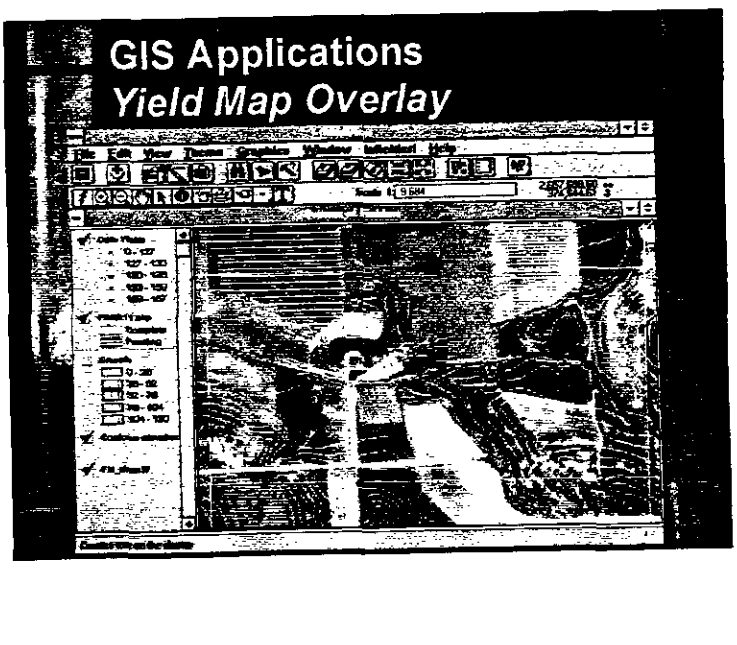
High yield management helps reduce soil erosion, by producing more vigorous plant root systems that help hold soil in place, and by producing more crop residue which holds soil and lessens impact of raindrops. Higher-yielding crops also absorb more nutrients into the vegetative plant material, which acts as a slow-release system to supply future crops. More nutrients are also taken off the field in the harvested portion of high-yielding crops.

When the global positioning satellite (GPS) system was put in place a couple of decades ago, little thought was given to the potential for this system as a resource or tool for agriculture. But it has become an important component of modern crop and soil management systems.

The objectives of site-specific management are:

- to identify and quantify the variability within fields
- to understand the impact of that variability
- and to manage that variability to increase profits.

Farmers are using site-specific management practices to help them better understand the sources of variability within their fields and how it affects yields with the ultimate goal of improving profitability.



Using geographic information systems (GIS) software, farmers and their input suppliers and advisers can relate the variability of soil characteristics, topography, nutrient levels and other factors to the yield variability they measure within their fields. Eventually, more sophisticated computer analysis can develop cause/effect relationships among factors of production and guide recommendations for best management practices.

These analyses become more accurate as more years of data are added to the database. The farmer's experience and that of others involved in the decision process must always be taken into account in making final recommendations for action.

Research into the application of site-specific technology and its economic and environmental impact is really lagging behind the implementation, but the concept is not really new. We are applying well-researched agronomic concepts on smaller areas—parts of a field instead of field-scale. So there is not much question that the practices are agronomically sound. That has already been proven. The question to be answered is whether applying the agronomic principles on a smaller scale will improve the economics over using the same inputs and rates over the entire field.

To address this question and further study the application of best agronomic practices on a variable-rate within-field basis, the Foundation for Agronomic Research (FAR) has initiated a multi-state on-farm research program to compare site-specific management with field-average management. Working with the predominant corn-soybean rotation system in the Midwest, this study was started with funding from the United Soybean Board (National Soybean Check-Off funds), and has received substantial matching support from several industry and government sources. The Natural Resources Conservation Service (NRCS) is a major partner and has helped provide detailed digitized soil survey information for all of the fields in the study. Several University of Illinois projects funded through the Council for Food and Agricultural Research (C-FAR) are contributing information to the project. Data compilation and analysis are being coordinated through the University of Illinois Crop Sciences Department. Experiment Station, local dealer and cooperator farmer support has also been a major component. Numerous partners have provided in-kind contributions of equipment and services to the project.

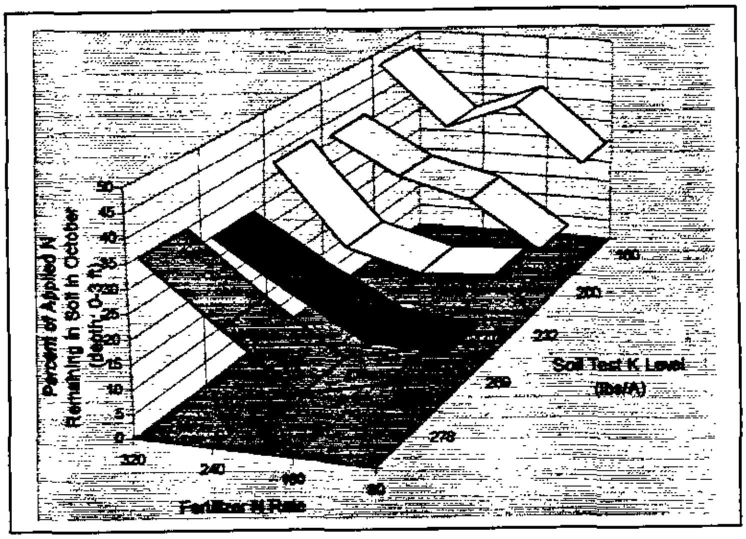
A partial listing of partners and the estimated value of their contribution during the first two years of the project includes:

- NRCS—$100,000+; new survey protocol
- TopSoil Testing Service—soil testing; mapping
- Mark II Agronomy / Illini FS—soil testing; mapping—$50,000+
- University of Illinois—Land, funding, staff—$500,000+ in C-FAR grants for Don Bullock and co-workers in related projects
- Ohio State University—$50,000+ in matching, plus cooperation in a major USEPA project
- University of Florida—crop models
- Adcon Telemetry—weather stations--$75,000
- NOAA—$90,000 equipment + technical support
- ESRI—Software, training, technical support —$50,000
- Ag-Chem Equipment Company—technical support
- South Dakota State University—cooperation with a projected funded by state soybean check-off money.
- Illinois Soybean Program Operating Board—$50,000+ to develop software decision aids for use in the project.

Perhaps the most important factor to date with this research has been the demonstration of the importance of partnering among all of the people involved in making management decisions for a field. Farmers are more and more dependent on assistance from a variety of input and information suppliers in developing the right management plan for their fields. So this research program is not only evaluating site-specific management, but also is teaching the farmers and their advisers how to best develop effective teamwork.

The project is expanding beyond the original 20 fields in Illinois and Indiana to include farms in several other states. Additional university, farmer, industry and government partners are being added to the project. We plan to continue this effort for at least 5 years to be sure to cover a range of growing seasons and build a broad data base for the final evaluation. The data base is already one of the most extensive collections of site-specific, geographically-referenced crop and soil data ever assembled, and will grow substantially with the addition of the new sites. Data from the project are being made available for other researchers and software developers to use in testing their ideas and tools. So far, over 70 people from throughout the world have taken advantage of this opportunity. This data base sharing activity is helping improve the compatibility of software for decision aids and data analysis, which will eventually benefit all users of this technology.

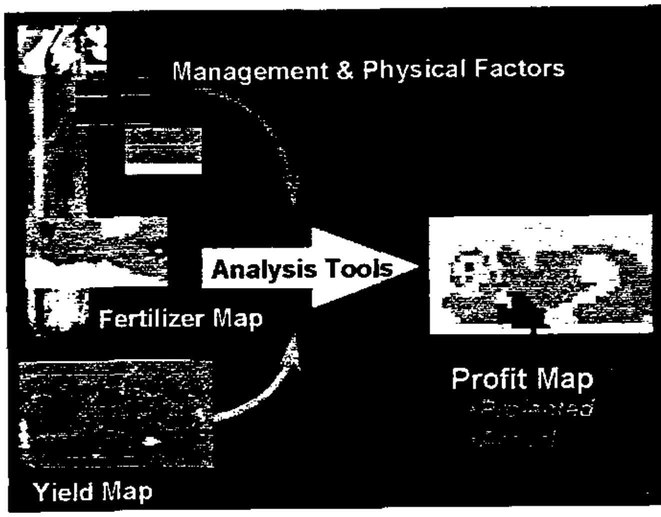
The first yields from variable-rate application studies were harvested in the fall of 1997 and the data will be analyzed during the coming months. Updated information about this project may be obtained by visiting the internet website: http://w3.aces.uiuc.edu/AIM/precision. This website also contains links to various cooperators. Access to the data bases may be obtained through the website: http://w3.aces.uiuc.edu/INFOAG/GIS. Prospective users are asked to register their intended use of the data, but are welcome to share in this database.



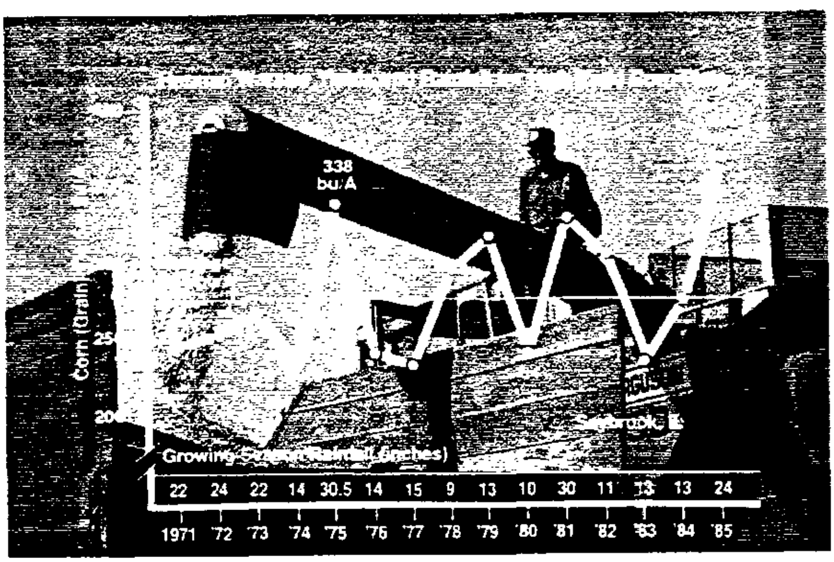
In evaluating agronomic practices for site-specific management systems, interactions among factors become critical. For example, research at Ohio State University has demonstrated the importance of maintaining high potassium (K) soil test in order for the corn crop to most effectively utilize available nitrogen. When K test is high, more of the N is utilized by the crop and less is left in the soil at the end of the growing season. When K soil test is lower, the efficiency of N use is diminished and more is left in the soil for potential loss. Corn yields also were higher where K soil tests were maintained at a high level and N was more efficiently utilized. Research in other states supports this conclusion.

Site-specific management involved integration of a wide range of information about the resources—physical, biological, financial and management—available for the cropping system. Through computer and satellite technology available today, these complex data sets can be made useful in management decisions.

The ultimate goal of site-specific management is to be able to develop a profitability map for each field, illustrating the variability in profit potential within the field. This analysis is based upon the various data sets, interpreted with selected analytic tools to develop a profit map either from the projected yields (in planning) of the actual yields (after harvest). This map is the ultimate integration of all of the input factors, the resources, the yield and the economics related to the field. It becomes the final basis for decision making for the farmer, the landowner and their advisers. These tools help us meet the major challenge of precision farming—to convert our increased understanding of the field into increased profits for the farmer. Site-specific management will not improve profitability unless we take advantage of this increased information to more intensively manage the fields.



Through yield maps, farmers are learning that parts of their fields have considerably higher yield potential than they expected. They then ask what can be done to take advantage of that potential. In 1985, Herman Warsaw of Saybrook, Illinois, set a new world-record corn yield of 370 bushels per acre on a measured one-acre of his farm, eclipsing the previous world record of 338 bushels that he had set 10 years earlier. I had the pleasure of working with Herman as he built his management system for these record yields, and rode the combine with him as he harvested the record yield.



Herman's secret was paying attention to details. He didn't use the terminology, "*site-specific management*", but that is what he practiced. He didn't use computers or satellite technology, but he did understand his fields better than any other farmer I have known. He worked at systematically identifying and eliminating yield-limiting factors and took full advantage of the soil and weather resources with which he worked. Farmers using today's site-specific systems attempt to do the same thing, but apply it on a larger scale that Herman was able to do.

Site-specific management is the right approach to better manage crop and soil systems. Data collected to date show that many farmers can improve their profits by more intensive soil testing and using variable-rate nutrient applications. Field-average management over-fertilizes the low-yielding areas of the field, spending resources that could better be applied somewhere else. Even more important, it under-fertilizes the high-yielding areas of the field, preventing them from reaching full potential, especially in the good weather years. With a field-average management plan, the soil test levels in the low-yield areas are built up and the levels in the high-yield areas are depleted. Each year field-average management continues, the variability in the field increases and potential productivity decreases.

With site-specific management we are not likely to see great changes in yield or profits. The goal is to add a few kernels of grain to every ear of corn — or another pod to each soybean plant—but these small increases translate into bigger profits in the overall operation of a farm. Farmers who have more profitable operations will tend to be better stewards of the environment, too, because they will be able to make the right changes in their operations to address the environmental concerns. Many of the same decisions that increase long term productivity and profitability also reduce potential environmental problems.

The tools used for site-specific farming have been found to benefit the entire community in ways even beyond their impact on agriculture. As an example, during the 1996 floods along Idaho's Snake River, an airplane equipped with digital video camera and a GPS system for remote sensing of crop fields was used to prepare geographically-reinforced images of flooded areas. Videotape from flights over the flood zone was digitized and put into GIS analytical and mapping programs to generate maps to guide rescue workers, emergency crews, and sandbagging operations. Local officials report that millions of dollars of damage and probably many lives were saved with the assistance of these agricultural tools. The maps were also used to help expedite insurance settlements and government disaster aid. In the process, the awareness of this technology among farmers was increased, leading to greater adoption, and the general public learned about how advanced computer and satellite systems are being used to make agriculture more efficient while helping protect natural resources.

The full potential for site-specific management as a tool for protecting soil and water resources cannot yet be assessed. But as more farmers adopt these tools, more nutrient and pesticide applications are being guided with detailed information to help determine the appropriate rate, location and timing of applications. Better yield data for individual fields is helping guide farmers and their advisers to be sure yield goals are appropriate, so that recommendations can be targeted more precisely. As improved management increases yield potential, crops will be healthier, leading to more extensive root systems that help hold soil in place and help intercept more of the N moving through the soil profile. More nutrients will be absorbed by plant roots and ultimately removed in the harvested grain or held in the crop residue, providing a slow-release nutrient source for future crops. Higher yields also increase the amount of crop material left to hold the soil in place between growing seasons. More soil and nutrients held by the crop means less is going to be found in the surface water of lakes and streams collecting water from these fields.

The Certified Crop Adviser (CCA) program, a voluntary certification program for input suppliers and consultants making recommendations on nutrient and pest management, is now in place throughout North America. In the first 3 years of the program, over 10,000 individuals have passed state and national exams, completed a required period of in-field experience, and signed a Code of Ethics. In addition, the CCA's are required to maintain a rigorous continuing education program to be sure they stay informed of the latest developments in crop and soil management. Illinois leads the nation in participation in the CCA program with over 1,300 CCA's. Managed by state and regional certification boards, under the supervision of the American Society of Agronomy and an International CCA Board, the program has gained the support of state and federal agriculture and environmental agencies, and has widespread endorsement by agribusiness and farm organizations. Over 10,000 additional individuals have taken the exam and are in some stage of becoming certified. The CCA program is another positive step agriculture is taking to show our concern for proper use of production inputs and protection of natural resources, including our river systems and groundwater.

Productive agriculture and environmental stewardship can go hand-in-hand. Farmers are generally concerned about protecting our natural resources, and there are several aspects of site-specific management that can help put those concerns into action. High-yield crop management built around site-specific systems employing GIS, GPS and variable-rate technology is one of the most promising opportunities for production agriculture and environmental concerns to find harmony as we move into the 21st century.

Dr. Reetz is Midwest Director, Potash & Phosphate Institute, 111 E. Washington Street, Monticello, Illinois. He also serves as Vice-President of the Foundation for Agronomic Research and is a member of the Illinois Groundwater Advisory Council.

PLAN-IT EARTH

Pairing Learners And Nature with Innovative Technology for the Environmental Assessment of Resources Trends and Habitats

A Partnership of the Illinois Department of Natural Resources, the Illinois State Board of Education, Illinois Board of Higher Education and the National Science Foundation

Chuck Wheeler

Illinois Department of Natural Resources/Lincoln Tower Plaza
524 South Second Street, Springfield, IL 62701-1787
e-mail: cwheeler@dnrmail.state.il.us

ILLINOIS ECOWATCH NETWORK

The Illinois EcoWatch Network is a program designed to involve high-school students and volunteers in hands-on activities that focus on evaluating the ecological condition of the state of Illinois. The goals of EcoWatch are twofold. The first goal is to develop an involved group of Illinois citizens who are interested in the environmental health of the state and to provide them with information on some of the pressing problems in Illinois' ecosystems. The second goal is to have these citizens help in the long-term monitoring of the state's ecosystems so that changes in these ecosystems may be tracked. By committing to yearly data collection and the long-term monitoring of a site, or sites, EcoWatch participants not only become part of the scientific process but benefit their local community and all citizens of Illinois.

PLAN-IT EARTH HIGH SCHOOL SCIENCE CURRICULUM

This curriculum is centered on major Illinois ecosystems and is aligned with the Critical Trends Assessment Project's Illinois EcoWatch Network. All classroom activities are designed to meet state and national education standards. Training and follow-up sessions are funded through the National Science Foundation's Teacher Enhancement Program. Curriculum development and training is funded through the Illinois State Board of Education's Scientific Literacy Program. The PLAN-IT curriculum is divided into two major sections: the classroom module and the field-based ecosystem monitoring manual. Participating teachers are trained by EcoWatch staff in proper ecosystem monitoring procedures. The entire curriculum will be developed and piloted over a three year period.

The object of this high-school level curriculum is to bring teachers and students into the process of science and give them the necessary tools and methods to understand and collect information on the extent and condition of their local environment. Students will then submit their data to state scientists, who will analyze and incorporate it into their environmental databases. This valuable information will allow scientists and students, policy makers and citizens of the state to make informed decisions concerning the resources and habitats of our state.

Classroom activities are designed to introduce students to environmental concepts and give them the background necessary to conduct scientifically valid field research. Properly following the scientific techniques developed by state scientists validates the data that is collected.

TECHNOLOGICAL EXTENSIONS

The PLAN-IT curriculum infuses technology into each ecosystem module. Through innovative teacher training and PLAN-IT's home page, technology is perceived as both a reference and research tool. Beginning with the 1997/1998 School Year, participating schools have the option of submitting the ForestWatch, monitoring data they collect through electronic forms on the World Wide Web. These forms are a digital analog of the data collection forms contained in the ForestWatch manual.

EcoWatch scientists also use remote sensing techniques to monitor Illinois' environment. PLAN-IT teachers are among the first to have access to this digital information. The PLAN-IT curriculum and ecosystem monitoring methodology use these, and other, tools for geo-referencing the environmental information collected in the field. Included in the digital information products are: a cd-rom of Illinois Land Cover information (ecosystem types, roads, cities, etc.), satellite imagery data, and a two-cd-rom set of Geographic Information System (GIS) data for more advanced users. The use of Global Positioning System (GPS) units will also be introduced and made available for participating teachers.

HOW IS THIS PROJECT UNIQUE?

- a specific focus on Illinois ecosystems;
- a set of scientifically developed monitoring activities with data that will be used by state scientists;
- interdisciplinary curriculum modules that are developed by teachers and are aligned with state and national standards;
- authentic assessment opportunities;
- state of the art technology;
- partnership with Illinois Department of Natural Resource's EcoWatch and education colleagues across the state;
- training in field-based monitoring strategies;
- curriculum applications;
- technology connections;
- data submission and analysis;
- networking;
- developing partnerships.

ECOWATCH/PLAN-IT INTERNET ADDRESS:

http://dnr.state.il.us/inringif.htm
http://dnr.state.il.us/nredu/plan-it/planlay.htm

TO ACCESS ECOFORUM, DIAL:

1-217-782-8447, or toll free:
1-800-528-5486

RIVERWEB™ [1]
BUILDING ELECTRONIC KNOWLEDGE NETWORKS IN THE MISSISSIPPI RIVER BASIN[2]

David H. Curtis, Ph.D.

Education and Outreach Division
National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign
605 E. Springfield Avenue, Champaign, IL 61820
E-mail: dcurtis@ncsa.uiuc.edu

BACKGROUND

In 1993, prolonged and extensive flooding in the Upper Midwest, including Illinois, served to remind us that there are limits to "engineering" Nature. In the 21st century, more flexible approaches to river basin management will be needed. Developing such approaches will rely, in part, on further scientific research to better comprehend the behavior of entire river systems. But meeting the challenge of sustainable development in the river basin of the 21st century is not just a matter for scientists. The escalating cost of river containment is inducing government and citizenry to face tough choices and to learn to adapt differently to the ways of the river.

Following the '93 floods, the U.S. Executive Branch established the multi-agency Scientific Assessment and Strategy Team (SAST) in order to examine and report on alternative approaches to river management in the Upper Mississippi River basin, both structural and non-structural. In its report,[3] the SAST stated that recent flood events point to the need for more flexible, cost-effective approaches to floodplain management and that such approaches would, in turn, require better coordination between state and federal agencies involved, greater use of science and technology, and increased sharing of responsibility between the Federal government, states, localities and individuals for decisions on river basin management, as well as the costs and risks posed by such decisions. For example, river communities and the states in which they reside must weigh the needs of agriculture, transportation, commerce, recreation, tourism, and urban or suburban development versus those of preserving or restoring the natural systems in both the uplands and bottomlands. Among the key SAST recommendations was the proposal for a National Floodplain Management Program, with greater responsibility and accountability devolved to state and local government.

The recommendations of the SAST are very much in line with the White House's National Performance Review (NPR) initiative, which called for intensive use of new information technology to make government more efficient and accountable at all levels—federal, state and local.[4] The NPR stressed the importance of establishing a National Spatial Data Infrastructure (NSDI)[5] in improving the effectiveness and reducing the societal cost of environmental regulation.

> "We live in an age of information, and in recent years the nation has made unprecedented investments both in information and the means to assemble, store, process, analyze and disseminate it. Given the high costs of these activities, the nation needs to develop policies that are designed to invest and allocate information resources wisely and to ensure the greatest possible efficiency, effectiveness, and equity in the use of information."[6]

During past decades, a wealth of data on the Mississippi River Basin has been collected and archived, largely at taxpayers' expense. Following the '93 floods in the Upper Mississippi River basin, the SAST team assembled digitized geospatial data into a comprehensive data clearinghouse on the web. This resource constituted "a database useful for river basin management, and the beginnings of an integrated river basin management system that incorporates the needs of society and the natural environment."[7] It could also provide an excellent data foundation for raising public understanding of a) the river as a total system, b) how river systems have responded to human intervention, and c) the anticipated consequences of alternative river management policies.

But fuller involvement by citizens and their communities in integrated river basin management demands much more than merely making data available on the Internet. Better, user-friendly software tools are required to support rapid, "transparent" access to diverse electronic data. And, users must be intellectually equipped to apply the data to understand, formulate, discuss and solve real problems of concern or interest to themselves, their families and their communities. In short, there is a need for sustained environmental education aimed at all levels, from K-12 through college, as well as the public-at-large.

INTRODUCING RIVERWEB

To help meet this challenge, the National Center for Supercomputing Applications (NSCA)[8]

To help meet this challenge, the National Center for Supercomputing Applications (NSCA)[9] initiated the RiverWeb program, a multifaceted, World Wide Web (web)-centered framework for education and outreach in the Mississippi River Basin. Our vision is to harness advanced information technologies to promote science-based, informed discourse between diverse stakeholders, and thereby help strengthen environmental planning and decision-making for sustainable development of watershed resources. A major goal of RiverWeb is to work with broad constituencies of users to build web-centered, information architectures for the Mississippi River watershed, learning networks that enhance broad public access to and active use of information, tools and data required for integrated river management, wetland conservation and land use. Additional societal and educational goals of the RiverWeb program are to raise scientific, computer and media literacy among broad sectors of society; enhance lifelong learning; and link education, particularly K-12, more closely with community needs.

As the RiverWeb program unfolds, the role played by NCSA will be closely coupled with the science and technology agenda of the National Computational Science Alliance[10] it now leads. This nationwide alliance of computational scientists, computer scientists and experts in education, outreach and training is funded by the National Science Foundation to prototype a national computational and information infrastructure for the next century. Infrastructure components are to include advanced computing, visualization, remote instrumentation, massive databases and high-speed networks, and integration of these enabling technologies with applied scientific research in six areas. One of these areas, environmental hydrology, is concentrating in part on the development of computational tools that support decision-making by natural resource managers. In adapting such tools for broader audiences, RiverWeb will provide a conduit for technology and knowledge transfer aimed at enhancing public education and increasing citizen participation in watershed management and planning.

CURRENT INITIATIVES AND PLANS

At present, we are assembling a number of initial building blocks upon which to implement the RiverWeb vision in the longer term. First, we are beginning to establish partnerships with science museums and science and technology centers, community watershed conservation programs, resource management agencies, K-12 education organizations, institutions of higher learning and research, and environmental groups. Second, we intend to prototype and evaluate promising software applications along three research and development pathways: 1) museum-based and Internet-accessible interactive computer exhibits on the past, present and future dynamics of rivers; 2) web-centered, mapping and environmental modeling tools to support student-centered, project- and inquiry-based learning, as well as citizen science; 3) educational materials that integrate such tools within an interdisciplinary context; and 4) deployment and testing of Internet software to support distance learning and collaboration among educators and students and informed, science-based discourse between stakeholders. All four lines of pursuit are designed to be consistent with and to contribute to current national, state and local initiatives to harness information technology to re-engineer education at all levels, with the goal of equipping today's and tomorrow's citizens to "live, learn, and work successfully in a technological society..."[11]

Museum- and web-based informal education[12]

The Science Museum of Minnesota (SMM), the Illinois State Museum (ISM), the St. Louis Science Center (SLSC), and NCSA have formed a Mississippi RiverWeb™ Museum Consortium to secure funding to develop a series of museum- and web-based learning tools for adults, families, and school children. These tools will deploy user-friendly computer simulations and the latest virtual reality (VR) technology. In interacting with these simulations, visitors will be able to examine the Mississippi River basin as a complex interrelated system. The resulting software modules will complement a number of physical exhibits on the Mississippi River that are currently in development or planning. For example, SMM is developing a 5,000-square foot Mississippi Exhibition Gallery to be housed in a new facility overlooking the river and scheduled to open in 1999. ISM is planning a major exhibit on the Illinois River. SLSC has plans to develop a gallery area dedicated to aquatic ecosystems, including the Mississippi River.

Knowing about the physical, natural, and human forces that have shaped the river in Minnesota allows one to fully understand their effects on the river in Illinois. Understanding the confluence of the Missouri and Mississippi rivers in St. Louis helps one to more fully understand the forces that have shaped the Delta in the vicinity of New Orleans.

Funding permitting, each museum, working together and in concert with NCSA, plans to utilize advanced VR software and projection displays, including CAVE™[13] technology developed at the University of Illinois, to create "Digital River Basins" that focus on the river in their area and can be integrated with their own river exhibits. These interactive computer simulations would allow museum visitors to "see" and explore phenomena that are either too subtle or complex, or occur too slowly to be revealed by traditional physical exhibits. Through such experiences, visitors would come to understand how subtle environmental processes shape the Mississippi River and its watershed over years, decades, centuries, and millennia.

The river's local presence would serve as an entry point from which visitors could begin to understand it as a large, complex, and integrated system. Exhibits would feature simulations of the confluence of the Mississippi and Missouri Rivers near St. Louis; the Illinois River in the vicinity of Dixon Mounds; locks and dams in the Upper Mississippi River; the Dead Zone in the Gulf of Mexico; and a river pilot simulation, in which visitors could "steer" a towboat. Science content covered across the combined exhibits includes river hydrology and geomorphology, the life sciences, environmental studies employing geographic information systems (GIS), and the physics of motion. The consortium also intends to develop a shared site on the World Wide Web that invites users to engage in guided inquiry that will deepen their understanding of the Mississippi River.

Web technology for inquiry-based learning

Geographical Information Systems (GIS) have found widespread use in government, business and education to structure, archive and analyze spatial data of environmental significance, including a wealth of public domain data on the Mississippi River and its watershed. In many cases, GIS provides a spatial data foundation for such modeling exercises. Thanks to commercial software such as ArcView, a product of the Environmental Systems Research Institute (ESRI),[14] GIS is becoming increasingly popular in K-16 education, finding applications across the curriculum, from the arts and humanities to mathematics and the sciences. However, requirements for specialized software and non-uniform data formats pose barriers to yet broader uses of GIS among educators, students and the public-at-large. Recently, however, ESRI and other leading GIS vendors have begun marketing a variety of software products that support dynamic query and display of GIS data on the web.[15]

In tandem with GIS, environmental scientists and resource managers also turn to computer modeling to understand possible hydrologic, economic and ecological impacts of different watershed management strategies. We intend to prototype educational applications that harness both these technologies, as in the two examples that follow.

<u>Map-IT! Empowering Citizen Science</u>

In a small-scale demonstration project funded partly by Partnership Illinois, NCSA, together with the Department of Agricultural Engineering at the University of Illinois at Urbana-Champaign (UIUC) is developing a web-centered, GIS-grounded map query and display tool entitled "Map-IT!" Written in the Java programming language and based on ESRI's ArcView and associated Internet Map Server software, Map-IT! will allow a non-technical web user to display, examine and overlay maps; zoom and pan; select features (e.g. levees, soil type, population, roads); and print the resulting maps to hard copy without having to run costly software or worry about computing platform. Resources permitting, we also plan to build into the tool a data entry and map layer-generating capability to complement student field activities employing hand-held Global Positioning System (GPS) technology.

Our approach to Map-IT! is to "build it with them and they will come." The application and its user interface will be designed in close consultation with selected K-12 educators, resource managers, and stakeholders in Champaign and Douglas Counties, through which run the Sangamon and Embarras rivers respectively. GIS data layers from the USDA/Champaign County Soil and Water Conservation Service, the Illinois Department of Natural Resources and other data sources will be selected for archiving in an experimental database, with attention to matching scale and resolution of the selected data with projected educational uses. Near the end of the project, NCSA will train small groups of educators how to use Map-IT!, with a view to subsequent curriculum integration. We anticipate that diverse groups and organizations in the Illinois River watershed could also use the software to understand and address a variety of planning issues of concern to their own communities (for instance, the K-12 science curriculum and citizen science projects organized under the auspices of Illinois RiverWatch Network).[16] We believe that this project could help spur further geographic information services in support of lifelong learning and help forge closer coupling between government and citizenry, as motivated by and organized through the Illinois River Valley Partnership.[17]

Web-based Watershed Runoff Simulation

In another, small-scale prototyping project, a common hydrologic simulation model, CASC2d, was used in conjunction with a public domain geographic information system, GRASS,[18] to model storm runoff in a 517-acre watershed in Champaign County, Illinois, near the town of Mahomet. Runs were performed at UIUC's Geographic Modeling Systems Laboratory[19] to simulate two site conditions: existing (rural) conditions and coverage by extensive suburbanization.

Simulations of watershed responses to 5-year, 100-year and 500-year storm events were carried out for simulated time periods of 8.33, 12.5, 25.0 hours respectively. Model output was evaluated for peak flow, runoff volume, interception volume, and percentage of total rainfall mass intercepted, outflow volume, percent of total rainfall as outflow, infiltration volume, and runoff as a percentage function of total rainfall. At present, we are building a demonstration web "front-end" using Common Gateway Interface (CGI)- or Java-scripting to query simulation output data in a variety of ways and display the results through a web browser. Simulation products will include outlet hydrographs, maps illustrating surface runoff depth and infiltration depth, and animations based on interpolated data to highlight changes in hydrologic response over time. These data products, once rendered as graphs, images and movies, will be integrated with previously prepared contextual materials on hydrology and other aspects of watershed science (for example, the hydrology module in the WW2010 website[20] on climate and weather pioneered by UIUC's Department of Atmospheric Sciences) and also combined with GIS mapping tools and data sets made accessible on the web via tools such as Map-IT!

After evaluation of the resulting web module by small groups of target users (principally pre-college and college educators and students), the next step will be to design and implement a simulation that can be run interactively via the web in response to different input parameters and dynamically present model output data through a viewer programmed in Java. The emerging, web-based simulation program could be applied to any watershed, provided that suitable input data is available for that area. Combined with other interactive models (for example, an ecological model that computes projected impacts of alternative land uses on species distribution in a watershed), the runoff simulation could eventually serve as a powerful educational tool for students and educators living and working throughout the Illinois River Basin.

Interdisciplinary, online educational materials

The World Wide Web is evolving from a digital space used mainly to browse content to one in which users can manipulate content and data, and perform a variety of data processing tasks, share the results, and collaborate from anywhere on the Internet. This paradigm shift finds its parallel in current notions about reforming secondary education, which emphasize the need for authentic learning environments that adopt query-based, project-driven approaches to teaching and assessment.[21] The following two web projects have the potential to support this shift in educational practice within distinct educational settings.

The American Bottom RiverWeb™ Landing Site

This year NCSA, the UIUC Department of History and the Illinois State Museum were awarded a modest grant from the National Endowment for the Humanities to construct a prototype of an initial, RiverWeb site focusing on the American Bottom region in the vicinity of East St. Louis.[22] We are now constructing discrete narratives on topics such as the prehistoric city preserved at the Cahokia archeological site, the origins of the blues, and steamboats, river navigation, and railroads. We are building multimedia data archives and teacher and student guides to accompany these limited narratives. The resulting prototypic learning resource will stimulate discovery of the past among high school and college students.

Later, we intend to secure funding to turn the prototype into a fully developed model of a RiverWeb "landing site." Our goal is to create a unique, web-based learning and teaching resource that promotes interdisciplinary approaches to the study of and teaching about human cultures, past and present, in keeping with emerging education standards for history, anthropology, and the humanities.[23] Instead of the discrete narratives in the prototype, the model site would be organized around eight themes dwelling on the long-term history (from prehistory to present day) of the American Bottom: environment, settlement patterns, economy, technology, health and mortality, art, politics and society, and religion. In addition, "How do you know?" vignettes would equip students to evaluate the content critically and use primary sources structured in underlying databases to develop their own interpretations, which they can share on the web with the aid of novel collaborative software (see further below).

In constructing the model landing site, we plan to use the latest Internet, World Wide Web, database and multimedia technologies, including web-based GIS tools, Virtual Reality Mark-up Language, Java programming, and streamed video and audio, to develop an electronic learning environment featuring multi-layered, dynamic content and user-friendly, graphical interfaces to this content. It is our intention to cater to a wide range of client capabilities (processor speed, memory, local and wide-area connectivity, etc.). And, because we want to reach the broadest possible audience in high school and college settings, as well as the general public, the planned model RiverWeb resource will need to offer flexibility in accessing, viewing, and interacting with the content and original source data. For example, the viewer should be able to choose between three modes of navigation: place, time or theme. Therefore, the web architecture we adopt will need to be fully modular and extensible and accommodate several different types of databases, each interlocking with and cross-referenced to several different pieces of information and data. Later, pending additional funding, the resulting model landing site could then be extended to other locations, including perhaps selected stretches of the Illinois River.

Kansas City RiverWeb Hub

As part of the RiverWeb program, the Pan-Educational Institute (PEI) in Kansas City, Missouri has partnered with NCSA and a number of Kansas City organizations (school districts, local area schools, the Kansas City Museum/Science City, Steamboat Arabia Museum, the National Trails Museum, Riverfront Park, and the Kansas City Zoo) to develop web-based, informal and formal learning resources targeted at broad audiences, including underrepresented and underserved youth. Active efforts are now underway to secure funding to develop a comprehensive site, an early version of which already can be viewed on the web.[24]

Collaboration Environments

Historically, computer software tools have tended to focus on single-user control, with the user subsequently attempting to communicate the results to colleagues. Internet-based, collaborative environments, however, promise to transform learning and work into a much more cooperative venture in coming decades. NCSA is developing or adapting and testing both synchronous and asynchronous Internet-based collaboration software. As part of the RiverWeb program, we would eventually like to investigate and evaluate the deployment of such software among prospective "virtual" learning communities along the Illinois River and other areas in the Mississippi watershed. Such Internet communities could be structured around classes and courses in schools and colleges or focused on citizen science initiatives involving educators, students, resource managers and stakeholders.

Synchronous collaboration could be supported via emerging software such as Habanero,[25] which supports synchronous (i.e. real-time) sharing of Java objects with colleagues distributed around the Internet. Applications included in the latest version of Habanero include a shared electronic whiteboard, realtime audio and video players, a text editor, a chat program, a voting tool, a number of other tools for viewing different types of image data (e.g., weather data), and a web browser controller. Other applications that could be integrated for collaborative use include spatial query and display tools such as Map-IT! and interactive simulations (for example, the runoff simulation outlined above). Looking ahead to the future, diverse members of river basin communities could use software like Habanero and "meet" in Internet space to exchange information and viewpoints about a pressing environmental concern. Such a session might focus on evaluating the feasibility and potential impacts of alternative approaches to flood control along a nearby stretch of river, perhaps in consultation with resource managers, environmental experts, high school students working on river science projects, and representatives of communities located downstream. However, many technical hurdles remain to be overcome before this scenario can become a reality.

In addition to synchronous collaboration software, we are interested in experimenting with commercially available, asynchronous tools to facilitate project implementation among geographically dispersed project participants. For example, Lotus Notes[26] and its accompanying web browser, Domino can provide a framework for such asynchronous collaboration on the web and is currently being considered by NCSA as part of its strategy to build so-called Intranets in support of collaborative work by scientists and engineers in the NCSA-led Alliance.

CONCLUSION

Realizing the vision of RiverWeb will pose considerable technical, administrative and editorial challenges. It would be unreasonable for any one organization to develop or even oversee the development of all projects that could be a part of RiverWeb. Different combinations of partners and collaborators will have the necessary expertise and resources to develop and implement discrete projects. Therefore, the program will need to be implemented within a decentralized, though coordinated, structure. We have begun to lay the foundations for a growing program by establishing consortia with interested organizations and through initial prototyping and evaluation of key enabling technologies. In the coming year, we will continue to pursue such implementation strategies in keeping with the overriding vision of RiverWeb: to excite, educate and empower both individuals and communities to manage their destinies in greater harmony with the ways of the river.

REFERENCES

[1] The University of Illinois is currently registering RiverWeb™ as a trademark. Once registered, the label will be freely available for use by NCSA and its RiverWeb partners with all products and activities that are related to the RiverWeb program initiated by NCSA.

[2] University of Illinois staff and students who have contributed intellectually, creatively or technically to the RiverWeb program include Lisa Bievenue, Ian Binnington, John Braden, Bertram Bruce, Vernon Burton, Alan Craig, David Herr, Christopher Hewes, Doug Johnston, Bart Lammey, Todd Larson, Matthew Lossau, Brian Orland, Mark Schmidt, Juhan Sonin, and Raul Zaritsky. Their participation is gratefully acknowledged. We also thank our RiverWeb partners outside the University for sharing their ideas and expertise.

[3] "Sharing the Challenge: Floodplain Management into the 21st Century," *Report of the InterAgency Floodplain Management Review Committee to the Administration Floodplain Management Task Force*, Washington, D.C., June 1994.

[4] For information on the National Performance Review website, see http://www.npr.gov/.

[5] Background on the NSDI can be viewed on the web at http://www.fgdc.gov/nsdi2.html.

[6] *A Data Foundation for the National Spatial Data Infrastructure*, National Research Council, National Academy Press, Washington, D.C., 1995.

[7] John Kelmelis, "Science and Computer Technology for Ecosystem Management: A River Basin Application." In *Space and Time in Environmental Information Systems*, 9th International Symposium on Computer Science for Environmental Protection (CSEP'95), Horst Kremers and Verner Pillman (Eds.), Metropolis-Verlag GmbH, Marburg, Germany, 1995.

[8] For current information on the RiverWeb program, see the website at http://riverweb.ncsa.uiuc.edu.

[9] See http://www.ncsa.uiuc.edu for further information on NCSA.

[10] Up-to-date information on the National Computational Alliance can be viewed on the web at http://alliance.ncsa.uiuc.edu/.

[11] Cited from p. 7 of the *State of Illinois K-12 Information Plan*, Illinois Board of Education (ISBE), October 1996. See also the recently released *Illinois Learning Standards* [for elementary and secondary students] published by ISBE, as well as the *National Science Education Standards*, National Research Council, National Academy Press, 1996.

[12] This section is adapted from text written jointly by the consortium for a proposal that was submitted in May 1997 to the National Science Foundation.

[13] The CAVE™ is an advanced virtual reality system that was developed at the Electronic Visualization Laboratory at the University of Illinois, Chicago. Comprehensive information on the CAVE™ and related technology can be found on the web at http://evlweb.eecs.uic.edu/EVL/VR/systems.html.

[14] See ESRI's website at http://www.esri.com for detailed information about ArcView and its other GIS software products, as well as excellent explanations of GIS—what it is and how it works.

[15] See for example, ESRI's demonstrations of GIS on the web at http//maps.esri.com/ESRI/arcview/demos.htm.

[16] Illinois RiverWatch (http://dnr.state.il.us/river/intro.htm) is the stream monitoring component of the Illinois EcoWatch Network (http://dnr.state.il.us/ctap/ecowatch/ecowatch.htm).

[17] Further information about the Illinois River Valley Partnership can be obtained from the Illinois Lt. Governor's website at http://www.state.il.us/ltgov/ilriver/report.html.

[18] Details about this GIS can be found on the website of U.S. Army Corps of Engineers' Construction Engineering Research Laboratory. See http://www.cecer.army.mil/grass/GRASS.main.html.

[19] The Geographic Modeling Systems Laboratory at UIUC specialized in the development and applications of geographic systems for research, education and in support of environmental resource management and planning. For more information, see http://www.gis.uiuc.edu/.

[20] This hydrology learning module can be viewed at http://ww2010.atmos.uiuc.edu/(Gh)/home.rxml.

[21] Beverly Hunter and Bruce Goldberg, "Learning and Teaching in 2004: The Big Dig," OTA Contractor Report, NTIS No. 95-172235, in U.S. Congress, Office of Technology Assessment, *Education and Technology: Future Visions*, OTA-BP-HER-169, U.S. Government Printing Office, Washington, D.C., September 1995, pp.121-122. Also see Amanda Z. Pryor and Elliot Soloway, "Practicing Authentic Science," in *Electronic Learning*, March/April 1996.

[22] Named the "American Bottom" by archeologists, this region of the Mississippi River floodplain is also termed the "American Bottoms" by some historians (*Omni Gazetteer of the United States of America: A Guide to 1,500,000 Place Names in the United States and Territories*. Detroit, MI: Omnigraphics, Inc., 1991. Vol. 6 Great Lakes States, p.6). For this project, we have elected to use the term "American Bottom."

[23] See information on standards compiled by Los Angeles-based National Center for History in the Schools (http://www.sscnet.ucla.edu/nchs/) and referenced by the National History Association (http://Web.gmu.edu/chnm/aha/).

[24] An early version of a prototype Kansas City RiverWeb Hub can be viewed at http://pei.pei.edu/RiverWeb/.

[25] For information on the Habanero project, see http://www.ncsa.uiuc.edu/SDG/Software/Habanero.

[26] For details of Lotus Notes and Domino software, see the vendor's website at http://www3.lotus.com/home.nsf.

OPERATIONAL WATER LEVEL MANAGEMENT OF THE ILLINOIS WATERWAY

Rick D. Granados

U. S. Army Corps of Engineers, Illinois Waterway Project Office
257 Grant Street, Peoria, IL 61603

GENERAL OBJECTIVES

The general objective in water control on the Illinois Waterway is to provide an all season navigation link of at least nine-foot depth between Lake Michigan and the Mississippi River. A second important objective is the diversion of wastewaters originating in the Chicago area away from Lake Michigan, the city's water source. A third objective is the operation of the headwater system in a way to provide a degree of flood control to alleviate flooding in the Chicago area.

MAJOR CONSTRAINTS

The water in the canal system above Lockport comes from three sources: (1) water pumped from Lake Michigan for domestic use and discharged into the canal as wastewater, (2) storm and groundwater runoff from the basin that was previously tributary to Lake Michigan, and (3) water diverted directly into the system from Lake Michigan. The latter is composed of water required for lockages at the Chicago Harbor and O'Brien locks; Leakage originating from the Chicago Harbor Controlling Works, O'Brien Lock and Dam, and the Wilmette Pumping Station; and water diverted for navigation make-up and discretionary purposes at the three above locations. The major component of discretionary diversion is water to improve the water quality of the Chicago Sanitary and Shipping Canal. A Supreme Court decree limits the diversion of water from Lake Michigan from the three sources mentioned above to an average of 3200 cubic feet per second computed over a 40-year period. High flows must be compensated for by reduced diversion to maintain the specified average.

ORGANIZATION FOR WATER CONTROL

Upstream of Lockport Lock and Dam the canal system is regulated by the Metropolitan Sanitary District of Greater Chicago (MSDGC) in cooperation with the U.S. Army Corps of Engineers,(USACE) Rock Island District. Downstream from Lockport, the Rock Island District is responsible for regulation.

MSDGC monitors regulation from the Waterways Control Center at 100 East Erie St., Chicago. MSDGC controls Wilmette and Chicago controlling works through a telephone communication system. USACE personnel make manual adjustments at the O'Brien Lock Controlling Works through the direction of the MSDGC dispatcher at the Water Control Center.

Field operations of the locks and dams operated by USACE fall under the jurisdiction of the Lockmaster of each lock and dam. The Lockmasters fall under the Lock and Dam Section of the Illinois Water Project Office in Peoria Illinois.

OVERALL PLAN FOR WATER CONTROL

Water control is achieved with sluice gates at the three Lake Michigan structures (Wilmette Chicago Harbor and O'Brien) and with sluice gates and turbines at Lockport. With head and tainter gates at Brandon Road; with tainter gates at Dresden Island, Marseilles and Starved Rock; and with a submersible tainter gate, movable wickets and butterfly valves at Peoria and LaGrange.

Two hydroelectric power plants exist on the waterway as well and contribute to the regulation equation of the waterway's flow. One at Lockport, which is operated by MSDGC and another, located on the Starved Rock dam, which is owned by the City of Peru, Illinois.

During major flood events, the sluice gates at the Lockport Controlling works supplement the discharge capacity of the sluice gates and turbines at Lockport. The maximum stage to which the Chicago Sanitary and Ship Canal can be drawn down to is 570.5 feet NGVD at Lockport and 575.5 feet at the Calumet-Sag Junction. When the stage at either location approaches to within 0.2 feet of these limits, preparations are made to reduce the Lockport discharge. Reversal of flows into Lake Michigan is implemented at Wilmette when the North Shore Channel reaches 584.5 feet NVGD. It occurs at the Chicago Harbor Controlling works and the O'Brien Lock and Dam when the Chicago and Calumet Rivers reach 582.5 feet NVGD. If the rivers are at near peak and there is no longer significant rainfall, a stage of 583.0 feet can be reached before action is taken to divert Chicago and Calumet River flows into Lake Michigan.

Downstream from Lockport, all of the water control structures are operated on a run-of-the-river basis. When flow changes are made at any facility, they are reported to the downstream facilities in a chain sequence. The amount of change made at any water control structure is based upon the experience and judgement of the Lockmasters. Input from the Water Control Section in Rock Island on existing and predicted weather and river conditions help Lockmasters form their decisions.

As previously described, wicket dams exist at both Peoria and LaGrange Lock and Dams. At high to medium flows, there is sufficient depth in the Waterway so that open-pass conditions prevail. The wickets are in the down position and the locks are not used under these circumstances. As the flows recede, a point is reached when wickets at the dams have to be raised in order to maintain navigation depths. The installation of the submersible tainter gates at both Peoria and LaGrange has significantly improved operations at these facilities. This allows the wickets to generally be in the all-up or all-down positions.

The principal control points for Peoria Lock and Dam are at Henry,Ill. and Starved Rock Dam, and a supplementary point is the headwater at Peoria Dam. During normal operations, the submersible tainter gate is use to regulate the flow. Based on rising or falling river conditions, the lock staff will either lower or raise the wickets if the submersible tainter gate is unable to hold the authorized pool level.

Similar to Peoria Dam, during high and medium flows at LaGrange, there is sufficient depth in the Waterway so that open pass conditions prevail. As the flow recedes and Peoria Dam has raised their wickets, the wickets at LaGrange are raised using the following criteria. As the flows continue to fall and the falling pool reaches elevation 427.0 to 427.5 feet NGVD, all wickets will be raised and the will be regulated with the submersible tainter gate. The pool will then be maintained at elevation 429.0 NGVD. When the wickets are in the "up" position and flow begins to rise, a difference of 2.0 feet of head or less between the pool and tailwater stages triggers action to lower the wickets. When the tainter gate is out and 2.0 feet of head is reached, all wickets are lowered. Because the Sangamon and LaMoile Rivers, both major tributaries, empty into the lower end of the LaGrange Pool, a careful monitoring of flows in these tributaries is required in the water control operations at LaGrange

DEVIATION FROM NORMAL REGULATION

Deviation from normal regulation is occasionally requested at a water control facility. Prior approval for a deviation is obtained from the Mississippi Valley Division Headquarters (MVD) in Vicksburg, Mississippi, except as described below. Deviation requests fall into the following catagories:

a) Emergencies. Some emergencies that can be expected are: drownings and other accidents, and failure of operation facilities or towboat accidents at a dam site. Necessary action under emergency conditions is taken immediately, unless such action would create equal or worse conditions. The Mississippi Valley District is informed as soon as possible.

b) Unplanned Minor Deviations. There are unplanned instances that create a temporary need for minor deviations from the normal regulation of a pool, although they are not considered emergencies. Changes in releases are sometimes necessary for maintenance and inspection. Requests for changes of release rates are generally for a few hours to a few days. Each request is analyzed on its own merits. Consideration is given to upstream watershed condition, potential flood threat and possible alternative measures. In the interest of maintaining good public relations, the requests are complied with, providing there are not any adverse effects on the overall relation of the project for the authorized purposes. Approval for these minor deviations will normally be obtained from MVD by telephone and confirmed in writing.

c) Planned Deviations. Each condition should be analyzed on its own merits. Sufficient data on flood potential and watershed conditions, possible alternatives measures, benefits to be expected and probable effects on the other authorized and useful purposes of the waterway will be presented by letter, telephone or teletype to The Mississippi River Valley Division along with recommendations for review and approval.

VISIT OUR HOME PAGE @ WWW.MVR.USACE.ARMY.MIL

REFERENCES

U. S. Army Corps of Engineers 1996. Upper Mississippi River Basin, Illinois Waterway – Nine Foot Channel, Master Water Control Manual pp.7-1 – 7-5, Plate no. II-2.

PATTERNS OF EROSION AND SEDIMENTATION IN THE ILLINOIS RIVER BASIN

Misganaw Demissie

Illinois State Water Survey
2204 Griffith Drive, Champaign, IL 61820-7495

ABSTRACT

Bottomland lakes along the Illinois River are important ecological, recreational, and economical resources of the state of Illinois. Because of a combination of natural geological conditions and manmade hydraulic controls, there are numerous bottomland lakes along the Illinois River valley. Sedimentation has long been identified as a major problem for bottomland lakes in the Illinois River. It was estimated that on the average the bottomland lakes in the Illinois River valley had lost 72 percent of their water storage capacity to sedimentation by 1990. Some lakes have completely filled with sediment. The impact of sedimentation on the bottomland lakes is dramatically illustrated by what has happened to Peoria Lake, the largest, deepest lake in the Illinois River valley. The overall impact of the sedimentation in Peoria Lake is the shrinking of the deeper parts of the lake into a narrow deep navigation channel in the middle of the lake.

INTRODUCTION

Bottomland lakes along the Illinois River (Figure 1) are important ecological, recreational, and economical resources of the state of Illinois. Because of a combination of natural geologic conditions and manmade hydraulic controls, there are numerous bottomland lakes along the Illinois River valley. The present-day Illinois River occupies only a small part of an ancient river valley formed by glacial action when the Illinois River valley was the drainage outlet for much of the Upper Mississippi River basin. The ancient river that occupied the valley carried much more flow than the present Illinois River. During the last stages of the glacial period, drainage into the Illinois River valley was significantly reduced when drainage from the Upper Mississippi and Rock Rivers was diverted into the present-day Mississippi River valley. This left the Illinois River valley with much reduced flow and a smaller river that occupied only a small portion of the valley and could not transport the sediment delivered by tributary streams, resulting in the formation of alluvial fans and deltas near the mouths of the tributary streams. These fans and deltas created narrow constrictions that held back water in the deeper channels and depressions in the floodplain forming some of the bigger bottomland lakes in the valley. Natural levees were also created along the riverbanks by continuous sediment deposits from overbank flows during floods isolating old channels, sloughs, depressions, and lakes from the main river. Over time these natural processes have created a number of bottomland lakes along the Illinois River valley. Under normal flow conditions, most of the lakes are connected to the main river by narrow outlet channels.

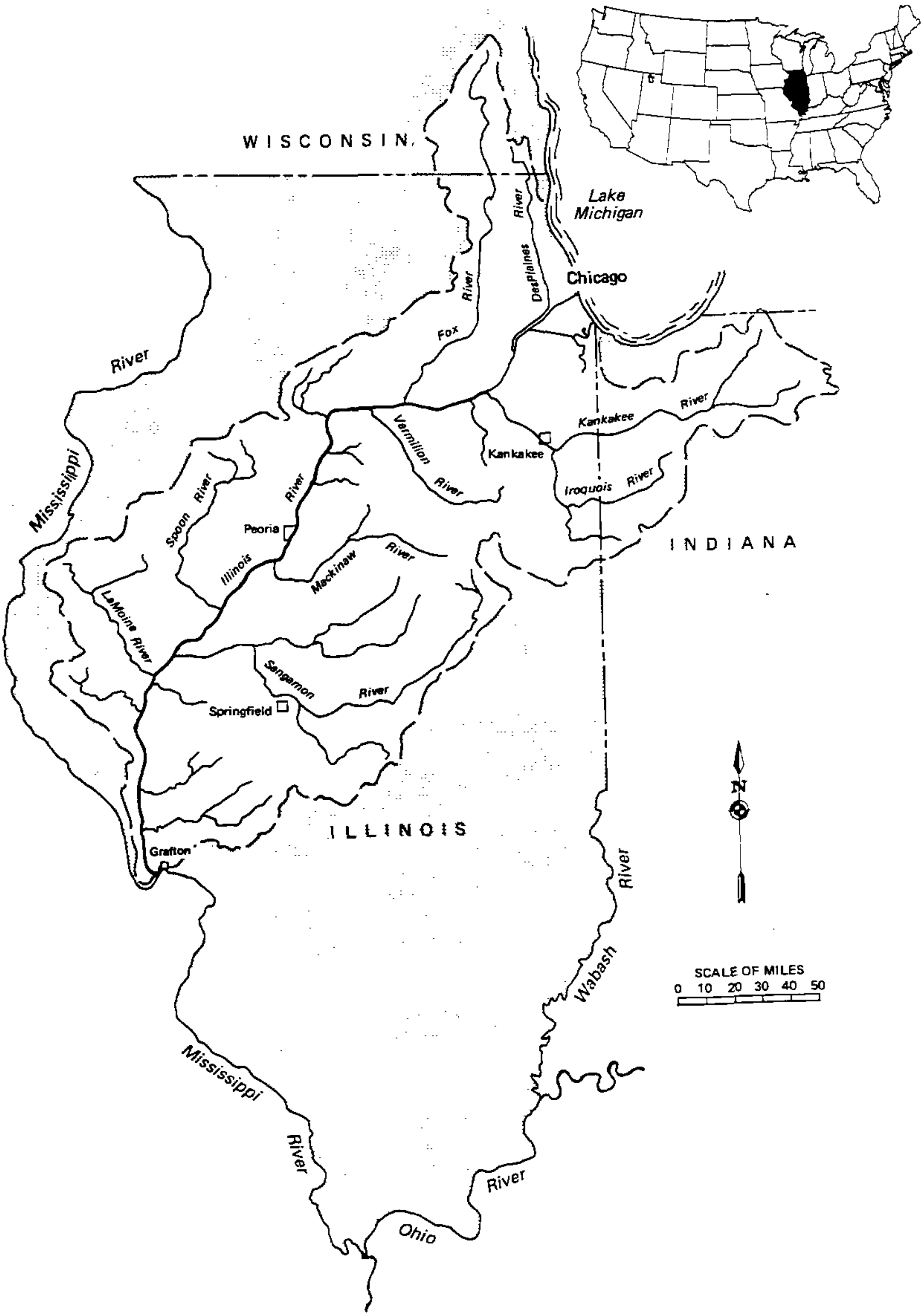


Figure 1. Location of the Illinois River basin.

The conditions of bottomland lakes along the Illinois River valley were significantly altered when the state of Illinois increased the diversion of water from Lake Michigan to the Illinois River through the Sanitary and Ship Canal starting in 1900. The increased diversion raised the low water level in the Lower Illinois River valley resulting in larger bottomland lakes than before. Sloughs, marshes, ponds, wetlands, and small lakes were inundated by the higher low water levels to create bigger lakes. The completion of the 9-foot navigation waterway with a system of locks and dams along the Illinois River in the 1930s further increased the low water level, resulting in increased bottomland lake surface areas in the valley. At the same time, however, a large part of bottomland lakes, sloughs, ponds, and wetlands were leveed-off and drained for agricultural purposes . It was estimated that there were 53 bottomland lakes with surface area greater than 50 acres in the Illinois River valley in 1975. The total surface area of the bottomland lakes was estimated to be 39,000 acres occupying only 5.2 percent of the floodplain area.

Sedimentation has long been identified as a major problem for bottomland lakes in the Illinois River. It was estimated that on the average the bottomland lakes in the Illinois River valley had lost 72 percent of their water storage capacity to sedimentation by 1990. Some lakes have completely filled with sediment. The impact of sedimentation on the bottomland lakes is dramatically illustrated by what has happened to Peoria Lake, the largest, deepest lake in the Illinois River valley. It is located near the city of Peoria between River Miles 162 and 182 on the Illinois River. Sedimentation surveys conducted at different times show how the lake has filled with sediment over time. Sedimentation is more severe in the upper reaches of the lake than in the lower reaches. As a result, the lake gets shallower in the upstream direction. The overall impact of the sedimentation pattern in Peoria Lake is the shrinking of the deeper parts of the lake. In the near future, the only deep part of the lake will be a narrow navigation channel in the middle of the lake. As sedimentation continues and the shallow flat areas start supporting vegetation, much of the lake will be transformed into seasonally flooded wetland area.

LAND USE CHANGES AND SOIL EROSION

More than 80 percent of the Illinois River basin is used for agricultural purposes. The change in areas used for different crops in Illinois over time is shown in Figure 2. Agriculture in Illinois started to expand very rapidly in the 19th century, from 8.2 million acres in 1866 to about 15 million acres in 1881. There were increases in all major crop types. After 1881, the total crop acreage increased at a reduced rate until 1918 when a period of decline started. Total crop acreage started to increase gradually in 1940 until it peaked in 1980. In addition to an increase in total agricultural area, several changes in agricultural practices during the same period have significantly affected the erosion process in the Illinois River basin. One of the major changes is the increase in land area used for soybeans accompanied by a proportional decline in land area used for the production of grassy crops, such as wheat, oats, and hay. Soybean acreage increased from zero to 8.5 million acres from 1919 to 1987, while acreage for grassy crops decreased from 20 million to 2 million acres during the same period. Assuming soil erosion rates from soybeans to be greater than for grassy crops, it can be concluded that this change in land use has resulted in increased soil erosion from agricultural lands in the Illinois River basin, even though the

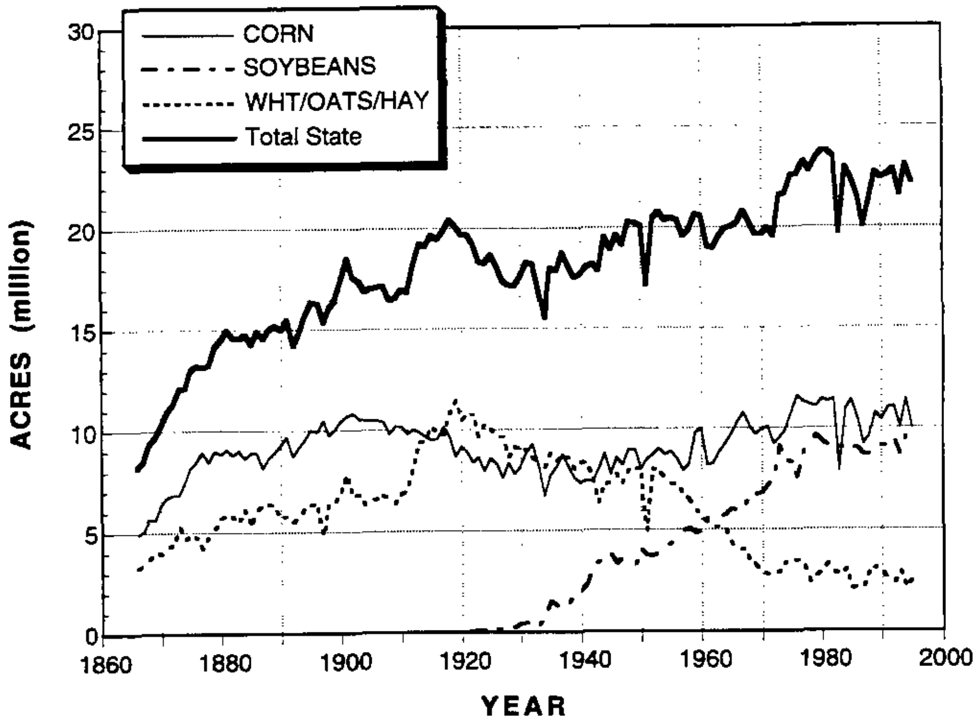


Figure 2. Changes in agricultural crop acreages for the state of Illinois from 1866 to 1988.

total agricultural acreage has not increased drastically since the introduction of soybean. Other factors that have contributed to increased erosion are improvements in tractors and plowing techniques that pulverized the soil more efficiently and the increased use of inorganic fertilizers to farm marginal areas continuously without crop rotation (Walker, 1984).

Sediment budget calculations based on suspended sediment data in recent years show that tributary streams on the average deliver 13.7 million tons of sediment into the Illinois River valley, of which 5.8 million tons is discharged to the Mississippi River and 7.9 million tons is trapped in the Illinois River valley (Demissie, et al., 1997). This conservative estimate does not include contributions from bank and bluff erosion along the Illinois River that were not calculated as part of tributary streams. This recent rate of sediment delivery is estimated to be greater than the rate in the late 19th and early 20th century. Because of the absence of long-term sediment load data, the only way to estimate the long-term trend of erosion and sediment delivery is based on sedimentation rates in the bottomland lakes in the valley. For example, the long-term sediment accumulation in Peoria Lake, where the best data is available, from 1903 to 1985 is shown in Figure 3, which indicates that the rate of sedimentation in more recent years is greater than during the early 1900s. However, it is still difficult to determine when the rate of sedimentation started to increase because of the lack of lake sedimentation data between 1903 and 1965.

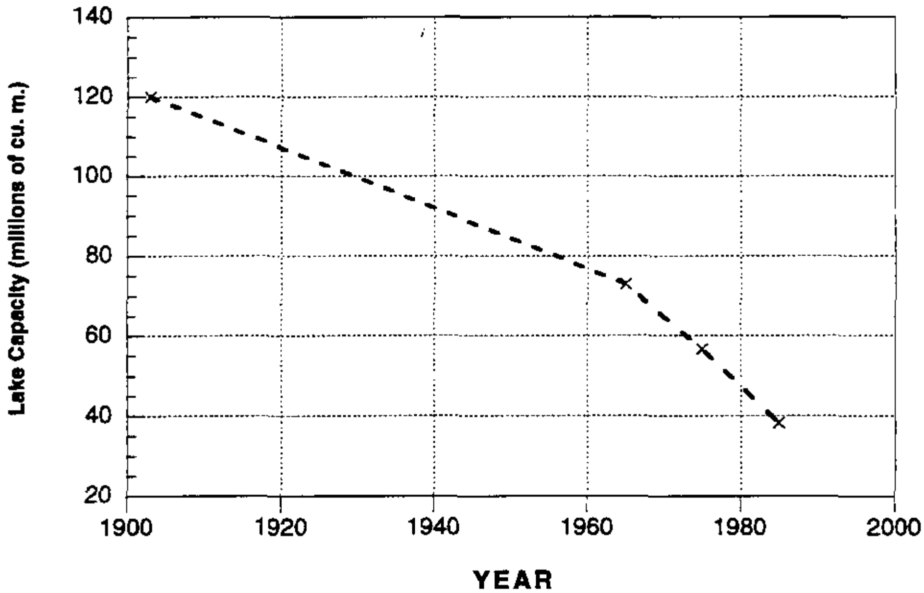


Figure 3. Rates of sedimentation in Peoria Lake.

SEDIMENTATION IN BOTTOMLAND LAKES ALONG THE ILLINOIS RIVER

Bottomland lakes along the Illinois River are important ecological, recreational, and economical resources of the state of Illinois. Because of a combination of natural geologic conditions and manmade hydraulic controls, there are numerous bottomland lakes along the Illinois River valley. The present-day Illinois River occupies only a small part of an ancient river valley formed by glacial action when the Illinois River valley was the drainage outlet for much of the Upper Mississippi River basin. The ancient river that occupied the valley carried much more flow than the present Illinois River. During the last stages of the glacial period, drainage into the Illinois River valley was significantly reduced when drainage from the Upper Mississippi and Rock Rivers was diverted into the present-day Mississippi River valley. This left the Illinois River valley with much reduced flow and a smaller river that occupied only a small portion of the valley and could not transport the sediment delivered by tributary streams, resulting in the formation of alluvial fans and deltas near the mouths of the tributary streams. These fans and deltas created narrow constrictions that held back water in the deeper channels and depressions in the floodplain forming some of the bigger bottomland lakes in the valley. Natural levees were also created along the riverbanks by continuous sediment deposits from overbank flows during floods isolating old channels, sloughs, depressions, and lakes from the main river. Over time these natural processes have created a number of bottomland lakes along the Illinois River valley. Under normal flow conditions, most of the lakes are connected to the main river by narrow outlet channels (Demissie & Bhowmik, 1986; Division of Waterways, 1969).

The conditions of bottomland lakes along the Illinois River valley were significantly altered when the state of Illinois increased the diversion of water from Lake Michigan to the Illinois River through the Sanitary and Ship Canal starting in 1900. The increased diversion raised the low water level in the Lower Illinois River valley resulting in larger bottomland lakes than before. Sloughs, marshes, ponds, wetlands, and small lakes were inundated by the higher low water to create bigger lakes. The completion of the 9-foot navigation waterway with a system of locks and dams along the Illinois River in the 1930s further increased the low water level, resulting in increased bottomland lake surface areas in the valley. At the same time, however, a large part of bottomland lakes, sloughs, ponds, and wetlands were leveed-off and drained for agricultural purposes (Bellrose et al., 1983). It was estimated that there were 53 bottomland lakes with surface area greater than 50 acres in the Illinois River valley in 1975. The total surface area of the bottomland lakes was estimated to be 39,000 acres occupying only 5.2 percent of the floodplain area (Lee & Stall, 1976).

Sedimentation has long been identified as a major problem for bottomland lakes in the Illinois River since most of them have been filling up with sediment (Lee & Stall, 1976, 1977; Bellrose et al., 1984; Illinois Division of Water Resources, 1987; Demissie et al., 1992). It was estimated that on the average the bottomland lakes in the Illinois River valley had lost 72 percent of their water storage capacity to sedimentation by 1990 (Demissie et al., 1992). Some lakes have completely filled with sediment. In addition to the loss of capacity, there is concern with the quality of sediment in the lakes. As the lakes become shallower, waves generated by wind and river traffic continuously resuspend the bottom sediment. If contaminants are stored in the sediment, they are resuspended along with the sediment and become available to aquatic biota in the water column.

THE CASE OF PEORIA LAKE

The impact of sedimentation on the bottomland lakes is clearly illustrated by what has happened to Peoria Lake, the largest, deepest lake in the Illinois River valley. It is located near the city of Peoria in central Illinois between River Miles 162 and 182 on the Illinois River. River miles on the Illinois River are measured starting from Grafton, Illinois, where the Illinois River joins the Mississippi River (Figure 1) The cumulative result of sedimentation in Peoria Lake is shown in Figure 4, which compares the 1903 and 1985 lake bed profiles at four locations along the lake. As can be inferred from the figure, much of the lake has filled with sediment. Sedimentation is more severe in the upper reaches of the lake (River Miles 175 and 179) than in the lower reaches (River Miles 164 and 168). As a result, the lake gets shallower in the upstream direction. The overall impact of the sedimentation pattern in Peoria Lake is the shrinking of the deeper parts of the lake as illustrated in Figure 5, which compares that portion of the lake deeper than 5 feet for 1903 and 1985. In 1903 much of the lake would have been deeper than 5 feet under present-day normal pool conditions, while in 1985 much of the lake was shallower than 5 feet, with a narrow navigation channel in the middle of the lake. As sedimentation continues and the shallow flat areas start supporting vegetation, much of the lake will be transformed into seasonally flooded wetland. This possibility is clearly illustrated in Figure 6, that shows the most recent depth survey of Peoria Lake. The 1996 survey shows that the deeper areas of the lake are shrinking further, with only 10 percent of the lake having water depth greater than 5 feet. The depth of water is less than 2 feet for nearly half of the lake (46 percent).

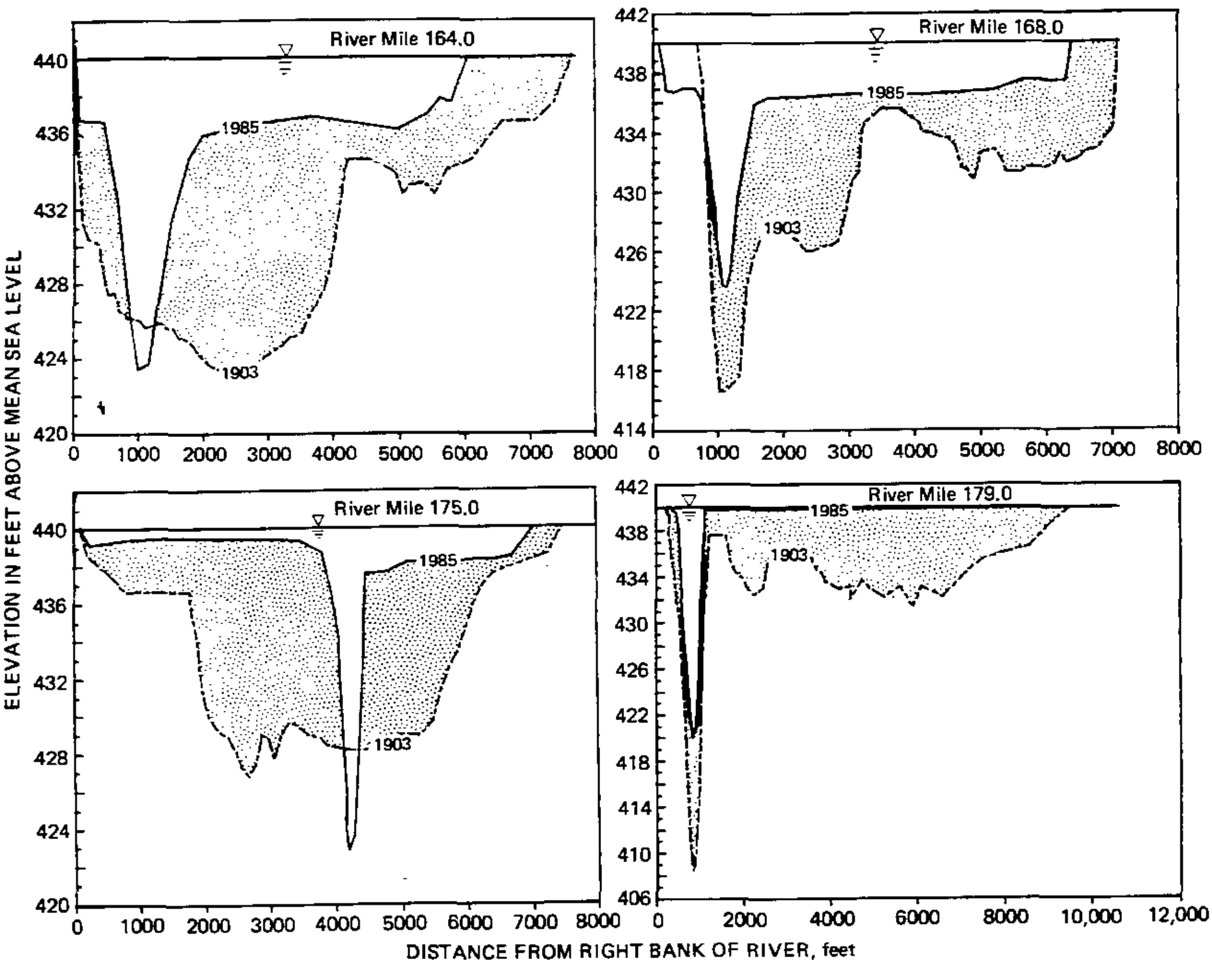


Figure 4. Accumulation of sediment in Peoria Lake as indicated by changes in cross-sectional profiles from 1903 to 1985.

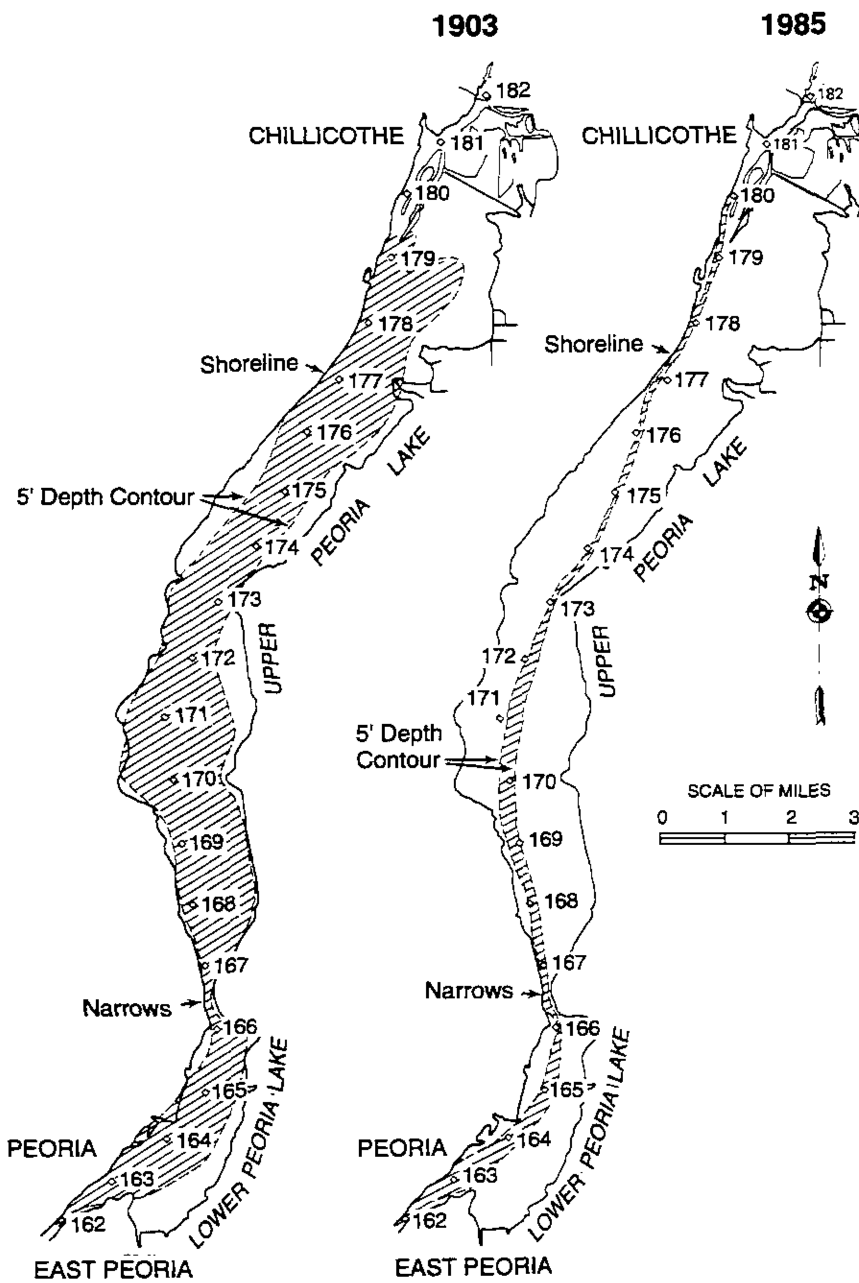


Figure 5. Shrinkage of lake area with water depth greater than 1.5 m in Peoria Lake from 1903 to 1985.

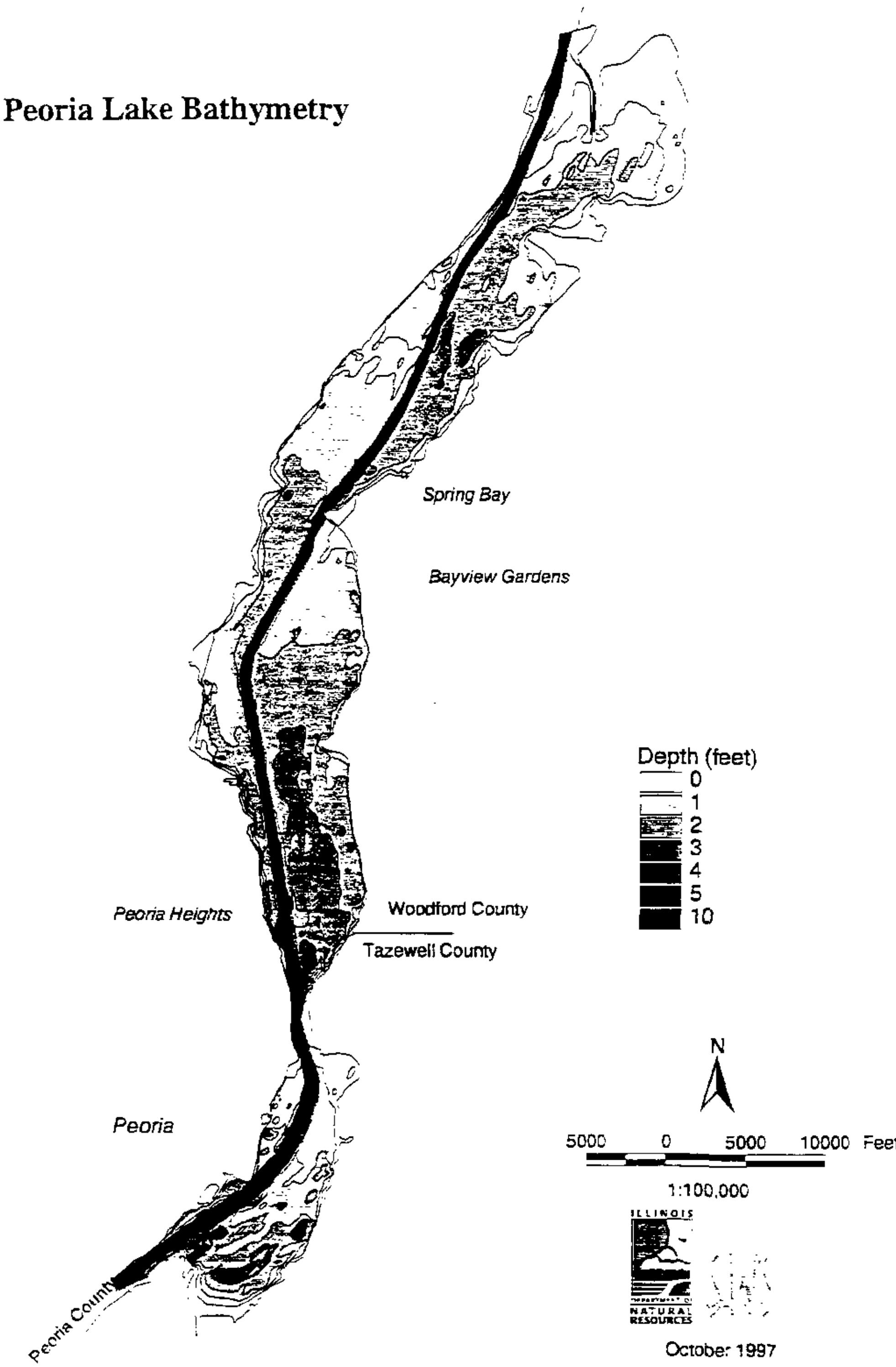


Figure 6. Water depth in Peoria Lake based on a 1996 survey by the U.S. Army Corps of Engineers.

REFERENCES

Bellrose, F.C., S.P. Havera, F. L. Paveglio, and D.W. Steffeck. 1983. *The Fate of Lakes in the Illinois River Valley*. Illinois Natural History Survey Biological Notes 119, Champaign, Illinois.

Demissie, M. and N.G. Bhowmik. 1986. *Peoria Lake Sediment Investigation*. Illinois State Water Survey Contract Report 371, Champaign, Illinois.

Demissie, M., L. Keefer, and R. Xia. 1992. *Erosion and Sedimentation in the Illinois River Basin*. ILENR/RE-WR-92/104, Illinois Department of Energy and Natural Resources, Springfield, IL.

Demissie, M., R. Xia, and L. Keefer. 1997. *Sedimentation Budget of the Illinois River*. Draft Illinois State Water Survey Contract Report.

Division of Waterways. 1969. *Report for Recreational Development: Illinois River Backwater Areas*. Springfield, Illinois.

Illinois Division of Water Resources. 1987. *Illinois River Action Plan*. Special Report No. 11, Illinois State Water Plan Task Force, Springfield, Illinois.

Lee, M.T., and J.B. Stall. 1976. *Sediment Conditions in Backwater Lakes: Along the Illinois River - Phase I*. Illinois State Water Survey Contract Report 176A, Champaign, Illinois.

Lee, M.T., and J.B. Stall. 1977. *Sediment Conditions in Backwater Lakes: Along the Illinois River - Phase 2*. Illinois State Water Survey Contract Report 176B, Champaign, Illinois.

Walker, R.D. 1984. Historical changes in Illinois agriculture. *Illinois Conference on Soil Conservation and Water Quality*, Doc. No. 84/02, pp. 1-17.

GEOMORPHOLOGICAL PRINCIPLES FOR 'NATURALIZING' STREAMS AND RIVERS IN ILLINOIS

Bruce L. Rhoads and Kelly M. Monahan

Department of Geography, University of Illinois at Urbana-Champaign
220 Davenport Hall, 607 S. Mathews
Urbana, IL 61801

INTRODUCTION

Over the last 200 years, land cover throughout the Illinois River watershed has been transformed from prairie with scattered forest to agricultural fields with scattered towns and cities. In the fifty counties contained wholly or partly within the Illinois River watershed, an estimated 5.9 million hectares of native prairie essentially have been eradicated; today, less than 1000 hectares of prairie remain in this portion of the state (IDENR, 1994). The presettlement appearance of the landscape, described vividly by pioneers and settlers as an ocean of grass (Winsor, 1987), today can only be imagined.

Human alteration of land cover undoubtedly has impacted, both directly and indirectly, the form and dynamics of stream channels in the Illinois River basin. Direct impacts have been greatest in headwater areas; in some subbasins of the Illinois River watershed as much as 100% of the total length of headwater streams is channelized (Mattingly et al. 1993). Indirect effects are most severe downstream, accounting in large part for high rates of sedimentation in the Illinois River and the backwater lakes and riparian wetlands on its floodplain. Concern about indirect and direct effects of human activity on stream channels is embodied in recommendations 9 and 10 of the Integrated Management Plan for the Illinois River Watershed (IMPIRW). Recommendation 9 encourages incentives for selective dechannelization of tributaries on a voluntary basis, whereas recommendation 10 calls for stabilization of unstable streams in rural and urban areas. Together, these recommendations are directed toward efforts to improve the environmental quality of streams and rivers in the watershed.

This paper defines an important role for fluvial geomorphology in the process of integrated environmental management of the Illinois River watershed. It illustrates how geomorphological analysis and information can contribute substantively to various stages of the management process. The paper also describes the concept of naturalization, which is recommended as a viable strategy for achieving environmentally based, sustainable stream management in the Illinois River basin. Naturalization is broadly consistent with the vision statement contained in the IMPIRW, but extends this vision by emphasizing the importance of fluvial geomorphology in stream management and by explicitly acknowledging that human social and economic activities are components of the contemporary natural environment.

THE CONCEPT OF NATURALIZATION

All efforts to manage environmental resources are, by necessity, guided by objectives, even in cases where these objectives are not defined explicitly. At a national level, the National

Research Council (NRC) (1992) has identified three environmental-management objectives for aquatic ecosystems: restoration - the complete structural and functional return of an ecosystem to a pristine, predisturbance state; rehabilitation - partial structural and functional return of a system to a predisturbance state, and enhancement - any structural or functional improvement. All three of these objectives retain the pristine, predisturbance state as the frame of reference for assessing environmental-quality benefits. The definition of enhancement, i.e. any improvement, is tautological and does not identify an objective that is useful in any practical sense; however, the NRC position clearly implies that improvement involves the re-establishment of pristine elements in an otherwise disturbed system. Effective restoration, rehabilitation, or enhancement requires a sound body of scientific information on the structural and functional characteristics of the pristine, predisturbance system. Without such information, attempts to reproduce or approximate the pristine state may be fundamentally misconceived or misguided.

Although some historical scientific information is available on the hydrology and ecology of the Illinois River prior to dam construction and major changes in land use (IDENR, 1994), the pristine, geomorphological character of the river is difficult to ascertain, at least in detail. For headwater areas, scientific data are even more limited. The fishes of Champaign County studies began in the late 1800s (IDENR, 1994), during the period of major channelization, but corresponding historical information on the chemical, hydrological, and geomorphological characteristics of headwater streams is meager at best. Undoubtedly, transformation of headwater streams has been as dramatic as transformation of the botanic landscape; however, in most cases, the exact nature of change in fluvial environments is unknown.

The lack of scientific information on the pristine state of many streams in the Illinois River basin calls into question the appropriateness of stream restoration, rehabilitation, or enhancement as defined by the NRC. Even if fragments of information were available, attempts to direct stream systems toward the pristine state would be challenged by two factors: 1) environmental conditions throughout the watershed, especially land cover, are now dramatically different than those that existed under predisturbance conditions and 2) environmental restoration of land cover characteristics at the watershed scale is economically impractical. These limiting factors imply that the pristine geomorphological character of stream systems, even if it could be accurately determined, probably has little relevance for the development of sustainable management strategies in the contemporary environmental setting.

Naturalization is an alternative to restoration that specifies an environmental-management goal appropriate for watersheds characterized by intensive, ongoing human utilization of biophysical resources (Rhoads and Herricks, 1996). In particular, naturalization promotes the establishment of sustainable, morphologically and hydraulically varied, yet dynamically stable fluvial systems that are capable of supporting healthy, genetically diverse aquatic ecosystems. The term sustainability, as used in this context, refers to *system insurance sustainability* (Gale and Cordray, 1994), in which management is directed toward human economic and social concerns as well as toward preservation of existing biophysical diversity or enhancement of this diversity. It embraces the notion that recurring human interaction with biophysical components of fluvial systems is part of the contemporary and future natural environment in resource-rich settings, but seeks ways to take advantage of this interaction to sustain or enhance morphological diversity and dynamic stability. Thus, system states other than the pristine one are valued and system dynamics may be actively "managed" through recurring human intervention. Where human manipulation of the environment has occurred in the past, but is not expected to recur in the future, naturalization may rely on duplication of the present condition of a comparable undisturbed or recovered part of a fluvial system. Although naturalization does not actively seek to direct fluvial systems toward the pristine, predisturbance state, it sanctions re-establishment of documented pristine characteristics within the contemporary setting if it can be determined that such characteristics are sustainable and will contribute to the general goals of morphological diversity and dynamic stability.

FLUVIAL GEOMORPHOLOGY AND STREAM MANAGEMENT

Environmental management generally involves four distinct phases: planning, design, implementation, and monitoring/appraisal. The discussion below focuses on how fluvial geomorphology can contribute to the four phases of stream management for the Illinois River watershed. The emphasis is on the types of geomorphological information needed to develop naturalized management strategies at the watershed and reach scales.

Planning Phase

Effective management of fluvial systems must be based on information concerning the geomorphological dynamics of these systems, including the role of human activity in these dynamics. Failure to base environmental-management strategies on such information will result largely in uninformed, trial-and-error approaches that may prove costly and that most likely will accomplish little in relation to management objectives. Geomorphological information ensures that management strategies are consistent with the fluvial dynamics of specific streams and rivers.

Perhaps the most important aspect of examining the dynamics of stream systems is to evaluate the degree to which they are stable or unstable. As noted in the Technical Report for the Integrated Management Plan for the Illinois River Watershed, the distinction between "stable" and "unstable" streams varies among disciplines. From an engineering perspective, an unstable stream channel has a rate or magnitude of erosion great enough to generate public concern (Brice, 1982). From a geomorphological perspective, an unstable stream is one that exhibits abrupt, episodic, or progressive changes in location, geometry, gradient, or pattern *because of environmental or human-induced changes in water or sediment inputs from the surrounding watershed and/or spatial imbalances between sediment inputs and outputs* (Rhoads, 1995). The geomorphological view recognizes that streams are dynamic systems that change through time, *even when environmental conditions are constant.* Only when change in a stream channel is systematic and can be tied definitively to human-induced disturbances or to sustained environmental change should this channel change be viewed as instability. Progressive enlargement or infilling of a stream or river through time, such as the sedimentation occurring in the Illinois River, is a hallmark of instability. On the other hand, lateral or down-valley migration of channel bends is part of the natural dynamics of meandering rivers and should not automatically be viewed as a sign of instability. All meandering streams erode their banks to some extent. The key is to identify rates of erosion that are increasing systematically through time, especially in conjunction with progressive human-induced changes in watershed conditions. Also, a rate of migration for a meandering reach that is far in excess of rates for other meandering reaches in a watershed may, but will not always, reflect disturbance-induced instability.

At the watershed scale, the primary focus of stability assessment involves historical analysis of changes in stream-channel characteristics. This type of analysis is useful for identifying systematic patterns of channel change and for relating this change to land-use changes or to human manipulation of stream channels (Kondolf and Larson, 1995). A variety of information sources can be used to try to establish the geomorphological character of streams in Illinois prior to widespread development of agriculture, including pioneer and settler accounts; newspapers and journals; U.S. General Land Office Survey Records; nineteenth century railroad surveys; early U.S. Geological Survey topographic maps and stream-gaging records; U.S. Army Corps of Engineer navigation surveys and flood damage reports; U.S. Department of Agriculture soil surveys; and documents/photographs in county historical societies, county courthouses, and state museums or libraries (Trimble and Cooke, 1991; Rhoads and Herricks, 1996).

Perhaps the most valuable information on stream-channel changes over the past 60 years is historical aerial photography. The University of Illinois Map and Geography Library has photographic coverage ranging from the late 1930s to 1993-1994 for most portions of Illinois. Analysis of historical aerial photography involves digitizing stream-channel positions for each year of photographic coverage into a Geographic Information System (GIS) database. The data handling, analysis, and display capabilities of the GIS can be used to: 1) register each data set to a common scale and projection using control points identified on planimetric base maps, 2) assess image to map rectification error as well as digitization error, 3) determine systematic trends in channel change through time and space, 4) evaluate the extent to which detected changes are the result of human manipulation of the stream or of natural processes, and 5) relate changes in channel position to potential controlling factors, such as variations in stream power, material properties, land use, and stream management (Rhoads and Urban, 1997). Another advantage of GIS-based analysis is that it provides a framework for integrating data on streams and rivers with a wide variety of other types of environmental information, especially ecological data (Montgomery et al., 1995).

A complement to historical analysis of stream-channel change is field-reconnaissance assessments of current stream-channel conditions (e.g. Simon and Downs, 1995). Such assessments should be conducted by a trained fluvial geomorphologist who is familiar with the dynamics of the fluvial system of interest. The goal is to characterize and classify various channel types in the watershed. An effective classification scheme will be based not only on current characteristics of the channels, but also on historical information concerning channel dynamics (Kondolf, 1995). Although a variety of generic classification schemes for rivers have been developed (e.g. Rosgen, 1994; Downs, 1995), such schemes are most useful when they are tailored to the watershed of interest (Kondolf and Downs, 1996). No geomorphological classification system currently exists for the Illinois River watershed, but a scheme developed for streams in east-central Illinois provides a starting point for classification of streams in the Illinois River system (see Rhoads and Herricks, 1996).

Once an appropriate scheme is developed, classification can proceed based on stereoscopic analysis of recent aerial photography and on additional field evaluations of reaches that are difficult to classify accurately using aerial photography. Information on classified reaches can be entered into the GIS to produce a map showing the spatial extent of various channel types throughout the watershed. From an ecological perspective, this information is useful for determining the spatial heterogeneity, interconnectedness, and temporal stability of physical habitat conditions within the stream system. Because the classification scheme includes information on channel history and dynamics, maps of reach types are valuable for identifying portions of drainage net requiring channel stabilization or naturalization and for evaluating whether specific naturalization strategies will be sustainable at particular stream locations.

After potential sites have been identified for implementation of stabilization or naturalization strategies, detailed geomorphological investigations should be conducted to generate site-specific information on the fluvial dynamics of target reaches. Data collection activities performed in these investigations should include surveys of channel morphology, sampling and analysis of bed and bank materials, monitoring of water-level fluctuations, and measurements of flow structure, sediment transport, and bed and bank erosion at several different flow stages. Detailed field studies provide an in-depth understanding of the processes that maintain or actively change the geomorphological character of a particular reach of stream (e.g. Rhoads, 1996) and also yield information that can be used to calibrate analytical or numerical models of river dynamics developed by engineers. At sites deemed unstable, detailed field studies can help pinpoint the exact cause of instability, thereby improving the effectiveness of mitigation strategies. At sites being considered for naturalization, reaches nearby that are considered representative of desired conditions can be investigated to generate pertinent information on process-based interactions between morphological structure and hydrodynamic properties. This information can serve as the basis for developing sustainable naturalization designs for the target reach and for assessing the success of the design following implementation.

Design Phase

Recommendation (9) in the Integrated Management Plan for the Illinois River watershed endorses selective dechannelization of tributaries on a voluntary basis. The desire for dechannelization of streams is a recent development in stream management. To those unfamiliar with the complexity of natural rivers, this new task may seem easy to accomplish. A logical approach is to simply let streams recover naturally from channelization. This approach suffers from two limitations. First, many streams in Illinois are low-energy systems that take decades or even centuries to re-establish a suite of forms and processes characteristic of undisturbed streams (Rhoads and Urban, 1997). Thus, realization of geomorphological goals, and attendant ecological benefits, may be greatly delayed. Second, naturalization emphasizes that natural recovery is not possible in all circumstances due to socioeconomic constraints, but that controlled reconfiguration of the system nonetheless may be desirable. These two limitations provide justification for the development of new stream-management technology consisting of codified design criteria for dechannelizing human-modified streams. At first glance, the development of this new technology may be seen as a variant of river engineering. However, reproduction of the complex dynamics of natural rivers, including the geomorphological and ecological functions of these systems, lies outside the domain of standard engineering practice, which traditionally has focused on how to change rivers into controllable, artificial forms that have predictable hydraulic characteristics.

The desire for dechannelization has created an opportunity for fluvial geomorphologists to contribute to the development of design technology to support this type of stream management. At present, most attempts at dechannelization or naturalization are guided partly by general principles, but also include substantial expert-judgement or trial-and-error components. Existing restoration principles consist of a poorly integrated mix of traditional engineering analysis and empirical geomorphological relations (see Brookes and Sear, 1996 for a state-of-the-art review). Engineering formulae are precise, but emphasize static stability of the channel boundary, whereas rivers are dynamic systems with erodible beds and banks. On the other hand, geomorphological relations implicitly incorporate dynamic adjustment, but lack precision and often are specific to the set of data from which they were derived. Engineers, ecologists, and geomorphologists must work together to develop new technology for naturalizing streams and rivers in specific environmental settings. The IMPIRW provides an opportunity for cooperative interaction among various technical experts to produce a set of naturalization guidelines for streams in the Illinois River basin.

It is beyond the scope of this paper to present specific suggestions concerning design criteria for naturalization of streams in Illinois; however, some general suggestions are offered. First, the development of design criteria should be based on a sound body of scientific information developed specifically for the Illinois River system. Existing information on the geomorphology of this system is insufficient to support holistic strategies aimed at naturalizing and stabilizing streams throughout the entire Illinois River basin. Second, the establishment of riparian corridors is a vital component of any effort to naturalize streams. From a hydrological perspective, riparian corridors act as storage areas for floodwaters, thereby decreasing the rate of delivery of water to downstream areas in the watershed. They also help to filter sediment and nutrients from field runoff before it reaches the stream channels. Geomorphologically, these corridors provide space for natural recovery or for post-project adjustment of naturalized streams. A riparian corridor eliminates the need for straight channels and allows alternative channel configurations to be developed that are morphologically varied and dynamically stable. Where riparian corridors are present there is less need for artificial levees. Thus, floodplain-main channel interaction can be restored B a process that is important ecologically both for riparian vegetation and aquatic organisms (IDENR, 1994). Third, stream geomorphology is the physical framework within which aquatic ecosystems develop. In particular, geomorphological conditions determine in large part the heterogeneity and volume of physical habitat (Schlosser, 1987). Recent evaluations of fish populations in Illinois suggest that a deficiency of physical habitat is the most critical limiting factor for stream ecosystems, especially in headwater environments (Terhaar and Herricks, 1989; IDENR, 1994). Many attempts to create or enhance physical habitat involve the use of habitat-enhancement techniques that do not adequately duplicate either the three-dimensional structure of reach-scale geomorphological features (e.g. riffles, pools) or the role of these features in the fluvial dynamics of the stream system (Brookes et al., 1996). Future efforts to naturalize streams in Illinois will require better integration of fluvial geomorphology and stream ecology.

Implementation Phase

Once a general watershed-scale plan for naturalization has been developed, and designs have been formulated for specific stream locations, implementation of naturalization projects can begin. As noted in recommendation 9 of the IMPIRW, demonstration projects first should be initiated on public land to refine naturalization technology and to illustrate to private stakeholders the benefits of adopting this new technology. Fluvial geomorphologists can play an important role in this phase by conducting on-site visits to ensure that the project is constructed as designed. On-site inspection is critically important because implementation of naturalized designs will involve unconventional construction practices that contractors may perceive as unnecessary.

Appraisal Phase

Post-project evaluation of implemented naturalization strategies is a vital, but often neglected part of the stream-management process. Without effective post-project assessments, the degree to which specific designs achieve management objectives is difficult to ascertain. Appraisal also provides the basis for adaptive refinement of management prescriptions. Geomorphological methods can contribute to post-project assessments at a variety of temporal and spatial scales (Kondolf and Micheli, 1995). Field-based measurement programs initiated at target sites during the planning phase should be continued following project implementation so that comparisons can be made between pre-project and post-project data. Such comparisons provide an objective basis for assessing the immediate success of the project. It is especially important to survey the channel morphology, sample the substrate material, and measure flow conditions in the project reach immediately after construction has been completed. Repeated surveys, sampling, and measurements should be conducted at regular intervals for several years following construction and immediately after all large floods. Of course, geomorphological field monitoring should be coordinated with field-based biological monitoring to determine the relation between physical and ecological conditions.

GIS analysis of aerial photographs is valuable for evaluating long-term sustainability. Currently, the Illinois Department of Transportation conducts complete aerial surveys of the state every 5 to 6 years. If possible, this photography should be supplemented by large-scale aerial photographs that allow details of channel form to be measured photogrammetrically. Over time spans of decades GIS and photogrammetric analyses of project sites can be supplemented by occasional field investigations. Repeat ground-based photography and video recordings also can provide a valuable visual record of changes at each site over a period of years or decades. Together these sources of information can be used to evaluate the need for periodic site maintenance.

CONCLUSION

Fluvial geomorphology, the sub-field of earth science that focuses on the dynamics of rivers, has an important role to play in environmental management of the Illinois River watershed. The geomorphological structure and dynamics of streams constitute the physical framework within which aquatic ecosystems develop and are sustained. The dependency of aquatic ecosystems on geomorphological conditions necessitates that any management strategy that seeks to alter the structure and function of existing aquatic ecosystems must be based on a sound understanding of fluvial forms and processes, both at the watershed scale and at the reach scale.

This paper has demonstrated how various types of geomorphological analyses can contribute to a comprehensive understanding of the fluvial dynamics of the Illinois River system. It has also argued that naturalization, not restoration or its variants, is the most appropriate management goal for this system. Naturalization seeks to establish morphologically and hydraulically varied, but dynamically stable fluvial systems capable of supporting healthy, genetically diverse aquatic ecosystems. Because human resource utilization must be seen as a component of the contemporary and future natural landscape in the Illinois River watershed, the predisturbance, pristine geomorphological state, which is largely unknown in any case, is not an appropriate standard against which to assess environmental benefits.

ACKNOWLEDGEMENT

Many of the ideas presented in this paper have been developed as part of a project supported by the U.S. Environmental Protection Agency (EPA-R82-5306-010).

REFERENCES

Brice, J.C. 1982. Stream channel stability assessment. U.S. Department of Transportation, FHWA/RD-821021.

Brookes, A. and D.A. Sear. 1996. Geomorphological principles for restoring channels. In River Channel Restoration, ed. A. Brookes and D.F. Shields, Jr., pp. 75-101. Chichester, UK, Wiley.

Brookes, A., S. S. Knight, and F.D. Shields, Jr. 1996. Habitat enhancement. In River Channel Restoration, ed. A. Brookes and D. F. Shields, Jr., pp.103-126. Chichester, UK, Wiley.

Downs, P.W. 1995. River channel classification for channel management purposes. In Changing River Channels, ed. A. Gurnell and G.E. Petts, pp. 347-365. Chichester, UK, Wiley.

Gale, R.P. and S.M. Cordray. 1994. Making sense of sustainability: nine answers to "what should be sustained?" Rural Sociology 59: 311-332.

IDENR. 1994. The Changing Illinois Environment: Critical Trends. Technical Report of the Critical Trends Assessment Project Volume 3: Ecological Resources. Illinois Department of Energy and Natural Resources, Springfield, IL, USA, 167 pp.

Kondolf, G.M. 1995. Geomorphological stream classification in aquatic habitat restoration: uses and limitations. Aquatic Conservation: Marine and Freshwater Ecosystems 5: 127-141.

Kondolf, G.M. and M. Larson. 1995. Historical channel analysis: techniques for application to riparian and aquatic habitat restoration. Aquatic Conservation: Marine and Freshwater Ecosystems 5: 109-126.

Kondolf, G.M. and E.R. Micheli. 1995. Evaluating stream restoration projects. Environmental Management 19: 1-15.

Kondolf, G.M. and P.W. Downs. 1996. Catchment approach to planning channel restoration. In River Channel Restoration, ed. A. Brookes and D. F. Shields, Jr., pp.129-148. Chichester, UK, Wiley.

Mattingly, R.L., E.E. Herricks, and D.M. Johnston. 1993. Channelization and levee construction in Illinois: review and implications for management. Environmental Management 17: 781-795.

Montgomery, D.R., G.E. Grant, and K. Sullivan. 1995. Watershed analysis as a framework for implementing ecosystem management. Water Resources Bulletin 31: 369-386.

National Research Council. 1992. Restoration of Aquatic Ecosystems. National Academy Press, Washington, D.C., USA, 552 pp.

Rhoads, B.L. 1995. Stream power: a unifying theme for urban fluvial geomorphology. In Stormwater Runoff and Receiving Systems, ed. E.E. Herricks, pp. 65-75. Boca Raton, Florida: Lewis Publishers.

Rhoads, B.L. 1996. Mean structure of transport-effective flows at an asymmetrical confluence when the main stream is dominant. In Coherent Flow Structures in Open Channels, ed. P.J. Ashworth, S.J. Bennett, J.L. Best, and S.J. McLelland, pp. 491-517. Chichester, UK, Wiley.

Rhoads, B.L. and E.E. Herricks. 1996. Naturalization of headwater streams in Illinois. In River Channel Restoration, ed. A. Brookes and D. F. Shields, Jr., pp.331-367. Chichester, UK, Wiley.

Rhoads, B.L. and M.A. Urban. 1997. Human-induced change in low-energy agricultural streams: an example from east-central Illinois. In Management of Landscapes Disturbed by Channel Incision, ed. S.S.Y. Wang, E.J Langendoen, And F.D. Shields, Jr., pp. 968-973. Oxford, MS: University of Mississippi.

Rosgen, D.L. 1994. A classification of natural rivers. Catena 22: 169-199.

Schlosser, I.J. 1987. A conceptual framework for fish community structure in small warmwater streams. In Community and Evolutionary Ecology of North American Stream Fishes, ed. W.J. Matthews and D.C. Heins, pp. 17-24. Norman, OK, Oklahoma University Press.

Simon, A. and P.W. Downs. 1995. An interdisciplinary approach to evaluation of potential instability in alluvial channels. Geomorphology 12: 215-232.

Terhaar, M.J. and E.E. Herricks. 1989. Management and Development of Aquatic Habitat in Agricultural Drainage Systems. Water Resources Center Research Report No. 212, University of Illinois, Urbana, Illinois, USA, 145 pp.

Trimble, S.W. and R.U. Cooke. 1991. Historical sources for geomorphological research in the United States. The Professional Geographer 43: 212-227.

Winsor, R.A. 1987. Environmental imagery of the Wet Prairie of East Central Illinois. Journal of Historical Geography 4: 375-397.

PERSPECTIVES ON STORMWATER MANAGEMENT

Michael D. Platt

Executive Director, Heartland Water Resources Council
416 Main Street, Suite 828, Peoria, IL 61602

As the title implies, this is not a technical presentation. Rather, my comments represent my personal perspective on stormwater management, a perspective which is no doubt shared by others among us and many more who are not with us today.

Personal perspectives are shaped by one's life experiences.

I was raised on a grain and livestock farm and today, I own and operate two farms along the banks of Spoon River.

For several years, I ran a commercial hunting club and from that, I had the opportunity to become friends with other sportsmen who came primarily from urban areas.

I spent fourteen years with the Illinois Department of Agriculture working on natural resource issues in close contact with this state's soil and water conservation districts.

For the last five years, as Executive Director of the Heartland Water Resources Council, I have worked for measures to protect the Illinois River and the Peoria Lakes.

In my five years at Heartland, I have met countless homeowners who have suffered tremendous financial losses as a result of stormwater flows. I have met many farmers who are frustrated by the damaging effects of stormwater delivered from upstream. I have talked with marina owners who are struggling because their patrons have sold their boats or moved on to deeper, bluer waters. I have met many river rats, and I use that term with affection because I count myself as one, many river rats who are nothing less than despondent over the condition of their beloved Illinois. And I have met many fine young people who legitimately question whether the adults in charge truly appreciate their understandable concern for the welfare of the world around them.

These things have shaped my perspectives about the stormwater issue, an issue which pulls out of me some very passionate feelings.

Passion derived from my firm belief that the issue I now speak of cannot be drug out of its deep, dark hole without the discussion of reality...a difficult reality for those who would paint too a rosy picture of the battle we are losing against the laws of nature for which we have demonstrated too little respect.

Uncontrolled stormwater is a force of destruction and those land-use practices which produce elevated stormwater discharges should be required to prevent off-site damages.

The public does not appreciate nor condone activities which endanger their health, their property or their livelihoods.

Let's be completely honest about this. Lives have been lost, property has been destroyed and livelihoods have been ruined all as a direct result of un-natural stormwater flows.

Here, in the Illinois River Basin, agriculture and development are responsible for creating the vast majority of stormwater discharges.

And let's not make any mistake about it, agriculture and urban development are activities conducted in the pursuit profit. And who could deny that profit is a good thing? Profit is the heart of our economic system.

However, profits earned at the expense of another's health or property or livelihood is not the proper foundation on which to build a social structure which provides all citizens equal protection and equal opportunity.

One of the issues at hand is property rights. And I speak not of the right to use land as one sees fit, but rather the rights of those who are damaged as a result of another's actions.

Invariably, those who ferociously resist regulatory approaches toward reducing the off-site damages created by stormwater pollution whine and worry about the infringement of property rights. Yet, when these same people are asked to justify the losses suffered by downstream property owners, their replies run the gamut from weak logic to an incriminating silence.

Still, the inequities that stormwater pollution heaps on our individual constitutional rights pale in comparison to the indefensible environmental and economic transgressions inflicted against our domestic interests and, indeed, our national security.

In a time of explosive world demand for food and fiber, erosion of topsoil by uncontrolled stormwater continues to degrade this nation's future agricultural capacity.

In a time of growing public demand for outdoor recreational opportunities, uncontrolled stormwater tears at the banks of our tributary streams and delivers to our rivers and reservoirs a suffocating blanket of mud.

More than any other group citizens, the people in this room understand the economic and environmental implications of the damages created by uncontrolled stormwater.

And so we must ask ourselves, have we done enough to educate the public about the debilitating effects of uncontrolled stormwater?

Have we been forceful enough in calling for stormwater control measures that can help prevent the damages we collectively strive so hard to repair?

Have we been honest enough with ourselves to admit that solving our stormwater problem is so complex, so pervasive and so immune to the effects generated by a patchwork of voluntary actions that it is time we consider a regulatory approach toward stormwater control?

Over the last sixty years, this nation has spent billions on voluntary programs to control the non-point pollution generated by uncontrolled stormwater and still the damages mount.

Sure, you could site progress in certain areas, but the deteriorating condition of our nation's waters provides the final verdict about the sad failure of a voluntary approach. The filling of the Peoria Lakes with only one foot of mud over the last decade is hardly anything to cheer about.

In recent years, a select few urban areas have enacted ordinances to control the stormwater generated by development. But to suggest that urban areas are adequately addressing their stormwater problems would be overstatement.

On the agricultural side of the stormwater equation, some progress on preventing non-point pollution can be claimed through advances in land management. But the fact remains, the off-site damages created by upstream agricultural hydraulic modification fall disproportionately on downstream landowners and on publicly owned resources.

To be blunt about at all, the water laws of this state are now creating more problems than they are solving. The water laws are antiquated, out of step with the times and change is in order.

The Land and Water Task Force, The Integrated Management Plan for the Illinois River and the 1997 Conservation Congress have added their weight to the call for more rigorous laws governing stormwater movement.

The public's perception about what is fair and what is appropriate with regard to the private and commercial use of natural resources stands in stark contrast to the unfair and inappropriate state statutes governing the triangular relationship between land-use, hydraulic modification and the off-site damages created by uncontrolled stormwater.

But it is not enough for me to stand before you and say these things without offering alternatives.

And the most simple alternative would be to treat the cost of preventing stormwater damages as a cost of doing business.

And why shouldn't we accept this approach as fair and reasonable?

The public already demands the regulation of other pollution hazards for the prevention of off-site damages to health, property and livelihoods.

Can anyone provide an answer for why the economic and environmental losses created by stormwater pollution are any less traumatic to the wrongfully damaged parties than those losses created by other forms of pollution which our laws have sought to prevent through regulation?

For me and a good many others, the situation is obvious. We have a serious stormwater pollution problem and our our downstream neighbors and our public resources are being damaged as a result of it.

Common sense yields to the proposition that the right to own property carries with it the inseperable obligations to proper resource management and the prevention of off-site damages.

It is long past the time when we should open a serious dialogue about who should rightfully bear the costs of preventing those damages their stormwater creates.

Individually, we must accept our responsibility to ensure the well-being of those resources our nation will be dependent upon long after we are gone and have been forgotten.

As Americans serving our duties to citizenship, we must look to the future with a vision unblinded by self-interest, and we must strive to do what is right by our neighbor and what is right by our children.

This nation can no longer afford to passively accept the self-serving and irrational argument that by regulating the causes of pollution we are somehow being unfair to the polluters.

NAVIGATION IMPROVEMENTS ON THE ILLINOIS RIVER

D.A. Tipple

U.S. Army Corps of Engineers, Rock Island District
P.O. Box 2004, Rock Island, IL 61204-2004

ABSTRACT

Commercial navigation on the Illinois Waterway (IWW) plays a vital role in our national economy. The importance of the IWW system as a shipping artery is reflected in the continual increase in tonnage on the system, from 27.2 million tons in 1965 to 39.7 million tons in 1995. Similarly, tonnage has increased on the Upper Mississippi River (UMR) between Minneapolis, MN, and the mouth of the Missouri River, from 37.8 million tons in 1965 to 84.4 million tons in 1995. Many of the 37 locks on the UMR and IWW were designed to accommodate a fraction of the current level of traffic. For example, most of the locks on the system were built in the 1930's and are 600 feet long, while many of the tow/barge configurations are 1,200 feet in length. The growing traffic and increasing delays to commercial navigation are the basis for the Corps of Engineers ongoing system navigation study on the Illinois Waterway and Upper Mississippi River.

The UMR-IWW System Navigation Study is a six-year nine-month effort examining the feasibility of navigation improvements to these waterways. This study is considering small-scale and large-scale enhancements to the system at existing lock and dam sites over a fifty-year period (2000-2050). Efforts are focused on opportunities to reduce the transit times at locks for commercial navigation traffic. Small-scale measures include structural solutions such as extended guidewalls or powered traveling kevels, and nonstructural measures such as locking policies or industry self-help. Large-scale measures include new lock construction such as additional 600-foot or 1,200-foot long structures.

The Corps of Engineers is taking a multi-disciplined approach to executing this study and recognizes the Water Resources Development Act of 1986 designation of the UMR system as "a nationally significant ecosystem and a nationally significant commercial navigation system." The plan formulation process will consider engineering, economic, and environmental input in developing alternative plans for evaluation. In assessing any environmental consequences associated with potential navigation improvements, study efforts are looking at both construction site impacts and consequences within pools and open river reaches from incremental traffic increases. As part of the study process, coordinating committees have been established for the environmental, economics, engineering, and public involvement aspects. In addition, each Governor has appointed a representative to the Governors' Liaison Committee to input during the study process. The study will result in a system feasibility report and Environmental Impact Statement which will document the plan formulation process and discuss a recommended alternative plan for navigation improvement investments on the UMR and IWW over the 50-year period from 2000 though 2050.

1997 Governor's Conference on the Management of the Illinois River System

Navigation Improvements on the Illinois River

October 8, 1997

Illinois Waterway

LOCK	FIRST YEAR OF OPERATION	LENGTH (FEET)	LIFT (FEET)[1]
T.J. O'Brien	1960	1,000	5
Lockport	1933	600	40
Brandon Road	1933	600	34
Dresden Island	1933	600	22
Marseilles	1933	600	24
Starved Rock	1933	600	19
Peoria	1939	600	11
La Grange	1939	600	10

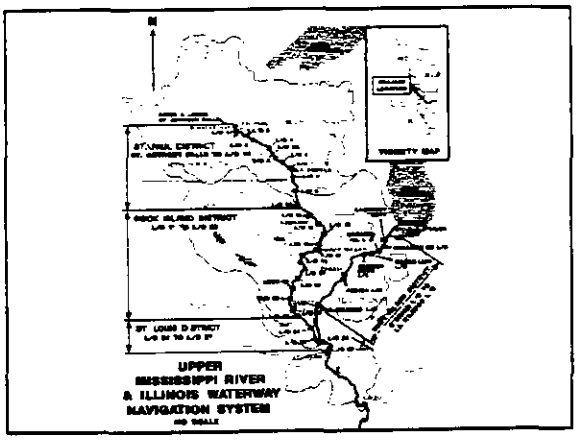
[1] With flat pool.

- **Excessive Delays at Some Locks due to:**
  - Increased Traffic
  - Double Lockages

Upper Mississippi River - Illinois Waterway System Navigation Study

Study Scope

A system study to examine the feasibility of navigation improvements to the Upper Mississippi River and Illinois Waterway to reduce delays to commercial navigation traffic.



System Facts

- 29 Locks on Upper Mississippi River
- 8 Locks on the Illinois Waterway
- Primarily 600-foot Locks
- 1200-Foot Locks at L/D's 19, 26, & 27
- UMR: 27 million tons in 1960
  86 million tons in 1992
- IWW: 23 million tons in 1960
  43 million tons in 1992

La Grange Lock

La Grange Lock

1996 Commodity Percentages

• Farm Products	50%
• Chemical	13%
• Coal	11%
• Petroleum Products	9%
• Other*	17%

* Includes: Manufactured, Crude, and Misc. Materials

Measure

- For the Navigation Study, efforts to reduce delays to increasing commercial traffic at the locks over the 50-year study period.

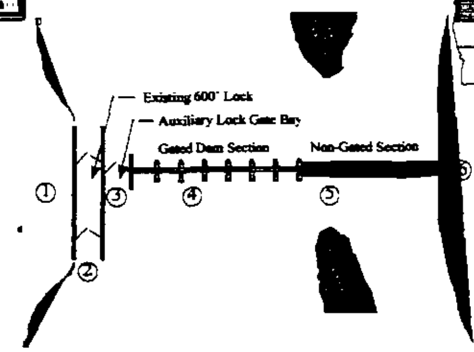
Small-Scale Measures

- Scheduling programs
- Helper boats, switch boats, self help
- Guidewall extensions/powered traveling kevels
- Adjacent mooring facilities
- Universal couplers/standardized training
- Congestion tolls/excess time charges
- Approach channels

Large-Scale Measures

- New Locks
- Looked At:
  - 6 locations at existing dam sites
  - 3 types:
    - traditional
    - intermediate
    - least first cost

ALTERNATIVE LOCK LOCATIONS



Large-Scale Measures

- New Locks
- Looked At:
  - 6 locations at existing dam sites
  - 3 types:
    - traditional
    - intermediate
    - least first cost

Where We Are Now

- Initial Screening: Qualitative
  - 16 Small-Scale Measures
  - Large-Scale to Essentially Locations 2, 3, 4
- Secondary Screening: Quantitative
  - Performance and Cost Data
  - Currently Underway

Alternative Plan

Existing L/D Sites	Alternative Plan: Measures Implemented in a Given Year								
	2000	2002	...	2010	2020	2025	...	2045	2050
A									
B									
C									
D									
E									
F									
G									
...									

Plan Formulation

Interaction Between:
- Economics
- Engineering
- Environmental
- Public Involvement

Committees

- Governors' Liaison Committee:
  - Don Vonnahme, IDNR
- Economics Coordinating Committee:
  - Jim Johnson, IDNR
- Navigation Environmental Coordination Committee:
  - Bill Bertrand, IDNR
- Engineering Coordinating Committee:
  - Bruce Barker, IDNR
- Public Involvement Coordinating Committee:
  - Gary Clark, IDNR

Public Meetings & Outreach

- Oct/Nov 93: Study Introduction, 14 Locations
- Nov 1994: Problems & Opportunities, 8 Locations
- Nov/Dec 95: Navigation Improvement Measures, 5 Locations
- Jul 98: Alternative Plans
- July 99: Draft Feasibility Report & DEIS

Milestones

• Public Meetings on Alt. Plans	Jul 98
• Select Recommended Plan	Oct 98
• Public Review of Draft Rpt. & DEIS	Jun 99
• Div. Commander's Public Notice	Dec 99

RELATIONSHIP BETWEEN WATER QUALITY AND TOURNAMENT FISHING ON THE ILLINOIS RIVER

Roy Heidinger and Ron Brooks

Fisheries Research Laboratory, Southern Illinois University
Carbondale, IL 62901-6511

ABSTRACT

In the late 1800s largemouth bass, walleye, and sauger were so abundant in the Illinois River that they were harvested commercially. Since the early 1900s until the 1970s, pollution from municipal waste water treatment plants and nutrients from farmland run-off have caused frequent periods of low oxygen and high ammonia that prevented sportfish from surviving in large numbers in the Illinois River. Water quality gradually improved since the 1970s following implementation of industrial wastewater treatment, soil conservation programs, and municipal refuse disposal projects. By the mid-seventies, fish species diversity increased and species tolerant of turbid water became established. Following a build-up of prey species, there was a proliferation of sportfish such as sauger and walleye. By the late 1980s, walleye/sauger and bass tournaments were initiated on the Peoria and La Grange Pools. Tournaments for other species such as the white bass are now an annual event. What does the future hold?

DISCUSSION

The Illinois River may have once been the most biologically diverse and productive river in the United States. In 1682, Henri de Tonty's travel log indicated a tremendous population of large fish. The early history of the fish community in the Illinois River can best be traced by looking at the commercial fishing industry. Commercial fishing thrived on the Illinois River after railroads were built that could move iced fish from the river to the East Coast. "Commercial fishing peaked in 1908 when more than 2,000 commercial fishermen along the Illinois River harvested nearly 25 million pounds of fish - equal to 178 pounds per acre - with a commercial value of more than $1 million" (Talkington 1991). This was 10 percent of the United States total harvest from fresh water. Much of this harvest was carp (Cyprinus carpio) which had been brought to North American from Europe in 1831 (Balon 1974). This fish was well established in the Illinois River by the early 1900s.

Fish such as the largemouth bass (Micropterus salmoides) were very abundant and commercially harvested around the turn of the century. "The Havana fish markets handled about 13,000 pounds of largemouth bass in 1897, but between 1899 and 1908, the volume increased by 322 percent" (Talkington 1991). According to Smith (1898) approximately 70,000 pounds of bass were harvested from the Illinois River system in 1894. Commercial harvesting declined rapidly after 1908 and in five years it was reduced by approximately fifty percent. By the 1970s, annual harvest was only four pounds per acre and in 1976 there were only two full-time commercial fishermen working the river (Talkington 1991). Today of course the largemouth bass is considered a sport fish and it is protected from commercial harvest.

There were two primary causes for the decline of commercial fish harvest on the Illinois River. The first was a loss of habitat and the second was a degradation in water quality. Biologically much of the biodiversity and productivity of a river system is due to its floodplain. In the 1880s the Illinois River had approximately 56,000 acres of ponds, sloughs, and backwater. After the diversion of Lake Michigan in 1890 this area doubled (Bellrose et al. 1983). Levees and siltation have reduced the 546,000 acres of floodplain down to 195,000 acres, a loss of 67 percent (Raibley et al. 1996). Dams and levees do not stop the siltation that is a natural river process but they do inhibit or prevent natural processes that create new backwater habitats.

Although many factors created a degradation of water quality, such as the reduction of the floodplain, discharges from municipal sewage treatment plants were the most detrimental. These outflows cause lethal levels of ammonia and low levels of oxygen downstream. Better waste water treatment facilities and procedures have enhanced water quality since the late 1970s. Commercial harvests have increased since the 1980s. However, even though certain species of fish can live and reproduce in the system, in the upper portion of the river some fish such as carp and channel catfish (Ictalurus punctatus) contain PCBs, DDT, and mercury at sufficiently high levels that they should not be eaten. This legacy of poor stewardship will be with us for a long time.

In addition to trends in commercial fishing, trends in sport fishing also reflect the enhanced water quality in terms of better sport fish populations. One measure of sport fishing is tournament fishing. In the 1960s freshwater fishing tournaments were rather rare events with small amounts of prize money going to the winners. Over the past twenty years they have become very common and a multi-million dollar industry has developed around them.

During the late 1980s and 1990s numerous fishing tournaments have been held on the Illinois River. For example, Raibley et al. (1996) documented 106 bass tournaments on the La Grange and Peoria reaches of the Illinois River from 1992 to 1995. In these tournaments anglers brought in 6,793 bass that weighed 11,544 pounds. Tournaments are also held for other species of fish such as sauger (Stizostedion canadense)/walleye (S. vitreum) and white bass (Morone chrysops). For example, since 1989 there has been a very large two day sauger/walleye tournament on the Peoria Pool of the Illinois River (Table 1). The 450 angler slots available for this tournament are usually filled the first day that applicants can apply. If 450 tournament anglers each spend a conservative $300 pre-fishing and on this two-day event, this brings in $135,000 to the surrounding community. This amount does not count what spectators spend.

Sauger are much more abundant than walleye in this reach of the Illinois River. This may be due to the sauger's higher tolerance for poorer water quality conditions than the walleye. In a 1995 sample of 616 fish, 88.8 percent were sauger, 7.1 percent were walleye, and 4.1 percent were hybrids between sauger and walleye (Billington, Brooks and Heidinger 1997). We have been studying the sauger population in the Peoria Pool since 1988 (Heidinger, Brooks, and Weaver 1996) One characteristic of this population is that it has very strong and very weak year classes. From 1988 to 1995 catch per hour of electrofishing of young-of-the-year ranged from 0.5 to 48 fish per hour. The magnitude of the recruitment depends upon water level. Strong year class occur when water is high (10-15 feet above pool level) in June and July. Such conditions occurred in 1990, 1993, and 1996. We, in cooperation with the

Illinois Department of Natural Resources, have been stocking sauger into the Peoria Pool in an attempt to increase the weak year-classes. (Heidinger, Brooks, and Weaver 1996).

FUTURE

Species of fishes such as sauger and walleye spawn in the river proper. Once the water quality permitted their survival these species began to reproduce and recruit. Other species such as the largemouth bass normally spawn in the floodplain during the spring high water periods. These sport species have been most affected by loss of attached lakes and backwaters. Scientists have recognized for a long time that these areas were very important spawning, nursery, and food producing areas of the river system. More recent work has indicated that many species of fish especially young fish need to overwinter in the backwater areas that are attached to the river proper (Sheehan et al. 1990; Bodensteiner, Lewis, and Sheehan 1990). In the winter, river water cools to essentially 32°F. The deeper backwater areas stratify and may only cool down to 40-36°F. Many fish die if they cannot overwinter in these slightly warmer areas. Isolating these areas with levees prevents the fish from reaching their winter refuges and silting in of these areas leads to oxygen depletion under the ice which forces the fish to either die from lack of oxygen or move into the stressful low temperatures of the river.

In addition to reducing siltation, economic ways need to be found to reconnect some of the land in the levee districts with the river at least during critical periods. Only when progress is made in reducing siltation, reestablishing habitat, and improving water quality can we hope to see the full potential of the Illinois River reached both aesthetically and economically. A biologist has a lot more flexibility in managing fish communities in good quality river water with an intact ecosystem than in a highly degraded river system. We probably cannot bring the Illinois River system back to its 1800 grandeur, but we can certainly bring it back part of the way.

Table 2-4. Results from the 1989 Manufacturer's Walleye Circuit Tournament and the 1990-97 Masters Walleye Circuit Tournaments held in the Peoria Pool at Spring Valley, Illinois. Results were based on two days fishing from 7:00 a.m. to 3:00 p.m. each day.

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997
Date	1-2	24-25	13-14	5-6	27-28	26-27	25-26	30-31	5-6
Month	April	March	April	April	March	March	March	March	April
Number of anglers	346	350	356	384	450	450	450	450	450
Total angler hours	5,882	5,950	4,872[a]	6,144	6,750	7,200	7,200	7,200	7,200
Sauger caught	491	783	448	1,853	81	1506	1,390	1,800	937
Sauger/hr	0.083	0.132	0.092	0.302	0.012	0.209	0.193	0.250	0.130
Walleye caught	25	33	12	41	3	16	65	25	22
Caught walleye/hr	0.004	0.006	0.003	0.007	0.0004	0.002	0.009	0.003	0.003

[a] Not all participants fished both days.

REFERENCES

Balon, E.K. 1974. Domestication of the carp, Cyprinus carpio L. Royal Ontario Museum Life Sciences Miscellaneous Publication. Toronto, Canada.

Bellrose, F.C., S.P. Havers, F.L. Paveglio, Jr., and D.W. Steffeck. 1983. The fate of lakes in the Illinois River valley. Illinois Natural History Survey, Biological Notes No. 119, Champaign, IL.

Billington, N., R.C. Brooks, and R.C. Heidinger. 1997. Frequency of natural hybridization between saugers and walleyes in the Peoria Pool of the Illinois River, as determined by morphological and electrophoretic criteria. North American Journal of Fisheries Management 17:220-224.

Bodensteiner, L.R., W.M. Lewis, and R.J. Sheehan. 1990. Differences in the physical environment of the Upper Mississippi River as factors in the overwinter survival of fish. Pages 109-117 in The Restoration of Midwestern Stream Habitat: Symposium Proceedings; Rivers and Streams Technical Committee, North-Central Division of the American Fisheries Society. 52nd Midwest Fish and Wildlife Conference, Minneapolis, Minnesota, December 4-5, 1990.

Heidinger, R.C. and R.C. Brooks. 1996. Illinois River sauger and walleye project. Illinois D-J Completion report F-85-R, 276 pp.

Raibley, P.T., T.M. O'Hara, K.S. Irons, K.D. Blodgett, and R.E. Sparks. 1996. Mark and recapture studies and angling impacts on largemouth bass in La Grange and Peoria reaches of the Illinois River. Illinois Natural History Survey Aquatic Ecology Technical Report 9611, 37 pp.

Sheehan, R.J., L.R. Bodensteiner, W.M. Lewis, D.E. Logsdon, and S.D. Sherck. 1990. Long-term survival and swimming performance of young-of-the-year fishes: link between physiological capacity and winter habitat requirements. Pages 98-108 in The Restoration of Midwestern Stream Habitat: Symposium Proceedings; Rivers and Streams Technical Committee, North-Central Division of the American Fisheries Society. 52nd Midwest Fish and Wildlife Conference, Minneapolis, Minnesota, December 4-5, 1990.

Smith, H.M. 1898. U.S. Commissioner of Fish and fisheries, commissioner's report, 520 pp.

Talkington, L.M. 1991. The Illinois River: Working for our state. Illinois State Water Survey, Miscellaneous Publication 128, 51 pp.

WATERWAYS FOR MARITIME INDUSTRIAL DEVELOPMENT AND JOB CREATION

Don W. Miller, Jr.

Port Director, Clark Maritime Centre
5100 Port Road, Jeffersonville, IN 47130

Thank you for that nice introduction. First, let me tell you a little bit about the Indiana Port Commission. We are one of six state port authorities in the United States, and America's newest port system; we've been in business for just 25 years. We're administering and developing three public ports, including Indiana's International Port at Portage on Lake Michigan, Southwind Maritime Centre at Mount Vernon on the Ohio River near Evansville, and Clark Maritime Centre, also on the Ohio River near Jeffersonville. We are also charged by the Indiana legislature with Foreign Trade Zone development statewide and have been most successful in this effort, creating seven zones and nine sub-zones, the last two comprising several of the largest projects ever for Amoco Oil Company and Toyota.

Indiana's International Port opened for business in 1970, and the two river ports were both built and opened for business during the early 1980s. Our three public ports primarily handle bulk cargoes like iron and steel, grain, coal and fertilizers. We also operate foreign trade zones at each of the three public ports. Maritime-based industrial tenants lease land at each of the ports, and cargo-handling duties are contracted to stevedoring firms at each of the ports. Local 1969 of the International Longshoremens Association is the bargaining agent for dockworkers at Indiana's International Port. Employees at our river ports are affiliated with the Teamsters.

The seven-member state commission, our governing board, is appointed by the Governor of Indiana for staggered six-year terms. We are fortunate in Indiana in that our Governor, Frank O'Bannon, is a big supporter of the public port system. Governor O'Bannon likes to say that the Ohio River ran through his backyard. He grew up in the small southern Indiana community of Corydon just north of the River, and among his earliest memories are watching barges shuttle back and forth along the Ohio.

Monthly meetings of the Commission are rotated among the three ports and our Commission headquarters, and the seven current members of our commission have all been appointed within the past decade. They set policy, monitor operations, approve all major leases and agreements and interact with our congressional and legislative delegations. They do not micro-manage the day-to-day operations. That's the job of our highly professional management team.

At a time when privatization of government services has become a public policy watchword here in North America and around the world, the public port role in an increasingly competitive global marketplace can — and should — be a model for governments to follow. Public ports can no longer be "public" in the sense that they can rely exclusively upon tax revenues to support capital investment projects, operations and maintenance.

To survive and thrive in the 21st Century, we in the public port industry, both here and abroad, simply must develop sources of private capital. We must wean ourselves from public support. And we simply must diversify our economic base. The development of maritime industrial development projects, feeder ports and foreign trade zones is critical to the health of our public port industry in the next century.

That trend towards diversification and privatization will allow us to concentrate on the vitally important task of developing markets for our ports. And as we continue to develop markets for our ports, we will undoubtedly experience even more privatization of our public port system.

I see examples of that happening every day in North America. At our own public port system in Indiana, we've logged more than half-a-billion dollars in private investment during the past year alone, thanks to ConAgra's announcement of a major new soybean crushing facility at our Southwind Maritime Centre on the Ohio River, FedMar's announcement that it is building a 200,000-square-foot steel warehouse at our International Port on Lake Michigan near Portage, Indiana, and Vogt Valves and General Electric's decision this summer to undertake major expansion projects at my port of Clark Maritime Centre at Jeffersonville.

Indiana's state ports represent a public-private investment of more than half a billion dollars in the past 10 years alone. Indiana farmers and manufacturers enjoy access to some of the most modern, most efficient port facilities on the North American continent. They also enjoy access to one of the most modern, most efficient waterway systems on our planet. I've said before, and I'll say it again, that public private partnerships are the key to the survival of America's inland waterways and public port systems in the 21st century. We like to think that Indiana's public port system is a privatization model for America's maritime transportation system. As public ports, we have a responsibility to our users to operate as cost-efficiently as we can.

Substitute the word inland waterways for public ports, and the concept is exactly the same. We've heard too many presentations in recent years that point out that federal support for our inland waterways is being reduced, and in some cases is in danger of drying up altogether. It is incumbent upon all of us to do what we can to forge those public-private partnerships which will help infuse our inland waterways programs with much-needed private investment capital.

THE IMPORTANCE OF THE RIVERS

An intriguing article in the Wall Street Journal last week pointed out that while the U.S. economy is booming, we are losing ground on our ability to move goods by road, by rail and by water. The nation's freight transport system is facing unprecedented strains, and docks from Los Angeles to Cairo to New York are beginning to back up with gridlocked cargo.

I sometimes think that we fail to appreciate — and fail to communicate to our many stakeholders — the scope of cargo movement along the inland waterways. We tell anybody in Indiana who will listen that more cargo tonnage transited the Ohio River along the state's southern border last year than passed through the Panama Canal. Navigable channels in the U.S. provide the most efficient and economic means to move more than 2.2 billion tons of

American cargo each year. Coal and grain and chemicals constitute more than a quarter of total inland waterway shipments each year, and they are critical to the smooth functioning of the American economy.

Take coal, for example. Coal-fired power plants located along the nation's inland waterway system account for three of every four kilowatts generated by America's electric utility industry. Literally all of that coal moves by water from the mine to the generating station.

U.S. chemicals and allied products account for a $300 billion chunk of the nation's economy; 36 percent of America's chemical manufacturing plants are located on the nation's inland waterway system. Or take petroleum. We transport more than a billion barrels of petroleum on the nation's inland waterways each and every year, enough to provide 200 gallons a year of oil to every American; more than 300 oil terminals and 37 percent of the nation's petroleum refineries are located on the navigable waterway system. Without the inland waterway system, we'd all have a difficult time of getting our daily bread. A total of 17 river states — most in the nation's heartland, but also in the Southeast and the Pacific Northwest — ship 60 million tons of grain each year on the inland waterway system. That generates $25 billion worth of export earnings each year, which goes a long way toward balancing America's trade deficits.

The state ports and Indiana agriculture go hand-in-hand and have for most of the state's history. Even before Indiana achieved statehood in 1816, Indiana's farmers were hauling the produce from the Hoosier heartland by ox and wagon to landing on the Ohio River, where boatmen floated rafts south to markets in Memphis and New Orleans. In the 1880s and 1890s, northern Indiana wheat farmers hauled wheat and corn north to the docks on Lake Michigan, where Great Lakes steamers waited to haul their grain east to the mills at Niagara Falls.

Together, Indiana's three state-owned ports provide a vital link for the agricultural sector of the Hoosier economy at the dawn of the 21st century. Take the facilities available for transhipment of grain at Clark Maritime Centre, for example. The state port at Jeffersonville offers rail service by CSX and Conrail. Interstates 65, 64 and 71 are all accessible to the port, and two years ago, Clark became the terminus for I-265, a 1.8 mile loop that makes Clark one of the most accessible ports in North America. Clark's state-of-the-art material handling technology is mirrored by Clark tenants who provide superior storage and processing facilities for Indiana's farmers, names like Consolidated Grain and Barge and LaRoche Industries Inc.. At Clark, 670,000 bushels of Indiana grain can be stored on site, with a throughput rate of 30,000 bushels per hour.

Downriver, the Southwind Maritime Centre near Mt. Vernon boasts a grain elevator with capacity of 2.35 million bushels and a load-out rate of 235,000 bushels per hour. The elevator is capable of handling 200 trucks and 150 railroad cars. Southwind also has three one-million gallon liquid fertilizer storage tanks, and a 55,000-ton covered facility for dry fertilizer. Southwind's tenants include Cargill and Consolidated Grain and Barge Company. I don't need to tell you in Illinois the importance of the inland waterways to the state's agricultural economy. From now until ice-up, a never-ending string of barges hauling Illinois wheat, corn and soybeans down the Illinois, Ohio and Mississippi Rivers will deliver the bounty of Illinois farms to America and the world. In recent years, more than 35 million tons of Illinois grain products have been shipped downriver to New Orleans and the Gulf of Mexico.

Much of that Illinois — and Indiana — grain helps feed a hungry world. But there are bright prospects for other Illinois exports going to world markets via the inland waterway system. Illinois, the nation's sixth largest coal producing state, hasn't been a major player in export coal markets in recent years. But an export marketing initiative backed by the administration of Governor Jim Edgar holds promise for dramatically increasing coal exports from the state.

Illinois is the center of the Illinois Basin coalfields, a vast reserve of coal deposits stretching across southern and south central Illinois, southwestern Indiana and northwestern Kentucky. Illinois Basin coal has been powering utility steam electric boilers from the Mid-Atlantic states to the Rocky Mountains and beyond for decades.

The U.S. Energy Information Agency projects that worldwide demand for electricity will increase by six trillion kilowatt hours between now and 2010, and coal is expected to retain its current, 35 percent primary share of the world's generation market. The U.S. Department of Energy estimates that by 2010, global demand for energy technology, fuel and services will create a $200 billion annual export market.

In 1994, coal exports from Illinois totaled 236,000 tons, according to figures I've seen from the Office of Coal Development and Marketing in the Illinois Department of Commerce and Community Affairs in Springfield. In 1995, coal exports from Illinois were 2.7 million tons.

Although final figures aren't in yet, Illinois coal industry officials estimate that coal exports in 1996 slightly exceeded three million tons. That's an eleven-fold increase in just two years, and the Office of Coal Development says every sign that it has seen indicates that high sales are continuing for 1997. The bulk of that Illinois coal goes via rail or barge down the Mississippi River to terminals on the Gulf of Mexico. The Illinois Central Railroad announced last spring that it intends to build a $50 million bulk materials handling facility on the Mississippi River below Baton Rouge, Louisiana. The facility will be served by both barge and rail lines and will be capable of handling and storing large amounts of coal. The terminal will also be capable of blending coals on site and is expected to begin operations by mid-year. We in Indiana and you in Illinois share a marvelous economic development advantage in our proximity to the nation's inland waterway system. How we make the best use of that opportunity could well dictate the direction our respective state economies take in the 21st century.

While I have your attention, I'd like to show you a very short, seven-minute video on the public ports of Indiana. And then I'd be happy to take any questions you might have.

PEORIA RIVERFRONT DEVELOPMENT - ECONOMIC, RECREATIONAL, AND SOCIAL IMPACTS

Tom Tincher

City of Peoria
419 Fulton Street, Rm. 302, Peoria, IL 61602

ABSTRACT

In 1994, the City of Peoria embarked upon a community initiative to promote development of its Downtown Riverfront Area. A plan was approved in December of that same year and the first phase of construction started a few months later. In just two short years, that initial effort has grown into 18 major public and private projects being implemented at the same time, representing tens of millions of dollars in public and private sector investment.

This tremendous success is a direct result of the overall community's commitment to the project and the unique organizational structure which has been established. The entities involved to date are the Riverfront Business District Commission which has been delegated the responsibility to implement the plan, and the Illinois River Development Corporation which has raised nearly $7 million in private donations to support the overall endeavor.

The implementation of this important project will transform the Riverfront Area into a major regional entertainment, recreation, and specialty shopping destination. It also will result in the construction of a major education and training facility, and expand housing, business development, and job opportunities.

It is important to note that in addition to the successes highlighted above, this project has been instrumental in bringing about a new spirit of cooperation throughout the community. New alliances are being formed to address problems and bring about positive change. New intergovernmental agreements are being executed and implemented in ways that were not possible in the past. All of this is amazing, and we're not finished yet!

SENACHWINE CREEK EPA 319 PROJECT

Jon Hubbert

United States Department of Agriculture, Natural Resources Conservation Service
2412 West Nebraska Avenue, Peoria, IL 61604

Slide #1 -- Title

Good morning, and welcome to the third day of the Illinois River Governor's Conference. For those of you that haven't met me, my name is Jon Hubbert, and I am employed by the USDA Natural Resources Conservation Service as the District Conservationist here in Peoria. It is my pleasure today to be presenting a brief synopsis of one of the very successful watershed efforts in the Peoria area. I will be starting off with a brief history of the Creek, then pointing out the details of the project -- with a focus on the reasons, that I feel, made the project a success.

Slide #2 -- Map of the Watershed

Senachwine Creek is a relatively small stream that winds across Southwestern Marshall County, with its origin near Bradford Illinois, and then continues on through Northeastern Peoria County until it empties into Upper Peoria Lake (the Illinois River) on the Northern edge of Chillicothe. The watershed encompasses 57,300 acres (89.5 square miles).

Slide #3 -- Stream Picture

The creek was born nearly 11,000 years ago, as the melt water from the receding Wisconsin glacier carved a valley into the glacial till that it had recently deposited. The watershed continued to change as wind blown soil, (loess) was blanketed across the landscape. As vegetation took root and grew the land was covered by tall grass prairie on the flat plains to the North and oak hickory woodlands in the steep bluffs to the South, with transitional areas known as bur oak savannas in between.

Slide #4 -- Cropland Picture

Many years later the early pioneers realized the value of the land in producing grain crops, livestock, and lumber.

Slide #5 -- Land Use

Current land uses and approximate percentages include: **cropland 60%, woodland 25%, pasture land 6%, residential 5%,** and **other 4%.**

Slide #6 -- Resource Planning

The Senachwine Creek Resource planning Committee was formed in 1986 to assess the need for a collaborative effort in addressing resource concerns. Early progress was made with the help of financial assistance through the "Build Illinois" program which provided **$168,647** of cost share assistance to landowners installing conventional upland conservation practices on cropland areas. Research and demonstrations were also under way to address the streambank erosion issue. In 1993-94 additional streambank protection was done with funding from the USDA Natural Resources Conservation Service, Emergency Watershed Protection Program.

Slide #7 – "EPA 319 Grant"

In 1994 the Senachwine Creek Watershed Committee with the Illinois River Soil Conservation Task Force applied for and was awarded a $300,000 matching grant through the EPA 319 program. The matching portion indicates that local money had to be generated to match the federal grant dollars. The ratio of federal grant to local match was 60/40. In other words we needed to generate $200,000 locally to match the $300,000 grant amount. Even though this appeared to be a large amount, we were actually able to generate $384,931 of local match during the grant implementation.

Slide #8 – Purpose

The mission of the Senachwine Creek Watershed Committee and the purpose of their EPA 319 Project, **was to improve water quality, and protect soil productivity through a locally driven, voluntary, incentive based approach that encouraged landowners and operators to protect these resources.**

Slide #9 – Key Principles

The key principles that proved vital in the success of the grant were:

strong local leadership

mutual benefit (projects that did not meet the common objectives of the landowner and the watershed committee were not funded)

education (to provide landowners with a new insight of how to prevent erosion and water quality problems and to ensure long term maintenance of projects installed)

and trust (Many of the people that sought assistance were leery of government intervention. We were able to develop a degree of trust for some of these individuals, however some of them decided against cooperating in the grant) In our role we had to make sure that <u>they</u> were well informed so that <u>they</u> could make the decision. Nothing was hidden.

Slide #10 – Other Key Factors

The other key factors were high percentage rate cost sharing, and strong local match. Turning a 60/40 grant into a 75-90% cost share program with money left over for administrative and educational components was difficult to conceive and at times even more difficult to explain. The ability to actually do it was totally dependent on finding sizable local matching funds.

Slide #11 – Cost Share Rates

In deciding on the cost share rates the planning committee tried to reflect the value of the project versus the cost, **as the landowner would see it.** Also, consideration was given to the planning requirements attached and the short (two year) time frame for complete implementation of the grant.

Upland Treatment -- 75% up to $7,500 maximum cost share
Ponds and Wetlands -- 75% up to $7,500 maximum cost share
Streambank Stabilization -- 90%

#12 -- Other Slide Required Components

Pest Management, Nutrient Management, and Soil Conservation issues present on all land areas receiving cost share was required.

Slide #13 -- Prioritization Considerations

During the prioritization process, special consideration was given to projects that provided **stormwater retention** and/or **wildlife habitat**.

Slide #14 -- Projects Completed

39 -- Upland
8 -- Ponds
<u>6 -- Streambank Stabilization</u>
53 -- Total Projects

Slide #15 -- Streambank Project "Before"

The Shepard site is an example of the six streambank stabilization projects. This is a **"before"** picture showing the unstable condition.

Slide #16 -- Streambank Project "During"

During construction in March 1996, the streambank was reshaped, geo-textile fabric and large rip-rap were placed on the lower bank, dormant willow posts were placed above the rip-rap, and a grass filter strip was seeded.

Slide #17 -- Streambank Project "Shortly After"

Soon after construction was complete the willow posts came out of dormancy and began to sprout new branches and roots.

Slide #18 -- Streambank Project "One year later"

Early the following spring (1997) the site was stabilized and stood in stark contrast to the before picture.

Slide #19 -- Pond Project

An example of the 8 ponds that were cost shared is the Voss site which quickly attracted "wild life". A before picture, if available, would have shown you a wooded ravine with active erosion at the bottom and on the steep side slopes.

Slide #20 – Upland Project

Several of the 39 upland projects included narrow base (grassed) terraces. Other projects included grassed waterways, dry dams, and water and sediment control basins.

Slide #21 – Stormwater and Wildlife

The upland projects helped to reduce soil loss and improve water quality. In addition many of them provide stormwater retention and wildlife habitat while allowing the surrounding land to generate revenue and grow a food crop.

Slide #22 – Impact on Soil Loss

The soil saved as a result of the 319 grant has been estimated at **23,600** tons per year. More visibly this equates to **1,180** semi loads of soil per year or **3.23** semi loads per day.

Slide #23 – Impact on Water Quality

Recent aquatic sampling conducted by IDNR indicates that the water quality in Senachwine Creek has greatly improved. Unfortunately, three fourths of you know all about water quality indicators and my knowledge is basically limited to the ones that can bite on a hook. *By the way, don't tell anybody, but, there were some nice 2-3 lb. small mouth bass moving into the Senachwine Creek this Spring.* A more comprehensive analysis that will hopefully upgrade the stream rating has been requested.

Slide #24 – Final Analysis

Mutual benefit, improved water quality, and reduced soil loss has resulted in a win-win solution for the project participants, the sponsors, EPA and the public.

Slide #25 – Current Status

At the present time all of the funding allocated through the original 319 grant has been expended. Due to the strong interest in continuing the efforts already started, the Senachwine Creek Watershed Committee is preparing to submit a second grant request.

Slide #26 – Summary

The success of the Senachwine Creek EPA 319 Project can be largely attributed to four key principles:

- **strong local leadership**
- **mutual benefit**
- **education**
- **trust**

Without any one of these, the project would have failed. If these key principles can be duplicated in other watersheds feeding into the Illinois River the benefits will transform the river and our appreciation for it. As Leon Wendte pointed out yesterday during his presentation "We're doing resource planning with people, not to people".

Slide #27 – Special Thanks To

It has been my pleasure to work with the Senachwine Creek Watershed Committee during this project and to provide this report to you. Please feel free to contact me if you have questions that I did not address.

Slide #28 – Program Availability

As always, all USDA programs are available to all landowners and managers without discrimination.

JOLIET ARMY ARSENAL RESTORATION (THE MIDEWIN NATIONAL TALLGRASS PRAIRIE AND THE PRAIRIE PARKLANDS PARTNERSHIP: AN OPPORTUNITY FOR ILLINOIS)

Lawrence Stritch and Francis M. Harty

United States Forest Service and Illinois Department of Natural Resources
Midewin National Tallgrass Prairie
P.O. Box 88, Wilmington, IL 60481

ABSTRACT

The disposition of the Joliet Army Ammunition Plant and its thousands of acres of undeveloped land provides the opportunity to recreate the Midwestern prairie/savanna ecosystem on a landscape scale. The project area is located at the confluence of the Des Plaines and Kankakee Rivers where they join to form the Illinois River, just 40 miles from Chicago, in Will County, Illinois.

The transfer of 15,000 acres of former Arsenal land to the United States Forest Service on March 10, 1997, laid the groundwork for the restoration of the nation's first National Tallgrass Prairie. Midewin is currently the largest tallgrass prairie restoration ever attempted. It will involve thousands of volunteers and thousands of hours of planting, monitoring, and stewardship. The Midewin National Tallgrass Prairie also will provide the eight million people who live within the greater Chicagoland area an unparalleled outdoor recreation experience.

ILLINOIS: THE LAND BEFORE LINCOLN

Gary Foreman

Writer, Producer/Director, Historian
2319 Yout Street, Racine, WI 53404

ABSTRACT

ILLINOIS: The Land before Lincoln is a multimedia, video and print package that integrates the early history, geography, and environmental themes of Illinois prior to 1833 and the subsequent rise of Abraham Lincoln's fame. The ultimate design of the product is to be used as a major reference tool to put the viewer/user on an eventual life-journey through a state whose storied past has remained obscure.

The package is comprised of several key components. The first is a one-hour video that is designed to hook the viewer. The video is an attractive visual presentation of authentic scenic, wildlife, re-enactments, and time-lapse sequences supported with changing music and historic narratives. Hosted and narrated by Bill Kurtis, these voices from the past will thread the dramatic and evolving story together. The next element is a CD-ROM which incorporates video clips from the one-hour presentation and delves into the subject matter with detailed text, animation, and creative visualization. Segmented into six major eras (reflecting the different controlling powers — Indians, French, British, Virginians, New Americans, Fort Dearborn) the integration of disciplines begin to show the effects on the cultures and the land. A teacher/ user study guide will provide further insight on the material, advising the user on related topics, language, self-guided tours, additional projects, research, and opportunities. A series of display maps will support the themes of the package.

This project is designed for everyone. Obviously, schools, libraries, museums and related historic sites sorely need this material and yet, most Illinois citizens are unaware of their own past and natural heritage. This situation affects our ability to make informed choices in critical areas including education, tourism, conservation, and historic preservation. Anyone who watches and comprehends the early morning news on television can easily absorb this material.

Illinois has a rich heritage that has mostly been centered around the legacy of Lincoln. This myopia has severely hampered the state's ability to present itself in a new and refreshing way to business, environmental, and educational opportunities. By widening the vision of our heritage, we can begin to approach our future with better perspectives while providing sound educational benefits. Also, *Illinois: The Land before Lincoln* is providing a new theme for which other products are planned. This includes development of the French Heritage Corridor, the Land Before Lincoln Outdoor Drama, museum exhibits, interactive kiosks, and thematic merchandise.

GULF HYPOXIA: HOW DOES THE ILLINOIS RIVER WATERSHED CONTRIBUTE TO THE PROBLEM

Frederick C. Kopfler and Larinda Tervelt

Gulf of Mexico Program
Gulf of Mexico Program Office, Building 1103, Stennis Space Center, MS 39529

BACKGROUND

Nutrients, such as nitrogen and phosphorus, are essential for healthy marine and freshwater environments. However, an overabundance of nutrients can literally be too much of a good thing. Excessive nutrients can trigger excessive algal growth which results in reduced sunlight, loss of submerged aquatic vegetation, loss of bottom-dwelling animal habitat, and a decrease in oxygen dissolved in the water column. The condition that exists when the concentration of dissolved oxygen falls below 2 parts per million is referred to as hypoxia. It has been demonstrated that at this level of dissolved oxygen, organisms that can leave to seek higher levels of dissolved oxygen will do so; those that are less mobile such as starfish and worms will get as high into the water column as possible and show signs of stress.

On the Gulf of Mexico's Texas-Louisiana Shelf, an area of hypoxia forms during the summer months which covers 6,000 to 7,000 square miles, an area that has doubled in size over the past 10 years. The cause of this condition is believed to be a complicated interaction of excessive nutrients transported to the Gulf by the Mississippi River, physical changes to the River, such as channelization and loss of natural wetlands and vegetation along the banks, and the interaction of freshwater from the River with the saltwater of the Gulf. The nature of the hypoxia problem is further complicated by the fact that some nutrient load from the Mississippi River is vital to maintaining the productivity of the Gulf fisheries, but too much can eventually adversely affect commercial and recreational fishing. Approximately 40% of the U.S. fisheries landings, including a substantial part of the nation's most valuable fishery (shrimp), come from this productive area. Commercial landings of all species in both 1995 and 1996 for Louisiana, Mississippi, and Texas were 1.4 billion lb., with 82% from Louisiana waters for both years.

A significant portion of the nutrients entering the Gulf from the River come from a variety of human activities, including discharges from sewage treatment plants and stormwater run-off from farms and city streets. Also, some nutrients may enter the waterways and the Gulf directly from the air after being released by sources such as automobiles and fossil fueled power plants. The precise contribution of each source is not known at this time. This circumstance creates significant public policy issues concerning the management of large ecosystems that cross political, economic and social boundaries. It is also symptomatic of the larger issue concerning the role of scientific information in public policy, and how and when to act in the face of scientific uncertainty. These issues are discussed within the context of what can be done to reduce nutrient loading in the Mississippi river system and to reduce the potential impact of hypoxia on the northern Gulf ecosystem.

Turner and Rabalias first suggested that hypoxia that occurs on the inner continental shelf of Louisiana each year is a result of the nutrient load of the Mississippi River. They analyzed the U.S. Geological Survey's historical data for nitrate concentrations in the lower Mississippi River. They showed that nitrate concentrations were fairly constant from the early part of the twentieth century until the early part of the 1960s. During the next 20 years the nitrate concentration in the river water doubled. They also determined that during this same time application of nitrate in fertilizer increased fourfold and hypothesized that this increase in fertilizer was responsible for the increase in nitrate in the Mississippi River. They believe that the nitrate stimulates the growth of phytoplankton to higher than normal levels. When these phytoplankton die they sink to the bottom and decay. The decay process consumes most if not all of the oxygen in the water above the bottom. The fresh water provided by the Mississippi River does not mix rapidly with the salt water of the Gulf. Rather it forms a layer on the surface which prevents reoxygenation of the bottom water.

Several investigators from the U.S. Geological survey have conducted their own studies on nitrate concentrations and loads in the Mississippi River and have attempted to determine the source of the nitrate. Some of the investigators collected and analyzed the data from the U.S. Department of Agriculture on amounts of fertilizer and manure applied by county. These results indicate that some of the highest levels are applied in the corn belt. Ron Antweiler conducted several cruises up the river collecting and analyzing water samples from the major tributaries as well as above and below the point where each enters the Mississippi River. His data show that during the spring and early summer of 1991 the Illinois River contributed about 750,000 kilograms (825 tons) of nitrogen in the form of nitrate to the Mississippi River each day. He estimated that during that year the Illinois River contributed about 11 percent of the total nitrate-nitrogen reaching the Gulf of Mexico.

All of this information is available in the proceedings of the First Gulf of Mexico Hypoxia Management Conference. A limited number of copies are available from the Public Information Center of the Gulf of Mexico Program. The proceedings are also available on the Gulf of Mexico Program page on the World Wide Web at <http://www.gmpo.gov>.

Over the past several years many agencies in all sectors collected data and began evaluating the conditions of nutrient over-enrichment and hypoxia. These efforts focused on understanding the issue and exploring activities which could begin to address and alleviate the problem. The current focus is to identify and coordinate efforts which will address hypoxia throughout the Mississippi and Atchafalaya River systems and the Gulf of Mexico.

COORDINATION

The Sierra Club Legal Defense Fund, Inc. (now known as the Earthjustice Legal Defense Fund) filed a petition for a Section 319(g) conference on Gulf hypoxia. In response, the Environmental Protection Agency (EPA) and the State of Louisiana held a management conference to outline the issue and identify potential actions. Following that conference, EPA convened a group of Federal Senior Administration Officials (the Principals) to discuss potential policy actions and related science needs. After two meetings, the Principals asked an interim working group (IWG)composed of members of their staffs to develop recommendations for action. The IWG made three recommendations that were endorsed by the Principals at a meeting in June 1997.

- Establish a formal coordinating structure;
- Highlight and emphasize a series of existing programs and actions within base resources, focused on identifying immediate win-win, actions; and
- Support an FY99 budget initiative that has both stewardship and scientific support elements.

The overall coordinating structure will be led by the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force (an expansion of the Principals group to include State representation). The Task Force will investigate the causes and effects of nutrient management and hypoxia related activities in the Mississippi River and Gulf of Mexico watersheds and to coordinate activities related to the phenomena.

The Coordination Committee (the former IWG) will direct the efforts of the strategic assessment team and coordinate the efforts of the Ecosystem/Watershed Management Committee and the Scientific Evaluation and Support Committee (the CENR Subcommittee on Ecological Systems).

Establishment of key milestones will enable evaluation of the effectiveness of these actions. Over the next 7 years the key milestones are:

1) Determine baseline characterizations, particularly for nutrients.
2) Reach agreement on, establish , and implement, an initial nutrient load reduction and specific performance measures.
3) Assess the cost effectiveness of additional nutrient reduction versus the status quo.
4) Assess the need for a longer term response plan to address hypoxia.

This coordination involves ways to reduce the nitrogen/nutrient loading in the watersheds (at the local level) throughout the Mississippi system, the need for "basin-wide" solutions and for focusing existing federal activities across agencies. It emphasizes the need for all sources to reduce nutrient pollution (wastewater, stormwater, non point, atmospheric, etc.) and the need for urban, suburban, and rural sectors to work together in light of drinking water requirements and surface water impacts.

ASSESSMENT

As part of the process of developing potential policy actions and implementing the proposed initiative, the Committee on Environment and Natural Resources (CENR) was asked to conduct a scientific assessment of the causes and consequences of Gulf of Mexico Hypoxia. The CENR assigned this to their Subcommittee on Ecological Systems. An Hypoxia Assessment Workgroup was formed to oversee the effort, and has prepared the following approach:

A. Six interrelated topic papers will be developed by scientific experts drawn from the academic and governmental sectors. Team leaders have been identified by the interagency Hypoxia Assessment Workgroup. The papers are:

TOPIC 1. Characterization of hypoxia: Distribution, dynamics, and causes. This report will describe seasonal, interannual, and long-term variation in hypoxia, and its relationship to nutrient loads from the Mississippi/Atchafalaya system. It will also document the relative roles of natural and human-induced factors in determining the size and duration of the hypoxia zone. Lead: Dr. Nancy Rabalais, Louisiana Universities Marine Consortium.

TOPIC 2. Ecological and economic consequences of hypoxia. This report will evaluate the ecological and economic consequences of hypoxia, including impacts on Gulf of Mexico fisheries and the regional and national economy. It will articulate both ecological and economic consequences and, to the extent appropriate, their interaction. Ecological co-lead: Dr. Robert Diaz. Virginia Institute of Marine Science. Economics co-lead: Dr. Andrew Solow, Woods Hole Oceanographic Institution, Center for Marine Policy.

TOPIC 3. Sources and loads of nutrients transported by the Mississippi River to the Gulf of Mexico. This report will identify the sources of nutrients within the Mississippi/Atchafalaya system and has two distinct components. The first is to identify where, within the basin, the most significant nutrient additions to the surface water system occur. The second, more difficult component, is estimating the relative importance of specific human activities in contributing to these loads. Lead: Dr. Donald Goolsby, U.S. Geological Survey.

TOPIC 4. Effects of reducing nutrient loads to surface waters within the basin and Gulf of Mexico. This report will estimate the effects of nutrient source reductions in the Mississippi-Atchafalaya Basin on water quality conditions in these waters and on hypoxia in the Gulf of Mexico. Modeling analyses will be conducted to aid in identifying magnitudes of load reductions needed to affect the extent and severity of hypoxia in the Gulf of Mexico. Upper watershed co-lead: Dr. Patrick Brezonik, University of Minnesota. Gulf of Mexico co-lead: Dr. Victor Bierman, Limnotech.

TOPIC 5. Evaluation of methods to reduce nutrient loads to surface water, ground water, and the Gulf of Mexico. The main focus of this report will be to identify and evaluate methods to reduce nutrient loads to surface water, ground water, and the Gulf of Mexico. The analysis will not be restricted to only reduction of sources. It will also include means to reduce loads by allowing the system to better accommodate those sources through, for example, modified hydraulic transport and internal and internal cycling routes. Led: Dr. William Mitsch, Ohio State University.

TOPIC 6. Evaluation of social and economic costs and benefits of methods (identified in topic #5) for reducing nutrient loads. In addition to evaluating the social and economic costs and benefits of the methods identified in topic 5 for reducing nutrient loads, this analysis will include an assessment of various incentive programs and will include any anticipated fiscal benefits generated for those attempting to reduce sources. Lead: Dr. Otto Doering, Purdue University.

In addition to being developed by appropriate scientific experts, each report will be subjected to a rigorous independent peer-review facilitated by the Hypoxia Assessment Workgroup.

B. An "integration team", composed of topic paper leaders and additional government and academic experts, will integrate information from the six reports into an assessment that will provide ecological and economic analysis of various policy actions for reducing nutrient loads to surface waters in the Mississippi River Basin and the Gulf of Mexico.

The Hypoxia Assessment Workgroup will also facilitate an external review, prior to submitting the assessment to the Subcommittee on Ecological Systems and CENR for formal agency review.

C. The primary and ultimate target audience for the integrated assessment is the Gulf of Mexico Hypoxia Task Force currently led by EPA. However, "lay versions" of each of the six reports will be prepared and made public along the way. These will also likely feed into proposed Congressional Hearings on hypoxia in 1998.

CURRENT STATUS

NOAA is leading and coordinating the hypoxia assessment. This process is an academic pursuit of data available, and/or modeling of estimates (e.g., reductions and responses) to be generated primarily by academic and federal agency scientists. Draft proposals have been developed for the six reports, and were reviewed by the Hypoxia Assessment Workgroup at a workshop of the topic team leaders and the Workgroup, held on August 15, 1997. The individual proposals were evaluated and discussed for content and approach towards developing each topic paper, along with detailed discussions of the assessment process, and next steps. The proposals and topic paper titles are now being revised to address the concerns and comments received at that workshop.

Extensive coordination is being conducted with team leads and other internal and external contacts to improve the approaches in the proposals, to strengthen teams, to bring in additional expertise where appropriate, and to coordinate with other related efforts (e.g., Council for Agricultural Sustainable Technology, Land-Grant University research). The Hypoxia Assessment Work Group hopes to initiate the work in fall 1997. The next meeting of the Hypoxia Assessment Workgroup and team leads is scheduled for October 22, 1997 in Washington D.C.

The first meeting of the Hypoxia Task Force will be held in Washington D.C. in November or December of 1997. Prior to that meeting, the Coordination Committee will meet and invite stakeholder participation (i.e., a cross section of interests) to hear first-hand their views on how best to structure public input and membership on the Ecosystem/Watershed Management Committee. The first meeting will be in Washington, D.C. Future meetings are likely to be rotated throughout the Basin.

CONCLUSIONS

From the national perspective, the nutrient enrichment and resultant hypoxic condition which occurs on the inner continental shelf of Louisiana each year is significant in terms of its sheer size, persistence, and location. However, the concern for coastal eutrophication and hypoxia is not unique to the inner continental shelf of Louisiana. Rather, eutrophication is a widespread problem in many coastal areas; in 1990, the National Oceanic and Atmospheric Administration (NOAA) estimated that nearly half the Nation's estuaries were susceptible to eutrophication.

Although Progress has been made, eutrophication of freshwater, estuarine, and marine ecosystems continues to threaten the ecological integrity, safe use, and the economic productivity of inland and coastal waters of the United States. In some of these waters, conditions of hypoxia and anoxia may develop. In contrast to many other marine pollution problems, coastal eutrophication has been in ascendancy during the later half of the twentieth century. Given growth and development projections in many coastal areas, additional steps will be necessary to restore and maintain an acceptable nutrient balance in surface water systems.

NATIONAL ASSESSMENT OF HYPOXIA IN THE NORTHERN GULF OF MEXICO

Derek Winstanley

Chief, Illinois State Water Survey
Champaign, IL 61821

BACKGROUND

Hypoxia is a condition of reduced levels of dissolved oxygen in shallow coastal waters in the northern Gulf of Mexico. Hypoxia also occurs in other coastal waters, from natural and human-induced causes, but these other hypoxic areas are not the subject of this national scientific assessment. Hypoxia causes changes in the composition and structure of ecosystems

In response to concerns expressed by communities along the Gulf, the United States Environmental Protection Agency, in conjunction with the Sierra Club, requested that the White House consider taking action to address the condition of hypoxia in the Gulf. The White House requested the interagency Committee on the Environment and Natural Resources to establish a scientific working group to conduct a scientific assessment of the issue. I am attending meetings of the group, comprised mainly of Federal and university scientists, and am coordinating my input with the Illinois Department of Natural Resources, the Illinois Environmental Protection Agency and the Illinois Department of Agriculture.

NATIONAL SCIENCE ASSESSMENT

An open and comprehensive science assessment should identify and test multiple hypotheses. The main hypothesis is that excess nutrient loads from the Mississippi and Atchafalaya River system are causing increased ecosystem productivity in the Gulf and that, as the marine organisms die, they consume dissolved oxygen. A concern is that hypoxia may adversely impact commercial fisheries in the region.

The assessment will provide a synthesis of existing data and information on the causes and consequences of hypoxia in the northern Gulf of Mexico. It will also identify information gaps that need to be filled through research and data collection. Six peer-reviewed technical reports will be produced by late summer 1998 and a peer-reviewed integrated .assessment report will be produced by the end of 1998. It is also likely that there will be Congressional hearings on the subject next year.

Teams of scientists have been established to address the following topics:

- The characteristics and causes of hypoxia in the Gulf
- The ecological and economic impacts of hypoxia in the Gulf
- The sources and fluxes of nutrients

- The effects of reducing nutrient loads
- Methods for reducing nutrient loads
- The costs and benefits of reducing nutrient loads

Although this is an assessment of hypoxia in the Gulf, the study will also address the impacts of nutrients on water quality and riverine ecological systems in the Mississippi/ Atchafalaya basin. It will also address the potentially positive effects of nutrient enrichment in the Gulf.

Although the intent is to involve multiple stakeholders, including the states, they are not yet well represented. It is probably that state representatives will be invited to serve on the high-level Task Force.

Looking into a crystal ball, the following outcomes of the assessment are possible:

1) Nutrient loads from the Mississippi/Atchafalaya system will be found to contribute to hypoxia in the Gulf.

2) Reductions in commercial fisheries in the Gulf due to hypoxia will be difficult to determine.

3) The costs of nutrient control will be high and will likely outweigh the economic benefits in the Gulf.

4) There will be an emphasis on cost-effective methods of nutrient control, rather than on cost-benefit analysis.

5) Controlling nutrient loads in the Gulf has secondary benefits to the states in the Mississippi Basin.

6) The issue of hypoxia will be tied to the Clean Water and Clean Air Acts.

7) Significant gaps in our understanding of hypoxia will be identified.

I will continue to do my best to ensure that the science assessment is sound and comprehensive.

GULF HYPOXIA: HOW DOES THE ILLINOIS RIVER CONTRIBUTE TO THE PROBLEM?

Dan Towery

Conservation Technology Information Center/Natural Resources Conservation Service
1220 Potter Drive, Rm. 170, W. Lafayette, IN 47906
(765) 494-6952

Is there a connection between raising corn in Illinois and the hypoxia zone in the Gulf of Mexico? While some are proposing a direct link, the connection may not be quite so simple.

Hypoxia occasionally occurs in the Midwest, but usually in farm ponds. When excess algae dies and starts to decay, the oxygen content of the water declines, especially during warm weather. This may result in a fish kill if the oxygen content gets low enough. The culprit in farm ponds which causes excess algae is excess phosphorus.

Approximately 40% of the U.S. fisheries landings, including a substantial part of the nation's shrimp come from the nutrient rich waters of the nearshore Gulf of Mexico. However in saltwater, it is excessive nitrogen which can cause excessive algae growth which can lead to hypoxia conditions. This preliminary result is based on stream monitoring, nitrogen fertilizer sales, and manure production.

Nitrates are very mobile being easily absorbed in water and then are transported to surface water through subsurface drainage (tile flow) or base flow. According to Randall, climate and soil properties, i.e. precipitation, texture, infiltration rate, etc. dictate nitrate-N loading into surface water. The soils and climate in the Midwest provide a somewhat "natural leaky" environment for nitrogen movement and loss. The challenge is to use the best technology and management to improve nitrogen efficiency, realizing that the weather is always the last deciding factor.

Last December a couple of days were spent touring the Gulf and meeting those involved with the Gulf of Mexico Program. The topography, vegetation, and soils are very different from anything in the Midwest and the vastness of the marsh and swamp area is hard to describe. Casual observations include the following:

- the levee system on the Mississippi River has prevented high water flows from entering the Atchululaya River system, resulting in the loss of the filtering system though this marsh area;
- sediment is not being replenished in this marsh area;
- land area is being lost in the marsh area to open water;
- wave action is eroding the barrier islands;
- salt water is invading the marsh area;
- septic systems of some of the homes are very questionable;
- industrial discharges may be involved;
- channels excavated for oil wells in the marsh areas reduce the filtering capacity;

- channelization of the Mississippi River delta results in a direct discharge into the Gulf with no filtering;
- the fisheries have NOT been adversely affected (however, if the hypoxic zone reaches shore, the results would be devastating to the fisheries).

The overall impact of these activities on the nitrate loading in the Gulf may be a contributing factor, however, Turner (1996) suggests that the overall impact of the channel modification, levee construction, and other activities is not a major contributor to hypoxia and that nutrient loading from the Mississippi River is the main cause.

Potential sources of nitrogen include the following:

- commercial fertilizer
- animal feedlots
- municipal sewage systems
- industrial sources
- failed septic systems
- lawns and golf courses
- legumes
- manure spread on fields
- atmospheric deposition
- mineralization of soil organic matter.

The nitrogen sources listed above are pertinent whether it is the Spoon River watershed, the Illinois River watershed, the Ohio River watershed, or the entire Mississippi River watershed. The movement and cycling of these various nitrogen sources is extremely complex. A major complicating factor in analyzing nitrate movement is that residual nitrogen may be held in the soil and then released under certain rainfall events. For example, Hatfield documented that over 120% of all the nitrogen applied in the Walnut Creek watershed in Iowa was flushed out during the excessive rains of 1993.

The Illinois Agronomy Manual states that over 40% of the nitrogen and organic matter has been lost from Illinois' soils since cultivation began. The combination of drainage and tillage has improved aeration resulting in the loss of this organic matter and nitrogen. Kenney and DeLuca (1993) concluded that intensive agricultural practices that enhance mineralization of soil N with subsurface tile drainage are the major contributors of nitrate-N rather than solely nitrogen fertilizer. However, practices such as no-till can increase organic matter content and nitrogen levels in the soils surface.

The average nitrogen rate applied to corn in the Midwest has changed little in the past 15 years according to the Economic Research Service, 125 lbs/ac in 1980 compared to 129 lbs/ac in 1995. The average nitrogen rate for corn (1995) in Illinois was 150 lbs/ac, 134 lbs/ac in Indiana, and 114 lbs/ac in Iowa. Average nitrogen rates are an indicator but not entirely accurate in assessing the situation. All of the factors which deal with nitrogen management must be examined in order to ascertain the complete story. Randall (1997) suggest that there is less risk associated with spring applied nitrogen as compared to fall applied nitrogen (36% higher nitrate leaching with fall application as compared to spring).

The leaching of nitrogen (from ag or other sources) is a natural phenomenon and is going to occur. Fawcett (1997) reported that simply tilling soils in northern Iowa and growing corn and soybeans in the absence of any added fertilizer resulted in standard-exceeding nitrate concentrations coming out of tile lines. Nitrate coming out of tile lines is quickly diluted as it mixes with stream waters to a much lower concentration. However, the drinking water standard of 10 mg/L may not be appropriate for sampling out of tile lines or for other resource concerns. More research and monitoring is needed to better understand where the nitrates are coming from. What is even more difficult to ascertain: will a certain change in management actually result in change in nitrate loading. For example, will a 20% reduction in nitrogen application rates result in a 20% or even 10% reduction in loading? This will be extremely difficult to determine because of the many sources of nitrates, residual nitrogen, and the variations associated with the weather.

However, agriculture needs to be proactive. Fine tuning nitrogen management should be done where it is appropriate. Using the best technology and management available makes good economic and environmental sense. Ten techniques that can be adopted include the following:

1) reduce nitrogen rates if planting is delayed substantially,
2) do not apply nitrogen in the fall until the soil temperature is < 50 degrees,
3) use a nitrogen monitor instead of a regulator,
4) sandy soils need special management,
5) use nitrification inhibitor if nitrogen is fall applied,
6) test manure, inject, and take appropriate credit,
7) be clear if you are applying Nitrogen or anhydrous ammonia,
8) determine realistic yield potential X 1.2 lb./acre,
9) take 40 lb/acre credit after soybeans,
10) include ALL nitrogen sources in nitrogen budget.

Additional research is needed on improving nitrogen efficiency, as well as timing changes, precision and variable rate application, use of nitrification inhibitors, soil N testing (especially after dry years or manure application), and the use of constructed wetlands to discharge tile into).

SUMMARY

Sediment is the principal pollutant in the Illinois River watershed, but in order to improve the overall health of the watershed a systems approach is needed. Key conservation practices include conservation tillage (to enhance soil quality), conservation buffers, and nutrient and pest management. If these key practices are widely applied, along with stream bank stabilization, the Illinois River watershed will benefit and the Gulf of Mexico will also benefit.

REFERENCES

Antweiler, R., D.A. Goolsby, and H.E. Taylor. Nutrients in the Mississippi River(1991-1992). Presented at: Hypoxia Information Workshop. Davenport, Iowa. June 25-26, 1996. (http://pelican.gmpo.gov/gulfweb/hypoxia/antweil.html)

Fawcett, D. Water Issues for the Midwest.

Gulf of Mexico Program. Oxygen Depletion, or Hypoxia, in the Nearshore Gulf of Mexico off the Louisiana Coast. Fact sheet (http;//pelican.gmpo.gov).

Illinois Agronomy Handbook, 1997-1998. University of Illinois.

Randall, G.W. Nitrate-N in Surface Waters as Influenced by Climatic Conditions and Agricultural Practices. Presented at: Agriculture & Hypoxia in the Mississippi Watershed Conference. St. Louis, MO. July 14-15, 1997.

Turner, R. E., N.N. Rabalais, Q. Dortch, D. Justic, and B.K. Sen Gupta. 1996. Evidence for Nutrient limitation and Sources Causing Hypoxia on the Louisiana Shelf. Presented at: Hypoxia Information Workshop, Davenport, Iowa. June 25-26, 1996. (http://pelican.gmpo.gov/gulfweb/hypoxia/turner.html)

USDA, Economic Research Services. 1993 Cropping Practices Survey.

RESTORATION OF THE RIVER OTTER IN THE ILLINOIS RIVER VALLEY

R.D. Bluett, G.H. Hubert, Jr., E.A. Anderson, and G.W. Kruse,
Illinois Dept. of Natural Resources
S.E. Lauzon, Illinois Endangered Species Protection Board

Illinois DNR, Division of Wildlife Resources
524 S. Second Street, Springfield, IL 62701-1787

ABSTRACT

River otters were common in Illinois during early European settlement. Habitat degradation and unregulated harvests caused populations to decline dramatically by the late 1800s. Otters were rare by the mid-1900s, and listed as state endangered in 1989. Recovery strategies developed by the Illinois Department of Natural Resources included reintroducing otters in suitable but unoccupied habitats. Wild otters of the same subspecies as occurs in Illinois were obtained from a supplier in Louisiana and released in the Wabash (n = 137), Kaskaskia (n = 72) and Illinois (n = 137) River Basins from Jan 1994 through Mar 1997.

River otters are persisting and reproducing near release sites. Native populations along the Mississippi and Cache rivers have increased and expanded their range. Habitat conservation practices already implemented by individuals (e.g., conservation tillage), groups (e.g., private duck hunting clubs, The Nature Conservancy) and state and federal governments provide a solid base for achieving and maintaining healthy otter populations in the Illinois River Valley. Fairly new initiatives which focus on landscape-level management and monitoring (e.g., Conservation 2000, RiverWatch program, Integrated Management Plan for the Illinois River System) promise an even brighter future.

INTRODUCTION

River otters (*Lutra canadensis*) were common and distributed widely in Illinois during early European settlement (Cory 1912, Mohr 1943). Habitat loss and unregulated harvests caused their numbers to decline noticeably by the early to mid-1800s (Hoffmeister and Mohr 1957, Thomas 1861:655). They were rare or absent in most of northern and central Illinois by the early 1900s (Wood 1910, Cory 1912, Forbes 1912), and sightings were uncommon in the state by the mid-1900s (Brown and Yeager 1943, Hoffmeister and Mohr 1957).

Thom (1981) and Anderson (1982) documented the presence of a small population along the Mississippi River and its tributaries in northwestern Illinois. Reports from southern Illinois were clustered along the Cache River and consistent enough to suggest the existence of a second population (Anderson 1982). Anderson (1982) estimated that fewer than 100 otters existed in Illinois at this time. Listed as state threatened in 1977, the river otter's status was revised to state endangered in 1989 because of its limited distribution and abundance.

A recovery plan drafted by the Illinois Department of Natural Resources (IDNR) and Illinois Endangered Species Protection Board advocated an overall goal of re-establishing river otters in suitable habitats, monitoring populations and conserving key habitats (Bluett 1995). Tasks specified by the plan included releasing 110 river otters in the Wabash Landscape Management Unit (Fig. 1), 60-70 in the Kaskaskia, and 100-125 in the Illinois (Bluett et al. 1995). We describe the reintroduction phase and status of recovery efforts through Nov 1997.

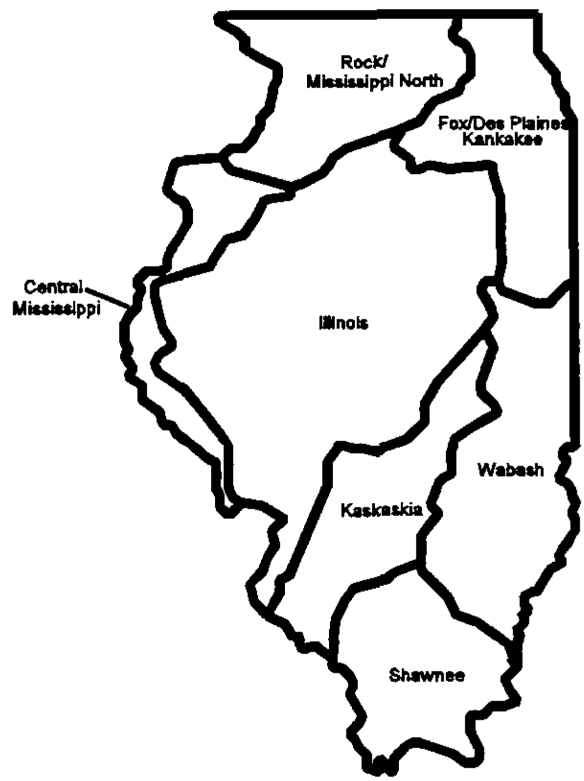


Figure 1. River otter landscape management units in Illinois (from Bluett et al. 1995).

METHODS

Wild otters of the same subspecies as occurs in Illinois (van Zyll de Jong 1972) were purchased from a private supplier in Loiusiana (L.R. Sevin, Theriot, LA) who trained local fur trappers to capture otters in small leghold traps, then restrain, cage and transport them to his facility using techniques that avoided injuries. There the otters were examined by a veterinarian, treated for any injuries, vaccinated for canine and feline distemper, and held in captivity in individual cages for 3-15 weeks.

The supplier combined two to three animals of the same sex in each cage two to three days before they were scheduled for transport. Otters were transported by vehicle from Louisiana to the University of Illinois' Dixon Springs Agricultural Experiment Station during a one to two day trip. Otters were restrained using a device described by McCullough et al. (1986) so that they could be tranquilized, examined, administered an antibiotic, vaccinated, treated for injuries, marked with metal tags and allowed to recover from anesthesia according to a protocol developed by staff from the University of Illinois' College of Veterinary Medicine and approved by the University's Laboratory Animal Care Advisory Committee (Bluett 1995:91). Most otters were released at or near locations specified by the Recovery Plan (Bluett 1995) within 48 hrs after their arrival in Illinois.

IDNR solicited sighting information from the public through posters displayed at IDNR offices beginning in 1994 and report forms printed in IDNR's Digest of Hunting and Trapping Regulations (1994-95 through 1996-97). Other common sources of reports included IDNR staff and researchers from the Cooperative Wildlife Research Laboratory at Southern Illinois University in Carbondale (Schieler 1995, Farrand 1997). Reports from the public were screened by a follow-up phone call or letter to evaluate their legitimacy and collect additional information about exact locations of sightings. Sightings deemed reliable were added to IDNR's Natural Heritage Database.

RESULTS

IDNR released 346 at 15 locations from Jan 1994 through Mar 1997 (Table 1). Twenty-six of these were recovered as of 30 Nov 1997. Known sources of mortality included hoop nets (7), vehicles (7), traps (4) and domestic dogs (1). Six deaths were attributed to stress from transport and handling because the otters were recovered shortly after and in the immediate vicinity of releases without any signs of physical trauma. Cause of death was unknown for one otter, but lack of injuries and water detected in its lungs during necropsy suggested drowning in a hoop net. Losses were greater in the Wabash LMU (15) than the Illinois (8) or Kaskaskia (3), and included more males (17) than females (9).

River otter releases in Illinois, 1994-97.

River basin	Release site	Date	No. otters released
Wabash	Little Wabash River (Newton Lake)	1/94	25 (15 M, 10 F)
Wabash	Little Wabash River (near Golden Gate)	1/94	25 (15 M, 10 F)
Wabash	Embarras River (Fox Ridge SP)	3/95	18 (10 M, 8 F)
Wabash	N. Fork Embarras River (near Casey)	4/95	19 (9 M, 10 F)
Wabash	Skillet Fork (near Helm)	3/95	20 (10 M, 10 F)
Wabash	Vermilion River (Kennekuk Co. Park)	4/96 & 3/97	30 (18 M, 12 F)
Wabash	Combined		137 (77 M, 60 F)
Kaskaskia	Lake Shelbyville	3/95 & 4/95	24 (12 M, 12 F)
Kaskaskia	Carlyle Lake	2/96	25 (15 M, 10 F)
Kaskaskia	Shoal Creek (near Litchfield)	2/96	23 (14 M, 9 F)
Kaskaskia	Combined		72 (41 M, 31 F)
Illinois	Spoon River (near London Mills)	4/96	24 (12 M, 12 F)
Illinois	Mackinaw River (near Hudson)	4/96	28 (13 M, 15 F)
Illinois	LaMoine River (near Brooklyn)	3/97	24 (15 M, 9 F)
Illinois	Illinois River (Sanganois CA)	3/97	26 (14 M, 12 F)
Illinois	Illinois River (De Pue)	3/97	25 (14 M, 11 F)
Illinois	Quiver Creek (near Havana)	3/97	10 (6 M, 4 F)
Illinois	Combined		137 (74 M, 63 F)
Statewide	Combined		346 (192 M, 154 F)

Recovery of kits from Lake Shelbyville (Kaskaskia LMU), the LaMoine River near Macomb (Illinois LMU), and two locations on the upper Illinois River verified breeding and births in release areas. Given the circumstances, kits from Lake Shelbyville (2) and the LaMoine River (6) probably represented one litter each. Kits recovered near Henry, IL (2) and Putnam, IL (1) might have been from a single litter because they were about the same size, found 3 days apart and old enough to have traveled the eight km between locations. Three reports of family groups in the Wabash LMU (North Fork of the Embarras River, Skillet Fork and the Little Wabash River) and one from the Illinois (Sangamon River) provided more evidence of reproduction, as did the capture of an untagged otter on the Little Wabash River in White County.

IDNR's Natural Heritage Database contained 309 reports of sightings that occurred from Jan 1994 through 30 Nov 1997 (Table 2). Three of these occurred before the first release on 22 Jan 1994. Almost half of the sightings (42%) came from Landscape Management Units (LMUs) where releases occurred, including 48 from the Wabash, 36 from the Kaskaskia and 45 from the Illinois. Another 20 reports were received but pending entry because people had not yet responded to letters requesting more information. These included nine from the Illinois LMU, four from the Wabash, two each from the Kaskaskia and Rock/Mississippi North, and one each from the Shawnee, Middle Mississippi and Fox/Des Plaines/Kankakee. More reports (including those pending entry) were received from the Wabash, Kaskaskia and Illinois LMUs during 1996 (53) than in 1995 (35) or 1994 (25). Thirty-one sightings occurred in these areas from 1 Jan through 30 Nov 1997.

DISCUSSION

Numbers of otters released in the Wabash, Kaskaskia and Illinois LMUs exceeded goals established by the Recovery Team. Fifty otters released in the Patoka River System during 1997 by the Indiana Department of Natural Resources aided recovery efforts in the vast Wabash River Basin. Recent (1994-1997) reports from Illinois verify the persistence of otters in LMUs where releases were made and outnumber those from the previous decade by more than tenfold. Reports from other parts of the state substantiate observations by Anderson (1995) that: (1) otters in northwestern Illinois appeared to be increasing and had expanded their range to include portions of the Rock River System, (2) the Cache River population appeared at least stable and had expanded its range to include portions of the Big Muddy River System, and (3) otters had colonized the Middle Mississippi River Tributaries, probably as the result of releases made in Missouri during the 1980s.

Leading sources of mortality were similar to those reported for Missouri (Erickson and McCullough 1987). None of the deaths documented in Indiana were caused by hoop nets (Johnson et al. 1996), but releases occurred in parts of the state where use of these devices was prohibited. Mortality rates cannot be estimated from data available for Illinois. We assume first-year mortality rates were similar to those confirmed by radiotelemetry studies in Missouri (19%; Erickson and McCullough 1987) and Indiana (29%; S. Johnson, pers. comm.) because all three states obtained otters from the same source, used similar methods to process otters and employed similar strategies for releases.

Given the reproductive biology of otters (Liers 1951, Wright 1963), we expected that protocols for capturing and holding them would disrupt normal reproduction for about two years. All except seven females due to give birth the same year as their release had whelped in captivity and likely completed their estrus cycle unbred. In such cases, they wouldn't breed until the spring following their release and bear young about a year later. We attributed litters observed the year after releases (i.e., Skillet Fork and the North Fork of the Embarras) to two-year-old females which had reached sexual maturity, bred before their capture and given birth the next spring. Kits found on the LaMoine and Upper Illinois rivers in 1997 could not have come from otters released in these areas earlier in the year. We suspect that the kits belonged to females which had dispersed there from the Middle Mississippi LMU or from releases on the Spoon and Mackinaw rivers in 1996.

River otters are persisting and reproducing near release sites. Habitat conservation practices already implemented by individuals (e.g., conservation tillage), groups (e.g., private duck hunting clubs, The Nature Conservancy) and state and federal governments provide a solid base for achieving and maintaining healthy otter populations in the Illinois River Valley. Fairly new initiatives which focus on landscape-level management and monitoring (e.g., Conservation 2000, RiverWatch program, Integrated Management Plan for the Illinois River System) promise an even brighter future.

Table 2. Distribution of river otter reports for 21 river otter habitat and population management units and corresponding portions of the Mississippi, Ohio, and Wabash rivers which adjoin Illinois, 1900-1997[a].

	Years of Reports				
Population Management Unit	1900-1950	1951-1982	1983-1993	1994-1997[b]	Total
Galena, Apple, and Plum River Systems	–	44	60	38	142
Rock River System	–	18	28	62	108
Middle Mississippi River Tributaries	–	6	17	25	48
Des Plaines River and Lake Michigan Tributaries	–	2	1	4	7
Fox River System	–	3	1	5	9
Little Vermillion River, Big Bureau and Kickapoo Creek Systems	2	3	2	1	8
Kankakee - Iroquois River System	–	3	–	2	5
Vermilion and Mazon River Systems	1	2	–	1	4
Spoon River System	1	2	1	9	13
La Moine River System	–	–	–	3	3
Mackinaw River System	2	1	2	11	16
Sangamon River System	2	3	–	14	19
Lower Illinois River Tributaries and American Bottoms	6	3	–	6	15
Kaskaskia River System	3	5	2	36	46
Big Muddy River System	8	3	10	14	35
Cache River System	9	8	15	14	46
Massac, Bay, Lusk, Big Grand Pierre and Big Creek Systems	4	5	5	11	25
Saline River System	7	1	1	5	14
Little Wabash River and Bonpas Creek Systems	7	1	3	29	40
Embarras River and Wabash River Tributaries	2	–	2	16	20
Vermilion and Little Vermilion River Systems	–	–	–	3	3
All units combined	54	113	150	309	626

[a] Data for 1900 through 1993 are from Anderson (1995); data from 1997 do not include December.
[b] Three observations occurred from 1 Jan through 21 Jan 1994, one from the Rock River System and two from the Galena, Apple and Plum River Systems.

REFERENCES

Anderson, E.A. 1982. Status and distribution of the river otter (*Lutra canadensis*) in Illinois. M.S. Thesis, Southern Ill. Univ., Carbondale. 77pp.

Anderson, E.A. 1995. Status in the Midwest and Illinois. In Illinois river otter recovery plan, ed. R. Bluett, pp. 23-32. Illinois Dep. Nat. Resour., Springfield.

Bluett, R., ed. 1995. Illinois river otter recovery plan. Illinois Dep. Nat. Resour., Springfield. 96pp.

Bluett, R., G. Kruse, S. Lauzon, E. Anderson, G. Hubert, Jr. and D. Glosser. 1995. Recovery goal, objectives and criteria. In Illinois river otter recovery plan, ed. R. Bluett, pp. 33-52. Illinois Dep. Nat. Resour., Springfield.

Brown, L.G. and L.E. Yeager. 1943. Survey of Illinois fur resource. Ill. Nat. Hist. Surv. Bull. 22:435-504.

Cory, C.B. 1912. The mammals of Illinois and Wisconsin. Field Mus. Nat. Hist. Pub. 153, Zool. Ser. 11:1-505.

Erickson, D.W. and C.R. McCullough. 1987. Fates of translocated river otters in Missouri. Wildl. Soc. Bull. 15:511-517.

Farrand, D.T. 1997. A GIS-based PATREC model to predict the distribution of river otters (*Lutra canadensis*) in southern Illinois. PhD. Thesis, Southern Illinois Univ., Carbondale. 92pp.

Forbes, S.A. 1912. The native animal resources of the state. Trans. Ill. Acad. Sci. 34(2):216-217.

Hoffmeister, D.F. and C.O. Mohr. 1957. Field book of Illinois mammals. Illinois Nat. Hist. Surv., Urbana. 233pp.

Johnson, S.A., K.A. Berkley and J.E. Fisher. 1996. Indiana river otter reintroduction program - 1996. Indiana Div. Fish & Wildl., Bloomington. 9pp.

Liers, E.E. 1951. Notes on the river otter (*Lutra canadensis*). J. Mammal. 32(1):1-9.

McCullough, C.R., L.D. Haggermann and C.H. Caldwell. 1986. A device to restrain river otters in Missouri. Wildl. Soc. Bull. 14(4):177-180.

Mohr, C.O. 1943. Illinois furbearer distribution and income. Ill. Nat. Hist. Surv. Bull. 22(7):505-537.

Schieler, C.T. 1995. Habitat characterization of an otter release area in southcentral Illinois. M.S. Thesis, Southern Illinois Univ., Carbondale. 55pp.

Thom, R. 1981. Endangered and threatened mammals. In Endangered and threatened species of Illinois, Natural Land Institute, pp. 59-69. Illinois Dep. Conserv., Springfield.

Thomas, C. 1861. Mammals of Illinois. Trans. Ill. State Agric. Soc. 4:651-661.

van Zyll de Jong, C.G. 1972. A systematic review of the Nearctic and Neotropical river otters (Genus *Lutra*, Mustelidae, Carnivora). R. Ontario Mus., Life Sci. Contrib. 80. 104pp.

Wood, F.E. 1910. A study of the mammals of Champaign County, Illinois. Ill. State Nat. Hist. Surv. Bull. 8(5):501-613.

Wright, P L. 1963. Variations in reproductive cycles in North American mustelids. In Delayed implantation, ed. A.C. Enders, pp. 77-98. Univ. Chicago Press, Chicago.

THE UPPER MISSISSIPPI RIVER SYSTEM–ENVIRONMENTAL MANAGEMENT PROGRAM (UMRS-EMP) CURRENT STATUS AND FUTURE DIRECTION

Jerry Skalak

U.S. Army Corps of Engineers, Rock Island District
Clock Tower Building, P.O. Box 2204, Rock Island, IL 61204-2004

INTRODUCTION AND PROGRAM OVERVIEW

Good afternoon. During the next few minutes I'll present an overview of the Upper Mississippi River System - Environmental Management Program, highlight some of the habitat rehabilitation and enhancement projects that have been completed under this program, and briefly discuss the pending Report to Congress.

The Environmental Management Program has become the single-most significant effort in realizing an increased understanding of the Upper Mississippi River System ecosystem and in protecting, restoring, and enhancing its ecological values.

The Upper Mississippi River System consists of 13 hundred miles of navigable waterways linking the States of Illinois, Iowa, Missouri, Minnesota, and Wisconsin to the Gulf of Mexico.

This river system supports important waterborne commerce activities, makes available many recreation opportunities, supplies drinking water to more than 20 million people, and provides significant natural resource benefits and values.

For years river interests considered how best to balance the realities of traffic delays caused by the growth of commercial navigation on the system with the increasing public concern that habitat and recreational values not be degraded.

In the Water Resources Development Act of 1986, Congress recognized the Upper Mississippi River System as both a "nationally significant ecosystem and a nationally significant commercial navigation system," and stated that the system "be administered and regulated in recognition of its several purposes."

The legislation authorized construction of a second lock at Locks and Dam 26 at Alton, Illinois, to help alleviate the traffic congestion at that area of the river and established the Upper Mississippi River System - Environmental Management Program, or EMP, for the purpose of monitoring, restoring, and improving the natural resources of the Upper Mississippi River System and for guiding future river management.

The EMP is truly a multi-agency partnership. Partners in this program include the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, the U.S. Geological Survey, and the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. The Upper Mississippi River Basin Association facilitates coordination and cooperation among the program's partners.

Multiple Federal and State agencies participate in the implementation of the UMRS-EMP.

However, Congress placed overall implementation responsibility for the EMP with the Corps of Engineers.

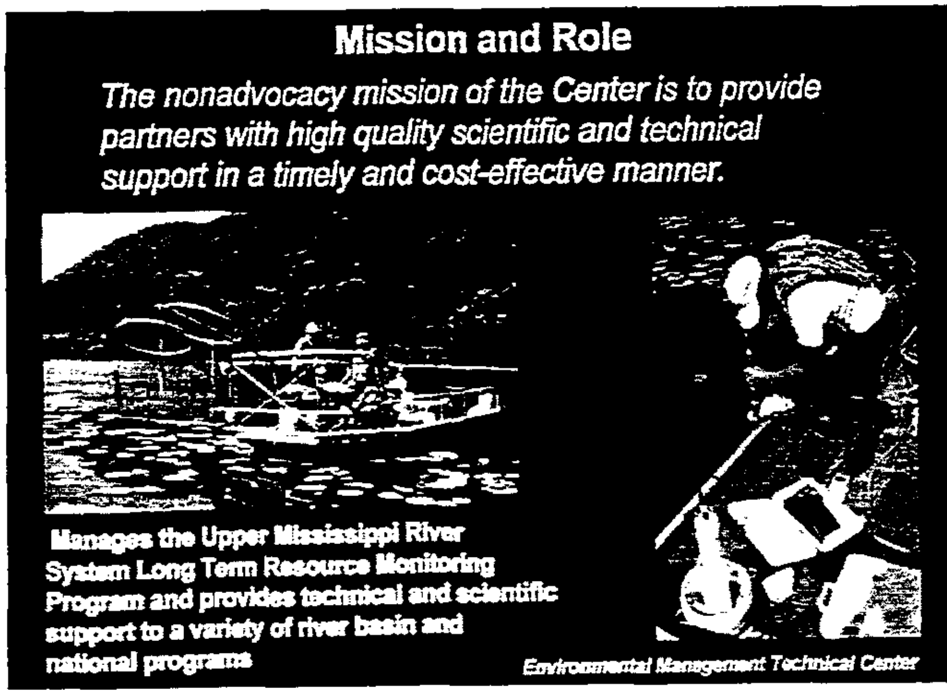
The Water Resources Development Act of 1990 extended the program's authorization an additional five years until the year 2002.

PROGRAM ELEMENTS

The EMP consists of five elements: Habitat Rehabilitation and Enhancement Projects, Long Term Resource Monitoring, Recreation Projects, Economic Impacts of Recreation Study, and Navigation Monitoring. The Habitat Rehabilitation and Enhancement Projects and the Long Term Resource Monitoring Program represent nearly 93% of its authorized annual budget of $19.5 million.

The Habitat Rehabilitation and Enhancement Projects are proposed by the five Upper Mississippi River states, and the U.S. Fish and Wildlife Service. They are designed to provide benefits for fish and wildlife by counteracting the loss of habitat principally due to sedimentation.

The Long Term Resource Monitoring Program is managed and administered by the U.S. Geological Survey's Environmental Management Technical Center (EMTC) located in Onalaska, Wisconsin.



The LTRMP element of the UMRS-EMP is administered by the EMTC.

Six state-operated field stations have been established as part of the Long Term Resource Monitoring Program. They collect data on water quality, sedimentation, fisheries, vegetation, and other river resources. These data are analyzed to support more informed river system management decisions and to describe and predict changes in the ecosystem.

Minimal funds have been expended in the planning of Recreation Projects under the EMP. This program element was intended to provide additional access to the river and increased recreational opportunities.

The Economic Impacts of Recreation program element was completed in 1994. This element consisted of a major study that estimated recreation use and expenditures for selected river-dependent activities.

The fifth program element, Navigation Traffic Monitoring, collected data on navigation traffic and the locking process. This element was funded on an as-needed basis through 1990. This program element's functions are now being accomplished as part of the Upper Mississippi River - Illinois Waterway System Navigation Study.

That completes the overview of the five Environmental Management Program elements. As stated earlier, the Habitat Rehabilitation and Enhancement Projects, or as we call them, HREPs, element comprises nearly two-thirds of the EMP budget.

HABITAT REHABILITATION AND ENHANCEMENT PROJECTS (HREPs)

The information that follows further describes the purpose and accomplishments of the HREPs.

When the lock and dam system was built in the 1930s, a series of relatively wide riverine lakes, or pools, with bordering wetlands was created. An explosive growth in fish and wildlife resources followed.

Nearly 500 species of birds, mammals, amphibians, reptiles, fish, and mussels, including many that are considered to be endangered or threatened species, find food and habitat on the river system. More than 40 percent of North America's migratory waterfowl and shorebirds feed and rest along the Upper Mississippi River System during their migrations.

In a free-flowing river, sedimentation is balanced by the periodic carving of new channels and movement of sediment. However, the navigation pools of a regulated river act as sediment traps. River regulation also reduces the system's natural ability to maintain backwater areas or to create new ones.

To date, 23 Habitat Rehabilitation and Enhancement Projects have been completed. 12 additional projects are under construction and 18 projects are in various stages of design. Completion of these projects will result in thousands of acres of fish and wildlife habitat being rehabilitated or enhanced. Many more projects have been identified as future opportunities.

Types of HREP features constructed in include: islands; sediment control structures; water level management units; and backwater dredging.

ILLINOIS RIVER HREPs

Habitat projects completed or being designed for the Illinois River include:

Peoria Lake, IL

The Peoria Lake Habitat Rehabilitation and Enhancement Project is located on the Illinois Waterway. Peoria Lake has been plagued with sedimentation problems. Since 1903, the average depth of the lake has been reduced from 8.1 feet to 2.6 feet. Much of the fish and wildlife habitat has been lost.

Features designed to address this problem included: constructing a barrier island to promote aquatic vegetation growth by reducing wave action and sediment re-suspension; dredging to construct the island-created deep water fish habitat; designing a forested wetland management unit to provide reliable habitat for migratory waterfowl; and restoring flowing side channel habitat which is rare on the Illinois Waterway.

Lake Chautauqua

Lake Chautauqua is part of the Illinois River National Fish and Wildlife Refuge. It provides valuable moist soil plants and other types of habitat needed by migratory bird populations. The habiat rehabilitation and enhancement project underway at this site will greatly improve USFWS management capabilities. Increased habitat reliability, quality and quantity will all be realized upon completion of this project.

Banner Marsh

Banner Marsh, a State owned and managed conservation area, is a unique complex of formerly strip-mined lands. By restoring the levee that protects this area from Illinois River water level fluctuations, preferred plant communities can be established and maintained and a better fishery developed. *Habitat diversification is an important aspect of this project.* Award of the major construction contract for this site is currently scheduled for 10/98.

Rice Lake

Rice Lake is another State-owned and managed site on the Illinois River. It lies adjacent to the Banner Marsh site. Again the goal of the habitat project at this location is to enhance management capabilities thus increasing the reliability of preferred habitat types. The levee will be improved and additional water level management structures will be added as part of the proposed project. Project contract award is expected in late 1999.

Swan Lake

Swan Lake, located near the confluence of the Illinois and Mississippi Rivers, provides important migratory bird habitat and fisheries benefits. By improving the water level management capabilities at this site and protecting the site from sedimentation this site's many fish and wildlife outputs will increase and continue long into the future.

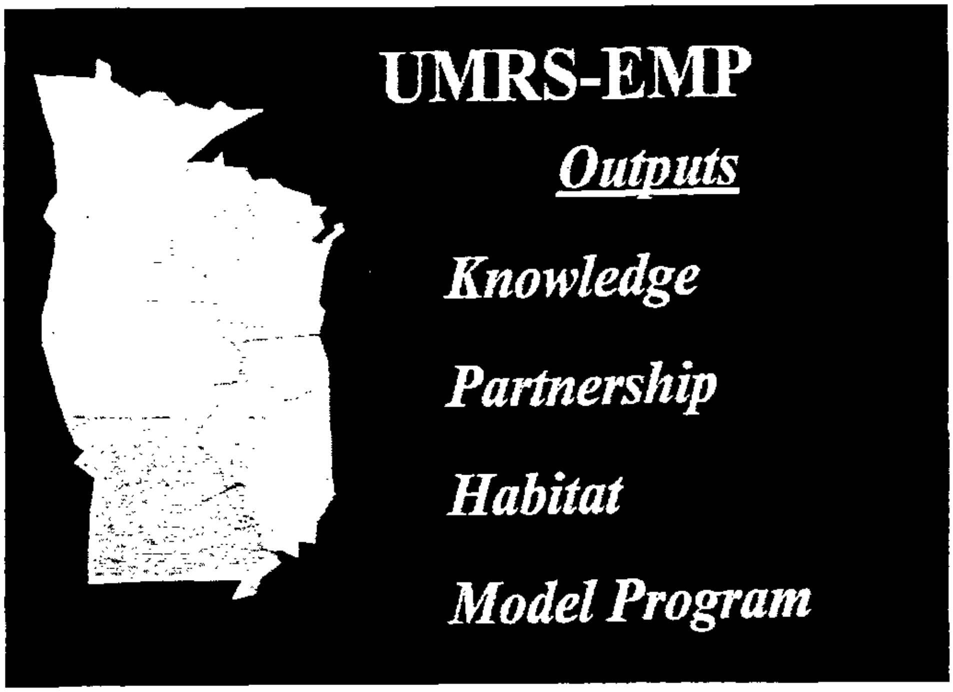
Stump Lake

Stump Lake, also located near the confluence of the Illinois and Mississippi Rivers, provides many fish and wildlife benefits. Like Swan Lake and all of the other HREPs, restoration, protection, and enhancement of this area will provide important habitat for many years to come.

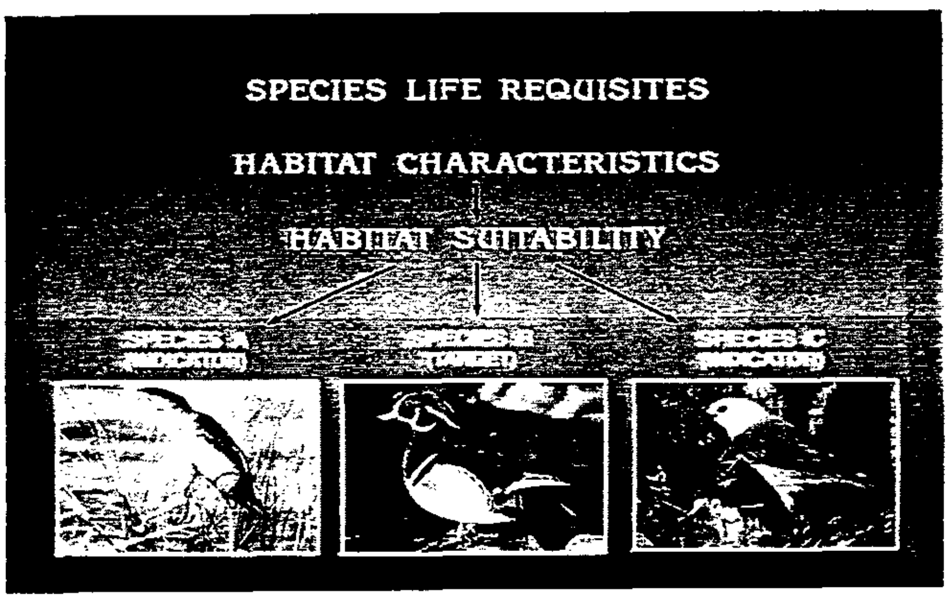
Several potential future habitat projects for the Illinois River have also been identified. These include Emiquon NWR and Upper and Lower Alton Pool side channels restoration.

MODEL PROGRAM

Implementation of the UMRS-EMP is providing many outputs. These outputs are: knowledge (increased understanding of species habitat needs and life requisites, sediment transport and fate mechanisms, restoration techniques, etc.); habitat (physical modifications of the landscape to create, protect, and enhance critical and preferred aquatic, wetland, and terrestrial conditions); and partnership (important coordination and cooperation that leverages resources and assures consideration of the goals and objectives of all river constituencies). The combination of these outputs results in a program that many recognize as a potential model for other similar national efforts.



The UMRS-EMP is providing multiple outputs, both quantitative and qualitative.



UMRS-EMP outputs include an increased understanding of the needs of various species.

Unfortunately EMP is still considered to be a well kept secret. Efforts to highlight, locally, regionally, nationally, and even internationally, the program's successes and its "lessons learned" are underway. Development of the Report to Congress is one such effort. Other efforts will include increased public outreach and involvement activities. Evaluation of completed projects is resulting in each subsequent project being more effective and efficient. Also, as our understanding of the river system's dynamics increases through monitoring and data analysis, project identification, selection, and design processes will continue to improve.

THE FUTURE

To comply with directives in the Water Resources Development Act of 1986, an evaluation of the Environmental Management Program is to be submitted to Congress prior to the end of the existing program. The authorizing legislation for the UMRS-EMP (Water Resources Development Act of 1986, Section 1103(e)(2) as amended) states that:

> "Programs for the planning, construction, and evaluation of measures for fish and wildlife habitat rehabilitation and enhancement; implementation of a long-term resource monitoring program; and implementation of a computerized inventory and analysis system shall be carried out for 15 years. Before the last day of such 15-year period, the Secretary, in consultation with the Secretary of the Interior and the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin shall conduct an evaluation of such programs and submit a report on the results of such evaluation to Congress. Such evaluation shall determine each such program's effectiveness, strengths, and weaknesses and contain recommendations for the modification and continuance or termination of such program."

The Corps of Engineers, Upper Mississippi River Basin Association, U.S. Fish and Wildlife Service, U.S. Geological Survey, State natural resource agencies, and several non-governmental organizations are cooperating in the preparation of a Report to Congress.

The report includes: a brief history of the program; a description of the current condition and status ("health") of the Upper Mississippi River System; an evaluation of the Habitat Rehabilitation and Enhancement Projects and the Long Term Resource Monitoring Program elements; descriptions of alternative program scenarios; multiple conclusions about various aspects of the current program; and recommendations to the Corps of Engineers and the Congress for future consideration and possible implementation. It also presents public perspectives based upon input from other agencies, private organizations, and the general public.

The report proposes the following recommendations to Congress:

> That Congress further amend Section 1103 of the Water Resources Development Act (WRDA) of 1986, as previously amended, to provide for the continuing authorization of a program for the implementation and evaluation of measures for fish and wildlife habitat restoration, protection, enhancement, and for resource monitoring and research.
>
> That the annual amount authorized to be appropriated for the program for the implementation and evaluation of Habitat Rehabilitation and Enhancement Projects (HREPs) be increased to $22,750,000.
>
> That current program authorization language specifying separate LTRM and CIA program elements be rewritten to identify a single long term resource monitoring, data analysis, and applied research element, herein referred to as the LTRMP.

That the annual amount authorized to be appropriated for the Long Term Resource Monitoring Program (LTRMP) be increased to $10,420,0003.

That the Secretary of the Army, in consultation with the Secretary of the Interior and the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, be required to submit a report to Congress every six years describing the accomplishments of the programs; providing updates of a systemic habitat needs assessment; and identifying any needed adjustments (e.g., funding level, program scope, etc.) in the authorization. Submittal of this report is to be timed so as to allow consideration as part of a comprehensive Water Resources Development Act.

That cost sharing for EMP projects be continued as prescribed by Section 906(e) of the Water Resources Development Act of 1986, under which implementation costs of projects "on lands managed as national wildlife refuge" are 100% Federal, and implementation costs of all other projects are shared 75% Federal/25% non-Federal, providing:

> (a) That up to 80% of the 25% non-Federal cost share of a habitat Rehabilitation and Enhancement Project may be in the form of in-kind services, including a facility, supply, or service or lands (LERRDS credits) that is necessary to carry out the project. This would be similar to other habitat restoration programs such as Section 1135 of the Water Resources Act of 1986, Project Modifications for the Improvement of the Environment, as amended by Section 204(d) of the Water Resources Act of 1996.
>
> (b) That, subject to appropriations, non-Federal interests may execute and be reimbursed for the Federal share, without interest, of studies, design documents, and implementation costs of approved Habitat Rehabilitation and Enhancement Projects.

After the Corps' final review, this report will be submitted to members of Congress for their use in making decisions affecting the Upper Mississippi River System.

CLOSING REMARK

We must continue our efforts to maintain the balance among the Upper Mississippi River System's many uses. With proper planning and partnership, we can meet Congress' commitment to keeping the system both a nationally significant ecosystem and a nationally significant commercial navigation system.

HISTORY OF COMMERCIAL FISHING ON THE ILLINOIS RIVER

R. A. Williamson

Illinois Department of Natural Resources, Fisheries Division
600 North Grand Avenue West, Springfield, IL 62701

ABSTRACT

Historically the Illinois River was the largest freshwater commercial fishery in North America. Early in the twentieth century, commercial fishermen on this river harvested nearly 25 million pounds of fish annually. This harvest was valued at more than one million dollars. About ten percent of the total freshwater fish harvest in the United States was taken from the Illinois River. Commercial fish harvest declined steadily from around 1910 until 1979. Declines were due to many factors including pollution, declining fish populations and market competition with saltwater fishes. Since 1980 commercial harvests have increased as water quality and fish populations have improved. In recent years, the annual commercial harvest has averaged around one million pounds with a value of more than one quarter of a million dollars.

INTRODUCTION

The Illinois River valley is a major geographic feature of Illinois. The watershed includes 44% of the state land area and 95% of Illinois urban area. Native Americans depended upon the rich fish and wildlife resources of the river and its bottom lands. Nearly every area of high ground in the river floodplain contains evidence of human habitation and the remains of fish and wildlife that sustained these native Americans.

European explorers recognized the tremendous richness of the Illinois River valley. Father Jacques Marquette wrote in 1673: "We have seen nothing like the river....as regards to its fertility of soil, its prairies and woods; its cattle, elk, deer, wild cats, bustards, swans, ducks, parroquets, and even beaver. There are many small lakes and rivers." In 1682 French explorer Henri de Tonty wrote in his log that one Illinois River catfish served as supper for 22 men.

Commercial fishing on the river began with European settlement and demand for food in eastern and Midwestern cities. Commercial fishing became lucrative in the mid nineteenth century when railroads began carrying fish to urban markets. Fish were shipped by rail salted in wooden barrels, packed in boxes of ice and later in refrigerated cars. Wooden boxes were packed with 250 pounds of fish and 100 pounds of ice. River people were employed in saw mills to cut local timber and build the shipping boxes. They also worked during the winter cutting blocks of ice from local ponds and rivers for use in shipping the fish. Ice was stored in large ice houses and packed in sawdust to keep it until summer. Many families lived in houseboats. Their total sustenance came from the river and adjacent bottom lands. They ate fish and game. Commercial fishing was their main source of income but they also trapped fur, cut ice, and cut timber. River people lived on whatever the river could provide.

Fish and game were served in the finest urban restaurants. Urban markets were major outlets for Illinois river fishes although all river towns also had local markets to serve the growing population along the river. Commercial fishing was a major industry on the Illinois River by the late nineteenth century. In 1894 the U. S. Fish Commission reported that "Fisheries of this state are more important than any other interior state." The state of Illinois harvest was more than 11.5 million pounds that year with more than one half the harvest consisting of fish from the sucker family. The abundant sucker resource earned Illinois the nickname "sucker state". The Illinois River yielded between 10 and 24 million pounds of fish annually during the late 1800's and early 1900's. This was approximately 10% of the freshwater fish harvest for the entire United States.

HISTORIC HARVEST BEFORE 1950

From 1899 to 1908 1,700 to 2,500 men and boys worked as commercial fishermen each year. The reach of the river from Meredosia to Peoria produced the majority of the catch. Havana markets shipped more fish than any town on the river, averaging more than 100 train car loads of fish per year. The commercial markets provided about one half the total income for the town of Havana and employed 250 to 350 people. The estimated income in 1907 was $100,000. In 1997 dollars this would equal nearly 1.7 million dollars.

The fish harvest peaked in 1908 with 24 million pounds harvested. The value was more than one million dollars. In 1997 dollars the value would be nearly seventeen million dollars. The Havana markets alone shipped 3.8 million pounds of fish that year. From 1908 to 1921 harvests declined from 24 million pounds down to four million pounds. In a 1915 report, John Alvord attributed the decline to reclamation of lakes and overflowed land by drainage and levee districts.

After the 1908 record catch the commercial harvest declined until 1921 when the catch was only four million pounds. A flood occurred in 1922 and the harvest jumped to 10.6 million pounds. From 1922 to 1950 the harvest slowly declined to 5.6 million pounds.

HUMAN IMPACTS ON THE FISH HABITAT

The Illinois River originally flowed in a constantly changing but natural state. Fish, wildlife, plant communities and man lived in harmony with the natural flows of the river. Beginning in the late nineteenth century, man's activities had a major impact on the river and the commercial fisheries. The first change was the introduction of the European carp. Immigrants entering the new land were accustomed to having carp as a food item in Europe. They demanded that the federal government import the carp for stocking into ponds for culture and into all waters to establish wild populations. From 1879 to 1894 carp were introduced into every major lake and river in Illinois with the assistance of the U S Fish Commission and the Illinois Fish Commission. This dramatically altered the composition of the fishery. In 1894 the commercial harvest was 55% buffalo and 10% carp. By 1897 carp was nearly 60% of the catch. In 1908 the harvest was 65% carp and only 7% buffalo. By 1930 carp was 90% of the catch.

A major change in the river occurred with the opening of the Chicago Sanitary and

Ship Canal. The Chicago River originally drained into Lake Michigan. As the river became more polluted, the city decided to reverse the flow away from the lake and drinking water supplies and diverted the polluted waters south and west into the Illinois River. The first attempt was through a pumping system into the Illinois and Michigan Canal and ultimately into the Illinois River. This system was operational by 1867. Water quality improved in the Chicago River at first but eventually the system was unable to handle waste water from the growing city. Epidemics were common with as many as 90,000 Chicagoans dieing in the worst one in 1895. Health conditions in the city improved with the opening of the Sanitary and Ship Canal in 1900. Unfortunately the new canal opened the door to degradation of the river. The traditional values of the river would never again be the same. Commercial fishing, musseling and ice cutting were to decline because of the polluted water. Major fish kills also occurred in the upper reach of the river because of the wastewater originating in Chicago. Black bass was the most important commercial fish until 1898. After 1899 the bass harvest declined. Besides the entire wastewater discharge from Chicago, up to 10,000 cubic feet per second of Lake Michigan water was diverted down the canal to aid navigation and flush the wastewater downstream.

Flows increased dramatically and water levels raised by 1.5 to 4.0 feet all along the river. This action nearly doubled the surface acreage of backwater areas. This expanded backwater acreage improved fish spawning and feeding habitats. Fish harvest increased until 1908. As the human population grew and industry developed, more pollutants were dumped into the river. So much sewage, slaughter house offal, and industrial waste were dumped into the river that the channel had to be dredged. Waste was carried in scows to be dumped off the main channel to allow the river to flow and boats to pass. Demand for fish from the river declined as pollutants caused an "off flavor". After World War I ponds were built near the river to hold fish and eliminate the "gassy" flavor of fish caused by the decomposition of sewage and sludge in the river. By 1950 fish above Ottawa were considered unfit for human consumption.

The next major change was the development of drainage districts that levied and pumped wetlands and backwater lakes to protect homes and businesses and to convert land to agriculture. From 1900 to 1926 levees and drainage districts had removed more than 200,000 acres from the floodplain and had destroyed 40 to 50% of the backwater lakes and wetlands that represented the state's richest fish spawning areas.

As development continued, flooding problems increased. In 1930 the U. S. Supreme Court issued a decree that reduced the water diverted from Lake Michigan over a 10-year period from 10,000 cubic feet per second down to 1,500 cubic feet per second by 1939. During the same period, the 9-foot navigation channel was created with a series of seven locks and dams. The dams stabilized the low water flows. However, the clean water from Lake Michigan no longer helped to dilute the polluted water from Chicago and water quality declined. As human populations increased and industry grew, the pollution increased. The upper reach of the river became devoid of fish life. Although the reduced Lake Michigan diversion undoubtedly helped reduce high flows, flooding and abnormally high flows have continued to this day. This is a result of high peak runoff from increased urban development, drainage of wetlands, tiling, stream channelization, and modern agricultural practices.

HARVEST SINCE 1950

The statewide harvest of fish has remained relatively stable for the past 45 years. However, the Illinois River harvest has declined substantially during this period. The Mississippi River is the other major commercial harvest area in Illinois. From 1950 to 1996 the average annual harvest increased from around two million pounds to about four million pounds. During the same time, the Illinois river declined dramatically from four million to one million pounds. The percentage of the statewide harvest taken from the Illinois river dropped from 70% to about 15%. Although the total statewide harvest declined slightly, the Mississippi River harvest appears to have increased to compensate for the reduced harvest in the Illinois river. Most of the state's harvest now occurs on the Mississippi River.

The number of full and part time commercial fishermen has declined on both rivers during the past 45 years. Mississippi River fishermen declined from 248 in 1950 to 221 in 1996. The number on the Illinois River declined dramatically from 275 in 1951 to 79 in 1996. At the lowest point in 1980 only 26 active fishermen were fishing the Illinois River.

There are several possible reasons why market demand for fresh water fish in general has not grown with the demand for other food products as the population in North America has expanded. Carp were a major component of the fresh water harvest after their introduction and establishment. They were served at high class restaurants when they first became available. Carp adapted so well that they were an abundant and cheap source of food to poor immigrants. Carp fell out of favor with the upper class when they became so available to the masses and became known as "a poor man's fish". In addition, the carp were able to survive the increased levels of pollutants which were found in the Illinois and other major rivers. Many native fishes could not tolerate the pollutants and declined or disappeared entirely. Although competition with the carp may have been a factor, the major cause of the loss of native fishes was habitat destruction and decreased water quality. Ironically the carp that was hardy enough to survive was blamed for the loss of game fishes. To this day it remains unpopular with diners and anglers in Illinois.

Seafood markets could expand inland just as inland markets expanded with rail transportation. Modern transportation and processing make fresh and frozen seafood readily available. Marine fisheries are far larger than inland fisheries allowing large harvests and economical processing facilities. Due to the small volume of fresh water fisheries, processing has not been mechanized or modernized. Fish are still processed by hand in small markets. Freezing, packaging, and other modern methods common in the marine industry are generally not feasible for small local markets. They are unable to compete for large markets with modern packaging and are essentially limited to marketing fresh products.

Animal husbandry and production of poultry, pork, and beef have also made major advances during this century. These industries effectively compete with fish markets by producing large amounts of meat at low costs.

Aquaculture of fresh water fishes has expanded particularly in the southern states, providing a low cost, high quality, dependable supply of catfish and other fresh water fishes. The aquaculture industry can guarantee portion sizes, quality, and supply which commercial fishermen cannot guarantee. Winter weather, floods, water conditions and other factors are all variable and affect the supply, size and quality of the commercial catch.

Fisheries managers have responded to sport fishing interests and attempt to manage fish populations for the more popular sport fishes. Management information often refers to commercial species as "trash" or "rough" fish further eroding the public attitude about these fishes.

CONCLUSION

The river has been modified beyond recognition from what it was when Marquette first described it. A return to pristine conditions is unlikely as long as civilized man inhabits the valley. Although the river will never be the same as it was, it can provide the economic benefits wanted by the people of Illinois including a viable commercial fishery. In spite of the lack of growth in the Illinois River commercial fish harvest, the industry has managed to survive. Less people work in the industry, but the market is currently stable. The potential for growth does exist based on the fish populations. The Illinois River contains approximately 60,000 acres of water surface. Assuming an average annual harvest of 80 to 100 pounds per acre, the potential harvest is four to five times the current average of 1.2 million pounds. In recent years, fish species diversity has been increasing. Water quality has improved with elimination of point source pollutants. The record harvests reported in the early part of the century prior to the formation of levee districts will never be reached again unless water acreage is increased, but the current acreage could support an expanded harvest. That harvest may occur if profitable markets are available.

REFERENCES

Alvord, J. W. and Burdick, C.B. 1915. Second Edition of Report made to former Rivers and Lakes. Commission on the Illinois River and Its Bottomland Lakes. 135p.

Cooper, E.L. editor 1987 Carp in North America.84p Maryland: American Fisheries Society.

Smith, H. M. 1898 U.S. *Commission of* Fish *and* Fisheries Report.

Starrett W.C. and Parr S.A. 1951 Commercial Fisheries of The Illinois River. Natural History Survey Biological Notes # 25.

Talkington, L.M. 1991 The Illinois River: Working for Our State. 51p Illinois State Water Survey Publication 128.

Taylor, H.T. 1924 Fishery industries of United States for 1922. Appendix J to Report of U. S. Commission of Fish for 1923. 113p.

Thompson, J. 1988 *From Carp to Corn, An Historical Geography of Land Drainage in the* Lower Illinois Valley 1890-1930. 454pp.

Williamson, R.A. 1997 1996 Commercial Catch Report Exclusive of Lake Michigan. Illinois Department of Natural Resources 12p.

MUSSEL RESOURCES OF THE ILLINOIS RIVER SYSTEM - VALUE TO ILLINOIS' ECONOMY AND NATURAL HERITAGE

K. Douglas Blodgett[1], Richard E. Sparks[1], Scott D. Whitney[1], and Robert Williamson[2]

[1]Illinois Natural History Survey and [2]Illinois Department of Natural Resources
Long Term Resource Monitoring Program Field Station
704 North Schrader Avenue, Havana, IL 62644

INTRODUCTION

Through the ages, freshwater mussels have been utilized by a variety of peoples for a variety of purposes, most often for the raw materials they have provided. More recently we are beginning to appreciate these organisms for the services they provide in aquatic ecosystems. And increasingly we are using mussels as a source of valuable knowledge that will have direct application to maintaining and even improving our quality of life in the future. This paper reviews the history of our exploitation of native freshwater mussels, especially of the Illinois River, and then briefly discusses some of these newer values of our mussel resources.

EARLY USES OF MUSSELS

The fact that mussels were an important resource for native Americans in the Illinois River Valley can be gleaned from numerous archaeological digs throughout the valley. In addition to their worth as an important food source, native Americans used mussel shells for a variety of utensils, such as spoons, and as tools, especially hoes and scrapers. They were made into decorative ornaments such as pendants and were fashioned into fish lures or decoys.

As do their marine relatives, freshwater mussels sometimes produce pearls, and pearls have been treasured for several thousands of years. Early settlers and later loggers and trappers, also collected mussels for food, and while pearls are relatively rare, they were sometimes discovered. In the Midwest in the mid-1800s, single pearl finds often precipitated "pearl rushes" during which eager fortune seekers ravaged entire mussel beds, collecting every mussel they could get their hands (or feet) on, cutting them open and inspecting them for pearls, and then discarding the dying animals. Claassen (1994) reports that in the early 1900s, single pearls from the Wabash River sometimes sold for up to $4000 each (about $67 thousand in 1996 dollars) and that during a five-year period the Wabash River yielded more than $1 million worth of pearl; that was more profit than had been realized from the exploitation of other natural resources of the region such as zinc, gold, silver, gas, oil, and copper, and all public utility companies during the previous 10 years.

THE PEARL BUTTON INDUSTRY

According to Coker (1919), in 1872 a William Slater of Peoria, IL shipped some freshwater mussel shells to Europe; those shells were reportedly collected from the Illinois

River at Peoria. Apparently a box of those shells eventually ended up on the workbench in a button maker's shop in Germany. The shop's owner, John F. Boepple, found the strange shells known to him only as from a river "somewhere about 200 miles southwest of Chicago" were a raw material from which he could produce good quality, durable buttons. In March of 1887, Boepple immigrated to America and while staying with his sister in Petersburg, IL, he heard of a good supply of shells in the Rock Island area. He finally found just the right kind of shells in the Mississippi River near Muscatine, IA. In January of 1891, Boepple formed a partnership which has been labeled as the beginning of the freshwater pearl button industry (Claassen 1994). In 1894, 196,000 pounds of shells were harvested from the Mississippi River near Muscatine and at an average value of almost $0.015 per pound, the harvest was reportedly worth $2,700 (Bartenhagen 1976 in Claassen 1994); converted to 1996 dollars, that is equivalent to $0.23 per pound and a total worth of $45,000.

Initially, mussels usually were collected without specialized tools; harvesters entered the water and collected shells by hand (called hand picking) or with their feet (called toe-digging). These methods, collectively referred to as pollywogging, limited harvest to those areas where the water was shallow enough for collectors to swim to the bottom and probably protected deep-water beds from overharvest. Around 1897, the crowfoot or brail hook was developed. The hooks were attached to pipes or boards and dragged from boats across mussels beds. Some of these wire hooks slipped into the openings between the shells of mussels. The mussels closed, clamping down on the hook and being dislodged from the substrate, they then could be lifted to the surface. The brail bars, as they were called, allowed shellers (those collecting mussels) to harvest beds in deeper water. Coker (1919) reported that about 70% of the shells collected between 1912 and 1914 were taken by brail. Other tools used to harvest shells included forks, clam tongs, and dredges.

The shell button industry flourished. On a good bed, a sheller could earn $30 per week (about $500 in 1996 dollars) in 1898, and overall earnings averaged $10 per week (Claassen 1994). Coker (1919) reported 13 button factories along the Mississippi by 1897, and the number had grown to 49 in 1898. There were 16 or 17 button factories in Muscatine alone in 1899 (Claassen 1994). According to Scarpino (1985) an estimated 9,746 shellers worked the Mississippi River between 1912 and 1914.

While Danglade (1914) indicated there was some shelling done on the Illinois River in 1872 and 1892, it was in 1907 that shellers from the over-harvested Wabash River first focused considerable attention on the Illinois. Shelling that year was on the lower one-third of the river between Bath and Pearl. According to Coker (1919), in 1908 shell sales from the Illinois River amounted to $139,000 ($2.3 million in 1996 dollars) and accounted for 20% of all proceeds from musseling in the Mississippi Basin. The top price for shells was about $0.008 per pound ($20 per ton), so it is likely over 14 million pounds were sold.

Shelling peaked on the Illinois in 1909 when according to Danglade (1914) about 2,600 boats were shelling between Peru and Grafton; that was an average of more than 10 boats per mile. By 1912, Danglade had labeled the Illinois as the most productive mussel stream, per mile, in the North America. However, by that time the Illinois was already showing signs of overharvest, and only about 400 boats were working the river. Coker (1919) reported that in 1913, 11.8 million pounds of shells were sold from the Illinois River at a price of $88,797 ($1.4 million in 1996 dollars) and associated pearls sold for almost $40,000 ($633,246 in 1996 dollars).

Over the next several years the effects of overharvest coupled with negative impacts of pollution and habitat alterations (e.g., from dams) reduced the mussel populations in the Illinois River. While harvest fluctuated from year to year, by 1940 it had dropped below five million pounds annually (Figure 1). The use of plastics further reduced the market and harvest. However, about this time a new market for Midwestern mussel shells was developing.

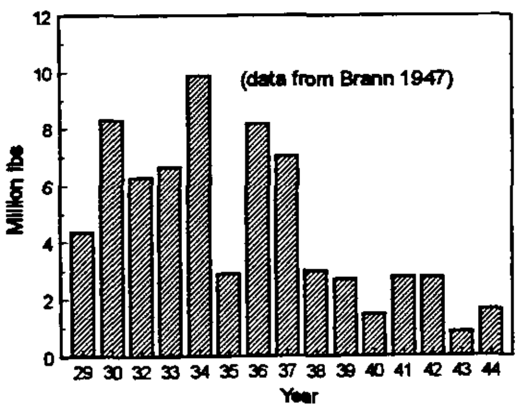


Figure 1. Mussel harvest from Illinois, 1929-1944.

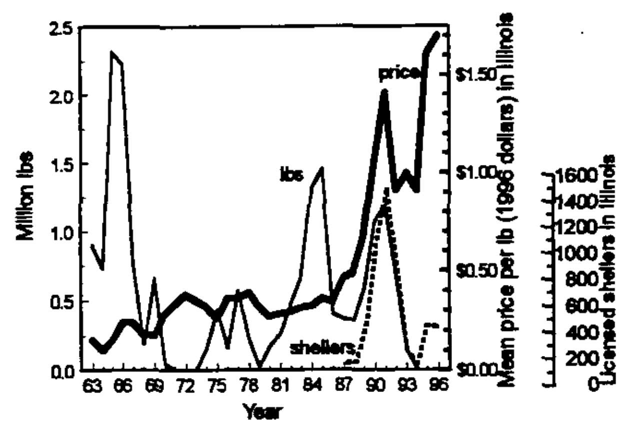


Figure 2. Mussel harvest from the Illinois River, 1963-1996.

CULTURED PEARL INDUSTRY

Japanese had been experimenting with pearl culture since the late 1800s. They had found freshwater mussel shells were an excellent raw material from which to produce cultured pearls. Significant shell export to Japan began in the late 1940s and early 1950s. In Japan the shells are sliced, the slices cut into cubes, and then the cubes are machined into spheres or nuclei. These nuclei are surgically implanted in marine oysters. The implanted oysters are maintained in bays, and during this culturing process, they lay down a layer of pearl over the outside of the shell nucleus. The longer the period of time over which the nucleus remains in the oyster, the thicker the layer of pearl over the mussel shell nucleus becomes. Originally, pearls were cultured for several years, but now they are more often cultured only several months; most cultured pearls produced today are more than 95% Midwestern mussel shell with only a thin layer of true pearl over the outside.

Today, the cultured pearl industry is big business. From 1990 through 1995, a total of nearly 100 million pounds of shells was exported to Japan from the United States (personal communication, Baker 1995 in Fassler 1997); the 19.8 million pounds exported in 1991 was reportedly worth $40 million (personal communication, Baker 1993). In the United States, retail sale of cultured pearl jewelry is estimated to be worth about $700-800 million per year and worldwide amounts to $3 billion annually (personal communication, Peggy Baker, president, Tennessee Shell Company, November 1993). Mussel harvest fluctuates dramatically and is dependant on many factors including price, shell availability, and river conditions; for example, fewer shells are usually collected during flood years. From the Illinois River, from 1963 through 1993, the reported harvest was 18.7 million pounds (9350 tons) or an annual average of almost 700 thousand pounds (Figure 2). In 1996 dollars, shellers have received a total of almost $8.5 million since 1963, an average of $300 thousand per year, for Illinois River shells.

Up through the early 1990s, the mean price per pound paid to shellers fluctuated less dramatically than harvest and had increased somewhat faster than the cost of living (Figure 2). While license data prior to 1987 are not available, from 1988 through 1993 there was a positive relationship between average price per pound and both numbers of shellers (which may be used as an indication of effort) and harvest (Figure 2). When the mean price per pound paid to shellers more than doubled from 1987 through 1991, the number of shellers increased almost ten fold, from 173 shellers in 1987 to about 1500 in 1991. Harvest from the Illinois River increased over 200% from 369 thousand pounds in 1987 to 1.19 million pounds in 1991. In 1992, the mean price per pound dropped by one third; so did the number of licensed shellers and harvest dropped over 40%. Although prices stabilized in 1993, the number of shellers and the harvest continued to drop, probably due in part to the 1993 flood which made harvesting difficult. That same year, a dense infestation of zebra mussels in the Illinois River threatened native mussel populations, and the Illinois was closed to harvest in 1994. With the Illinois River closed, only the Mississippi River remained open for harvest in Illinois beginning in 1994. Average price rebounded to $1.56 per pound in 1995 and $1.70 per pound in 1996. However, neither the number of shellers nor the harvest in Illinois has rebounded to the levels of a few years ago, and preliminary information indicates even lower numbers for the 1997 season.

CURRENT STATUS OF MUSSELS

Today, our North American mussels are one of the most endangered groups of organisms in the world. According to Williams et al. (1994) of the 297 taxa or kinds of native freshwater mussels described from North America, one-third are endangered, more than 14.5% are threatened, and 24% are of special concern. That means we know that at least 71% are either gone or in trouble. When you eliminate the ones we are not sure about, that leaves only 24% of our native mussel fauna that is considered stable.

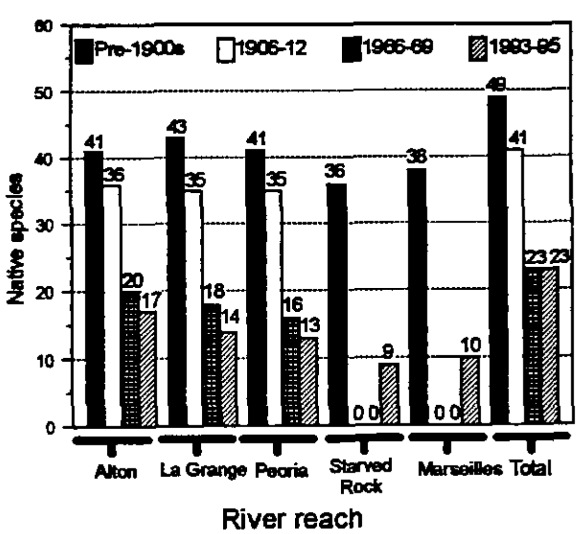


Figure 3. Mussel diversity in the Illinois River over time.

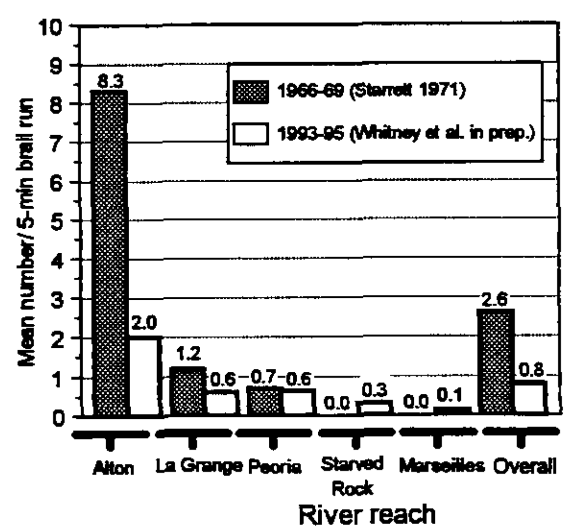


Figure 4. Mean catch rates for brail collections from the Illinois River, 1966-69 and 1993-95.

If we focus on the Illinois River, around the turn of the century several mussel surveys give us a reasonable idea of the mussel diversity (the kinds of mussels) once present in the Illinois River (i.e., Calkins 1874, Kelley 1899, Baker 1906, Forbes and Richardson 1913, Danglade 1914, and Richardson 1928). However, because their sampling methods were not quantitative, we do not have data on historical densities. Based on their reports and more recent analysis of museum records by Kevin Cummings of the Illinois Natural History Survey, we now believe there were 49 species of native freshwater mussels in the Illinois River at the turn of the century (Figure 3).

In his work on the Illinois River during the 1960s, Starrett (1971) found only 23 species (Figure 3). During our recent survey of the Illinois River from 1993 through 1995 (Whitney et al. in preparation), we also collected 23 species, but found diversity on the lower river has continued to decline. We were pleased to find mussels on two upper reaches of the river where Starrett collected none during the 1960s. However, during our recent survey, we used diving which is a more effective sampling technique than those employed by previous researchers. It is likely that had we employed only the less efficient collection methods used by previous researchers, our diversity would have been less. It is also noteworthy that four of the species we collected during our recent survey were represented by single specimens, and one other by only two individuals.

During our recent survey of the Illinois River, we also made collections with a brail bar, similar to what Starrett used in the 1960s, and we compared our catch-per-unit-effort (mussels collected per five-minute brail run) with Starrett's. Overall, our catch rate was about one-fifth that reported by Starrett 30 years ago, so it appears mussel densities have declined drastically (Figure 4).

ZEBRA MUSSELS

Recently, in addition to habitat alteration, pollution, and overharvest, native mussels are facing a new threat--the invading zebra mussel. The first zebra mussel reported in the Mississippi River drainage was collected from the Illinois River in June 1991 near Bath, approximately 60 miles downriver from Peoria. It was collected by a sheller and was attached to a native mussel. We deployed zebra mussel samplers at five sites along the lower 210 miles of the Illinois soon after the first find in 1991. When we retrieved those samplers in November 1991, the only one with zebra mussels was from our upriver site at Hennepin, and that sampler had only three zebra mussels on it (equal to less than 15 per square meter). Zebra mussel numbers on the Illinois increased dramatically in 1992; we collected them at all sites we monitored, and we documented densities as high as 650 per square meter at one site. In 1993, during the flood, the Illinois River experienced a zebra mussel population explosion which resulted in densities as high as 60,000 per square meter on the lower river. By the fall of 1993, we saw significant mortality of both zebra and native mussels, and native mussel mortality increased through 1994 and 1995. Since then, it appears zebra mussel numbers have not rebounded on the lower two-thirds of the river, but we believe the potential for additional dense infestations on the river is still high.

Zebra mussels produce microscopic larvae which drift in the water column. Since 1994, we have monitored zebra mussel larvae in the Illinois River mainstem at one site near Havana. In both 1994 and 1995, we documented densities well over 100 per liter, and when we multiplied those densities by the discharge of the river, at times we estimated more than 60 million larvae were passing our sample site each second; we estimate about 200 trillion larvae passed Havana in both 1994 and 1995 (Stoeckel et al., 1997). We were pleased to see larvae numbers down during 1996, but they have rebounded somewhat in 1997. If environmental conditions are right, we could see adult zebra mussel densities similar to those we saw of 1993.

SERVICES MUSSELS PROVIDE

Ecosystem Services

Native mussels play several critical roles in aquatic ecosystems. For example, in rivers and streams, mussels can provide important stable substrates in a shifting, unstable environment. Aquatic insect eggs and larvae, and fish eggs attached to mussel shells are protected from being scoured away or from being buried by sand and silt, because mussels move up and down in the substrate to maintain their position at the substrate-water interface. Mussel beds also create structure and habitat diversity used by many fishes as nursery and feeding areas.

Mussels are filter feeders. They function as small water treatment plants by removing particulate organic matter (and its associated oxygen demand) from the water column. Basically they clean the water. These filter feeders then convert that organic matter into biomass (their flesh) which can be an important food source for some fish and wildlife (e.g., freshwater drum, catfish, muskrats, and raccoons).

Knowledge

Mussels provide knowledge, knowledge that can be used to maintain or even increase the quality of our aquatic ecosystems and even our lives. Understanding the ecological roles organisms play in ecosystems helps us discern the ways these complex systems function, how much stress they can take before they break, and how they sometimes repair themselves. Then this knowledge can be used to help us with risk assessments and predicting the ecological consequences of perturbations, both intentional and accidental, as well as rehabilitation efforts on the system. As an example, a better understanding of the filter-feeding roles of mussels (and other filter feeders) may assist us in determining the capacity of the Illinois River to assimilate organic matter from municipal wastes--how much could we improve water quality in the Illinois River by enhancing native mussel populations?

Mussels have been used in basic physiological research. They use tiny hairlike projections called cilia that beat like little paddles to create water currents to transport oxygen and food into their shells. These cilia also trap and transport food particles to the mussels' mouths. We too have cilia, among other places in our lungs, and one function of these cilia is to aid us in removing foreign particles from our lungs. Nervous control of these cilia is localized in humans just as it is in mussels, and some of the research to understand neural control of cilia in human lungs was carried out at the Southern Illinois University-Carbondale School of Medicine using native mussels collected from the Illinois River.

Biomedical research has also used mussels. Some degenerative diseases, such as Parkinson's disease, are due to problems with substances called neurotransmitters. Again at

SIU, basic research on the roles of neurotransmitters has been carried out using native mussels and their relatives the fingernail clams. Because filter feeding mussels are exposed to a host of disease-causing bacteria and viruses, they have developed impressive immune systems. Future studies of mussel immune systems could provide insights into the systems of other organisms including humans.

Often, structural designs used by living organisms in nature can be copied to provide new materials with improved properties--biomimetics. A mussel shell is composed primarily of calcium carbonate, but a complex layering of the calcium carbonate with organic substances produces a structure far stronger than that of calcium carbonate alone. A knowledge of the shell structure is being used in attempts to create similar structure in some ceramic materials in anticipation that the resulting complex will be stronger than conventional ceramics alone.

CONCLUSION

We reemphasize that while native mussels have been valuable to us in the past and they are currently, it is likely their future worth will be even greater. While we have provided only a few examples, we believe the point is made that mussels and other obscure organisms that many may think of as relatively worthless, may hold the answers to questions in fields as diverse as medicine, agriculture, and manufacturing–some which have not yet been asked. Unfortunately, negative human impacts from factors such as habitat alterations and destruction, and pollution, combined with what appears to be over exploitation, have reduced our native mussel populations over time. And zebra mussels and navigation expansion are additional and significant threats to their future. As a result, the benefits we will derive from this natural resource, both currently and in the future, may be only a fraction of what might be realized if we were able to better protect and even enhance our native mussel communities. To do this, we need to be aware that management decisions based on cost-benefit analyses which totally ignore ecosystem services and the potential value of new knowledge will not adequately protect organisms such as our freshwater mussels of the Illinois River. Our challenge is to do what we can to insure organisms such as freshwater mussels persist, to be diligent and imaginative both in our management efforts and our research to understand these organism, and to apply that knowledge to solving problems.

ACKNOWLEDGMENT

We are indebted to the following sponsors: Illinois Natural History Survey, Illinois Department of Natural Resources, Long Term Resource Monitoring Program for the Upper Mississippi River System, Kentucky Department of Fish and Wildlife Resources, Upper Mississippi River Conservation Committee, U.S. Fish and Wildlife Service, and Tennessee Shell Company. Conclusions and opinions expressed are those of the authors and not necessarily those of sponsors.

REFERENCES

Baker, F.C. 1906. A catalogue of the mollusca of Illinois. Bull Ill. State Lab. Nat. Hist. VII(VI):53-136.

Baker, P.M. President, Tennessee Valley Shell Company, Inc. 1993. Personnel communication to K.D. Blodgett, November 1993, Camden, TN.

Baker, P.M. President, Tennessee Valley Shell Company, Inc. 1995. Personnel communication to C.R. Fassler, 22 September and 8 November 1995. *Reported by* C.R. Fassler, 1997. The American mussel crisis: effects on the world pearl industry. *In* Conservation and Management of Freshwater Mussels II. Initiatives for the Future, K.S. Cummings, A.C. Buchanan, C.A. Mayer, T.J. Naimo, eds. Pp. 265-277. St. Louis, Missouri.

Bartenhagen, M. 1976. Notes of Mabel Bartenhagen. Notes on file, Musser Public Library, Muscatine, Iowa.

Brann, W.P. 1947. Fresh-water mussel shells. U.S. Fish and Wildlife Service Fishery Leaflet No. 246. U.S. Government Printing Office, Washington, D.C.

Calkins, W.W. 1874. The land and freshwater shells of La Salle County, Ill. Ottawa Academy of Natural Sciences Proceedings. 48 pp.

Claassen, C. 1994. Washboards, pigtoes, and muckets: historic musseling in the Mississippi Watershed. Historical Archaeology 28(2):1-145.

Coker, R.E. 1919. Freshwater mussels in the Upper Mississippi River. Bull. U.S. Bur. Fish. 1917-18. Washington, D.C.

Danglade, E. 1914. The mussel resources of the Illinois River. U.S. Bureau of Fisheries, Document No. 804. U.S. Commissioner of Fisheries 1913. Washington, D.C.

Fassler, C.R. 1997. The American mussel crisis: effects on the world pearl industry. *In* Conservation and Management of Freshwater Mussels II. Initiatives for the Future, K.S. Cummings, A.C. Buchanan, C.A. Mayer, T.J. Naimo, eds. Pp. 265-277. St. Louis, Missouri.

Forbes, S.A., and R.E. Richardson. 1913. Studies on the biology of the upper Illinois River. IL State Lab. Nat. Hist. Bull. 9(10):481-574 + 21 pl.

Kelley, H.M. 1899. A statistical study of the parasites of the Unionidae. Illinois State Laboratory of Natural History Bulletin 5(8):399-418.

Richardson, R.E. 1928. The bottom fauna of the middle Illinois River, 1913-1925. Its distribution, abundance, valuation, and index value in the study of stream pollution. IL Nat. Hist. Surv. Bull. 17(12):387-475.

Scarpino, P.V. 1985. Great river: an environmental history of the Upper Mississippi, 1890-1950. Univ. Missouri Press, Columbia. 219 pp.

Starrett, W.C. 1971. A survey of the mussels (Unionacea) of the Illinois River: a polluted stream. Ill. Nat. Hist. Surv. Bull. 30(5):265-403.

Stoeckel, J.A., D.W. Schneider, L.A. Soeken, K.D. Blodgett, and R.E. Sparks. 1997. Larval dynamics of a riverine metapopulation: implications for zebra mussel recruitment, dispersal, and control in a large-river system. J. N. Am. Benthol. Soc. 16(3):586-601.

Whitney, S.D., K.D. Blodgett, and R.E. Sparks. 1996. A comprehensive evaluation of three mussel beds in Reach 15 of the Upper Mississippi River. Illinois Natural History Survey, Center for Aquatic Ecology Technical Report 96/7. 15 pp. + Appendices.

Whitney, S.D., K.D. Blodgett, and R.E. Sparks. In preparation. A comprehensive mussel survey of the Illinois River, 1993-95. Illinois Natural History Survey, Center for Aquatic Ecology Technical Report.

Williams, J.D., M.L. Warren, Jr., K.S. Cummings, J.L. Harris, and R.J. Neves. 1993. Conservation status of freshwater mussels of the United States and Canada. Fisheries 18(9):6-22.

ENVIRONMENTAL POOL MANAGEMENT

David Busse

Senior Water Control Manager, Potamology Section
Hydrologic and Hydraulic Branch, U.S. Army Engineering District
1222 Spruce Street., St. Louis, MO 63103

PRELUDE

"What is it that confers the noblest delight? What is that which swells a man's breast with pride above that which any other experience can bring him? Discovery! ...To give birth to an idea--to discover a great thought--an intellectual nugget, right under the dust of a field that many a brain-plow had gone before...To be the first--that's the idea. To do something, say something, see something, before anyone else--these are the things that confer a pleasure compared with which other pleasures are tame and trivial." The great American writer, Mark Twain wrote these words in his book The Innocents Abroad. It is with this pride that this paper is presented.

INTRODUCTION

The United States Government with the General Survey Act of 1824 directed the United States Army, Corps of Engineers (Corps) to begin improvements to the navigation system of the Mississippi River. The dawn of the twentieth century saw the era of the steamboat fade and the birth of other more efficient forms of water transportation. This called for extensive studies to be made to create one great integrated waterway system utilizing the waters of the Mississippi, the Illinois, and the Ohio Rivers. The United States Congress authorized the legislation necessary to build a nine foot (2.7 meter) navigation channel. To obtain this minimum depth for the full range of hydrologic conditions locks and dams were built. On the Upper Mississippi River (UMR) a series of 29 locks and dams maintain navigation depths.

These projects have worked as designed, and provide a safe and dependable navigation channel for the UMR. *The environmental stewardship mission of the Corps on the Mississippi* River has increased since the original authorization. The Corps has made major strides in altering/redesigning navigation structures (dikes and revetments) to serve both environmental and navigation needs. In addition, numerous small scale (geographically) habitat restoration projects have been undertaken in this reach of the river. However, these efforts did not focus on one of the largest concerns river biologists have relative to the lock and dam system.

One of the main concerns expressed by river and wildlife biologists relative to the management of the navigation pools is the overall health of the ecosystem. They believe the natural water level fluctuation allows for tremendous biological diversity and substainability of the UMR ecosystem. They believe the annual low water, that allowed wetland (emergent aquatic) vegetation to grow naturally, is missing.

The Corps of Engineers' principal focus in ecosystem restoration is on those ecological resources and processes that are directly associated with the hydrologic regime of the ecosystem. Human influence has had, and will continue to have, an impact on virtually all ecosystems. This should always be recognized when developing ecosystem restoration goals and objectives.

In 1994, the St. Louis District of the Corps, launched an innovative concept on the three southern most locks and dams on the UMR. This new concept is Environmental Pool Management (EPM). This concept works with the natural hydrograph to provide a safe and dependable navigation channel in an environmental sensitive manner.

The ecological response to EPM has been outstanding. Habitat restoration, specifically the growth of large areas of wetland vegetation has been outstanding. The many resource agencies that deal with the Mississippi River Basin on a daily basis are impressed with the results.

THE IMPORTANCE OF MACROPHYTES

Macrophytes (vegetation) provide a variety of benefits to a river ecosystem. These benefits include, but are not limited to, wildlife and fish habitat cover and food sources, erosion control and water quality improvement.

Millions of birds use the UMR for their spring and fall migration. The North American Waterfowl Management Plan has identified the UMR as 1 of 34 waterfowl habitat areas of major concern in the United States and Canada. One of the concerns regarding the UMR is its long-term viability as a migratory resource relative to the shrinking macrophyte community.

During the fall migration, the birds need high energy food. The macrophytes provide this energy through the seeds they produce. During the spring migration, the birds (especially the females who need high protein and carbohydrate levels to produce eggs), are in search of high protein food. The residual vegetation supports invertebrate communities needed to supply such high protein nourishment for the birds.

It is commonly accepted that macrophytes are beneficial to waterfowl. In the past there has been concern that management practices that are beneficial to waterfowl are not necessarily beneficial, and in some cases, detrimental to fish. The EPM program provides benefits to both waterfowl and fish.

In 1988, the Upper Mississippi River Conservation Committee published Fishes Interactions With Aquatic Macrophytes With Special Reference to the Upper Mississippi River System. They reported the following.

> "More than half of the fish species on the Upper Mississippi River system use macrophytes to satisfy some habitat need. Aquatic plant communities are used as feeding grounds for primary and secondary consumers, and play a vital role in aquatic food webs. They provide substrate and concealment for reproduction and larval development. They protect vulnerable organisms from predation and other environmental hazards."

Tallgrass (Leersia, Panicum) and Shortgrass (Enchinochloa, Cyperus) are two of the dominant plant groups expected to occur as the result of EPM. This group of macrophytes provide substrate for terrestrial and aquatic macroinvertebrates. It also attenuates wave action, thereby creating micro-habitat conditions for the accumulation of plankton and free-floating plants.

Smartweed (Polygonum) is found in abundance from EPM. This macrophyte group provides mid- and late-season cover, which may be important as substrate for insects during peak emergence periods.

The importance of the wetland macrophytes from EPM is not limited to the UMR. As with almost every river in the world the Gulf of Mexico, west of the Mississippi River delta, is suffering from severe oxygen deficiency on a seasonal basis. Studies have shown that waters from the river have nutrients which allow for the growth of algal blooms. The dead algae organisms consume oxygen in Gulf waters leading to a low oxygen or hypoxic zone. When this zone is present, there is an extremely high mortality rate for benthic organisms.

Urban and agricultural sources contribute to the high nitrogen levels. The pooled portion of the river, above the mouth of the Missouri River, is thought to contribute about 31 percent of the nitrogen delivered to the Gulf.

It is known that wetlands play a significant role in water quality improvement for certain chemicals, sediments and nutrients. One study showed that when wastewater was passed through a wetland, 70 percent of ammonia nitrogen, 99 percent of nitrite and nitrate nitrogen and 95 percent of total dissolved phosphorus was removed. Much of this water quality improvement can be directly attributed to aquatic, semi-aquatic and water tolerant macrophytes taking up the nutrients during growth periods.

Empirically it may be stated:

A) The desiccation of river mud flats and the oxidation of surface soils can lead to denitrification.

B) Wetland vegetation will utilize nitrogen during the period of growth.

C) The positive ammonium ion can be immobilized by negatively charged soil particles.

The wetlands from this project should not be considered a solution to the problem of the hypoxic zone in the Gulf of Mexico. However, the expansion of the EPM program to the entire UMR Lock and Dam system has the potential to measurable reduce the nitrogen load entering the Gulf of Mexico.

TRADITIONAL OPERATION

The dams create slack-water pools for navigation during periods of low and medium flows. The locks pass river traffic from one pool to another. In order to operate the slack-water pool system, it was necessary for the federal government to acquire interest in all real estate (lease and purchase) that would be subject to flooding caused by the use of the dams. In a desire to lessen these real estate requirements the St. Louis Districts' three Mississippi River Locks and Dams (L&Ds) are regulated using a hinge-point.

Hypothetically, if there was zero discharge in the Mississippi River, the water surface between two L&Ds would be level. Maximum pool must be maintained at the downstream L&D to maintain the authorized 2.7 meter (9 feet) channel at the upstream most point in the pool. As river flows increase, the upstream portion of the pool rises, lessening the need to maintain maximum pool. Utilizing a hinge-point, the water level at the downstream L&D is lowered to reduce real estate requirements and still maintain a 2.7 meter channel throughout the pool.

The hinge-point method of managing water levels allows for a range of water levels for various flow rates. The modern technology now available to a water control manager (i.e., data collection platforms, satellite transmissions, computers) were not always available. Without the advantage of modern technology, water control managers of the past had to work in the middle of the hinge-point range. Flow rates on the Mississippi River are very dynamic and can be altered dramatically based on numerous variables such as precipitation, ice, and hydropower generation. The water control manager of the past had only one value per day to use in making water management decisions. Therefore to be prudent, the water control manager attempted to keep the pool in the middle of the hinge-point range to provide for the unknowns.

Drawdowns utilizing the traditional method, were generally not sufficient to provide a valuable vegetative response. They were too small and more importantly, too short in duration to produce viable habitat. The typical drawdown in Pool #25, for example is between 0.1 - 0.5 meters for about 20 days. The duration of the typical drawdown is insufficient to produce vegetation that was able to remain above the water level when the pool was returned to the maximum regulated pool.

The traditional method allowed for a safe and dependable navigation channel. However, it was unable to produce the kind of vegetative response the river biologists were looking to achieve. Historically only one out of every four years was a drawdown of 0.1 - 0.5 meters achieved for 30 days.

GENESIS OF ENVIRONMENTAL POOL MANAGEMENT

In the summer of 1994, the Missouri Department of Conservation (MODOC) made a proposal to the Corps for an experiment in Pool #25. The goal of this experiment was to achieve, on a regular basis, drawdowns that might increase habitat. The Corps immediately expanded the scope of the experiment to include the pools #24 and #25.

The parameters that were used in this experiment included:

1. Provide a safe and dependable navigation channel.

2. Utilize the following vegetative growth parameters:

a. Employ a pool drawdown of 0.2 to 0.7 meters for at least 30 days.

b. Employ a pool drawdown during the period from May 1 to July 30, with the May-June period being the most desirable for vegetative growth and seed production.

c. After the initial drawdown, allow the pool to rise at a rate of not greater than 2.5 centimeters per day. Vegetation will grow at a rapid rate if not overtopped by water and if a slow pool rise is provided.

An important feature of the plan is close coordination with resource managers in the field, who provide valuable insight into actual conditions. As with any natural process, the vegetative response will vary from year to year. Time of year, temperature, and precipitation all have an effect. The resource managers in the field, provide important real time input on the vegetative response and provide important suggestions relative to adjustments that may be needed. For example, in 1996 several plant species germinated during the middle of the drawdown and additional time was requested to allow these species to gain sufficient height.

The MODOC provide the initial monitoring of the project. They established various control locations in all three pools within the St. Louis District. The vegetative response was greater than originally envisioned. Preliminary estimates revealed that over 1,200 hectares of vegetation were created as a result of this first experiment.

After the successful 1994 experiment, the decision was made to continue with the research during 1995, 1996 and 1997. The monitoring done by MODOC and other agencies such as the Illinois Department of Natural Resources was much more extensive in 1995,1996 and 1997. The successful results in 1995 surpassed those in 1994. The successful results in 1996 exceeded those in 1995. The cold temperatures during the early Spring of 1997 hindered the growth of vegetation during the early part EPM. Even with the early unfavorable weather 1997 was another successful year.

RESULTS

A total of eight sampling sites were established for evaluation. In Pool 24, sites were established at Crider Island, Pharrs Island , and at Clarksville National Wildlife Refuge. In Pool 25, sites were established at Stag Island, Jim Crow Island, Turner Island, and Batchtown. The only site established in Pool 26 was at Dresser Island.

Three photographic points were established at each sample site. These points were at several different elevations. A 0.5 meter square template was used to record various vegetation parameters. The species, number, and height of the vegetation within the 0.5 meter square were recorded. In addition, photographs were taken at each site during the weekly visits.

Seven genera of vegetation were identified in the 20 different sample sites during 1995. The following genera were found:

1. Polygonum spp. ——— smartweed
2. Cyperus spp. ———— chufa
3. Echinochloa spp. —— wild millet
4. Amaranthus spp. —— pigweed
5. Setaria spp. ———— yellow Foxtail
6. Panicum ——————— panic grass
7. Leersia ——————— rice cutgrass

Chufa, wild millet and smartweed were the three most likely plants to be found in any given location. The distribution of each genera in any given year is very dependant on the time of the year of the drawdown and the corresponding temperatures.

The three dominant genera had similar growth patterns during the first five weeks. After five weeks, the growth pattern started to diverge. Chufa leveled off at 35 inches, millet leveled off at 40-45 inches and smartweed was continuing to grow at the time of the last survey.

Approximately 30 days were required for plants to grow to a height of 7-10 inches during the Summer of 1995. Plant height did not increase until the pools were raised slowly back to maximum regulated levels. The vegetation height increased dramatically after the pools were raised in mid-July.

FUTURE CONSIDERATIONS

Adaptive Management has been employed on this project due to the relative uniqueness of restoration techniques in Corps pool management. Under Adaptive Management, restoration measures are implemented and monitored. Information is provided, based on new insights gained on the response of the ecosystem and its resources, and adjustments are made to the project as necessary and feasible.

Improving the knowledge base with regard to a particular restoration approach or ecosystem component, is a significant part of adaptive management. The St. Louis District is committed to improving the knowledge base regarding EPM. This knowledge base will be useful to other Corps districts as they explore the possibility of EPM in their districts. The St. Louis District has learned important lessons in each of the past four years.

CONCLUSION

EPM has been a success in 1994, 1995, 1996 and in 1997. Vertebrates and invertebrates were direct beneficiaries of vegetative growth. They used the wetland vegetative growth for both food and escape cover. Wetland vegetative cover is one of the most critical needs in the UMR food chain web.

The success of this restoration effort has resulted in a continuation of the EPM program in the St. Louis District. In addition, a fresh look at the EPM program in other Corps districts is occurring due in part to the success of this program. The continuation of the coordination and cooperation among the wildlife biologists and the water control managers will continue. Any serious restoration project cannot rest on its past successes. We must continue to strive toward a better understanding of the ecosystem and evolving management practices.

Those who are concerned about local stewardship of the river are encouraged by this program. They see evidence of real progress and not just another study.

This project has required no additional taxpayer dollars. What was required was a willingness to be innovative and to work in a cooperative manner with a multitude of resource agencies and groups.

The EPM program, conducted by the St. Louis District, is an example of how the environmental and navigation communities can share the river in a mutually beneficial way. Coordinated water level management represents a true step toward ecosystem management on the Upper Mississippi River System.

The views expressed in this paper are the views of the authors, and are not necessarily the views of the United States Army Corps of Engineers.

CLOSING ADDRESS

Stephen P. Havera

Director, Forbes Biological Station and Frank C. Bellrose Waterfowl Research Center
Havana, IL

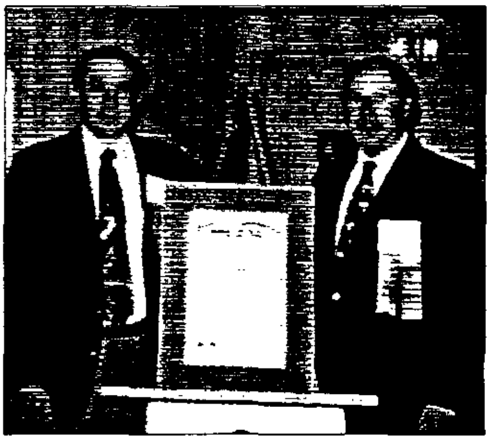
I would like to thank all of you for attending the sixth Governor's Conference on the Management of the Illinois River System. Your interest in the welfare of the river, as demonstrated by your participation in the conference, is essential if we are going to embark into a new century with a biologically and economically sound river system. The twentieth century witnessed many changes to the Illinois River system ranging from the significant diversion of Lake Michigan water into the waterway in 1900 to the sedimentation and unnaturally fluctuating water levels with which we are dealing today. What the twenty-first century will bring to the Illinois River system can be greatly influenced by us. We have a century of knowledge to build upon. We need to draw upon this knowledge, integrate new methodology, techniques, and information as they emerge, and incorporate these aspects into our desire to extend the longevity, biological productivity and economical aspects of the Illinois River system.

We must work together toward these goals, and here too, we already have a vehicle to do so and that is the Lt. Governor's Integrated Management Plan for the Illinois River Watershed. The coordinating council established to implement this management plan is there to listen to your input. Use them to express your ideas. The Illinois River system directly or indirectly affects almost everyone in our state. The river is one of our most important natural resources and it is up to all of us to do our part to insure its livelihood.

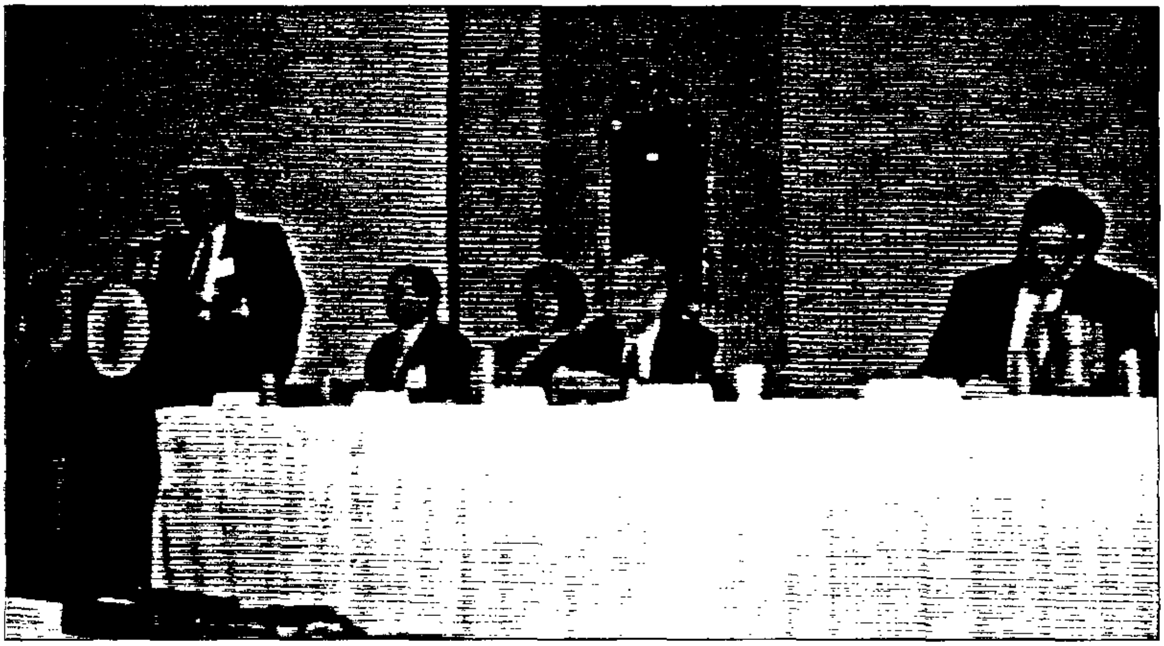
I want to thank you for your participation in this conference, I want to thank our more than 60 cosponsors for their support and financial contributions, I offer very special thanks to co-chair Bob Frazee, Mike Platt and Wendy Russell at Heartland Water Resources Council and the steering committee, all of whom devoted numerous hours toward the success of this conference. We are grateful for the addresses by Lt. Governor Bob Kustra, Directors Doyle and Manning and to Frank Bellrose and for their comments and insights. Now it is time for us to carry the information acquired here to our respective destinations and apply that toward our responsibilities in sustaining the Illinois River system. Our 1997 conference stands adjourned.

Appendices

Photographs



Above left: More than 300 people attended the sixth
biennial conference on managing the Illinois River System. Above right: Pictured are Conference Co-Chairs, Stephen P. Havera and Robert W. Frazee holding the Governor's Proclamation that reaffirms the State of Illinois commitment to improving the Illinois River.



Above: Opening Session of the conference featured Keynote Addresses by leading state government officials. Left to right is Wayne Zimmerman, Session Moderator; Bob Frazee, Conference Co-Chair; Becky Doyle, Director of the IL Department of Agriculture; Lieutenant Governor Bob Kustra; and Brent Manning, Director of the IL Department of Natural Resources.

"Technology Showcase" was a new feature that provided conference participants with opportunities to access information sites on the Internet related to river and watershed resources. Above left: Pictured is Joel Cross, IL EPA, leading an Internet Session. Center left: A SeniorNet Volunteer, sponsored by Illinois Eye Center & Bradley University, who assisted participants in "surfing the net."

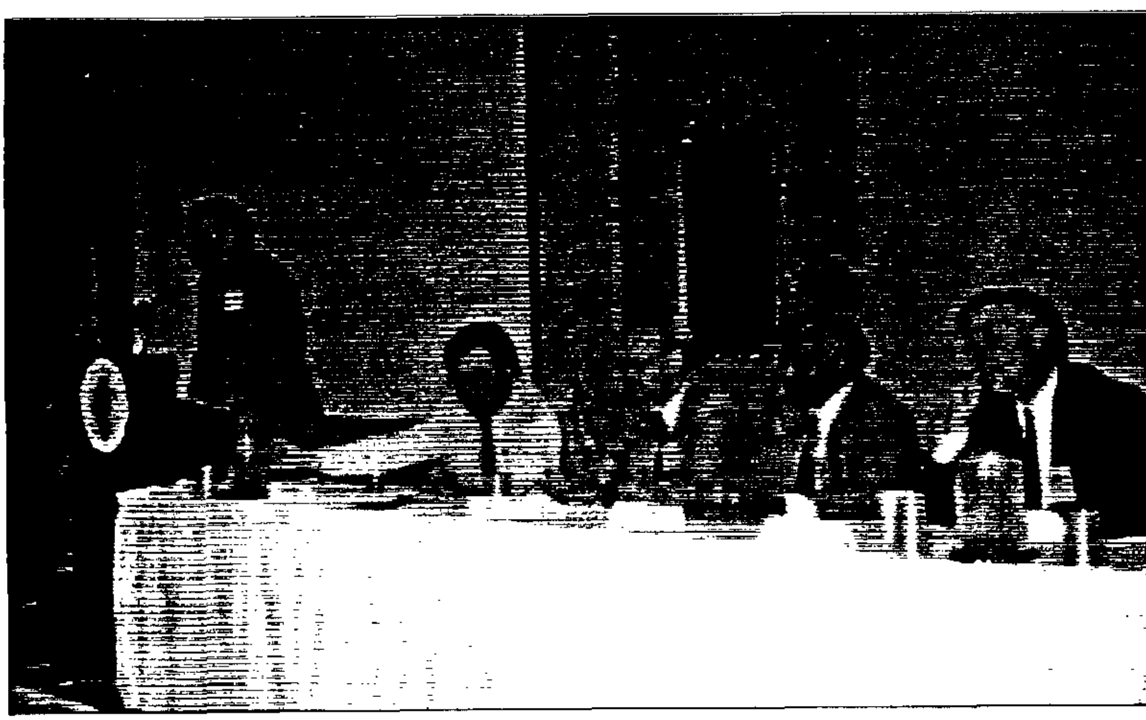
Above: The Conservation Tour put participants face to face with both problems and solutions affecting the Illinois River watershed. Pictured is Bill Allen, Nature Conservancy volunteer, who discussed erosion at Singing Woods Park.

Right: Karen Dvorsky, NRCS, is shown discussing stormwater retention and runoff problems at Dover Pointe, a newly annexed subdivision of Peoria.

Above: A panel discussion on the Gulf Hypoxia situation provided an increased awareness of the contribution of the Illinois River Watershed to this emerging national problem. Pictured left to right are: Steve Havera, Conference Co-Chair; John Comerio, Session Moderator; Frederick Kopfler, Gulf of Mexico Program, Mississippi; Dan Towery, Conservation Technology Information Center, Indiana; and Derek Winstanley, IL State Water Survey.

Left: The conference showcased displays from over 30 exhibitors. Pictured is Don Roseboom, (center) IL State Water Survey, discussing streambank problems with other participants.

Left: The Peoria Riverfront provided the setting for the Wednesday evening barbecue and included a tour of the newly-constructed Gateway Building.



Above: The Hydrology & Hydraulics Session provided new information regarding long-term river and stream management. Pictured left to right are: Gary Clark, Session Moderator; Rick Granados, U.S. Army Corps of Engineers - Rock Island Dist.; Bruce Rhoads, University of Illinois; Mike Demissie, IL State Water Survey; and Mike Platt, Heartland Water Resources Council.

Exhibit Participants

American Fisheries Society - Illinois Chapter
Conservation Technology Information Center
Heart of Illinois Sierra Club - Senachwine Creek
Heartland Water Resources Council
Illinois-American Water Company
Illinois Department of Agriculture - Bureau of Land and Water Resources
Illinois Department of Commerce and Community Affairs
Illinois Department of Natural Resources - EcoWatch
Illinois Department of Natural Resources - Fisheries Division
Illinois Department of Natural Resources - Integrated Water Protection
Illinois Environmental Protection Agency
Illinois Farm Bureau
Illinois-Indiana Sea Grant
Illinois Natural History Survey - Forbes Biological Station
Illinois Natural History Survey - Unionid Mussels Survey
Illinois River Carriers Association
Illinois River Soil Conservation Task Force
Illinois State Museum
Illinois State Water Survey
Illinois State Water Survey - Bank Erosion
Illinois State Water Survey - Lake Decatur Nitrate Monitoring
Illinois Water Resources Center
The Nature Conservancy - Mackinaw River Project
Prairie Rivers Resource Conservation and Development
Soil and Water Conservation Society - Illinois Chapter
Tri-County Regional Planning Commission
Tri-County Riverfront Action Forum, Inc.
United States Army Corps of Engineers (CELMS-PD-F)
United States Army Corps of Engineers Rock Island District
United States Department of Agriculture Natural Resources Conservation Service
United States Geological Survey
United States Geological Survey - Groundwater Trace Element Concentrations
United States Geological Survey - Habitat Characterization
United States Geological Survey - Surface Water Activities
University of Illinois - Cooperative Extension Service

Appendix C

Participants

Ross Adams
U.S. Fish & Wildlife Service

Lynn Anderson
IL Natural History Survey

Brian Anderson
IDNR

Bob Anstine
Dept of Commerce & Community Affairs

Angie Astrowski
East Peoria High School

Doug Austen
IDNR Office of Resource Conservation

Lee Austin
QST Environmental

Tom Austin
USDA - FSA

Sukhendu Banerjee
Two Rivers Regional Council

Gary Barnett
USDA - NRCS

Frank Bellrose
Principal Scientist Emeritus/IL Natural History Survey

Martin Behrends
Heartland FS

Tom Beissel
IDNR

Maitreyee Bera
Illinois State Water Survey

Bob Berg
U of I CES - Marshall-Putnam

Jim Berle
IDNR Office of Planning

Ariel Blancaflor
City of Peoria

Douglas Blodgett
IL Natural History Survey

Charlie Blye
Heartland Water Resources Council

Dorie Bollman
USACE - Rock Island

Gretchen Bonfert
Green Strategies

Deva Borah
Illinois State Water Survey

John Braden
U of I Water Resources Center

Jack Brighton
U of I WILL - AM

Mel Bromberg
University of Illinois

Mark Brown
IDNR Div. of Forest Resources

Marvin Brown
USDA - NRCS

Debbie Bruce
IDNR

Rodger Bruyn
Bureau County Farm Bureau

Paul Burczak
Holnam

Laurie Burgar
AISWCD

Dave Busse
USACE - St. Louis

Joe Bybee
IDOA - BLWR

Richard Cahill
IL State Geological Survey

Dennis Campion
U of I Coop. Extension Service

Doug Carney
IDNR Div. of Fisheries

Kyle Cecil
U of I CES - Knox County

Steve Chard
IDOA Bureau of Land & Water Resource

Patrice Charlebois
Illinois - Indiana Sea Grant

Bob Church
IDNR Div. of Forest Resources

John Cima
QST Environmental

Gary Clark
IDNR Office of Water Resources

Dale Claus
City of Washington

Julie Claussen
IL Natural History Survey

Tom Clevenger
Illinois Power Company

Michael Cline
Caterpillar Inc.

Mike Cochran
IDNR Div. of Fisheries

Don Condit
Prairie Rivers R.C. & D.

Dean Corgiat
IDNR

Kirby Cottrell
IDNR

Mike Cox
USACE - Rock Island

Tami Craig
Monsato Life Scienes

Jeff Crank
Midland R.I.V.E.R.S.

Joel Cross
Illinois EPA

Andi Curry
Midland R.I.V.E.R.S.

Dana Curtiss
IDNR

Ellen Dailey
Tri-County Regional Planning Commission

Christine Davis
Illinois EPA

Dora Dawson
Meredosia - Green Strategies

Dave Day
IDNR Office of Resource Conservation

Robert Dean
Natural Resources Cons. Service

Mike Demissie
Illinois State Water Survey

Gary Dreher
IL State Geological Survey

Claudia Emken
The Nature Conservancy

Tom Ennis

MaryAlice Erickson
Congressman Ray LaHood

Nancy Erickson
Illinois Farm Bureau

Chris Everts
QST Environmental

Pete Fandel
U of I CES

Rick Farnsworth
University of Illinois

Robbi Farrell
IL Waste Management & Research Center

Doug Fehr
Peoria County Farm Bureau

Tom Fentem
Great River Economic Development Foundation

Mark Finley
Heartland Community College

Dan Fitzpatrick
U.S. Geological Survey

Tom Flattery
IDNR

Gary Foreman
Keep Illinois Beautiful

Steve Frank
IDNR

Barbara Frase
Bradley University

Andrew Fraser
SeniorNet

Bob Frazee
U of I CES - East Peoria

Wayne Freeman
Great Rivers Land Preservation

Duane Friend
U of I CES Morgan - Scott

Mike Gardiner
IVY Club

Michelle Geogi
IL Natural History Survey

Tara Gibbs
IDNR

Dave Gillespie
IDNR Div. of Forest Resources

Tanner Girard
IL Pollution Control Board

Jack Gittinger
LZT Architects, Inc.

Mike Godar
City of Washington

Bill Gradle
USDA - NRCS

Rick Granados
USACE - Rock Island

Simon Grimm
East Peoria High School

David Gross
IL State Geological Survey

Alan Gulso
IDOA Bureau of Land & Water Resource

Randolf Habben
Heart of IL Sierra Club

Lisa Haderlein
The Nature Conservancy

Grant Haley
IDNR Div. of Forest Resources

Ron Hall
IDSA - NRCS

Heather Hampton-Knodle
IL Assoc. of Drainage Districts

Dudley Hanson
USAED - Rock Island

Joyce Harant
League of Women Voters

Sunshine Hardin
East Peoria High School

Mitchell Harris
U.S. Geological Survey

Steve Havera
IL Natural History Survey

Earl Henderson
DCCA

Harry Hendrickson
IDNR

Chris Hine
IL Natural History Survey

Mike Hirschi
U of I Dept. Agr. Engineering

Bob Holmes
U.S. Geological Survey

Lori Horstman
Illinois American Water Co.

Jennifer Horwath
Tazewell County Soil & Water

Glenn Hovis
Midland R.I.V.E.R.S.

Jon Hubbert
USDA - NRCS

Martin Hudson
USACE - Rock Island

Bob Hunsaker
Woodford County Board

Wayne Ingram
QST Environmental

Robert Innis
Tri-County Regional Planning Commission

Stu Jacobson
Illinois Times

Lacie Jeffers
Illinois State Water Survey

Don Jenkins
Illinois Central College

Truls Jensen
Illinois Natural History Survey

Gary Johnson
U.S. Geological Survey

Mark Johnson
Northern Illinois Water Corporation

Amy Jorden
MARC 2000

James Kammueller
Illinois EPA

Laura Keefer
Illinois State Water Survey

Al Kellerstrass
IL Dept. of Transportation

Timothy Kelley
IDNR Div. of Natural Heritage

Valerie Kenner
IDNR - Education

Ron Kern
Ogle County Farm Bureau

Robin King
U.S. Geological Survey

Mike Kingner
Klingner & Associates, P.C.

Tom Kingsley
SeniorNet

Kay Kitchen-Maran
USDA - NRCS

Kathy Knapp
Kickapoo Council of Girl Scouts, Inc.

Todd Koel
IL Natural History Survey

Terry Kohlbuss
Tri-County Regional Planning Commission

Frederick Kopfler
Gulf of Mexico Project

Jackie Kraft
McLean Co. SWCD

Gary Kramer
Caterpillar, Inc.

Tony Kramer
USDA - NRCS

Tom Krapf
USDA - NRCS

Paul Krone
USDA - NRCS

Mike Kruse
East Peoria High School

Tom Lercazk
IL Nature Preserves Commission

Bill Lewis
USDA - NRCS

Marilyn Leyland
Caterpillar Inc.

John Marlin
IL Waste Management & Research Center

Bill Mathis
Bradley University

Ravi Mathur
IDNR Office of Water Resources

Paul Mauer
IDNR

Chris McCann
McCann Environmental Prod.

Sally McConkey
IL State Water Survey

Doyle McCully
USACE - Rock Island

Jim McMahon
The Nature Conservancy

Barrie McVey
IDNR Div. of Forest Resources

Don Meinen
Tri-County Riverfront Action Forum, Inc.

Michael Meno
U.S. Geological Survey

Carol Merna
Congressman Ray LaHood

Bill Meyer
Illinois State Water Survey

Jim Mick
IDNR Div. of Fisheries

Tim Mihuc
IL Natural History Survey

Don Miller
Indiana Port Commission

Larry Miller
Caterpillar, Inc.

Mike Miller
Illinois State Geological Survey

T. Miller
USACOE - St. Louis

Tim Minor
CF Industries, Inc.

Richard Monzingo
Commonwealth Edsion Co.

Robert Moore
Central States Education Center

Lynn Morford
Dept. of Commerce & Community Affairs

Bill Morrow
U.S. Geological Survey

Jim Mudd
USAED - Rock Island

Crystal Myers
USDA - NRCS

John Nelson
IL Natural History Survey

Miranda Neumann
Midland R.I.V.E.R.S.

Rich Nichols
IDOA Bureau of Land & Water Resource

Brian Nicholson
City of Peoria

Garry Niemeyer
Illinois Corn Growers

John Nikolai
IL River Carriers

Darren Olson
U.S. Geological Survey

Lloyd Orrick
City of Pekin

Darin Osland
Illinois American Water Co.

Jerry Paulson
The Wetlands Initiative

James Pence
IDNR Office of Water Resources

Robert Phelps
Lake Wildwood Association

Mark Phipps
IDNR

John Picco
SeniorNet

David Pittman
Peoria Park District

Mike Platt
Heartland Water Resources Council

Mike Plumer
U of I CES Marion

Jennifer Pondelick
Illinois EPA

Becky Porter
CF Industries Inc.

Brenda Pregler
Piatt County SWCD

Chad Pregracke

Nancy Price
Knox County SWCD

Al Pyott
The Wetlands Initiative

Mike Rahe
IDOA Bureau of Land & Water Resource

Jerry Rasmussen
U.S. Fish and Wildlife Service

Lyle Ray
Illinois EPA

Jody Rendziak
USDA - NRCS

Michael Reuter
The Nature Conservancy

Bruce Rhodes
U of I Department of Geography

Dusty Rhodes
USACE - Mississippi Valley Division

Katie Roat
IL Natural History Survey

JeanAnn Robinson
Canal Corridor Assn.

Blake Roderick
Pike/Scott County Farm Bureau

Jon Rodsater
IL State Water Survey

Gordon Ropp
Secretary of State - Rural Affairs

Fred Royal
Lake County Stormwater Mgmt. Comm.

Diane Rudin
The Nature Conservancy

Wendy Russell
Heartland Water Resources Council

Jim Rutherford
McLean County SWCD

Ron Satzler
Caterpillar, Inc.

Sue Schliepsiek
Teacher - East Peoria High School

Bill Schmidt
City of Washington

John Schmitt
IL Conservation Foundation

Ken Schoemaker
USACE - Peoria

Dick Schroeder
Senachwine Duck Club

Sue Schultz
Illinois - American Water Company

Susan Shaw
Illinois State Water Survey

Karen Sheets
The Nature Conservancy

Martha Sheppard
USDA - NRCS

Kay Shipman
FarmWeek

Matt Siemert
IDNR Div. of Forest Resources

Dorothy Sinclair
Tri-County Riverfront Action Forum, Inc.

Jerry Skalak
USACE - Rosk Island

Glen Smiddy
USDA - NRCS

George Smith
SeniorNet

Dianne Smith
Woodford County Board

Steve Sobaski
IDNR Div. of Resource Conservation

David Soong
Illinois State Water Survey

Rip Sparks
IL Natural History Survey

Kim St. John
Prairie Rivers R.C. & D.

George Stourton
George Stourton Co.

Alesia Strawn
U of I Water Resources Center

Scott Stuewe
IDNR Div. of Fisheries

Jean Suchomski
U of I CES Vermilion County

Gary Sullivan
IDNR Office of Water Resources

Clarice Sundeen
USACE - Rock Island

John Taylor
Illinois Valley Flood Control Association

Mike Taylor
City of Peoria

Ryan Taylor
IDNR

Doug Tennis
Illinois American Water Co.

Paul Terrio
U.S. Geological Survey

Nick Textor
Consoer Townsend Envirodyne Engineers, Inc.

Mike Thompaon
USACE - St. Louis

Brad Thompson
USACE - Rock Island

Gregg Tichancek
IDNR Div. of Fisheries

Tom Tincher
City of Peoria Riverfront Development Dept.

Dave Tipple
USACE - Rock Island

Melissa Tonsor
East Peoria High School

Dan Towery
Conservation Technology Information Center

Lee Trail
U of I Water Resources Center

Brad Underwood
East Peoria High School

Christine Urban
U.S. EPA - Chicago

Estel Vaugn
City of Washington

Andrew Vitale
IDNR Div. of Resource Conservation

Michael Vodkin
Illinois Natural History Survey

Don Vonnahme
IDNR Office of Water Resources

Tom Ward
U of I CES

Rodney Weinzierl
Illinois Corn Growers Assoc.

David Weiss
SeniorNet

Leon Wendte
USDA - NRCS

Mark Werth
IDOA Bureau of Land & Water Resource

Jamie West
Midland R.I.V.E.R.S.

Bill White
IDNR - OREP

Bill Wicland
SeniorNet

Gene Wilcenski
Hartung Bros Inc.

Christina Wilkinson
WIRL Radio

Tom Wilson
IDNR Div. of Forest Resources

Terry Wiltz
Sea River Maritime

Derek Winstanley
IL State Water Survey

Karen Witter
IDNR

Donald Wolland
Peoria Chamber Izaak Walton

Aaron Yetter
IL Natural History Survey

Angelo Zerbonia
Tri-County Riverfront Action Forum, Inc.