River Restoration:
Practices and Concepts Series

Beyond the Basics of Dam Removal and Modification Workshop

June 4, 2003

Business Conference Center
Elgin Community College
Elgin, Illinois

Sea Grant
ILLINOIS - INDIANA

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River Restoration: Practices and Concepts Series Agenda and Speaker List

Date and Time	Topic/Session	Speaker and Organizations
Wednesday, June 4		
8:30 a.m.	Registration, Continental Breakfast	
9:00 a.m.	Welcome	Jeff Mengler, US FWS
9:05 a.m.	*National Dam Activity and Initiatives*	Dave Wegner, Ecosystem Management International, Inc.
9:50 a.m.	*IL, IN, and WI State Perspective*	Steve Pescitelli, IL DNR
10:10 a.m.	*NH Case Study*	Stephanie Lindloff, NH Dept. of Environmental Services
10:45 a.m.	Break	
11:05 a.m.	*Hydrologic Analysis and Sediment Transport*	Jim MacBroom, Milone and MacBroom, Inc
11:40 a.m.	*Post Removal Stream Bank and Habitat Restoration*	Jim MacBroom, Milone and MacBroom, Inc
12:15 p.m.	Lunch	
1:10 p.m.	Evaluation of the North Batavia Dam Modification on the Fox River	H.R. Dodd, S.E. Butler, and D.H. Wahl, IL NHS
1:45 p.m.	*Fish Passage for Midwestern Species with Examples from the Fox River*	Vic Santucci, Max McGraw Wildlife Foundation
2:20 p.m.	*Understanding Community Attitudes about Dams and Dam Removal Projects*	Jody Rendziak, NRCS
2:55 p.m.	Break	
3:15 p.m.	*Funding Projects*	Michael Hoff, US FWS
3:50 p.m.	*Panel Discussion: Regulations and Permits*	Moderator Karen Kabbes, Kabbes Engineering Gary Jereb, IL DNR– OWR Bruce Yurdin, IL EPA Bureau of Water Cathy Chernich, US ACE, Chicago District
4:40-5:00 p.m.	Open Discussion and Wrap	

Thank you to all of the steering committee members that worked to organize this workshop:

Thomas Burke, Christopher Burke Engineering, LTD and IL Section ASCE - EE&WR
Leslie Dorworth, Illinois-Indiana Sea Grant College Program
Dennis Dreher, Northeastern Illinois Planning Commission
Karen Kabbes, Kabbes Engineering, Inc.
Karen Kosky, Kane County Environmental Management
Neil Ledet, Indiana Department of Natural Resources
Rob Linke, Watershed Resource Consultant, Inc.
Jeff Mengler, US Fish and Wildlife Service
Steve Pescitelli, Illinois Department of Natural Resources
Jean Sellar, US Army Corps of Engineers
Kent Taylor, Openlands Project
Scott Tomkins, Illinois Environmental Protection Agency
Diane Trgovcich-Zacok, Chicago Wilderness
Nancy Williamson, Illinois Department of Natural Resources

River Restoration: Practices and Concepts

Beyond the Basics of Dam Removal and Modification

Workshop, June 4, 2003

Workshop Evaluation

How did you hear about the workshop?	❑ Brochure mailing ❑ Newsletter ❑ Website	❑ Email or listserv announcement ❑ Word of mouth ❑ Other: ________________	
What state do you work in?	❑ Illinois ❑ Indiana ❑ Michigan	❑ Ohio ❑ Wisconsin ❑ Other-Please list: ________	
What type of organization are you affiliated with?	❑ Natural Resource Department ❑ Consultant ❑ Park Department	❑ City Planner ❑ Public Works ❑ Engineer	❑ Landscape Architect ❑ Academia or Student ❑ Other:

Please rate the conference on the following items:

	(Please circle one)			
Overall quality of presentations:	*excellent*	*good*	*adequate*	*poor*
Workshop notes and handouts:	*excellent*	*good*	*adequate*	*poor*
Audio-visual logistics:	*excellent*	*good*	*adequate*	*poor*
Lunches and breaks:	*excellent*	*good*	*adequate*	*poor*
Conference location, facilities:	*excellent*	*good*	*adequate*	*poor*
Hotel accommodations:	*excellent*	*good*	*adequate*	*poor*
Overall conference:	*excellent*	*good*	*adequate*	*poor*

Which presentations did you find most useful and why?	
What two areas would you most like to attend a future workshop in?	

Have you attended previous River Restoration Series Workshops?	❑ Stream Restoration, June 12-13, 2001 at Elgin Community College ❑ Dam Removal, April 18, 2002 at Purdue University Calumet ❑ This is the first River Series Workshop that I have attended. ***Please continue to next page***
If yes, have you used the information presented in past workshops in your profession?	❑ At work ❑ Communicating to public ❑ Consulting other organizations ❑ Education within your own organization ❑ Educating local officials ❑ Other- Please explain:
How do you plan on using the information from today's workshop?	❑ At work ❑ Communicating to public ❑ Consulting other organizations ❑ Education within your own organization ❑ Educating local officials ❑ Other- Please explain:

Please complete this survey and return it to the registration desk before you leave. If you are unable to turn in the survey the day of the conference, please send it to Susan Delatorre, IL-IN Sea Grant Program, Biological Sciences, Purdue University Calumet, Hammond, IN 46322-2094, fax 219-989-2130.

Thank you for taking a few moments to fill out this survey to better serve you at future workshops.

Kathy Chernich
U.S. Army Corps of Engineers

Kathy Chernich, Permits and Enforcement Project Manager of the Regulatory Branch of the U.S. Army Corps of Engineers, Chicago District has 8 years of experience processing permit applications, performing compliance inspections, and investigating and resolving enforcement actions under Federal regulations and policies within the authority of Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. Kathy represents the Chicago District and state, county and local governments on task forces as a technical advisor on Federal regulations and related laws. She is the Point of Contact (POC) for projects in North Cook County, controversial projects within Kane County, Dam removals, O'Hare Airport, Metropolitan Water Reclamation District of Greater Chicago, and Power projects. Kathy graduated from Elmhurst College with a B.S in Environmental Management and Biology and also has field experience in Botany, Soil Science and Hydrology.

Hope R. Dodd
Illinois Natural History Survey
Center for Aquatic Ecology

Ms. Dodd has been a Stream Ecologist at the IL Natural History Survey for four years. Her research focuses on stream restoration and remediation and its influence on aquatic communities. Ms. Dodd received her M.S. in Fisheries and Wildlife from Michigan State University in 1999 where she studied the effects of low-head dams on stream fish communities in tributaries of the Great Lakes. Ms. Dodd received her B.S. in Aquatic Biology from Ball State University in 1996 where she worked on a project that evaluated the impacts of zebra mussels in the Indiana waters of Lake Michigan.

Michael Hoff
U.S. Fish and Wildlife Service

Michael Hoff is the Fish Passage Program Coordinator and Aquatic Nuisance Species Program Coordinator for Region 3 of the U.S. Fish and Wildlife Service. Mike previously worked more than 26 years for the U.S. Geological Survey, National Biological Service, U.S. Fish and Wildlife Service (previous stint), and Wisconsin Department of Natural Resources where he conducted management-oriented research on fish and wildlife populations, communities, and habitats.

Stephanie D. Lindloff

New Hampshire Department of Environmental Services
Water Division Dam Bureau

Stephanie Lindloff manages the River Restoration and Dam Removal Program for the New Hampshire Department of Environmental Services. She joined the agency in 2001to establish this new program. The program's goal is to develop and implement an efficient and effective means of restoring rivers and eliminating public safety hazards through selective dam removal.

Ms. Lindloff provides assistance to dam owners, and helps coordinate the involvement of multiple interests throughout the dam removal decision-making, planning, regulatory and implementation processes. She routinely works with community members, state and federal government agencies, conservation groups, and private interests. She also serves as project manager for several agency-led dam removal projects statewide. Ms. Lindloff chairs the New Hampshire River Restoration Task Force, a public-private initiative that assists in the planning of individual projects and statewide approaches to dam removal. She is also drafting new administrative rules and revising current rules relevant to dam removal and river restoration in New Hampshire.

Prior to her current position, Ms. Lindloff managed the small dams program for the River Alliance of Wisconsin, a statewide river conservation organization. She was a co-organizer for a technical workshop of dam removal experts in the Great Lakes Basin, and coordinated trainings for citizens with an interest in advocating for river restoration through dam removal. She is the primary author of *Dam Removal: A Citizen's Guide to Restoring Rivers*, and co-creator of an award-winning video, *Taking a Second Look: Communities and Dam Removal.*

She was a selected member of The Aspen Institute panel that convened over the course of two years to develop national policy recommendations on dam removal, and has been a speaker/lecturer at numerous professional events throughout the United States and Australia.

Ms. Lindloff holds an M.S. in Water Resources Management, and a B.A. in Political Science and Environmental Studies, both from the University of Wisconsin-Madison.

James G. MacBroom
Milone & MacBroom Inc.

Jim earned BS and MS degrees in Civil Engineering from the University of Connecticut and is a registered Professional Engineer in five states. He is Vice President of Milone & MacBroom Inc, author of the River Book, and teaches graduate courses in River Processes & Restoration and Applied Hydrology at Yale University. His has 30 years of experience in watershed management, open channel hydraulics, computer modeling, fluvial morphology, stream restoration, and tidal systems.

Jim has participated in many dam management projects, including repairing unsafe or aging dams and providing fish passage at dams with fish ladders, ramps, and removal of obsolete dams. Locally, he has worked in conjunction with local consultants performing studies at the South Batavia Dam on the Fox River and for three dams on the Des Plaines River in Illinois.

Stephen M. Pescitelli
Stream Ecologist
Illinois Department of Natural Resources

Steve Pescitelli is a Stream Ecologist with the Illinois Department of Natural Resources. He obtained both his B.S. and M.S. degrees from the University of Illinois at Urbana Champaign. He has been responsible for the following watersheds in northeastern Illinois since July 1994: Fox, Des Plaines, DuPage, and Kankakee. Job responsibilities include monitoring fish communities, management of sport fisheries, permit review, watershed planning, habitat and stream restoration, and outreach and education. Steve has many professional interests including the various factors affecting fish community structure, fragmentation in aquatic systems and dam modification and removal.

Jody A Rendziak

USDA-Natural Resources Conservation Service

Jody Rendziak is a social sciences specialist for the USDA-Natural Resources Conservation Service. Her role with NRCS is to help the county offices and partners enhance their effectiveness in working with people to address natural resource issues. Much of Ms. Rendziak's work involves helping citizens throughout Illinois develop watershed management plans. Her conduct training about the watershed planning process, facilitate meetings to help communities reach consensus about problems, objectives and solutions, provide technical assistance in community planning, develop guidance material, and write planning documents. She also helps groups conduct mail surveys, do strategic planning, and apply for grant money.

Vic Santucci

Vic received both bachelors and masters degrees in Zoology from Southern Illinois University at Carbondale and is certified as a Fisheries Scientist by the American Fisheries Society. He has been working in fisheries research since 1985 and has been employed as a Fisheries Research Biologist with the Max McGraw Wildlife Foundation for the past 11 years.

DAVID L. WEGNER
Principal Scientist
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ACADEMIC EDUCATION

1980 M.S. Aquatic Sciences, Colorado State University, Ft. Collins, Colorado
(Emphasis on fluvial geomorphology, engineering and hydrology)

1975 B.S. Aquatic Ecology, University of Minnesota, St. Paul, Minnesota

PROFESSIONAL EXPERIENCE

2001-present Providing scientific support to the development of Resource Management Plans, Wild and Scenic River evaluations and scientific evaluation of agency actions. Assisting Bureau of Land Management and U. S. Forest Service in the development of Resource Management Plans with specific emphasis on the implementation of project specific Endangered Species Act coordination. Supports the development and mentoring of junior staff for project specific Biological Assessments and Evaluations including programmatic reviews of agency actions and applications. Assists agencies in the development of science based adaptive management programs that support the completion of specific actions identified in the Resource Management Plans.

Additional expertise and applications focused on the development of Geographic Information System strategies and programs for Federal government applications. Provided field and technical verification of aerial photographs and maps utilizing Geographic Positioning. Provides guidance to agencies on the development and application of GIS processes to address biological opinion actions.

Served on the H.John Heinz Center for Science, Economics and the Environment committee studying and developing recommendations related to the science and decision-making process related to the removal of dams. Assisted various agencies and groups in the review and assessment of river and aquatic ecosystem restoration programs throughout the United States and Internationally.

1997-present Principal Scientist and President of Ecosystem Management International, Inc. in Durango, CO. The focus of the business is on the development, analysis and application of sound scientific logic to the evaluation of complex ecosystem problems. A significant component of the work is focused on ecosystem restoration and the development of innovative solutions to management and environmental problems. Extensive effort in facilitating and coordinating the use of science and public process as related to endangered species and river management. Director of Science for the Glen Canyon Institute, Research Associate with the Museum of Northern Arizona and a field naturalist for the Grand Canyon Field Institute. Consulting ecologist and facilitator with the Forest Service, Fish & Wildlife Service, Bureau of Land Management, Bureau of Reclamation and academic institutions. Coordinated resource studies and land use plans with the Hualapai and Havasupai Tribes, AZ. Has spent considerable time working with the Lower Colorado Multi Species Conservation Plan as it relates to the four Colorado River specific endangered fish species.

Supported the Nevada Fish and Wildlife Office in the development of Recovery Implemenation Plans to support Recovery activities associated with the listed Lahontan cutthroat trout in both the Truckee and Walker River systems. This work has been accomplished in coordination with multiple stakeholders concerned with restoration of Lake Tahoe, Pyramid Lake and Walker Lake ecosystems. This coordination has included coordination with the Regional Office and the California and Oregon offices of the FWS. In addition work has been coordinated with multiple federal and state agencies and over 40 stakeholder groups.

Supporting the Nez Perce Tribe, Bureau of Land Management, the conservation community, NOAA and FWS (Idaho State Office) in the review of the FERC relicensing process for the Hells Canyon complex of dams on the Snake River in Idaho. This has required extensive coordination with the FWS on the review of aquatic and terrestrial species as they are impacted by the operation of the Hells Canyon dams (3).

1983-1997 Principal Scientist and Program Manager for the Glen Canyon Environmental Studies, a Department of the Interior, Bureau of Reclamation, program which was focused on the evaluation of the environmental impacts associated with the operation of Glen Canyon Dam. The program was a 70 million dollar program that required extensive coordination with hundreds of scientists, administrators, Tribal leaders, Congressional staffs, power and water users, the public, academic institutions and the National Research Council. Federal agencies associated with includes the Department of the Interior, Fish & Wildlife Service (Biological Opinions), Bureau of Reclamation, Environmental Protection Agency, U.S. Geological Survey, National Park Service, and Bureau of Indian Affairs. Extensive effort was focused on the management of the multi-agency program, which culminated in the successful completion of the Glen Canyon Dam Environmental Impact Statement and the experimental flood in the Grand Canyon. Development of an integrated GIS database with linkages to multiple users was and important product from this applied research program. The program resulted in a modification of the management of the Colorado River.

1981-1983 Limnologist for the Upper Colorado Region of the Bureau of Reclamation, Salt Lake City, UT. Specific studies focused on the multi-level intake structure studies at Flaming Gorge reservoir, circulation study of Utah Lake, development of a limnological sampling program for Lake Powell, Flaming Gorge and Deer Creek Reservoirs, and providing technical expertise throughout the Colorado River basin on the application of instream flow studies and water quality studies.

1977-1981 Aquatic Ecologist for the U.S. Fish & Wildlife Service, Ft. Collins,CO. Worked while attending graduate school and focused on the development of specific instream flow studies related to the restoration of rivers and streams throughout the Western United States. Included the development of computer linkages for water quality and thermal studies. Taught the Instream Flow Incremental Application throughout the country.

1975-1977 Engineering Technician for the Bureau of Reclamation, Duchesne, UT. Worked on the study and evaluation of various dams, which were being built as components of the Central Utah Project. Focused on the application of engineering, hydrology and surveying expertise to rivers.

Bruce J. Yurdin

Illinois Environmental Protection Agency
Bureau of Water

Mr. Yurdin is the Manager of the Watershed Management Section in the Illinois EPA's Bureau of Water. This Section is responsible for a wide variety of planning and regulatory activities. Some of those activities include:

- The oversight and funding of nonpoint source pollution control projects under Section 319 of the Clean Water Act (2002 budget of approximately $9.5 million),
- The review of permit applications for agrichemical facilities, livestock operations and stream and wetland conversion projects, and
- The development of Total Maximum Daily Loads (TMDLs) for impaired waters in Illinois.

Mr. Yurdin has been with the Illinois EPA since 1979. Mr. Yurdin is a graduate of the University of Southern California, with a B.S. in Biology, and has a M.S. in Civil Engineering from Southern Illinois University.

BEYOND THE DAM:
WHEN DOES DAM REMOVAL MAKE SENSE?

Presented by:
David L. Wegner
Ecosystem Management International, Inc.
H. John Heinz III
Center for Science, Economics and the Environment

Durango, CO

June 2003

I. Introduction

For the last 4,000 years man has been attempting to control the rivers of the world. The physical control of rivers was deemed as necessary and important if man was to dictate the manifest destiny of growth and development. The landscape that we inhabit on this Earth was formed by the combined actions of land and water shaping and massaging the geology of the land. Fragmenting rivers and watersheds disrupts the natural processes necessary to sustain ecological systems and the evolution of the landscape.

Our relationship to water and rivers has changed over the last 4,000 years. It is widely believed that early civilization evolved in the area today known as the *Fertile Crescent*, that area of land between the Tigris and Euphrates Rivers in the Middle East. Early man viewed and worshipped rivers as the rejuvenator of the lands and supplier of food and nutrients necessary for survival. People celebrated the annual spring floods that rejuvenated the landscape and soils and provided the bounty of fish and plants so important to survival. It is no coincidence that the evolution of man began and was centered on rivers, as water is critical to survival. Early man had a reverence for the rivers and lakes and realized that they provided the wealth of the land. Water was not a commodity; it was an integral and communal part of life itself.

As man began to spread out into other areas he developed a new relationship with water. Rivers and lakes were not seen as community property but were instead viewed as entities for development and control. First rivers were used as conduits for transportation and commerce. River travel was necessary to move goods and people up and down the watersheds. River were used as conduits of waste and people. Dominance over the water required man to control it in order to profit from it. Dams began to be seen as necessary for control of the rivers and along the way the perception of water changed from one of being an *integral component* of our life to a view of water being a *utilitarian commodity* to be controlled, marketed and generally taken for granted. This change in our relationship to water and rivers set the stage for the era of dams to emerge.

Dams have been marketed as the panacea for the management of water and controlling rivers. The result has been the unnatural manipulation of rivers and has resulted in the loss of the ecological and social integrity of the fish, wildlife, vegetation and peoples who have evolved with the natural flowing rivers. Dams have left us with a false sense of security for flood control, water management and navigation. Long-term integrity of river systems requires that we look beyond the concrete and take into consideration watershed and river dynamics.

II. The Religion of Dams

Beginning in the early -1800's, dams began to become a much more important part of the landscape of river systems. Early dams were small, usually constructed on smaller tributaries and upstream of areas that experienced significant seasonal flooding. The control of rivers with dams began simply enough - first for powering mill wheels for grinding grains and cutting lumber for housing and building. As experience and need expanded, dams did to, both in size and number. Dams have been built to meet the need in five major areas:

- Flood control
- Irrigation
- Hydroelectricity
- Development
- Recreation

Today over 75,000 dams exist in the United States alone with an approximate 2.5 million existing throughout the world. Of this total over 45,000 large dams have been built in the last century alone. As the size of the dams increases so does the amount of water that is stored behind them. To put that number into perspective, that represents approximately *one-dam a day being constructed in the United States from July 4, 1776 to the present.* Dams have become integral parts of our landscape and have reshaped rivers and their watersheds.

Dams come in a variety of sizes from small (less than 100 acre feet) to large (greater than 1 million acre-feet). The majority of dams are small to medium size with control and management defined by local, regional and national regulations. While sizes of dams differ the impacts of small dams may be as significant as the larger ones.

Dams have become a religion onto themselves as man has enforced his domination over the rivers and waters of this Earth.

Dams and the development of rivers have become a national and an international symbol of success. The World Bank and other funding entities have regularly financed billions of dollars to construct dams as centerpieces of development in third world and developing countries. The investment has been high and so has the costs associated with this religion of dams (World Commission on Dams, 2000).

III. An Evolving Perspective on the Importance of Rivers

Beginning in the early 1980's dams and rivers began to be looked at differently. Attributing this change in perspective and attitude to one specific event or example is not possible. This change in perspective has come about as our cumulative knowledge about the effects of dams has increased and we have learned that dams have not met the short-term expectations that many had predicted. Our reassessment of dams has begun at local levels associated with small dams that have grown old, has expanded to regional and watershed levels on a national basis and is now being debated internationally as investors question the potential return on their investment dollars.

Recently the World Commission on Dams completed a comprehensive and global assessment of the benefits and disadvantages of large dams (dams greater than 15 meters tall and impounding over 3 million cubic meters of water) and concluded that *dams have made an important and significant contribution to human development ... but in too many cases, the social and environmental costs have been unacceptable and often unnecessary* (WCD, 2000). In the

United States the issue of dams and their longevity came full circle when the Edwards Dam on the Kennebec River in Maine was officially decommissioned and removed in July 1999. Clearly the era of big dams is over. The vision of the future includes not the subjugation of rivers with dams but a restoration of river processes and function. In essence, finding alternatives to dams.

- **Dam Decommissioning is not a New Concept**

Local, usually private interests, whose intent was to control rivers for economic development, initially developed dams. As dams grew in size and as the potential impacts of their placement increased local governments and private investors began to take more of an active role in building dams. In the early 1900's as the size of dams grew, the Federal government became more of the dominant players and financiers in dam development. Around the world international financiers and governments decided that dams were symbols of power and standing. Unfortunately the concept of watershed integrity was sidestepped in the desire to build monuments to governments and power. As much as we have learned about ecosystem management and the problems of large dams, incomplete decision-making continues.

In the United States there are three primary groups who control the dam building efforts:

- Federal - Corp of Engineers and the Bureau of Reclamation
- State/local governmental entities- regional and local flood control and watershed groups

- Private investors - hydropower and water management

Each of these groups has to abide by a set of rules and regulations. It is important to realize that most of the dams constructed in the United States and internationally have not been subject to stringent environmental review. In the United States the environmental review of dams did not begin until the National Environmental Policy Act was passed into law in 1969. Prior to that dams would be constructed with little or no thought or concern to the resources or people who were directly impacted. Today all Federal dams or federally funded dams or dams that impact Federal lands must undergo NEPA compliance and review, including impacts to endangered species, clean water and air, and cultural resources.

Private dams that generate electricity and utilize Federal funding or impact public resources must be licensed by the Federal Energy Regulatory Commission (FERC). The FERC issues licenses varying in length from 30 to 50 years. Private dams must undergo periodic review and relicensing in order to remain in place. Federal dams do not have the same requirements for periodic review and relicensing and therefore their impacts may extend for a significantly longer period of time than private dams.

Decommissioning of private dams and environmental review of Federal facilities is being initiated for several reasons:

- Concerns over the safety of the existing dams and their appurtenant structures

- Impacts to the ecological resources upstream and downstream of the dams
- The cost of maintenance and management of existing facilities in comparison to the lost benefits from the environment and the costs of meeting specific legal requirements
- Community and ecosystem revitalization
- Recovery of the costs that went into the original construction of the dams

Over the past 10 years over 200 dams (mostly private) have been removed in the United States. Today there are over 290 dams in the United States and 16 internationally that are actively being reviewed for potential decommissioning. The size of these dams range from small dams of less than ten feet to Glen Canyon, which is over 500 feet tall. Most recently the Corp of Engineers four large dams on the Snake River underwent a national review with a sizeable segment of the population requesting that the four dams be dismantled and removed.

The Role of Reviewer and Non-Governmental Organizations

There has been little consistency in the approach taken so far on the appropriate role of federal agencies and other organizations in the planning leading up to the decision to remove or decommission a dam. Recently the H. John Heinz Center for Science, Economics and the Environment (2002) published a scientifically peer reviewed journal on the science and decision making steps that should be taken when reviewing the potential for dam removal.

Internationally, increasing numbers of people are questioning the building of new dams, the management of existing dams and in many cases demanding the restoration of ecological and social integrity to impacted rivers. Currently reviews of existing dams is ongoing in Europe, Russia, Siberia, New Zealand, Turkey, Canada, Australia, Indian and Japan. Ongoing struggles over the construction of new dams is primarily occurring in developing countries where the potential for large-scale development is funneling construction funds into governments and international businesses, rarely assisting local populations or environments. In China, the massive Three Gorges Dam on the Yangtze River has attracted national and international attention as over 1 million people are relocated and the potential for substantial increases in sedimentation, water pollution and regional impacts are debated.

Non-governmental organizations (NGO's) play a critically important role in the review and debate on the role and impact of dams on the world's rivers. NGO's support three important ingredients in process that ultimately decides what decisions are made:

- Improved public policy
- Grassroots organizing
- Public education and political credibility

Public policy related to dam construction is defined by those who are in political control and wish to increase their position of power. These entities have historically driven water development. NGO's help to bring the issues out and provide a forum for alternate perspectives to be discussed debated and explored. NGO's also provide an organizational nexus for grassroots politics and alternative policy and issue debate. Grassroots organizations of disenfranchised groups and individuals can help in providing alternative forums and the raising of public interests. Lastly, NGO's provide an important function in educating the public and decision-makers. People in control rarely actively bring alternative information forward. NGO's provide an important vehicle for issue education and debate.

IV. THE EFFECTS OF DAMS AND RIVER REGULATION. WE NEED TO START AT THE BEGINNING

River development historically has meant the damming and diverting of rivers. To understand and put into context what affect this has on downstream environments, it is necessary to identify and articulate how a natural river responds to watershed influences. This characterization can be categorized into two broad components:

- The **physical** processes
- The **biological** processes

Physical Processes. A river is a representation of the watershed in which it exists. Typically a river will have a high-energy upper section; a middle section where the energy and mass find equilibrium; and a slow moving lower section where deposition occurs. A river defines itself by the substrate that makes up the watershed, the amount of runoff available, its length, and the chemical composition of the soils and riparian area of the watershed. Rivers find their equilibrium through a long balancing act between available water and the substrate through which the river flows.

Hydrologically rivers undergo seasonal cycles of high and low flows corresponding to the upstream water supply and runoff conditions. In many river basins this correlates to high flows during certain times of the years and low flows during other times. The high flows initially pickup and erode sediments as the flows increase and then redeposit them as the runoff decreases.

The equilibrium balance that occurs in the physical system occurs on several different time scales.

- Real-time - related to a minute-by-minute distribution of sediments and water in the local environment
- Seasonal/Annual - based on the yearly high and low flow pattern
- Decadal - based on longer term trends in rain, snow and runoff patterns

Native species of plants, birds, mammals and fish develop specific life history strategies to conform to the variability of the riverine system.

Biological Processes. As the river defines itself physically, the biological components evolve on a concurrent timeline reflective of the habitats, water quality and food resources available. Typically the upper sections of a river will support cold water species of fish, have lower nutrients and a specialized group of insects and plankton. A *biological continuum* evolves as the river flows downstream with a broader array of riparian and aquatic species developing as the habitat diversity and water quality changes. The resulting aquatic and riparian biological community reflects a continuum connecting the upstream ecosystem with the downstream (Cummins, 1974). Understanding the evolution and stratification of the riverine system is essential in order to design effective restoration approaches (NRC, 1992).

- **Fragmentation of the river environment**

Dams and water development *fragments* and *disrupts* the natural physical and biological processes of rivers. This happens as flowing rivers are changed from moving entities into reservoirs and slack-water environments. Reservoirs do not follow the same limnological patterns that natural lakes do (USEPA, 1984). When rivers are dammed major physical and biological changes begin to occur immediately:

- Dams become barriers to the upstream and downstream movement of fish, insects and amphibians.
- Reservoirs trap sediments that were historically essential for downstream deltas and river channels for habitat and floodplain development
- Reservoirs modify the water quality of the river system

- Reservoirs change the downstream water quality through the chemical changes that occur in reservoirs
- Dams modify the flow regimes downstream usually by taking away the life defining high flows, reducing the minimum flow and modifying the daily, seasonal and annual flow patterns of the river
- Biological food web modifications occur and domino their effects upstream and downstream

The problems are magnified as more dams are added to a river system, resulting in an increased and cumulative loss of resources, habitat quality, environmental sustainability and ecosystem integrity. Non-native species, modified water quality, loss of system dynamics and loss of the ability to maintain a continuum of an ecosystem result in disrupted and ecologically corrupted river systems.

In summary, dams affect the natural hydrologic patterns, which ultimately affect the geomorphic complexity of the river, which impacts that biocomplexity of the ecosystem and ultimately affects the species that live in and are supported by the river. Dams disrupt the natural hydrology and biological species across the entire flow regime. An example in the United States is the cumulative affect that the closure of Columbia and Snake River dams have had on the numbers of salmon. The loss of these species has had a significant effect on the economic and social well being of the people and have directly impacted the ecological integrity of the entire river system.

V. WHAT HAVE WE LEARNED AND WHAT OPTIONS EXIST?

- **Dams and water development has an effect that must be qualified and quantified before *useful* restoration or proper river management can occur.**

Studies conducted by scientists and managers across the world have documented the effects that dams have had on river ecosystems and societies. These effects have been documented in scores of technical papers and books (McCulley 1996, Collier, et. al, 1996, Ward and Stanford, 1979). The key issue is that no two rivers are the same. Each river is unique and requires an approach that takes into consideration the physical and biological aspects of the watershed and hydrological system.

Development of dams compromises the normal processes of rivers. Adequate procedures to evaluate the impacts and recommend remedial actions must be based on quantifiable information about the river and watershed. There is no cookie cutter approach to river restoration.

- **Dams compromise the dynamic aspects of a river. The dynamic aspects of the river are what define its character, not the *average* conditions of controlled dam operations.**

Natural rivers are a function of the flow, the quantity and character of the sediment in motion through the channel and the character or composition of the materials that make up the bed and banks of the channel (Leopold, 1994). The defining river discharge includes both high and low flow elements. The high flow elements initially defines the available habitats and often serves as the biological queues for the initiation of spawning, nesting, seed dispersal and insect hatching. As dams and flow modifications control rivers, the physical processes are constrained and the biological processes are disrupted. The result is a loss of biological integrity as species are unable to complete essential life history strategies. The result is that critical ecosystem elements are lost or modified to such a point that they are biologically unusable.

The resulting modified habitats often create environments that are more conducive to non-native and exotic plant, fish, snail, insect and animal species (MRSG, 1982, NRC, 1996b). These resulting non-native species often out compete the native species and end up developing ecosystems that are unstable, conducive to disease vectors, and unable to support the historical environmental and social components. The short-term gain in having a reservoir or hydroelectric plant may not compensate for the loss of critical ecosystem functions.

- **Dam and reservoir management must take into consideration the historical environmental and social resources.**

Historically dam and river management has focused on the development of reservoirs and the more efficient movement and control of water. Development has often been justified based on the value to be returned to the people and the increased efficiency of water management. Undoubtedly some of these goals are important from a social perspective (Water Resources Environment Technology Center, 1998). These development goals however have often come at a significant price, the loss of river ecosystems, the loss of social integrity, and the loss of the ability for a watershed to maintain its ecological sustainability.

It is essential that the long-term impacts to the environmental and social environments be considered when river development is being proposed. It is essential that the social and environmental costs be taken into consideration when dams are being debated. Intact and functional river systems will support many more people in the long run than the short-term benefits gained from undefined river development.

VI. RIVER RESTORATION. ALTERNATIVES TO DAMS AND TOOLS ARE NOW AVAILABLE TO RETHINK AND MODIFY HISTORICAL APPROACHES

Around the world people are questioning the results that the decisions to build dams has brought. These questions are not about what the dams provided. These debates are over the residue of what the dams have brought - corrupted ecosystems, lost species and impacts to cultural resources. Societies and people are asking whether anything can be done to lessen the impacts and restore parts or all of the lost ecosystem structure and integrity. Some of the ideas that are being formulated include.

- **Managed Flow Regimes from Dams.**

In 1996 the U.S. Department of the Interior conducted an experiment on the Colorado River, Glen Canyon Dam, to determine if an artificial flood through the Grand Canyon could restore important sediment and habitat resources for native fish and bird species (Wegner, 1996, 1997). The experimental flood was a short-term success in restoring important ecosystem physical and biological functions. The long-term sustainability of the high flow experiment has not proven to be stable. Alternative operations were officially determined through the scientific studies completed at Glen Canyon Dam (USDI, 1995).

- **Retrofitting Dams.**

On several dams across the United States and the world federal, state and tribal entities are retrofitting dams in order to provide increased management and operation flexibility (COE, 1993, Collier, et al, 1996). Several different types of retrofits are being looked at:

  - Thermal modification (Flaming Gorge, Shasta, Glen Canyon)
  - Fish Screens (Bonneville, Lower Granite)
  - Increased spillway capacity

- **Watershed Habitat Restoration.**

Habitat restoration on selected tributaries and mainstem habitats may help to provide necessary areas for spawning, juvenile fish rearing, riparian habitats for birds, and increased bank stability. Specific examples include:

  - Creation of buffer zones along the riparian corridor (NRC, 1992)

    - Restoring spawning habitat (Columbia River Inter-Tribal Fish Commission, 1999)
    - Improved habitat management (NRC, 1992, NPPC, 1992a, 1992b)
    - Watershed area management plans (Hualapai Tribe, 1999)
    - Development of migration corridors (NRC, 1992)

- **Reservoir Management.**

Many migrating fish species have time critical life stages that require movement from fresh to salt water environments. Reservoirs slow down water and increase the amount of time it takes a young fish to move from its upstream habitat to its downstream habitat. Drawing down reservoirs during critical times of the year has been shown to increase the velocity of the river and reduce the amount of time that young fish are moving from one habitat to another (NPPC, 1996 a,b,c). The Northwest Power Planning Council is currently evaluating the potential to increase the river flow through the Snake and Columbia River system in an effort to move juvenile salmon through the system.

    - Reservoir drawdown programs (USCOE, 1993)
    - Increased river velocity (NPPC, 1999 a,b)

- **River System Management.**

On many river systems multiple dams control the flow of water. Management of multiple reservoirs and dams requires additional cooperation, planning and system management efforts. Flood control, hydropower generation, irrigation requirements, and flushing flows require a significant amount of coordination. Specific examples include:

- Columbia River management (USCOE, 1993)
- Colorado River management (BOR, 1995)
- Yangtze River (Probe International, 1991)

- **Modification of Reservoir Water Quality.**

On smaller reservoirs water quality considerations increase under conditions of extensive thermal and density stratification. Anaerobic conditions lead to increased migration and transformation of heavy metals into the volatile and potentially dangerous constituents. If these constituents are taken up by the plankton, they can lead to a cumulative impact to the forage fish, the non-game fish and eventually the game fish species that are of economic, social and recreational importance. Modifications to reservoir water quality can include:

- Aeration to break up stratification (USEPA, 1984)
- Increasing the turnover rate of reservoirs (NRC, 1992)
- Impacts on heavy metals (Wegner, 1999)

- **Dam Decommissioning.**

Across the United States and the world, NGO's, private companies and governments are evaluating and implementing actions to decommission specific dams. The dams being targeted for study and evaluation are those that have caused considerable harm to the riverine ecosystems, have fragmented critical river systems and have led to considerable negative impacts to social and economic conditions downstream.

In the United States hundreds of small dams have been removed. In the majority of these efforts little scientific information was available to assess the pre and post dam effects. Two specific examples include:

- Woolen Mills Dam – Milwaukee River, Wisconsin
- Edwards Dam – Kennebec River, Maine

These efforts have led to a considerable increase in the sharing of information among scientists around the world to document impacts caused by dams.

- **Dam Review Efforts in the United States**

Recently two national efforts have produced reports evaluating the state of the knowledge regarding dam removal and river restoration, the *H.John Heinz III Center for Science, Economics and the Environment* and the *Aspen Institute* (2002). The Heinz Center (2002) has completed a peer-reviewed assessment of the state of the science of small dam removal and has assembled a list of recommendations that are pertinent to the study of dams and river everywhere. Specific conclusions that can be drawn from the Heinz Center efforts include the following:

1. **Dam Removal Decisions must follow a specific process that includes:**
    a. Establishment of objectives and the collection of data
    b. Identification of the complete range of issues

    c. Assessment of likely outcomes
    d. Transparent decision process
2. **A summary of indicator parameters should be developed to guide the decision process. The information should be locations specific and assess response with and without the dams. The parameters should include:**
    a. Physical
    b. Chemical
    c. Biological
    d. Economic
    e. Social issues
3. **Uncertainty must be recognized as an important element in the decision process. Uncertainty should be integrated into the decision process through an adaptive science and management effort.**

The recommendations developed by the Heinz Center and the Aspen Institute is being used nationally to further the study and debate of the role of dam removal in river and ecosystem restoration. It is clear that a scientifically driven process is necessary to ensure adequate assessment and to guide administrative decision-makers.

- **Ongoing Dam/River Studies**

Examples of specific river systems being studied include:

- Colorado River, USA (Wegner, 1997)

- Elwha River dams, USA (USDI, 1994)
- San Clemente Dam, Carmel River, USA
- Lower Snake River dams, Snake River, USA

VII. SUMMARY

It has been documented that dams have a negative impact on natural river systems. Fragmented habitats, lost ecosystem production and connection, introduction of exotic species and diseases, and increased water quality problems are but a few of the impacts seen when natural riverine processes are constrained. This does not mean that all dams are bad. Certainly the development of water resources has played an important and valuable role for societies and cultures or people. Today we must develop adaptive management approaches to meeting our social and environmental goals (Meretsky, et al, in press). The issues facing us today is if the process we have been traditionally following makes sense for the future and if certain rivers can be sustained through a combined effort of reoperation, management and restoration.

We are poised at a threshold regarding the ecological health of the world's rivers. At no time in the world's history have we had both the technology and ability to restore critical riverine ecosystem functions. Balancing the societal short-term needs for water, electricity and transportation with the long-term needs for river ecosystem sustainability and integrity requires a unique set of people, agencies, governments and private groups to cooperatively work together. Science can provide the basics for outlining the existing conditions and the options for restoration. Implementation of actions requires people with initiative and vision for the future.

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Institutionalizing the Option of Dam Removal: The New Hampshire Initiative[1]

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ABSTRACT

Since 2001, the State of New Hampshire has worked to institutionalize the option of dam removal. The high gradient streams which flow through the granite hills and mountains of this small northeastern state provided ideal conditions for dam construction, particularly during America's Industrial Revolution of the 1800s when mills were constructed throughout the area. With more than 4,800 dams in the state's database, there are many opportunities for the removal of dams that no longer serve a useful purpose, have become public safety hazards and impact the river environment. Efforts to facilitate removal of dams in New Hampshire include the formation of a River Restoration Task Force and the creation of a dam removal program within the state agency responsible for regulating dams. This has led to the removal of two dams and approximately ten additional projects in various stages of planning. A history of this agency-led initiative, as well as a discussion of the program's strengths, challenges and goals for the future are presented.

INTRODUCTION

The State of New Hampshire is located in the northeastern United States, and is one of six states that are typically referred to as New England. With a total area of only 9,304 square miles, the state is ranked 46th in size in the nation. New Hampshire is bordered on the north by the Canadian province of Quebec, on the east by the State of Maine and the Atlantic Ocean, on the south by the State of Massachusetts, and on the west by the State of Vermont.

Forested, granite hills and the White Mountains provide the geology that allows New Hampshire to serve as the headwaters for five of the great rivers of New England: the Connecticut, the Merrimack, the Piscataqua, the Androscoggin, and the Saco rivers.

New Hampshire's nearly 42,000 miles of rivers have significant drops in gradient and provided ideal conditions for harnessing the power of water through dam construction. More than 4,800 dams are listed in the state's dam database. Of these, 3,200 dams are considered "active" while the remainder are in a condition that does not require regulation under state or federal law (e.g., very small, incomplete, in ruins, breached). The regulatory responsibility for the vast majority of

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dams rests with the New Hampshire Department of Environmental Services, Water Division-Dam Bureau. A small portion of the state's dams (i.e., large-scale hydropower, flood control) is regulated by federal agencies.

Many New Hampshire dams were built during the Industrial Revolution, and they played central roles in the state's economic and societal growth during that period. Many were constructed to provide mechanical power, and later hydropower, for industrial mills or to provide water for log drives, which made New England famous in the 1800s and early 1900s.

Today, few of these dams still perform their original function. Of the 3,200 active dams in New Hampshire the uses are as follows: fire protection (8% of active dams statewide), hydropower production (5%), water supply (3%), and flood control (2%). The remaining are mostly impoundments that may enable and enhance valued recreational uses such as boating, fishing, and swimming. While some dams still may serve a useful purpose, many are obsolete and rapidly deteriorating, representing financial and legal burdens to their owners, posing a safety hazard to the public and impacting the health and quality of rivers and riverine species. Many of these dams are excellent candidates for removal.

In less than three years the State of New Hampshire has successfully institutionalized the option of dam removal. This paper discusses the state's significant advancements that include the formation of the New Hampshire River Restoration Task Force, the creation of a dam removal program within the state agency responsible for regulating dams, the removal of the first dam expressly for the purpose of river restoration, and the establishment of a process for complying with the National Historic Preservation Act, in addition to a variety of state and federal environmental laws.

METHODS

In the winter of 2000, nearly forty people representing a variety of state and federal government agencies, local interests and conservation groups convened in New Hampshire with the objective "to exchange information regarding dam removal experiences, regulatory requirements and funding sources." This meeting resulted in the conception of the New Hampshire River Restoration Task Force.

This gathering confirmed the belief that a high level of interest in dam removal existed in the state, and provided the momentum for the formation of a dam removal program within the New Hampshire Department of Environmental Services (NHDES). The agency felt that it was best situated to provide the critical role of providing assistance to dam owners, communities and others throughout the dam removal process, and received a two-year grant to pilot the program from the U.S. Environmental Protection Agency New England Regional Office which included funds for a full-time program coordinator.

The author of this paper was hired for the program coordinator position because of her experience in the interdisciplinary nature of dam removal (i.e., engineering, ecological, economic and societal issues), as well as her experience with environmental conflict management in public decision-making processes, fundraising, media relations, public education and the management of multiple projects. Initially the agency had the goal of hiring a professional engineer who was familiar with the technical aspects of dam removal but realized that engineering is only one component of managing a dam removal program and therefore should not be considered a critical qualification. In June 2001, the program was officially launched.

New Hampshire is only the second state in the United States to formally develop such a program, Massachusetts being the first to do so. The program is housed within the NHDES Water Division-Dam Bureau, which has the mission of ensuring all dams in the state are constructed, maintained and operated in a safe manner. The Bureau conducts dam safety inspections, permits dam construction and reconstruction, and serves as the primary source of information regarding dams. The Bureau also owns approximately 113 dams, thirteen of which generate hydropower, and is responsible for maintaining the 260 dams that are owned by the combination of New Hampshire's state agencies. The Dam Removal Program provides the public with information on dam removal, technical assistance to dam owners and the consulting community in planning a project, assistance in navigating the necessary regulatory process, and assistance in developing a funding package to offset dam owners' costs of removal.

A key component of the program is the assistance and guidance of the River Restoration Task Force, which explores opportunities to selectively remove dams, typically for the purpose of restoring rivers and eliminating public safety hazards. The Task Force is made up of a variety of stakeholders (*see* Table 1), which speaks to the interdisciplinary nature of dam removal.

Table 1. New Hampshire River Restoration Task Force participants, as of May 2003

State & Federal Government Agencies	Not-for-profit Organizations
U.S. Environmental Protection Agency	American Rivers
U.S. Army Corps of Engineers	Ashuelot River Local Advisory Committee
U.S. Fish and Wildlife Service	Coastal Conservation Association
U.S. Geological Survey	Coldwater Fisheries Coalition
U.S. National Park Service	Connecticut River Watershed Council
U.S. Department of Agriculture, Natural Resource Conservation Service	Conservation Law Foundation
National Oceanic and Atmospheric Administration, Fisheries Restoration Center	Merrimack Valley Paddlers
N.H. Department of Environmental Services	New Hampshire Rivers Council
N.H. Division of Historical Resources	The Nature Conservancy
N.H. Office of Emergency Management	Trout Unlimited
N.H. Fish and Game Department	

After nearly three years of existence, the Task Force meets regularly to discuss specific dam removal projects as well as state-level policies and procedures concerning dam removal. Task Force members often serve on local advisory teams that are created for specific projects. This helps provide consistency among projects and expands the Task Force's cumulative base of experiential knowledge.

RESULTS AND DISCUSSION

During its first year the River Restoration Task Force developed a set of objectives that shaped the direction of New Hampshire's dam removal efforts, and laid the foundation for the subsequent development of the NHDES's Dam Removal Program. The initial objectives were to: identify potential dam removal project sites; assess the ecological, historical, public safety, and local interest issues associated with each dam removal proposal; and seek ways to improve the regulatory process (Levergood, 2001).

Initial identification of potential projects

The initial identification of potential dam removal project sites was a four-part process that identified: 1) run-of-river dams (i.e., non-flood control) with no identified beneficial use; 2) dams on rivers with existing fisheries restoration programs, specifically for migratory fish; 3) dams with known safety concerns or high potential for future NHDES enforcement action; and 4) dams where the benefits of removal appeared to outweigh the negative impacts. For the dams identified using these criteria the Task Force then applied a series of yes/no questions to gauge owner willingness, hazard mitigation and public safety, ecological value, cultural value, recreational value, and project feasibility. The systematic process allowed the Task Force to objectively select potential projects and demonstrate that the initial selection of projects was neither random nor that specific dams, or dam owners, were targeted for removal without putting them in context with other dams in the state (Levergood, 2001).

Approximately 30 dams were identified statewide, ranging from four to thirty feet in height, and under various types of ownership (i.e., public, private and ownerless). A database was developed to catalog these dams, including facts about the structure and dam ownership, and information on the predicted impacts specific to each dam removal. Fifteen of the dam owners were approached to determine their interest in dam removal. Ten initially expressed interest in pursuing removal with the assistance of the Task Force. The Task Force chose to direct its energies toward these projects. To date New Hampshire has removed two of these dams – both on the Ashuelot River (one project is discussed in more detail below). The owners of three dams, whose projects appeared on the initial list but who had not been approached by the Task Force have since, of their own volition, begun to pursue the removal of their dams. Meanwhile, the owners of several dams not appearing on the original list have requested information about dam removal and are seeking assistance in the removal their dams. The increased interest in dam removal is clearly due to the successful and publicized removal of two dams, and the creation of the NHDES Dam Removal Program.

As with many organized efforts with the goal of pursuing the selective removal of dams, New Hampshire decided to narrow the universe of potential project sites by identifying candidates that met a variety of criteria. This process assisted the Task Force in focusing on a small number of potential projects. While this can be a valuable method of beginning a dam removal effort, it can also be a risky endeavor. If dam owners and/or the general public feel that dams are being targeted for removal (e.g., a "hit list" of dams to remove) the process could cause very strong reactions against the prospect of dam removal. This could not only impact efforts for a specific dam removal, but could also be damaging to the effort in general.

Despite the intrinsic delicacy of the four-part process described previously, it was useful for identifying initial projects in New Hampshire and has led to two successful removals thus far. The Dam Removal Program is currently in the process of expanding and formalizing the criteria in order to prioritize the allocation of limited time and resources available for dam removal projects that have been proposed by dam owners.

Development of a Permit Application Specific to Dam Removal Projects

Task Force members recognized that the existing permitting process for projects involving dams and surface waters of the state would not adequately address specific concerns that can be unique to dam removal. Experiences in New Hampshire and other states suggested that the requirement of a variety of separate permits for one project can be confusing and viewed as excessively burdensome. This can serve as a disincentive to pursuing the option of dam removal and river restoration. Therefore, NHDES personnel and Task Force members collaborated in the development of a permit application specific to dam removal projects.

The original concept was to develop a stand-alone permit application specific to dam removal projects, one that would be sufficient for the regulatory review processes of both the NHDES Wetlands Bureau and the Dam Bureau. Both bureaus have regulatory authorities for aspects of dam removal projects. However, after using the single permit application concept for over a year, it became clear that applicants, consultants and local officials were confused by the new application and the regulatory processes associated with it.

Therefore, NHDES decided to develop an Attachment to the Standard Dredge and Fill Application for Dam Removal Projects to address a variety of issues, including some that are unique to dam removal. The applicant is required to provide well-founded answers to questions regarding anticipated project impacts to wetlands, fish and wildlife, navigation and commerce, aesthetics, water supply and quality, historic resources, sediment quality and quantity, and the floodplain.

The permit application also requests proof of consultation/coordination with the State Historic Preservation Office. This is a federal requirement per the National Historic Preservation Act, not a state requirement, and is discussed in more detail later in this paper. Other agencies and NHDES Water Division bureaus may review the application materials as necessary for related issues such as water quality, water supply impacts, sediment quality, and impacts to existing infrastructure. The application covers the requirements for state-regulated dams, regardless of size, but does not meet federal requirements for the removal of hydropower dams under Federal Energy Regulatory Commission jurisdiction.

First project, first lessons

Dams located on the Ashuelot River in southwestern New Hampshire rose to the top of the list generated by the Task Force during the four-step project identification process. Since 1995, the New Hampshire Fish and Game Department and the U.S. Fish and Wildlife Service have been working to restore and enhance anadromous fish populations to the Ashuelot River. The Ashuelot, a tributary to the Connecticut River, historically supported abundant runs of Atlantic salmon, American shad, blueback herring, and sea lamprey. These fish populations were severely impacted by the construction of dams, which block access to critical spawning and nursery habitats. While stocking has helped, installation of fish passage on three small-scale hydropower dams as well as the elimination of non-natural fish barriers were seen as essential elements of a restoration plan. In 1999, New Hampshire Fish and Game Department identified three dams on the Ashuelot as candidates for removal, and, with the assistance of the newly formed Task Force, the McGoldrick Dam was the first dam to be removed in New Hampshire for river restoration purposes.

The McGoldrick Dam was a privately owned dam. It was a six-foot high, 150-foot long timber crib dam, capped in concrete. Built in 1828 to impound water for a canal that supplied water to eight manufacturing facilities until 1950, the dam has since served no purpose. There was a minimal amount of sediment accumulated in the impoundment, and what was there was free of contamination. Through late 1999 and early 2000, the Task Force developed a permit application for the project, and set July 2000 as an estimated removal date.

In Spring 2000, project partners learned that the McGoldrick Dam removal project could not be permitted without coordination with the State Historic Preservation Office - the state office charged with ensuring adherence to the requirements of the National Historic Preservation Act of 1966 (NHPA). Upon coordination, project partners were notified that the project was subject to the NHPA and would require further public involvement and an historic resource inventory of the dam and associated properties to determine if the proposed undertaking (i.e., the dam removal) would impact resources of historic significance. The need to comply with the NHPA is triggered when federal funding is provided or when federal permits are required for a project. Both federal funding and a federal permit were components of the project and therefore it was clear that the project must adhere to the NHPA. Compliance with NHPA required the removal to be postponed by one year and a new date of July 2001 was set for the McGoldrick Dam removal.

The historic inventory found the dam and its associated canal to be eligible for listing to the National Register of Historic Places. According to the State Architectural Historian, the dam and canal were found to represent a rare survival of an early attempt to harness waterpower on a moderately large scale. In accordance with the NHPA, a Memorandum of Agreement (MOA) was executed between the New Hampshire State Historic Preservation Office (SHPO) and the U.S. Fish and Wildlife Service, the lead federal agency on the project. The MOA stipulated specific actions that would be performed to mitigate the project's impact to historic resources. These included taking archival quality photographs to be stored with the SHPO and the local historical society and the installation of interpretive signage concerning the significance of the dam and canal at the former dam site.

The NHDES Dam Maintenance Crew carried out the deconstruction of the dam. The removal was completed through the use of a hydraulic hammer mounted on a backhoe to break up the concrete portions of the structure. A second excavator transferred the rubble concrete and much-deteriorated timber crib to a dump truck that moved them off-site to be used by a local farmer for filling eroded areas of his property. Rocks found within the timber crib structure were redistributed throughout the river channel at the project site. The project was entirely completed in three weeks, at a cost of $52,300. Financial and technical assistance was provided by the following partners: U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration, N.H. Fish and Game Department, NHDES, N.H. Division of Historical Resources, N.H. Department of Transportation, and the American Sportfishing Association-FishAmerica Foundation.

Program strengths and challenges

New Hampshire's dam removal program is rather new but several strengths and challenges can be identified thus far.

The NHDES's decision to place the program within the Dam Bureau, as opposed to other bureaus that may have a more direct link to river restoration activities, has paid many dividends. The program's development has allowed for the centralization of information and assistance related to the issue. This has been helpful for the general public, consultants, government agencies and others. It is also the most likely place dam owners will look to for information about dam removal. The location of the program within the Dam Bureau also provides the program coordinator direct access to the dam safety information and to dam safety engineers, who have technical expertise and the personal knowledge of specific dams, such as information about their recent history and their ownership. Likewise, the Dam Bureau staff has the opportunity to learn about the value of dam removal, appropriate methods for removing dams and the value of free-flowing rivers.

Another noteworthy strength is that the Dam Bureau has a Dam Maintenance Crew that operates, maintains and repairs the 260 state-owned dams. Thus far crew has conducted the two dam removal projects and future projects will be completed with their assistance. This has served two important purposes. First, based upon cost estimates for similar projects, the State's crew can conduct the physical removal of a dam at considerably less cost than contracting to private parties. The costs of the removals are not borne by the Dam Bureau budget; the expenses (e.g., labor, materials, equipment) are paid through funding packages that are developed for each project. Secondly, by using the State's crew, the NHDES has been able to closely coordinate the design and implementation of these first removals in New Hampshire, allowing regulators to directly determine appropriate methods for removal, and learn valuable lessons in the process.

Given the number of dams New Hampshire plans to remove in the future it is clear that the Dam Maintenance Crew will not be capable of handling all the projects. Nor will the program coordinator be capable of managing the number of potential projects that have arisen since the formation of the program. Therefore, dam owners and others will become increasingly dependent upon the private consulting and contracting community. Since the formation of NHDES's Dam Removal Program a large number of engineering and environmental consulting firms have expressed significant interest in gaining experience in river restoration and dam removal. In fact, the State recently put the first comprehensive dam removal feasibility analysis project out for bid and received 17 proposals. Firms from throughout the Northeast region submitted proposals, as well as one firm from the Midwest.

While it is exciting that such interest in projects of this type exists, there is also a clear need for professional education and training related to dam removal and its impacts to rivers, wetlands, existing infrastructure and flooding regimes. The consultant community is in need of training on the issue. Recent conceptual project plans and cost estimates developed by consultants for private or municipal clients, and reviewed by the NHDES, have included questionable methods and have been quite expensive, even in comparison to similar privately-conducted projects in other states. However, consultants are not the only ones in need of training and education on dam removal and natural river processes. State and federal agencies with various authorities relevant to dam removal permitting and design processes also tend to lack experience and understanding about dam removal. To help meet this need, the NHDES recently collaborated with the University of Wisconsin Engineering Professional Development Program and American Rivers in providing a four-day technical course on dam removal and nature-like fish passage. The course was held in the White Mountains of New Hampshire in October 2002 and was attended by over 100 people from across the United States and Canada, representing the consulting community, state and federal agencies, academia and non-profit organizations. The curriculum included two days on the wide variety of issues relevant to dam removal, and an additional two days on nature-like fish passage -- a relatively new fish passage technique within the United States, yet one that has been successfully implemented throughout Europe, Australia and New Zealand. A second four-day technical course on natural channel design methods in river restoration is being planned for the future.

Every dam removal project provides lessons, ranging from the decision-making process to the method of physically removing a dam. New Hampshire's first experiences have highlighted the need for early inter- and intra-agency coordination with all relevant state and federal agencies. The most important lesson learned through the McGoldrick Dam removal was that, in the pursuit of restoring rivers, the cultural and historic value of the property must be considered. It is now well understood that historic preservation interests must be involved early in the planning of the project. A lesson of this type could only have been learned through experience.

In the case of the McGoldrick Dam removal, the project was postponed for a year because of the unforeseen need to comply with federal laws pertaining to historic preservation. The State Historic Preservation Office (SHPO) is now an active member of the Task Force and is consulted early in the planning process of all projects. In an effort to standardize the process, the SHPO and NHDES have developed generalized guidelines for conducting architectural and archaeological resource reviews specific to dam removal projects. However, a learning curve remains, and projects continue to experience delays, largely due to the fact that dam removal and associated regulatory processes are new to the state. The Dam Removal Program and the SHPO are working to develop an acceptable, standardized and predictable process.

Coordinated efforts between the Dam Removal Program and the SHPO is an example of how the Task Force enables important relationships. The Task Force has played a critical role in building trust, fostering mutual respect and increasing understanding of the multiple interests that converge on the issue of dam removal. The Task Force generates a culture of learning about the various issues related to dam removal decisions, planning and implementation, and helps to direct the future efforts of New Hampshire's Dam Removal Program.

A more fundamental challenge for both New Hampshire and the nation is that many existing state and federal environmental regulations triggered by a dam removal project focus on environmental *protection*, rather than the associated environmental *restoration* activities. This represents a combination of challenges. Some regulations are not easily adapted to restoration activities. Some include guidance on restoration activities, but are not commonly applied or enforced as such by the relevant regulatory agencies. And, some laws actually discourage environmental restoration efforts because they deviate from the status quo (Bowman, 2002).

To date, the New Hampshire experience suggests that an increased understanding of dam removal and its impacts to rivers allows for accommodation of different requirements than those that are standard for implementing traditional development projects (e.g., construction of dams, bridges, pipelines). A key difference is that traditional development projects often require maintenance for years to come, resulting in repeated impacts to the environment. Requiring similar construction methods during restoration projects, because they are required for development projects, may actually exacerbate temporary project impacts and/or cause long-term impacts to rivers. An example of this would be requiring that a temporary trap-rock road or pad be installed in the river channel in order to keep equipment off the stream bottom and out of the water during construction. This might be necessary given some site conditions (e.g., a stream with silt substrate during certain flow conditions). Given other site conditions, this might be unnecessary (e.g., a stream with cobble substrate during low flow conditions), and the goal of alleviating impacts to the river might be better served by shortening the project's time period and not requiring a trap-rock road/pad, which impacts the river twice – when it is installed and when it is removed.

Certainly, broad-brush exemptions from environmental protection laws for restoration projects are not advisable because environmental restoration projects do have impacts that need to be reviewed and minimized. The author concurs with Bowman's (2002) recommendation that

> A better approach may be to provide regulatory direction or guidance that allows a decisionmaker to provide some accommodation for projects with restoration as their primary purpose. For example, a state or federal agency could establish a policy that enables flexibility in the interpretation of permitting requirements when a proposed project's primary purpose is environmental restoration. An agency could also direct permitting officials to consider the long-term benefits of a restoration project as mitigating factors in determining whether the short-term impacts of a project are acceptable. The challenge is to develop this in a fashion that avoids the appearance (or reality) of unfair treatment or relies so heavily on professional judgment that it renders the regulations unpredictable or

unenforceable. And if restoration activities are given special accommodation, it will be especially important that the project proponents demonstrate that the restoration goals were actually met.

There are discussions underway in New Hampshire to create certain exemptions to the State standard of not allowing equipment in the water. With an ever-increasing number of restoration projects on the horizon in both New Hampshire and nationwide, future discussions are likely regarding revisions to, and the application and enforcement of, existing regulatory policies.

CONCLUSIONS

The New Hampshire initiative has shown that there are many benefits to an agency-led effort to institutionalize the option of dam removal. It can enable efficiencies for both statewide and project-specific efforts. It can provide valuable public education and outreach opportunities regarding the interdisciplinary nature of dam removal. It can result in creative approaches and solutions through public-private partnerships, and it can play a critical role in building relationships among parties that must work together to achieve successful projects.

The NHDES recently underwent a five-year strategic planning process through which many goals were set for the Dam Removal Program, including: developing new Dam Bureau rules regarding procedures for dam removal; developing a guide to the regulatory requirements associated with dam removal in New Hampshire; developing a system of prioritizing dam removal projects; providing continuing training opportunities on dam removal and river restoration for both public agency personnel and the private sector; creating a staff position that provides agency expertise on fluvial geomorphologic concepts; and monitoring the effects of dam removals on three river systems through partnerships with academic institutions, local stakeholder groups, agencies and other interests.

The State of New Hampshire's accomplishments in the first years of its initiative have created a strong foundation for the future of dam removal in the state. In the coming years the many partners of the Task Force look forward to restoring rivers and making New Hampshire's waters safer for the public through the selective removal of dams.

REFERENCES

Bowman, Margaret B. (2002). Legal Perspectives on Dam Removal. *Bioscience*, **52**(8), 739-747.

Levergood, P.E., Grace. (2001). A Historical Perspective to Dam Removals: The New Hampshire Program. Association of State Dam Safety Officials. 2001 Annual Conference Proceedings. Snowbird, Utah.

Evaluation of the North Batavia Dam Modification on the Fox River

Hope R. Dodd, Steven E. Butler, and David H. Wahl
Center for Aquatic Ecology
Illinois Natural History Survey

Collaborators and Funding

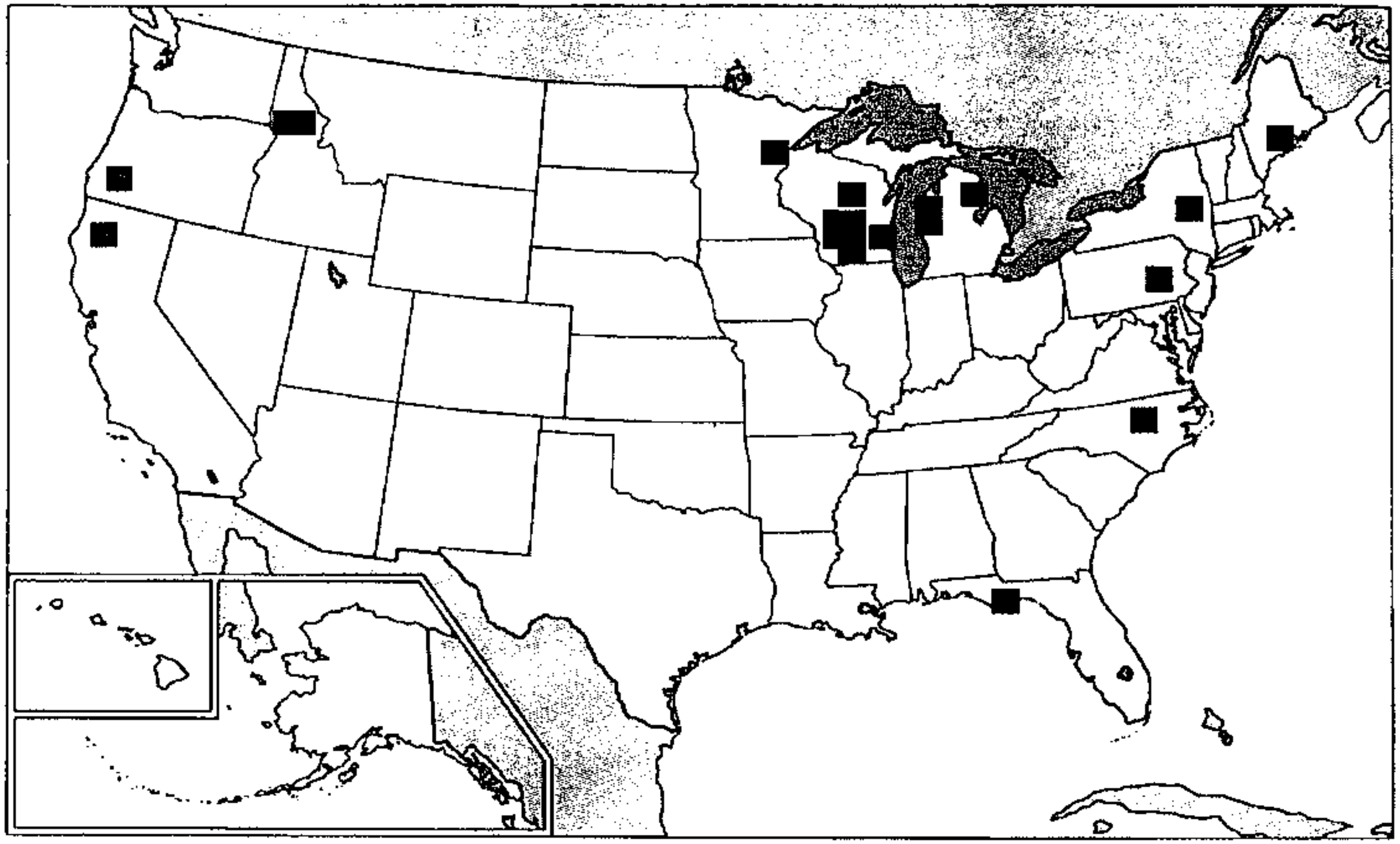
Vic Santucci - Max McGraw Wildlife Foundation

Steve Pescitelli - IDNR Stream Biologist

Office of Water Resources - IDNR

Illinois Natural History Survey

Dam Removal Studies



- 76,000 dams in U.S. (USACE 2001)
- 500 dams removed to date (American Rivers et al. 1999)
- 20 dam removals studied for environmental impacts

Reasons for Dam Removal/Modification

- Safety issues
  - abandonment and deterioration
- Economic issues
  - older dams are less cost-effective
- Environmental issues
  - habitat loss/fragmentation
  - block fish movement

Above Photo: North Batavia Dam Website

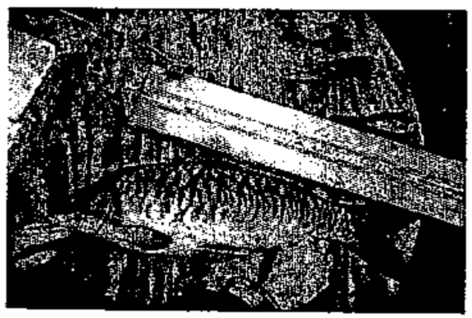
Expected Results from Removal/Modification

<u>Impoundment (IMP)</u>

- Decrease depth
- Increase flow and sediment size
- Decrease temperature and stabilize dissolved oxygen levels
- Shift from impoundment to free flowing organisms
- Increase aquatic insect and fish diversity and abundance

<u>Free Flowing (FF)</u>

- Minor sediment deposition and short-term shift in benthic organisms
- Movement of impoundment fish into downstream/upstream free flowing areas
- Possible decline in undesirable fish due to change in habitat utilization
- An overall increase in fish movement and range



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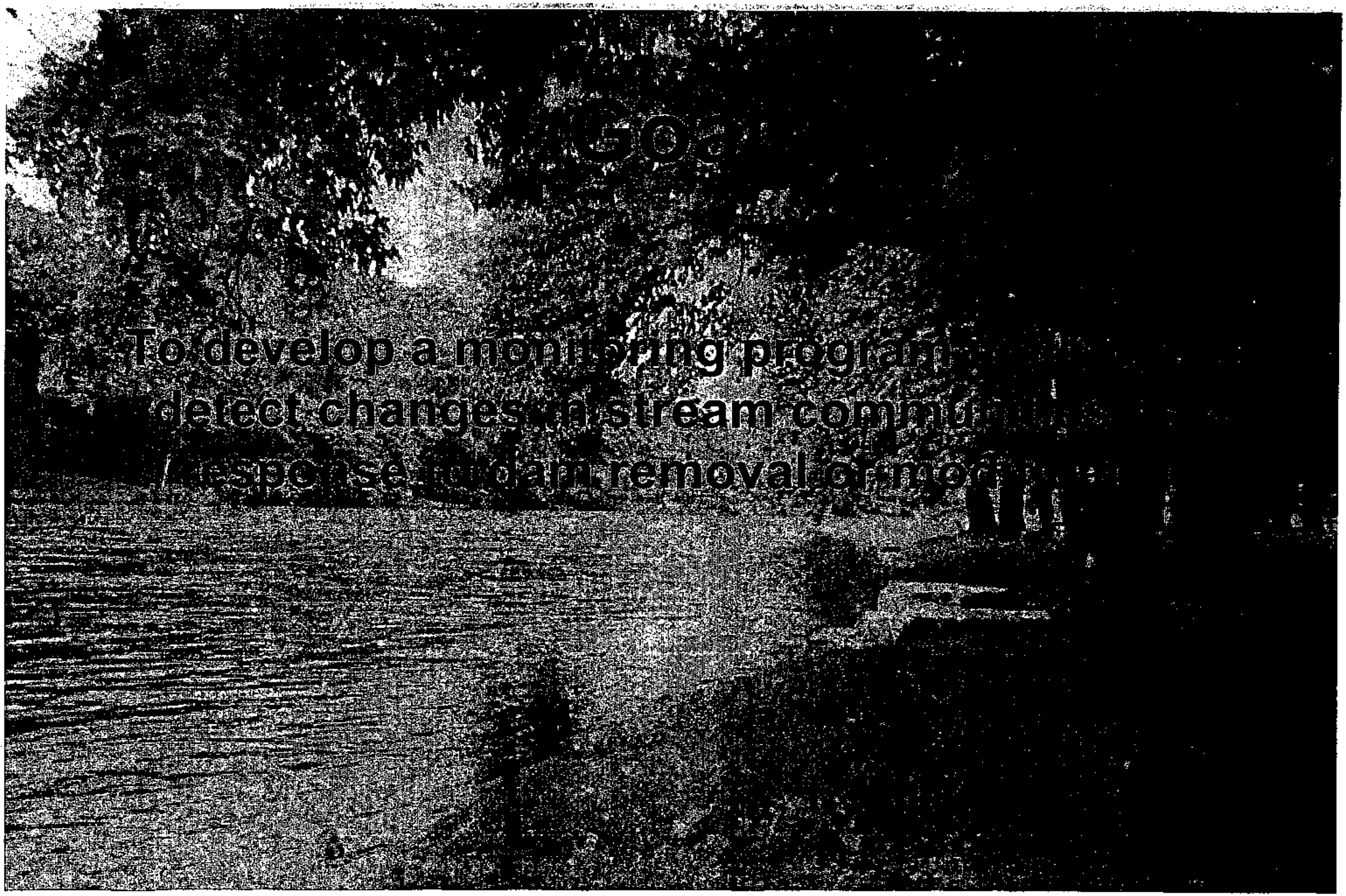
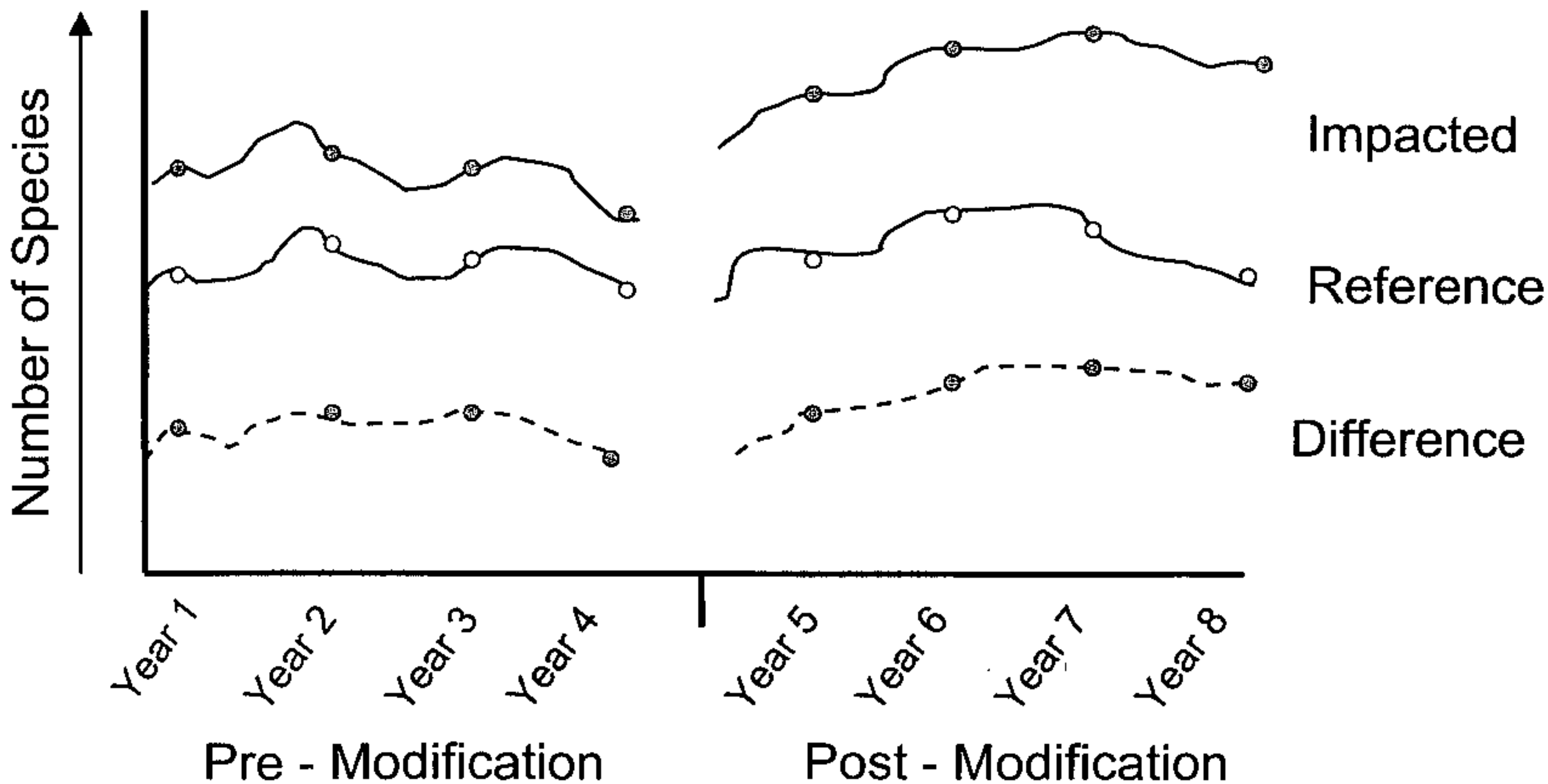

Goa
To develop a monitoring progra
detect changes in stream commu
response to dam removal or mod

Study Objectives

- Monitor short- and long-term changes in habitat associated with modification/removal of Batavia dams
- Evaluate short- and long-term responses of aquatic insects and mussels
- Quantify short- and long-term responses of fish assemblage structure and growth
- Document changes in fish movements and habitat utilization

Before-After-Control-Impact (BACI) Design (Stewart-Oaten et al. 1986)

Difference = Impact Site - Reference Site



Why a Reference?

- Account for temporal variability
  - changes in climate, watershed landuse, etc. from year to year

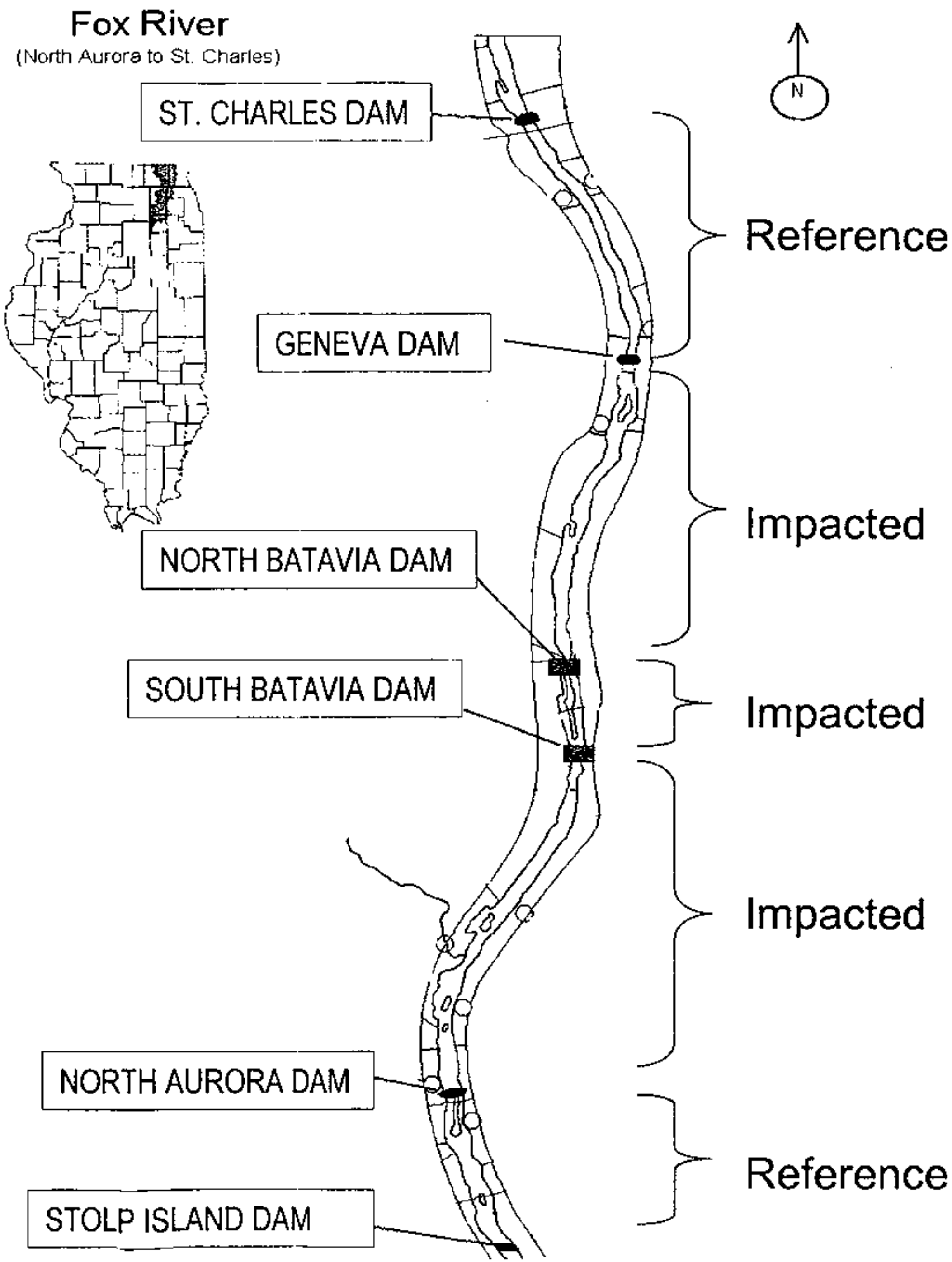
Geneva

- Account for spatial variability
  - multiple treated and reference sites

N. Batavia

Selecting a Reference

- Close proximity to treated sites
  - similar conditions - climate, landuse, geology, physical/chemical habitat



Study Sites

St. Charles FF
Geneva IMP

Geneva FF
N. Batavia IMP

N. Batavia FF
S. Batavia IMP

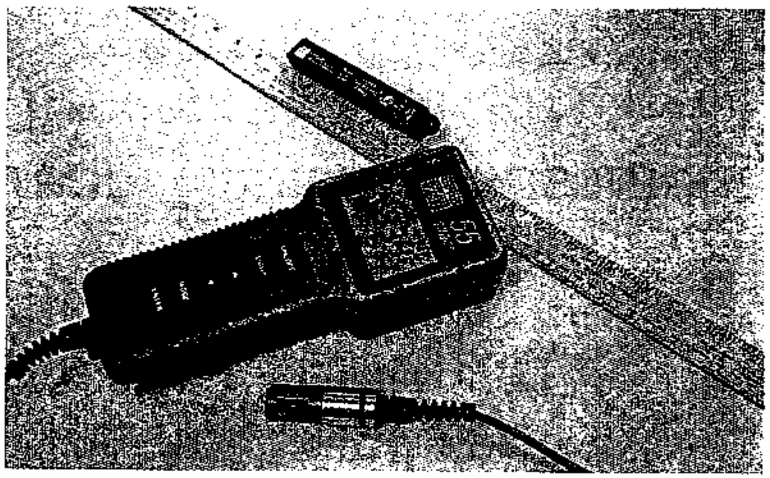
S. Batavia FF
N. Aurora IMP

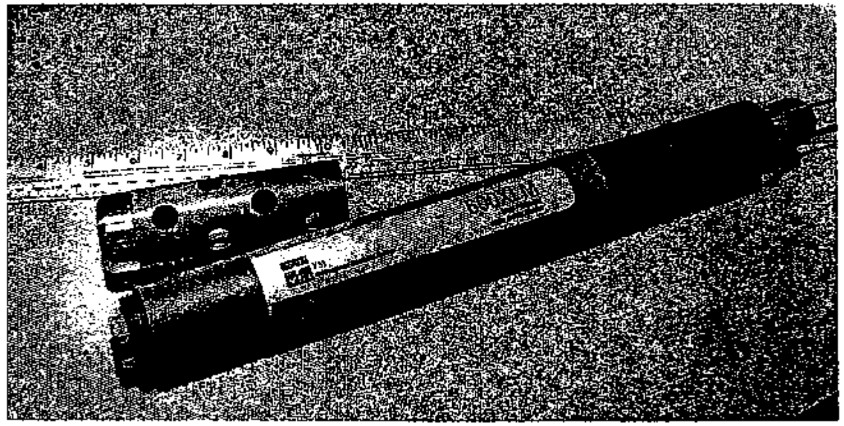
N. Aurora FF
Stolp Island IMP

Water Quality

N. Batavia Dam (Impacted)

-Temperature (15 min)
- Dissolved Oxygen (15 min)
- pH and Conductivity (15 min)





S. Batavia (Impacted) & Geneva (Reference) Dams

-Temperature (1/hour)
- Dissolved Oxygen (1/day)
- pH and Conductivity (1/day)

Additional Water Quality

- Phosphorous (1/week)
- Chlorophyll *a* (1/week)

Qualitative Habitat

Qualitative Habitat Evaluation Index (QHEI)

Stream Habitat Assessment Procedures (SHAP)

- Both use rating system from excellent to poor
- Categories include:

  substrate and bank stability

  instream habitat and cover

  channel morphology

IL SHAP

Site ________________ GPS Location (LAT) ________________ (LON) ________________

Reach Length ________________ Assessed by ________________ EPE ________

Reach Description ________________________________ Date ________

Habitat Parameter	Excellent	Good	Fair	Poor
1. Bottom substrate	Greater than 50% gravel, cobble, or boulders	30-50% consolidated gravel, cobble, or boulders	10-30% gravel (largely unconsolidated), cobble, or boulders	less than 10% gravel, cobble, or boulders; predom. sand or silt
Score:	16-20	11-15	6-10	1-5
2. Deposition	less than 5% affected; minor accumulation of coarse praticles at channel bars, point bars, snags, or submerged vegetation	5-30 % affected; moderate accumlation of sand/gravel at channel/point bars, snags, or submerged vegetation	5-30% affected; major deposition of sand at channel/point bars, snags, or submerged vegetation; pools shallow from heavy deposition	mud, silt and/or sand in braided or nonbraided channels: pools almost absent due to deposition
Score:	10-12	7-9	4-6	1-3
3. Substrate stability	abundance of boulders or cobble; periphyton/ aquatic vegetation often abundant	presence of some boulders or cobble with some periphyton	few boulders and cobble; small shifting particles common; periphyton rare; OR predom. claypan or bedrock	stable substrate types absent; small gravel, sand and silt abundant; periphyton usually absent or present only during low flow

Channel Morphology / Quantitative Habitat

Once each summer with fish sampling

3 transects / site

- Width
- Riparian vegetation
- Bank height

In-stream habitat every 5 m

- Depth
- Velocity
- Substrate size
- Cover & vegetation

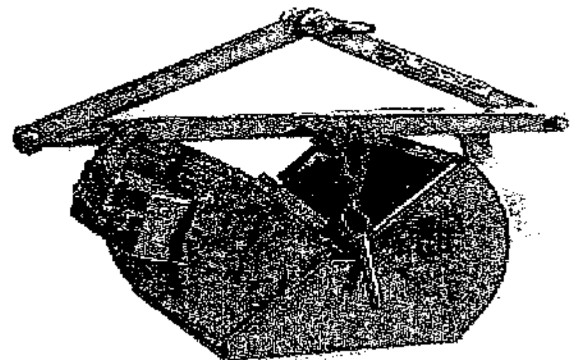
Aquatic Insects and Mussels

Collected summer and fall

<u>Impoundments</u> : 6 ponar grabs

3 Hess, 3 kicknets

<u>Free-flowing</u> : 3 Hess, 3 kicknets



Response variables:

- Taxa richness
- Diversity
- Abundance
- MBI

Fish Assemblage Composition

Summer daytime electrofishing

- 60 min Boat
- 30 min Backpack

Response variables:

- Species richness
- Abundance
- Index of Biotic Integrity
- Growth

Fish Movement & Habitat Utilization

Mark/Recapture

Site specific colored elastomer tags

8 species marked:

- Smallmouth bass
- Common carp
- Channel catfish
- Walleye
- 4 Redhorse Species

Response variables:

- Upstream/downstream movements
- Ability to traverse dams

Fish Movement & Habitat Utilization

Radio Telemetry

Internally tagged at 6 sites

St. Charles - Geneva (Reference)

Geneva - N. Batavia (Impact)

S. Batavia - N. Aurora (Impact)

3 Species:

Smallmouth bass

Common carp

Channel catfish

Response variables:

Seasonal movement

Total longitudinal range

Home Range

Seasonal Habitat Preferences

Preliminary Habitat Data

QHEI		SHAP	
Good	>60	Excellent	>=142
Degraded	46-60	Good	100-141
Severely Degraded	<46	Fair	59-99
		Poor	<59

	Impoundment			Free Flowing		
	QHEI	SHAP	Rating	QHEI	SHAP	Rating
Geneva	42.0	68.0	SD/Fair	70.8	104.0	Good
N. Batavia	49.3	89.0	D/Fair	78.5	128.0	Good
S. Batavia	55.5	96.0	D/Fair	86.0	147.0	Good/Excel
N. Aurora	38.5	75.0	SD/Fair	69.0	115.0	Good

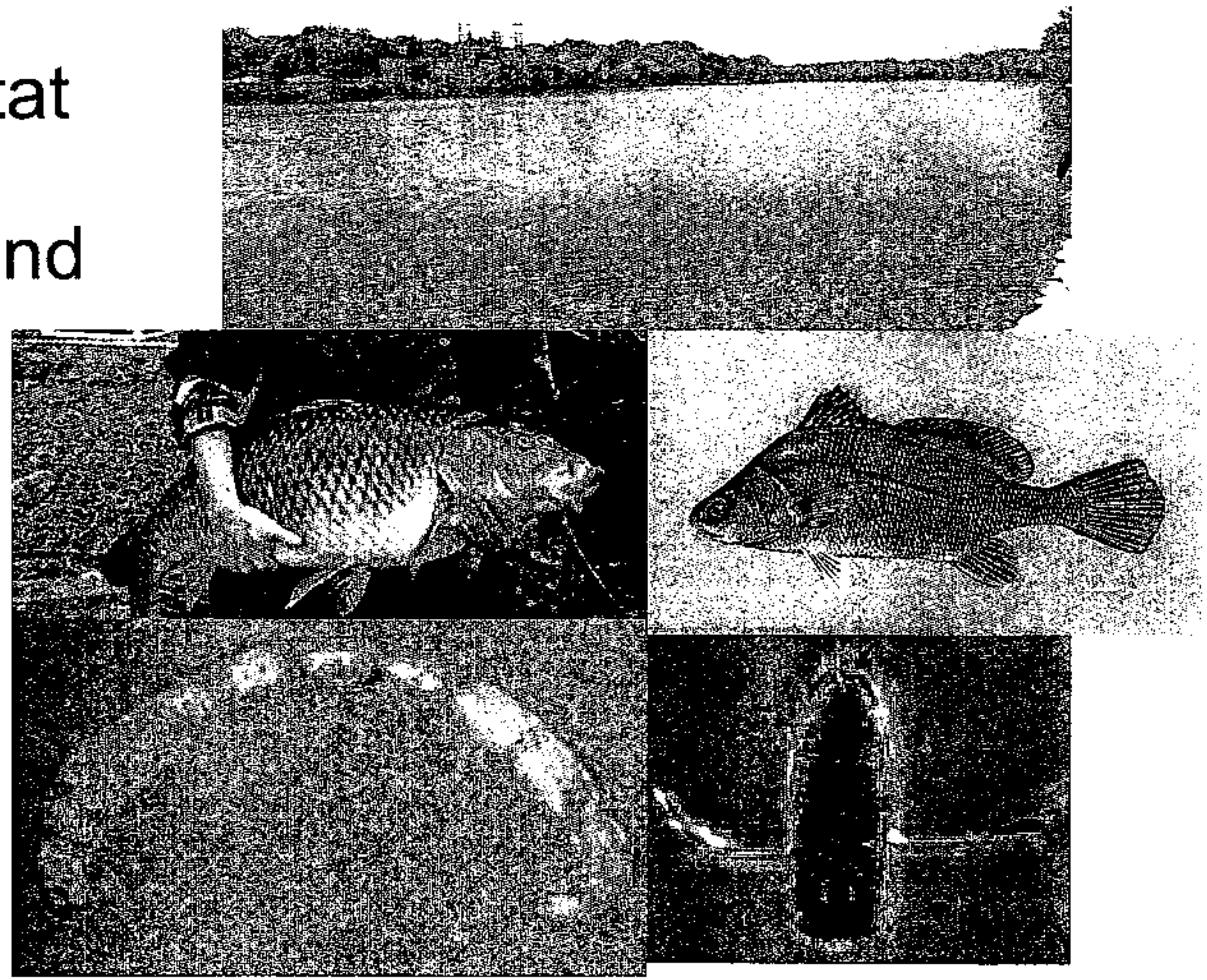
Preliminary Fish Richness & Total Catch

	Impoundment		Free Flowing	
	Richness	Catch	Richness	Catch
St. Charles	n/a	n/a	21	283
Geneva	12	70	23	235
N. Batavia	6	36	29	443
S. Batavia	11	74	27	680
N. Aurora	9	29	22	366
Stolp Is.	6	33	n/a	n/a
Total	21	242	40	2007

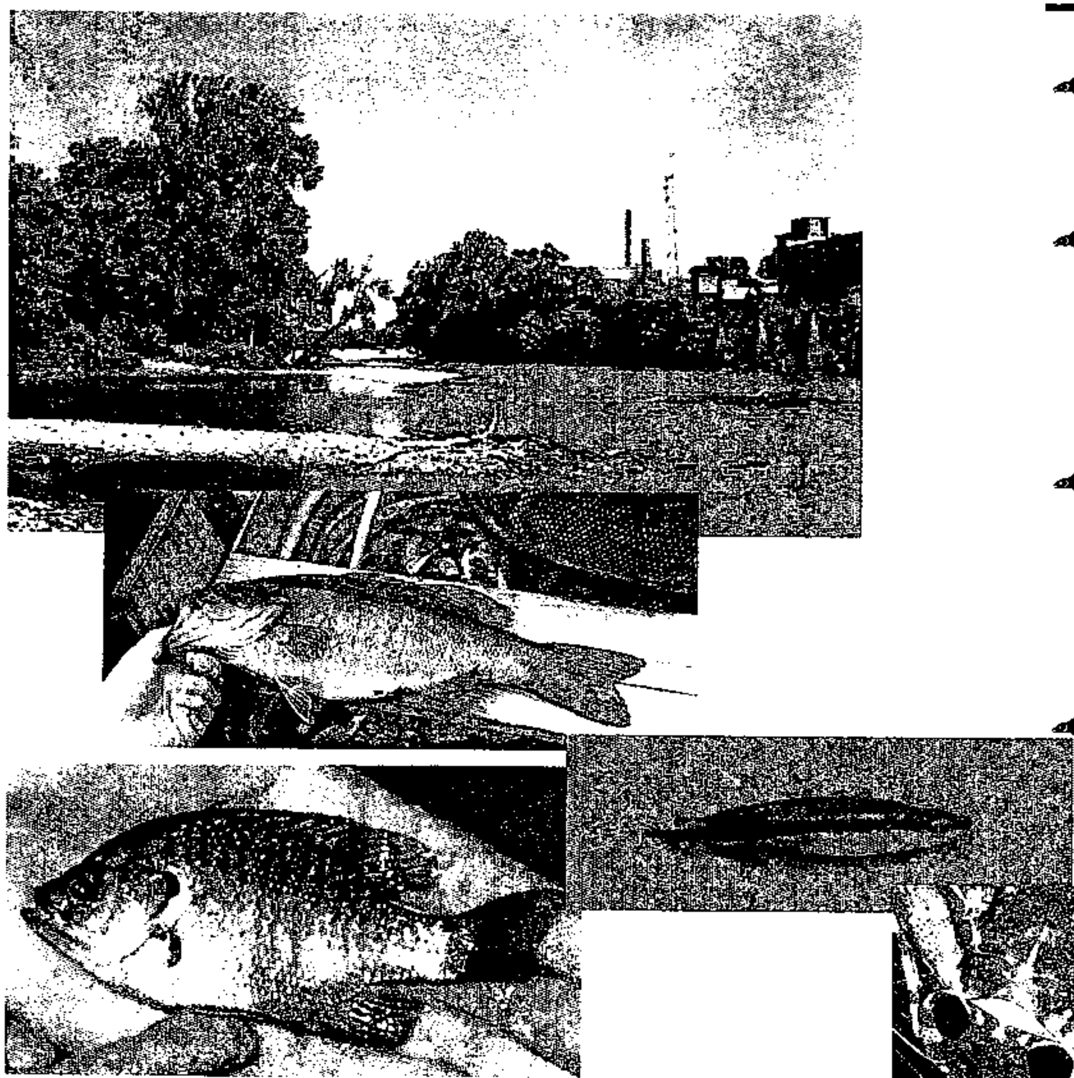
Preliminary Observations

Impoundments

- Low quality habitat
- Tolerant insect and fish species
- Less diverse communities
- Few game fish

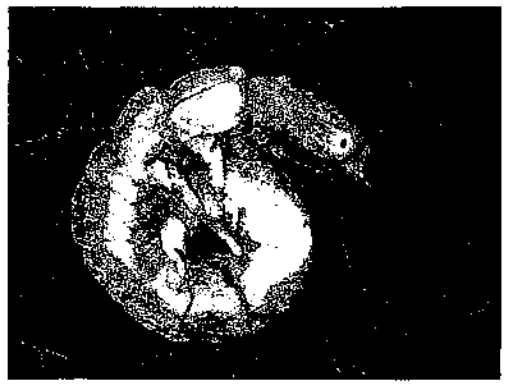


Preliminary Observations



__Free Flowing__

- Good quality habitat
- More intolerant insect and fish species
- More diverse insect and fish communities
- More game fish



Previous Fox River Studies

Fox River Fish Passage Study (Santucci and Gephard 2003)

Impoundments:	Free Flowing
Poor water quality/habitat	Good water quality/habitat
Low fish & insect diversity	Diverse fish & insect communities
More tolerant and diseased fish	More intolerant and sport fish

Critical Trends Assessment Program (IDNR 1998)

Impoundments: 35 fish spp. & 7 mussel spp.

Free Flowing: 90 fish spp. & 32 mussel spp.

Extensive Basin Surveys (IDNR 1982 , 1996, 2002)

Previous Removal Studies - Midwest

Woolen Mills Dam Study - Wisconsin (Kanehl et al. 1997)

Impoundment: Fair → Good habitat quality, Few → Abundant smallmouth, Abundant → Few carp, Poor → Good biotic integrity

Downstream: initial decline in smallmouth and biotic integrity

Baraboo River Dam Study - Wisconsin (Stanely et al. 2002)

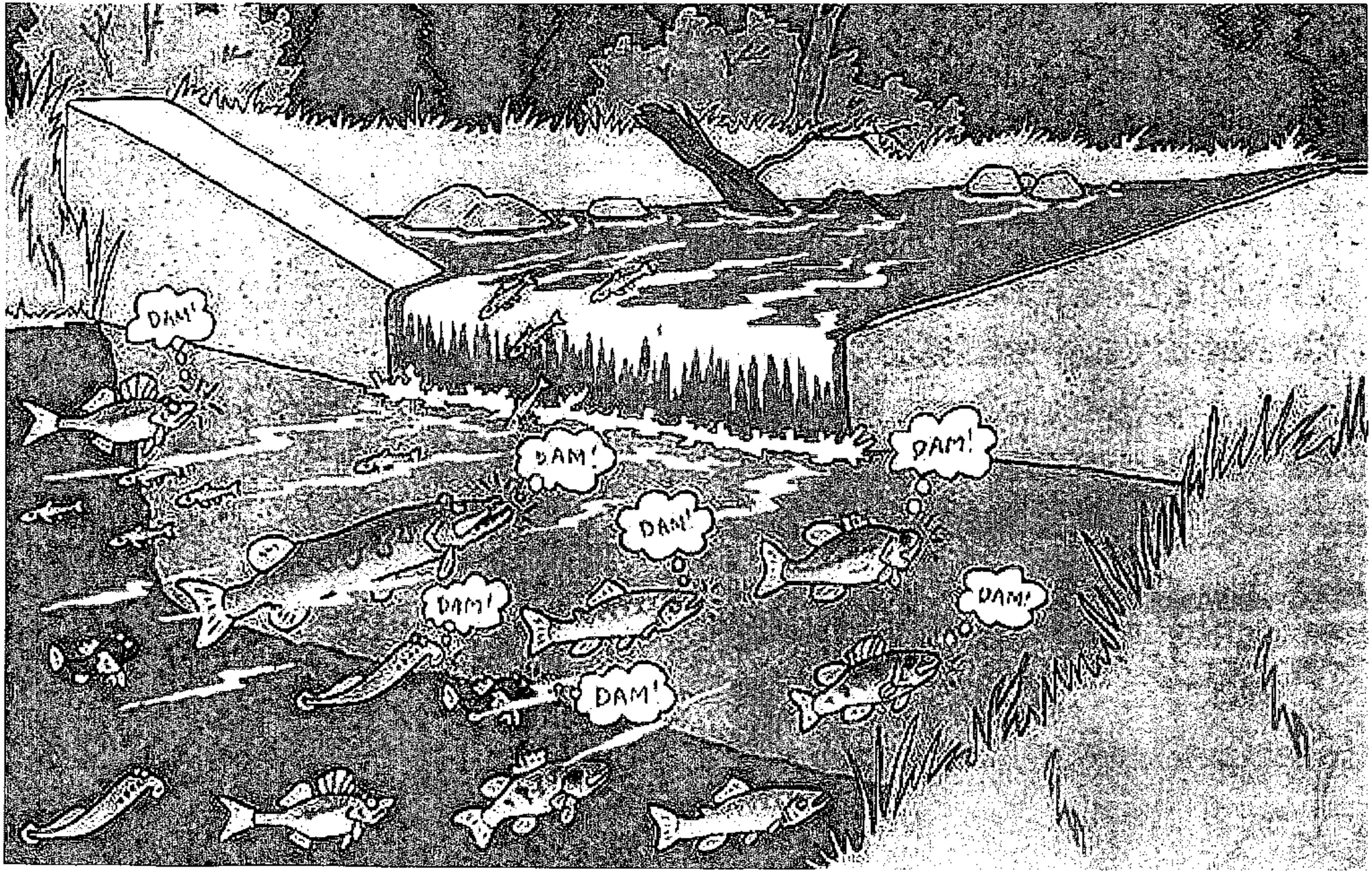
Impoundment: increased quality of habitat and macroinvertebrate community

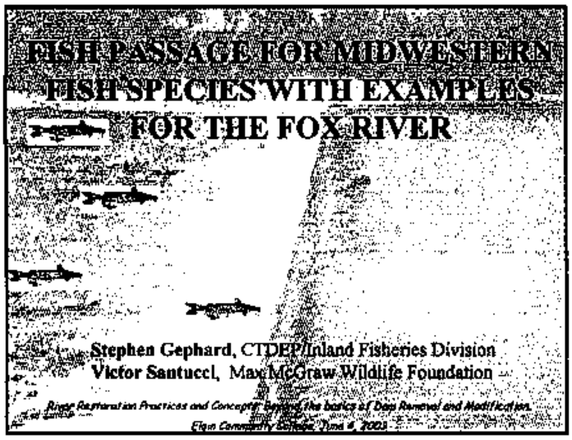
Downstream: initial sand deposition; no changes in channel morphology or macroinvertebrates

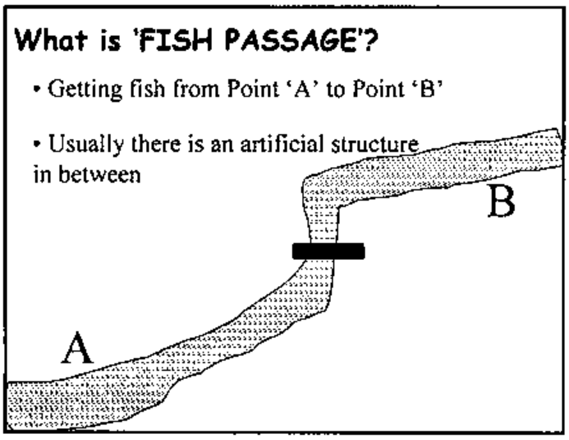
Implications

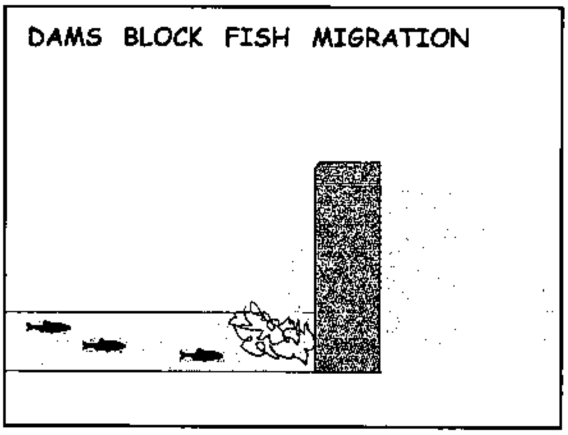
- Increase public awareness of the benefits of dam removal
- Improve knowledge on the immediate and long-term impacts of dam removal or modification
- Aid resource managers and stakeholders in making decisions on dam removal or modification
- Establish protocols for detecting changes after dam removal to guide future projects

Questions?




FISH PASSAGE FOR MIDWESTERN
FISH SPECIES WITH EXAMPLES
FOR THE FOX RIVER
Stephen Gephard, CTDEP/Inland Fisheries Division
Victor Santucci, Max McGraw Wildlife Foundation
River Restoration Practices and Concepts: Beyond the basics of Dam Removal and Modification.
Elgin Community College, June 4, 2003


What is 'FISH PASSAGE'?
• Getting fish from Point 'A' to Point 'B'
• Usually there is an artificial structure in between
B
A

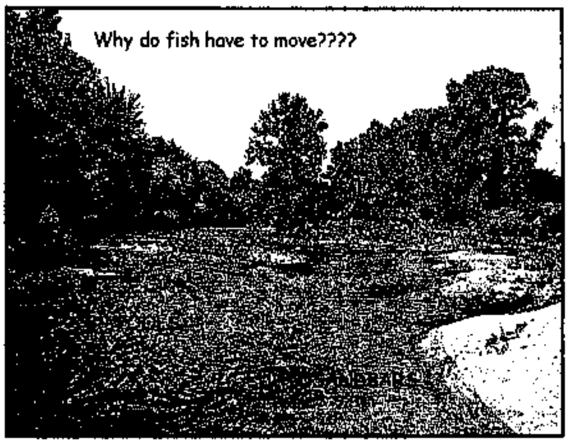

DAMS BLOCK FISH MIGRATION

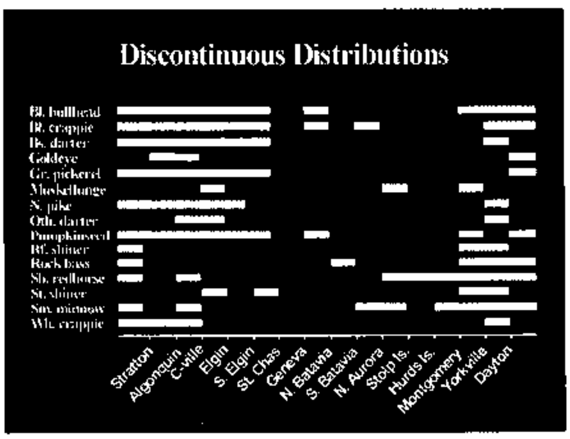
Some fish can leap...

- Atlantic salmon
- most Pacific salmon
- trout

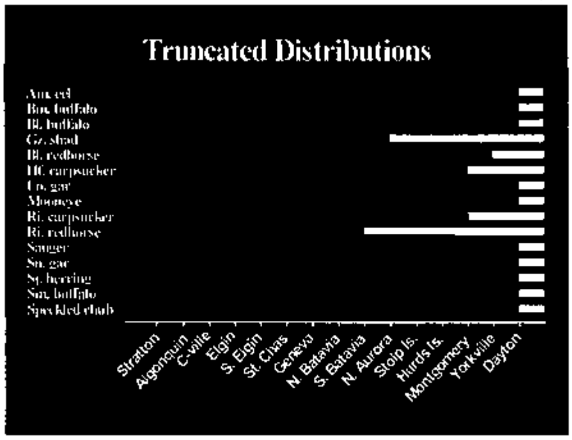
Generally, leaping species evolved in steep rocky streams, e.g. New England, the Pacific Northwest.

Midwestern streams are flat without falls. Most native midwestern species never evolved the ability to leap.





Truncated Distributions



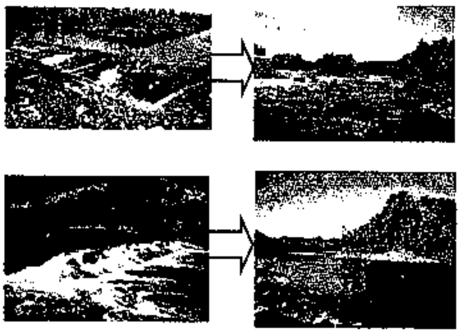
TWO MAJOR TYPES OF FISH PASSAGE PROJECTS:

1. DAM REMOVAL

2. FISHWAY CONSTRUCTION

Dam Removal

BEFORE after



Potential Benefits

Complete dam removal > Lowering and ramping > Fishways and bypasses

Complete dam removal
- Improved habitat
- Improved water quality
- Reconnected river

Lowering and ramping
- Limited habitat improvement
- Reconnected river

Fishways and bypasses
- Partially reconnected river

A PHILOSOPHY FOR FISH PASSAGE-

- Maximize the number of species passed
- Attempt to pass all sizes and ages of fish
- Allow passage at all seasons, all days, all times of day: volitional passage
- If compromises are needed, determine which species must have passage to survive and design for them ("design species")
- Design for the weakest swimming of the design species (if a fish passage project passes them, the stronger swimming species will be sure to pass

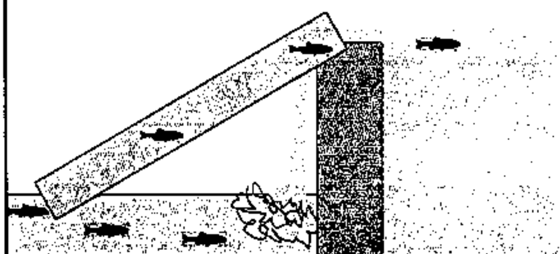
TARGETED SPECIES

Northern pike
Muskellunge

Redhorses
Suckers
Buffalo
Skipjack
Minnnows, e.g. striped shiner, sand shiner

Walleye
Largemouth bass
Smallmouth bass
Channel catfish

WHAT IS A FISHWAY???



BASIC TYPES OF FISHWAYS

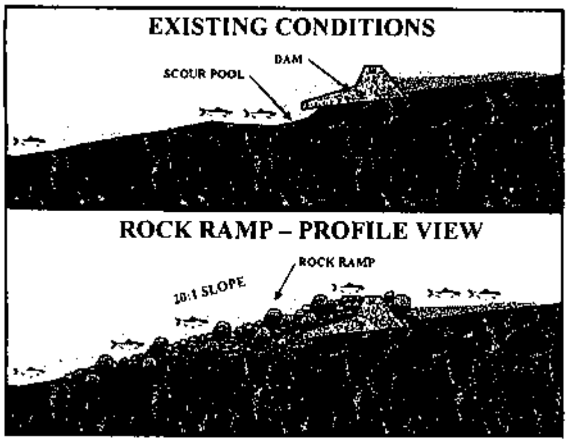
I. Pool-and-weirs

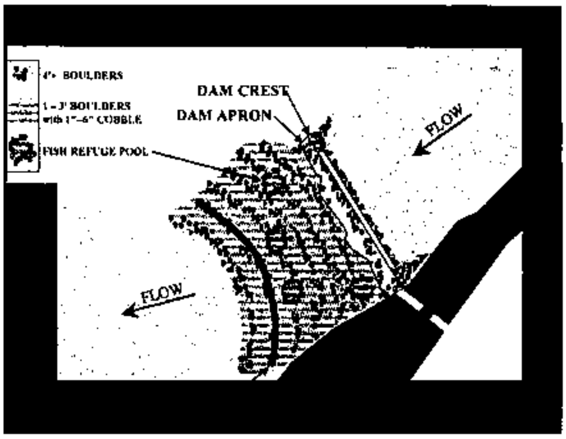
II. Lifts

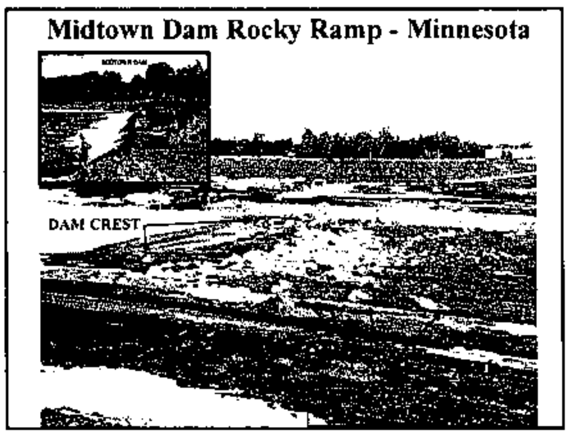
III. Rocky Ramps

IV. Roughened Chutes (Denil Fishway)

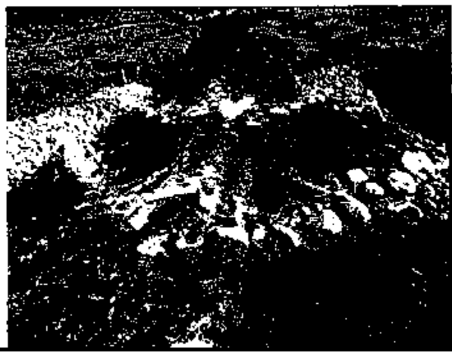
V. Semi-natural bypass channels


EXISTING CONDITIONS
DAM
SCOUR POOL
ROCK RAMP – PROFILE VIEW
ROCK RAMP
10:1 SLOPE

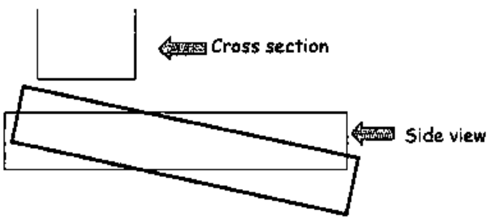

4'+ BOULDERS
1 – 3' BOULDERS with 1"–6" COBBLE
FISH REFUGE POOL
DAM CREST
DAM APRON
FLOW
FLOW


Midtown Dam Rocky Ramp - Minnesota
DAM CREST

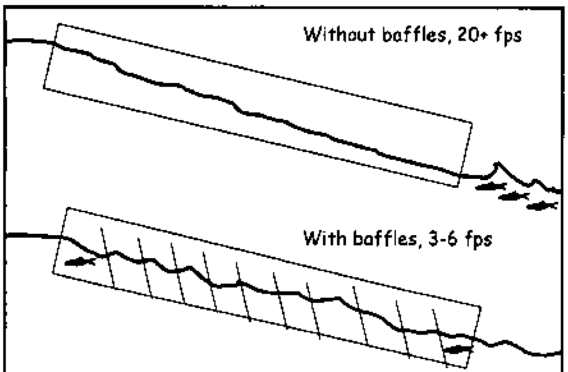
Rocky Ramp



Roughened Chutes

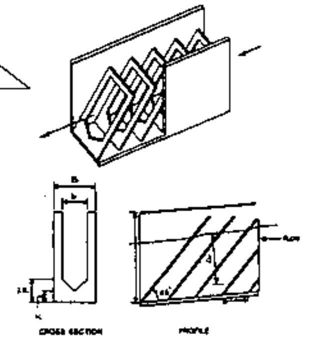


A chute is just a trough that passes water. It can be set at an angle.



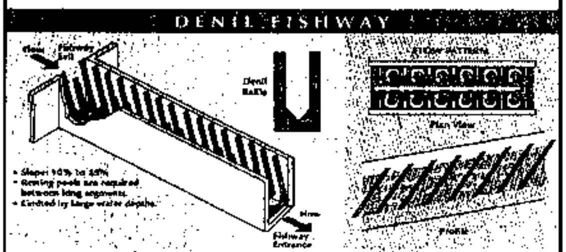
BAFFLES CREATE THE 'ROUGHENING'

DENIL FISHWAYS

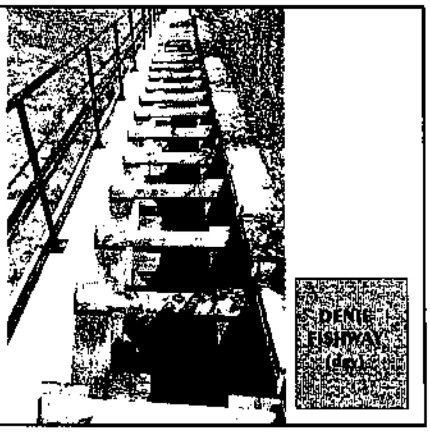


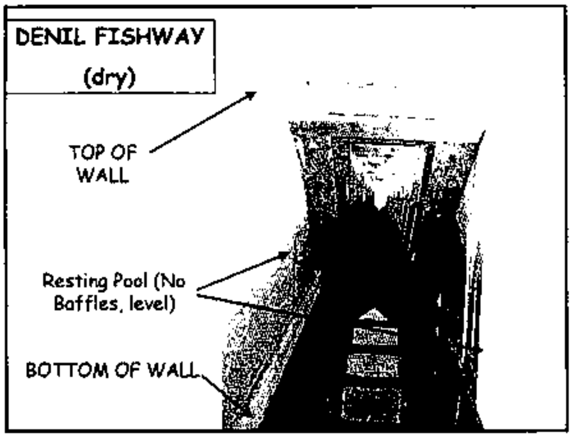
Institution of Civil Engineers modified Denil fishway.

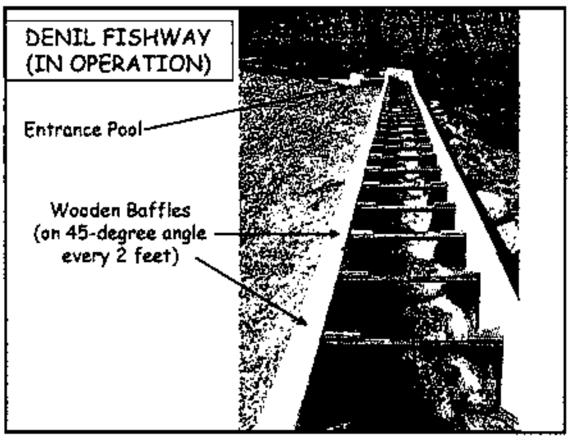
(Adapted from Oraborn, 1985)

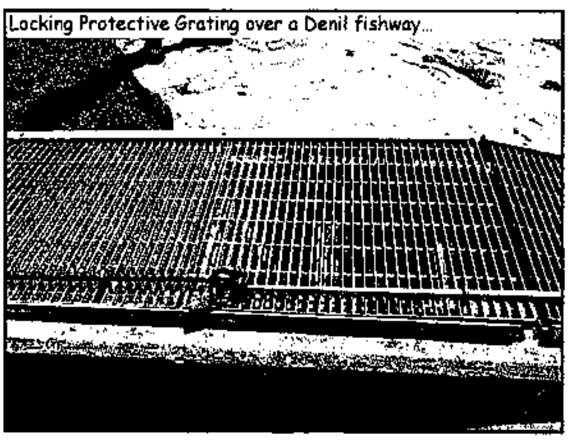


SAFETY RAILS




DENIL FISHWAY
(dry)
TOP OF
WALL
Resting Pool (No
Baffles, level)
BOTTOM OF WALL

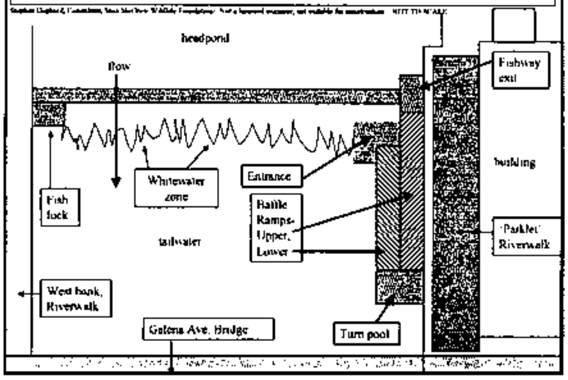

DENIL FISHWAY
(IN OPERATION)
Entrance Pool
Wooden Baffles
(on 45-degree angle
every 2 feet)


Locking Protective Grating over a Denil fishway...

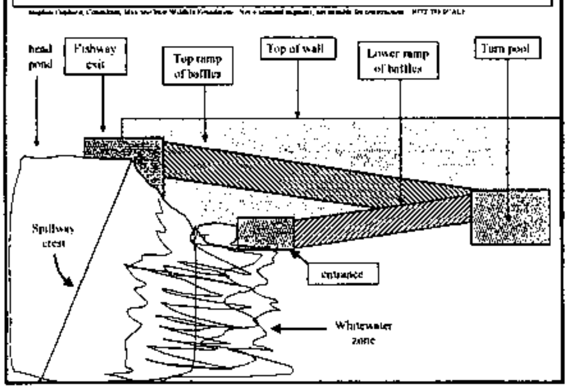
Recommended Guidelines for Fox River Denil Fishways to pass Targeted Species:

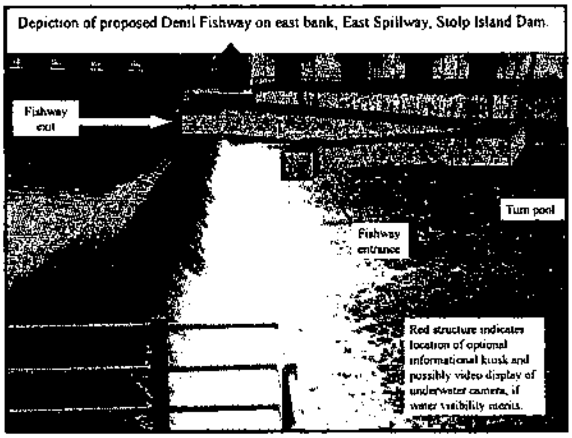
- **1 on 15 slope (6.6%)** (baffled sections depicted by red & white stripes)
- **5.2 feet wide**
- **resting pools every 6 vertical feet** (depicted by green)
- **standard Denil baffle dimensions**
- **total fishway flow equal to 2 – 5% of mean annual flow**
- **typical entrance location near downsteam edge of whitewater zone below the spillway, on one or both of river banks, entering at a 45 degree angle**

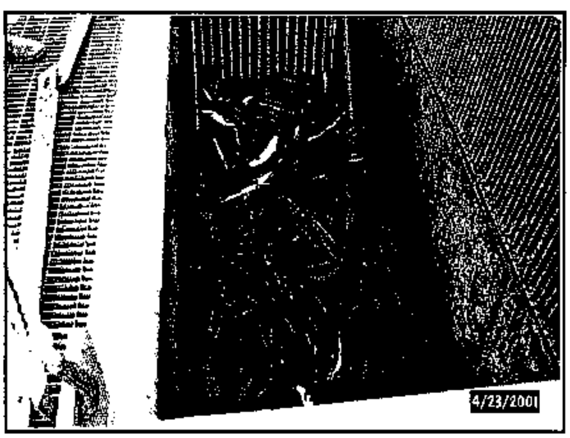
Conceptual Plan of a Denil fishway on the east bank of the East Spillway, Stolp Island Dam, Aurora- Plan View.

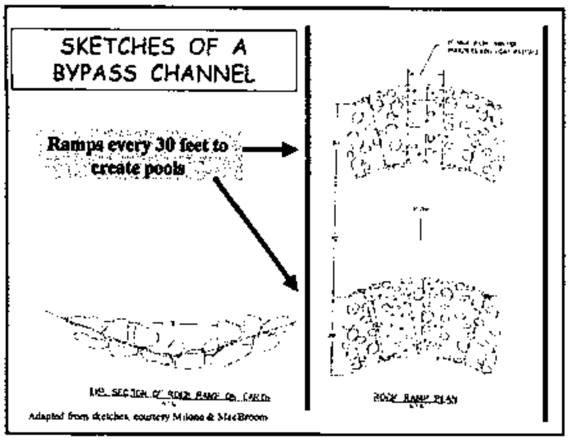


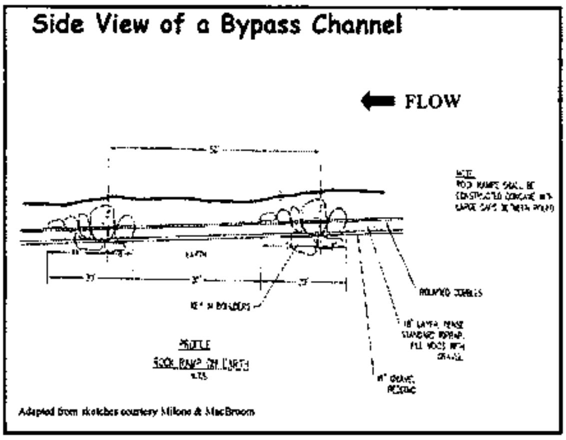
Conceptual Plan of a Denil Fishway, East Bank, East Spillway, Stolp Island Dam, Aurora- Profile View.

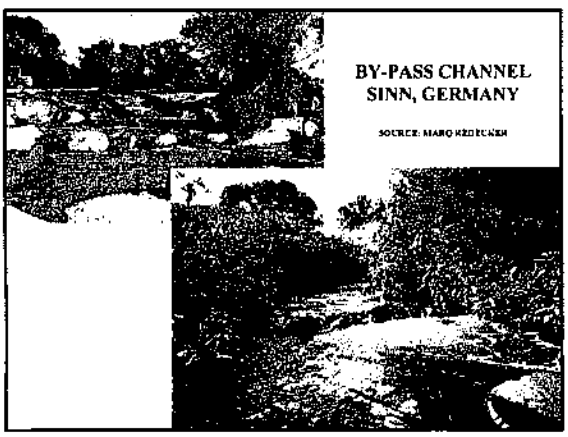


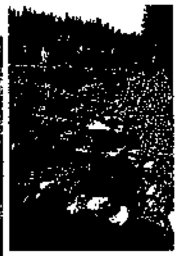

Depiction of proposed Denil Fishway on east bank, East Spillway, Stolp Island Dam.
Fishway exit
Turn pool
Fishway entrance
Red structure indicates location of optional informational kiosk and possibly video display of underwater camera, if water visibility merits.


4/23/2001


SKETCHES OF A BYPASS CHANNEL
Ramps every 30 feet to create pools
Adapted from sketches courtesy Milone & MacBroom


Side View of a Bypass Channel
FLOW
Adapted from sketches courtesy Milone & MacBroom


BY-PASS CHANNEL
SINN, GERMANY



By-pass Channel in Austria

By-pass Channel in Muelenhangen, Germany on the Goldbach River

Length: 38m　Height 1.70m
Width: 3.40 m　Avg. Flow 0.38m³/s

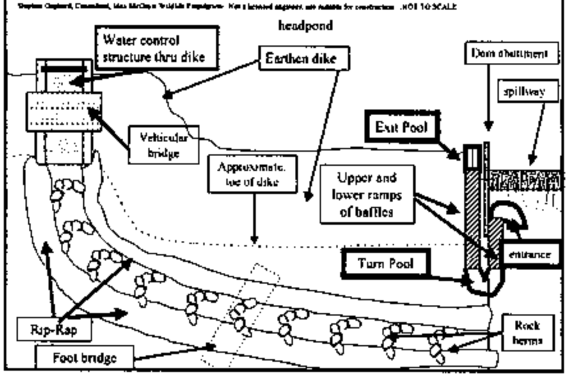
Photographs courtesy of Boyd Kynard and Marq Redeker

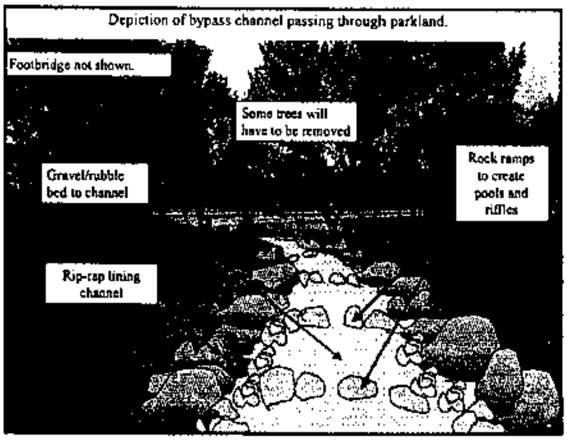
Recommended Guidelines for Bypass Channels to pass Targeted Species on the Fox River:

- slopes of 1 on 25 (4%) if only for fish; 1 on 33 (3%) if for boats
- total discharge of bypass equivalent to 5% of mean annual flow
- minimum bottom width of 3 feet if only for fish; 6 feet if for boats, too. (Actual widths can be larger)
- no vertical drops greater than 6 to 7 inches
- flow at drops are "streaming" not "plunging"
- entrance near toe of dam or provide Denil spur (if needed)
- limit bed permeability using clay or geotextile mats
- aim for natural appearance– will vary among sites

Two options for fish passage at the South Elgin Dam: Conceptual Plans, Plan View. Bypass Channel to the left or a Denil Fishway to the Right.

NOT TO SCALE





COSTS OF ALTERNATIVES*:

Dam Removals: In CT, typically $126,000 - $200,000 ("clean")
Fox River? Maybe twice that ("clean")
Dredging, cofferdams

Denil Fishways: In New England, typically $1,600/linear foot
Fox River? $150,000 - $400,000
Dayton Dam ~ $2 million
Dredging, cofferdams

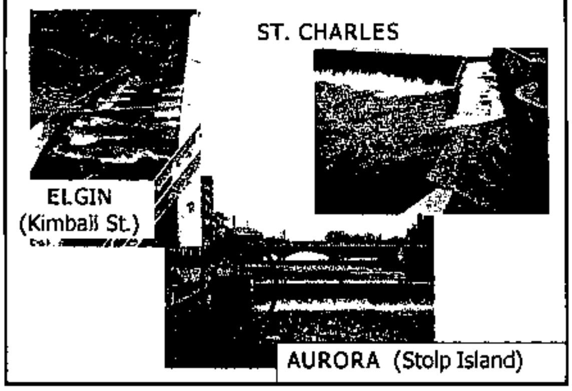
Bypass Channels: Very little U.S. experience. Presumably cheaper than Denils per linear foot.

SOME CLOSING THOUGHTS-

The design is handled by specialists- biologists & engineers.

Don't trust fishway design to inexperienced people. (Examples of poor designs can be found on the Fox.)

Existing (non-functional) "fishways" on the Fox



SOME CLOSING THOUGHTS (cont.)-

Fishways are custom designed for each dam; no two are identical.

Fishways are very common in the West and East (and other countries). The Midwest has been slow to embrace them. However, they are not experimental. They DO work.

Due to lack of experience, Illinois groups must initially rely on experienced fish passage specialists to guide early projects.

However, Illinois must develop in-house fish passage specialists who can customize existing technologies to Illinois rivers and species.

If a fishway is built, someone has to own & operate.

Max McGraw
Wildlife Foundation
P.O. Box 9
Dundee, Illinois 60118

Fox River Fish Passage Feasibility Study

Summary Report

Victor J. Santucci, Jr. and Stephen R. Gephard
Principal Investigators

Submitted to:
Illinois Department of Natural Resources
C2000 Ecosystem Program
One Natural Resources Way
Springfield, Illinois 62702

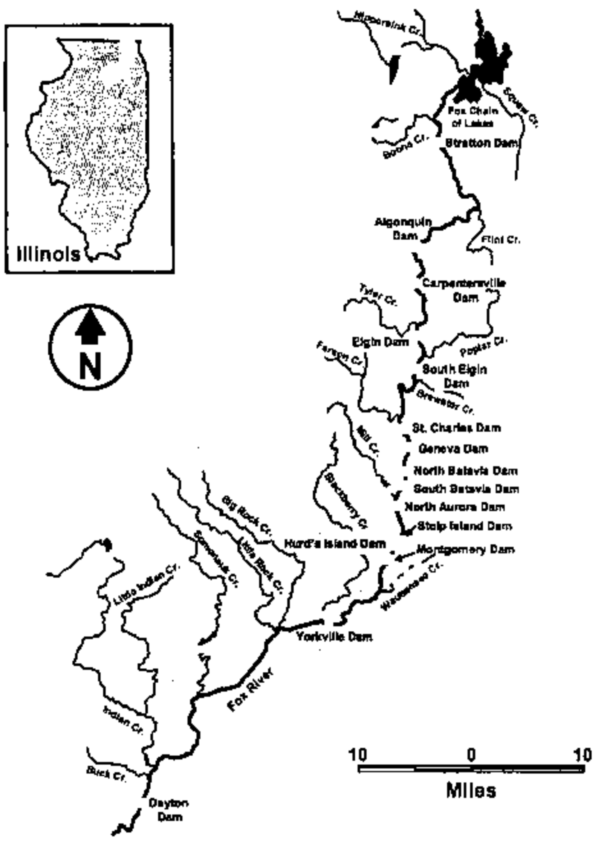
April 2003

ACKNOWLEDGMENTS

We would like to acknowledge the Illinois Department of Natural Resources (IDNR) C2000 Ecosystem Program for project funding and the U.S. Environmental Protection Agency (USEPA) for extensive in-kind contributions. The Max McGraw Wildlife Foundation provided additional funds for the project and the Fox River Ecosystem Partnership lent its support. Steve Pescitelli and Bob Rung assisted with the selection of sample sites and methods and coordinated activities with IDNR Office of Resource Conservation. Bill Rice, Frank Novak, and Rita Lee coordinated activities with IDNR Office of Water Resources. Nancy Williamson coordinated activities with IDNR C2000 Ecosystem Program. Kevin Cummings provided historic fish and freshwater mussel data from the Illinois Natural History Survey database and Bob Schanzle provided mussel data from recent IDNR sampling. Ed Hammer assisted with water quality sampling and coordinated all activities with USEPA. Other USEPA Region V staff assisting with the study included: Dertera Collins (data management), John Dorkin (sediment sampling), Mari Nord (GIS mapping), George Azevedo, Terrance Patterson, and Nancy Thomas (GPS), Danielle Tillman (QAPP development), and the Central Regional Laboratory (water quality and sediment contaminant analysis). The Illinois Environmental Protection Agency analyzed chlorophyll samples and Howard Essig provided historic macroinvertebrate data. Laura Wildman, of American Rivers, reviewed cost estimates and offered helpful suggestions. Jeroen Gerritson, of Tetra Tech, offered advice on the development of the macroinvertebrate condition index. Bert Gray organized a tour of Waubansee Creek dam sites. John Thompson reviewed a draft of the report. Special thanks to Christina Battistuzzi, Art Daigle, Cliff Hohman, Mike Mahoney, Jason Miller, Beth Panocha, Stan Proboszcz, and Matt Wolfe for their hard work and dedication during field collections and sample identification. More thanks are due to Cindy Skrukrud, David Horn, Pat Kirmse, and Friends of the Fox River for organizing and hosting two public seminars and Aurora University and the Dundee Public Library for providing seminar venues.

Fox River Fish Passage Feasibility Study

Draft Summary Report

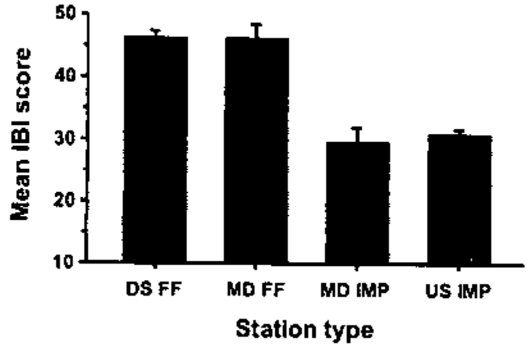


Fox River watershed, tributaries, and dams in Illinois.

The Fox River and its surrounding watershed are highly valued ecological and recreational resources. Currently, there are 15 dams on the river's mainstem in Illinois and numerous smaller dams on tributaries. Many of these dams were originally built in the 1800's to provide mechanical power for grist and lumber mills and have since been rebuilt to maintain the flat water ponds or impoundments that form upstream of the dam. Although extremely important in their time, most dams today serve no functional purpose. The Fox River Ecosystem Partnership (FREP) has identified dam removal or modification as an important watershed management tool to effect recovery of the Fox River ecosystem.

This report presents the results of a two-year study of approximately 100 miles of river and 15 mainstem dams located between McHenry and Dayton, Illinois. The report is divided into two main sections and a series of appendices. In Part A, we used historical and current data to determine the effect of dams on the ecological health of the river. Specifically, we examined fish and invertebrate communities, aquatic habitat, and water quality. In Part B, we discuss fish passage in general and identify specific options for each dam that will facilitate a reconnected river system. Options include complete dam removal and river restoration, dam lowering and in-stream ramping, and the construction of fishways and bypass channels that allow fish to migrate over or around dams. The appendices present site-specific data on fishes, macroinvertebrates, habitat, sediment, and water quality, as well as results from public seminars and a study evaluating use of the Aurora canoe chute and Stratton fishway by migrating fish.

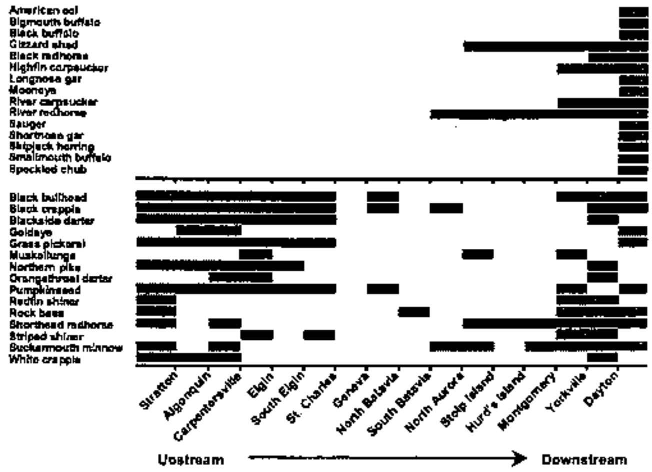
To determine the effects of dams on river ecology, we used IDNR and IEPA approved methodologies to sample fish, macroinvertebrates, and aquatic habitat during July through early September 2000 at 40 stations within the study area. Stations were located directly above (US IMP) and below (DS FF) each of the 15 Fox River dams and at 10 mid segment locations in impounded (MD IMP) and free-flowing (MD FF) areas between dams. Water quality sampling took place during August and September 2001 at 11 free-flowing and 11 impounded stations and 6 to 9 transects spaced throughout four river segments. Sampling included continuous monitoring (readings every 15 min.) of temperature, dissolved oxygen, conductivity, and pH during 16-, 40-, and 960-hour sampling periods, spot sampling to determine horizontal and vertical variation in these measured parameters, and grab sampling to assess nutrients (phosphorus and nitrogen), algal biomass, (chlorophyll a), total suspended solids, and turbidity. In addition, we quantified macrohabitat (impounded reaches, free-flowing reaches, natural pools, riffles, runs, aquatic vegetation, islands, and streamside wetlands) within the study area and determined the quantity, particle size, and toxic chemical characteristics of bulk sediments accumulated behind dams.



Higher quality non-game and sport fish communities occurred in natural flowing portion of the river compared to areas impounded by dams.

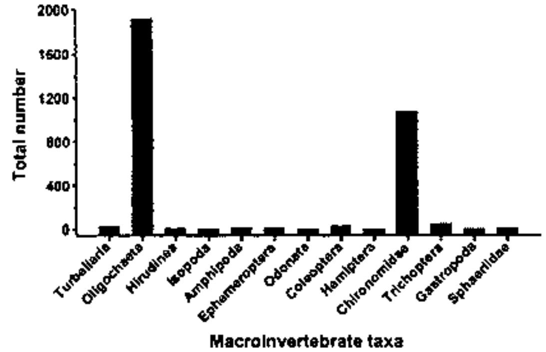
The distribution of fish species among station types during summer indicated that most fishes favored free-flowing portions of river over impounded areas created by dams. Further, we found higher quality fish communities in the free-flowing river. Index of Biotic Integrity (IBI) scores in free-flowing areas averaged 46, which indicates a "B" quality stream or highly valued aquatic resource. In contrast, mean IBI scores for impounded areas were below 31, indicating a "D" quality stream or limited aquatic resource. On average, the natural flowing river had more species, four times the number of individuals, double the number of harvestable-sized sport fish, more suckers, darters, and intolerant fishes (including the state threatened river redhorse), a higher percentage of insectivorous minnows, and a lower proportion of diseased individuals than impounded areas. Impounded stations typically had lower species richness, low overall and sport fish abundance, more diseased fish, and a predominance of tolerant and omnivorous species, such as common carp, bluntnose minnow, quillback, and green sunfish. The adverse effects of impoundment on non-game and sport fish communities extended well upstream of the dams. Similarly, high quality fisheries were not confined to reaches immediately below dams but extended throughout free-flowing areas.

In addition to altering habitats, dams appear to have altered distributions of nearly one third of Fox River fishes by acting as barriers to upstream fish movement. Data from 1980 to the present showed thirty species of fish having either truncated (only found in the lower river) or discontinuous distributions (absent from the middle river). Sauger, American eel, skipjack herring, mooneye, speckled chub, longnose gar, shortnose gar, and three species of buffalo were collected only below the lowest dam (Dayton), which is located 5.6 miles above the Illinois River confluence. The 15 species with discontinuous distributions were absent from the river between St. Charles and Montgomery. This is a highly urbanized section with a particularly high density of dams (eight dams in 14 river miles) compared to other parts of the Fox River in Illinois (an average of one dam every 9.5 mi.).



Dams have restricted distributions of 30% of Fox River fishes.

Free-flowing reaches supported higher quality macroinvertebrate communities than impounded waters above dams. Mean macroinvertebrate condition index scores (MCI; a multimetric index developed for the Fox River) for stations in free-flowing habitat were more than twice as high as scores for stations in impounded areas. Free-flowing areas typically had higher abundance and richness of mayflies and caddis flies (EPT taxa), more intolerant taxa, lower Macroinvertebrate Biotic Index (MBI) scores, and a higher percentage of clinger organisms than the wadable portions of impoundments. Densities of Chironomini midges, hydropsychid caddis flies, baetid mayflies, and the flatworm *Dugesia tigrina* often were extremely high immediately below dams due to nutrient enrichment and high plankton production in impoundments. Differences between free-flowing and impounded habitats were even more pronounced when we considered samples from open-water impounded areas.



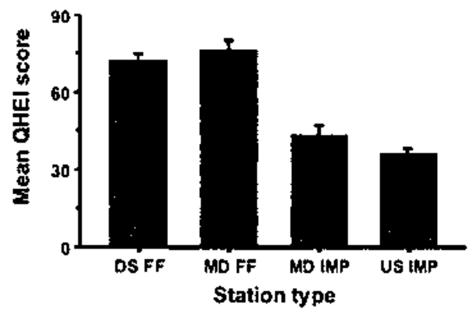
Tolerant aquatic worms and midge larvae were the primary macroinvertebrates found in open water areas of impoundments.

Tolerant chironomid larvae and aquatic worms (Oligochaeta) combined to make up over 95% of the organisms sampled from offshore areas of impoundments.

Dams may be preventing freshwater mussels from reestablishing populations in areas where they once were abundant. Although a few large mussel beds exist in the Fox River today, a recent IDNR survey indicates that freshwater mussel diversity and abundance currently is low compared to historical samples. Most mussel species rely on fish to expand their distributions because glochidia (mussel larvae) attach to fish for a period of time in their development. By fragmenting habitat and restricting fish movement, dams in turn may be restricting distributions of this state and nationally imperiled group of invertebrates.

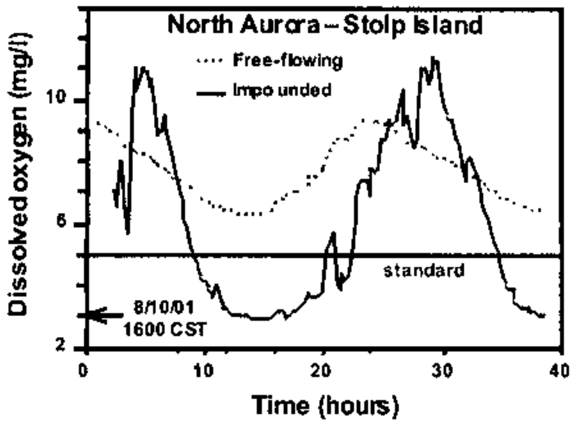
The quality of aquatic habitat available to fish and invertebrate communities differed substantially between free-flowing and impounded portions of river. QHEI and SHAP habitat indices indicated that habitat at free-flowing stations was of good quality whereas habitat in impounded areas was rated as severely degraded by QHEI and fair to poor by SHAP. In free-flowing areas, there were a variety of water depths, current velocities, and substrate types, abundant cover for fish and invertebrates, and good quality riffle and run habitat. Habitat in impounded areas was more lake-like in that water depths were more uniform and deep, current velocity was low, fine silt deposits were high, and riffles and runs were absent. Habitat quality had a strong positive relation to the quality of fish and macroinvertebrate communities underscoring the importance of habitat to aquatic biota in the river.

Impoundments tended to accumulate large quantities of fine sand and silt, particularly downstream of islands, along impoundment margins, and in the region closest to the dam. The volume of fine grain sediments accumulated in impoundments approximately 1,000 ft. above each Fox River dam was estimated to be between 10,500 (Montgomery Dam) and 292,000 (Elgin Dam) cubic yards. Results of core and surface sediment samples showed undetectable or low levels of heavy metals, PCBs, polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides, cyanide, endocrine disruptors, oil and grease. Upstream reaches of many impounded areas accumulated little silt and maintained substrates typical of the free-flowing river.



Habitat quality was rated "good" in free-flowing reaches and "severely degraded" throughout impounded areas.

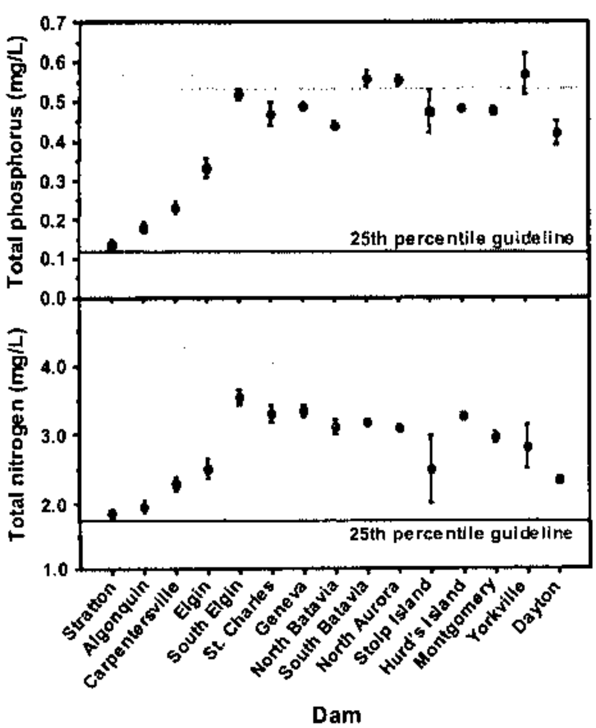
Like habitat, water quality conditions varied between the impounded and free-flowing river. Dissolved oxygen concentrations fluctuated widely on a daily basis in impounded areas (2.5 to >20 mg/L), but not in free-flowing areas (5 to 10 mg/l). These wide fluctuations resulted in violations of the IEPA standard for dissolved oxygen (<5 mg/L) at 9 of 11 impounded stations, but only 2 of 11 free-flowing stations. Substandard dissolved oxygen occurred throughout impounded reaches (not just immediately above dams), lasted for up to 16 hours in a 24-hour period, and occurred when discharge was low and water temperature was high (or potentially from mid July through mid October each year). Maximum pH values were at or above the upper IEPA standard of 9.0 units at 8 of 11 impounded stations and 4 of 11 free-flowing stations. Maximum pH tended to occur during early evening sampling when oxygen concentrations were at highly supersaturated levels. The duration of



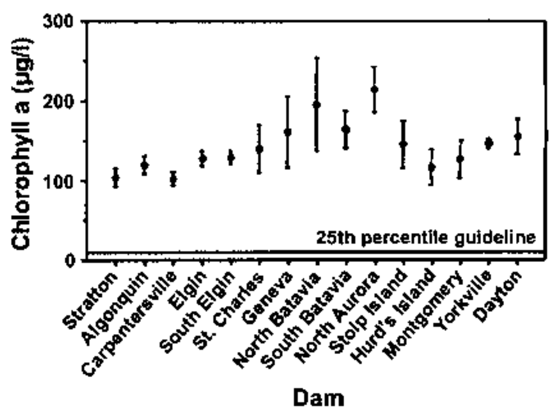
Differences in dissolved oxygen concentrations existed between free-flowing and impounded portions of river. Substandard D.O. was widespread in impoundments, but occurred infrequently in free-flowing areas.

elevated pH in a 24-hour period ranged from less than 1 hour at Stolp Island to 11.75 hours in Yorkville and 24 hours in Dayton.

Although not acting alone, impoundments created by dams played an important role in the widespread occurrence of substandard water quality in the Fox River. Our data indicate that most of the river carries a high nutrient load during low flow periods. Total phosphorus and nitrogen were near recommended 25th percentile guidelines at Stratton Dam (high fertility zone Midwestern streams; 0.11 mg/L phosphorus, 1.75 mg/L nitrogen), but were extremely high at all stations below Elgin (~0.50 mg/L phosphorus or 90th percentile; ~3.0 mg/L nitrogen or 50th percentile). High nutrient levels and the lake-like environments that occurred above dams combined to produce excessive algal biomass. Chlorophyll α, an indicator of algal biomass, was extremely high at all sampling stations (75 to 275 μg/L) relative to recommended 25th percentile guidelines (7.3 μg/L). This high algal biomass, in turn, influenced dissolved oxygen and pH through daytime photosynthesis (oxygen is produced) and nighttime respiration (oxygen is consumed). Decomposition of organic material from sediments accumulated in impoundments also may have contributed to low oxygen levels. Through physical processes dams added oxygen to the river at night and caused oxygen to be released to the atmosphere during the day. However, the overall effect of water flowing over dams during a 24-hour period was a net loss in oxygen from the river.



Elevated nutrient levels occurred in the Fox River below Elgin.



Chlorophyll α (an indicator of algal biomass) was high throughout the river.

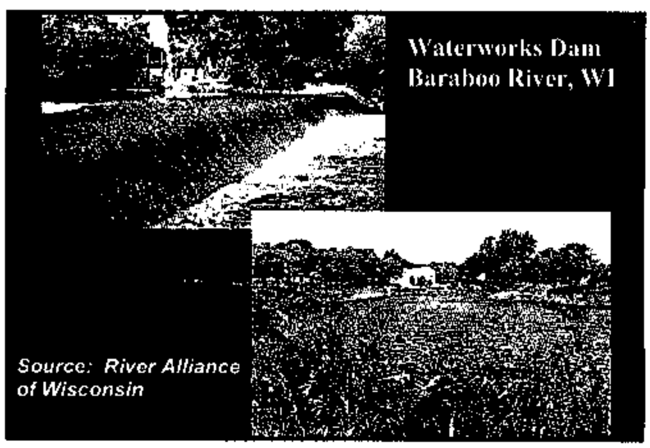
Dissolved oxygen did not reach concentrations low enough to kill fish directly, but it may partially explain the predominance of tolerant species of fish and invertebrates in impoundments. Further, highly fluctuating oxygen levels and extended periods of substandard oxygen and pH occurred at a time of year when other stressors, such as high turbidity, low discharge rates, and high water temperatures might adversely affect fish and invertebrates. Whether from single or multiple sources, stress can indirectly cause mortality by depressing immune system response and increasing susceptibility to epizootic bacterial or viral infections. A stress-induced epizootic event probably was responsible for a widespread channel catfish die-off that occurred throughout the Fox River during summer 2000.

A Fox River channel catfish with a large lesion and eroded barbells.

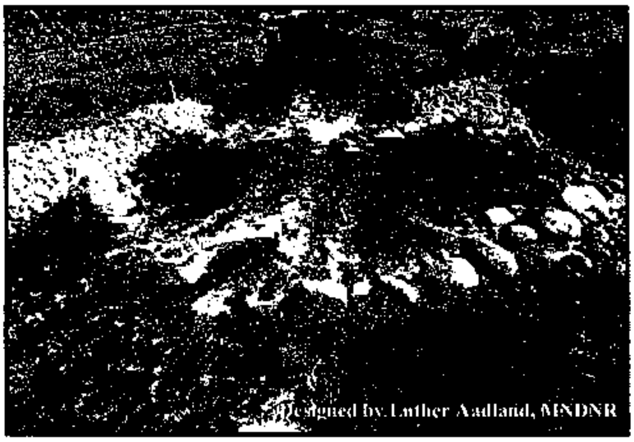
Given the adverse effects of impoundments on habitat, water quality, and aquatic biota in the Fox River, the proportion of impounded waters in the system should give an indication of the overall influence of dams on the river's ecological condition. We found that dams impounded 47% of the river's length and 55% of its surface area between Chain of Lakes and Dayton, Illinois. This high density of impounded habitat suggests that improvements to the ecological health of the river would be realized if some dams were removed and riverine habitat was restored. Further, dams prevented access by fish to important spawning and nursery habitats, such as tributaries and wetlands, which were absent from many sections of the river isolated by dams. Similarly, the Fox River is the third largest tributary to the Illinois River, yet the Dayton Dam prevents access by Illinois River fish to all but the lower 5.6 miles of this important resource.

Based on the strong and consistent nature of our results, we recommend reconnecting the river through the removal or modification of all mainstem and tributary dams. Benefits of a reconnected river may include: elimination of barriers to canoeists and kayakers, enhanced habitat and water quality conditions and corresponding improvements to fish and macroinvertebrate communities, improved access by Fox River and Illinois River fish to important spawning and nursery habitats in tributaries and stream-side wetlands, repopulation of areas where certain species of fish and mussels no longer exist, genetic mixing in fish and invertebrate populations isolated by dams, and improved recreational fishing opportunities provided by enhanced sport fish populations and seasonal migrations of fishes, such as walleye, northern pike, muskellunge, sauger, white bass, skipjack herring, and large sucker species.

Options to reconnect the river include: removing dams completely, lowering dams and ramping the remaining structure, constructing traditional fishways (e.g., Denil fishways), and constructing fish/canoe bypass channels. In many cases, we present more than one option for individual dams. Dam removal is the best option when the ecological health of the river is of prime consideration because removing dams will eliminate barriers to migration for all types and sizes of fish, restore high quality river habitat, and improve water quality. In addition, dam removal is relatively inexpensive compared to other options presented and it eliminates safety risks (people drown at dams) and maintenance costs because the structure is gone.



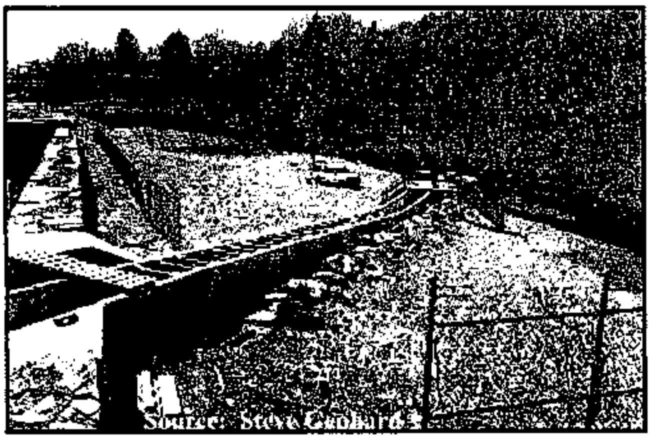
Dam removal is the best option to reconnect the river when ecological and safety benefits are of prime importance.



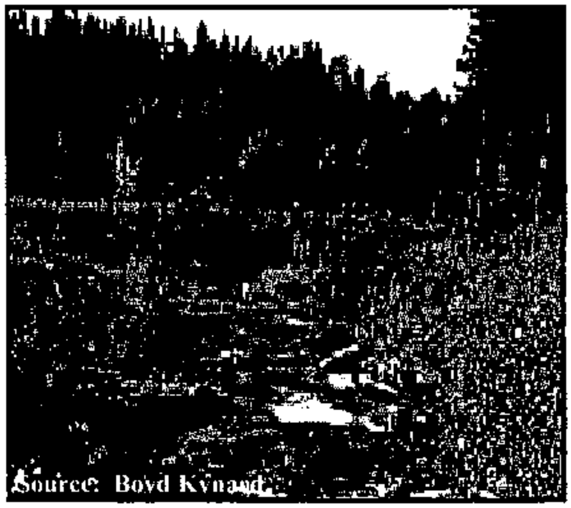
Roughened ramps may be most appropriate in tributary streams when dams must remain in place.

Lowering and ramping dams provides for reconnection of the river by allowing most fishes to pass upstream and paddle craft downstream, but it does little to improve degraded water quality and habitat conditions. This option probably is not feasible at most dams on the Fox River because they are long (>250 ft.) and the amount of fill (small and large boulders) needed to build a ramp at the proper slope (5%) may be cost prohibitive or unacceptable to regulating agencies. Ramping may be a suitable option for small tributary dams when removal is not an acceptable option.

Fishways and bypass channels will allow many (not all) fish to navigate over or around dams, but will do nothing to improve habitat and water quality conditions in the river. Priority species targeted for fishways or bypass channels include channel catfish, flathead catfish, muskellunge, northern pike, white bass, smallmouth bass, sauger, walleye, goldeye, mooneye, skipjack herring, redhorse suckers (golden, silver, shorthead, and the Illinois threatened river redhorse), buffalos (smallmouth, bigmouth, and black), carpsuckers (highfin and river), and northern hog sucker. Fishways have associated operational and maintenance costs and are relatively expensive to build (~$1,600/linear ft. for Denil fishways). Fishways and bypass channels should be considered only when dam removal is ruled out as a fish passage option.

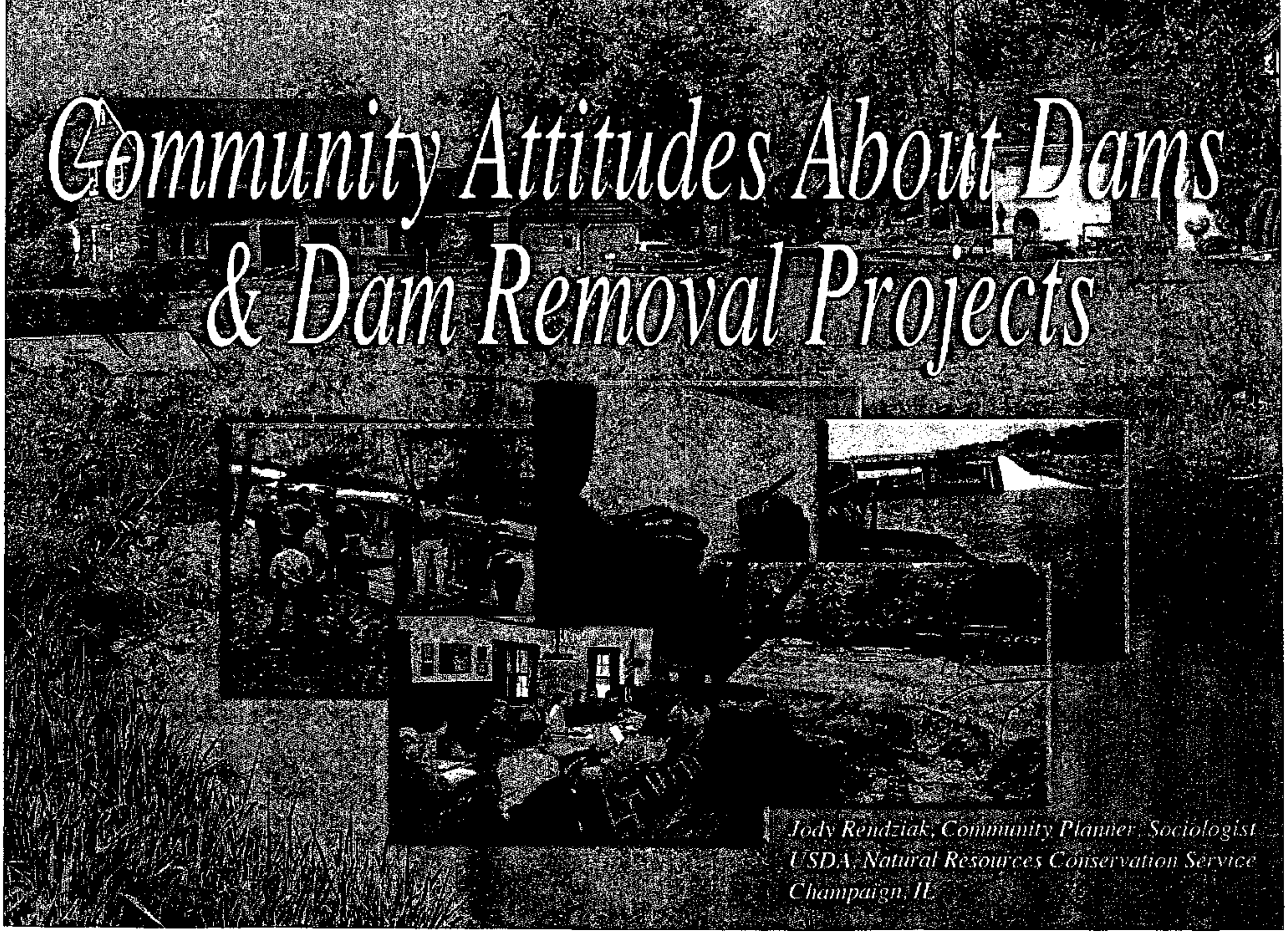


Properly designed Denil fishways will pass fish like those found in the Fox River over dams, but they do nothing to improve habitat or water quality.



Bypass channels look natural and can be designed to pass fish upstream and canoes downstream. Like fishways, bypass channels do nothing to improve habitat or water quality.

The Fox River is an important ecological and recreational resource that is worthy of restoration efforts. Based on past work in Wisconsin, dam removal is likely the most cost effective and practical restoration technique available today. Reconnecting the Fox River with fishways and bypass channels at dams also will provide substantial improvement over existing conditions, but these options are less beneficial than dam removal. Although potential benefits are high, removing and modifying dams will not address all problems affecting the river. Additional watershed management practices, such as incorporating Best Management Practices (BMP's) in rural areas, protecting tributaries and wetlands from development, and reducing input of nutrients and non-point source pollutants, will be necessary to ensure that the Fox River remains a vital natural resource for future generations.


Community Attitudes About Dams
& Dam Removal Projects
Jody Rendziak, Community Planner, Sociologist
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Champaign, IL

Origins

- Decisions are being made to restore, rebuild, or remove aging, obsolete and nonfunctional dams.
- Controversial dam removal study in northeastern IL.
- Lack of understanding about public opinion of dams.

Purpose

- Guidance about how to understand public opinion of dams and use this insight for planning.
- Collect community attitude information about dams in the Fox River watershed.

Methodology

- Three Fox River community case studies.
- Develop method for assessing community attitudes.
- Results described in Understanding Community Attitudes about Dams and Dam Removal Projects.

Findings

- Local community may have an interest in what happens to the dam.
- Use qualitative methods to get preliminary understanding of the local perspective.
- Depending on scope and complexity, add public surveys .
- Consider community interest and potential impact to devise problem solving process.

Fox River Community Attitudes

- Importance of the Fox River to the history, identity, character, economy and quality of life in the region.
- Impounded reach of river is the focus of community events and activities.
- Source of community pride and image.

Fox River Community Attitudes

- Concern about growth and change.
- Link protection of aesthetic and recreational values to overall quality of life.
- Removal of the dam and pool threatens:
  - Beauty of river
  - Desirability of community as a place to live
  - Viability of entire "River Town"

Fox River Community Values

- Protect and maintain quality of life:
  - Family and recreational amenities
  - Existing aesthetics
  - Public access
  - Property values
  - Local economic growth and stability
- Protect and enhance community investment in recreational, aesthetic, and other amenities associated with river.

Attitudes about River Function

- Rivers are like bathtubs. If dammed they are full of water, if undammed they empty out.
- Remove all the dams on a river and the whole river will drain from top to bottom.
- The streambanks will erode without the dams, because the water will move faster and weaken trees and other vegetation.

Attitudes about River Function

- If the water level falls there will be big bug problems, “mud flats”, and “swamp land”.
- The fishing is better on rivers with dams. Without dams there will be no quality fishing on the river.
- There are adjacent springs that the fish go to, and lowering stream flow will eliminate access to these springs.

Recommendations

- Start with a basic assessment of public attitudes.
- Focus on community values and perceptions in education and decision-making.
- Consider how much public involvement is necessary and with which groups.

Levels of Public Involvement

- Information-Only
  - People who make and implement the decisions tell the public what is happening.
- Consultation
  - Ask people to comment on ideas and activities.
- Collaboration
  - Stakeholders *decide together*.

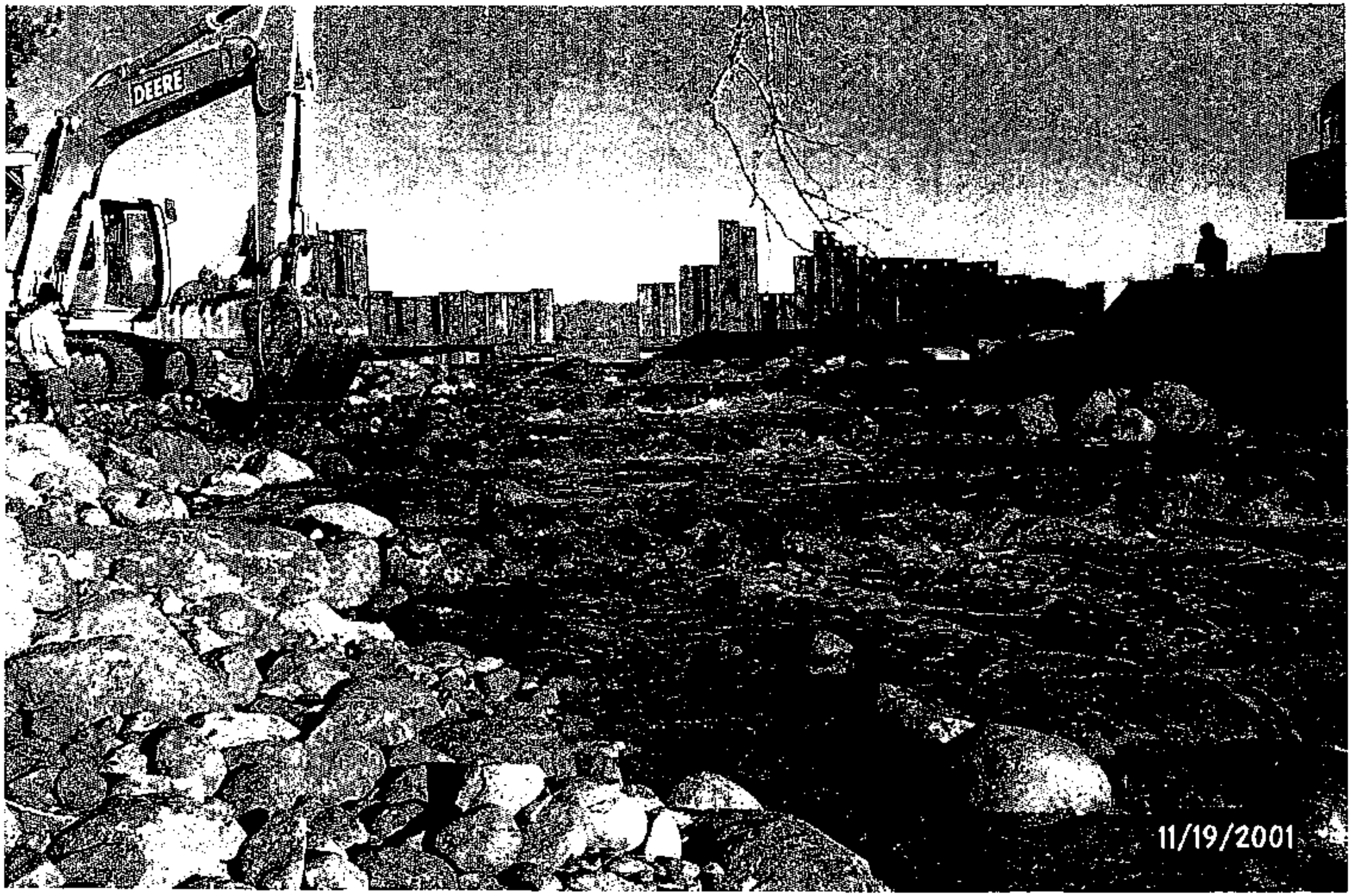
Considerations

- Complexity of the issues
- Stakeholder interest
- Decision-making authority and constraints
- Available resources

Additional Suggestions for the Fox River

- Start with streamside stakeholders.
- Address potential aesthetics problem.
- Address potential loss of river focal point.

U.S. FISH AND WILDLIFE SERVICE
FISH PASSAGE PROGRAM



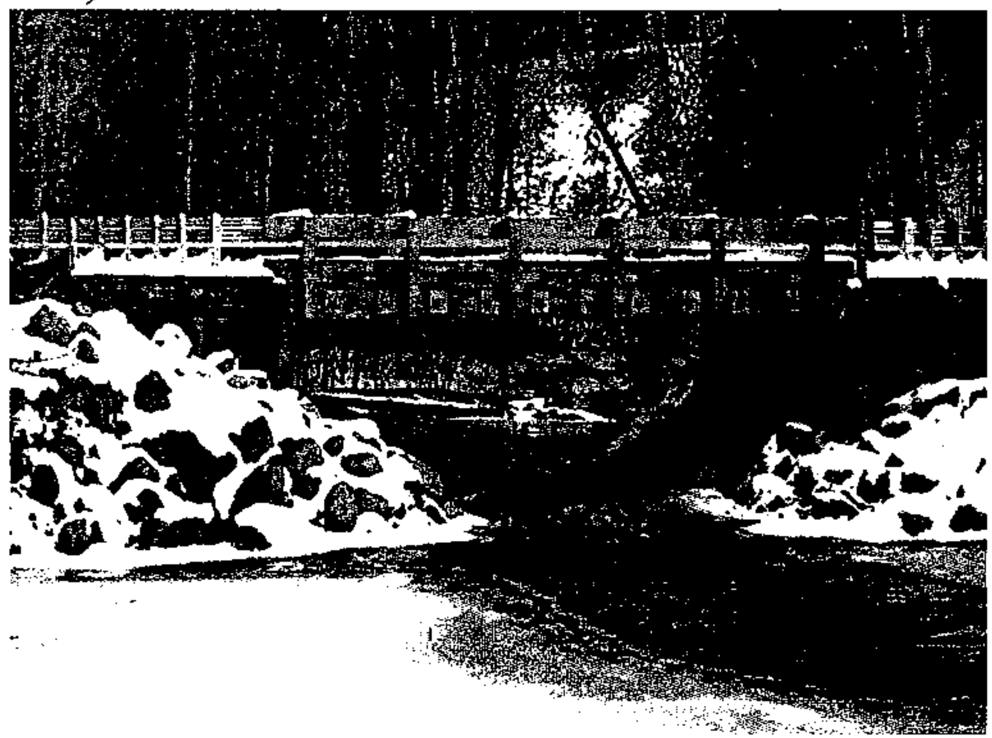
Pelican River Dutton Lock, Minnesota

FWS National Program Goal

To restore native fish and other aquatic species to self-sustaining levels by reconnecting habitat that has been fragmented by barriers, where such reconnection would not result in a net negative ecological effect.

USFWS PROGRAM ELEMENTS

- Policy and budget
- Fish passage projects
- Fish Passage Decision Support System
  - (i.e., National dam data base)
- Outreach
- Training



N. Branch of the Manistee River, Michigan

How is Program Structured?

- The program is implemented by Program coordinators, field stations, and partners
- Appropriations support coordinators, projects, and National data base of dams
- Coordinators and Field station staff work with partners to plan, prioritize, and execute projects, and maintain the data bases

ACCOMPLISHMENTS Through 2001

Nationally

- 76 projects in 26 states; 141 partners; 3,443 miles, 65,088 acres; 18 T, E, C species; Partner match: 73%

Region 3

- 15 projects in 5 states
- 39 partners
- 162 miles; 960 acres
- 14 species
- Partner Match: 74%

How does FWS implement projects? (Compliance Requirements)

- FWS Project managers:
  - Comply with all regulations
  - Coordinate with partners to identify and implement projects
  - Ensure appropriate documentation
    - Project plan that delineates responsibilities and commitments
  - Ensure project quality
  - Follow-up and evaluate projects
  - Track accomplishments

What are Ranking Factors?

- Demonstrate the greatest ecological benefits
- Exhibit permanence of fish passage benefits
- Use current scientific knowledge and proven technology
- Evidence the greatest number of partners
- Matching funds from partners
- Address objectives in approved management plans

Minimum Requirements for Funded Projects

- Be executed in accordance with Compliance Requirements
- Be submitted in FWS data base (Aug.-Oct.) for ranking (funding the following season)
- Projects must be completed in the year funded
- Final report required

Minimum Requirements for Final Reports

- Enumerate species benefited and miles of river or acres opened to fish movement
- Submit photos of pre- and post-project conditions

How are Program funds used?

- Direct costs
  - Each Region must use at least 70% of project funds for in-the-water activities (includes engineering costs)
- Indirect costs
  - Regions may use no more than 30% of funds for planning, processing agreements, evaluation, outreach

Cost Sharing by Partners

- Will seek to secure at least 50% of Regional total project costs from partners

Non-eligible projects

- Projects for any Federal or State compensatory mitigation
- If fish passage is a condition provided by Federal or State regulatory program
  - e.g., may not use funds to construct, operate, or maintain fish passage at facilities licensed or permitted by the Federal Energy Regulatory Commission

Suggestions: 2004 Fish Passage Projects

• Begin planning for FY04 and even FY05 projects now

• Establish partnerships with FWS and other groups and obtain commitments for match

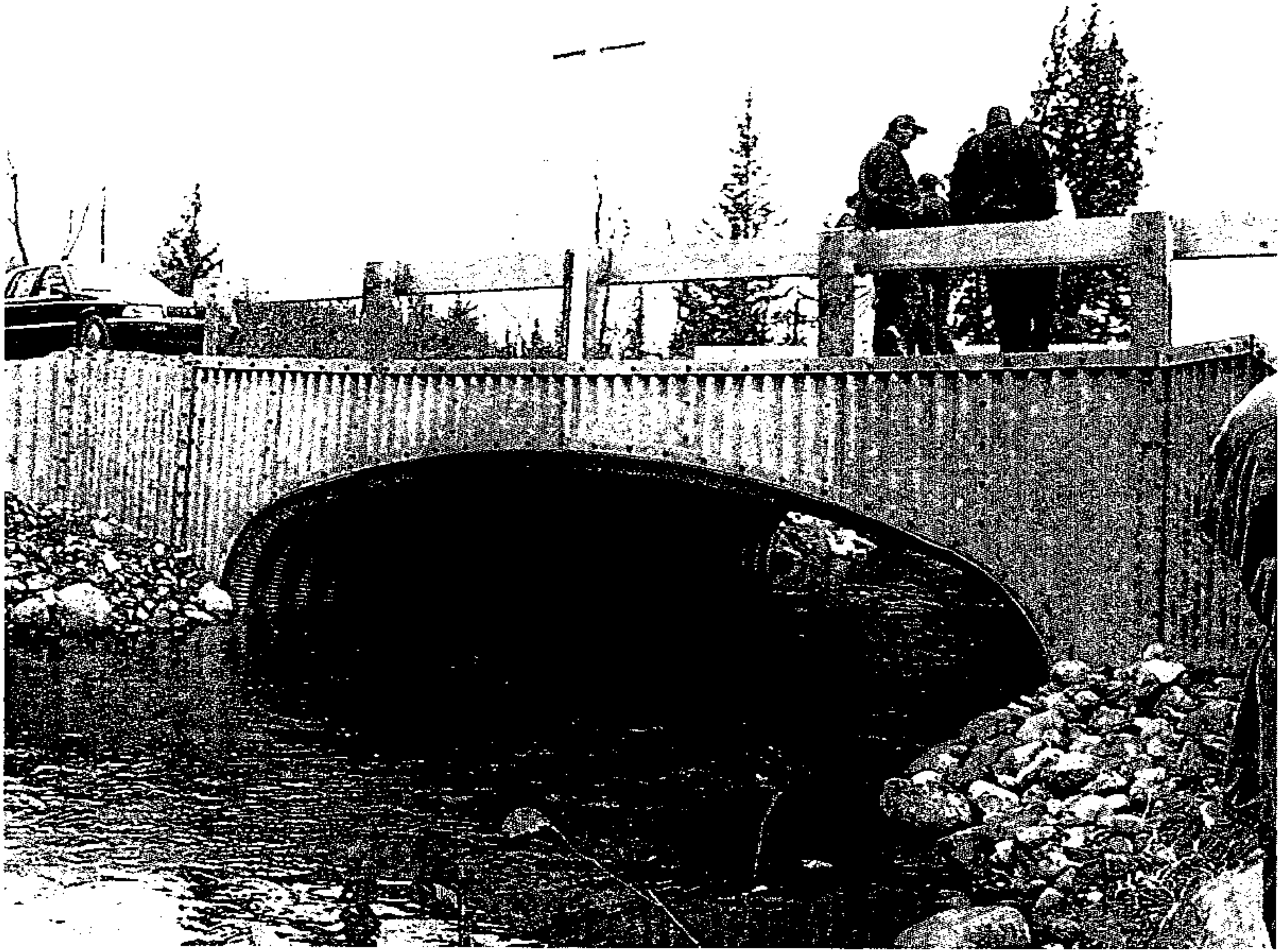
(undersubscribed partners include American Rivers, Trout Unlimited, U.S. Forest Service, counties, municipalities, State and Federal DOTs, U.S. Army Corps of Engineers)

• Work with FWS to prepare submissions for projects that are likely to be completed in FY04 (e.g., probability of completion near or at 100%) (Completion Probability Criterion important)

How to get Involved

- In Illinois and Indiana, contact
  Chuck Surprenant, FWS, at:
  618-997-6869, Chuck_Surprenant@fws.gov
- Elsewhere in this Region contact me
  612-713-5114, Michael_Hoff@fws.gov

  I will help you contact the appropriate
  field station, which can work with you
  to develop proposals and implement projects.



Black River, Michigan

River Restoration: Practices and Concepts

Held at:
Elgin Community College
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June 4, 2003

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