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PROCEEDINGS OF THE

MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.

VOLUME 23
1991

SESSION III	**WILDLIFE/VEGETATION** **Moderator:** John Barko
01:00-01:15 P.M.	Monitoring Bald Eagle Activity on the Upper Mississippi River: A Review of Recent Initiatives and Predictions of Management Implications. Joan Galli.
01:15-01:30 P.M.	Tick Attack!, Part III: More Lyme Borreliosis in the Saint Croix Valley. A.R. Weisbrod, R.B. Harvey, and R.C. Johnson.
01:30-01:45 P.M.	Potential Water Quality Factors Contributing to the Decline in Aquatic Vegetation in the Upper Mississippi River. John Sullivan.
01:45-02:00 P.M.	Interactions Between Sediment and Submersed Macrophyte Growth in Riverine Systems. John Barko and Dwilette McFarland.
02:00-02:15 P.M.	Preliminary Evaluation of a Vegetative Streambank Stabilization Site on Richland Creek, Woodford County, Illinois. James Slowikowski, William Bogner, and Nani Bhowmik.
BREAK/POSTERS	02:15-03:15 P.M.
SESSION IV	**SEDIMENT CONTAMINANTS/BIOACCUMULATION** **Moderator:** Teresa Naimo
03:15-03:30 P.M.	Metal Contamination of Lake Pepin in Historic Perspective. James Wiener, Ronald Rada, and David Powell.
03:30-03:45 P.M.	Polychlorinated Biphenyls in Emergent Mayflies (*Hexagenia bilineata*) in the Upper Mississippi River. Mark Steingraeber, T. Schwartz, J. Wiener, and J. Lebo.
03:45-04:00 P.M.	Cadmium and Mercury in Emergent Mayflies in the Upper Mississippi River. Jeanne Dukerschein, James Wiener, and Ronald Rada.
04:00-04:15 P.M.	Levels of Polychlorinated Biphenyls (PCBs) in Common Carp (*Cyprinus carpio*) from the Upper Mississippi River, and the Need for a Trend Monitoring Program. Cynthia Biedron and Dan Helwig.
04:15-04:30 P.M.	Bioaccumulation of Cadmium in Juvenile Bluegills Exposed to Resuspended River Sediment. Gregory Cope, Gary Atchison, James Wiener, and Mark Steingraeber.
04:30-04:45 P.M.	Should We Sound the Alarm: Biotic Changes in Pool 19, Mississippi River. Richard Anderson, David Day, Dan Sallee, Bill Bertrand, and Stephen Havera.
04:45 P.M.	**DISMISS UNTIL 6:30 CRUISE ON "ISLAND GIRL"**
06:30-08:30 P.M.	**SOCIAL AND DINNER CRUISE ON THE "ISLAND GIRL"**

FRIDAY, APRIL 26, 1991

SESSION V	**GIS APPLICATIONS/WATER QUALITY MODELING** **Moderator:** Nani Bhowmik
08:00-08:15 A.M.	GIS Applications in Fisheries: Opportunities and Difficulties. David McConville, Gary Oberfoell, John Pitlo, and Barry Drazkowski.
08:15-08:30 A.M.	LaCrosse River Valley Environmental Analysis GIS Project. Lance Perry and Stuart Utley.
08:30-08:45 A.M.	A Conceptual Model of the River Reaches of the Upper Mississippi River System. Ken Lubinski.
08:45-09:00 A.M.	Validation of Models Applied to the Mississippi River. Barry Johnson.
09:00-09:15 A.M.	Application of HEC-6 Movable-Bed Mathematical Model to Pool 20, Mississippi River: RM 343.2-RM 364.2. Tatsuaki Nakato.
BREAK	09:15-09:30 A.M.
SESSION VI	**MUSSELS** **Moderator:** Michael Dewey
09:30-09:45 A.M.	The Mussel Resource at Prairie Du Chien, Wisconsin: A Summary of Six Years of Quantitative Data. Drew Miller and B. Payne.
09:45-10:00 A.M.	A Salvage Survey for Naiad Mollusks (Unionidae): Illinois River Mile 162.2, Franklin Street Bridge, Peoria, Illinois, August 1988. Marian Havlik.
10:00-10:15 A.M.	Life Cycle and Population Fluctuations in the Fingernail Clam, *Musculium transversum*, Pool 19, Mississippi River. Richard Anderson, Richard Sparks, and Jeffrey Arnold.
10:15-10:30 A.M.	Characterization of Illinois Mussel Sanctuaries, Pools 19 and 20, Mississippi River. Todd Pederson and Richard Anderson.
10:30-10:45 A.M.	Enumeration and Evaluation of Zebra Mussel (*Dreissena polymorpha*) Control Strategies. Leif Marking.
10:45-11:00 A.M.	Considerations in Using Freshwater Mussels in Aquatic Toxicity Studies. Teresa Naimo.
BUSINESS MEETING	
11:00-12:00 A.M.	**Moderator:** Kent Johnson
ADJOURN	12:00 NOON
DIRECTORS' MEETING	
12:00-01:00 P.M. (With Lunch)	Kent Johnson, Mike Romano, Joe Wlosinski, and New Directors
	THANKS FOR YOUR PARTICIPATION!!

MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.
23RD ANNUAL MEETING

POSTER AND DISPLAY PRESENTATIONS

THURSDAY, APRIL 25, 1991

10:15-11:15 A.M. 02:15-03:15 P.M.

Source Monitoring of Sediments: Peoria Lake. William Bogner, James Slowikowski, and Nani Bhowmik.

Effectiveness of Acute and Chronic Testing Protocols for Evaluating POTW Toxicity- One Municipality's Experience. Garry Durland, Kent Johnson, and Paul Aasen.

Classification of Aquatic Macrophytes in an Upper Mississippi River Backwater Lake with Aerial Videography. Cecil Jennings, Mike Dewey, and Paul Vohs.

Initial Studies on the Decline and Restoration of *Vallisneria* in the Upper Mississippi River. Anne Kimber and Arnold van der Valk.

Minnesota River Assessment Project (MRAP). Tim Larson and Mike Meyer.

Vegetation Changes Between 1975 and 1989: Pool 13, the Upper Mississippi River. Mark Laustrup.

GIS Displays of EPPL7 and FWA. Carol Lowenberg.

The Ohio River Basin Consortium for Research and Education. William Mitsch.

The North American Lake Management Society. North American Lake Management Society.

A Demonstration Application of the EPPL7 Geographical Information Systems (GIS) Software to Analyze Telemetry Fisheries Data. Gary Oberfoell, David McConville, John Pitlo, and Barry Drazkowski.

Habitat Restoration: The Prospect of *Vallisneria americana* Re-Establishment in Backwater Areas of the Illinois River. Susan Peitzmeier Romano, Barry Newman, Douglas Blodgett, Richard Sparks, and Carl Korschgen.

Gilmore Creek Macroinvertebrate Recovery Following a Shock Dose of Calcium Hypochlorite. Brian Pember and Gregory Mastey.

Electrophoretic Analysis of the Host-Parasite Relationship Between the Flathead Catfish (*Pylodictus olivaris*) and the Mapleleaf Mussel (*Quadrula quadrula*). Mike Romano, D.B. Markillie, and R.V. Anderson.

Habitat Rehabilitation and Enhancement Projects on the Mississippi River and Illinois Waterway. Jerry Skalak and Robert Clevenstine.

Forest Management on the Upper Mississippi River: Implementing a Forest Resource Field Inventory and Using a Geographic Information System (GIS) as a Repository for Resource Information. Randall Urich.

Section of Ecology- National Fisheries Research Center, LaCrosse. James Wiener.

Table 1

OHIO RIVER BASIN CONSORTIUM FOR
RESEARCH AND EDUCATION
CURRENT MEMBERSHIP

INSTITUTIONAL MEMBERS

Butler University
Illinois State University
Indiana University
Marshall University
Miami University
Murray State University
The Ohio State University
Ohio University
University of Cincinnati
University of Kentucky
University of Louisville
University of Pittsburgh
University of Southern Indiana
Virginia Polytechnic Institute & State University
West Virginia University

CORPORATE MEMBERS

CECOS International, Inc.
Louisville and Jefferson County Metropolitan Sewer District
Louisville Water Company
Monsanto Company
The Procter & Gamble Company

COOPERATING MEMBERS

Carnegie Mellon University
Central State University
The Cincinnati Gas & Electric Company
Dayton Power and Light Company
Depauw University
Jefferson Technical College
Kentucky Environmental Protection Cabinet - Division of Water
Louisville Gas & Electric Company
Morehead State University
Ohio Department of Natural Resources - Division of Water
Ohio Environmental Protection Agency
River Fields, Inc.
Shawnee State University
Terrestrial Environmental Specialists, Inc.
Thomas More College
The University of Tennessee
USGS Water Resources Division, Kentucky District
USGS Water Resources Division, Ohio District
USGS Water Resources Division, Pennsylvania District
Washington Technical College

CORPORATE SPONSOR

E.I. du Pont de Nemours & Company

Mitsch, 1991

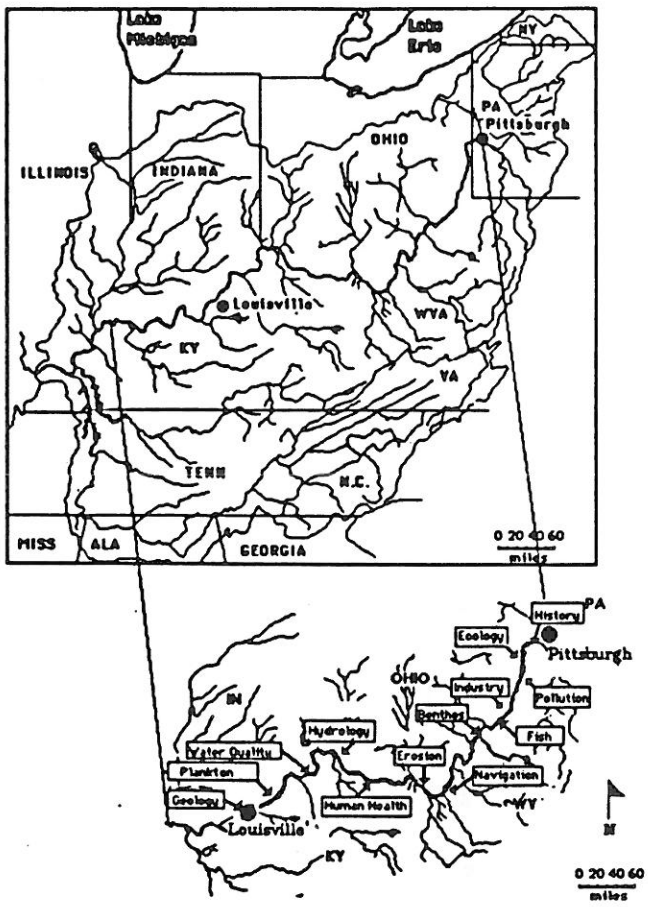


Figure 1. Route and Approximate Location of Topics for 1987 "Boatload of Knowledge" Voyage on Ohio River (Mitsch, et al, 1989)

SAMPLE SIZE AND ACCURACY IN ESTIMATING THE BENTHOS OF MISSISSIPPI RIVER BACKWATER LAKES.

Jim Eckblad, Steven Lehtinen, Andrew Wold, and David Bartelt, Department of Biology, Luther College, Decorah, Iowa 52101.

Five benthic taxa (*Hexagenia*, Sphaeriidae, Chironomidae, Oligochaeta, and Misc. Taxa) were sampled from eight backwater lakes in 1990 to evaluate how the accuracy of mean population density estimates was influenced by the number of sites per lake, and the number of samples per site. The relative accuracy of the mean was calculated from the formula,

$$Accuracy = \frac{(t\text{-}value)\ (\sqrt{Sample\ variance/Sample\ size})}{Sample\ mean}$$

In general, the accuracy of sample means increased as the number of sites per backwater lake were increased up to about five, but changed very little as the number of sites increased from five to 15. As the number of ponar grab samples per site increased, up to about five, there was an increase in the accuracy of sample means. As the number of samples per site increased from five to 15 there was relatively little increase in sampling accuracy. Population estimates were, in general, more accurate for the Total Benthos, Oligochaeta, and Chironomidae, and less accurate for the Sphaeriidae, *Hexagenia*, and Misc. Taxa. Relative accuracy in estimating population numbers of the five taxa between the eight backwater lakes varied by as much as from 30 to 300 percent. Lakes with relatively low population densities for some taxa (e.g. Green Lake, Mallard Pond, Fish Lake, Lumber Lake; see Figure 1) had lower relative accuracy in estimating population means.

Eckblad, 1991

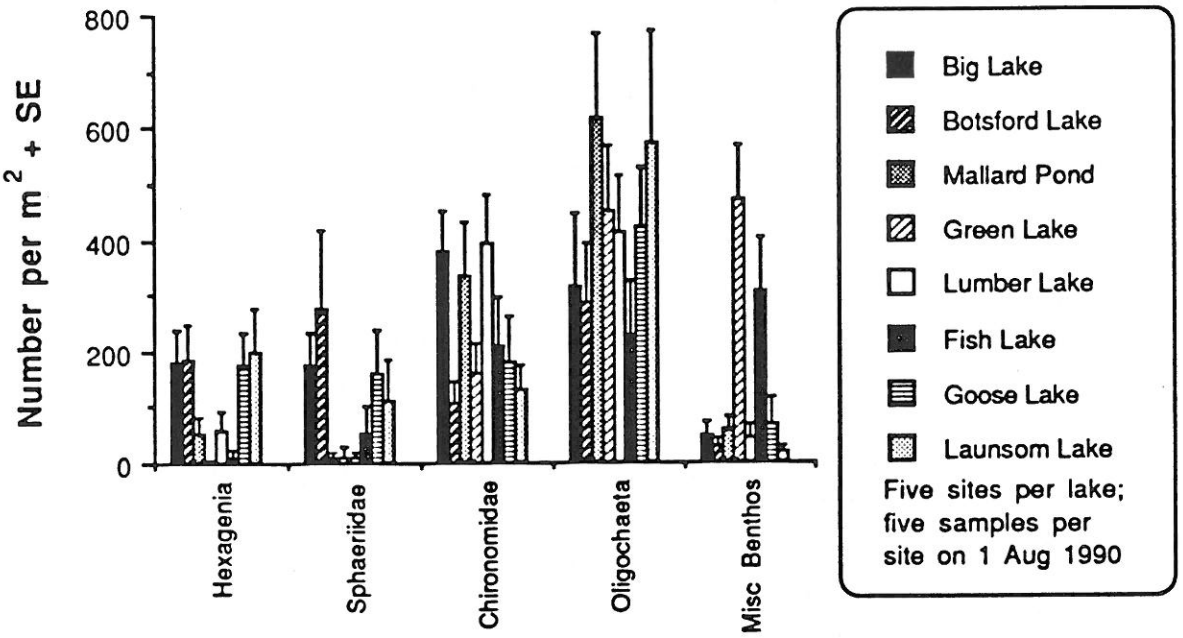


Figure 1. Benthic Taxa from Backwater Lakes of Pool 9.

GEAR FOR SAMPLING JUVENILE FISHES IN SUBMERGENT VEGETATION

Michael R. Dewey, U.S. Fish and Wildlife Service, National Fisheries Research Center, P.O. Box 818, La Crosse, Wisconsin 54602.

We evaluated gears for both quantitative and non-quantitative sampling of juvenile fishes in vegetated habitats in the upper Mississippi River. Replicated field tests conducted from July through September in a backwater lake compared catches of three quantitative sampling gears: an electrofishing frame, a drop net, and a pop net. The electrofishing frame was modified with a drop-net mechanism to assess the capture efficiency of the electrofishing device and to serve as a drop net. Catches with all three gears were dominated by juvenile centrarchids, mainly bluegills *Lepomis macrochirus*. In vegetated, turbid water, catches with the electrofishing frame were significantly less than those with the other two gears, due to the difficulty in observing and netting stunned fish. Capture efficiencies with the electrofishing frame were much higher (mean efficiency 80%) in nonvegetated, relatively clear water than in vegetated, turbid water. The drop net and pop net yielded similar catches in number and species composition. If a removal method would have been used to estimate abundance within the drop net enclosure instead of extensive seining, required sampling effort would be comparable to that of the pop net. Replicated tests were also conducted to evaluate three non-quantitative sampling gears: fyke nets, hoop nets and minnow traps. Fyke nets yielded greater numbers and more species of fish than the two other gears tested.

GROWTH AND MORTALITY OF LARVAL FRESHWATER DRUM AND SUNFISH IN POOL 8 OF THE UPPER MISSISSIPPI RIVER

Steven J. Zigler and Cecil A. Jennings, U.S. Fish and Wildlife Service, National Fisheries Research Center, La Crosse, WI 54602-0818

We estimated the growth and mortality of larval freshwater drum and sunfish (*Lepomis spp.*) at two backwater (Lawrence Lake and Target Lake) and two adjacent main channel stations in Pool 8 of the upper Mississippi River. Instantaneous growth rates at each station were estimated by two methods. In the first, growth rates were estimated by regressing log-transformed lengths of larvae in 1-mm increments against the mean dates that larvae were recruited to these lengths (as determined from the distributions of larvae abundance in each length increment). In the second, growth rates were estimated by regressing the log-transformed total lengths of larvae against the otolith-ages of larvae. Larvae lengths were converted to ages with both sets of growth equations, and the instantaneous mortality rates were estimated as the slope of the descending arm of the cumulative catch curves.

The two methods of estimating growth produced comparable results. Length-based estimates of growth of freshwater drum larvae were 0.045 and 0.051, whereas estimates based on otoliths were 0.055 and 0.061. The two methods produced similar estimates of sunfish growth at Target Lake (0.045 and 0.048), but not Lawrence Lake (0.027 and 0.042). However, fewer sunfish larvae were captured at Lawrence Lake, possibly reducing the reliability of the length-based growth and mortality estimates. Estimates of instantaneous mortality of larval freshwater drum at the two main channel stations ranged from 0.28 to 0.42. Mortality of sunfish larvae at Target Lake was 0.40 and 0.46, based on the otolith growth and the length-based growth models, respectively.

The reliability of estimates of mortality and length-based growth are dependent on the abundance and catchability of the target population. The high abundance of freshwater drum eggs and larvae in the main channel reduces the required sampling effort and makes length-based methods of estimating growth practical. In contrast, sunfish early life stages are less vulnerable to capture because they are most abundant in vegetated habitats that cannot be effectively sampled with plankton nets. Although labor-intensive, the use of otoliths can reduce the number of larvae necessary to estimate growth; however, reliable estimates of larval mortality will require large sample sizes.

PERFORMANCE OF A CONTINUOUS WATER QUALITY MONITORING SYSTEM IN UPPER MISSISSIPPI RIVER BACKWATERS.

Jennifer L. Owens, and William G. Crumpton, Department of Botany, Iowa State University, Ames, IA 50011.

Backwater areas of the Upper Mississippi River are important habitats for fish and wildlife and are subject to high sediment and nutrient loads. High sediment and nutrient loads in backwaters can lead to wide ranging water quality problems, and not surprisingly, fish kills and macrophyte declines are now major concerns for shallow backwater areas of the Upper Mississippi River. Data are seldom sufficient to link fish kills and other problems to specific causes or to track water quality trends. In cooperation with the U.S. Fish and Wildlife Service, we are evaluating the potential for developing a network of portable water quality monitors for Upper Mississippi River backwaters. This network will allow for more informed management of the river system. Data provided by this network will be helpful in addressing a large array of factors, including determinations of primary production, turbidity based on light extinction coefficients, oxygen deficits, and light availability. This study was designed to evaluate the field performance of an inexpensive, portable water quality monitor.

Between June 28, and October 4, 1990, eight continuous monitors were deployed at sites in Lake Onalaska, Pool 7, Upper Mississippi River. One monitor was placed at each of seven sites on Lake Onalaska, while two monitors, located approximately 5 m apart, were placed at the eighth site. Each continuous monitor was programmed to collect measurements of dissolved oxygen, temperature, light at the surface, and light at 0.5 m, every six minutes. Accuracy of the monitors was assessed by comparing data to reference values of each parameter collected in the field. Reference values were collected at each site three times per week for the first half of the study and one time per week thereafter. Dissolved oxygen reference values were averages of three Winkler determinations from each site. Temperature was measured at each site using two mercury thermometers. Light values were collected at each site, at the surface, and at 35 and 50 cm below the surface, using a LI-COR model LI-192s underwater quantum sensor. Secchi depth transparencies were also measured at each site.

The continuous monitors performed well throughout the season and results indicate that the units are capable of monitoring diurnal and seasonal patterns of each parameter measured. The units tracked diurnal patterns of oxygen concentration and temperature and compared well to field reference values throughout the season (Figure 1). Figure 2 illustrates results from two diel studies and displays the monitor's ability to track diurnal patterns, as well as its accuracy as compared with reference values. Data for light illustrate the dynamic and variable nature of light reaching the lake surface (Figure 3).

Owens and Crumpton, 1991

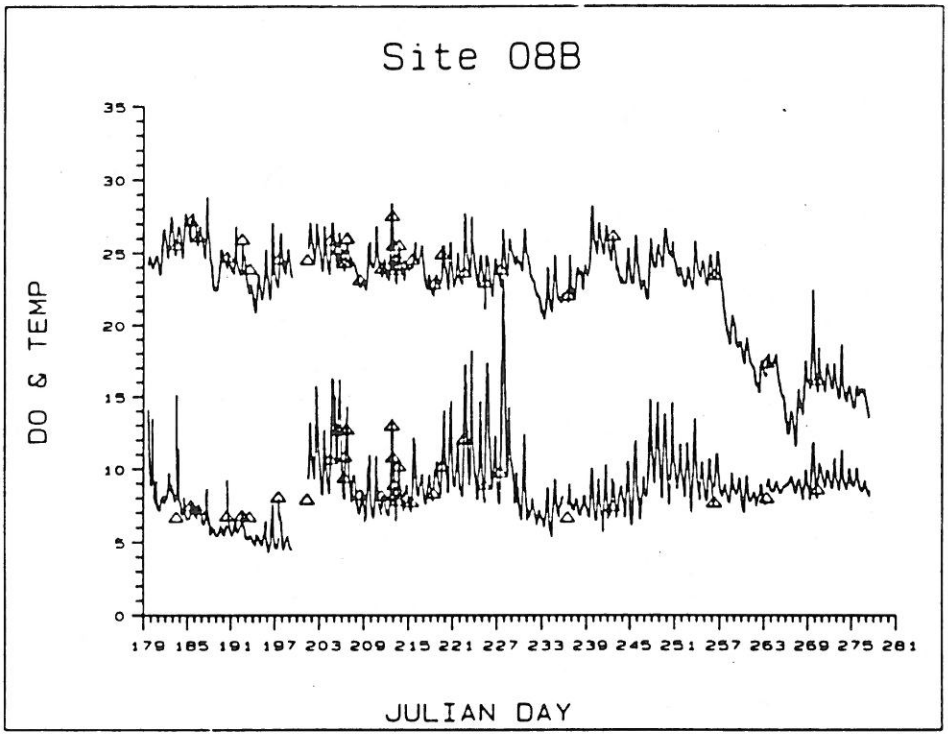


Figure 1. Temperature in degrees C (top line) and dissolved oxygen in mg/L (bottom line) as determined using the Waterlogger or measured as field reference values (triangles) for entire season at a site in Lake Onalaska.

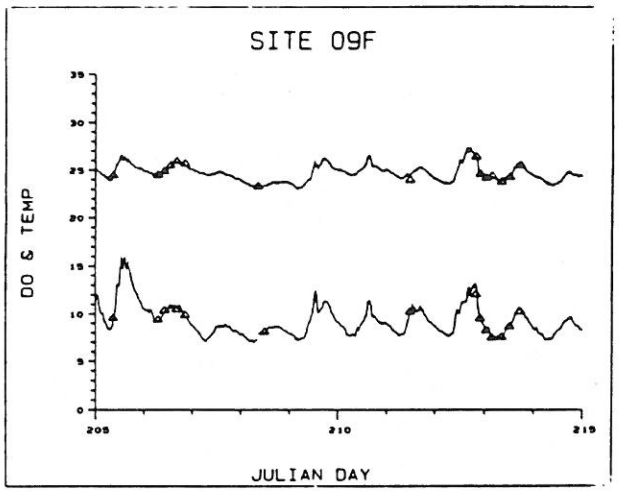


Figure 2. Temperature in degrees C (top line) and dissolved oxygen in mg/L (bottom line) as determined using the Waterlogger or measured as field reference values (triangles) for a site in Lake Onalaska

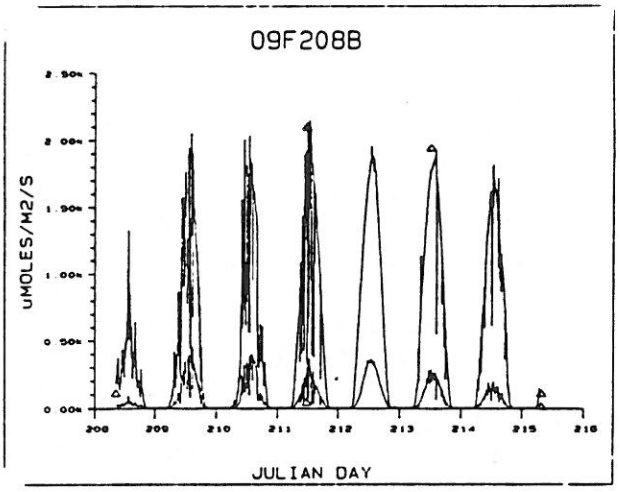


Figure 3. Photosynthetic photon flux density (PPFD) in umoles/m^2 /s for the surface (top line) and for 0.5 m below surface (bottom line) as determined using the Waterlogger or measured as field reference values (triangles) for a site in Lake Onalaska.

MINNESOTA RIVER ASSESSMENT PROJECT (MRAP) - A BASIN WIDE APPROACH TO WATER QUALITY PROTECTION

Timothy J. Larson, Minnesota Pollution Control Agency, Water Quality Division, St. Paul, MN 55155

The Minnesota River Basin is 16,770 sq. miles and drains all or parts of 37 counties in Minnesota. This represents approximately 18.5% of the land mass of the state. The most significant land use in the basin is cultivated land at 82%. The Minnesota River's average discharge into the Mississippi River increases the flow of the Mississippi by 47% and adds greatly to its pollutant load, since the Minnesota River is the most highly impacted water body in Minnesota, with regard to Nonpoint Source pollution (NPS). A Waste Load Allocation (WLA) for the Lower Minnesota River defined the water quality problem and the objective for improvement. The WLA predicted that a 40% reduction in organic BOD in the Minnesota at Shakopee is necessary to meet water quality limits in the Lower Minnesota during critical conditions. To determine the feasibility of reaching the 40% reduction in organic BOD at Shakopee and for improving the water quality of the river and its tributaries throughout the basin, a comprehensive nonpoint source evaluation of the entire Minnesota system is necessary. A cooperative effort called the Minnesota River Assessment Project (MRAP) was established to carry out this evaluation. The study involves the MPCA, U.S. Geological Survey, U.S. Environmental Protection Agency - Environmental Research Laboratory in Duluth, South Central Minnesota Counties Water Planning Project, Mankato State University, Board of Water and Soil Resources, USDA Soil Conservation Service, Minnesota Department of Natural Resources, and the Minnesota Department of Agriculture, with additional support from Metropolitan Waste Control Commission, Metropolitan Council, U.S. Army Corps of Engineers, and the University of Minnesota. The study has established a comprehensive monitoring network in the Minnesota River Basin, which will identify critical mainstem reaches and tributaries for estimation of the NPS load reductions necessary to achieve water quality goals, the amount of resources necessary to achieve those goals, and for the targeting of future water quality management programs. MRAP will demonstrate two processes for the state of Minnesota: the approach to be taken for determining NPS loading in a large watershed, and the ability of federal, state, and local units of government to work together toward a common goal. This project consists of three interrelated components which are essential in order to develop the information necessary to TARGET WATER QUALITY IMPROVEMENTS and SET WATER QUALITY GOALS for the Minnesota River Basin. The presentation will discuss those components, which are: Physical/Chemical assessment, Biological/Toxicological assessment, and Land Use assessment.

A LOWER MINNESOTA RIVER NONPOINT SOURCE MONITORING PROGRAM

Mike Meyer, Water Quality Monitoring Division, Metropolitan Waste Control Commission, 230 East Fifth Street, St. Paul, MN 55101

The Metropolitan Waste Control Commission (MWCC), Minneapolis/St. Paul, MN, is presently in the fourth year of a five-year program designed to determine the impacts of nonpoint source (NPS) pollutants from Metropolitan Area tributaries on the Lower Minnesota River. Event-activated monitoring/sampling sites have been established on the main stem of the Lower Minnesota River, near Jordan, Minnesota, and on seven Lower Minnesota River tributaries. During snowmelt and rainfall events, flow-proportioned composite samples are obtained from these eight sites, for analysis of carbonaceous material, suspended solids, nutrients, and toxic substances (heavy metals and PCBs). Loading rates of these materials to the Lower Minnesota River can subsequently be determined.

Concentrations of total suspended solids (TSS) in the tributaries and Lower Minnesota River can be extremely high during snowmelt and rainfall events. The potential for aquatic habitat destruction due to suspended solids loading may be enormous. Concentrations of TSS range from 100 to 1000 mg/l during periods of increased flow. Loading of solids from one tributary during moderate events ranges from 50,000 to 500,000 lbs. On a larger scale, during a two-day event in June, 1990, the Lower Minnesota River at Jordan transported 67 million lbs. of solids.

During spring runoff events, concentrations of total phosphorus (TP) in rural tributaries range from 1 to 3 mg/l. A TP concentration of 0.98 mg/l was measured in a Lower Minnesota River composite sample obtained in June, 1990. Loadings of TP during events are very large, and correlate with TSS concentrations.

Concentrations of carbonaceous material, measured as biochemical oxygen demand (BOD) and chemical oxygen demand (COD), increase with flow and TSS concentrations. COD concentrations range from 50 to 200 mg/l during events.

Limited analysis of PCB concentrations in selected tributaries has been conducted, indicating that both rural and urban tributaries may be significant sources of PCB. During events, measured concentrations of total PCB in water range from 0.03 to 0.29 μg/l (ppb). Concentrations of total PCB on suspended solids range from 0.12 to 3.30 mg/kg (ppm) (dry weight).

MWCC's five-year NPS monitoring initiative will culminate with a project report in 1992, describing the impacts of the seven tributaries on the Lower Minnesota River, and providing recommendations for water quality improvements through application of best management practices in the tributary watersheds.

PHYSICAL CHANGES ASSOCIATED WITH COMMERCIAL TRAFFIC ON THE UPPER MISSISSIPPI RIVER SYSTEM

Nani G. Bhowmik and Colleagues, Office of Hydraulics and River Mechanics, Illinois State Water Survey, Champaign, IL 61820-7495

Movement of river traffic on any waterway is associated with a series of physical changes that interact with the ambient hydraulic conditions of the river. These changes in the hydraulic parameters are measurable in the field and can be evaluated with normal mathematical and statistical tools. Physical changes associated with the movement of river traffic are: altered velocities and turbulence, development and generation of return flows, scour and resuspension of bed materials, creation of waves and drawdown, pulse inputs of water and sediment into side channels and backwater areas, and an overall temporary alteration of the flow patterns within the river cross section. The Illinois State Water Survey, with the support of the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service through the EMP program, has been collecting field data from the Illinois and Mississippi Rivers on the physical changes associated with navigation traffic.

Field data and analyses completed so far have shown that the altered velocity regime and return flows within the channel border areas can last several minutes, maximum suspended sediment concentrations within the channel border area can increase by about 2 to 8 times, and increased suspended sediment concentrations can also last from several minutes to 30 minutes or more. Lateral velocity distributions have shown that the ambient velocity will either increase or decrease depending upon the direction of movement of the barge traffic. In a few instances when the river traffic moves in a downstream direction, the ambient velocity within the channel border area can change direction altogether and move in an upstream direction for several minutes. Figures 1 and 2 show some of the changes in velocities and suspended sediment concentrations for a site along the Illinois River during the movement of a barge-tow.

Data on pressure fluctuations, waves, and drawdown were also collected. Maximum measured wave heights and drawdowns were about 0.35 meters and 0.3 meters, respectively. An evaluation of the wave heights resulting from the movement of recreational boats within the Upper Mississippi River System has also been completed, and a predictive relationship has been developed for estimating the wave heights generated by recreational boats.

Bhowmik and Colleagues, 1991

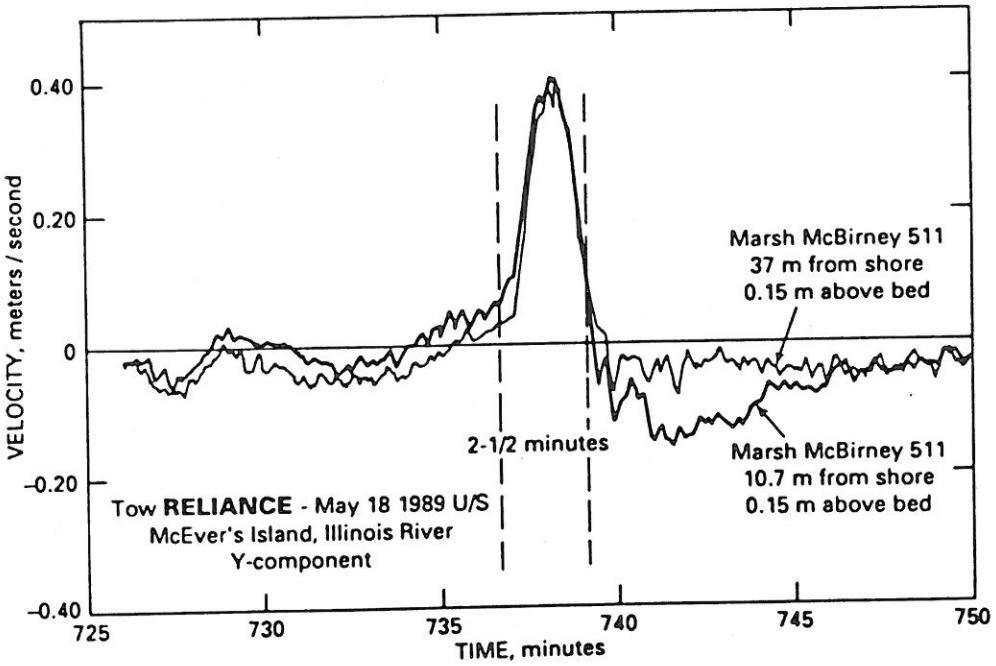


Figure 1. Net velocity changes, Illinois River, RM 50, McEver's Island Site

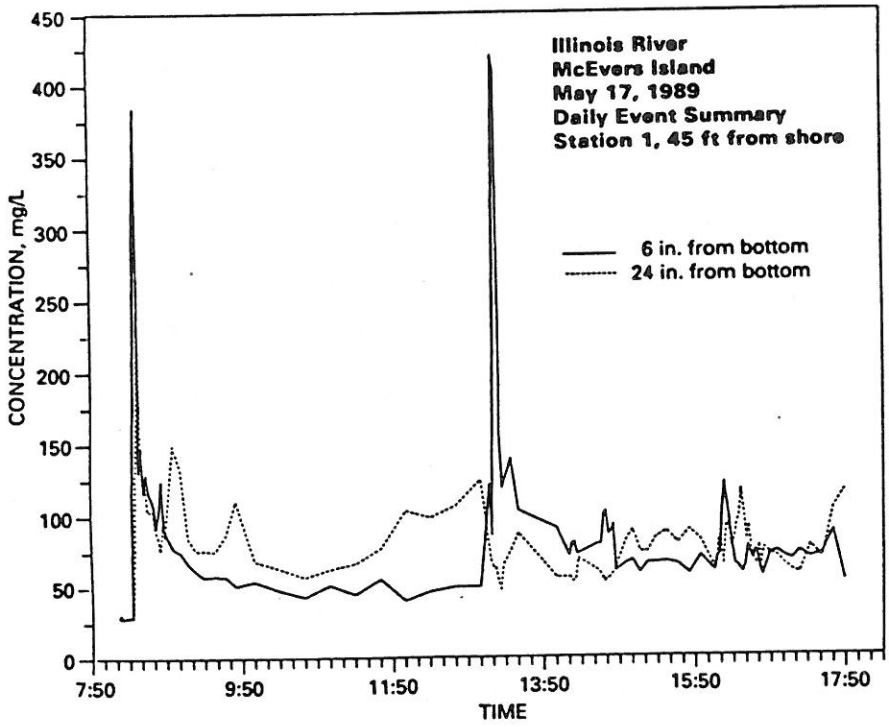


Figure 2. Daily suspended sediment concentration changes with time

MONITORING BALD EAGLE ACTIVITY ON THE UPPER MISSISSIPPI RIVER: A REVIEW OF RECENT INITIATIVES AND PREDICTIONS OF MANAGEMENT IMPLICATIONS

Joan M. Galli, Mn. Department of Natural Resources, Nongame Wildlife Program, 500 Lafayette Ave., St. Paul, Mn. 55155.

In 1978, the bald eagle was listed as "threatened" in Minnesota, Wisconsin, Michigan, Oregon, and Washington; and "endangered" in the remaining contiguous United States. Since that time, the number of breeding pairs in the Upper Midwest has more than doubled. In Minnesota, the breeding range has been expanding southward into the Twin Cities area and along the major corridors of the Mississippi, Minnesota, and St. Croix Rivers. The disjunct subpopulation in southeastern Minnesota along the Mississippi River is also expanding. Predictions are for a continuous distribution of breeding territories along the Upper Mississippi River by the turn of the century, provided suitable habitat is retained.

This presentation reviews the efforts of the Mn. DNR's Nongame Wildlife Program to monitor, manage, and protect Minnesota's recovering bald eagle population. The bald eagle is a year-round resident in Minnesota. Preliminary findings from the Nongame Wildlife Program's ongoing study to monitor eagle winter activity along the Mississippi River, and to identify and protect roost sites utilized by the estimated 100 - 200 eagles which winter along the river north of Iowa are also discussed.

Sullivan 1991.

FIGURE 1. MISSISSIPPI RIVER FLOW (1000s cfs) AT McGREGOR, IA

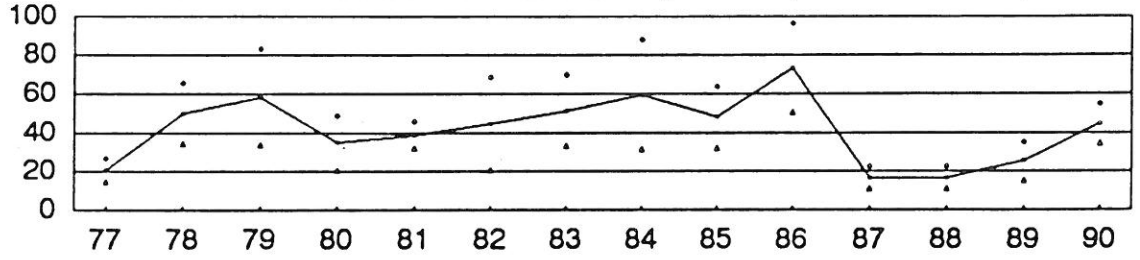


FIGURE 2. DISSOLVED INORGANIC N (mg/l) AT L/D 9

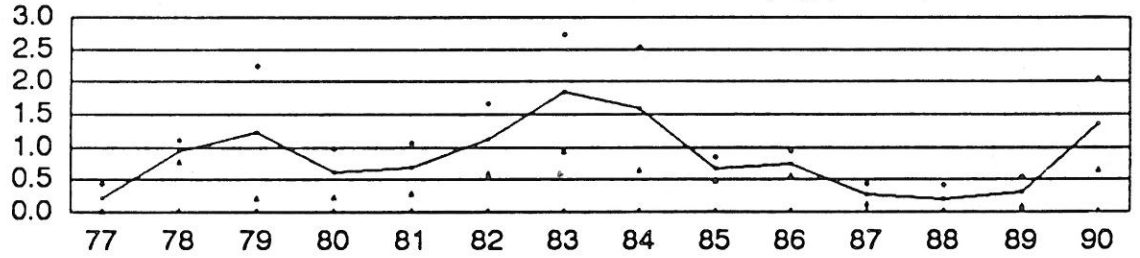


FIGURE 3. DISSOLVED REACTIVE P (mg/l) AT L/D 9

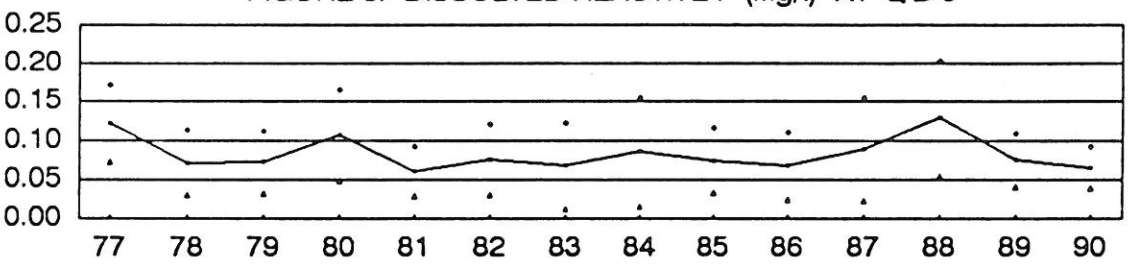
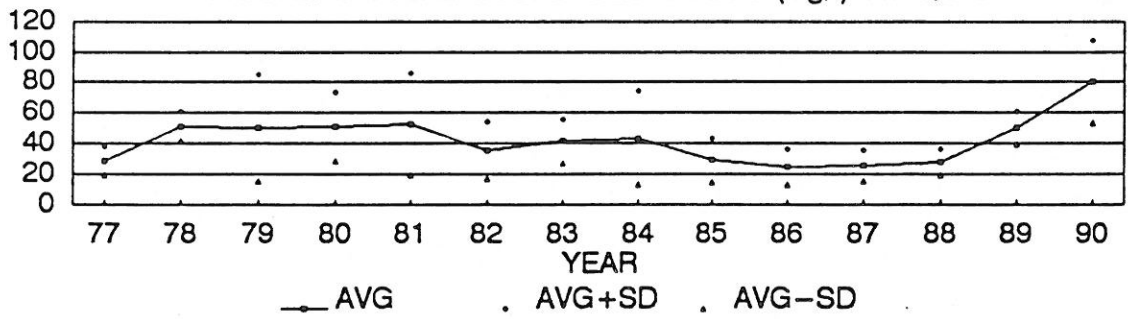


FIGURE 4. TOTAL SUSPENDED SOLIDS (mg/l) AT L/D 9



Notes: All graphs represent data for the May - September time period. Flow data were obtained from USGS.

INTERACTIONS BETWEEN SEDIMENT AND SUBMERSED MACROPHYTE GROWTH IN RIVERINE SYSTEMS

John W. Barko and Dwilette G. McFarland, Environmental Management Technical Center, Onalaska, WI 54650 and Waterways Experiment Station, Vicksburg, MS 39180-6199.

Submersed aquatic macrophytes rely primarily on sediment as a direct source of nitrogen (N) and phosphorus (P) for their nutrition. The availability of these nutrients in sediments is affected markedly by sediment type, but can also be influenced by macrophyte growth. Results of laboratory and field studies have demonstrated conclusively that macrophyte species, even with relatively diminutive root systems, can significantly deplete sediment N and P pools. From fertilization experiments involving sediments from the Potomac River and elsewhere, macrophyte growth on nutritionally-depleted sediments has been shown to be limited by the availability of sediment N, but not P. In riverine systems, the vigor of submersed macrophyte beds is likely maintained by nominal inputs of sediment providing a nutritional subsidy. However, excessive inputs of sediment may result in macrophyte declines due to burial or to unfavorable irradiance conditions. Hydrologic factors and watershed activities that influence seasonal dynamics and magnitudes of sediment transport in riverine systems need to be evaluated within the context of their effects on submersed macrophyte growth.

PRELIMINARY EVALUATION OF A VEGETATIVE STREAMBANK STABILIZATION SITE ON RICHLAND CREEK, WOODFORD CO., ILLINOIS

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In 1988-1989 the Soil Conservation Service (SCS), along with several state and local agencies, selected four sites on Richland Creek to serve as a Conservation Field Trial for Vegetative Stabilization of Severely Eroding Streambanks. Richland Creek, a tributary of Peoria Lake on the Illinois River, is characterized by a high stream gradient, a deep sand-gravel bed, and a surrounding floodplain having been converted to agriculture. Three sites were used to evaluate the effectiveness of bank stabilization by woody species, in diameter classes of greater than three inches, one to three inches, and less than one inch. Tree species used include native willow (*Salix sp.*), Cottonwood (*Populus deltoides*), Grey and Red Osier Dogwood (*Cornus racemosa, C. stolonifera*), as well as SCS plant material releases of Streamco (*Salix purpurea*) and Bankers Willow (*Salix cottettii*). A fourth site was used to investigate the effectiveness of grasses in stabilizing shaped streambanks. Eastern Gamagrass (*Tripsucum dactyloides*), Prairie Cordgrass (*Spartina pectinata*), and Reed Canary grass (*Phalaris arundinacea*) were utilized for this trial.

Monitoring of these sites is accomplished through the repeated surveying of two stream reaches, each containing nine transects. To help assess the affects of the stabilization practices, both reaches contain transects above and below the treatment sites. Surveying was initiated in September 1990 and incorporates the original ranges from the 1988 SCS baseline survey. Transects are resurveyed after each rainfall event that produces significant streamflow.

High plant mortality within the treatment sites, due in part to the abnormally dry conditions of 1988-1989, and continued bank erosion when stream flow has occurred, has resulted in the failure of three sites. The remaining treatment is comprised of the driven dormant posts (>3 inches). Bank profiles within this site have remained stable since installation in March, 1989. Streambanks above the posts have been unaffected to date, while erosion of the opposite bank below the site has apparently increased (Fig. 1). Possible causes for this increase will be presented.

Slowikowski, Bogner, and Bhowmik, 1991

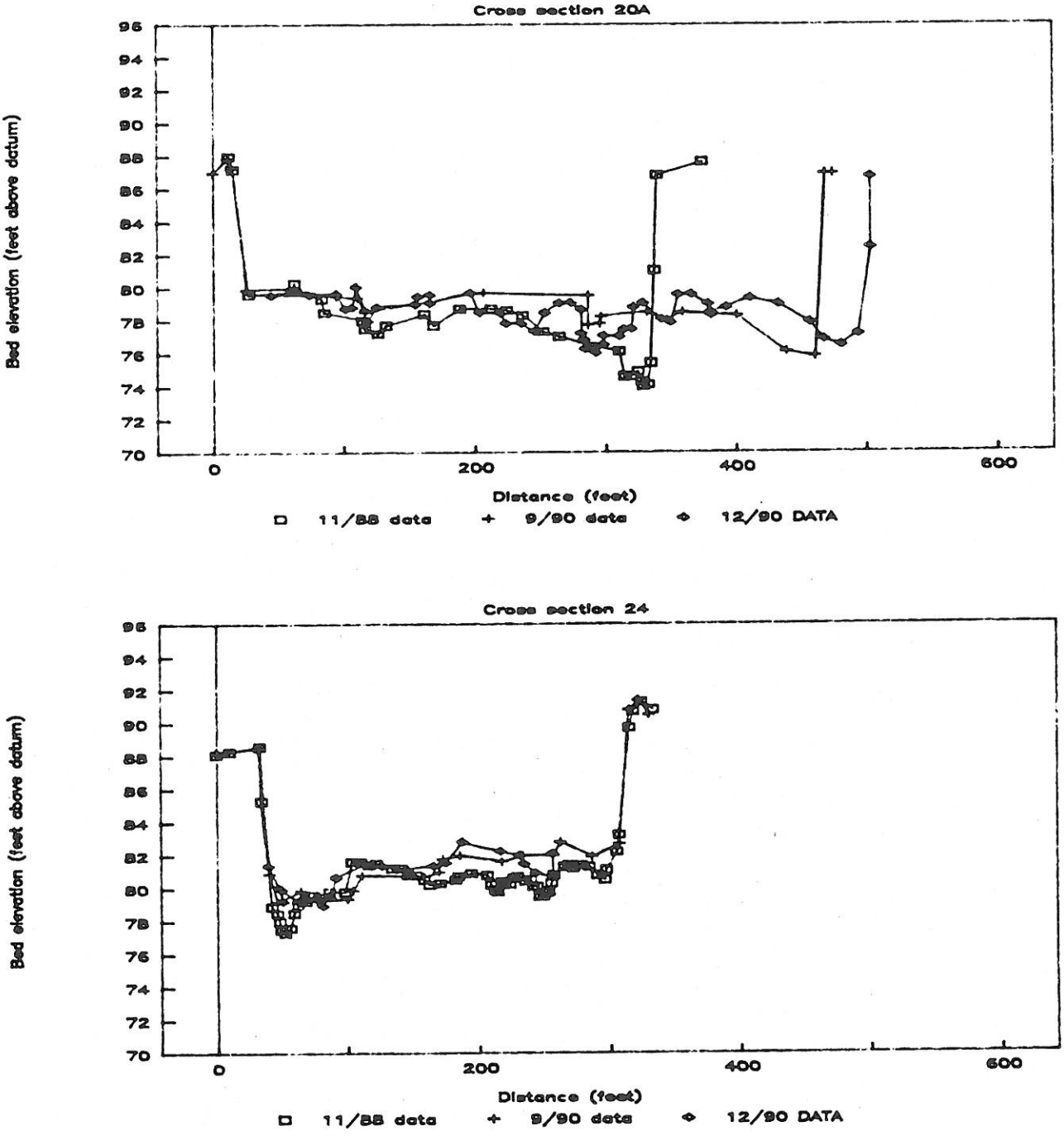

Fig. 1. Transect plots, 20A (top) illustrating bank erosion below the treatment site, and cross section 24 (bottom) showing bank stability within the treatment

METAL CONTAMINATION OF LAKE PEPIN IN HISTORIC PERSPECTIVE

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We analyzed sediment cores to reconstruct the historical contamination of Lake Pepin by metals from upstream sources. Lake Pepin, a riverine lake in Pool 4 of the upper Mississippi River, has a mean water-retention time of 9 days and a higher trapping efficiency for suspended sediments and associated contaminants than other pools in the river. Sediment cores (about 1.7-m deep) were collected in March 1989 with a piston corer at two sites, upper Pepin (river mile 782.5) and lower Pepin (river mile 767). Cores were sectioned into strata and analyzed for mercury, cadmium, lead, aluminum (a reference element), and volatile matter. Dating of the sediment profiles was done by analysis of $^{137}Cs/^{40}K$ (both cores) and ^{210}Pb (a replicate core in lower Pepin). Lake sediments were already contaminated with mercury in the mid-1800s, and sediments deposited in the 1890s were quite contaminated with mercury and lead, based on ^{210}Pb dating. The most mercury-polluted sediments were deposited in the 1920s through the 1960s, the most cadmium-polluted sediments in the 1950s through the mid-1970s, and the most lead-polluted sediments in the 1940s through the mid-1970s. Mean background (natural) concentrations of the three metals in the six deepest (oldest or pre-cultural) strata in the lower Pepin core ($\mu g/g$ dry weight) were 0.041 for mercury, 0.22 for cadmium, and 12 for lead. In comparison, concentrations in the most recently deposited stratum (0-3 cm) of this core ($\mu g/g$) were 0.31 for mercury, 3.1 for cadmium, and 51 for lead. The degree of anthropogenic enrichment of the three metals, relative to background concentrations, was cadmium > mercury > lead. The most recently deposited sediments in Lake Pepin remain notably contaminated, and our data suggest that deposition rates of these metals to lower Lake Pepin have not diminished, despite improvements in the treatment of waste waters in the Minneapolis-St. Paul metropolitan area. Fine-grained sediments deposited during the past century into Lake Pepin--and presumably into other depositional sites nearer the Twin Cities--contain a huge reservoir of potentially toxic metals, posing continuing risks to riverine biota.

POLYCHLORINATED BIPHENYLS IN EMERGENT MAYFLIES (*HEXAGENIA BILINEATA*) IN THE UPPER MISSISSIPPI RIVER

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Biomagnification of polychlorinated biphenyls (PCBs) at high trophic levels and concern for human health have prompted three states along the Upper Mississippi River (UMR) to issue fish-consumption advisories for the River's sport fishery. In earlier studies (1976, 1980, 1983), elevated concentrations of PCBs in adult UMR mayflies (*Hexagenia bilineata*) were reported as equivalents of Aroclor® 1254 (a common mixture of PCBs containing several congeners). Recent improvements in analytical techniques now permit the identification and quantification of individual PCB congeners, which can differ markedly in toxicity. We assessed spatial trends in the total PCB content and the PCB congener composition of emergent female mayflies (*H. bilineata*) collected in 1988 at 30 sites (23 pools) on the river, extending from Little Falls, Minnesota, to St. Louis, Missouri (Fig. 1). Composite samples of whole female *H. bilineata* (subimagos and imagos) from each site were analyzed for lipid, moisture, and PCB congener content. The bioaccumulation of PCBs by mayflies was greatest in pools adjacent to, and downstream of, the Twin Cities (in Minnesota) and the Quad Cities (bordering Iowa and Illinois) metropolitan areas. Total PCB concentrations in mayflies ranged from 0.21 to 4.1 ppm (μg/g) dry weight, exceeding 2.0 ppm in Pools 2, 3, 4, and 15, and exceeding 1.0 ppm in Pools 5, 5A, and 6 (Fig. 2). The total concentration of PCBs differed substantially between mayflies collected upstream and downstream from the Twin Cities Metropolitan Wastewater Treatment Plant in Pool 2; furthermore, the highest PCB concentration occurred 10 river miles downstream from the plant's effluent outfall. Principal component analysis indicated that the PCB congener composition of mayflies collected just upstream of the plant on Pool 2 and from the Quad Cities (Pool 15) was remarkably different from all other samples (Fig. 3). Evaluation of chromatographic histograms for both these samples revealed a relative abundance of early-eluting peaks that correspond to low molecular-weight congeners (e.g., tri-, tetra-, and penta- substituted). These differences may be due, in part, to the intermittent introduction of PCBs in surface water runoff from non-point sources in Pool 2 and a point source in Pool 15. Mayflies bioaccumulated PCB congeners that induce toxic responses in higher organisms (e.g., mammals) similar to that caused by the most potent dioxin, 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD). TCDD equivalents were calculated for 11 of the more toxic mono- and di-*ortho* coplanar congeners present in mayflies at each site. Total TCDD equivalents ranged from 12 to 303 pptr (ng/g) dry weight and exceeded 100 pptr in Pools 2, 3, 4, 5, and 15 (Fig. 4). Variation in the total TCDD equivalents of emergent female mayflies among and within pools closely followed that of total PCBs. We are currently evaluating the potential toxicity of the potent non-*ortho* coplanar congeners present in the mayflies.

Steingraeber et al. 1991

UMR MAYFLY
COLLECTION SITES
(BY POOL)

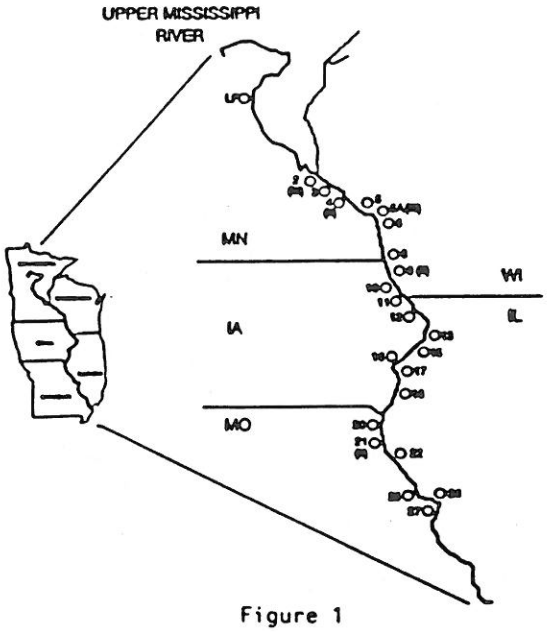


Figure 1

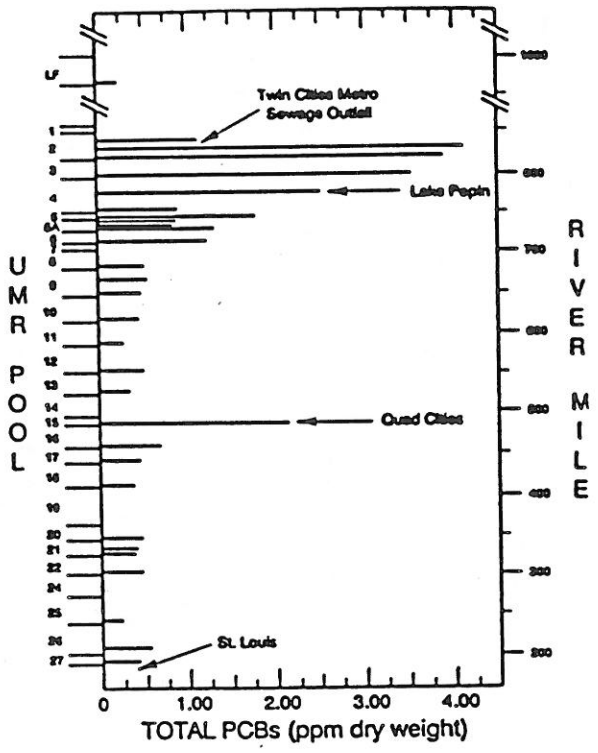


Figure 2

Principal Component Analysis
PCB Congener Composition of Female Mayflies
(by UMR Pool)

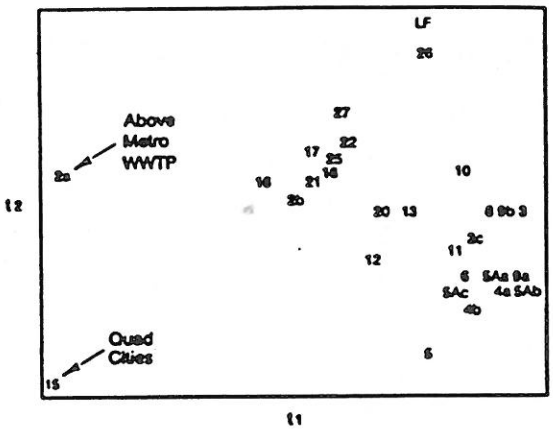


Figure 3

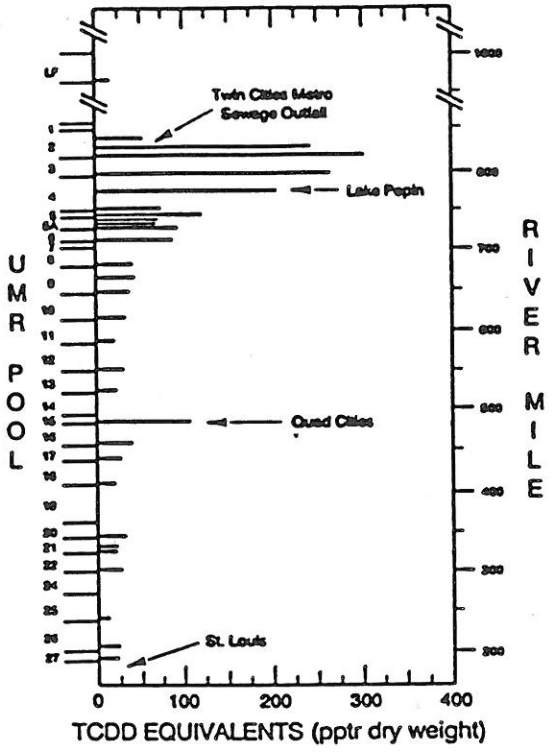


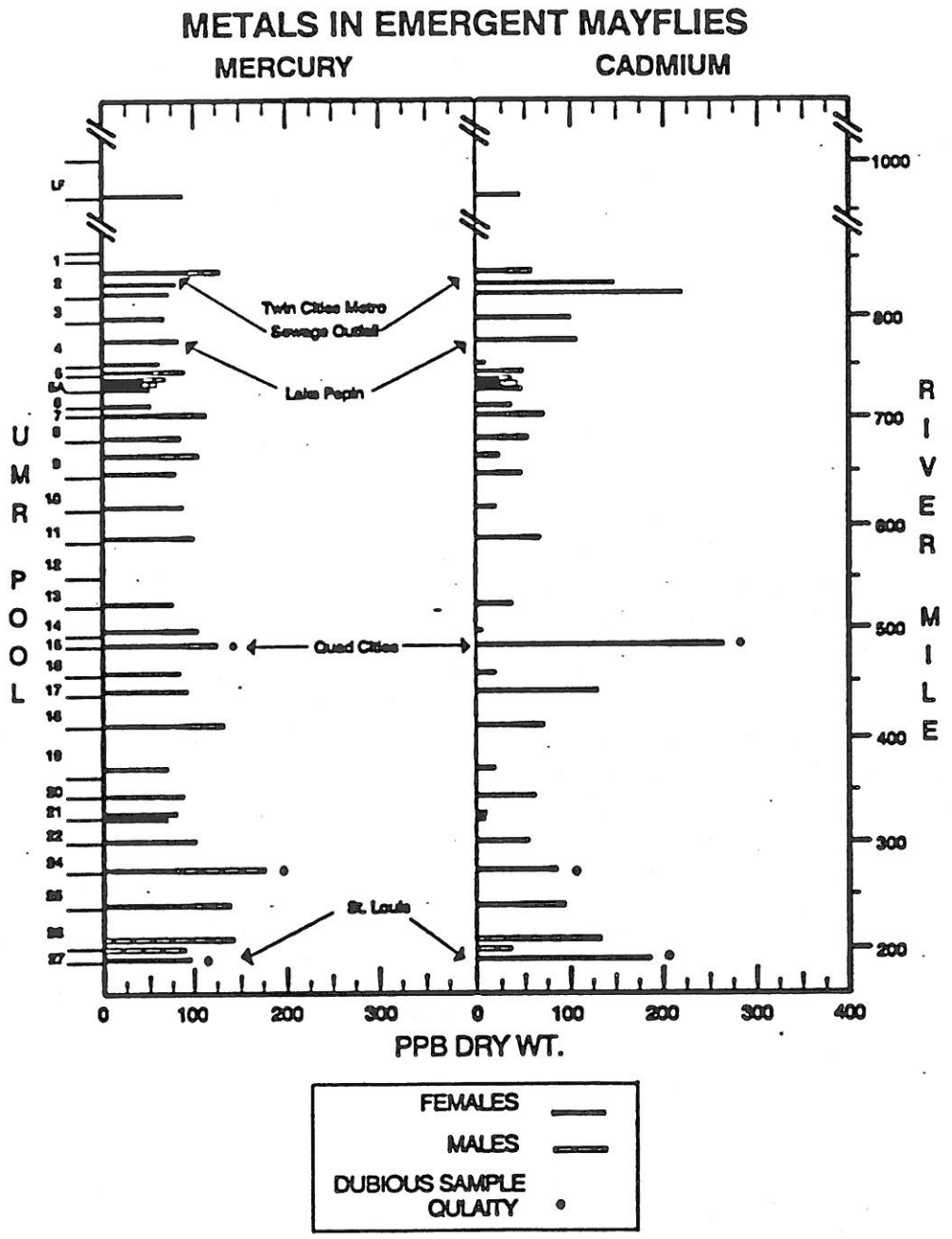
Figure 4

CADMIUM AND MERCURY IN EMERGENT MAYFLIES IN THE UPPER MISSISSIPPI RIVER

Jeanne T. Dukerschein, University of Wisconsin-La Crosse, River Studies Center, La Crosse, WI 54601; James G. Wiener, National Fisheries Research Center, La Crosse, WI 54602-0818; Ronald G. Rada, University of Wisconsin-La Crosse, River Studies Center, La Crosse, WI 54601.

We analyzed burrowing mayflies to assess the bioavailability of cadmium and mercury in sediments in the upper Mississippi River. Emergent mayflies (subimagos and imagos of *Hexagenia bilineata*) were collected in 1988 at 36 sites (26 pools) on the river, extending 783 river miles from Little Falls, Minnesota, to St. Louis, Missouri. Sampling effort was intensified in Pools 2, 4, 5A, and 9, because metal concentrations in sediments from these areas ranged from high in Pool 2 to relatively low in Pool 9. Cadmium concentrations (determined by graphite furnace atomic absorption spectrophotometry) ranged from 7 ng/g (ppb) dry weight (Pools 9, 14, 24) to 219 ng/g (Pool 2) in composite samples of whole female mayflies, and from less than 7 ng/g (Pool 14) to 265 ng/g (Pool 15) in males. Cadmium approached or exceeded 150 ng/g in samples from Pools 2 (below river mile 825), 3, 15, and 27--sites near the Twin Cities, Quad Cities, or St. Louis metropolitan areas. A broken-line linear regression of cadmium concentrations in female mayflies showed a significant decreasing trend in concentration from Pool 2 (river mile 825) downstream to Pool 9 (river mile 648), following the trend in cadmium-contamination of sediments downstream from the Twin Cities metropolitan area. Concentrations of mercury (determined by cold vapor atomic absorption spectrophotometry) in female mayflies ranged from 44 ng/g in Pool 5A to 102 ng/g in Pool 22. In males, mercury ranged from 60 ng/g in Pool 5A to 177 ng/g In Pool 24. A broken-line linear regression of mercury concentrations in females showed a significant decreasing trend in concentration from Pool 2 (river mile 825) to Pool 5A (river mile 728.5), following spatial trends in the mercury contamination of sediments below the Twin Cities metropolitan area. However, no major spatial trends in the concentration of mercury in mayflies were evident for the reach of river from Pool 6 to Pool 27. Concentrations of both metals were significantly higher in males than in females. Programs that involve analysis of mayflies to survey or monitor metals in aquatic systems should, therefore, analyze males and females separately.

Dukerschein, 1991



LEVELS OF POLYCHLORINATED BIPHENYLS (PCBs) IN COMMON CARP (*CYPRINUS CARPIO*) FROM THE UPPER MISSISSIPPI RIVER AND THE NEED FOR A TREND MONITORING PROGRAM

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PCBs have been intensively monitored in the Upper Mississippi River over the past 17 years by government agencies, and by public and private institutions. A majority of this monitoring has involved the collection and analysis of fish by the Minnesota Pollution Control Agency, Minnesota Department of Natural Resources, and the Wisconsin Department of Natural Resources. The data collected in these monitoring programs were amenable for developing fish consumption advisories to protect human health rather than assessing long-term trends of PCB contamination. For this reason, the Minnesota and Wisconsin tissue data have been examined here using an exploratory data analysis approach. Data on carp (*Cyprinus carpio*) from several size classes were evaluated in pools from Sauk Rapids, Minnesota, to LaCrosse, Wisconsin. There appears to be a decline in PCB levels from 1973 to 1988 in pools 1 to 7. A closer examination of the data reflects the need for a long-term monitoring program to determine temporal and spatial trends of PCB levels in fish tissue. A planned monitoring program with well-defined objectives for data collection will result in data sets better suited for the investigation and analysis of trends.

BIOACCUMULATION OF CADMIUM IN JUVENILE BLUEGILLS EXPOSED TO RESUSPENDED RIVER SEDIMENT

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Many large rivers contain contaminated sediments, which can be resuspended into the water column by human activities and natural processes. The factors influencing the bioavailability of sediment-associated contaminants to aquatic organisms are largely unknown. We assessed the bioavailability of cadmium in resuspended riverine sediments to bluegills (*Lepomis macrochirus*) in a laboratory bioassay. Surficial (uppermost 5 cm) sediments were collected at selected sites in the upper Mississippi, Des Plaines, and Illinois Rivers. Concentrations of cadmium in bulk sediments from these sites ranged from 1.3 to 21.4 μg/g (ppm) dry weight. The experimental design included three replicates in each of six treatments (five sediment exposures and one clear-water control). In each replicate, 25 juvenile bluegills were exposed to resuspended sediment (nominal total suspended solid concentration of 1000 mg/L) for 28 days. Total cadmium concentrations were measured in resuspended sediment, filtered water, and whole bluegills to quantify the partitioning of cadmium during the test. Cadmium concentrations in the resuspended sediment ranged from 0.6 to 17 μg/L (ppb), and dissolved cadmium in test waters ranged from 0.008 to 0.07 μg/L. Mean concentrations of cadmium in whole bluegills, which varied from 0.04 to 0.14 μg/g wet weight in the six treatments after exposure, were positively correlated with the cadmium concentration in water, resuspended sediment, and bulk river sediment. Interestingly, mortality of test fish averaged 24% in the three replicates with sediment from Lake Pepin (upper Mississippi River, Pool 4), which had intermediate concentrations of cadmium (4.1 μg/g dry weight) in bulk sediment. The cause of this mortality is unknown, but it was not presumably due to cadmium alone, because no mortality occurred in the treatments involving sediment with higher cadmium concentrations.

SHOULD WE SOUND THE ALARM:
BIOTIC CHANGES IN POOL 19,
MISSISSIPPI RIVER

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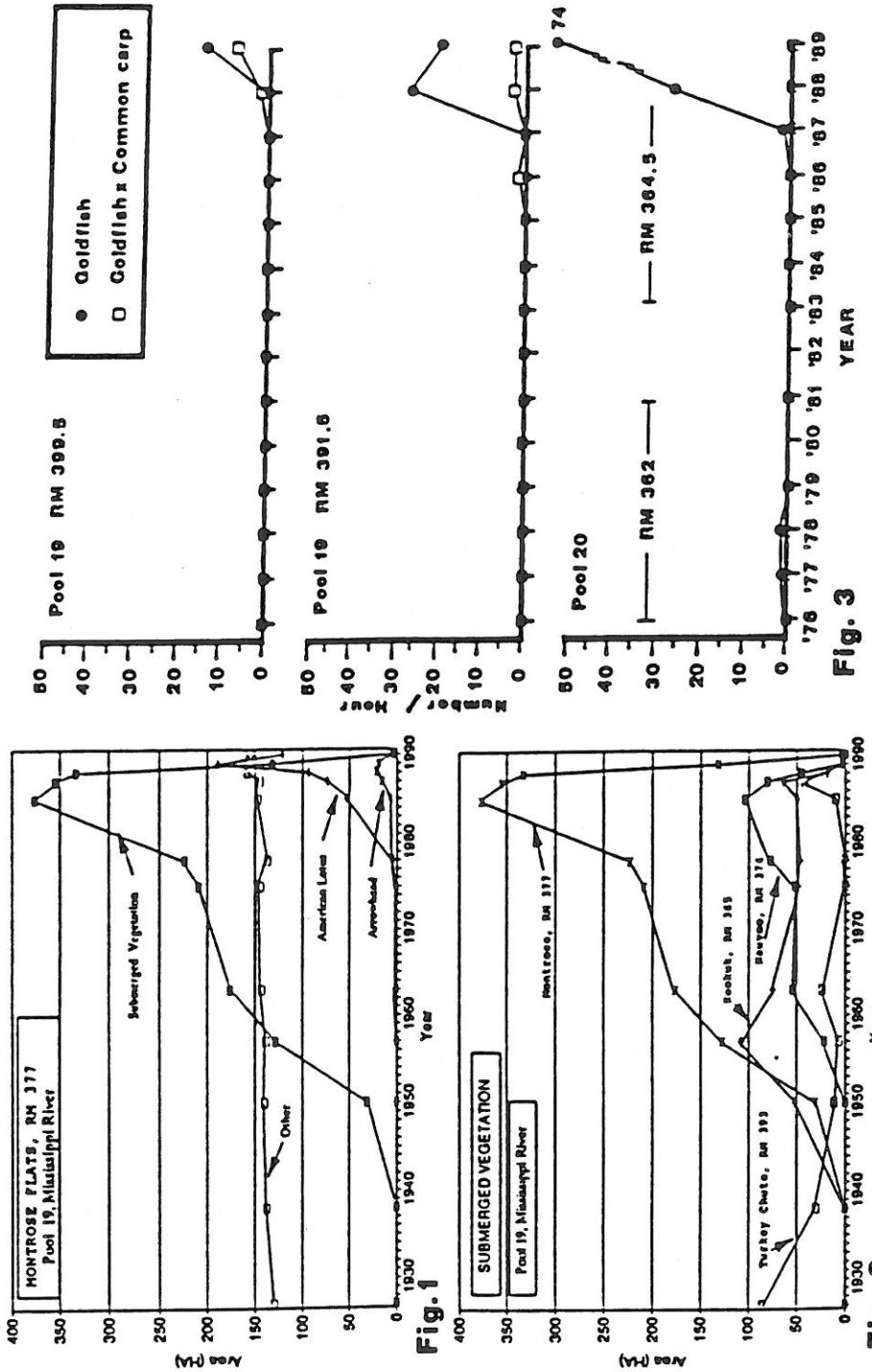
As the oldest anthropogenically created pool on the Upper Mississippi River, Pool 19 has had the longest period of time to age. The pool was recognized as an important habitat for a wide variety of organisms. An important commercial freshwater and mussel fishery has traditionally been found in the Pool 19 river reach. Because of its early formation and importance, numerous studies have been conducted on the biota of this pool, particularly in the past 30 years as it developed into a major staging site for waterfowl. All of these investigations indicate there have been population fluctuations, sometimes quite large. Some of these population shifts can be related to annual variation in climate or river discharge while other trends are longer term shifts related to sediment accumulation. Thus aquatic macrophyte beds have developed and go through a successional sequence of vegetation types (Fig. 1) in channel border areas which become shallow as sediment has accumulated. These soft sediments result in a high density benthic community which attracts migrating waterfowl. As macrophyte beds continue to develop, benthic invertebrate populations have changed from communities dominated by burrowing forms to communities predominated by littoral organisms. Sediment accumulation is a natural process in this river reach because of the lift gate type of dam at Lock and Dam 19 and thus these community shifts might be anticipated. However, during the last three years significant, alarming changes, not readily predictable have occurred. Submerged aquatic macrophyte beds have been severely reduced in size (Fig. 2), fingernail clams have disappeared from the benthic community, migrating waterfowl densities on the pool have been greatly reduced, and fish communities have changed with the sudden occurrence of goldfish and goldfishXcarp hybrids (Fig. 3). Most of these changes are similar to those reported on the middle Illinois River during the 1950's, when that river's community crashed. Should we be concerned?

Anderson, Day, Sallee, Bertrand, and Havera 1991

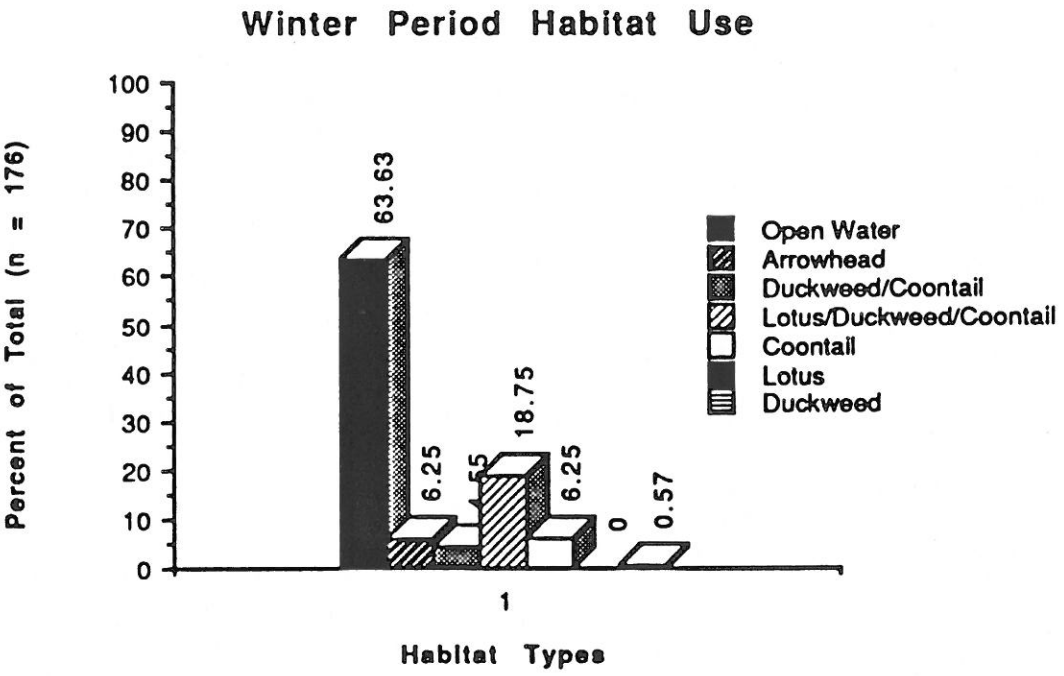


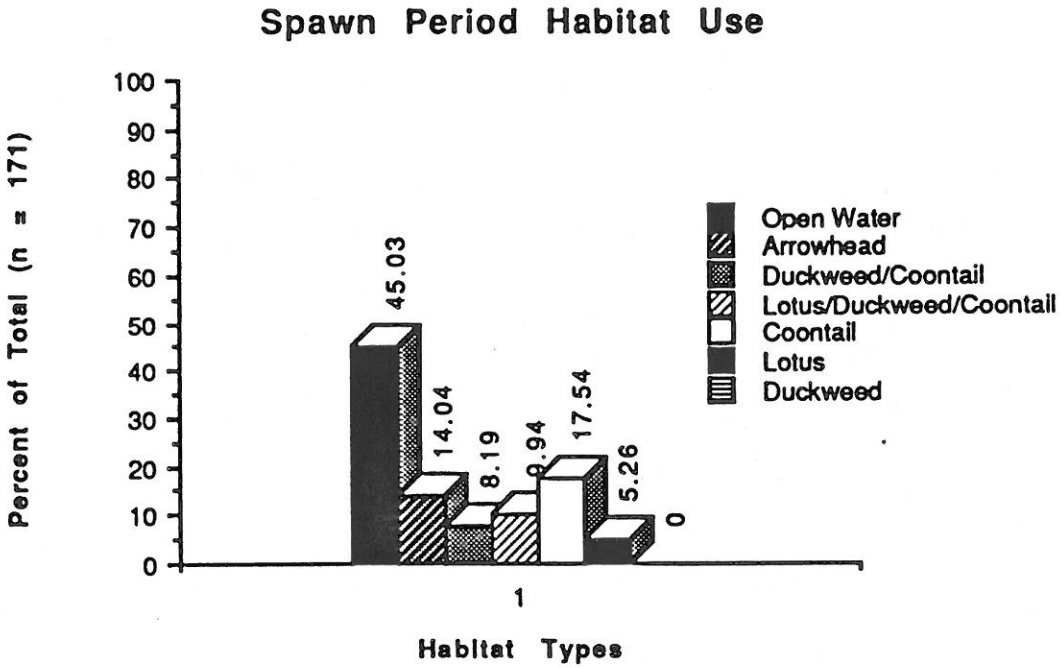
GIS APPLICATIONS IN FISHERIES: OPPORTUNITIES AND DIFFICULTIES

David McConville and Gary Oberfoell, Environmental Studies Center, Biology Department, Saint Mary's College of Minnesota, Winona, MN 55987; John Pitlo, Iowa Department of Natural Resources, Bellevue Field Station, Bellevue, IA 52031; and Barry Drazkowski, Environmental Management Technical Center, U.S. Fish & Wildlife Service, Onalaska, WI 54650.

Geographic Information Systems (GIS) analysis is a set of powerful analytical tools which offers the potential to provide fisheries biologists with an insight into the aquatic environment and a fisheries world never attained before. Several GIS programs are available for application, including mainframe and PC versions of ARC/INFO, GRASS and EPPL7. GIS is not a new concept; rather it takes map construction, presentation, analysis and projection to a level never previously possible. ARC/INFO excels at presentation. GRASS and EPPL7 are powerful analytical and projection tools. In this paper, we will present the results of an EPPL7 GIS analysis of Pool 12, UMR largemouth bass data; data obtained from the Iowa DNR and made available by EMTC. The data, collected via radio telemetry between 1986 and 1990, have been divided into five time segments for analysis. To date, two of the five periods have been analyzed: winter and spawn. Examinations of these results suggest that overwintering habitat in Pool 12 is extremely limited. During the spawning season, fish tend to disperse throughout the lower two-thirds of the pool. In both instances (winter and spawn), once fish reach the prescribed location, movement is relatively limited for the remainder of the period. Open water habitat is very important during the winter period (Figure 1), and budding aquatic vegetation, particularly *Ceratophyllum*, is an extremely important component of the breeding habitat (Figure 2). These data must be interpreted cautiously, however, as the fish telemetry data is overlaid on a database coverage nearly 16 years old (the 1975 summer habitat classification model). In addition, the process of recording fish location information in the field and recording it in EPPL7 requires a degree of subjective and positional judgment. Finally, projection analysis or "modeling" with these data are extremely limited due to the lack of data layers in the pool. Overall, this project has demonstrated clearly that GIS has a place in fisheries analysis, and its application can further our knowledge.

McConville, Oberfoell, Pitlo and Drazkowski, 1991





LACROSSE RIVER VALLEY ENVIRONMENTAL ANALYSIS GIS PROJECT

Lance G. Perry and Stuart Utley, IM/1, Wisconsin DNR, P.O. Box 7921, Madison, WI 53707

Like many Wisconsin cities, LaCrosse is under pressure to expand due to population growth. Additional development sites for housing, commercial enterprises, transportation corridors, etc., are limited due to the characteristics of the terrain. LaCrosse resides in the Mississippi, LaCrosse and Black River floodplains. Expansion westward is limited by the rivers. Development to the east currently extends to the valley bluffs, which are steep, dissected uplands of limited development potential. These constraints place a great demand on any existing "open space" for conversion to other land uses. Highly coveted in that regard is an area known as the LaCrosse Marsh, a 1800-acre expanse just north and east of the city. To date, its development has been restricted by open water, wetlands, and frequent flooding.

Economic development and environmental concerns in the area have been at odds for some time. The need to resolve this issue was emphasized during the governor's visit in 1988. An agreement to prepare a comprehensive land use plan was subsequently signed by the state DOT, DNR, and City and County governments. At issue is development impacts on existing resources such as wetlands and the wildlife habitat, flood control and other benefits that they provide. How much of a particular resource will be lost or otherwise impacted, and what land uses will replace those lost given a range of development options, are questions best addressed with geographic information system (GIS) techniques.

To date, a base map has been developed, all natural and cultural features have been mapped, and four alternative land use plans prepared. Each of the plans divides the area into zones which would be targeted for a specific type of development such as economic, recreational, transportational, etc. The zones differ in extent of land allocated to each type of use, as well as spatial distribution of land uses.

GIS overlay and database management techniques were used to calculate acreages for all existing and proposed development features. Of particular concern was change in acreage by feature type, assuming full implementation of each of the four development plans. For example, acres and type of wetland lost to proposed transportation corridors and economic development zones were derived with GIS functions. Those and other statistics related to spatial impacts were provided to participating agencies and presented to the public. The agencies will weigh the impacts of each initial plan and design of a final development plan to be implemented in the fall of 1991.

A CONCEPTUAL MODEL OF THE RIVER REACHES OF THE UPPER MISSISSIPPI RIVER SYSTEM

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Monitoring and research strategies developed in the Long Term Resource Monitoring Program require a current, objective understanding of the factors that control ecological structure and function of the river reaches of the Upper Mississippi River System. The conceptual model that we have constructed to fill this need lists major factors (abiotic and biotic) and disturbances (natural and human-induced) that operate at each of five spatial scales. The spatial scales are in decreasing order of scope: basin, stream network, floodplain reach, navigation pool, and habitat. Major factors are defined as those which act to keep ecosystem variables within predictable limits over a reference time period. A disturbance is an event that disrupts structure or function at the ecosystem, community, or population level of biological integration. Major factors and disturbances that operate at any one scale can, through more specific mechanisms, control ecological structure or function at smaller scales. A disturbance that acts at a small scale, if repeated often enough or at many locations, can have cumulative impacts at larger scales. The conceptual model is meant to be dynamic. It will be modified or elaborated as new information becomes available, and it will subsequently be used, as necessary, to re-direct Program priorities.

VALIDATION OF MODELS APPLIED TO THE MISSISSIPPI RIVER

Barry L. Johnson, U.S. Fish and Wildlife Service, National Fisheries Research Center, Box 818, La Crosse, Wisconsin 54602

Models and field data form the basis of our perceptions and analytical methods for addressing ecological questions. The specific question asked will determine the appropriate model and data to use. Models developed for other systems will require validation when applied to the Mississippi River. A strict definition of validity requires one-to-one correspondence between model predictions and system behavior. However, this approach has the problem that field data are themselves collected through a sampling model and are subject to error and bias, and that statistically significant correspondence may be scale dependent. A model can be invalid in that it does not predict all system behaviors correctly, but still provide useful information under a wide variety of conditions. Possible uses of models include deriving point estimates of variables, ranking alternative scenarios, testing sensitivity of model structure or inputs, generating a time sequence of dynamics between observations, bounding the possible future states of a system, exploring the distributional properties of model output, developing efficient sampling or data collection procedures, or determining critical experiments for hypothesis testing. In many of these applications, subjective methods of evaluation may be more helpful in determining the conditions under which a model can provide useful results. Validation then becomes a process of building confidence in a model and defining its realm of applicability.

APPLICATION OF HEC-6 MOVABLE-BED MATHEMATICAL MODEL TO POOL 20, MISSISSIPPI RIVER: RM 343.2-RM 364.2

Tatsuaki Nakato, Iowa Institute of Hydraulic Research, The University of Iowa, Iowa City, Iowa 52242

Localized areas of shoaling, in particular, near Fox Island (RM 355-356), and Buzzard Island (RM 349-350), in Pool 20 of the Mississippi River, extending upstream from L&D 20 at Canton, Missouri, to L&D 19 at Keokuk, Iowa, caused troublesome conditions for barge navigation due to the shallow water depth that resulted. In order to understand the exact causes of the shoaling, extensive sediment and flow data were collected in the areas in 1976 and 1978. These field data were employed to formulate power-law relationships between the water and sediment discharges, and were used to implement several corrective measures designed to relieve the shoaling problems. The field data were then used to test the HEC-6 mathematical model which is a one-dimensional steady flow simulation program designed to analyze scour and deposition in rivers and reservoirs. Twenty seven cross-sections were included over a 21-mile long reach of the pool, and the tributary entry point was established at RM 361.4 for the Des Moines River. The 1976 field data were used as initial conditions, and those of 1978 were used to evaluate the HEC-6 prediction. The first calibration procedure was to formulate a rating curve that would give an indication of the channel roughness by means of a value of Manning's n for a given flow discharge. The next calibration step was to modify the sediment-discharge rating curve for the Des Moines River so that HEC-6 was able to estimate appropriately the downstream main-channel sediment discharges which were measured in the field. The final calibration entailed observation of general trends of the bed-profile variation with time over the study reach. Some adjustments were made to include additional cross sections and to incorporate a dredging operation which was done on 4 September 1978 near RM 350. Figure 1 shows the computed, longitudinal profile of thalweg using monthly-averaged input data. This simulation was done over a 28-month period from May 1976 to August 1978. In this figure, several field data measured in August 1978 are also included for comparison. Although some large discrepancies can be seen in the figure, the overall prediction was not too disappointing. Figure 2 depicts the net change between the final and initial bed profiles for the results tested using the monthly-, weekly-, and daily-averaged quantities for the 28-month period. There were only minor differences among the results of the three simulations.

Nakato, 1991

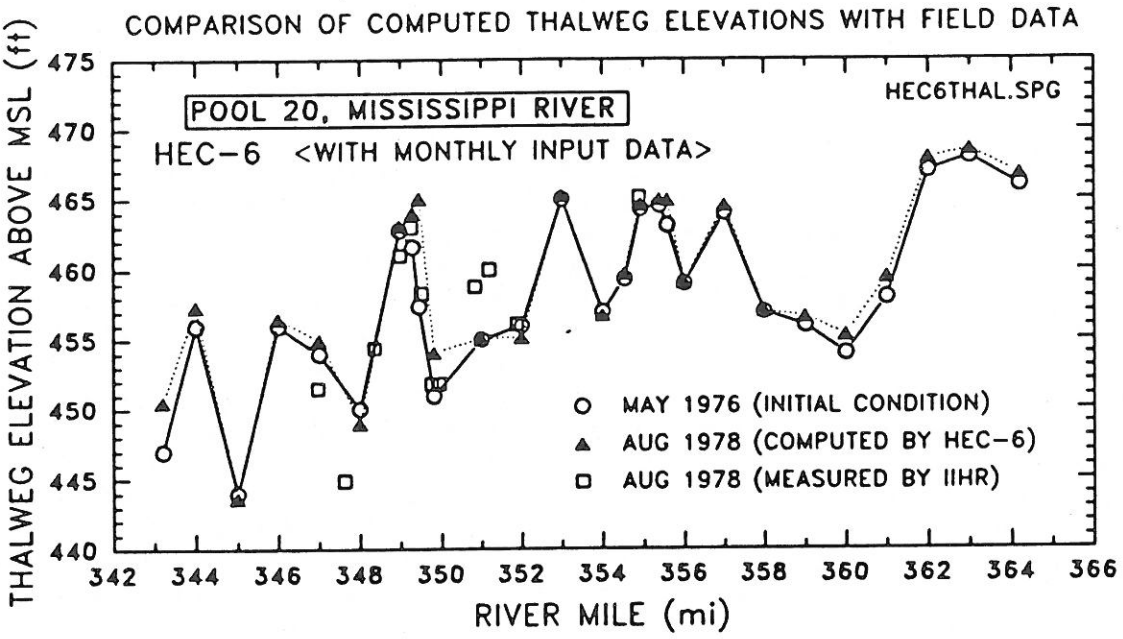


Figure 1

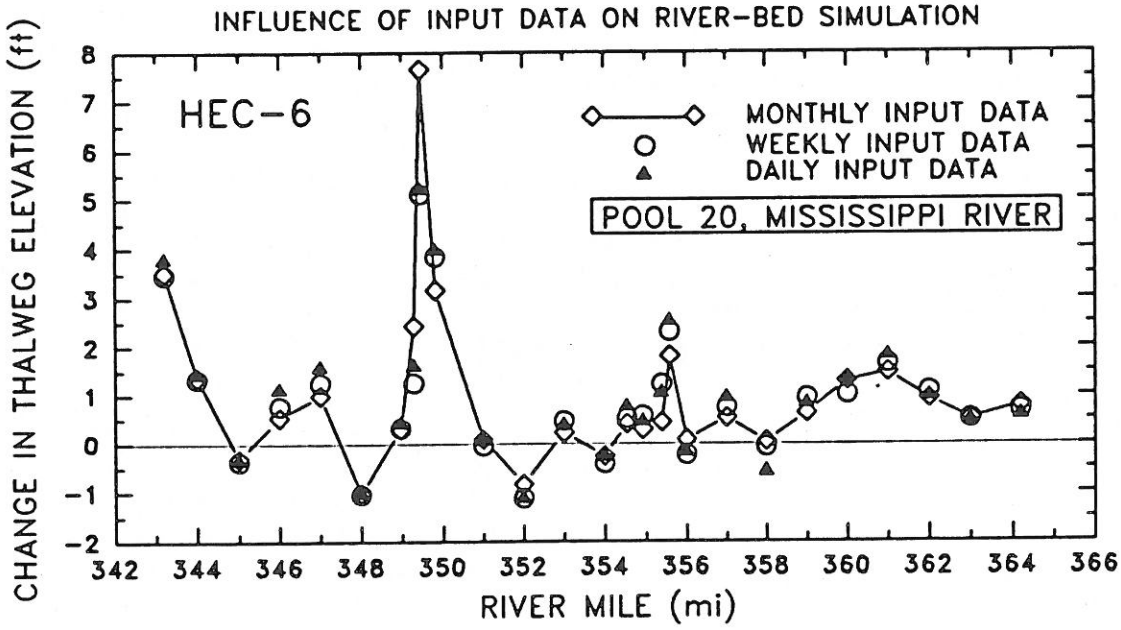


Figure 2

THE MUSSEL RESOURCE AT PRAIRIE DU CHIEN WISCONSIN: A SUMMARY OF SIX YEARS OF QUANTITATIVE DATA

A.C. Miller and B. S. Payne. Environmental Laboratory, US Army Engineer Waterways Experiment Station, Vicksburg, MS, 39180-6199.

Quantitative mussel samples have been collected in the east channel of the Mississippi River near Prairie du Chien, Wisconsin (1984-85 and 1987-90) using divers equipped with scuba or surface air supply. Between 10 and 30 samples are taken each year at an experimental site located within a barge turning basin and at a downriver reference site unaffected by vessel movement. The purpose was to determine if commercial vessels passing the turning basin affected recruitment of *Amblema plicata plicata* (Say 1817). Density of mussels greater than 30 mm SL in the turning basin was significantly less ($p < 0.05$ for unpaired t test) than at the reference site for all years except 1989. Inter-site density differences can be attributed to dredging in the turning basin in 1976 which removed substrate and live mussels. There were no significant inter-site density differences for mussels less than 30 mm total SL($t < 0.65$, $p > 0.05$ for all six years). This indicates that recruitment is proceeding at a similar rate at both sites regardless of earlier dredging and the continued use of the turning basin by commercial vessels.

A SALVAGE SURVEY FOR NAIAD MOLLUSKS (UNIONIDAE): ILLINOIS RIVER MILE 162.2, FRANKLIN STREET BRIDGE, PEORIA, IL, AUGUST 1988

Marian E. Havlik, Malacological Consultants, 1603 Mississippi Street, La Crosse, WI 54601.

A salvage survey for naiad mollusks, or unionids, was conducted August 1988, at three proposed bridge pier sites, downstream of the Franklin Street Bridge, Illinois R. M. 162.2, Peoria. Naiades were recovered from a total of 1653 m^2 using a semi-quantitative sampling method designed for this project. Sampling sites included a 4.6 m buffer zone around the area to be impacted by pier construction. Based on a 1984 preliminary survey, our method recovered 83.6% of the naiad fauna. Live specimens were moved to three nearby areas. Existing piers were also surveyed. Results at proposed sites were (followed by total number at site, densities/m^2, and total living species): Peoria pier (163 alive, 0.493/m^2, 8 species), middle pier (1625 alive, 2.457/m^2, 14 species), East Peoria pier (2595 alive, 3.924/m^2, 16 species), four existing bridge piers (150 alive, 8 species), a total of 4533 living naiades, with an overall average of 2.652 naiades/m^2. Seventeen living species were found (13 living species found during the 1984 survey), plus 8 dead species (1 fresh and 7 old-dead). Eight species were represented by juveniles. No living endangered species were found, but a relic valve of *Lampsilis higginsi* was found in the proposed middle pier area. *Corbicula fluminea* was represented by empty shells. Uncommon naiad species living in the Illinois River included *Tritogonia verrucosa* (1), *Obovaria olivaria* (1), and *Actinonaias ligamentina carinata* (34). The most common species were (followed by total number, overall percentage, and densities/m^2): *Amblema p. plicata* (2644, 58.3%, 1.60), *Leptodea fragilis* (725, 15.9%, 0.44), and *Quadrula quadrula* (629, 13.9%, 0.38) totaling 3998 (88.2%) of the unionids recovered. Age / length data obtained on 204 *A. p. plicata* (Figure 1) indicated a decrease in the 12 year age class which may correspond to reports that this portion of the Illinois River was in "terrible shape around 1978". Current velocities, water temperatures and depth profiles were obtained. During Starrett's 1969 survey only 23 species were found in the entire Illinois River. The 1988 mussel fauna below the Franklin Street Bridge probably represents a present day record number of living species, from a relatively small area of the Illinois River. Speculation regarding diversity of this fauna suggests that the narrowed channel, just downstream of Lake Peoria, probably provides increased current, and thus more suitable unionid habitat. Water quality in the Illinois River may also be improving.

HAVLIK 1991

AGE/NUMBER/LENGTH AMBLEMA P. PLICATA, PROPOSED FRANKLIN ST. BRIDGE, PEORIA,IL

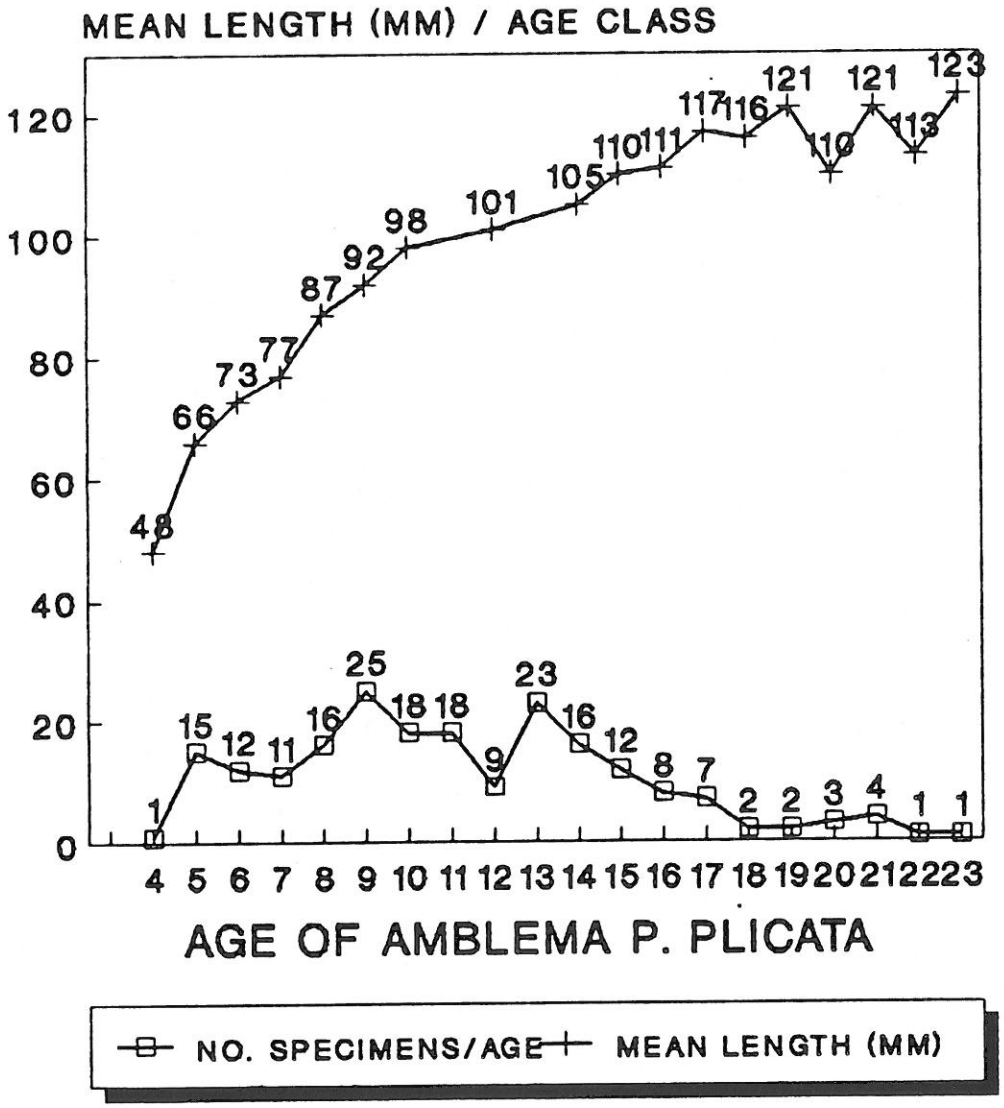


FIGURE 1

LIFE CYCLE AND POPULATION FLUCTUATIONS IN THE FINGERNAIL CLAM, *MUSCULIUM TRANSVERSUM*, POOL 19, MISSISSIPPI RIVER

Richard V. Anderson, Department of Biological Sciences, Western Illinois University, Macomb, IL 61455, Richard E. Sparks and Jeffrey L. Arnold, Illinois Natural History Survey, Box 599, Havana, IL 62644

Fingernail clams, *Musculium transversum*, have been reported in the benthos of Pool 19, Mississippi River since the late 1950's and early 1960's. They have become an important trophic link in the food web of the river, serving as a major food item for many fish and migratory waterfowl. The importance of this invertebrate was recognized early and a long term data set from dredge samples collected at standard locations has been developed over the past 25 years. These clams inhabit fine grain substrates of channel border habitats of the lower reaches of the navigation pool, where they have reached densities exceeding 100,000/m^2 (Fig. 1). They are not generally abundant in the upper, more riverine reaches of the pool. Clam populations have fluctuated dramatically. Population fluctuations within a year reflect the life cycle of the invertebrate, which usually has two generations each year. Clams can begin to produce young when they reach a shell length of about 6 mm, with larger individuals producing the largest number of young (Fig 2). Juveniles, brooded inside the female, may reach shell lengths up to 2.5 mm, however, most are .1 to .3 mm in length (Fig. 3). Highest annual densities were reported in the early 1970's and mid 1980's. A decline in density was noted in the mid 1970's during a drought, which also resulted in the rapid expansion of aquatic plant beds. Following this decline the populations recovered until the late 1980's when they again declined. At present there is a complete absence of *M. transversum* in the benthos of Pool 19. While there has again been a severe drought, 1987-1989, in this region, life cycle patterns in clam populations collected in 1984 and 1985 indicate populations may have been stressed prior to the drought. The cumulative effect of habitat loss, macrophyte mediated environmental changes and nitrogen loading coupled with the drought may be a possible cause for the rapid loss of this dominant benthic invertebrate in Pool 19.

CONSIDERATIONS IN USING FRESHWATER MUSSELS IN AQUATIC TOXICITY STUDIES

Teresa J. Naimo, U.S. Fish and Wildlife Service, National Fisheries Research Center, La Crosse, WI 54602-0818.

Several unique aspects in the life history of freshwater mussels (Mollusca: Unionidae) enhance their value as bioindicators in ecotoxicological studies. These include their benthic orientation, filter-feeding behavior, and long life span (reaching about 50 years). Freshwater mussels are unique as bioindicators of contaminant exposure in the field because they readily accumulate both aqueous and sediment-associated forms of contaminants. However, our understanding of basic biological processes in freshwater mussels and the effects of contaminants on these processes has lagged far behind the information that is available on marine bivalves. More insight on the ecotoxicology of freshwater mussels will necessitate more detailed laboratory studies, but such studies should be preceded by careful examination of several factors. These factors include the reproductive condition of test individuals, lack of sexual dimorphism in most species, nutritional requirements, availability of sufficient quantities for testing, reduced physiological condition in laboratory acclimated individuals, and the organism's use of valve closure as a toxicant escape response. These factors should be viewed as unique aspects of a mussel's life history and not preclude their use in aquatic toxicity tests. Toxicity tests with unionids should be designed to incorporate the unique features of their life history to ensure that the information obtained is ecologically relevant.

MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.
23RD ANNUAL MEETING
HOLIDAY INN, LACROSSE, WI

APRIL 25-26, 1991

ABSTRACTS OF POSTER AND DISPLAY PRESENTATIONS

SOURCE MONITORING OF SEDIMENTS: PEORIA LAKE

William C. Bogner, James Slowikowski, and Nani G. Bhowmik, Office of Hydraulics and River Mechanics, Illinois State Water Survey, Champaign, IL 61820-7495

The Illinois River and its related backwater lakes and channels are a major natural resource of the State of Illinois. Accrued benefits from water supply, navigation, recreation, and waterfowl developments along the river provide a base for long-term economic expansion and growth. Sedimentation problems within the river and its backwater areas seriously threaten the viability of many of these developments and have the potential to reduce the river/backwater lake system to one of dredged channels and marshes. Peoria Lake, the primary object of this study, is a particular example of these problems. Peoria Lake is the largest and deepest bottomland lake along the river and is unique among the Illinois River bottomland lakes in that it is a flow through lake. Research conducted at the Illinois State Water Survey has found that the average depth in the lake had been reduced from 8.0 feet in 1903 to 4.8 feet in 1965, 3.8 feet in 1976, and 2.6 feet in 1985.

The present study focuses on the undocumented sediment inputs from smaller direct tributaries to Peoria Lake. These direct tributaries drain approximately 400 square miles out of a total 14,165 square miles (sq mi) drainage area of the Illinois River at Peoria. Of this 400 sq mi of drainage area, 340 sq mi includes 10 creeks ranging in drainage areas from 5 sq mi to less than 100 sq mi. These streams are characterized by steep slopes and high sediment delivery rates to the lake. Based on previous research it was estimated that these tributaries were the source for 40% of the sediment deposited within Peoria Lake.

The 10 larger direct tributaries to Peoria Lake have been monitored on a weekly and event-oriented schedule to evaluate water and sediment discharges to the lake over a two-year period. These data are presently being analyzed and a final report prepared.

Figure 1 is an example plot of water and sediment discharge hydrographs for Senachwine Creek near Chillicothe, Illinois. This plot shows the extreme volatility of these streams. On June 29 the stream rose 8.4 feet over a three hour period and over four feet in one hour. Peak discharge has been estimated at 10,000 cfs for the June 20th and 29th storms. During this 15-day period our preliminary analyses estimate that over 195,000 tons of sediment passed our monitoring point in suspension. This is the equivalent of over sixty days of average sediment load in the Illinois River at Henry, Illinois.

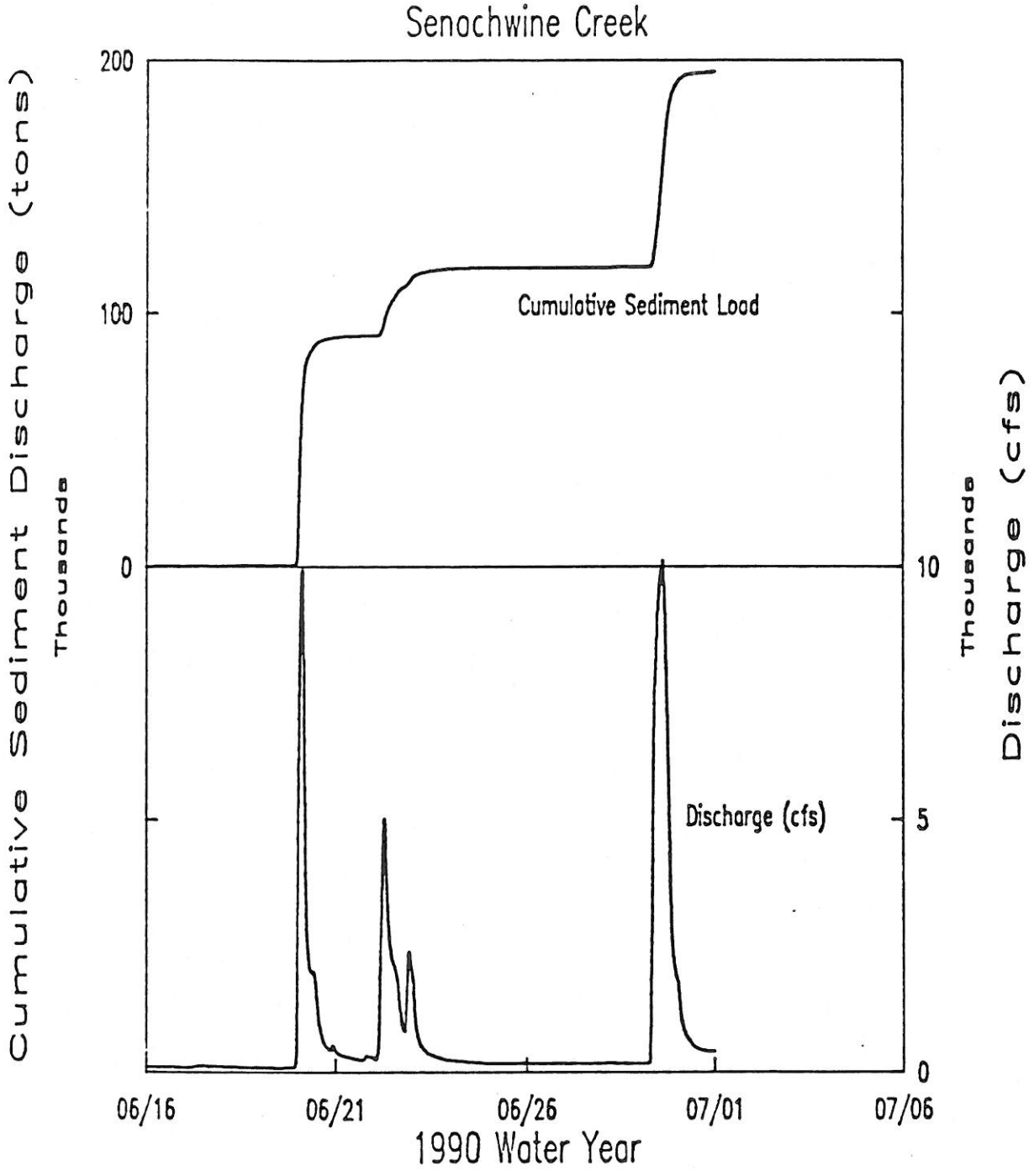


Figure 1. Water and sediment discharge hydrographs for Senachwine Creek near Chillicothe, Illinois

EFFECTIVENESS OF ACUTE AND CHRONIC TESTING PROTOCOLS FOR EVALUATING POTW TOXICITY: ONE MUNICIPALITY'S EXPERIENCE

Garry Durland, D. Kent Johnson, and Paul W. Aasen, Water Quality Monitoring Division, Metropolitan Waste Control Commission, 230 East Fifth Street, St. Paul, MN 55101.

The Metropolitan Waste Control Commission (MWCC) owns and operates 11 municipal POTWs in the Minneapolis/St. Paul, MN area. During 1988-1990, NPDES permit-required toxicity-testing at two plants, Blue Lake and Seneca (discharging to the Minnesota River), has provided an opportunity to assess the effectiveness of acute and chronic testing protocols for evaluating effluent toxicity. During chronic tests, the health of the test organisms (larval fathead minnows and neonate *Ceriodaphnia*) and conditions in the testing laboratory (temperature and air quality) are critical factors for producing results that reliably assess chronic toxicity. Data from seven-day tests with unhealthy organisms and inadequate laboratory conditions are provided to reinforce this observation. Even when QA/QC requirements are met, however, irregular dose-response curves are not uncommon during chronic tests (examples are again provided), and results must be interpreted knowledgeably and cautiously, to separate actual chronic toxicity from testing artifacts. Acute and chronic tests can be used very effectively to identify toxicity (or lack thereof) and evaluate POTW performance. The results of 1988-1990 acute screening toxicity-testing of the Blue Lake and Seneca POTWs indicate that nitrified effluents generally do not exhibit acute toxicity. During 40 acute screening tests with four test species, no acute toxicity was evident in 144 of 147 instances (98%). The results of 1988-1990 chronic toxicity-testing of the Blue Lake and Seneca POTWs indicate that nitrified effluents do not exhibit chronic toxicity. No chronic toxicity was evident during 12 *Ceriodaphnia* tests and 9 fathead minnow tests. To accurately assess acute and chronic effluent toxicity, an adequate number of tests, with a variety of aquatic species (fathead minnow, bluegill sunfish, *Ceriodaphnia dubia, Daphnia magna*, and Microtox), should be conducted.

CLASSIFICATION OF AQUATIC MACROPHYTES IN AN UPPER MISSISSIPPI RIVER BACKWATER LAKE WITH AERIAL VIDEOGRAPHY

Cecil A. Jennings and Michael R. Dewey, U. S. Fish and Wildlife Service, National Fisheries Research Center, La Crosse, WI 54602-0818; Paul A. Vohs, U. S. Fish and Wildlife Service, Iowa Cooperative Fish and Wildlife Research Unit, Iowa State University, Ames, IA 50011

We evaluated the use of aerial videography, and aerial photography for classifying aquatic macrophytes in a backwater lake in Pool 8 of the Upper Mississippi River. Feature maps produced from digitized video images and digitized 35 mm transparencies showed broad categories of aquatic macrophytes that reflected the general distribution of vegetation at known locations. Feature maps from digitized 35 mm transparencies offered better resolution and easier interpretation than did feature maps from video images, but took longer to produce. Prompt availability of feature maps from the video imagery was a major advantage of the technique. Limited vegetation samples restricted our ability to identify the array of spectra present in the feature maps. We anticipate that additional vegetation samples (e.g., along a transect) would improve the assignment of spectral values to specific plant types and enhance plant identification, increasing the utility of aerial videography as a tool for classifying aquatic macrophytes in backwater habitats.

INITIAL STUDIES ON THE DECLINE AND RESTORATION OF *VALLISNERIA* IN THE UPPER MISSISSIPPI RIVER

Anne Kimber and Arnold van der Valk, Department of Botany, Iowa State University, Ames, IA 50011

The 1989 decline of *Vallisneria americana* (Michx) in Pools 4 through 19 of the Upper Mississippi River followed a year of record low flows, a wider than normal range of water temperatures and possibly increased biogenic turbidity. Loss of this plant is of particular concern because it is a major food of the canvasback (*Aythya valisineria*), and this section of the Mississippi has been a major staging area for canvasbacks before winter migration. *Vallisneria* can become established by seed dispersal or invasion from surrounding areas by clonal growth. Once a bed has been established, it persists from year-to-year primarily by means of tubers produced in late summer and fall. Tubers and seeds are the only parts of the plant that overwinter. The successful reestablishment of *Vallisneria* requires knowledge of the minimum environmental (light and temperature) conditions under which this species can grow to a sufficient size to produce viable tubers. During the 1990 field season three studies were initiated on *Vallisneria* in Lake Onalaska: 1) transplant studies were done to observe growth and reproduction at 0.5m, 1.0m, and 1.5m depths at three locations, 2) a seed bank study was done to determine the location and density of viable seeds of *Vallisneria* and other macrophytes, and 3) a study was done to assess the effects of shading on seed germination. The first season's data indicate that 1) with present light conditions, only transplanted plants grown at 0.5m produce tubers, 2) viable seeds of *Vallisneria* and other macrophytes currently exists throughout the lake, and 3) non-dormant *Vallisneria* seeds are insensitive to light for germination.

VEGETATION CHANGES BETWEEN 1975 AND 1989: POOL 13, THE UPPER MISSISSIPPI RIVER

Mark S. Laustrup, Environmental Management Technical Center, U.S. Fish and Wildlife Service, 575 Lester Ave., Onalaska, WI 54650

A Geographic Information System (GIS) data base was created in the mid-1970's for Pools 1-14 on the Upper Mississippi River by the Environmental Systems Research Institute, Inc. of Redlands, CA. Land cover/land use was one of six themes generated. The classification system included five types of land use. Vegetation was mapped at the genus level. In 1989, the land cover/land use theme was compiled from 1:15000 color infrared (CIR) photography using the same classification system as in the mid 1970's. Data representing the two time periods were overlain using a GIS (Arc/Info). Each genus-level polygon was assigned to one of 10 groups representing a wet to dry continuum. Group codes included the following: 1) open water; 2) submergent vegetation; 3) submergents/rooted floating aquatic vegetation; 4) rooted floating aquatic vegetation; 5) emergent vegetation; 6) sand/mud; 7) annual/perennial grasses/forbs; 8) woody terrestrial vegetation; 9) agriculture, and 10) urban/developed. Crosstabulation of the data indicate that dramatic changes have occurred over the 14 year period. Open water was reduced by over 9500 acres. Over 1100 acres mapped as emergent vegetation in 1975 was mapped as annual/perennial grasses and forbs in 1989. Woody terrestrial vegetation increased by over 1500 acres and the Urban/Developed category increased by 1700 acres at the expense of annual/perennial grasses and forbs. Changes which have occurred in Pool 13 are illustrated in the context of vegetation groups. The relationship of genus to group is also provided. Graphs representing successional rates, antecedent hydrological conditions and a preliminary statistical analysis have been merged into the map compositions.

GIS DISPLAYS OF EPPL7 AND FWA

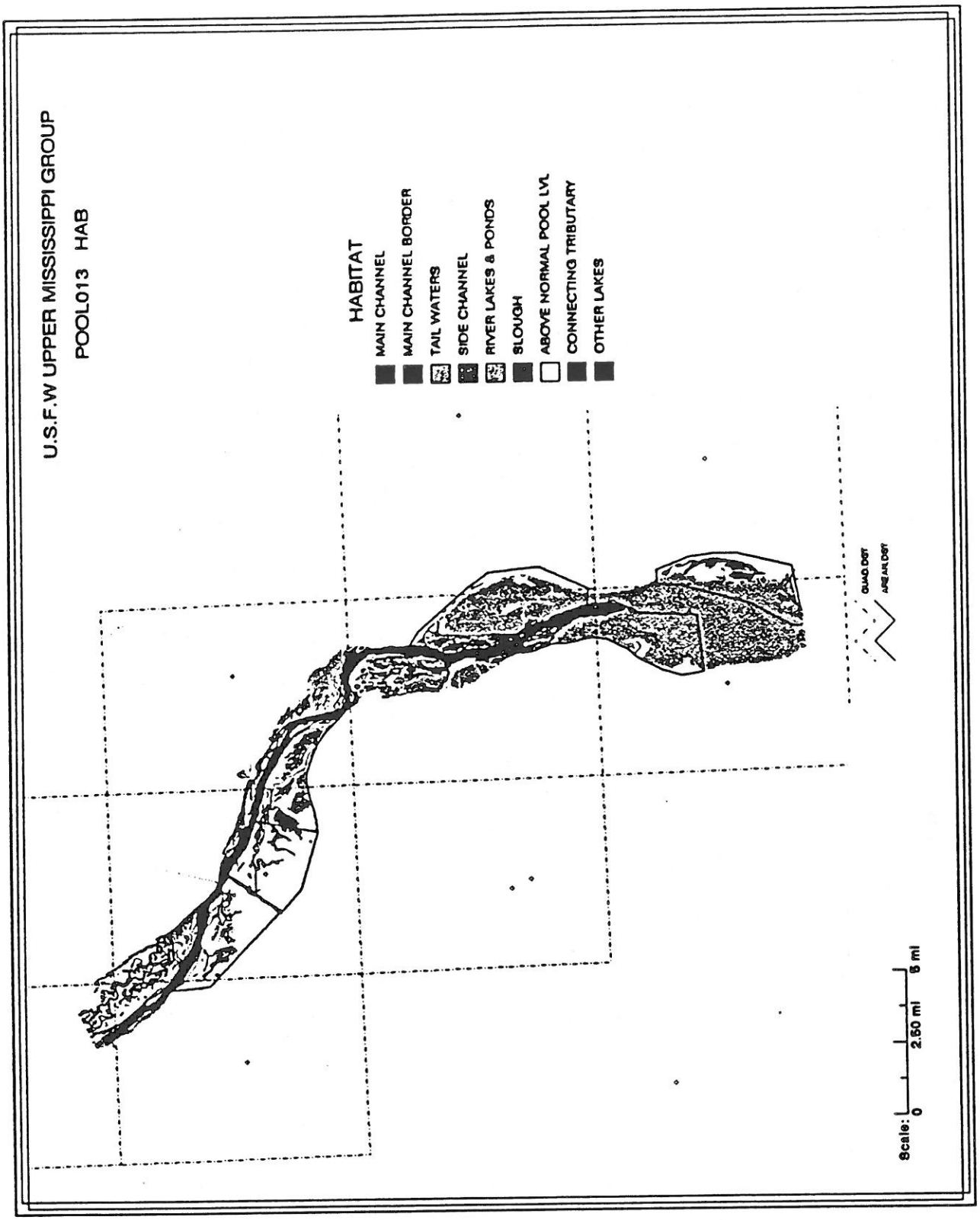
Carol Lowenberg, Environmental Management Technical Center (EMTC), Onalaska, WI 54650.

The Environmental Management Technical Center (EMTC) has chosen Environmental Planning and Programming Language, version 7 (EPPL7), as the chief computer modeling program to be used by the field stations in the Long Term Resource Monitoring Program (LTRMP). EPPL7 is a raster-based Geographic Information System (GIS) program written for use on an IBM personal computer, or compatible. The data files contain grid cell data, stored as rows and columns, often georeferenced to locations on the earth. A "class number" is assigned to each of the cells. The program utilizes the classification number in performing area calculations, modeling, displaying maps on the computer screen, and printing. Data associated with the grid cells are located in charts defining the classes, but are not utilized in actual calculation processes, reducing the amount of memory required to perform analysis.

The Fisheries and Wildlife Application program (FWA) was written by the Land Management Information Center (LMIC), for use with EPPL7. Since not everyone has the time or need to learn how to use EPPL7 well, FWA accesses several EPPL7 functions through a menu driven program to assist the EPPL7 user. FWA can be used to display a map, window into an area of study, overlay additional coverages, control several printing options, update associated map information, and print.

Several computers will be available to demonstrate EPPL7 and FWA. LMIC has put together a demonstration program explaining how information is entered into EPPL7, and used for modeling. Interested persons can go through this program at their leisure. FWA (and thus EPPL7) will also be available for demonstration and trial. Data from Pool 13 have been entered onto the computers for demonstration purposes. The data layers are: 1989 Aquatic and Land Cover/Use data; 1975 Geology; Vegetation; Habitat; Normal Pool Levels; and the area that was covered by the 1965 flood. Vector data available for overlay purposes are: Hydrology; Roads; Railroads; Quad map boundaries; and Habitat Rehabilitation and Enhancement Project (HREP) Boundaries. Several examples of maps generated with FWA and EPPL7 will be on display, and persons interested in trying FWA are encouraged to do so on the demonstration computers.

Lowenberg, 1991



THE NORTH AMERICAN LAKE MANAGEMENT SOCIETY

North American Lake Management Society, c/o University of Florida, Research and Technology Park, Alacha, FL 32615.

The purpose of the North American Lake Management Society (NALMS) is to promote further understanding of lakes, ponds, reservoirs, and impoundments, and their watersheds; the ecosystem of which they are a part; and their protection, restoration, and management. The objectives of NALMS are: To facilitate the exchange of information on the technical and administrative aspects of lake management; To promote public awareness of lake ecosystems; To encourage public support for national, state or provincial, and local programs promoting lake management; To provide guidance to public and private agencies involved in or planning lake management activities; To improve the professional status of all persons engaged in any aspects of lake management, and; To identify needs and encourage research on lake ecology and watershed management.

NALMS has approximately 2200 members and 11 state, provincial or regional chapters. The Society publishes *Lake and Reservoir Management*, a peer-reviewed technical journal, and a quarterly newsletter titled *Lake Line*. NALMS has also produced *The Lake and Reservoir Restoration Guidance Manual* and the *Lake Management Guide*. A data base for expertise referral is also available. Further information concerning the Society can be obtained from NALMS, c/o University of Florida, Research and Technology Park, One Progress Boulevard, Box 27, Alachua, Fl, 32615, or by calling (904) 462-2554.

A DEMONSTRATION APPLICATION OF THE EPPL7 GEOGRAPHICAL INFORMATION SYSTEMS (GIS) SOFTWARE TO ANALYZE RADIO TELEMETRY FISHERIES DATA

Gary Oberfoell and David McConville, Environmental Studies Center, Biology Department, Saint Mary's College of Minnesota, Winona, MN 55987; John Pitlo, Bellevue Field Station, Iowa Department of Natural Resources, Bellevue, IA 52031; and Barry Drazkowski, Environmental Management Technical Center, U.S. Fish and Wildlife Service, Onalaska, WI 54650.

A demonstration of the application of EPPL7 to analyze fisheries data will be presented. The data examined were obtained from John Pitlo, Iowa Department of Natural Resources, through Barry Drazkowski, Environmental Management Technical Center, U.S. Fish and Wildlife Service. The data represent partial results of the radio tracking of 24 largemouth bass in Pool 12 of the Upper Mississippi River between 1986 and 1990. In this study, the data are divided into five time segments, winter, prespawn, spawn, summer and fall, with each period marked with an appropriate chronological reference period. A major focus of this project has been to develop a flexible workplan and a thoroughly documented file structure and nomenclature. To accomplish our goal and to provide for maximum flexibility, time was divided into semi-monthly segments and then combined, as appropriate, to generate seasonal periods. Through the process, field data for each fish was coded into EPPL7 and referenced to Pool 12 coordinates. Following this, data for individual fish are tracked as they are combined and overlaid on a 1975 summer habitat classification model provided by EMTC. Next, data for all fish are combined for each season to obtain a composite picture of bass movement and habitat utilization in Pool 12. As a last step, the EPPL7 GIS is queried to provide a summary of river habitat usage per period by individual fish and by all fish combined. Many processing steps are required to accomplish these tasks, and the entire process will be presented.

HABITAT RESTORATION: THE PROSPECT OF *VALLISNERIA AMERICANA* RE-ESTABLISHMENT IN BACKWATER AREAS OF THE ILLINOIS RIVER

Susan Peitzmeier Romano, Barry E. Newman, K. Douglas Blodgett, and Richard E. Sparks, Illinois Natural History Survey, LTRM Field Station, 704 N. Schrader, Havana, IL 62644; and Carl E. Korschgen, National Fisheries Research Laboratory, P.O. Box 818, La Crosse, WI 54602.

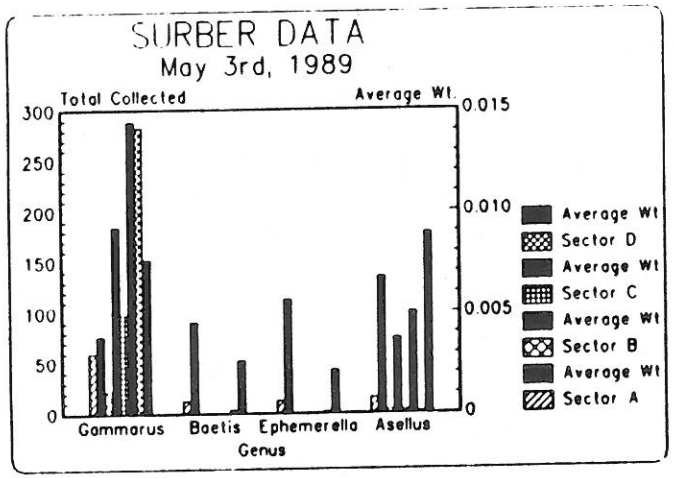
Vallisneria americana, also referred to as wildcelery, tape grass or eel-grass, was an important macrophyte of the Illinois River ecosystem. Historically, natural stands of wildcelery occurred in the middle and upper portions of the Illinois River. Since the 1950's, the range of wildcelery in the Illinois River has been reduced to the north-eastern portion in isolated lakes and tributaries. Thus, the loss of important habitat and food for fish, waterfowl, invertebrates and other aquatic life throughout a large portion of the Illinois River ecosystem.

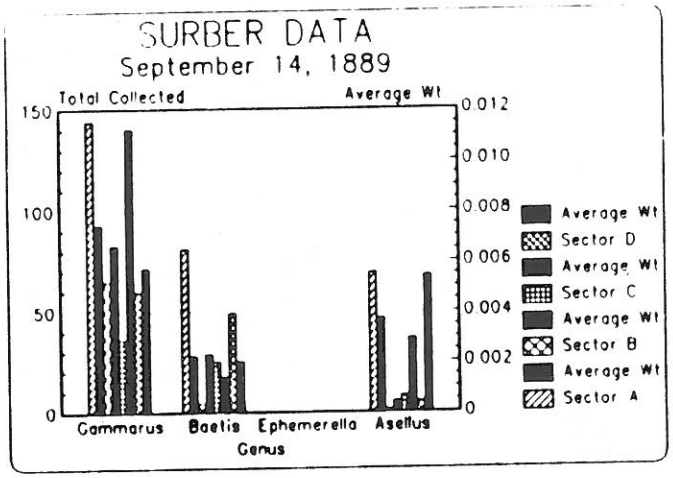
During the summer of 1990, wildcelery growth experiments were conducted by staff at the Havana LTRM Field Station in cooperation with Carl Korschgen from the U.S. Fish and Wildlife Service. Preliminary data indicate that growth of *V. americana* may be possible in specific backwaters of the Illinois River. We believe *V. americana* can be re-established in the Illinois River if particular habitat restoration practices are employed. If herbivory is controlled until aquatic beds can be established, if backwater lakes are managed for specific water depths, and if turbidities are reduced, there is the prospect for the return of wildcelery to the backwaters of the Illinois River.

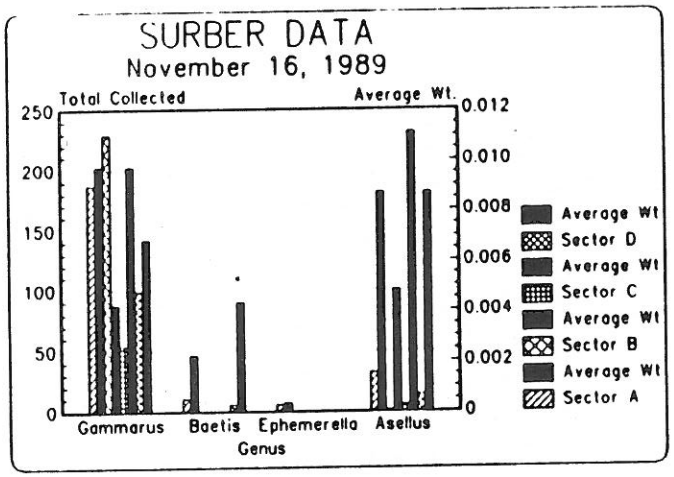
GILMORE CREEK MACROINVERTEBRATE RECOVERY FOLLOWING A SHOCK DOSE OF CALCIUM HYPOCHLORITE

Brian Pember and Gregory Mastey. Environmental Studies Center, Biology Department, Saint Mary's College of Minnesota, Winona, MN 55987.

The use of chlorine as a sanitizer and disinfectant began almost two hundred years ago. Its use as an eradicant of unwanted fish and as a therapeutic agent in eradicating fish diseases began over fifty years ago. Today its uses vary from the sanitizing of swimming pools and water mains to the sterilization of sweet potato roots and cabbage seeds. May 1989 changed Gilmore Creek, Winona, Minnesota. A new dorm on the Saint Mary's College campus was being built along the banks of Gilmore Creek. A common chemical H.T.H. (Olin, 65% Calcium Hypochlorite), used by contractors to sanitize the dorm's new water main, was flushed directly into Gilmore Creek, killing hundreds of brown trout and severely damaging the invertebrate populations. Several hundred samples have been collected since that fatal day. These were taken from a half mile section of the creek. This half mile section was divided into four smaller subsections, three below the impact point and one above. The section above the impact point was used as a control. Five Surber and sediment collection sites and two drift sites were established in each subsection. All invertebrates collected were, when possible, keyed to their genus and numbers recorded. Four genera (*Gammarus, Baetis, Ephemerella, Asellus*) were used in a life cycle study which included a weight analysis. Our study is documenting the rate of recovery of the invertebrate population and its elements as well as examining life cycle patterns. (See Figure 1 showing Surber data collected between May 3, 1989 and May 21, 1990.) Preliminary analysis indicates that *Gammarus* recovered rapidly but that overall species diversity is increasing at a much slower rate.


SURBER DATA
May 3rd, 1989
Total Collected
Average Wt.
300
250
200
150
100
50
0
0.015
0.010
0.005
0
Average Wt
Sector D
Average Wt
Sector C
Average Wt
Sector B
Average Wt
Sector A
Gammarus
Baetis
Ephemerella
Asellus
Genus


SURBER DATA
September 14, 1889
Total Collected
Average Wt
150
100
50
0
0.012
0.010
0.008
0.006
0.004
0.002
0
Average Wt
Sector D
Average Wt
Sector C
Average Wt
Sector B
Average Wt
Sector A
Gammarus
Baetis
Ephemerella
Asellus
Genus


SURBER DATA
November 16, 1989
Total Collected
Average Wt.
250
200
150
100
50
0
0.012
0.010
0.008
0.006
0.004
0.002
0
Average Wt
Sector D
Average Wt
Sector C
Average Wt
Sector B
Average Wt
Sector A
Gammarus
Baetis
Ephemerella
Asellus
Genus

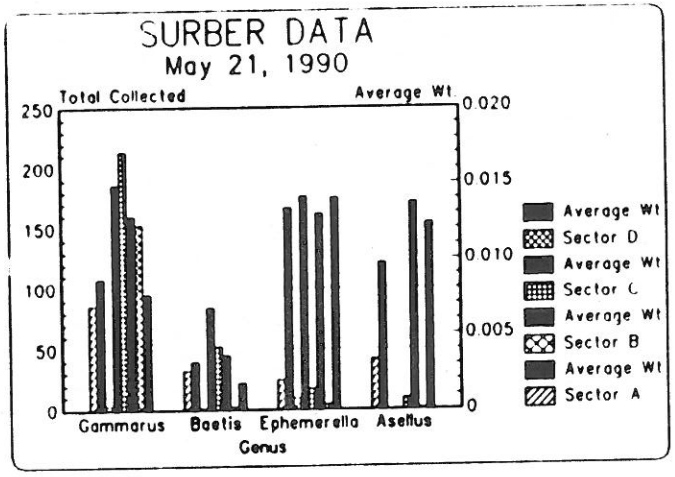

SURBER DATA
May 21, 1990
Total Collected
Average Wt
250
200
150
100
50
0
0.020
0.015
0.010
0.005
0
Average Wt
Sector D
Average Wt
Sector C
Average Wt
Sector B
Average Wt
Sector A
Gammarus
Baetis
Ephemerella
Asellus
Genus

Figure 1

ELECTROPHORETIC ANALYSIS OF THE HOST - PARASITE RELATIONSHIP BETWEEN THE FLATHEAD CATFISH (*PYLODICTUS OLIVARIS*) AND THE MAPLELEAF MUSSEL (*QUADRULA QUADRULA*)

M. A. Romano, D. B. Markillie, and R. V. Anderson, Department of Biological Sciences, Western Illinois University, Macomb, IL 61455

The only reported fish host for the glochidial stage of the mapleleaf mussel is the flathead catfish; therefore, patterns of genetic structure within these two species should be correlated. To test this hypothesis, sample sites of similar mussel density and diversity were chosen from Pools 15, 16, 18, 19, 26 of the Mississippi River, and one site from the Illinois River. Electrophoretic analysis indicated gene flow among the mapleleaf populations tended to be higher within pools and lower between pools separated by lock and dam systems. Catfish populations exhibited relatively low levels of genetic variability, particularly in Pool 19, where episodes of pollutant stress may have been a factor. *P. olivaris* appears to have a direct effect on the genetic structure of *Q. quadrula*. Analyses of systematic relationships among populations of both species showed some parallelism of population structure between the two species. A previous study on *Amblema plicata* did not produce a similarity in that species population structure with *P. olivaris*. Therefore, the data suggest that the flathead catfish is the predominant host fish for the mapleleaf mussel's glochidia.

HABITAT REHABILITATION AND ENHANCEMENT PROJECTS ON THE MISSISSIPPI RIVER AND ILLINOIS WATERWAY

Jerry Skalak and Robert Clevenstine, Planning Division, U.S. Army Engineer District, Rock Island, Rock Island, IL 61204-2004

The restoration, protection, and improvement of aquatic wetland and terrestrial habitat along the Upper Mississippi River and Illinois Waterway are being accomplished through the construction of habitat rehabilitation and enhancement projects which are specifically designed to provide the requisite habitat of selected waterfowl and fish species. They typically involve some combination of dredging, island building, and water control structures such as levees and pump stations.

Habitat projects are proposed by the U.S. Fish and Wildlife Service or the various State natural resources agencies. They are then evaluated and ranked by the Fish and Wildlife Interagency Committee (FWIC), a team of river biologists. A second interdisciplinary committee, the River Resources Coordinating Team, made up of staff members from various agencies involved with river management, reviews the FWIC's results and provides input with respect to project prioritization. The Corps of Engineers (Corps), as overall administrator of the Upper Mississippi River System - Environmental Management Program (UMRS-EMP), a multi-year program involving several Federal agencies and the five Upper Mississippi River Basin States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, develops and maintains project implementation schedules, based upon available funding, geographic distribution, and other considerations. Funding for these projects is provided through the UMRS-EMP.

The Corps Districts involved in the UMRS-EMP program manage the design and construction of the habitat projects. At the Rock Island District, this responsibility is accomplished by assigning an interdisciplinary team to each project, assuring comprehensive planning and engineering. Final project design is the net result of close interaction between proponent agency staff, other program participants, and the District's project team. Key to successful implementation is the continuous coordination with all participants through all phases of the project.

Of the three Corps Districts involved in this program, the Rock Island District is responsible for the greatest number of river miles and subsequently is allocated the largest share of available funds. Rock Island District currently has 13 habitat projects in various stages of design or construction. Also, in association with an additional three projects, monitoring to establish baseline (pre-project) conditions is under way.

FOREST MANAGEMENT ON THE UPPER MISSISSIPPI RIVER: IMPLEMENTING A FOREST RESOURCE FIELD INVENTORY AND USING A GEOGRAPHIC INFORMATION SYSTEM (GIS) AS A REPOSITORY FOR RESOURCE INFORMATION

Randall R. Urich, Natural Resource Management Section, Mississippi River Project Office, U.S. Army Corps of Engineers, La Crescent, MN 55947.

The Mississippi River Project Office of the St. Paul District, Corps of Engineers (COE) is currently implementing a forest management program on COE fee title lands in and along the Upper Mississippi River. Much of this land is included in the Upper Mississippi River National Wildlife and Fish Refuge through a Cooperative Agreement between the COE and the U.S. Fish and Wildlife Service. One of the primary goals of this program is to maintain or improve wildlife habitat through forest management techniques. There are approximately 30,000 acres of COE fee title land that remain above normal pool level. The initial step in implementing the forest management program is to complete a field inventory of the bottomland forest resource. The information collected during this phase of the program will be used to develop forest management prescriptions for individual management compartments. This poster shows some of the procedures being used to conduct the field inventory and includes an example of how a Geographic Information System (GIS) is being utilized in the program.

SECTION OF ECOLOGY- NATIONAL FISHERIES RESEARCH CENTER, LACROSSE

James G. Wiener, National Fisheries Research Center, P.O. Box 818, LaCrosse, WI 54602.

This display poster describes the staff, mission, and research activities of the Section of Ecology at the National Fisheries Research Center- LaCrosse. Areas of research activities have included larval fish ecology, impacts of navigation, endangered species, habitat use, benthic ecology, ecotoxicology, and technical assistance.

1991 BUSINESS MEETING AGENDA

MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.
23RD ANNUAL MEETING

Friday April 26, 1991 11:00 A.M.
Holiday Inn, LaCrosse, Wisconsin

1. Call To Order

2. Announcements and Acknowledgments

3. Approval of the Minutes of the 1990 Business Meeting

4. Secretary's Report

5. Treasurer's Report

6. Old Business

7. New Business
   a. Report from AD HOC Committee to Improve the MRRC
   b. Report from the By-Laws Committee
   c. Vote on By-Laws Changes
   d. Nomination and Election of the 1991-1992 Board of Directors
   e. Meeting Notice for the 24th (1992) Annual Meeting
   f. Meeting Format
   g. Presentation of the 1990 Best Paper Awards
   h. Other?

8. Adjourn

MINUTES OF THE BUSINESS MEETING, 22ND ANNUAL MEETING OF THE MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC., APRIL 20, 1990

1. Business meeting called to order at 8:22 a.m. Doug Blodgett presided for the 1989-90 Board of Directors.

2. Chair acknowledged all those who helped prepare for and run the meeting.

3. Minutes of the 1989 annual meeting were approved and adopted.

4. Treasurer's report was approved as follows:

Mississippi River Research Consortium
Balance Sheet
June 20, 1990

Balance on Hand (July 24, 1989)		$2,902.99
INCOME		
Registration and Dues		3,001.50
Book Sales (36)		180.00
Interest (6 mo. CD)		78.01
Total Income + 1989 Balance:		$6,162.50
EXPENSES		
Postage		8.40
State Corporation Fee		10.00
Printing Cost (430 announcements)		132.56
Printing Cost (140 Proceedings)		155.30
Refunds (Registration & Cruise)		66.00
Registration Supplies		38.13
Island Inn		980.08
Island Girl (79)		1,496.65
Total Expense:		$2,887.12
Balance:		$3,275.38
Balance on Hand (June 20, 1990)		
Checking		1,697.37
Savings		1,578.01
Balance:		$3,275.38

Respectfully Submitted,
John F. Sullivan
1989-90 Director

5. Old Business

Proceedings - John Ramsey reported the new Proceedings series approved last year was initiated with Volume 22 for 1990. There were no charges incurred to scan 24 abstracts, edit ASCII files, laser-print from WordPerfect 5.1 files using Helvetica 10pt font, or cut-and-paste figures and text. The cost to print, collate and staple 140 copies was $155.30 for 38 pages and a cover.

Announcement - John Ramsey mailed 430 copies of the 5-page 1990 meeting announcement and call for papers. Costs were $132.56 to print, fold and stuff envelopes. Mailing costs were covered by cooperating agency frank (in-kind value $107.50 for first-class postage and $10.00 for envelopes), as was the cost of printing labels from the MRRC mailing list.

Dues - There was no need to use the authorized dues increase from the present $5.00 annual membership rate. The cash outlay to publish the 1990 Proceedings came to only $1.11 per copy, excluding in-kind editorial and pre-printing costs.

6. New Business

Election of Directors - The outgoing Board of Directors nominated Kent Johnson (Metropolitan Waste Control Commission, St. Paul), Mike Romano (Western Illinois Univ.), and Joe Wlosinski (USFWS Environmental Management Technical Center) as candidates for the 1990-91 Board of Directors. The slate was moved and adopted unanimously.

Month of 1991 Annual Meeting - The month of April was proposed again despite being a fairly busy time for most members. It was urged that the meeting be coordinated with and announced by the Upper Mississippi River Conservation Committee.

Meeting Format - A separate poster session tentatively will be scheduled and promoted at the 1991 annual meeting.

Large Rivers Fisheries Research Initiative - Ray Hubley discussed a large rivers research initiative proposed for lead by the U.S. Fish and Wildlife Service. He submitted a resolution "to encourage the U.S. Fish and Wildlife Service to develop a research program to address fishery management needs of the nation's large river systems, including the Mississippi River as a prime candidate." After discussion on inclusiveness and wording, it was moved and seconded to adopt the resolution as submitted. Motion carried.

EMP Funding - Rick Anderson led a discussion on the status of congressional support for full UMR Environmental Management Plan (EMP) funding at $4.5 million in 1991. It was moved and seconded to have the 1990-91 MRRC Board of Directors write letters to area congressmen supporting full EMP funding. Motion carried.

Thompson Lake Restoration - John Wetzel proposed that the MRRC use its advisory group status to promote public ownership and restoration of Thompson Lake, of value to research on wetlands and their restoration. It was moved and seconded to have the 1990-91 Board of Directors write letters to area congressmen supporting public ownership and restoration of Thompson Lake. Motion carried.

7. There being no other business, the meeting adjourned at 9:05 a.m. (These Minutes submitted by John Ramsey.)

CONSTITUTION OF THE MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.

ARTICLE I. NAME AND OBJECT

1. This organization shall be named Mississippi River Research Consortium, Inc.
2. The objectives of this organization shall be:
   a. To establish and encourage communication between river scientists and between the scientific community and the public.
   b. To encourage pure and applied research concerning the water and land resources of the Mississippi River and its valley.
   c. To provide an annual meeting where research results can be presented, common problems can be discussed, information can be disseminated, and where river researchers can become acquainted with each other.
   d. To encourage cooperation between institutions and to encourage the sharing of facilities.
   e. To function as an advisory group to other agencies.
   f. To aid in the formation of a concerted and organized research effort on the Mississippi River.

ARTICLE II. ORGANIZATION

1. The organization of the Mississippi River Research Consortium shall be provided for by the enactment of suitable by-laws.
2. The by-laws of this organization shall designate the officers and standing committees, the provisions for the election of officers, the conduct of meetings, and for any other matters which are necessary for the government of this organization.

ARTICLE III. MEMBERSHIP AND DUES

1. The membership of this organization shall consist of any persons who demonstrate an interest in any aspect of the Mississippi River, and who express a desire to join the organization.

ARTICLE IV. AMENDMENTS

1. The constitution or the by-laws of the MRRC may be amended by an affirmative vote of two-thirds of the eligible voting members present at the annual meeting.

BY-LAWS OF THE MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.

ARTICLE 1: NAME, PURPOSE, AND DUTIES

1.01 There is hereby established a Board under the name of the Mississippi River Research Consortium, Inc., having the purpose and duties of governing all matters relating to this corporation. These shall be deemed to include the following without limitation:

(a) To have the ultimate decision making authority for any and all affairs of the Mississippi River Research Consortium, Inc. which includes, but is not limited to, the authority to create and terminate the corporation, to determine the budget and expenditure of funds, to manage affairs, to determine the manner, location and extent of services performed by the corporation, to determine the number of, location and job duties of any employees and to do all other and necessary work for the benefit of the corporation.

(b) To formulate all policies necessary for the effective and continuous operation of the corporation.

(c) To coordinate and make decisions regarding priorities of services.

1.02 The purpose of the organization shall be as follows:

(a) To establish and encourage communication between river scientists and between the scientific community and the public.

(b) To encourage pure and applied research concerning the water and land resources of the Mississippi River and its valley.

(c) To provide an annual meeting where research results can be presented, common problems can be discussed, information can be disseminated, and where river researchers can become acquainted with each other.

(d) To encourage cooperation between institutions and to encourage the sharing of facilities.

(e) To function as an advisory group to other agencies.

(f) To aid in the formation of a concerted and organized research effort on the Mississippi River.

ARTICLE 2: OFFICES

2.01 Principal and Business Offices

The corporation may have such principal and other offices, either within or without the State of Wisconsin as the Board of Directors may designate or as the business of the corporation may require from time to time.

2.02 Registered Office

The registered office of the corporation required by the State of Wisconsin corporation law to be maintained in the State of Wisconsin may be, but need not be, identical with the principal office in the State of Wisconsin, and the address of the registered office may be changed from time to time by the Board of Directors or by the Registered Agent. The business office of the registered agent of the corporation shall be identical to such registered office.

ARTICLE 3: BOARD OF DIRECTORS

3.01 General Powers and Number

The business and affairs of the corporation shall be managed by its Board of Directors. It shall be the responsibility of the Board to jointly organize, hold and preside over the annual meeting. The Board shall be responsible for the development of a program of technical papers to be presented at the annual meeting. The number of Directors of the corporation shall be not less than three (3) elected members.

3.02 Election and Term of Directors

Each director shall hold office for a term of one (1) year. The term of the office begins and ends with the annual meeting. At least one director shall be a representative of an academic institution and at least one director shall be a representative of either a state or federal agency. A director may be removed from the office by affirmative vote of a majority of the Board of Directors, taken at a meeting by the Board of Directors for that purpose. A director may resign at any time by filing a written resignation at the registered office.

3.03 Regular Meetings

The Board of Directors shall meet on the times and dates to be established by them but at least once per year.

3.04 Special Meetings

Special meetings of the Board of Directors may be called by or at the request of any officer. The president or secretary may fix the place of the meeting and if no other place is designated or fixed the place of the meeting shall be at the principal business office of the corporation in the State of Wisconsin.

3.05 Notice; Waiver

Notice of such meeting of the Board of Directors shall be given by written notice delivered personally or mailed or given by telegram to each director at his/her home address or at such other address as such director shall have designated in writing with the secretary of the Board of Directors, in each case not less than ten (10) days prior to such meeting. Whenever any notice whatever is required to be given to any director of the corporation under the Articles of Incorporation or By-Laws or any provision of law, a waiver thereof in writing, signed at any time, whether before or after the time of the meeting, by the director entitled to such notice, shall be deemed equivalent to the giving of such notice. The attendance of a director at a meeting shall constitute a waiver of notice of such meeting, except where a director attends a meeting and objects to the transaction of any business because the meeting is not lawfully called or convened. Neither the business to be transacted at, nor the purpose of any regular or special meeting of the Board of Directors need be specified in the notice or waiver of notice of such meeting.

3.06 Quorum

A majority of the elected members of the Board is necessary for the transaction of business at any meeting, and a majority vote of those present shall be sufficient for any decision or election.

3.07 Removal

Any member of the Board who is absent from three (3) consecutive regular meetings of the Board shall, unless excused by action of the Board, cease to be a member of the Board of Directors and shall be removed forthwith.

3.08 Conduct of Meetings

The president and in his/her absence a vice-president and in their absence, any director chosen by the directors present shall call meetings of the Board of Directors to order and shall act as the presiding officer of the meetings. The secretary of the corporation shall act as secretary of all of the meetings of the Board of Directors, but in the absence of the Secretary, the presiding officer may appoint any assistant secretary or any director or other person present to act as secretary of the meeting.

3.09 Vacancy

Any vacancy occurring in the Board of Directors shall be filled as soon as possible by the majority action of the Board.

ARTICLE 4: MEMBERSHIP AND DUES

4.01 Membership and Eligibility

Membership to include anyone interested in the research and study of the Upper Mississippi River and its valley.

4.02 Membership and Dues

Membership to be for one (1) year with annual dues determined by the Board of Directors.

ARTICLE 5: OFFICERS

5.01 Creation of Officers

The officers of the Board shall consist of a president, vice-president, secretary-treasurer and such additional assistant officers as the Board may elect.

5.02 Executive Director of the Corporation

The Board may retain and compensate and give directives to an executive officer. Said executive director shall not be considered as a member of the Board of Directors.

5.03 Election and Term of Office

The officers of the corporation shall be elected by the Board of Directors at the first meeting following the annual meeting to serve a one (1) year term. Each officer shall hold office until his successor shall have been duly elected or until his death, resignation or removal.

5.04 Removal

Any officer or agent may be removed by the Board of Directors whenever in its judgment the best interests of the corporation shall be served thereby, but such removal shall be made without prejudice to the contract rights of any person so removed. Election or appointment shall not of itself create contract rights.

5.05 Vacancies

A vacancy in any principal office because of death, resignation, removal, disqualification or otherwise, shall be filled by the Board of Directors for the unexpired portion of the term.

5.06 President

The president shall:

(a) Act as chairperson of the Board and of any executive committee,

(b) Appoint all committees unless otherwise specified by the Board,

(c) Be executive on behalf of the Board of all written instruments except as provided or directed by the Board,

(d) Be responsible for the agenda to be used at the meeting,

(e) Perform all duties incident to the office of a president and such other duties as shall from time to time be assigned to him by the Board.

5.07 Vice-President

The vice-president, at the request of the president, shall perform the duties and exercise the functions of the president, and when so acting shall have the power of the president and shall perform such other duties as delegated by the president.

5.08 Secretary-Treasurer

The secretary-treasurer shall:

(a) Keep the minutes of the meetings of the Board,

(b) See to it that all notices are fully given in accordance with the provisions of the By-Laws,

(c) Be custodian of the records of the Board,

(d) Perform all duties incident to the office of the secretary of the Board, and such other duties as from time to time may be assigned by the president of the Board.

(e) Keep all financial records of the Board,

(f) Be responsible for record keeping and assessment of dues as established by the Board of Directors,

(g) Supervise the preparation of the annual budget,

(h) Perform all duties incident to the office of the treasurer of the Board and such other duties as from time to time may be assigned by the president of the Board.

5.09 Other Assistance to Acting Officers

The Board of Directors shall have the power to appoint any person to act as an assistant to any officer, or agent for the corporation in his stead, or to perform the duties of such officer when for any reason it is impractical for such officer to act personally, and such assistant or acting officer or other agent so appointed by the Board of Directors shall have the power to perform all of the duties of the office to which he is so appointed to be assistant or as to which he is so appointed to act, except as such powers may be otherwise defined or restricted by the Board of Directors.

ARTICLE 6: COMMITTEES

6.01 Nominating Committee

The Board of Directors shall serve as the nominating committee, and file its report with the members at the annual meeting.

6.02 Other Committees

The Board may by resolution provide for such other committees as it deems advisable and may discontinue the same at its pleasure. Each entity shall have the power and shall perform such duties as may be assigned to it by the Board and shall be appointed and the vacancies filled in the manner determined by the Board. In the absence of other direction, the president shall appoint all committees.

ARTICLE 7: MEETING OF MEMBERSHIP

7.01 Annual Meeting

The Annual Meeting of the organization shall be held in La Crosse, Wisconsin, with local arrangements being handled by the membership located in La Crosse, Wisconsin. The time of the meeting shall be established by the Board of Directors within the month approved by a two-thirds (2/3rds) vote of the membership at the previous annual meeting. At the meeting reports of officers and committees shall be delivered. The Board of Directors shall be elected from those individuals nominated by the Nominating Committee and those nominated from the floor with prior consent of the nominee. All persons attending the annual meeting shall be required to pay membership dues for that year and be a member of the organization in order to participate. Notice of the annual meeting shall be sent in writing to all members.

7.02 Special Meetings

Special Meetings may be called by the president or by a majority of the Board and shall be called by the secretary on request of five (5) members in writing. The time and place of special meetings shall be announced at least two (2) weeks in advance.

7.03 Quorum

At all meetings the members of the corporation present shall constitute a quorum for the transaction of business.

ARTICLE 8: AMENDMENTS

8.01 By The Membership

These By-Laws may also be altered, amended or repealed and new By-Laws may be adopted by the Board of Directors by affirmative vote of two-thirds (2/3rds) of the members present at a meeting at which a quorum is in attendance.

PAST MEETINGS AND OFFICERS OF THE MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.

Meeting		Place	President
1st	1968	St. Mary's College, Winona	Brother George Pahl
2nd	1969	Wisconsin State Univ.-LaCrosse	Dr. Thomas Claflin
3rd	1970	Winona State College, Winona	Dr. Calvin Fremling
4th	1971	St. Cloud State Coll.-St. Cloud	Dr. Joseph Hopwood
5th	1972	Loras College, Dubuque	Dr. Joseph Kapler
6th	1973	Quincy College, Quincy	Rev. John Ostdiek
7th	1974	No Meeting	---
8th	1975	Monmouth College, Monmouth	Dr. Jacob Verduin
9th	1976	St. Mary's College, Winona	Mr. Rory Vose
10th	1977	Winona State University, Winona	Dr. Dennis Nielsen
11th	1978	Univ. of Wisconsin-LaCrosse	Dr. Ronald Rada
12th	1979	Cancelled	Dr. Edward Cawley
13th	1980	Loras College, Dubuque	Dr. Edward Cawley
14th	1981	Ramada Inn, LaCrosse	Mr. M. Vanderford
			Executive Committee
15th	1982	Radisson Hotel, LaCrosse	Dr. R.V. Anderson Dr. D. McConville Dr. J.G. Wiener
16th	1984	Radisson Hotel, LaCrosse	Dr. K.S. Lubinski Ms. R.A. Schnick Dr. M.M. Smart
17th	1985	Radisson Hotel, LaCrosse	Mr. R.C. Hubley Dr. J.G. Nickum Ms. P.A. Thiel
			Board of Directors
18th	1986	Radisson Hotel, LaCrosse	Dr. J.W. Eckblad Dr. C.E. Korschgen Dr. J.H. Peck
19th	1987	Univ. of Wisconsin-LaCrosse	Mr. Hannibal Bolton Dr. L.E. Holland Mr. M.R. Winfrey
20th	1988	Univ. of Wisconsin-LaCrosse	Mr. John Pitlo Dr. Verdel Dawson Dr. Nani Bhowmik
21st	1989	Holiday Inn, LaCrosse	Dr. Larry Jahn Mr. Jerry Rasmussen Dr. Bill LeGrande
22nd	1990	Island Inn, LaCrosse	Mr. Douglas Blodgett Mr. John Ramsey Mr. John Sullivan

ACKNOWLEDGMENTS

The following persons and institutions have contributed substantially to the planning, execution, support, and ultimately, the success of the 23rd Annual Meeting of the Mississippi River Research Consortium. The 1990-1991 Board of Directors gratefully acknowledges their involvement.

Local Meeting Arrangements, Meeting Announcements, and Mailing

Joe Wlosinski, Environmental Management Technical Center, U.S. Fish and Wildlife Service, Onalaska, WI.

Program and Proceedings

Kent Johnson, Water Quality Division, Metropolitan Waste Control Commission, St. Paul, MN.

Recruiting of Keynote Speaker, Moderators, and Judges; Raffle

Mike Romano, Department of Biological Sciences, Western Illinois University, Macomb, IL.

Keynote Speaker

William Mitsch, Ohio River Basin Consortium for Research and Education, and School of Natural Resources, Ohio State University, Columbus, OH.

Platform Session Moderators

Mike Romano, Department of Biological Sciences, Western Illinois University, Macomb, IL.

A.R. Weisbrod, Spring Creek Field Laboratory, USDI National Park Service, Marine On St. Croix, MN.

John Barko, Environmental Management Technical Center, U.S. Fish and Wildlife Service, Onalaska, WI.

Teresa Naimo, National Fisheries Research Center, U.S. Fish and Wildlife Service, LaCrosse, WI.

Nani Bhowmik, Office of Hydraulics and River Mechanics, Illinois State Water Survey, Champaign, IL.

Michael Dewey, National Fisheries Research Center, U.S. Fish and Wildlife Service, LaCrosse, WI.

Judges for Best Paper Awards

Names of the judges for best paper awards were unavailable at the time of printing. Their considerable effort is greatly appreciated.

Registration Table

Mary Mackrill, Environmental Management Technical Center, U.S. Fish and Wildlife Service, Onalaska, WI.

Laurie Wlosinski, Upper Mississippi Refuge, LaCrosse District, U.S. Fish and Wildlife Service, LaCrosse, WI.

Visual Aids

Randy Burkhardt, Environmental Management Technical Center, U.S. Fish and Wildlife Service, Onalaska, WI.

Assistance with Proceedings Preparation

Scott Schellhaass, Water Quality Division, Metropolitan Waste Control Commission, St. Paul, MN.

Poster and Display Arrangements

John Sullivan, Wisconsin Department of Natural Resources, LaCrosse, WI.

Ad Hoc Committee to Improve the MRRC

Joe Wlosinski, Environmental Management Technical Center, U.S. Fish and Wildlife Service, Onalaska, WI.

Kent Johnson, Water Quality Division, Metropolitan Waste Control Commission, St. Paul, MN.

Mike Romano, Department of Biological Sciences, Western Illinois University, Macomb, IL.

James Wiener, National Fisheries Research Center, U.S. Fish and Wildlife Service, LaCrosse, WI.

David McConville, Department of Biological Sciences, St. Mary's College of Minnesota, Winona, MN.

Raymond Hubley, Jr., National Fisheries Research Center, U.S. Fish and Wildlife Service, LaCrosse, WI.

Pam Thiel, Environmental Management Technical Center, U.S. Fish and Wildlife Service, Onalaska, WI.

MRRC By-Laws Committee

Joe Wlosinski, Environmental Management Technical Center, U.S. Fish and Wildlife Service, Onalaska, WI.

James Wiener, National Fisheries Research Center, U.S. Fish and Wildlife Service, LaCrosse, WI.

Raymond Hubley, Jr., National Fisheries Research Center, U.S. Fish and Wildlife Service, LaCrosse, WI.

Cover Art

Craig Phillips, Silver Spring, MD.

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