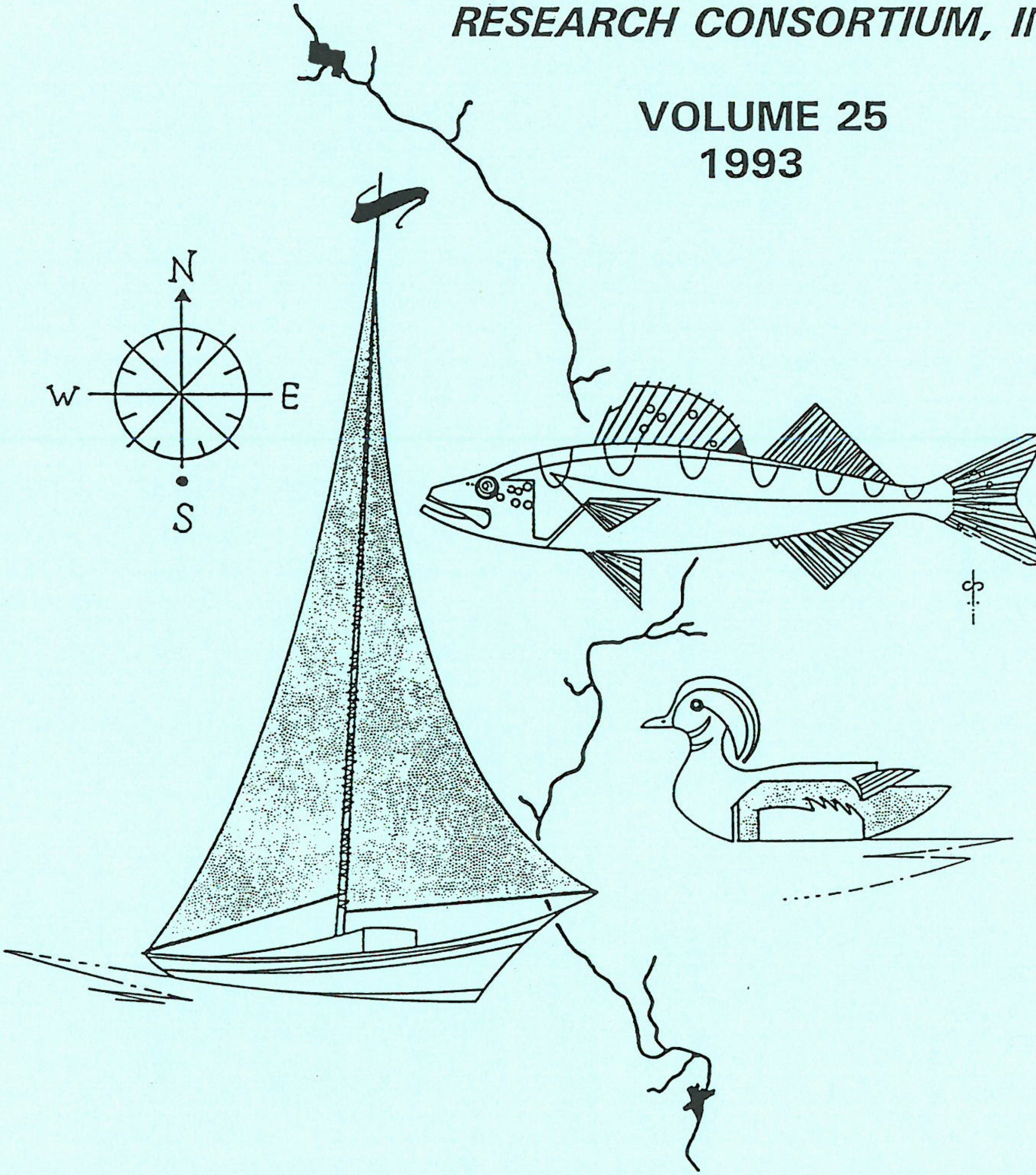
JON Duyvejonck

PROCEEDINGS OF THE

MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.

VOLUME 25
1993



Co-Sponsored by the U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, WI and the National Fisheries Research Center, La Crosse, WI

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MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.

25TH ANNUAL MEETING
APRIL 22-23, 1993

Holiday Inn
La Crosse, Wisconsin

1992-1993 Board of Directors

Contents

The Mississippi River Research Consortium: A Review of Its 25 Annual Meetings

Richard V. Anderson
1992-93 President, MRRC Board of Directors

The Mississippi River Research Consortium (MRRC) has reached one of the steps in what I believe will be a long staircase, the 25th Annual Meeting of the organization. From the 1st annual meeting, held at St. Mary's College in Winona, MN, in 1968 to this the 25th annual meeting (1993), the consortium's membership has observed, documented, and in many cases been a part of the ever changing Mississippi River ecosystem over the past 26 years. As was the hope of the organizations founders, the annual meetings have served as a forum for exchange of ideas, as a source of information, as a mechanism for the maintenance of interest in this river ecosystem, and as a vehicle for development and education of river scientists and the public. As an indication of the growth of the organization, a review of the participation and content of the annual meetings was undertaken as part of the proceedings for the 25th Annual Meeting of the Mississippi River Research Consortium. The following brief review of the organizations annual meetings was prepared based on the meeting proceedings published by the MRRC. It does not include information from the 1st, 4th, 6th, 8th, or 9th annual meetings as proceedings or programs for these meetings were not available. The 7th and 12th annual meetings were cancelled and thus are not part of the review. Consequently the following compilation is based on information from 18 annual meetings.

Participation

Individuals from 22 states and one foreign country have presented papers at the annual meetings (Fig. 1). Of the states, Illinois, Minnesota, and Wisconsin were represented at 17 of the evaluated meetings followed closely by Iowa, which was represented at 15 meetings. This probably reflects the fact that most of the founders of the organization were from these states and that most institutions and agencies actively involved in research on the upper Mississippi River were located in these states. Forty-five percent of the states were represented at only one meeting but these states covered a wide geographic range, coast to coast and north to south. An average of just over six states were represented at each meeting although presenters from only three states usually participated in the first few meetings (Fig. 2). The 15th Annual Meeting (1982) had the best state representation, 12 states, and over the past 10 years the average number of states participating has risen to 7.4 with more frequent participation by individuals from Missouri and Mississippi.

Individuals from 39 different academic institutions have presented papers at the annual meetings (Fig. 3). State and federal agencies were also well represented at the meetings with 21 and 18 different administrative groups, respectively, represented by presenters. Presentations from local agencies and the private sector were also important contributors to the meetings.

Some state and agency participation may reflect the location of the annual meeting. Before 1982, the location of the meeting rotated to different states depending on who was willing to organize and make arrangements for the meetings and subsequently serve as president of the organization. During this period the annual meeting was most frequently held in Minnesota (Fig. 4). A change in the bylaws of the organization at the 14th Annual Meeting (1981) made La Crosse, WI, the permanent site for the annual meeting from 1982 to the present.

The number of authors participating in the meetings has risen from a low of seven at the 3rd (1970) and 5th (1972) annual meeting to 102 at this years meeting (Fig. 5). Consequently, the meeting period has also expanded from a half day session to two full days and based on this years response may still be growing. Since the annual meetings were permanently located in La Crosse, WI, an average of 58 individuals have participated as senior or coauthors. However, not many individuals were an author at more than one meeting (Fig. 6) or on more than one paper (Fig. 7). Of the 475 authors presenting papers at the 18 annual meetings, 344 were authors at only one meeting. In fact over 96% of the individuals have been authors on papers presented at five or fewer meetings and only 1.1% have authored papers at more than 10 meetings. This does not reflect a large number of multiple authored papers. The average number of authors on a paper over the 18 annual meetings was 1.56 and 207 individuals were senior author on only one paper over this period (Fig. 7). The largest number of papers senior authored by an individual was 16 and the largest number senior and coauthored by an individual was 38 (Fig. 7).

The number of papers presented at each annual meeting has changed over the past 25 years from as few as five presentations in 1972, 5th annual meeting, to as many as 54 presentations in 1992 and 1993, 24th and 25th annual meetings (Fig. 8). During the three most recent years, a separate poster session has been included in the program and has accounted for approximately 30% of the presentations. The largest number of platform presentations, 45, occurred at the 15th annual meeting (1982) and the mean number of platform presentations since the annual meeting has been permanently located in La Crosse, WI, is 31.3, about the maximum for a two day meeting with a 20 minute per presentation format.

Presentation Coverage

In terms of the general aquatic areas covered by presentations, by far, the majority of the presentations at the annual meetings, in whole or in part, have dealt with the Upper Mississippi River (Fig. 9). The middle and lower Mississippi River have been the subject of presentations less frequently than the Illinois River, tributary streams, other rivers, or lakes. Within the Upper Mississippi River, Pool 19 and Pool 8 have been the river reaches most frequently included in presentations, 46 and 44 presentations, respectively (Fig. 10). Pools 4, 5, 7, 9, 13, and 26 were covered in material presented in 20 to 30 presentations. Pools 1, 22, 24, 25, and 27 have been dealt with in fewer than five presentations (Fig. 10). Only at the 24th annual meeting (1992) were all 27 pools included in material presented during the meeting (Fig. 11). With the exception of the 15th (1982), 22nd (1990), and 23rd (1991) meetings fewer than half of the navigation pools have been included in material presented at any particular annual meeting (Fig. 11).

Topics included in the 484 presentations examined ranged from aerial photographic methods to water quality (Table 1). Four topic areas: fish, invertebrates, plants, and sedimentation were covered in more than 100 of the presentations with invertebrates, primarily mussels, being the most frequently (28%) addressed topic.

Summary

The annual meetings of the Mississippi River Research Consortium have increased in diversity in terms of meeting participation by states and individuals and topics covered in the presentations. This diversity is encouraging since it reflects the continued development of awareness and appreciation for the structural and functional complexity of this major river ecosystem. Greater awareness is also apparent in the increased size of the meetings. As more individuals and agencies become actively involved in research on the river, attendance and participation have risen. While high diversity is an indication of a robust organization, continuity is maintained by a core of researchers and educators who have consistently participated in the annual meetings. Some of the original founders of the MRRC are still authoring presentations made at the annual meetings. Thus the strength of the organization is maintained through participation by a good mix of young scientist and senior scientist in established programs. To remain dynamic, the organization should continue to promote this breadth of participation and wide range of topics at its annual meetings.

Table 1. General topic area covered by annual meeting presentations.

Topic	Number of Presentations Dealing With Topic
Aerial Photography	9
Birds	46
Bridges	3
Capture and Sampling Methods	21
Computer-Assisted Programs and Models	24
Dams and River Channel Control	47
Dredging	34
Electric Generation	12
Electrophoretic Techniques and Enzymes	15
Erosion (Wind and Waves)	46
Fish	125
Habitat Assessment	89
Herpetology	3
Ice Conditions	12
Insects	28
Invertebrates (Primarily Mussels and Clams)	137
Mammals	21
Navigation (Vessels)	59
Oxygen and Carbon Dioxide	26
Plants	100
Recreation	28
Sedimentation and Bed Formation	120
Solar Energy	2
Thermal Effects	39
Toxicity	86
Water Discharge, Flow Rates, and Hydrology	82
Water Quality	52

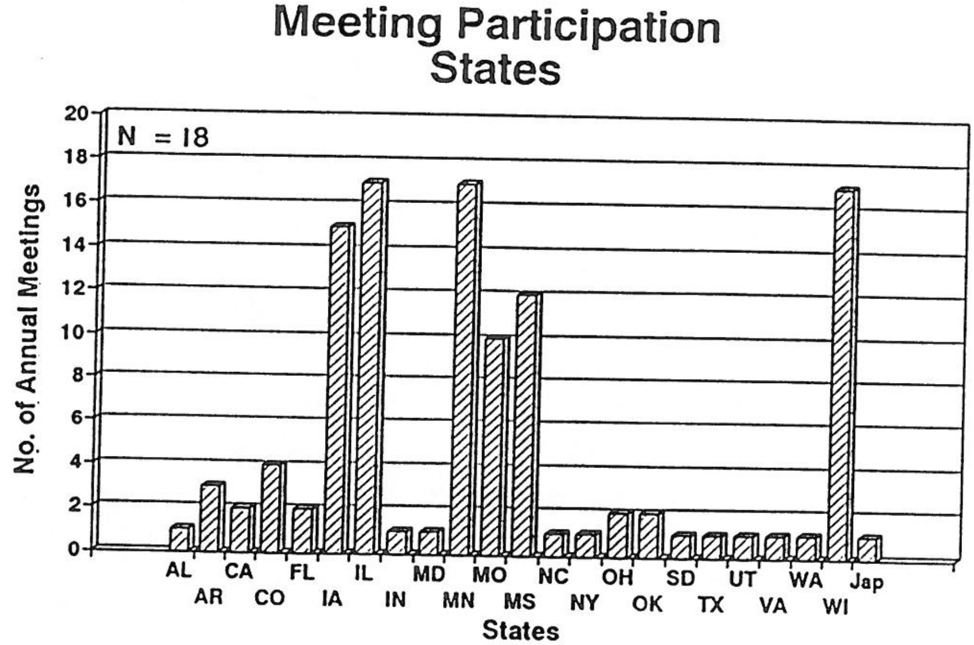


Figure 1. List of states from which annual meeting participants have come and the number of meetings at which each state was represented.

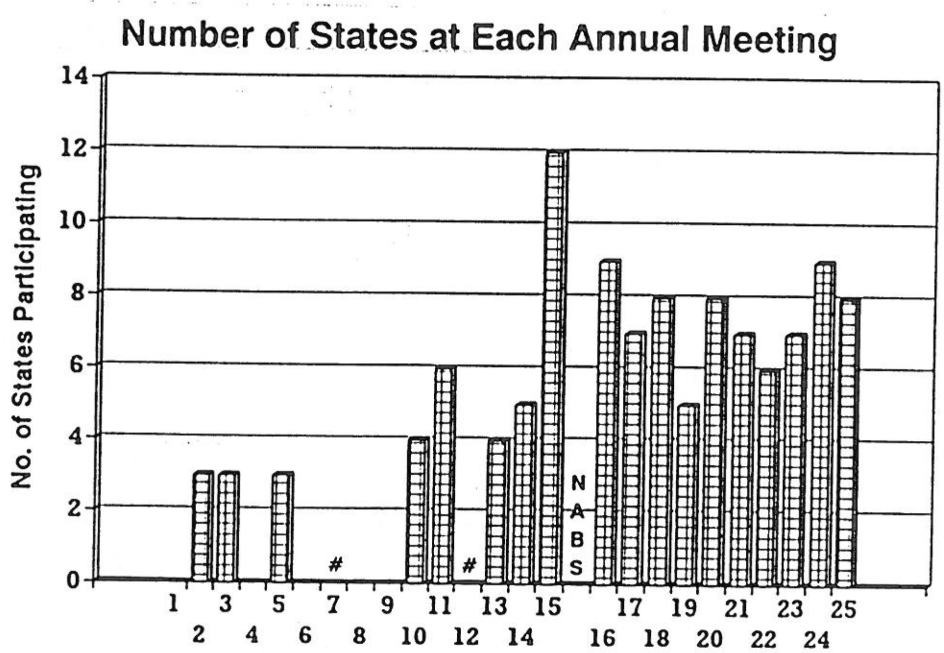


Figure 2. Number of different states represented at each of the annual meetings. # sign indicated cancelled meetings and NABS indicated the year the annual meeting was not held since the North American Benthological Society met in LaCrosse.

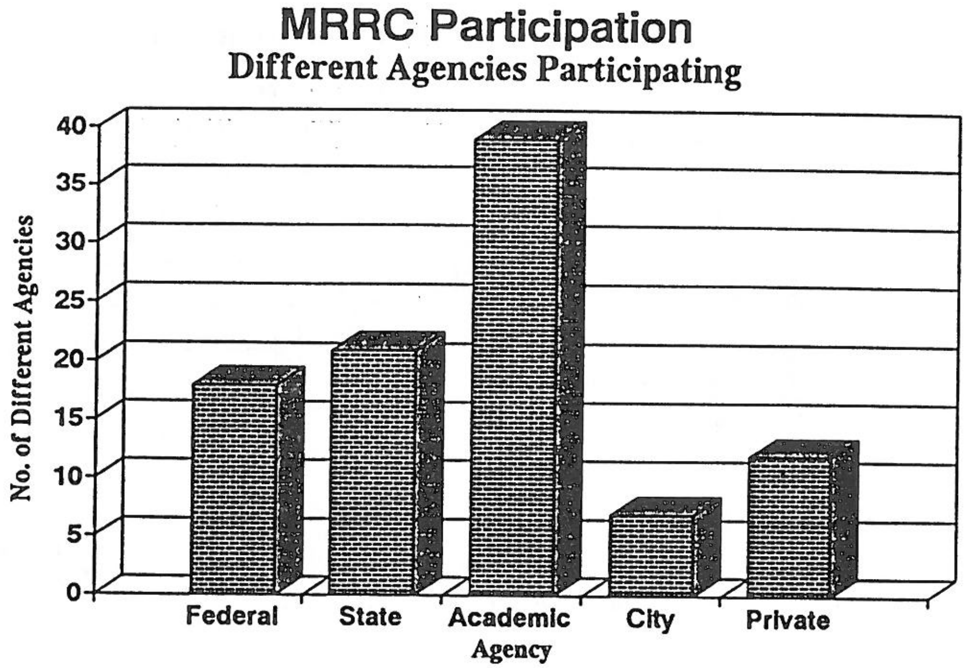


Figure 3. Number of different groups within broad categories of agency represented at the annual meetings.

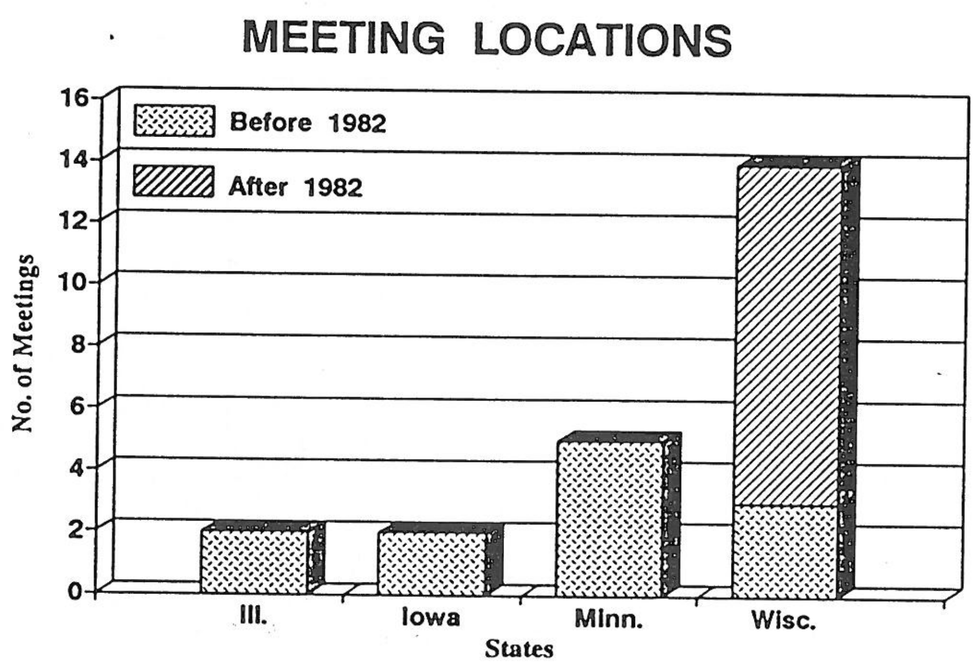


Figure 4. States in which annual meetings have been held and the number of meetings held in each of the indicated states.

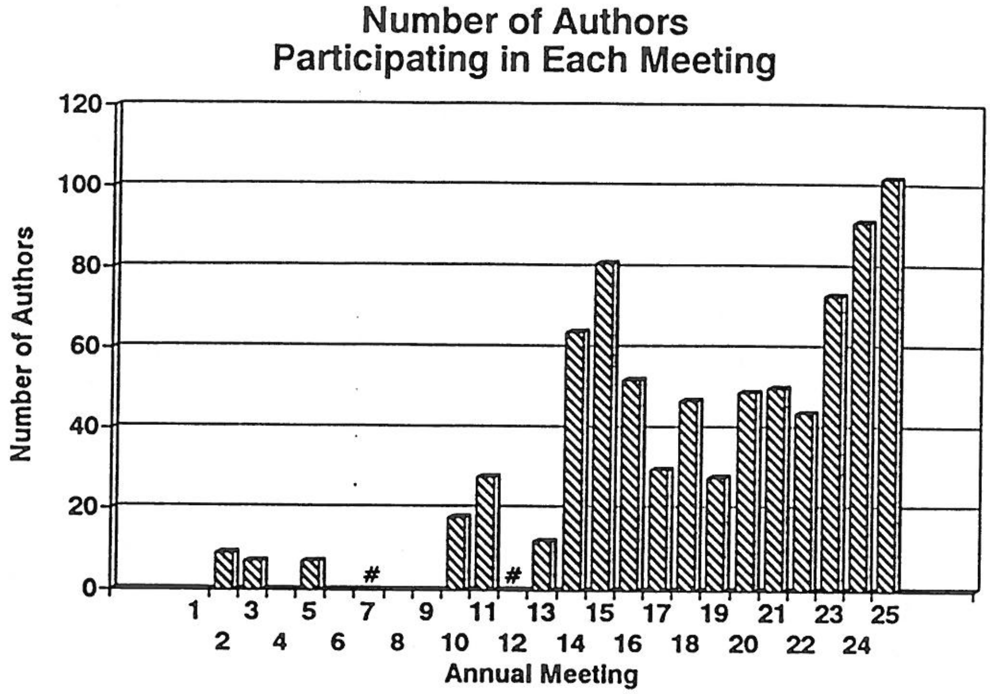


Figure 5. Number of different authors on presentations at each of the annual meetings.

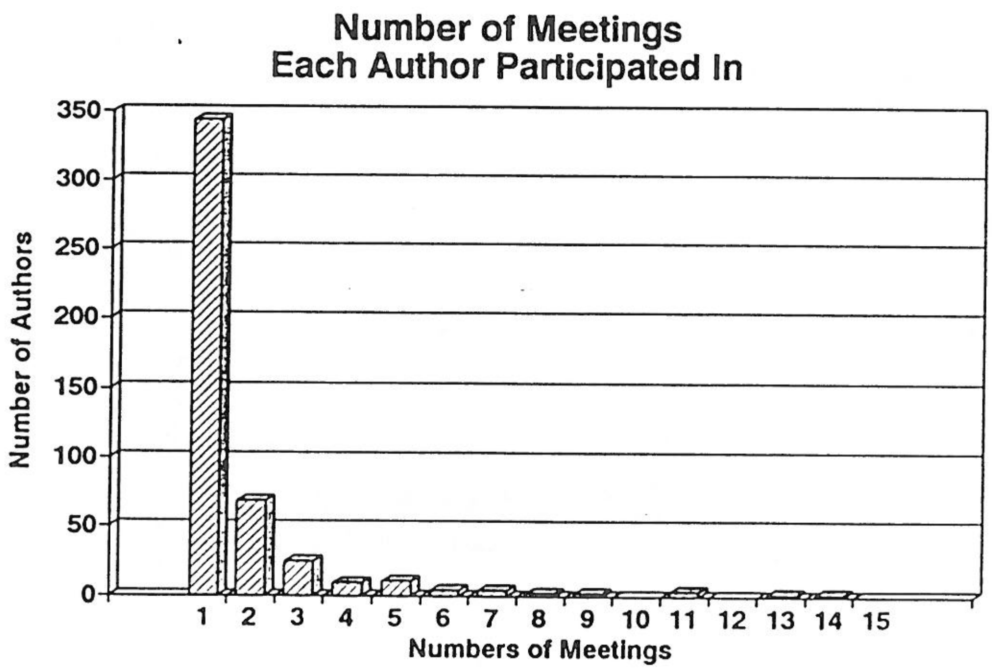


Figure 6. Number of annual meetings an author participated in.

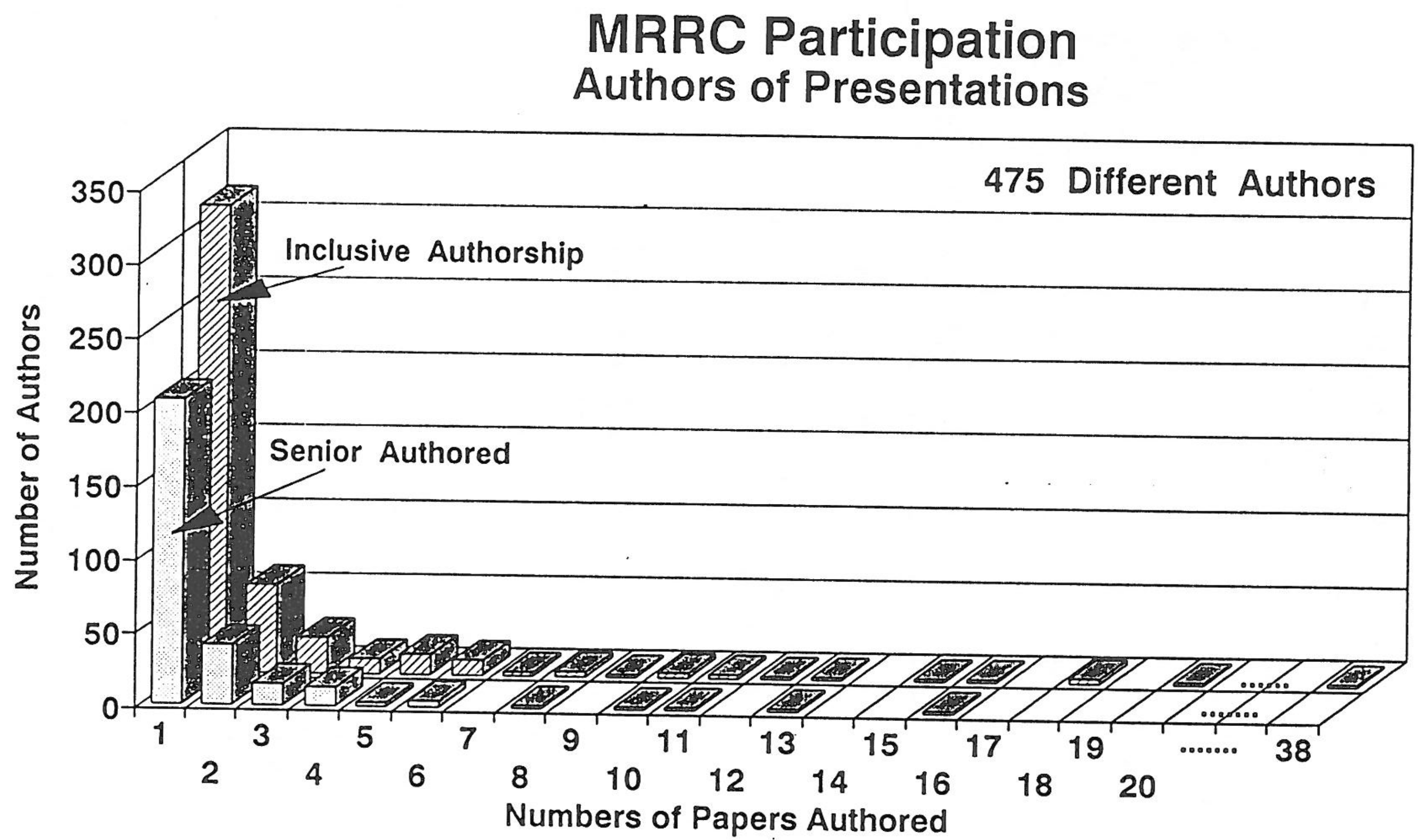


Figure 7. Number of different presentations senior authored or senior and coauthored by annual meeting participants.

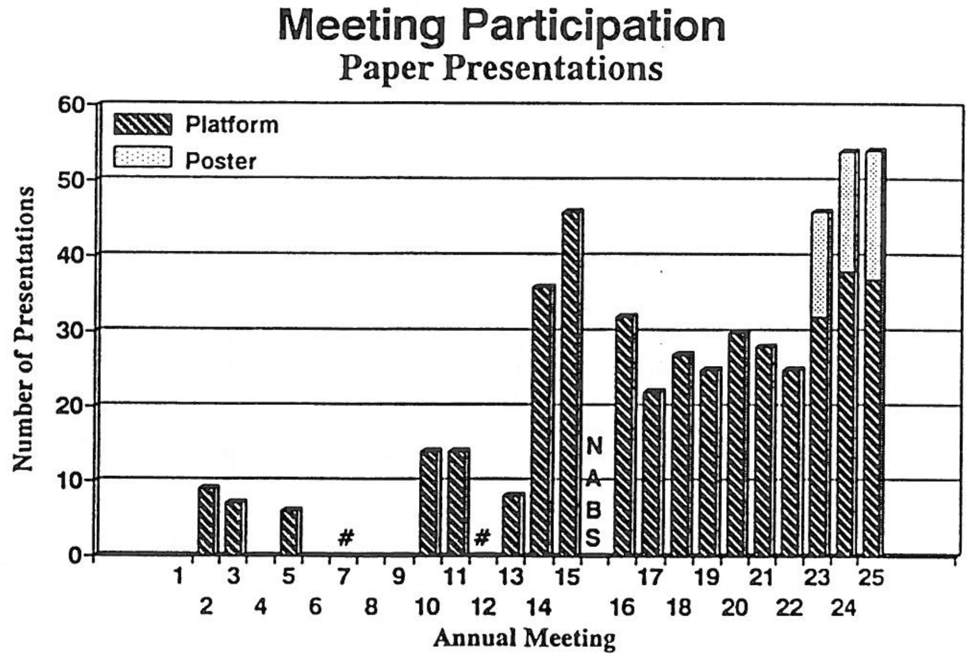


Figure 8. Number of presentations at each of the annual meetings.

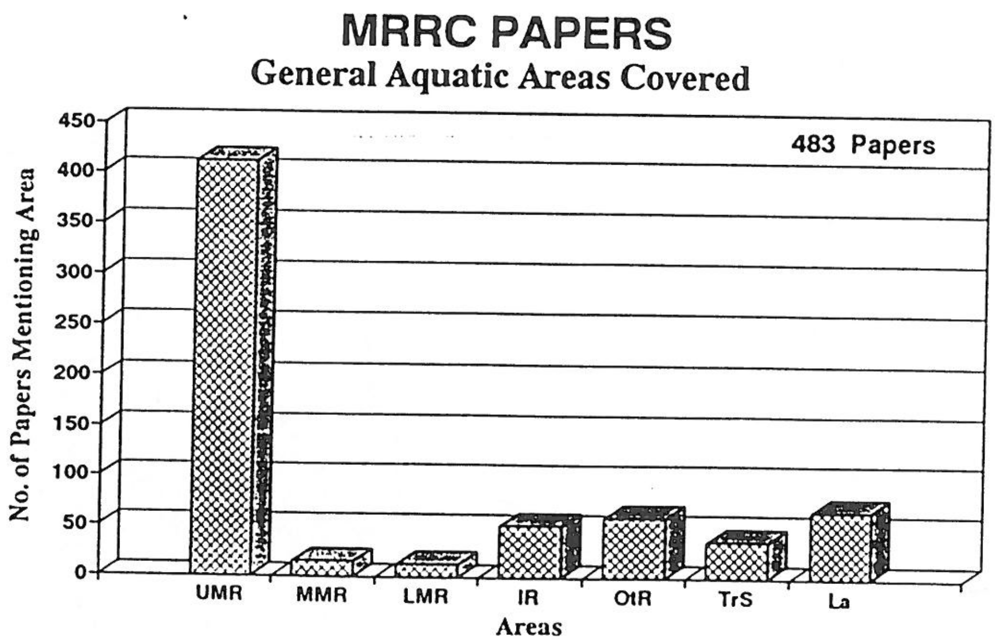


Figure 9. Number of meeting presentations dealing with each general aquatic area. UMR = Upper Mississippi River, MMR = Middle Mississippi River, LMR = Lower Mississippi River, IR = Illinois River, OtR = Other River, TrS = Tributary Streams, and La = Lakes.

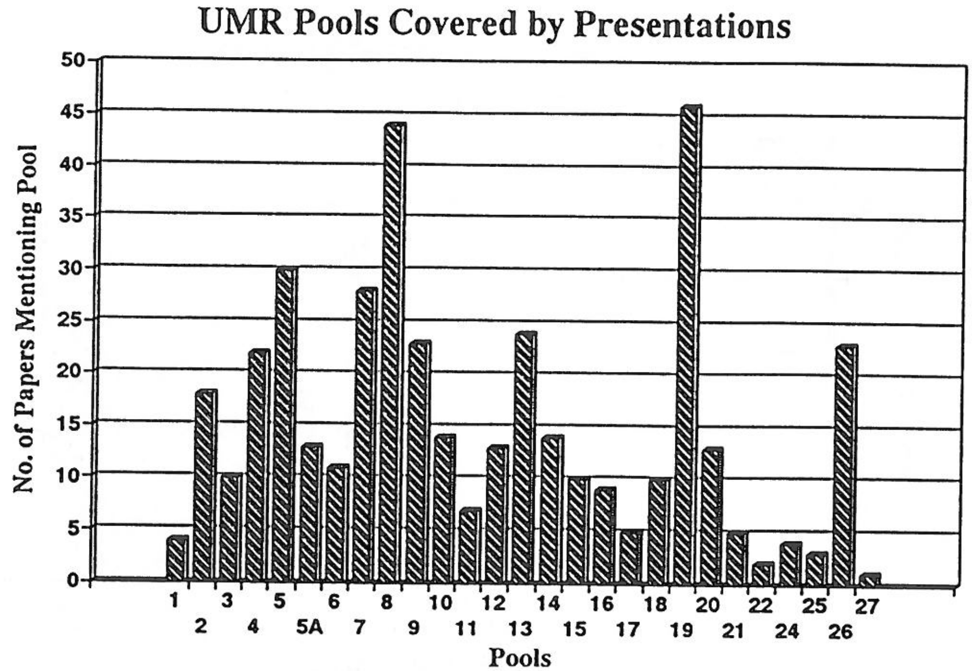


Figure 10. Number of annual meeting presentations dealing with each of the navigation pools of the Upper Mississippi River.

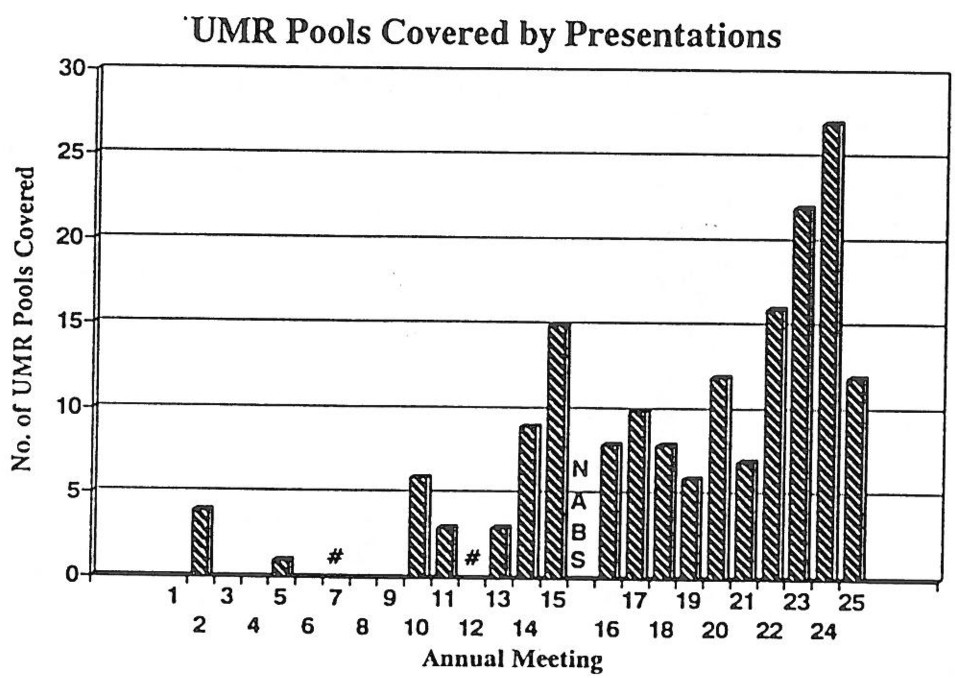


Figure 11. Number of different navigation pools of the Upper Mississippi River covered by presentations at each of the annual meetings.

Dr. Calvin R. Fremling
Recipient of the 1992 MRRC "Friend of the River" Award

Dr. Calvin R. Fremling, Professor Emeritus of Biology at Winona State University, has spent much of his adult life studying and enjoying the upper Mississippi River. As a scientist and an avid outdoorsman, he has seen the river undergo many changes in the last few decades, and his life, in turn, has been changed by the river.

Cal received his B.S. degree in Biology and Physical Science from St. Cloud State University in 1951. Following a brief teaching assignment at Motley High School (Minnesota) and a stint with the U.S. Army's Ecological Research Unit at Dugway Proving Ground (Utah), Cal returned to St. Cloud State, receiving his M.S. degree in Biology in 1955. He worked for the Minnesota Department of Conservation and was a Biology Instructor at Eveleth Junior College (Minnesota) before pursuing his Ph.D degree at Iowa State University. After completing his Ph.D in 1959, Cal joined the faculty at Winona State University, teaching a wide variety of Biology classes for 32 years until his retirement in 1991.

During his scientific career, Cal has authored a variety of journal articles and technical reports dealing with applied studies of the Mississippi River. He is well known for his work on Mississippi River mayflies, which has been featured in an Encyclopedia Britannica film and on the television program "Those Amazing Animals". His thorough and creative work on the Weaver Bottoms Rehabilitation Project was recognized by the U.S. Army Corps of Engineers, which presented the project with its highest award for projects worldwide. He has received nearly $400,000 in grants to fund his Mississippi River studies. Cal's studies of the river have always included valuable information collected during communications with towboat captains, lock masters, resort owners, hunters, commercial and recreational fishermen, and others who frequent the river on a regular basis. He recommends that more scientists should take the time to visit with those people who use the river most often. In 1976, the Minnesota Academy of Science presented Cal with its Distinguished Service Award in Scientific Research and in 1992, the Mississippi River Research Consortium presented him with the "Friend of the River" Award in recognition of his river research and his efforts in providing a better understanding of the ecology of the Mississippi River.

Cal's enthusiasm for sharing knowledge was particularly evident in the classroom at Winona State. He taught a wide variety of classes throughout his career, primarily in the areas of conservation, limnology, entomology, human biology, and principles of biology. His lectures were often lavishly illustrated with slides taken during his research projects, field laboratories, fishing and hunting expeditions, and travels throughout the country and to several foreign lands. Cal's classes consistently were enjoyed by his students, and former students regularly contact him to let him know how much they appreciated his classes. In addition to his regular classes, he frequently taught a summer Elderhostel class "The Mississippi River and Man" and conducted several "Mississippi River Ecology" workshops for the U.S. Army Corps of Engineers personnel. Cal also has strived to find new and better ways to preserve animals and their organs for classroom teaching. He holds a U.S. Patent for a biological preservation process and has authored 15 dissection manuals and teachers guides. The McKnight Family Scientific Fund Award was presented to Cal in 1967 for his contributions to college biology teaching, and the Minnesota Chapter of the American Fisheries Society presented him in 1989 with its Award of Excellence for Distinguished Contributions to Aquatic Education and Aquatic Biology/Fisheries. He was honored as the Alumnus of the Year by Brainerd Community College in 1985 and by St. Cloud State University in 1993.

Cal has worked tirelessly as a scientific consultant for a wide variety of private industries, citizens' groups, and governmental agencies. His most extensive efforts have been focused on the Lake Winona restoration project, one of the most complex lake restoration projects ever undertaken in Minnesota. He has co-authored two editions of the "Lake Winona Compendium", the book documenting the entire restoration project and the ongoing study of Lake Winona.

Today, Cal continues as a spokesman for the Mississippi River. He presents many illustrated, river-related lectures each year at professional meetings, other colleges and universities, and to various environmental organizations. He also has undertaken what may be his most ambitious project to date, writing a popular book on the Mississippi River. But when the walleye are biting or the mallards are flying, he cannot be found pecking away at the computer keyboard, he will be out enjoying the river that is so much a part of him.

Written by Neal Mundahl, Winona State University

PLATFORM PROGRAM SCHEDULE

MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.
25TH ANNUAL MEETING
HOLIDAY INN, LA CROSSE, WISCONSIN

THURSDAY, APRIL 22, 1993

07:15 AM Registration (Mississippi Room)

08:00 AM Introduction and Announcements, **Rick Anderson**, President, MRRC

SESSION I - AQUATIC MACROPHYTES (MODERATOR: SARA ROGERS)

08:20 AM ECOLOGICAL ASSESSMENT OF CHANGES IN THE DISTRIBUTION AND SPECIES COMPOSITION OF SUBMERSED AQUATIC MACROPHYTES IN THE UPPER MISSISSIPPI RIVER. **John W. Barko**, Craig S. Smith, and Sara J. Rogers, Waterways Experiment Station, Vicksburg, MS 39180 and Environmental Management Technical Center, Onalaska, WI 54650

08:40 AM APPLICATION OF THE MONOD MODEL TO THE SUBMERSED MACROPHYTE DECLINE IN THE UPPER MISSISSIPPI RIVER. **John F. Sullivan**, Wisconsin Department of Natural Resources, La Crosse, WI 54601

09:00 AM THE EFFECTS OF MECHANICAL HARVESTING ON THE GROWTH OF PLANT COMMUNITIES DOMINATED BY EURASIAN WATERMILFOIL. **Wendy Crowell**[1,2], Jim Perry[1], and Lloyd Queen[1], [1]Department of Forest Resources, University of Minnesota, St. Paul, MN 55108 and [2]USDI National Park Service, Spring Creek Field Laboratory, Marine On St. Croix, MN 55047

09:20 AM EFFECTS OF COMMON CARP (*CYPRINUS CARPIO*) ON AQUATIC MACROPHYTES IN A BACKWATER LAKE IN THE UPPER MISSISSIPPI RIVER. **Steve Bellrichard**[1], Steve Gutreuter[2], and Mark Sandheinrich[1], [1]River Studies Center, Department of Biology & Microbiology, University of Wisconsin-La Crosse, La Crosse, WI 54601 and [2]USFWS, Environmental Management Technical Center, Onalaska, WI 54650

09:40 AM **Break** (Mississippi Room)

SESSION II - BIOTIC COMMUNITIES (MODERATOR: KEVIN KENOW)

10:00 AM IMPROVING ELECTROFISHING BY STANDARDIZING POWER. **Randy W. Burkhardt**, U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, WI 54650

10:20 AM RANDOMIZATION AND CONTROL IN TREND AND RESPONSE MONITORING OF FISHES--STATISTICAL ISSUES MATTER. Steve Gutreuter, U.S. Fish and Wildlife Service, Environmental Management Technical Center, 575 Lester Avenue, Onalaska, WI 54650

10:40 AM ECOLOGY OF BOWFIN STOCKED INTO LAKE WINONA, MINNESOTA. Deena K. Spielman, Jason P. Harkins, and Neal D. Mundahl, Department of Biology, Winona State University, P.O. Box 5838, Winona, MN 55987

11:00 AM CANVASBACK HUNTING MORTALITY AND HUNTER EDUCATION EFFORTS ON THE UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE, 1991-92. Carl E. Korschgen, and Kevin P. Kenow, Northern Prairie Wildlife Research Center, Section of Lake States Ecology, La Crosse, WI 54602; James Nissen, La Crosse District, Upper Mississippi River Wildlife and Fish Refuge, La Crosse, WI 54601; and John Wetzel, Wisconsin Department of Natural Resources, La Crosse, WI 54601

11:20 AM SEASONAL PASSAGE OF NEARCTIC-NEOTROPICAL MIGRATING BIRDS ALONG THE SAINT CROIX RIVER. A. R. Weisbrod[1,2], Dwain W. Warner[2], and Wendy Crowell[1], [1]Spring Creek Field Laboratory, USDI National Park Service, Marine On St. Croix, MN 55047 and [2]Bell Museum of Natural History, University of Minnesota, Minneapolis, MN 55455

11:40 AM USING POST-RELEASE STRATIFICATION TO DETECT HETEROGENEITY IN MALLARD SURVIVAL. Larkin A. Powell and William R. Clark, Department of Animal Ecology, Iowa State University, Ames, IA 50011 and Erwin E. Klaas, Iowa Cooperative Fish and Wildlife Research Unit, Iowa State University, Ames, IA 50011

12:00 PM **Lunch** (On Your Own)

SESSION III - RIVER REHABILITATION AND EDUCATION (MODERATOR: GREG COPE)

01:00 PM HABITAT REHABILITATION AND ENHANCEMENT PROJECTS: A MID-PROGRAM REVIEW. Charles H. Theiling and Richard E. Sparks, Illinois Natural History Survey, LTRMP Pool 26, P.O. Box 368, West Alton, MO 63386

01:20 PM WHAT ARE THE BEST AND WORST APPROACHES TO RESTORE THE NATURAL FUNCTIONING OF LARGE RIVER-FLOODPLAIN ECOSYSTEMS? Peter B. Bayley, Illinois Natural History Survey, 172 Natural Resources Building, 607 E. Peabody, Champaign, IL 61820

01:40 PM LIMNOLOGY OF HABITAT REHABILITATION IN THE FINGER LAKES. David M. Soballe[1], William James[2], Robert F. Gaugush[1], and John Barko[1]. [1]EMTC, Onalaska, WI and [2]WES Eau Galle Limnological Laboratory, Spring Valley, WI 54767

02:00 PM RIVERS CURRICULUM PROJECT. Al Schutima, Fulton High School, 1207 12th Street, Fulton, IL 61252, Bernie Hermanson, Sumner High School, 802 W. 6th Street, Sumner, IA 50674, Dr. Robert Williams, Project Advisor, and Cynthia Bidlack, Project Coordinator, Rivers Curriculum Project, Southern Illinois University, Box 2222, Edwardsville, IL 62026

02:20 PM **Break** (Mississippi Room)

SESSION IV - ASPECTS OF DISTURBANCE (MODERATOR: DAN HORNBACH)

02:40 PM CHARACTERISTICS OF WAVES AND DRAWDOWN GENERATED BY BARGE TRAFFIC ON THE UPPER MISSISSIPPI RIVER SYSTEM. Ta Wei Soong and Nani G. Bhowmik, Illinois State Water Survey, Champaign, IL 61820

03:00 PM EFFECTS OF NAVIGATION DAMS ON WATER REGIMES: HYDROLOGIC CHANGES AT NAVIGATION POOL 26, MISSISSIPPI RIVER. John C. Nelson, Charles H. Theiling, and Richard E. Sparks, Illinois Natural History Survey, Long Term Resource Monitoring Program, Pool 26 Field Station, P.O. Box 368, West Alton, MO 63386

03:20 PM WATER INJECTION DREDGING DEMONSTRATION PROJECT. Teri Sardinas, St. Paul District, U.S. Army Corps of Engineers, Planning Division, Environmental Resources, 180 East Kellogg Boulevard, Room 1421, St. Paul, MN 55101, Mr. Jim Clausner, Mr. Dennis Brandon, Mr. Tim Welp, and Mr. Darryl Bishop, U.S. Army Corps of Engineers Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39180

03:40 PM SPATIAL AND TEMPORAL VARIATIONS IN WATER LEVEL FLUCTUATIONS IN THE UPPER MISSISSIPPI RIVER. Joseph H. Wlosinski and Lara Hill, U.S. Fish and Wildlife Service, Environmental Management Technical Center, 575 Lester Avenue, Onalaska, WI 54650

04:00 PM **Poster Presentations** (Concourse)

05:00 PM **Social Begins** (Concourse)

06:00 PM **Barbecue** (Outdoors)

FRIDAY, APRIL 23, 1993

07:30 AM **Registration** (Mississippi Room)

SESSION V - WATER QUALITY (MODERATOR: MARK SANDHEINRICH)

08:00 AM TRANSPORT OF SUSPENDED ORGANIC MATTER IN THE MISSISSIPPI RIVER. J. A. Leenheer and C. E. Rostad, Water Resources Division, U.S. Geological Survey, Denver, CO 80225

08:20 AM DISTRIBUTION OF ORGANIC CARBON IN THE MISSISSIPPI RIVER: COMPARISON OF SILT AND COLLOIDAL TRANSPORT. **Colleen E. Rostad** and Stephanie G. Monsterleet, U.S. Geological Survey, 5293 Ward Road, Arvada, CO 80002

08:40 AM HALOGENATED ORGANIC CONTAMINANTS IN THE UPPER MISSISSIPPI RIVER: DETECTION AND MEASUREMENT WITH A PASSIVE ACCUMULATOR. **Christopher J. Schmitt**, James N. Huckins, and Jimmie D. Petty, U.S. Fish and Wildlife Service, National Fisheries Contaminant Research Center, 4200 New Haven Road, Columbia, MO 65201 and Colleen E. Rostad and Geoffrey S. Ellis, U.S. Geological Survey, 5293 Ward Road, Arvada, CO 80002

09:00 AM SUSPENDED-SEDIMENT CONCENTRATION TRENDS ON THE MISSISSIPPI RIVER BETWEEN ST. LOUIS, MISSOURI, AND CAIRO, ILLINOIS. **Robert R. Holmes, Jr.**, U.S. Geological Survey, Rolla, MO 65401

09:20 AM PHYTOPLANKTON COMMUNITY STRUCTURE AND STANDING CROP IN LAKE PEPIN, UPPER MISSISSIPPI RIVER. **William R. Maurer** and Ronald G. Rada, River Studies Center, Department of Biology & Microbiology, University of Wisconsin, La Crosse, WI 54601

09:40 AM **Break** (Mississippi Room)

SESSION VI - SEDIMENTS (MODERATOR: TERESA NAIMO)

10:00 AM CHARACTERIZATION OF SEDIMENT TYPE AND BOTTOM DYNAMIC CONDITIONS BY AN *IN-SITU* SEDIMENT PENETROMETER: PRELIMINARY DATA FROM LAKE ONALASKA. **Robert F. Gaugush**, U.S. Fish and Wildlife Service, Environmental Management Technical Center, 575 Lester Avenue, Onalaska, WI 54650

10:20 AM AN ASSESSMENT OF SEDIMENT SUITABILITY FOR THE GROWTH OF *VALLISNERIA AMERICANA* L. IN LAKE ONALASKA. **Sara J. Rogers**, John W. Barko, and Dwilette G. McFarland, U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, WI 54650 and U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS 39180

10:40 AM TESTING CONTAMINATED SEDIMENT WITH FINGERNAIL CLAMS. **W. Gregory Cope**, Michelle R. McPeak, and Teresa J. Naimo, U.S. Fish and Wildlife Service, National Fisheries Research Center, P.O. Box 818, La Crosse, WI 54602

11:00 AM **Business Meeting** (Mississippi Room)

12:00 PM **Lunch at the Holiday Inn** (Concourse)

SESSION VII - FRESHWATER INVERTEBRATES (MODERATOR: PAM THIEL)

01:00 PM HABITAT CHARACTERISTICS FOR THE WINGED MAPLELEAF *QUADRULA FRAGOSA* AND ITS ASSOCIATION WITH OTHER MUSSELS IN THE ST. CROIX RIVER. **Daniel J. Hornbach**, Lindsay Powers, James March, Scott Villinski, Aleria Jensen, and Emily Mugnolo, Department of Biology, Macalester College, St. Paul, MN 55105

01:20 PM THE EFFECTS OF HANDLING AND TIME OUT OF WATER ON THE SURVIVAL OF FRESHWATER MUSSELS. **Diane L. Waller**, Jeffrey J. Rach, and W. Gregory Cope, National Fisheries Research Center, P.O. Box 818, La Crosse, Wisconsin 54602

01:40 PM COMPARISON OF MACROINVERTEBRATE ASSEMBLAGES FROM TWO BACKWATER LAKES IN POOL 10 OF THE UPPER MISSISSIPPI RIVER. **B. Will Green**[1], David C. Beckett[1], Andrew C. Miller[2], and Robert F. Gaugush[3], [1]Department of Biological Sciences, Box 5018, University of Southern Mississippi, Hattiesburg, MS 39406, [2]U.S. Army Engineer Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39180, and [3]U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, WI 54650

02:00 PM EPIZOIC INVERTEBRATE COMMUNITIES ON UPPER MISSISSIPPI RIVER UNIONID BIVALVES: ISLANDS IN THE STREAM. **David C. Beckett**[1], B. Will Green[1], Steven A. Thomas[1], and Andrew C. Miller[2], [1]Department of Biological Sciences, Box 5018, University of Southern Mississippi, Hattiesburg, MS 39406 and [2]U.S. Army Engineer Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39180

02:20 PM CULTURE OF ZEBRA MUSSELS IN FIVE WATER SOURCES. J. J. Rach, **S. D. Whitney**, and D. L. Waller, U.S. Fish and Wildlife Service, National Fisheries Research Center, P.O. Box 818, La Crosse, Wisconsin 54602

02:40 PM INHIBITION OF BYSSAL THREAD DEVELOPMENT AS A POTENTIAL METHOD FOR CONTROL OF ZEBRA MUSSELS. **Michelle R. McPeak** and W. Gregory Cope, U.S. Fish and Wildlife Service, National Fisheries Research Center, P.O. Box 818, La Crosse, WI 54602

03:00 PM BASELINE STUDIES TO ASSESS EFFECTS OF INTRODUCTION AND SPREAD OF ZEBRA MUSSELS ON MACROINVERTEBRATES IN RELATION TO SUBSTRATE CHARACTERISTICS. **Andrew C. Miller**, John W. Barko, Barry S. Payne, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS 39180 and David C. Beckett, Department of Biological Sciences, University of Southern Mississippi, Hattiesburg, MS 39406

03:20 PM **Break** (Mississippi Room)

SESSION VIII- COMPUTERIZED MAPPING TOOLS (MODERATOR: BILL RICHARDSON)

03:40 PM USE OF GPS DURING A UNIONID MOLLUSK BRAIL/DIVE SURVEY, LOWER OHIO RIVER MILE 938.9 TO 981.0, PADUCAH, KY, TO CAIRO, IL. **Marian E. Havlik**, Malacological Consultants, La Crosse, WI 54601

04:00 PM NAVSTAR GLOBAL POSITIONING SYSTEM DATA: ACCURACY ASSESSMENTS AND APPLICATIONS WITHIN THE LONG TERM RESOURCE MONITORING PROGRAM. **Carol Lowenberg**, U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, WI 54650

04:20 PM SATELLITE-DERIVED LAND COVER/LANDUSE FOR THE UMRS: POTENTIAL USES OF THE SYSTEMIC DATA BASE. **Mark S. Laustrup**, U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, WI 54650

04:40 PM INVESTIGATION OF ACCURACY OF LAND USE/LAND COVER COVERAGES. **Thomas Owens**, USFWS, Environmental Management Technical Center, 575 Lester Avenue, Onalaska, WI 54650

POSTER PROGRAM SCHEDULE

MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.
25TH ANNUAL MEETING
HOLIDAY INN, LA CROSSE, WISCONSIN

THURSDAY APRIL 22, 1993
04:00-06:00 PM
Concourse

SPATIAL DISTRIBUTION OF SEDIMENT CHEMISTRY DATA AND POTENTIAL POINT SOURCES OF POLLUTION FOR THE MARK TWAIN NATIONAL WILDLIFE REFUGE, UPPER MISSISSIPPI RIVER. **Mike Coffey**, Jody Millar, and Terri Jacobson, U.S. Fish and Wildlife Service, 4469 48th Avenue Court, Rock Island, IL 61201

GROWTH OF ZEBRA MUSSELS IN THE UPPER MISSISSIPPI RIVER. **W. Gregory Cope**, Leif Marking, and Michelle McPeak, U.S. Fish and Wildlife Service, National Fisheries Research Center, P.O. Box 818, La Crosse, WI 54602

RELATIVE SELECTIVITIES OF GEAR FOR SAMPLING ICHTHYOPLANKTON. **Michael Dewey**, U.S. Fish and Wildlife Service, National Fisheries Research Center, P.O. Box 818, La Crosse, WI 54602

METHODS AND PRELIMINARY RESULTS OF THE MINNESOTA COUNTY BIOLOGICAL SURVEY IN SOUTHEAST MINNESOTA. **Hannah Dunevitz** and Scott Zager, Natural Heritage Program, Minnesota Department of Natural Resources, St. Paul, MN 55115

COMPARISON OF TWO SAMPLERS FOR MEASUREMENT OF UN-IONIZED AMMONIA IN SEDIMENT PORE WATER IN POOL 8, UPPER MISSISSIPPI RIVER. **Bradley Frazier**[1], Thomas Claflin[2], Teresa Naimo[1], and Mark Sandheinrich[2], [1]U.S. Fish and Wildlife Service, National Fisheries Research Center, La Crosse, WI 54602 and [2]River Studies Center, University of Wisconsin-La Crosse, La Crosse, WI 54601

ARE UNIONID TRANSLOCATIONS A VIABLE MITIGATION TECHNIQUE? THE WOLF RIVER EXPERIENCE, COUNTY A BRIDGE, SHAWANO, WI, AUGUST 1992. **Marian E. Havlik**, Malacological Consultants, La Crosse, WI 54601

FACTORS CONTRIBUTING TO FLUCTUATIONS IN BLUE-GREEN ALGAL ABUNDANCES IN A SHALLOW PRAIRIE LAKE. **Mark Lesinski** and David German, U.S. Fish and Wildlife Service, National Fisheries Research Center, La Crosse, WI 54602 and Water Resources Research Institute, South Dakota State University, Brookings, SD 57007

A SPATIAL ASSESSMENT OF FISH COLLECTION SITES IN POOL 8, UPPER MISSISSIPPI RIVER. **David McConville**, Department of Biology, Saint Mary's College of Minnesota, Winona, MN & USFWS, Environmental Management Technical Center, Onalaska, WI 54650

PRESETTLEMENT AND PRESENT FLOODPLAIN VEGETATION AT THE CONFLUENCE OF THE ILLINOIS AND MISSISSIPPI RIVERS. John Nelson[1], Anjela Redmond[1], Sara Rogers[2], and Richard Sparks[3], [1]Illinois Natural History Survey, Long Term Resource Monitoring Program, Pool 26 Field Station, P.O. Box 368, West Alton, MO 63386, [2]U.S. Fish & Wildlife Service, Environmental Management Technical Center, Onalaska, WI 54650 and [3]Illinois Natural History Survey, River Research Laboratory, Forbes Biological Station, P.O. Box 599, Havana, IL 62644

CUSTOM GRAPHICAL USER INTERFACES AS A MEANS TO SIMPLIFY THE USE OF HIGH END GEOGRAPHIC INFORMATION SYSTEM SOFTWARE. Douglas Olsen, U.S. Fish and Wildlife Service, Environmental Management Technical Center, 575 Lester Avenue, Onalaska, WI 54650

LONG TERM RESOURCE MONITORING PROGRAM, HAVANA FIELD STATION: A SOURCE OF INFORMATION. Susan Peitzmeier-Romano, K. Douglas Blodgett, Paul Raibley, Steven Stenzel, and Richard Sparks, Illinois Natural History Survey, Havana LTRMP Field Station, P.O. Box 546, Havana, IL 62644

AQUATIC PLANT INTRODUCTION AND NATURAL COLONIZATION - HIGHWAY 35 MITIGATION POND, POOL 8 UPPER MISSISSIPPI RIVER. James Ramsey, 2907 Holly Place, La Crosse, WI 54601

EFFECTS OF COMMON CARP AND OTHER FISH ON MACROINVERTEBRATES IN A MISSISSIPPI RIVER BACKWATER. Mark Rogaczewski[1] and Steve Gutreuter[2], [1]Department of Biology and Microbiology, University of Wisconsin-La Crosse, La Crosse, WI 54601 and [2]U.S. Fish & Wildlife Service, Environmental Management Technical Center, 575 Lester Avenue, Onalaska, WI 54650

THE VERTICAL DISTRIBUTION OF FOSSIL FINGERNAIL CLAMS IN SELECTED BACKWATER AREAS IN NAVIGATION POOL NO. 8, UPPER MISSISSIPPI RIVER. Aaron Schmidt, Pamela Vetter, and Thomas Claflin, Department of Biology and Microbiology, University of Wisconsin-La Crosse, La Crosse, WI 54601

MONITORING OF A SMALL MAN MADE WETLAND ON AN UPPER MISSISSIPPI ISLAND. Brad Stermer, Jason Hute, Marykay Tabor, and Judith Smith, Department of Biology/Environmental Science, University of Dubuque, Dubuque, IA 52001

PHOTOTROPIC RESPONSE OF LARVAL AND JUVENILE NORTHERN PIKE. Steven Zigler and Michael Dewey, U.S. Fish and Wildlife Service, National Fisheries Research Center, P.O. Box 818, La Crosse, WI 54602

MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.,
25TH ANNUAL MEETING
HOLIDAY INN, LA CROSSE, WISCONSIN

APRIL 22-23, 1993

ABSTRACTS OF PLATFORM PRESENTATIONS

(listed in order of presentation)

ECOLOGICAL ASSESSMENT OF CHANGES IN THE DISTRIBUTION AND SPECIES COMPOSITION OF SUBMERSED AQUATIC MACROPHYTES IN THE UPPER MISSISSIPPI RIVER. John W. Barko, Craig S. Smith, and Sara J. Rogers, Waterways Experiment Station, Vicksburg, MS 39180 and Environmental Management Technical Center, Onalaska, WI 54650

Major declines in submersed aquatic macrophyte communities, involving a variety of different species, have been reported worldwide. Factors proposed as contributing to these declines include: reduced irradiance at leaf surfaces, nutrient depletion, parasites and pathogens, toxin accumulation, grazing, insect herbivory, climatic fluctuations, competition, and other.

Of local concern in the Upper Mississippi River (UMR), *Vallisneria americana* declined rather abruptly following a prolonged period of drought in the late 1980's. Notably, the decline of *Vallisneria* in the UMR was paralleled by declines of several species in other major river systems of the USA. The contemporaneous nature of these declines nationwide suggests a widespread climatic effect, perhaps involving reproductive failure. However, the exact mechanisms resulting in aquatic macrophyte declines in the UMR remain unknown.

In concert with the decline of *Vallisneria*, *Myriophyllum spicatum* has expanded significantly in the UMR. This species is capable of growing very rapidly to problem levels. In addition, due to its purported negative impacts on water quality, fish and invertebrate habitat, and gamefish abundance, *Myriophyllum*, now abundant in the UMR, is another local concern.

The purpose of this presentation is to address objectively the loss of *Vallisneria* and encroachment by *Myriophyllum* in the UMR. Evidence is provided here and in the presentation of Rogers et al. (this meeting) that the availability of light to *Vallisneria* during the drought period may have been less important in its decline than other ecological factors. Furthermore, the presence of *Myriophyllum spicatum* in the UMR does not necessarily portend ecological doom.

APPLICATION OF THE MONOD MODEL TO THE SUBMERSED MACROPHYTE DECLINE IN THE UPPER MISSISSIPPI RIVER. John F. Sullivan, Wisconsin Department of Natural Resources, La Crosse, WI 54601

Submersed aquatic vegetation in the Wisconsin reach of the Upper Mississippi River declined very noticeably in the late 1980's. Light and nutrient availability are primary factors regulating plant productivity in aquatic systems. High turbidity or total suspended solids (TSS) concentrations may have a dramatic impact on light attenuation and may limit photosynthesis in riverine systems. Further, excessive suspended solids can cover plant surfaces also contributing to reduced photosynthetic activity. There is increasing evidence that the availability of nitrogen, obtained primarily from the sediment, may be critical in sustaining macrophyte growth in highly productive systems.

The Monod model has been used to predict the influence of nutrients and light on algal growth rates in various quality models for over 30 years. A form of the model has been applied to the Mississippi River for summer conditions (June-August). The model is based on main channel water quality information collected by Wisconsin and Minnesota between 1976 and 1992 for the reach extending from Alma to Lynxville, Wisconsin (Pools 4-9). The purpose of this model was to evaluate its general use in predicting the decline and recovery of aquatic macrophytes in this river reach. The model has the following form:

Light Limit. factor = (1 - (TSS / (Critical TSS + TSS)))

Nitrogen Limit. factor = (Inorg. N / (Critical N + Inorg. N))

Normally, phosphorus is an additional term used in a Monod equation to assess nutrient limitation. However, long term monitoring results indicated that dissolved ortho-P concentrations remained high during summer periods, especially during low flow periods. Therefore, a phosphorus limitation factor has not been utilized at this time. Critical TSS and inorganic nitrogen concentrations, 30 and 0.5 mg/l, respectively, were derived empirically from water quality conditions occurring in 1980-86, when macrophyte biomass was relatively high. A TSS concentration of 30 mg/l would be roughly equivalent to a compensation depth (1% of surface photosynthetically active radiation) of 1.25 m. The limitation factors (dimensionless) would range from 0 (complete limitation) to 1 (no limitation). Application of these two models to 17 years of water quality data are shown in Figures 1 and 2. A limitation factor below 0.5 implies TSS levels exceeding 30 mg/l or inorganic nitrogen levels less than 0.5 mg/l, thus impaired plant growth. A combined model (taking the minimum of the two models and applying a 3-year rolling average, Figure 3) is proposed as a means of looking at long term conditions influencing macrophyte productivity. The combined model seems to generally predict what has been observed with submersed macrophytes over the last 5 years. However, further testing and verification of this modeling approach is necessary to determine its validity.

SULLIVAN 1993

FIGURE 1. LIGHT LIMITATION MODEL
CRITICAL TSS = 30 mg/l

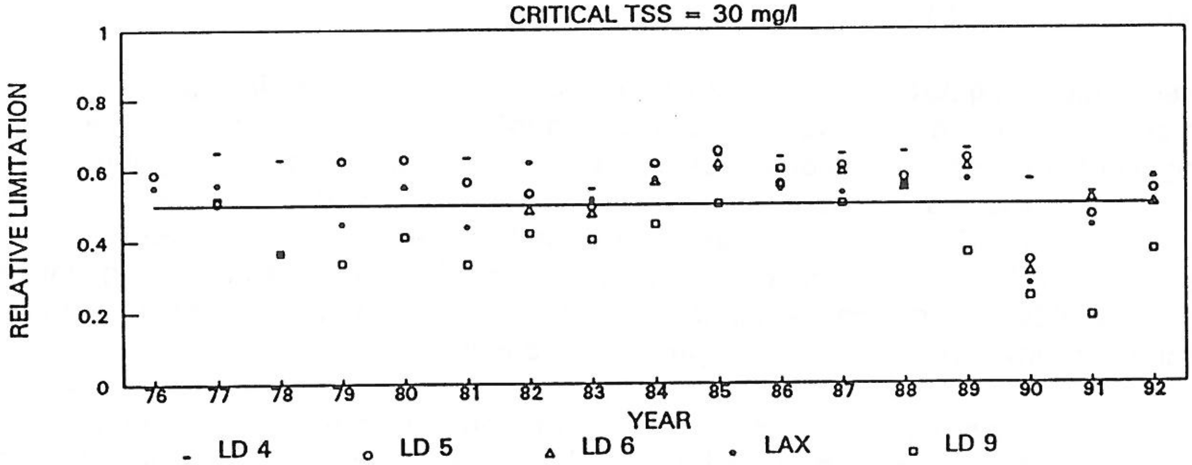


FIGURE 2. NITROGEN LIMITATION MODEL
CRITICAL INORGANIC N = 0.5 mg/l

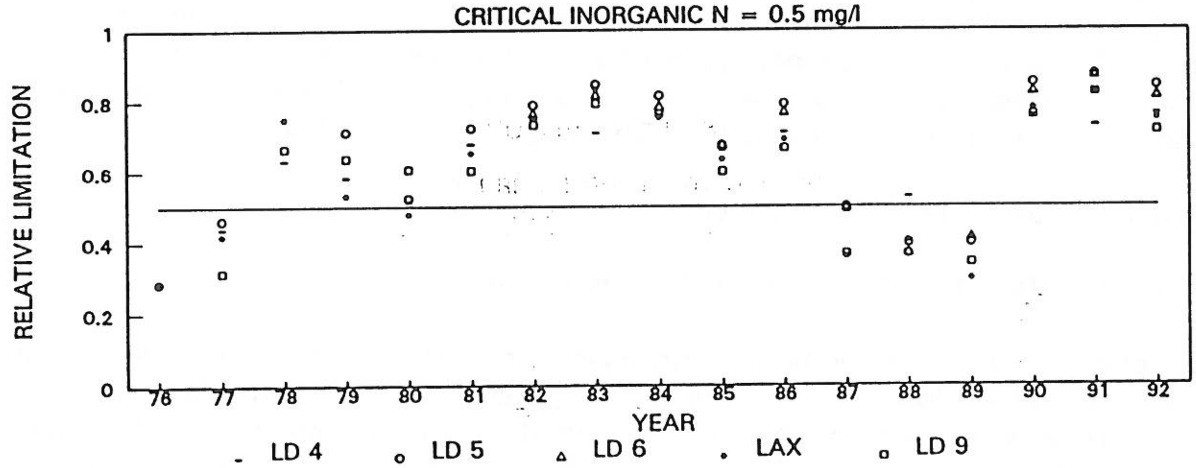
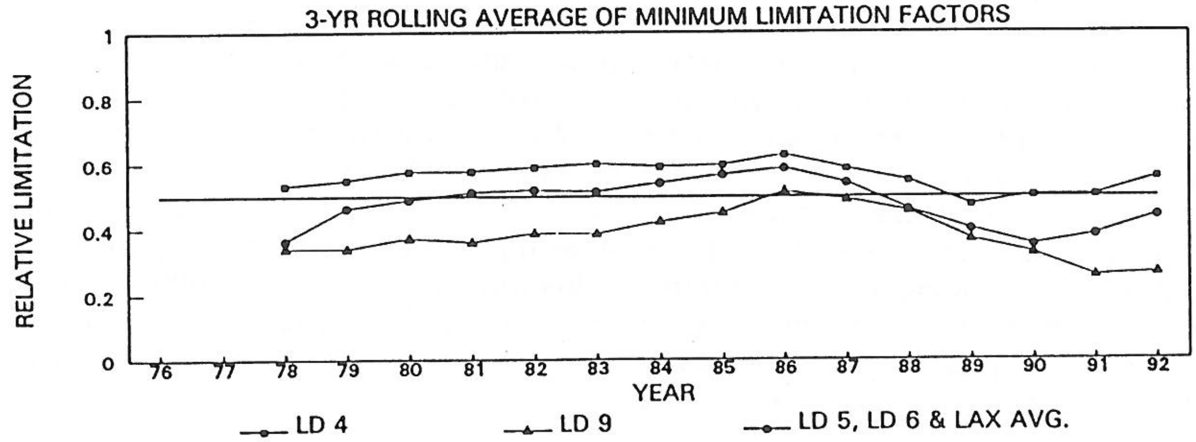


FIGURE 3. COMBINED LIGHT & NITROGEN LIMITATION MODEL
3-YR ROLLING AVERAGE OF MINIMUM LIMITATION FACTORS



THE EFFECTS OF MECHANICAL HARVESTING ON THE GROWTH OF PLANT COMMUNITIES DOMINATED BY EURASIAN WATERMILFOIL.
Wendy Crowell[1,2], Jim Perry[1], and LLoyd Queen[1], [1]Department of Forest Resources, University of Minnesota, St. Paul, MN 551081 and [2]USDI National Park Service, Spring Creek Field Laboratory, Marine On St. Croix, MN 55047

Eurasian watermilfoil *(Myriophyllum spicatum)* an exotic aquatic macrophyte is found in many lakes in the Mississippi River watershed. It has the potential to become an extreme nuisance to both recreation and navigation, and spreads easily by fragments. It was first found in Minnesota in 1987, in Excelsior Bay of Lake Minnetonka. Since that time it has spread to 54 lakes in Minnesota, as well as five pools on the Upper Mississippi River. Extensive mechanical harvesting has been used in Lake Minnetonka since 1989 to control nuisance levels of milfoil. We measured the effectiveness of one series of harvests in five separate locations in Lake Minnetonka. We found significantly higher plant growth rates in harvested areas compared to reference levels. However, harvested areas had significantly fewer stems at the surface and significantly lower total plant biomass compared with reference areas for six weeks after harvest. High biomass occurred most often in clearer water and in sediments which had higher percentages of organic matter.

EFFECTS OF COMMON CARP (*CYPRINUS CARPIO*) ON AQUATIC MACROPHYTES IN A BACKWATER LAKE IN THE UPPER MISSISSIPPI RIVER.
Steve Bellrichard[1], Steve Gutreuter[2], and Mark Sandheinrich[1], [1]River Studies Center, Department of Biology & Microbiology, University of Wisconsin-La Crosse, La Crosse, WI 54601 and [2]USFWS, Environmental Management Technical Center, Onalaska, WI 54650

Anecdotal evidence suggests that common carp *Cyprinus carpio* may decrease macrophyte density through its habits. However, few studies have determined the effects of different densities of common carp on macrophyte density. Twelve enclosures (25 m^2) were constructed in Lawrence Lake, a backwater lake in the upper Mississippi River, and stocked with 1 of 3 densities (0, 1, 10) of common carp greater than 17 cm TL. Total suspended solids (TSS), total volatile solids (TVS), turbidity, dissolved oxygen (DO), temperature, total phosphorus (TP) and chlorophyll a (Chl a) were measured in the 12 enclosures and 4 reference sites weekly from June 27 to August 11, 1992. The biomass of macrophytes in each enclosure and reference site was estimated before and after the experiment. Sample means of TSS and turbidity in enclosures with carp was greater than those without. Common carp had no effect on the sample means of TVS, TP, and Chl a. Common carp reduced the biomass of macrophytes in enclosures. These results demonstrate that carp do alter aquatic macrophyte density.

IMPROVING ELECTROFISHING BY STANDARDIZING POWER. Randy W. Burkhardt, U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, WI 54650

A standardized power (kW) output can improve consistency of electrofishing catch. Using the power transfer theory, a 3-kW power goal was adopted by the Long Term Resource Monitoring Program (LTRMP) to ensure constant effective power was transferred from the electrofishing boat to fish of a particular species and size. The desired power output is easily determined from conductivity and temperature measurements by using a power goal chart. The LTRMP conducted 492 electrofishing collections over four reaches of the Mississippi River and one of the Illinois River during 1990, capturing 15,290 fish. Catch per unit effort (CPUE) was plotted against the percent of power goal achieved during collection. Patterns in variation of CPUE were distinctive for some species at certain percentages of the power goal, and overall species catch showed more consistency near 100% of the power goal. The 3-kW power goal adopted by the LTRMP appears optimal for improving catch consistency of sampling in the Upper Mississippi River System. The use of a standardized power output appears to be an effective means for improving the consistency of electrofishing catches.

RANDOMIZATION AND CONTROL IN TREND AND RESPONSE MONITORING OF FISHES--STATISTICAL ISSUES MATTER. Steve Gutreuter, U.S. Fish & Wildlife Service, Environmental Management Technical Center, 575 Lester Avenue, Onalaska, WI 54650

The Long Term Resource Monitoring Program (LTRMP) is engaged in extensive trend monitoring and localized response monitoring in the Upper Mississippi River System. Historically, statistical issues have not received adequate attention in either monitoring endeavor, creating unnecessary constraints on interpretation of resulting data.

The original LTRMP system-wide trend monitoring design for fishes was based on fixed-site sampling, wherein non-randomly selected permanent sampling stations were monitored through time. Fixed-site sampling unnecessarily restricts valid inference to the specific sampling sites rather than supporting inference over a whole habitat class or study reach. Fixed site sampling is often justified on the supposition that variation among sites, even within a stratum, is greater than variation within specific sites, making it more "efficient" than stratified random sampling for detection of temporal trends. This notion of efficiency itself is false, and the supposition has not been critically tested. To examine this supposition, variance component analyses were conducted on 139 partitions of fish catch data obtained from four LTRMP study reaches. The partitions consisted of unique combinations of river reach, sampling gear, habitat class, season, and species. Variance within specific sites exceeded variance among sites in 53% of the partitions (Fig. 1). Among-site variation was not significantly greater than within-site variation. Therefore, conversion to stratified random sampling will expand the scope of inference without loss of precision.

Localized response monitoring efforts at habitat restoration and enhancement projects (HREPs) provide a second example of the importance of statistical issues. The objective of these efforts is to determine whether a particular action resulted in a change in some ecological feature. The question of uniqueness of a response to the HREP site has remained or will remain unanswered after too many evaluations. For example, a discussion erupted during the 1992 Annual Meeting of the Mississippi River Research Consortium regarding whether observed changes in the distribution and relative abundance of fishes in Weaver Bottoms were due to island construction or merely part of a broader change within Pool 4. Such questions can be answered by testing for interaction between time periods (before and after construction) and sites (HREP and one or more controls). A statistically significant interaction indicates that a unique change occurred at the HREP site. The use of appropriate monitoring designs and statistical analyses can insure that response evaluations yield interpretable results.

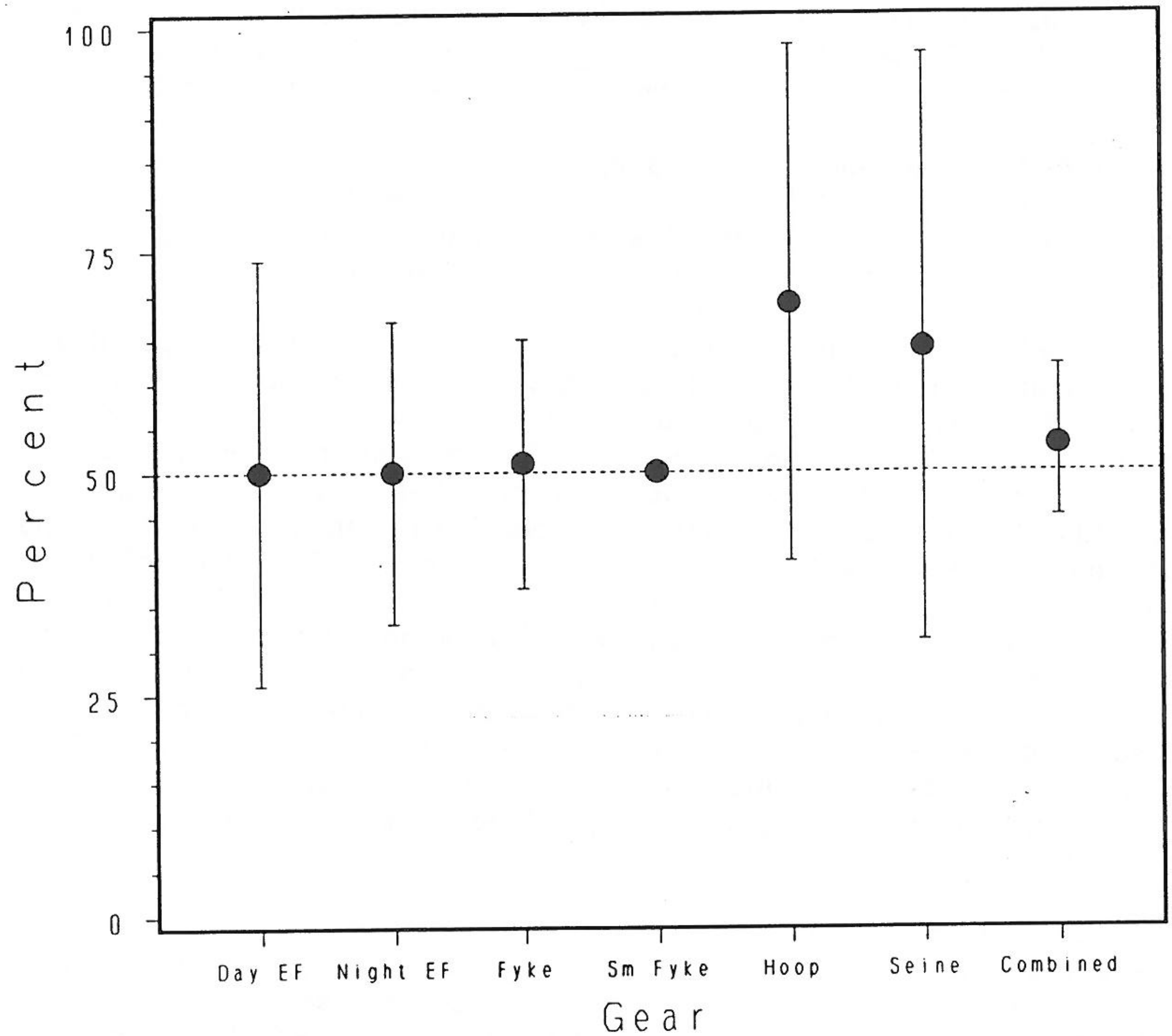


Fig. 1. Percentages of data partitions, based on unique combinations of species, study reach, habitat class and time period, in which among-site variation is less than or equal to within-site variation. The upper and lower bounds are 95% confidence intervals on the true percentage. Electrofishing is denoted EF; other gear types are fyke nets, small fyke nets, hoop nets, seines, and all gears combined.

ECOLOGY OF BOWFIN STOCKED INTO LAKE WINONA, MINNESOTA. Deena K. Spielman, Jason P. Harkins, and Neal D. Mundahl, Department of Biology, Winona State University, P.O. Box 5838, Winona, MN 55987

Adult bowfin (*Amia calva*) were introduced into Lake Winona, MN (initial density approximately 32 fish/hectare), from 1984-86 to control overabundant, stunted bluegill. Studies were undertaken during summer 1992 to assess bowfin abundance, distribution patterns, movements, and food habits in the lake's western basin (36 hectares). Preliminary laboratory studies also were conducted to examine the feeding rates of captive bowfin in pools containing artificial vegetation. Only adult bowfin (average age = 10 years, average weight = 3 kg) were captured in Lake Winona, and these were concentrated in or near dense *Ceratophyllum* beds. Straight-line distances moved by recaptured bowfin ranged from 76 to 731 m (average = 381 m). The final population estimate (± 95% CI) for bowfin in the west basin was 74 ± 42 fish (2 fish/hectare). Most bowfin (> 70%) consumed only age 3+ or older (> 12 cm TL) sunfish (probably bluegill). Captive bowfin captured an average of fewer than two bluegill per 24 hours, and were unsuccessful at capturing bluegill in pools lacking artificial vegetation. Bowfin in Lake Winona are feeding on older bluegill in or near dense weedbeds, but the apparent lack of natural reproduction by bowfin and the great reduction in their density during the past six years suggests that they may be ineffective in controlling the bluegill population.

CANVASBACK HUNTING MORTALITY AND HUNTER EDUCATION EFFORTS ON THE UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE, 1991-92. Carl E. Korschgen, and Kevin P. Kenow, Northern Prairie Wildlife Research Center, Section of Lake States Ecology, La Crosse, WI 54602; James Nissen, La Crosse District, Upper Mississippi River Wildlife and Fish Refuge, La Crosse, WI 54601; and John Wetzel, Wisconsin Department of Natural Resources, La Crosse, WI 54601

Canvasback (*Aythya valisineria*) mortality attributed to hunting in Navigation Pools 7 and 8 of the Upper Mississippi River was considered excessive by U.S. Fish and Wildlife Service (FWS) and Wisconsin Department of Natural Resources (WDNR) law enforcement personnel during the 1989 duck hunting season. The problem was exacerbated by a noticeable river-wide decline in the distribution and availability of wildcelery (*Vallisneria americana*), an important food source for migrating canvasbacks. Canvasbacks fed on alternative foods in shallow backwater marshes as a result of the decline in wildcelery tuber densities. Movement of canvasbacks into backwater areas brought them in proximity to waterfowl hunters who were not accustomed to seeing canvasbacks in this habitat and subsequently had trouble identifying the birds.

Prior to the 1990-92 hunting seasons, federal and state law enforcement and management personnel along with area waterfowlers joined forces to educate hunters on canvasback identification and to apprise them of the canvasback situation on the river through information leaflets, warning signs, media interviews, and waterfowl identification and information workshops.

Law enforcement during the 1990-92 waterfowl seasons was also increased. In 1990, the groundwork was laid initially for temporary closures of duck hunting in areas where canvasback mortality was deemed excessive or law enforcement was no longer a deterrent. In response, the need to quantify the number of attempts by hunters to take canvasbacks was identified.

A hunter monitoring program was implemented in 1991-92 to quantify the number of attempts by hunters to take canvasbacks and determine how well the hunter education and law enforcement programs were working to reduce canvasback mortality. Law enforcement personnel monitored the actions of hunting parties throughout the duck hunting season in a study area established within Lake Onalaska. Boat observations and vehicle counts were used to assess hunting pressure on the study area.

Law enforcement officers observed 266 parties on Lake Onalaska for 426 hours during the 1991-92 hunting seasons (Table 1). A total of 208 canvasback flocks flew within shooting distance. Canvasbacks were usually encountered by hunters as singles, doubles, or mixed with other species of ducks. Forty (%) of the parties with canvasback encounters shot at the birds (Figure 1). Hunting parties attempted to take canvasbacks on 56 occasions (27%) while under observation during the two waterfowl seasons. Eleven canvasbacks were observed shot down as a result of the 56 attempts observed. An estimated 4,172 hunting parties contributed 14,292 hunter-hours of hunting pressure within the Lake Onalaska study area during the two hunting seasons.

We used a ratio estimator to compute the total number of attempts at canvasbacks on the Lake Onalaska study area. The estimated number of attempts at canvasbacks on the study area was 790 ± 376 ($\bar{x}$ ± 95% confidence interval) during 1991 and 870 ± 405 during 1992. Mortality of canvasbacks, excluding crippling loss, was estimated to be 128 ± 128 in the study area during 1991 and 172 ± 155 during 1992.

Table 1. Numbers of canvasback encounters, attempts, and downed by hunters as observed by law enforcement personnel within the Lake Onalaska study area on Pool 7 of the Upper Mississippi River, 1991-92.

LOCATION	NUMBER OF PARTIES OBSERVED	NUMBER OF CANVASBACK ENCOUNTERS	NUMBER OF ATTEMPTS AT CANVASBACK	NUMBER OF CANVASBACK DOWNED
1991				
FIRING LINE	51	66	18	3
BEHIND LINE	54	53	11	2
OTHER	2	1	0	0
TOTAL	107	120	29	5
1992				
FIRING LINE	65	32	10	2
BEHIND LINE	91	56	17	4
OTHER	3	0	0	0
TOTAL	159	88	27	6

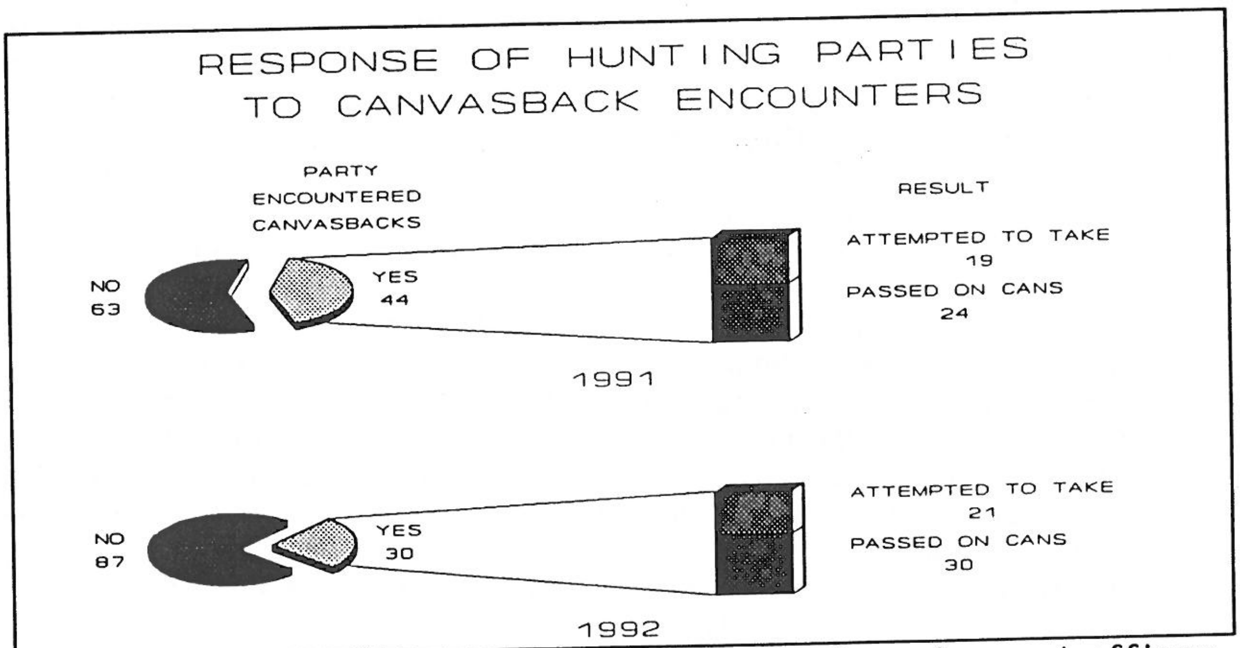


Figure 1. Response of hunting parties observed by law enforcement officers to canvasback encounters on the Lake Onalaska study area, Pool 7 of the Upper Mississippi River during 1991-92.

SEASONAL PASSAGE OF NEARCTIC-NEOTROPICAL MIGRATING BIRDS ALONG THE SAINT CROIX RIVER. A. R. Weisbrod[1,2], Dwain W. Warner[2], and Wendy Crowell[1], [1]Spring Creek Field Laboratory, USDI National Park Service, Marine On St. Croix, MN 55047 and [2]Bell Museum of Natural History, University of Minnesota, Minneapolis, MN 55455

During spring and fall migration periods of 1984 through 1987 we used 60 mist nets set in five habitats at each of two sites Valley Creek, St Croix R Km 19, and Sandrock Cliffs, St Croix R Km 146, to capture migrating birds. This labor intensive effort was conducted with the aid of over 120 volunteer bird banders who operated nets over 305,000 net-hours during the four year period to capture 33546 birds representing 124 species. Nearctic-neotropic migrants comprised about two thirds of all species, and at Sandrock Cliffs they comprised a majority of individuals taken in spring (82%), in autumn (69%) and overall (73%). We estimated migration timing, using median capture dates, for all species in which ≥ 10 individuals were captured over the study period at a single location. Nearctic-neotropic migrants averaged 15 weeks between each species spring and fall median capture dates, arriving later in spring and departing earlier in fall than temperate migrants. The latter species spend about 20 weeks elsewhere between spring and fall median capture dates. Five habitats at the Sandrock Cliffs location showed differences in spring and fall capture rates suggesting birds shift habitat use seasonally. There were also consistent seasonal differences in abundance for some species, probably reflecting divergent spring and fall migration routes for these species. These differences in seasonal habitat use and migration routes are important considerations in the conservation of long distance migrating birds.

USING POST-RELEASE STRATIFICATION TO DETECT HETEROGENEITY IN MALLARD SURVIVAL. Larkin A. Powell and William R. Clark, Department of Animal Ecology, Iowa State University, Ames, IA 50011 and Erwin E. Klaas, Iowa Cooperative Fish and Wildlife Research Unit, Iowa State University, Ames, IA 50011

Recovery data analysis methods of Brownie et al. (1985) assume that all individuals in a banded sample have the same probability of survival and recovery, but frequently there are reasons to doubt the validity of this assumption. We applied post-release stratification, developed by Schwarz et al. (1988), to 25 years of banding data from four banding reference areas in the prairie pothole region. Our goal was to determine its utility in detecting survival and recovery rate heterogeneity among mallards recovered along the Upper Mississippi River (UMR) and elsewhere in the central U.S. We stratified the recoveries according to four recovery strata: (1) UMR, (2) UMR-vicinity, (3) Lower Mississippi River, and (4) Southern Plains. We used the models of Schwarz et. al (1988) to estimate survival rates for mallards recovered in each of these strata. Only 10.9% of the tests between recovery strata rejected homogeneous annual survival models in favor of heterogeneous annual survival models. Regional stratification reduced data sets to a size which limited the effectiveness of post-release stratification. We conclude that there is no reason to abandon earlier estimates of average survival rates of mallards using the UMR region calculated by the methods of Brownie et al. (1985).

HABITAT REHABILITATION AND ENHANCEMENT PROJECTS: A MID-PROGRAM REVIEW.

Charles H. Theiling and Richard E. Sparks, Illinois Natural History Survey - LTRMP Pool 26, P.O. Box 368, West Alton, MO 63386

The 15 year, $289 million Environmental Management Program (EMP) for the Upper Mississippi River System (UMRS) was established by the Water Resources Development Acts (WRDA) of 1986 and 1990. Approximately $189 million is targeted for Habitat Rehabilitation and Enhancement Projects (HREP), $91 million for the Long Term Resource Monitoring Program (LTRMP) with the remainder devoted to recreation studies and navigation traffic monitoring.

HREPs primarily target off-channel habitats which have been degraded by sedimentation and associated problems. They fall into three broad categories: those that increase connectivity with the main channel, those that isolate backwaters from the main channel and those that transform or convert off-channel habitat. An example of projects increasing backwater/river connectivity is the Finger Lakes project in Minnesota. Examples of projects which isolate backwaters are the Weaver Bottoms project in Minnesota (non-EMP) and Swan Lake on the Illinois River. Projects which transform off-channel habitat are island building projects, habitat conversion projects are represented by Pharrs Island in Missouri.

Given three distinctly different approaches among HREPs, it is difficult to distinguish goals common to all projects. Most projects are directed toward the management of select groups of game species, each having unique ecological needs. We must clearly define our natural resource management strategies, recognizing that there are many competing interests seeking limited resources, and develop projects which maximize benefits for all interests. There are also questions as to what reference time period rehabilitation efforts should be striving to recreate or preserve (pre-dam or early post-dam). Finally, we must have clearly defined criteria to determine the success or failure of the projects. Each project should receive monitoring of pre- and post-project physical *and* biological resources so future monitoring efforts can build on the experiences of today.

Since the conception of most projects new theories regarding large river-floodplain ecosystems functioning have been accepted by river researchers and managers. The flood pulse concept states "the principle driving force responsible for the existence, productivity and interactions of the major biota in river-floodplain ecosystems is the flood pulse". The hydrology of the UMRS was greatly modified by the construction of the Lock and Dam system. Water elevations were raised following dam construction and created large amounts of new aquatic habitat. Also, low flow water elevations are maintained at artificially high levels which prevent periodic drying of backwaters. Such hydrologic perturbations caused many of the problems experienced in the UMRS today.

We believe it is time to reexamine the rational driving the development of HREPs throughout the UMRS. We must consider new information derived from project monitoring efforts and LTRMP studies and strive to fill information gaps. We must also make wise decisions regarding the future of the river and its' resources. We can take a systems approach toward restoration (restoration of the natural hydrologic cycle) or we can make piecemeal attempts at discrete sites to maximize production of select game species. We suggest the former approach as it is most likely to produce long lasting benefits for the broadest array of riverine flora and fauna.

WHAT ARE THE BEST AND WORST APPROACHES TO RESTORE THE NATURAL FUNCTIONING OF LARGE RIVER-FLOODPLAIN ECOSYSTEMS? Peter B. Bayley, Illinois Natural History Survey, 172 Natural Resources Building, 607 E. Peabody, Champaign, IL 61820

Restoration is a popular buzz word, but interpretations differ greatly among ecologists, engineers, and managers of specific resources. If the real cost of environmental alteration in the past and future is going to be included in economic evaluations, restoration must be in a direction towards natural functioning of the system. This is particularly true for river-floodplain systems, because their natural functions do enhance productivity of resources that are currently valued by man.

With few exceptions, large rivers are intimately associated with floodplains. In their natural condition, floodplains are dependent on the main channel hydrologically, but less obviously, the main channel is dependent on the floodplain in terms of most of the biota. The latter perspective, as a part of the flood pulse concept, contrasts with the view of the floodplain acting like an enlarged riparian zone, which has understandably been influenced by experiences in degraded temperate systems. The flood pulse concept also contrasts with the stream continuum concept. In a natural system, the floodplain normally receives a regular, extended pulse of water which results in high productivity in the aquatic as well as the terrestrial phase. The biota show adaptations to this hydrologic regime, such as fish using the main channel as a refuge during low water and floodplain habitats as feeding grounds for young and adults. Going downstream, as floodplains develop with increasing discharge and decreasing gradient, the longitudinal processes of the continuum concept in the main channel become secondary to lateral, batch processes in the adjacent floodplain which control production and community structure.

Therefore, any restoration project must be centered on a reasonable approximation of the natural flooding process on an appropriate scale. Current restoration projects are going in the opposite direction, because they are artificially separating the fauna of interest from the bad effects of an altered hydrologic regime instead of improving the hydrology and winning back the natural floodplain. Moreover, current projects are like aquaculture projects in that they are expensive to build and maintain per unit area, and they result in conflicts among managers and users with interests in different resources, such as fish and wildfowl.

LIMNOLOGY OF HABITAT REHABILITATION IN THE FINGER LAKES. David M. Soballe[1], William James[2], Robert F. Gaugush[1], and John Barko[1]. [1]EMTC, Onalaska, WI and [2]WES Eau Galle Limnological Laboratory, Spring Valley, WI 54767

The Environmental Management Program (EMP) for the Upper Mississippi River is sponsoring habitat rehabilitation and enhancement projects (HREPs) at selected sites along the River to improve conditions for fish and wildlife. One of these HREPs is the Finger Lakes Project, near Wabasha, Minnesota, which hopes to enhance water quality in an interconnected complex of backwater lakes by manipulating the volume, timing, and routing of river-water diversions through the lake complex. Of particular concern are the trade-offs between suitable water temperatures, flow velocity, and dissolved oxygen during the period of ice cover. In this presentation, we discuss the limnological and hydraulic aspects of the project, and summarize the limnological information obtained thus far.

RIVERS CURRICULUM PROJECT. Al Schutima, Fulton High School, 1207 12th Street, Fulton, IL 61252, Bernie Hermanson, Sumner High School, 802 W. 6th Street, Sumner, IA, 50674, Dr. Robert Williams, Project Advisor, and Cynthia Bidlack, Project Coordinator, Rivers Curriculum Project, Southern Illinois University, Box 2222, Edwardsville, IL 62026

The Illinois Rivers Project began in February, 1990 as a pilot program involving eight high schools along the Mississippi and lower Illinois Rivers. With scientific literacy as the ultimate goal of the Project, students from each of the participating schools collected and analyzed water samples from various test sites along both rivers. The study of the rivers was extended to include historical, social and/or economic implications of the state of the rivers, thus involving students from classes across the curricular areas of science, social studies, and English. SOILED NET, a telecommunication network linking all of the participating schools with each other and the Project headquarters, provides a technological framework for many of the Project's activities.

The Rivers Project Network has grown to include 157 schools in a six state region. Funding has come from a variety of sources: Illinois State Board of Education Scientific Literacy program, U.S. Fish and Wildlife Service, Illinois Board of Higher Education, Dwight D. Eisenhower Title II Program, National Science Foundation, and Illinois Bell. The Illinois Department of Energy and Natural Resources and Illinois Bell have both provided funding for the production of the Project's student-authored publication, *Meanderings*.

Meanderings and the Project newsletter, the *River Watchers' Log*, provide the opportunity for students to have their work published. From their study of the river and their surrounding communities, scientifically and otherwise, students produced reports, articles, essays, and creative writings. The best of the written materials were compiled into regional editions of Meanderings '92. To date, ten editions of student writings have been published. Students are also invited to submit articles for publication in the newsletter.

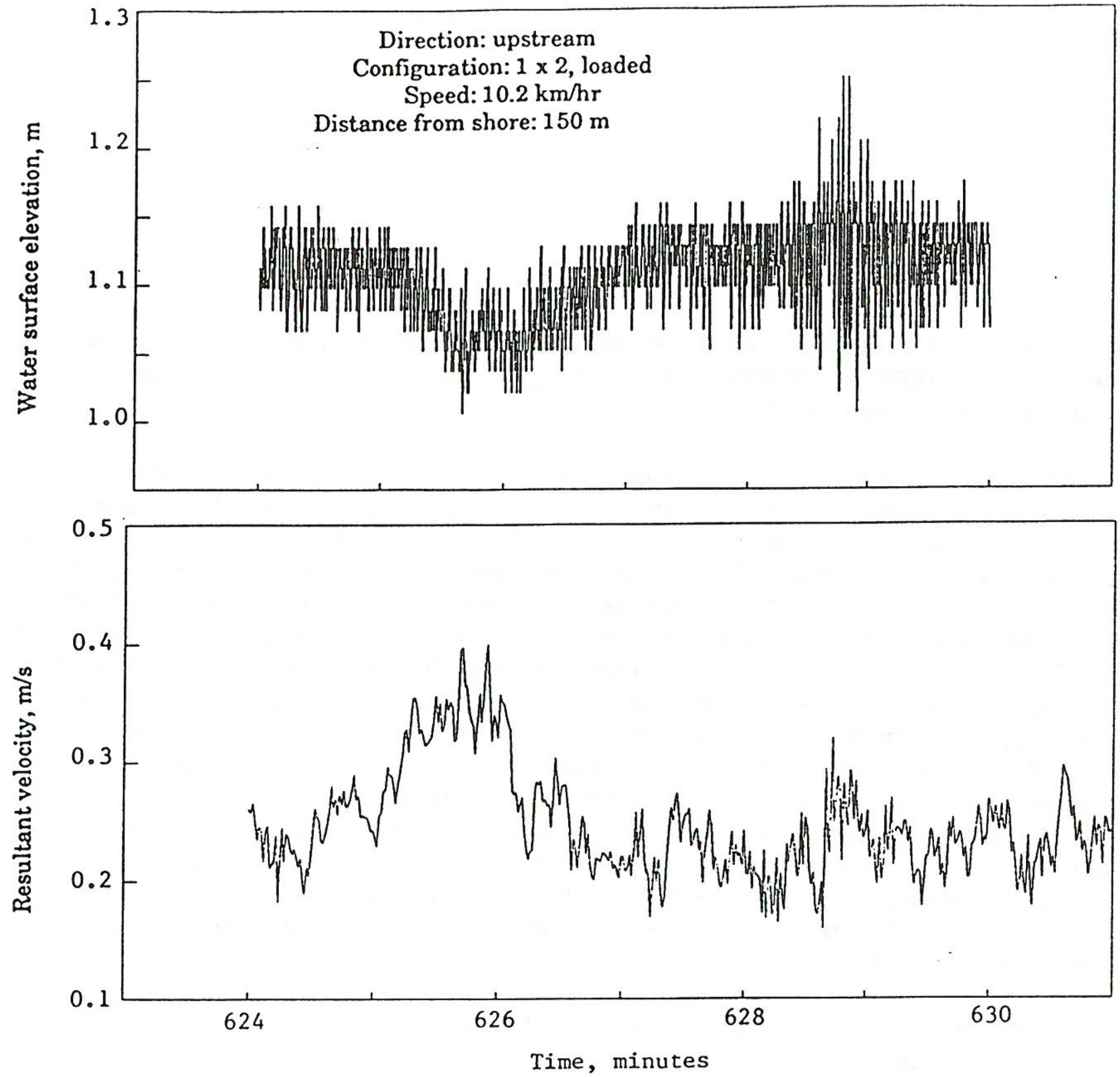
The Project held its Second Annual Illinois Rivers Project Student Congress in March, 1992. Students from 52 high schools in Illinois gathered in Peoria to share with each other the ideas and experiences gained as a result of their participation in the Project. Topics ranged from the scientific (water quality data) to the historic (slide presentations of local history) to the creative (original music and puppet shows). Response to the Congress was enthusiastic; plans are already in progress for next year's event.

Two major projects continue to develop. A National Science Foundation grant has allowed the Project to develop a formal "Rivers Curriculum" in the areas of chemistry, biology, geology, geography and language arts that will be applicable to any river in the world. A group of teacher/writers and content specialists gathered in August, 1991, to draft the curriculum. The Project sponsored a River's Curriculum Training Session in August of 1992 for 99 interested teachers. A second Rivers Curriculum Training Session will be offered in August of 1993. A cooperative effort has been undertaken with the Illinois Natural History Survey and the University of Illinois' Water Resources Center to help monitor the Zebra Mussel as it enters the Midwest. Each school received 2 monitoring devices through a grant from the Illinois-Indiana Sea-Grant Program. Participating schools will continue to monitor the water quality in their respective areas. The data collected will be transmitted to the Environmental Management Technical Center (a division of the U.S. Fish and Wildlife Service) in Onalaska, Wisconsin.

CHARACTERISTICS OF WAVES AND DRAWDOWN GENERATED BY BARGE TRAFFIC ON THE UPPER MISSISSIPPI RIVER SYSTEM. Ta Wei Soong and Nani G. Bhowmik, Illinois State Water Survey, Champaign, IL 61820

Waves and drawdown are two physical phenomena that are induced by vessels' movements. In the Upper Mississippi River System (UMRS), larger vessels like barge-tows are maneuvering in restricted waterways, thus amplifying the magnitudes of waves and drawdown for a longer duration. The Illinois State Water Survey (ISWS) research team has conducted an investigation on physical forces associated with barge traffic on the UMRS for the past three years and has found that waves and drawdown are major causes for disturbed turbidity levels in the nearshore zones. Increased turbidity levels can be detrimental to aquatic habitat. Figure 1 illustrates the correlation among local water surface fluctuations, local velocity, and turbidity level when the tow *Nicole Brent* passed the Kampsville site on the Illinois River. The wave gage, current meter, and the turbidity intake were all located within 10 m from the shore, and turbidity and currents were both measured at 0.25 m above the river bottom. Clearly, the figure shows that drawdown induces the largest velocity changes and waves can induce even steeper local velocity variations. Even though the turbidity measurements were averaged over a one-minute interval while waves and velocity were measured at 0.1 and 1 second, respectively, the comparisons clearly showed the interrelationship of these three parameters.

Barge-induced waves and drawdown can be affected by variables in four categories: 1) barge configurations (type, loading, and grouping); 2) maneuvering characteristics (speed, direction, and distance); 3) local geomorphology (cross-sectional depth, width, and shape, as well as reach meandering); and 4) local flow characteristics (discharge and ambient flow velocity). On the basis of data collected from 77 events at several sites along the Illinois and Mississippi Rivers, the maximum wave height was found to vary between 0.025 and 0.35 m, with the most frequent occurrence at 0.05 m. Similarly, the maximum drawdown ranged from 0.025 to 0.3 m, with most frequent occurrence at 0.05 m. Currently the ISWS team is investigating the mechanisms and factors for creating large waves and drawdown on the UMRS. However, they have found that there appears to be a stronger correlation between the blocking ratio, length, speed, and distance with the magnitudes than with the other variables.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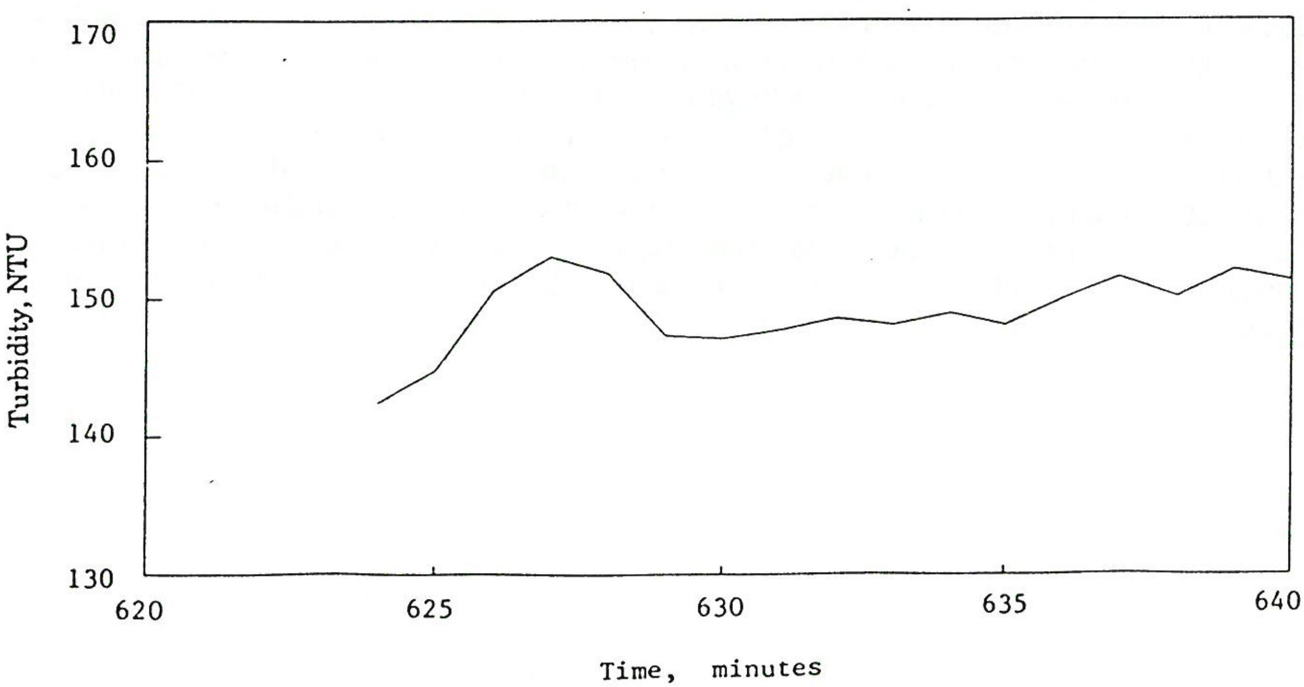
Configuration: 1 x 2, loaded
Speed: 10.2 km/hr
Distance from shore: 150 m
Water surface elevation, m
1.3
1.2
1.1
1.0
Resultant velocity, m/s
0.5
0.4
0.3
0.2
0.1
624
626
628
630
Time, minutes


Turbidity, NTU
170
160
150
140
130
620
625
630
635
640
Time, minutes

EFFECTS OF NAVIGATION DAMS ON WATER REGIMES: HYDROLOGIC CHANGES AT NAVIGATION POOL 26, MISSISSIPPI RIVER. John C. Nelson, Charles H. Theiling, and Richard E. Sparks, Illinois Natural History Survey, Long Term Resource Monitoring Program, Pool 26 Field Station, P.O. Box 368, West Alton, MO 63386

The annual hydrograph of a natural or undisturbed temperate large floodplain river system is characterized by a seasonal flood pulse. Normally, flooding expands main river channels into backwater and floodplain habitats. The degree of annual spatial and temporal expansion of aquatic habitats is an important factor regulating ecosystem productivity, community composition, and energy pathways. Like many rivers worldwide, hydrologic patterns within the Upper Mississippi River system have been severely altered by the construction and operation of navigation dams.

We assessed hydrologic changes at navigation Pool 26 resulting from impoundment and dam operating procedures that utilize a mid-pool control point (Fig. 1). Analysis of the 74-year record of daily water levels indicate that completion of Lock and Dam 26 in 1938 significantly increased ($P<0.05$) mean low, mean high and overall mean water levels (Fig. 2). Mean and minimum daily water levels were more constant in the postdam era, and the seasonal flood pulse more attenuated (Fig. 3). Constancy accounted for 76 percent of the postdam predictability of 0.91 (*sensu* Colwell, 1974, where predictability, P, ranges from 0, completely random, to 1.00, completely predictable), whereas seasonal periodicity accounted for 69 percent of the predam P of 0.70 (Table 1). Postdam seasonal flood pulse amplitudes increased with distance upstream from the dam. Close to the dam the flood pulse was actually inverted: water levels dropped as flow increased (Fig. 4). Some implications of these hydrologic changes are: 1) reductions in spatial and temporal availability of floodplain habitats to riverine organisms, 2) abrupt water level changes in lower pool reaches during critical life stages of some river fishes, and 3) artificially low river stages in middle and lower pool reaches that encourage floodplain development and result in greater economic losses when inevitable high flows occur. These adverse hydrologic conditions could be alleviated by moving water level control points from mid-pool sites to the dam and formulating water level management strategies that mimic the natural hydrologic regime.

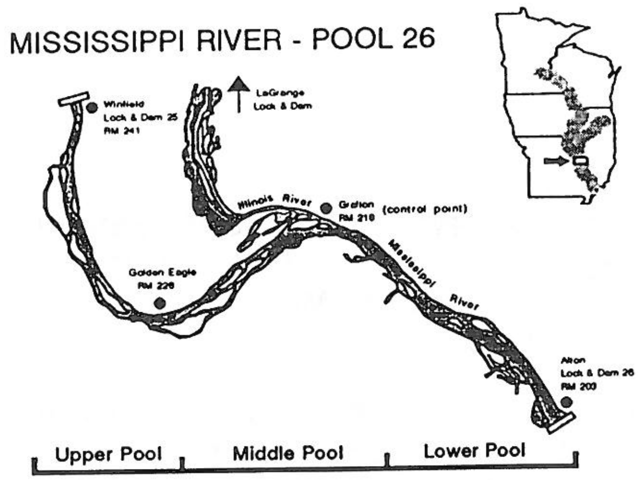


Figure 1: Diagram of Pool 26 and gage locations.

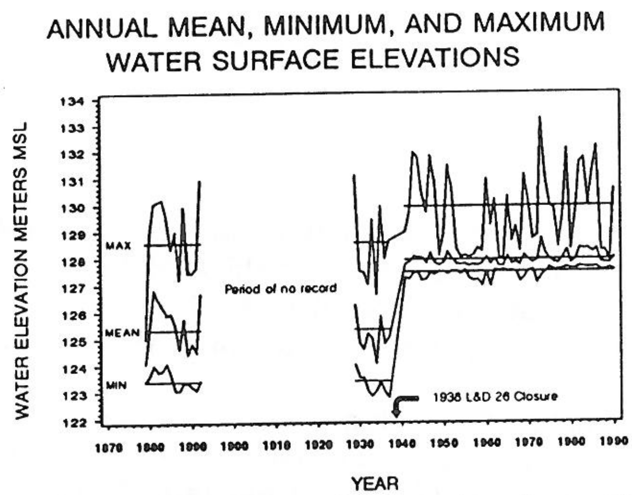


Figure 2: Annual mean, minimum and maximum water surface elevations recorded at the Grafton gage. Horizontal lines indicate averages of overall mean, minimum and maximum elevations for predam and postdam periods.

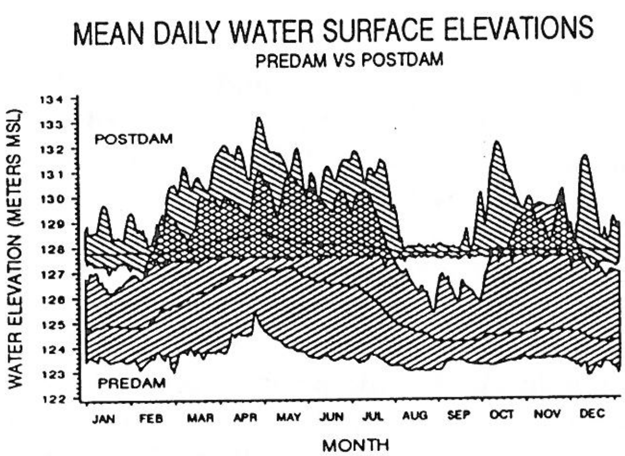


Figure 3: Generalized annual hydrographs for predam (N=23 years) and postdam (N=50 years) periods at the Grafton gage. Shaded areas indicate minimum and maximum recorded elevations.

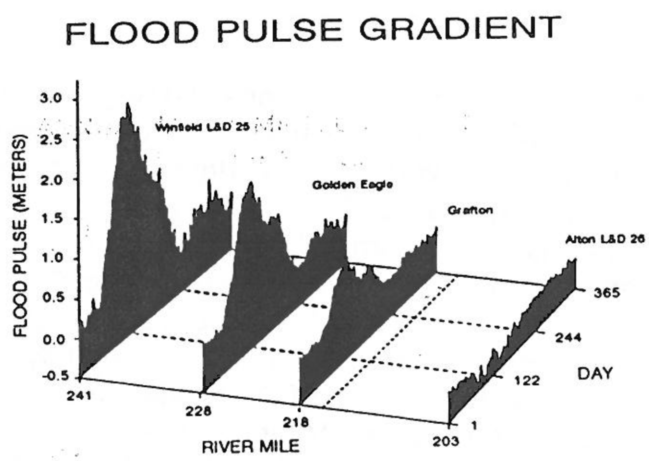


Figure 4: Mean annual hydrographs of the postdam period from four gage stations plotted by river mile.

Predam and Postdam Measures of Predictability

	Mean			Maximum			Minimum		
	Predam	Postdam	Change	Predam	Postdam	Change	Predam	Postdam	Change
Predictability (P)	0.70	0.91	+ 0.21	0.43	0.40	- 0.03	0.70	0.88	+ 0.18
Constancy (C)	0.22	0.69	+ 0.47	0.06	0.07	+ 0.01	0.41	0.76	+ 0.35
Contingency (M)	0.48	0.22	- 0.26	0.37	0.33	- 0.04	0.29	0.12	- 0.17
C/P	0.31	0.76	+ 0.45	0.14	0.18	+ 0.04	0.59	0.86	+ 0.27
M/P	0.69	0.24	- 0.45	0.86	0.82	- 0.04	0.41	0.14	- 0.27

Table 1: Predam and postdam measures of predictability as determined from overall mean, minimum, and maximum water surface elevations at the Grafton gage.

WATER INJECTION DREDGING DEMONSTRATION PROJECT. Teri Sardinas, St. Paul District, U.S. Army Corps of Engineers, Planning Division, Environmental Resources, 180 East Kellogg Boulevard, Room 1421, St. Paul, MN 55101, Mr. Jim Clausner, Mr. Dennis Brandon, Mr. Tim Welp, and Mr. Darryl Bishop, U.S. Army Corps of Engineers Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39180

As part of the operation and maintenance of the nine-foot channel, the St. Paul District participates in the Corps of Engineers Dredging Research Program. In July and August of 1992, water injection dredging was demonstrated at two sites on the Upper Mississippi River, at a "crossing" or thalweg site in the St. Paul District at the Lower Zumbro dredge cut near Weaver Bottoms, and at a "point bar" site in the Rock Island District near Savanna, Illinois. During water injection dredging, vessel-mounted pumps inject water directly into the sediment voids through relatively low-pressure jets mounted on a horizontal pipe. The sediment becomes fluidized, forming a quicksand-like layer that moves with gravity downslope into deeper water.

A monitoring program was developed for the St. Paul District site that included pre-, during and post-project monitoring. Before the demonstration began, the area was surveyed for mussels, and bathymetry was used to define the dredge cut and downstream area where material was expected to be deposited. Side-scan sonar was used to identify changes in benthic morphology, sediment samples were taken and current and turbidity meters were used to define existing conditions. During dredging, turbidity measurements and side-scan sonar were used in an unsuccessful attempt to locate the plume of fluidized material. Water samples were collected at various places and times and later analyzed for total suspended solids and particle size, the latter using a laser particle counter. Post-project, side-scan sonar and bathymetric data were gathered, and additional sediment samples were taken. Bathymetric data were gathered in the fall of 1992 and will be gathered in the spring of 1993, as will side-scan sonar data.

As noted above, the turbidity meter and side-scan sonar were not able to detect the location of the fluidized material during dredging. Total suspended solids analysis showed that the material remained close to the river bottom immediately downstream of the dredge, but was affected by the pushboat propeller and rudder. Farther downstream, initial results show little change in the amount of total suspended solids found in the water column. Bathymetric data is being analyzed to determine the quantity of and location of material moved as a result of the dredging.

SPATIAL AND TEMPORAL VARIATIONS IN WATER LEVEL FLUCTUATIONS IN THE UPPER MISSISSIPPI RIVER.

Joseph H. Wlosinski and Lara Hill, U.S. Fish and Wildlife Service, Environmental Management Technical Center, 575 Lester Avenue, Onalaska, WI 54650

Variations in water level fluctuations were investigated for over 115 gages located on the main stem of the Upper Mississippi River between river miles 2 to 854. Yearly fluctuations, calculated from the highest and lowest reading for a station for the year, were based on data collected daily between 1972 and 1990. A positive relationship was found as a function of location within a pool, with fluctuations averaging 11.3 feet for all tailwaters to 4.4 feet just above the dams. Among pools, tailwater fluctuations generally increased from north too south, from approximately 6 feet to 20 feet. Fluctuations also increased in a southerly direction for gages just above the dams, although the relationship was not as strong. Different management schemes among pools may have confounded results at the dams. In the open river, yearly fluctuations averaged 29.3 feet over a 19 year period for 23 gages.

Daily fluctuations were investigated using data from 1990. Daily values were obtained by subtracting the reading taken at approximately 6:00 AM on consecutive days. The same relationships were found for daily fluctuations among pools as were found for yearly fluctuations. In the tailwaters, daily fluctuations from north to south varied from approximately 0.2 feet to 0.5 feet. Average daily fluctuations above the dams were around 0.2 feet.

TRANSPORT OF SUSPENDED ORGANIC MATTER IN THE MISSISSIPPI RIVER.

J. A. Leenheer and C. E. Rostad, Water Resources Division, U.S. Geological Survey, Denver, Colorado 80225

Suspended sediment, sampled at 17 sites along the Mississippi River and major tributaries between St. Louis and New Orleans, Louisiana, during 7 sampling cruises during 1987-1990, and at an additional 9 sites between Minneapolis and St. Louis during 3 sampling cruises during 1991-1992, was fractionated aboard ship into sand, silt, and colloid fractions by a combination of sieving, continuous-flow centrifugation, and tangential-flow ultrafiltration. The colloid fraction ranged from 1.3 to 38% of the combined suspended silt and colloid fractions, and the organic-carbon load of the colloid fraction ranged from 5.6 to 58% of the organic-carbon load of the combined silt and colloid fractions. Computation and tracking of suspended sediment-fraction loads from tributaries (Illinois, Missouri, Ohio, and Arkansas Rivers) revealed that neither the mass of silt nor colloid were transported conservatively. The mass of organic carbon associated with the colloid fraction, however, was transported conservatively even through the navigation pools of the upper river, whereas the mass of organic carbon associated with silt decreased during transport. Organic matter in colloid fractions might prevent selective colloids from aggregating into larger size particles that settle from the water column during transport.

DISTRIBUTION OF ORGANIC CARBON IN THE MISSISSIPPI RIVER: COMPARISON OF SILT AND COLLOIDAL TRANSPORT. Colleen E. Rostad and Stephanie G. Monsterleet, U.S. Geological Survey, 5293 Ward Road, Arvada, CO 80002

Suspended sediment, a mode of transport for toxic hydrophobic organic compounds, was isolated from 16 sites on the Mississippi River and its major tributaries, in July-August and October-November 1991 and April-May 1992. After silt (<63 μm) was isolated by centrifugation, colloidal organic material was isolated by ultrafiltration. Colloids were about 10 percent by weight of the suspended material in summer. In the fall, they increased to 20 percent at most sites and 35 percent at two Upper Mississippi River sites. In spring, the colloid portion remained high on the upper river, but decreased to 5 percent on the lower river. Organic carbon on the silt is consistently lower (2 to 5 percent) than on the colloids (7 to 30 percent). The proportion of organic carbon transport during summer on the colloids averaged 35 percent at most sites and exceeded 50 percent at two sites. Because hydrophobic compounds partition into organic carbon, colloidal transport of pollutants may be as important as silt transport in the Mississippi River.

HALOGENATED ORGANIC CONTAMINANTS IN THE UPPER MISSISSIPPI RIVER: DETECTION AND MEASUREMENT WITH A PASSIVE ACCUMULATOR. Christopher J. Schmitt, James N. Huckins, and Jimmie D. Petty, U.S. Fish and Wildlife Service, National Contaminant Research Center, 4200 Hew Haven Road, Columbia, MO 65201 and Colleen E. Rostad and Geoffrey S. Ellis, U.S. Geological Survey, 5293 Ward Road, Arvada, CO 65201

The distribution and abundance of hydrophobic halogenated organic chemicals in the upper Mississippi River (UMR) was investigated with lipid-filled polyethylene membrane samplers during summer 1991. The samplers, which contained triolein (a model lipid), were deployed for 28 days at 7 UMR sites (upper and lower Pool 2; Lake Pepin; Lake Onalaska; Lynxville, WI; Keokuk, IA; and Winfield, MO) and in the lower Illinois and Missouri Rivers. Samplers were extracted dialytically, cleaned up by gel permeation chromatography, and analyzed by gas chromatography/negative chemical ionization mass spectrometry; target compounds included PCBs (penta-, hexa-, hepta-, and octachloro-biphenyls), and chlorinated pesticides. Among these, several distinctly different trends were evident: PCB concentrations were highest in Pool 2 and Lake Pepin, and decreased with distance downstream; concentrations were 10-fold lower at Winfield and in the Illinois and Missouri Rivers. Concentrations of pentachloroanisole, a metabolite of the wood preservative pentachlorophenol, were four-fold higher at Lake Pepin than elsewhere. In contrast, concentrations of cyclodiene insecticides (chlordane components, heptachlor epoxide, and dieldrin) increased with distance downstream; highest levels occurred at Winfield and in the Illinois and Missouri Rivers. These findings will be compared to trends from historic monitoring activities based on chemical residues in indigenous fishes.

SUSPENDED-SEDIMENT CONCENTRATION TRENDS ON THE MISSISSIPPI RIVER BETWEEN ST. LOUIS, MISSOURI AND CAIRO, ILLINOIS. Robert R. Holmes, Jr., U.S. Geological Survey, 1400 Independence Road, Rolla, MO 65401

Fluvial suspended sediment, which is derived from erosional processes, has long been a concern in many streams and rivers of the world. The concerns associated with suspended sediment generally are related to sedimentation in main channels, wetlands, and backwater areas of streams and rivers. Changes in sediment supply and transport can destroy fish spawning areas and decrease the quantity of wetlands available for waterfowl. Determination of the quantity of suspended sediment in transport, and the spatial and temporal distribution of the suspended sediment, can assist managers in understanding sedimentation processes.

Suspended sediment transport and trends in suspended-sediment transport are of particular interest in the Mississippi River, the largest river in the United States. Three suspended-sediment gaging stations are operated in the reach of the Mississippi River between St. Louis, Missouri and Cairo, Illinois, by the U.S. Geological Survey. These three gaging stations are located at St. Louis, Missouri, Chester, Illinois, and Thebes, Illinois. The gage at St. Louis, which was installed during 1948, is one of the longest term daily suspended-sediment stations in the United States. The gages at Chester and Thebes were installed during 1980.

Since the 1940's, many anthropogenic factors have affected sediment delivery to the Mississippi River and subsequent transport downstream. These factors include the construction of dams and control structures on the upper Mississippi and Missouri Rivers, U.S. Department of Agriculture incentives to remove erosion-prone farmland from crop farming, new farming techniques designed to reduce erosion, and several State-funded riverine corridor protection projects. To determine the effects of these factors on the suspended-sediment concentrations in this reach of the Mississippi River, instantaneous suspended-sediment data collected at the three suspended-sediment stations were analyzed for time trends. The instantaneous suspended-sediment concentration data used in this analysis were data for multi-vertical cross-section samples. The multi-vertical instantaneous concentration data, which is collected about eight times per year at these sites, was analyzed instead of the concentrations in the single-vertical depth integrated samples collected daily at one location near the middle of the stream because it is considered more representative of the true cross-sectional average suspended-sediment concentration.

The test used to detect the presence or absence of trends is a mixture of parametric and non-parametric statistical procedures. Because suspended-sediment concentration is correlated with water discharge, making it an exogenous variable, the effect of water discharge had to be removed before meaningful conclusions could be determined concerning the presence or absence of a trend in suspended-sediment concentrations. To remove the effect of discharge, a linear regression was constructed using water discharge and suspended-sediment concentration for each station. After each regression was performed, the suspended-sediment residuals were analyzed for normality to ensure the linear regression technique was not misapplied. A Mann-Kendall statistical procedure was then performed on the residuals, and the test of significance was whether Kendall's S was significantly different than zero (D. R. Helsel and R. M. Hirsch. 1992. Statistical methods in water resources. Amsterdam, Elsevier Publishers, 522 p.). To further ensure that seasonal effects were removed, a seasonal Mann-Kendall test was also performed on suspended-sediment concentration data for dormant and growing seasons.

The trend analysis of suspended-sediment data for the Mississippi River at St. Louis was performed for two time periods, 1948 to 1979 and 1980 to 1991 (the period of data collection at the Chester and Thebes gages). As expected, the suspended-sediment concentration data for the St. Louis gage from 1948 to 1979 indicated a large negative trend (decreasing concentration). It was during this period that the major dams on the Missouri River were completed. These reservoirs trap large quantities of suspended sediment that would otherwise continue downstream.

From 1980 to 1991, no trends in suspended-sediment concentrations in the Mississippi River were detected at the St. Louis, Chester, or Thebes gages. This was somewhat unexpected because during this period, although no major dam construction took place, many local conservation programs to limit upland erosion were in affect. The lack of a decrease in the sediment concentration since 1980 could be due to the fact that the river system is so large that only large-scale sediment reduction efforts (such as dam construction on tributaries that transport large quantities of sediment) are detectable. Also, resuspension of sediment previously deposited in the River and its major tributaries could have counteracted conservation efforts to decrease sediment supply.

PHYTOPLANKTON COMMUNITY STRUCTURE AND STANDING CROP IN LAKE PEPIN, UPPER MISSISSIPPI RIVER. William R. Maurer and Ronald G. Rada, River Studies Center, Department of Biology & Microbiology, University of Wisconsin, La Crosse, WI 54601

We studied phytoplankton community structure and standing crop (cell volume and chlorophyll a--CHL_a) in the middle region of Lake Pepin from June 9, 1987, through June 4, 1988, a period of relatively low water discharge. This large, natural lake is located in Navigation Pool No. 4 on the upper Mississippi River about 75 km downstream from the Minneapolis-St. Paul, Minnesota, metropolitan area. Sampling frequencies varied from 9 days in the summer to 1 month in the winter and corresponded to the estimated water retention times in the lake. Overall, Lake Pepin exported about 34% more CHL_a than was present in the inflow to the lake. Two major peaks in phytoplankton standing crop were observed during the study, mid-June in 1987 (CHL_a = 31.4 mg/m^3) and early May 1988 (CHL_a = 62.2 mg/m^3). These maxima are indicative of highly eutrophic conditions and may be related to the relatively long water retention times for the lake during this study period. The maxima were composed mainly of diatoms and cyanobacteria in 1987 and almost totally of diatoms in 1988. Throughout the study, the diatoms *Stephanodiscus* sp., *Melosira* sp., and *Cyclotella* sp. were the dominant taxa, comprising about 73% of the total cell volume. The most important non-diatom taxa were the cyanobacteria *Aphanizomenon flos-aquae, Anabaena spiroides*, and *Microcystis* sp. and cryptomonads. Correlational analyses of phytoplankton standing crops with physical and chemical constituents measured from the same water samples have just been initiated.

CHARACTERIZATION OF SEDIMENT TYPE AND BOTTOM DYNAMIC CONDITIONS BY AN *IN-SITU* SEDIMENT PENETROMETER: PRELIMINARY DATA FROM LAKE ONALASKA.

Robert F. Gaugush, U.S. Fish and Wildlife Service, Environmental Management Technical Center, 575 Lester Avenue, Onalaska, WI 54650

The measurement of sediment type (described by particle size distribution, bulk density, moisture content, and organic content) typically requires extensive sediment sampling with coring devices or Ponar dredges. While the sediment sampling may not require considerable field time, time required to complete laboratory analyses makes large-scale studies prohibitive. Determination of bottom dynamic conditions (or the prevailing hydrodynamic conditions that lead to sediment erosion, transportation, or accumulation) require continuous recording of flow velocities above the lake bed and sediment resuspension for the period of interest. Again, the logistical demands of such sampling prohibit studies aimed at characterizing large areas for sediment type mapping.

An *in-situ* sediment penetrometer, originally developed in northern Europe and modified for use in areas off the main channel of the Mississippi River, can be used to characterize a wide range of sediment types and the prevailing hydrodynamic conditions of the area. The penetrometer uses three weighted rods (L_1, L_2, and L_3) each of which terminates with a different size cone. The widest and lightest cone, L_1, usually penetrates a relatively short distance (1-3 cm) and can provide information on surficial sediments. The heavier and narrower cones, L_2 and L_3, penetrate further into the sediments and provide more useful information on the prevailing bottom conditions. Previous studies have developed empirical relationships which show that when values of $L_2 > 10$ cm, then sediment accumulation predominates and the sediments will be characterized by silts and clays with relatively high organic contents. Values of $L_2 < 3$ cm indicate erosional bottoms dominated by sands and gravel. Zones of sediment transport, areas which intermittently accumulate sediments which are later transported away, are indicated when 6 cm $< L_2 <$ 10 cm and the ratio $L_3/L_2 < 1.8$.

As part of a larger study dealing with the effects of the artificial islands in Lake Onalaska, a sediment survey using the penetrometer was conducted. Penetrometer readings were taken at 100 m intervals along 36 transects (each 1500 m long). In order to develop the empirical relationships between penetration depths and sediment characteristics such as moisture content, bulk density, organic content, and particle size, sediment cores were taken at approximately 20 percent of the penetrometer sampling sites. Preliminary data analyses suggest that the sediment penetrometer adequately characterizes sediment type and the hydrodynamic conditions in the sampled area of Lake Onalaska.

AN ASSESSMENT OF SEDIMENT SUITABILITY FOR THE GROWTH OF *VALLISNERIA AMERICANA* L. IN LAKE ONALASKA. Sara J. Rogers, John W. Barko, and Dwilette G. McFarland. U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, WI 54650 and U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS, 39180

Following a recent (1989-1990) widespread decline of *Vallisneria americana* in portions of the Upper Mississippi River (UMR), we conducted a transplant experiment in Lake Onalaska (Pool 7) to determine whether existing sediment conditions would support *Vallisneria* growth. *Vallisneria* tubers were planted at two sites differing greatly in sediment composition (one predominately sand and the other predominately fine-textured). Over a 12-week period, *Vallisneria* grew well at both sites with similar aboveground biomass production, average leaf length, and flower production. Thus, sediment composition did not affect growth between the selected field sites. However, in an associated greenhouse study on sediments from the same field sites, *Vallisneria* grew poorly unless fertilized with nitrogen (N). Marked differences between field and greenhouse study results suggest that sediment accretion during the growing season, potentially influencing N availability in surficial sediments, may be critical to the growth of *Vallisneria* in the UMR.

TESTING CONTAMINATED SEDIMENT WITH FINGERNAIL CLAMS. W. Gregory Cope, Michelle R. McPeak, and Teresa J. Naimo, U.S. Fish and Wildlife Service, National Fisheries Research Center, P.O. Box 818, La Crosse, WI 54602

Many contaminants that enter riverine ecosystems associate with fine-grained sediments that deposit in riverine pools and backwater lakes. These in-place contaminants can adversely affect the survival and growth of exposed benthic organisms. Fingernail clams are exposed to contaminants in both sediment and sediment-pore water through direct contact and filter-feeding activity. We examined the importance of the direct contact with sediment on short-term survival of the fingernail clam *Musculium transversum* in a laboratory test. Sediments (uppermost 7 cm) were obtained from four sites in Pool 8 of the upper Mississippi River that differed in physical characteristics and in the recent (1992) density of fingernail clams (range, 0 to 828 clams/m^2). The experimental design was completely randomized and included four sediment treatments and one sediment-free control. Each treatment consisted of six replicate 400-mL beakers: three with clams placed directly on the sediment, and three with clams placed in a Nitex® and glass enclosure suspended 1-2 mm above the sediment-water interface to prevent contact with the sediment. In each replicate, 10 fingernail clams were exposed to sediment for 7 days. Mortality, growth, and activity (foot movement) were measured to assess the importance of direct contact with sediment to fingernail clams. Mean mortality, length, and weight of fingernail clams did not vary significantly among the four sediments or between experiments permitting and preventing direct physical contact of fingernail clams with sediment. In contrast, significant differences were observed in activity of clams among treatments. These results indicate that growth and mortality may not be suitable indicators of short-term sediment toxicity in fingernail clams. However, the high survival (94%) of fingernail clams in the sediment-free controls indicates that toxicity tests may be conducted with sediment pore-water, more appropriately addressing the route of exposure of sediment-associated contaminants to benthic invertebrates such as fingernail clams.

HABITAT CHARACTERISTICS FOR THE WINGED MAPLELEAF *QUADRULA FRAGOSA* AND ITS ASSOCIATION WITH OTHER MUSSELS IN THE ST. CROIX RIVER. Daniel J. Hornbach, Lindsay Powers, James March, Scott Villinski, Aleria Jensen, and Emily Mugnolo, Department of Biology, Macalester College, St. Paul, MN 55105

We examined factors that may affect the distribution and abundance of the federally endangered mussel, *Quadrula fragosa* and its associations with other mussel species. Five stations were positioned along each of 3 transects parallel to the flow of the river near St. Croix Falls, WI. At each of the 15 stations, ten 0.25 m^2 quadrats were taken by SCUBA. From each quadrat all mussels were removed, identified and shell dimensions were recorded. The substrate from each quadrat was placed in a series of sieves to determine average sediment size. The water depth, velocity and discharge was also recorded at each site.

From these 150 quadrats a total of 1174 mussels representing 30 species of unionids were collected. Only 1 of these was a *Q. fragosa*. To supplement these samples, 35 diving hours were spent in specific SCUBA searches for *Q. fragosa*. An additional 10 individuals were found in these searches. When a *Q. fragosa* was located a 0.25 m^2 quadrat was taken and treated like the other 150 quadrats. The *Q. fragosa* found ranged in age from 3 to 16 years old, with six less than 10 years old. This, along with additional examination of data from Dave Heath and Glen Miller (pers. comm.), indicates that the population has reproduced in the period 1967-1989 with peak periods of reproduction in 1978, 1979, and 1984.

The average particle size of substrate in quadrats containing *Q. fragosa* was -2.64 phi (range: -1.58 to -3.18) as compared to -2.60 phi (range -1.28 to - 2.65) for the other 150 quadrats. There was little difference between locations with and without *Q. fragosa* in the average percentage of the sediment that constituted each of the 5 size fractions we examined. Consequently it appears that substrate texture is not a major determinant of the noted *Q. fragosa* distribution. In the 11 quadrats in which *Q. fragosa* was sampled, 120 other unionids, representing 20 species were found. A G-test indicated that there was no significant difference between the community structure of mussels found in the *Q. fragosa* quadrats and that found in the 150 other quadrats. On average, in the quadrats with *Q. fragosa*, the species richness was 5.45 species ($s^2 = 1.44$) while for the 150 other quadrats the average was 3.24 species ($s^2 = 1.94$). The average density of mussels taken in the 11 0.25 m^2 quadrats with *Q. fragosa* was 49.1 mussels/m^2 ($s^2 = 14.1$). For the 150 0.25 m^2 samples taken the average density was 31.3 mussels/m^2 ($s^2 = 28.2$). Thus those quadrats containing *Quadrula fragosa* were in the upper 85th percentile for species richness and mussel density of all samples taken at St. Croix Falls. Consequently, it appears that *Q. fragosa* is found only at sites in the river capable of supporting a diverse and abundant assemblage of mussels. That is, *Q. fragosa* is only found in high quality mussel habitat.

Funding provided by the U.S. Fish and Wildlife Service, Wisconsin DNR, and Minnesota DNR Non-game Wildlife Program.

THE EFFECTS OF HANDLING AND TIME OUT OF WATER ON THE SURVIVAL OF FRESHWATER MUSSELS. Diane L. Waller, Jeffrey J. Rach and W. Gregory Cope, National Fisheries Research Center, P.O. Box 818, La Crosse, WI 54602

The mortality of freshwater mussels following displacement by field surveys, relocation projects, and commercial harvest is assumed to be insignificant. However, survival is likely dependent on a number of variables such as water temperature, time out of water, habitat preference, and species sensitivity, none of which have been thoroughly investigated. In a preliminary study conducted in the fall, we found that 1 h air exposure did not cause significant mortality to threeridge (*Amblema plicata plicata*). The objective of this study was to measure the survival of three additional species following air exposure and handling. Also, seasonal effects on survival were compared by repeating the study in the fall and spring. The study was conducted in an existing mussel bed in Pool 7 of the upper Mississippi River (RM 713.2) in May 1992 and October 1992. Four species of mussels were tested including threeridge, pigtoe (*Fusconaia flava*), threehorn wartyback (*Obliquaria reflexa*), and mapleleaf (*Quadrula quadrula*). Mussels were collected by divers, marked, treated, and placed into 3 x 3 m PVC grid. The study design was a randomized block and consisted of three blocks divided into three-1 m^2 squares. One square within a block was a control and two were placement squares. Treatments included 0, 1, 4, and 8 h exposure to the atmosphere. The grid was re-examined after 6 months to measure mortality in the control and placement squares. Natural mortality was estimated from the percent of dead shells taken from the placement square prior to study initiation. These results were compared to the percent of dead shells collected from the control squares during reexamination.

COMPARISON OF MACROINVERTEBRATE ASSEMBLAGES FROM TWO BACKWATER LAKES IN POOL 10 OF THE UPPER MISSISSIPPI RIVER. B. Will Green[1], David C. Beckett[1], Andrew C. Miller[2], and Robert F. Gaugush[3], [1]Department of Biological Sciences, Box 5018, University of Southern Mississippi, Hattiesburg, MS 39406, [2]U.S. Army Engineer Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39180 and [3]U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, WI 54650

We sampled the benthic invertebrate fauna of two upper Mississippi River backwater lakes on 20 July 1991, using a petite Ponar grab. The two lakes, McGregor Lake and Thumb Lake, are located west of Prairie Du Chien in Pool 10, and are within a mile of each other. Ten inshore (near shore) and ten offshore samples were taken in each lake. Weight of particulate matter (mostly of plant origin) in the inshore and offshore sets of samples from Thumb Lake sediments were roughly equivalent. Mean weight of particulate matter in the McGregor Lake inshore samples was only l/5th of the Thumb Lake inshore samples; the weight of the offshore particulate matter in McGregor Lake was less than 1/100th of Thumb Lake's offshore samples. Marked differences existed in benthic invertebrate density and composition as well. Although *Hexagenia* nymphs were present in both lakes, densities of these mayflies were considerably less in McGregor Lake; e.g. offshore *Hexagenia* densities in Thumb Lake were approximately 50 times greater than the offshore densities in McGregor Lake. Larval chironomid densities were also greater in Thumb Lake. Offshore, chironomid densities in Thumb Lake were about 11 times the densities of McGregor Lake. A diverse chironomid fauna was present in the littoral zone of Thumb Lake.

EPIZOIC INVERTEBRATE COMMUNITIES ON UPPER MISSISSIPPI RIVER UNIONID BIVALVES: ISLANDS IN THE STREAM. David C. Beckett[1], B. Will Green[1], Steven A. Thomas[1], and Andrew C. Miller[2], [1]Department of Biological Sciences, Box 5018, University of Southern Mississippi, Hattiesburg, MS 39406 and [2]U.S. Army Engineer Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39180

Based on the Great Lakes experience with *D. polymorpha*, it is likely that the unionid fauna will be one of the riverine communities most severely impacted if high zebra mussel densities occur. Negative impacts on unionids will also affect the epizoic invertebrate communities which live on the shells of the unionids. In 1991 and 1992 we determined the composition and density of epizoic invertebrates on individual unionids from the upper Mississippi River. In addition, we also measured the "effective area" (amount of unionid shell surface area above the sediment-water interface) of each of the sampled unionids. The 1991 samples were from a location with a strong current; the numerically dominant epizoic invertebrates at this location were three species of hydropsychid caddisflies and the chironomid larvae *Rheotanytarsus* sp. and *Polypedilum convictum*. Linear regression analysis showed a strong correlation between effective surface area and: 1) number of epizoic chironomid larvae ($r = 0.81$), and 2) number of hydropsychid caddisflies ($r = 0.76$). Sampling in a slower current area in 1992 revealed a dissimilar epizoic composition from that observed in 1991. Although caddisfly larvae were common, they belonged to families other than the Hydropsychidae; *Glyptotendipes lobiferus* was the most common epizoic larval chironomid. Again, strong correlations existed between effective surface area of the unionids and: 1) total number of epizoic invertebrates ($r = 0.63$), and 2) number of chironomid larvae ($r = 0.57$). An appraisal of the unionids as "islands" revealed a strong correlation between the size of the bivalve islands and the number of epizoic species present.

CULTURE OF ZEBRA MUSSELS IN FIVE WATER SOURCES. J. J. Rach, S. D. Whitney, and D. L. Waller, U.S. Fish and Wildlife Service, National Fisheries Research Center, P.O. Box 818, La Crosse, WI 54602

The invasion of the zebra mussel into the Mississippi River Basin is an economic concern to commercial water users, and biologists fear the mussel may have a negative impact on native river fauna. There is minimal information regarding zebra mussel growth and survival in rivers of the Mississippi River Basin. We evaluated the growth and survival of zebra mussels in five different culture waters collected from laboratory and river sources. The sources of culture water were the Mississippi River, Black River (water was collected from two sites), laboratory well water, and reconstituted deionized water. Each treatment was evaluated in triplicate with 20 mussels (4-8 mm) per 38 L aquaria. Water from each source was collected weekly and twice a week one-half volumes of water were replaced in each aquaria. Dissolved oxygen, temperature, and pH were monitored daily. Mussel lengths were measured on week 10 and 17 of the study using a computer equipped with an Optical Pattern Recognition System. The survival rates after 17 weeks were: Mississippi River, 87%; Black River (South of Lake Onalaska), 48%; Black River (North of Lake Onalaska), 82%; well water, 53%; and reconstituted water, 75%. The mussels cultured in the Mississippi River water had the highest survival and growth rate. Zebra mussels cultured in reconstituted deionized water and Black River (North of Lake Onalaska) water had eroded shells possibly due to the low alkalinity and hardness of these water sources. Results of this study indicate zebra mussels will grow rapidly and survive well in the Mississippi River Basin unless there is some other limiting ecological or physiological factor limiting their range expansion.

INHIBITION OF BYSSAL THREAD DEVELOPMENT AS A POTENTIAL METHOD FOR CONTROL OF ZEBRA MUSSELS. Michelle R. McPeak and W. Gregory Cope, U.S. Fish and Wildlife Service, National Fisheries Research Center, P.O. Box 818, La Crosse, WI 54602

The exotic zebra mussel *Dreissena polymorpha* attaches to solid substrates with a byssus or tuft of byssal threads. The adhesive byssal threads allow the mussel to resist detachment caused by wave action and currents. We identified and tested 23 chemicals having potential for inhibiting the attachment of zebra mussels. The experimental design for each chemical was completely randomized with two replicates in each of six exposure concentrations. In each replicate, 15 zebra mussels (5-8 mm shell length) were exposed to the chemical for 48 hours followed by a 48-hour post-exposure in untreated water. Tests were conducted in hard (140 mg/L as $CaCO_3$), alkaline (100 mg/L as $CaCO_3$) water at 17°C. The ability of zebra mussels to re-attach was assessed at the end of the 48-hour exposure and the 48-hour post-exposure. Mortality was assessed at the end of the 48-hour post-exposure. The EC_{50} was defined as the concentration of chemical required to inhibit the reattachment of 50% of the test organisms after 48 hours of exposure. In initial tests, 8 of the 23 chemicals tested inhibited the reattachment of zebra mussels. Six of the eight chemicals had EC_{50} values ranging from 0.3 to 3.2 mg/L, and two had EC_{50} values of 10.6 and 10.7 mg/L. The range of concentrations that inhibited reattachment were not lethal to the exposed zebra mussels, which reattached after transfer to untreated water. Based on an analysis of chemical cost, anticipated treatment concentrations, solubility, and other chemical properties, two of these chemicals, both antioxidants, showed promise for future investigation; these were butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT). Nontoxicant methods for inhibiting the attachment of zebra mussels may be feasible with selected antioxidants.

BASELINE STUDIES TO ASSESS EFFECTS OF INTRODUCTION AND SPREAD OF ZEBRA MUSSELS ON MACROINVERTEBRATES IN RELATION TO SUBSTRATE CHARACTERISTICS.

Andrew C. Miller, John W. Barko, Barry S. Payne, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS 39180 and David C. Beckett, Department of Biology, University of Southern Mississippi, Hattiesburg, MS 39406

The zebra mussel, *Dreissena polymorpha*, a biofouler native to the Caspian Sea, was inadvertently introduced into Lake St. Clair from northern Europe in ballast water from an ocean vessel. By late 1992 zebra mussels had been found at over 30 Corps of Engineers locks and dams in the Illinois, Ohio, Mississippi, Cumberland, Tennessee, and Kanawha Rivers. Funds from the U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and the U.S. Army Corps of Engineers are being used to evaluate effects of spread and colonization of *D. polymorpha* in the upper Mississippi River. Objectives of our studies in 1992 were to evaluate effects of colonization on density, biomass, and community structure of native mussels and other macroinvertebrates, and to analyze changes in particle size and organic content of sediments likely to be colonized by zebra mussels. Data collected during these studies characterized conditions prior to suspected colonization by large numbers of zebra mussels.

Grain size distribution of mussel beds in Pools 24, 17, 14, 12, and 10 was extremely patchy, and no trends with respect to distance from shore or location were apparent. Particles larger than 6.3 mm comprised on average 42.9% of total sediment mass in beds among all pools except two locations in Pool 10 with mainly fine-grained sediments. Average organic composition of fine-grained sediments in two backwater lakes of Pool 10 was approximately 10%. Sediments of mussel beds in Pools 24, 17, 14, and 12 consisted of 0.80% organic matter, and in Pool 10, 2.5% organic matter.

Mean density (10 quantitative samples) of native mussels (Family: Unionidae) ranged from 21.6-49.2 individuals/sq m in Pool 12 and from 30.4-278.0 individuals/sq m at extremely dense sites downriver of a wing dam in Pool 7. The infaunal Oligochaeta and Chironomidae numerically dominated fine-grained sediments in backwater lakes. The filter-feeding caddisfly *Hydropsyche* sp. and Chironomidae dominated samples from wing dams. In the upper Mississippi River zebra mussels will probably quickly colonize wing dams and could compete with filter-feeding organisms. Zebra mussels may also colonize backwater lakes if appropriate substratum such as shells, woody vegetation, or plant stems are present.

USE OF GPS DURING A UNIONID MOLLUSK BRAIL/DIVE SURVEY, LOWER OHIO RIVER MILE 938.9 TO 981.0, PADUCAH, KY, TO CAIRO, IL. Marian E. Havlik, Malacological Consultants, La Crosse, WI 54601

Latitude and longitude (Lat/Long) calculations were taken from the Global Positioning System (GPS) with a Trimble Pathfinder Basic at beginning/end points of 367 brail runs and 60 dive sites during a unionid mollusk survey in lower Ohio River areas affected by maintenance dredging and riverine disposal. The focus of this paper is on GPS use and problems during river research. Without Lat/Long on navigation charts, it is difficult to "know where you are", to determine if satellite Selective Availability (SA) is causing GPS errors at a particular time and/or location. Topographic maps are difficult to use in the field. Recording and averaging multiple data points per site may solve some GPS problems, however, obtaining exactly the same location in a boat is difficult due to wind and current. If a reading is wrong due to satellite discrepancies, additional readings will presumably also be in error. We had difficulty daily in obtaining GPS readings in the 3D mode when four satellites were available. In one area, GPS readings for two brail runs at 11:30 a.m. fell correctly on large scale maps, but plots for runs 20 minutes later, fell on dry land, over 500′ from the Ohio River. Researchers must become knowledgeable about Lat/Long to determine if SA is causing problems. Color coded site results were plotted on 41 large maps, and mussel beds were outlined. About 10% of 800 sites had location errors, even when plotted by ArcInfo software. Questionable readings were confirmed by computer downloads of data, and hand plotted data points. Sorting data points by Longitude at East/West river sites (or by Latitude at North/South river sites), helped locate hand recorded errors. Since GPS location problems may continue, reports should also have a set of navigation maps to show where the researcher "believes" sites were located. GPS technology enhances river research, but in addition to a GPS field unit and base station, Lat/Long should be added to navigation charts. Data should be hand written and downloaded frequently. State of the art hardware and software is needed, such as GPS units with field plotters.

Unionid survey results are in Table 1. Over 25 miles of unionid beds were identified; 81% near the Illinois shoreline, and 19% along the Kentucky shoreline. Based on reported brail efficiencies, 4 mussels/brail run, and 2 mussels/dive site equaled densities of 1/m^2. Nearly 1/3 of 427 sites yielded unionids, with 24 species among 653 specimens. An endangered *Plethobasus cooperianus* (Lea 1834), Orange-foot Pimpleback, was marked, measured, and returned to the Ohio River Mile 949.2, 37° 11" 17.2′ N and 88° 49" 6.2 W. This site represented an upstream extension of the known Ohio River range of the species. No *Dreissena polymorpha* (Pallas 1771), Zebra Mussel, were found.

TABLE 1. JULY 1992 UNIONID SURVEY, OHIO RIVER MILE 938.9 - 981.0
PADUCAH, KY TO CAIRO, IL.

	SITE:	1	2	3	4	5	TOTAL	%	BRAIL	DIVE	RANK
1	Lasmigona complanata			1			1	0.15%		1	16
2	Megalonaias nervosa	2		4			6	0.92%	3	3	11
3	Tritogonia verrucosa		2	1			3	0.46%	2	1	14
4	Quadrula quadrula	25	14	44	31		114	17.46%	102	12	2
5	Quadrula cylindrica		WORN-DEAD								
6	Quadrula metanevra	2	5	7	30		44	6.74%	40	4	4
7	Quadrula nodulata	5	8	2	6		21	3.22%	20	1	7
8	Quadrula p. pustulosa	5	2	27	25		59	9.04%	53	6	3
9	Amblema p. plicata	16	2	9	14		41	6.28%	35	6	5
10	Fusconaia ebena	30	13	28	159		230	35.22%	170	60	1
11	Fusconaia flava				1		1	0.15%	1		16
12	Pleurobema cordatum	1	1		3		5	0.77%	5		12
13	Cyclonaias tuberculata	1		2	1		4	0.61%	4		13
14	Plethobasus cooperianus		1				1	0.15%	1		16
15	Plethobasus cyphyus			2			2	0.31%	2		15
16	Elliptio crassidens	1			3		4	0.61%	3	1	13
17	Obliquaria reflexa	9	1	7	15		32	4.90%	26	6	6
18	Ellipsaria lineolata	3	4	4	7		18	2.76%	15	3	9
19	Obovaria olivaria	4	4	4	9		21	3.22%	18	3	7
20	Truncilla truncata	1			2		3	0.46%	1	2	14
21	Truncilla donaciformis			1	2		3	0.46%	1	2	14
22	Toxolasma parvus		FRESH-DEAD								
23	Leptodea fragilis	1		17	1		19	2.91%	16	3	8
24	Potamilus alatus	2	1	5	6		14	2.14%	4	10	10
25	Ligumia recta		2	1	2		5	0.77%	4	1	12
26	Lampsilis t. teres			2			2	0.31%	2		15
27	Lampsilis t. anodontoides		WORN-DEAD								
	TOTAL:	108	60	168	317	0	653	100%	528	125	
	NUMBER OF SPECIES:	16	14	19	18	0			81%	19%	

TOTAL LIVING UNIONID SPECIES:	24
SPECIES REPRESENTED BY JUVENILES:	10
NUMBER OF FRESH-DEAD SPECIES:	1
SPECIES REPRESENTED BY WORN SHELLS:	2

SITE:	1	2	3	4	5	TOTAL
NUMBER OF BRAIL RUNS	49	39	114	152	13	367
# POSITIVE BRAIL RUNS	23	15	33	43	0	114
% POSITIVE BRAIL RUNS	47%	38%	29%	28%	-	31%
NUMBER OF DIVES	7	6	29	18	0	60
# POSITIVE DIVES	3	3	9	10	0	25
% POSITIVE DIVES	43%	50%	31%	56%	-	42%
TOTAL SITES	56	45	143	170	13	427
TOTAL POSITIVE SITES	26	18	42	53	0	139
% POSITIVE SITES	46%	40%	29%	31%	-	33%

NAVSTAR GLOBAL POSITIONING SYSTEM DATA: ACCURACY ASSESSMENTS AND APPLICATIONS WITHIN THE LONG TERM RESOURCE MONITORING PROGRAM. Carol Lowenberg, U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, WI 54650

The Long Term Resource Monitoring Program (LTRMP) for the Upper Mississippi River System utilizes the NAVSTAR Global Positioning System (GPS) to determine the location of data collection sites. Several years ago LTRMP purchased fourteen GPS receivers, two Trimble Polycorders, and twelve Magellan GPS Nav 1000 Pro receivers. Since their purchase, GPS technology has been rapidly evolving with the most notable change being the implementation of selective availability by the Department of Defense. EMTC has been conducting a study to evaluate the effect selective availability has had on the accuracy of their GPS receivers and determine if the receivers still meet the accuracy requirements of LTRMP.

LTRMP accuracy requirements vary and are project specific. Routine macroinvertebrate sampling, fish sampling, Landsat image rectification, and positioning the wave height recorders require GPS accuracies between 20 and 100 meters. Vegetation transect work, Bathmetry control sites, and detailed macroinvertebrate sampling require GPS accuracies between 2 and 5 meters. And site specific dye studies and several proposed aerial photo registration projects will require sub-meter accuracies.

Field data were collected within Upper Mississippi River Pool 8 comparing the Magellan GPS Nav 1000 Pro receivers and Trimble Polycorders. Data were collected simultaneously at forty-seven locations using both types of receivers. Locational positions calculated single receivers were compared to note individual receiver performance. The Trimble data were then differentially corrected using both local and remote base station data.

The Magellan GPS Nav 1000 Pro receivers are still useful for LTRMP projects which require positional accuracies of 100 meters. If accuracies better than 100 meters are required, differentially correctable data should be collected. The use of permanent base station data to differentially correct the Trimble data looks promising. Differential calculations made using a base station located over a hundred miles away are similar to calculations made using local base station data. LTRMP's current receivers cannot be used to collect sub-meter data. Both brands of receivers utilize the encoded signals broadcasted by the NAVSTAR satellites to calculate the receivers position, and current technology requires that survey grade receivers be used.

SATELLITE-DERIVED LAND COVER/LANDUSE FOR THE UMRS: POTENTIAL USES OF THE SYSTEMIC DATA BASE. Mark S. Laustrup, U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, WI 54650

Landsat Thematic Mapper (TM) satellite data were acquired over a 41-day period between September 15 and October 25, 1989. Seven TM scenes are required to provide systemic coverage. Each scene covers 185 x 170 km with a pixel resolution of 30 x 30 m. Trend analysis pools/river reaches are located in six of the seven TM scenes, the exception being the data covering the Chicago area.

The procedures used to generate the systemic data base included: (1) mosaicking, (2) rectification, (3) atmospheric correction, (4) study area (floodplain) extraction, (5) unsupervised classification, (6) editing (QA/QC), and (7) distribution. The 1989 land cover/landuse ARC/INFO data derived from 1:15000 CIR aerial photography were used to label classes and to evaluate the accuracy of the classification.

Because of the relationship between plant senescence, latitude, and time, the number of common classes which could be mapped systemically include: (1) open water, (2) aquatic vegetation, (3) grasses/forbs, (4) woody terrestrial, (5) agriculture, (6) urban/developed, (7) sand, and (8) clouds/shadows.

Potential uses of the data base include: (1) a systemic summary, (2) validation of the systemic three floodplain reach concept, (3) pool and river reach summaries, (4) within pool summaries (upper, middle, lower), (5) comparison of summary statistics with the 1975 land cover data, (6) evaluation of HREP project goals in a landscape context, (7) generation of habitat coverages at the systemic or pool/river reach scales, and (8) majority, minority, diversity, density, proximity, or boundary measures.

INVESTIGATION OF ACCURACY OF LAND USE/LAND COVER COVERAGES. Thomas Owens, Environmental Management Technical Center, 575 Lester Avenue, Onalaska, WI 54650

It is essential that geographic information system (GIS) databases meet the needs of users. A critical aspect of geographic databases is spatial accuracy. If spatial databases are not meeting user accuracy requirements, operating procedures must be upgraded. If the accuracy is too great, adjustments should be made so that resources are not expended needlessly.

Land cover databases are being developed at the EMTC to determine the trends in vegetation composition and distribution in key pools on the UMRS. The land cover databases meet USGS national map accuracy standards. However, the EMTC's ecological investigators need to determine the changes in beds of vegetation as small as 0.4 hectares (1 acre); this requires spatial accuracy on the order of less than 7 meters error between placement of an object in the database and its actual location.

An assessment of the 1989 and 1991 Land cover/Land use coverages of Pool 8 was performed using global positioning system (GPS) to assess the accuracy of the two coverages was conducted. Eleven points that were easily located on the aerial photos and accessible from boats were selected in the lower two thirds of the pool. Measurements of distance and direction were taken for the three coverages.

Neither coverage appeared to be more accurate. When including all points the average distance between the GPS points and points on the 1989 coverage is 19.7 meters, while the average distance between the GPS points and the points in the 1991 coverage is 16.4 meters. Including only the differential points the average distance between the GPS points and the 1989 points is 17.0 meters, and the distance between the GPS points and the 1991 points is 20.1 meters.

The direction of error has no consistent pattern. Directional errors between the GPS points and the 1989 and 1991 points are in three of the four compass quadrants. Directional error between the 1989 and 1991 points occurred in all four compass quadrants.

MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.,
25TH ANNUAL MEETING
HOLIDAY INN, LA CROSSE, WISCONSIN

APRIL 22-23, 1993

ABSTRACTS OF POSTER PRESENTATIONS

(listed alphabetically by first author)

SPATIAL DISTRIBUTION OF SEDIMENT CHEMISTRY DATA AND POTENTIAL POINT SOURCES OF POLLUTION FOR THE MARK TWAIN NATIONAL WILDLIFE REFUGE, UPPER MISSISSIPPI RIVER. Mike Coffey, Jody Millar, and Terri Jacobson, U.S. Fish and Wildlife Service, 4469 48th Avenue Court, Rock Island, IL 61201

Sediment chemistry data from several backwater sites along the Upper Mississippi River in Mark Twain National Wildlife Refuge were normalized using regression models. Ammonia and trace element concentrations were recalculated corresponding to percentage of clay at the site. The relative range of the adjusted concentrations were plotted with locations of known municipal and industrial outfalls (using the Geographical Information Systems program EPPL 7). The spatial patterns of upstream point sources of pollution at each site were analyzed with nearest neighbor distance methods (using EPPL 7). The results were used to identify areas of relatively higher contaminant concentrations and potential sources.

GROWTH OF ZEBRA MUSSELS IN THE UPPER MISSISSIPPI RIVER. W. Gregory Cope, Leif L. Marking, and Michelle R. McPeak, U.S. Fish and Wildlife Service, National Fisheries Research Center, P.O. Box 818, La Crosse, WI 54602

We examined the settlement and growth of zebra mussels *Dreissena polymorpha* in Pool 8 of the upper Mississippi River during the growing season after their initial discovery. The town of Stoddard, Wisconsin annually deploys and retrieves 28 small navigation buoys to delineate a narrow channel (about 1 river mile in length) through a shallow backwater area from a boat landing in Stoddard to the main channel of the Mississippi at river mile 684.7. The small navigation buoys, made of PVC pipe and anchored by cement blocks, are deployed throughout most of the ice-free season. The small navigation buoys were deployed on May 22 and retrieved on October 19, 1992, providing an opportunity to assess settlement and growth of zebra mussels during a single growing season (147 days). We found 48 zebra mussels, averaging 15 mm and ranging from 9 to 22 mm in shell length; 46 on cement blocks and 2 on buoys. The 12- and 15-mm length groups had the greatest numbers of zebra mussels. Based on the length-frequency distribution, there appears to have been at least two main periods of zebra mussel reproduction in Pool 8 of the upper Mississippi in 1992. The growth rate of zebra mussels in Pool 8 in 1992 was 0.15 mm/day, based on the buoy deployment period (147 days) and the shell length of the largest zebra mussel sampled (22 mm). This rate, however, probably underestimates actual growth in the river because it is unlikely that zebra mussels settled on the cement blocks immediately after their deployment. The Mississippi River is apparently a suitable environment for zebra mussels given the observed growth rate.

RELATIVE SELECTIVITIES OF GEAR FOR SAMPLING ICHTHYOPLANKTON. Michael R. Dewey, U.S. Fish and Wildlife Service, National Fisheries Research Center, P.O. Box 818, La Crosse, WI 54602

We compared catches of ichthyoplankton with two sampling gears, light traps and 0.5-m plankton nets, in a shallow backwater lake on the upper Mississippi River. Sampling was done on five dates in an open-water habitat from late May through mid-August 1990. Catches were dominated by gizzard shad *Dorosoma cepedianum* and Cyprinidae (larval cyprinids, excluding common carp *Cyprinus carpio*, that could not be further identified). The similarity in catch between gears was low on three of the four sampling events; catches of the plankton net were usually dominated by gizzard shad. Light traps were more effective than the plankton net for only one species, the brook silversides *Labidesthes sicculus*. The taxonomic diversity of the catch was similar with the two gears. In assessing size-selectivity, the percent similarity in length-frequency distribution between gears was always 50% or greater for gizzard shad and Cyprinidae. No differences between gears were found in the size distribution of gizzard shad and Cyprinidae sampled, whereas the larger, juvenile brook silversides appeared to avoid the net. Use of both gears may provide a better assessment of the size distribution and diversity of ichthyoplankton. However, light traps are often more efficient for sampling physically obstructed, shallow habitats or heavily vegetated waters where towed gear are not practical.

METHODS AND PRELIMINARY RESULTS OF THE MINNESOTA COUNTY BIOLOGICAL SURVEY IN SOUTHEAST MINNESOTA. Hannah L. Dunevitz and Scott C. Zager, Natural Heritage Program, Minnesota Department of Natural Resources, St. Paul, MN 55115

The Minnesota County Biological Survey (MCBS) is systematically inventorying terrestrial and palustrine natural communities and conducting rare plant and animal surveys in the counties bordering the Mississippi River in southeast Minnesota. Initially, plant ecologists interpret aerial photography to delineate potential natural vegetation. Teams of plant and animal ecologists then conduct intensive ground surveys of selected high-quality natural areas. Geographic boundaries are digitized using the ARC/INFO geographic information system, and survey data are recorded into the computerized Natural Heritage Information System.

The blufflands and floodplain of the Minnesota portion of the Mississippi River and its tributaries harbor many significant natural communities, rare plants and rare animals. Though heavily impacted in the 150 years since European settlement, the area still supports some intact ecosystems and significant natural areas. About 30 natural community types and 100 rare plant and animal species have been documented in Minnesota's Mississippi River blufflands area.

Digitized maps and sample printouts of MCBS data are displayed. A map of remaining natural communities, rare plants and animals in one portion of the study area illustrates that the area still harbors many significant natural communities and rare species, but in a fragmented and generally highly altered environment. A map of pre-European settlement vegetation is provided to illustrate the impact of 150 years of settlement on the region's natural landscape and its biological diversity.

COMPARISON OF TWO SAMPLERS FOR MEASUREMENT OF UN-IONIZED AMMONIA IN SEDIMENT PORE WATER IN POOL 8, UPPER MISSISSIPPI RIVER. Bradley E. Frazier[1], Thomas O. Claflin[2], Teresa J. Naimo[1], and Mark B. Sandheinrich[2], [1]U.S. Fish and Wildlife Service, National Fisheries Research Center, La Crosse, WI 54602 and [2]River Studies Center, University of Wisconsin-La Crosse, La Crosse, WI 54601

Recently, there has been a widespread decline in benthic filter feeding organisms in the upper Mississippi River. One hypothesis for the decline concerns concentrations of un-ionized ammonia in sediment pore water. However, little is known about the most appropriate method for sampling sediment pore water. Our objective was to compare the vertical distribution of un-ionized ammonia in sediment pore water with two different pore water extraction methods. One method was core extraction (4.8 cm I.D.) with subsequent centrifugation, and the other method was a new vacuum-operated sampler. Un-ionized ammonia concentrations in pore water were determined at 0-4, 4-8, and 8-12 cm below the sediment surface. Concentrations of un-ionized ammonia in sediment pore water sampled with cores were significantly higher than corresponding values from the vacuum-operated sampler in 7 out of 12 comparisons. For example, un-ionized ammonia concentrations in the 8-12 cm section of the core averaged 0.040 mg/L, while un-ionized ammonia concentrations from the vacuum-operated sampler averaged 0.003 mg/L. Concentrations of un-ionized ammonia increased with sediment depth, regardless of sampling method. Moreover, there was consistently less variation in un-ionized ammonia in pore water from cores. The concentrations of un-ionized ammonia in sediment pore water from Pool 8 approximate concentrations shown to have adverse chronic effects on filter feeding benthic organisms in laboratory studies.

ARE UNIONID TRANSLOCATIONS A VIABLE MITIGATION TECHNIQUE? THE WOLF RIVER EXPERIENCE, COUNTY A BRIDGE, SHAWANO, WI, AUGUST 1992. Marian E. Havlik, Malacological Consultants, La Crosse, WI 54601

Prior to demolition of two bridge piers, 8120 unionid mollusks, representing 14 taxa and densities of 10.8/m^2, were collected by divers from a 730.2 m^2 area by means of longitudinal qualitative transects. Mussels were hand translocated from County A bridge, Wolf River, N of Shawano, WI, 17-26 August 1992, into similar habitat 300 m upstream of the new bridge. Pre-translocation sampling at the transplant site, from 10 m^2 quadrats, yielded a mean density of 20.7 unionids/m^2, including two young, Wisconsin threatened *Alasmidonta viridis* (Rafinesque, 1829), Slipper Shell. The translocation site was permanently marked on the substrata, and latitude and longitude calculations were taken with Global Positioning System (GPS). Pre-translocation mussel densities, for 10 m^2 quadrats in a 7.62 m buffer zone around each pier, yielded mean densities of 9.7/m^2. The expected population was 7084 unionids. Depths ranged from 2 to 3.5 m. The substrata was sand, gravel, cobble, and detritus. Over 14% more mussels were collected than anticipated (Table 1). Mussels were marked with a hash mark on each valve's anterior end prior to translocation to facilitate recovery during anticipated followup survival studies. All mussels were out of water for only the few minutes needed to sort, identify, and mark specimens. To avoid stress, unionids were placed in mesh bags and hung in the Wolf River, before and after processing, and were translocated the same day. Thirty-three Wisconsin threatened unionids, or 0.43% of the total, were translocated. Fifteen *Simpsonaias ambigua* (Say, 1825), Salamander Mussel, 8 to 17 years of age, and 18 *A. viridis*, 8 to 13 years of age, were measured and aged, but these small shells were eroded and fragile, so they were not checked for sex or gravidity. At least 0.05% of the marked, hand planted mussels were unable to re-establish themselves at the relocation site since marked specimens were found 300 m downstream between the bridge piers. About 2% of unionids at a special quadrat site, were also unable to re-establish themselves when merely placed on the substrata (Figure 1). In one area downstream of the East Pier, there were 110 and 152 mussels respectively in two 0.25 m^2 samples, mostly *Elliptio dilatata* (Rafinesque, 1820), Spike; this species dominated the fauna at over 71%. A total of 8336 mussels were identified in the project area, for a project mean density of 11.3 unionids/m^2. This, and similar studies, have helped formulate our definition of a mussel bed at 5 to 10 unionids/m^2. We recommend hand relocation from May-September, and at a time when gravid special status species will not be stressed. Translocation goals should be to transplant the total mussel population into a similar nearby mussel bed, based on preliminary quantitative sampling at both the donor and recipient sites, with followup survival studies.

TABLE 1. TOTAL UNIONIDS TRANSLOCATED AND/OR COLLECTED, WOLF RIVER, N OF SHAWANO, WI, COUNTY A BRIDGE, 17 - 26 AUGUST 1992.

(PIER & TRANSLOCATION SITES)	TOTAL ALIVE	% OF TOTAL	OVERALL DENSITY /m2	SP. RANK	JUVE-NILES
1 Anodonta grandis f. grandis	3	0.04%	0.004	13	J
2 Strophitus u. undulatus	193	2.32%	0.26	4	J
3 Alasmidonta marginata	21	0.25%	0.03	10	
*4 Alasmidonta viridis	20	0.24%	0.03	11	
*5 Simpsonaias ambigua	15	0.18%	0.02	12	
6 Lasmigona costata	374	4.49%	0.51	3	J
7 Fusconaia flava	163	1.96%	0.22	8	
8 Pleurobema sintoxia	38	0.46%	0.05	9	
9 Elliptio dilatata	5953	71.4%	8.04	1	J
10 Elliptio complanata	1	0.01%	0.001	14	
11 Actinonaias l. carinata	1024	12.3%	1.38	2	J
12 Ligumia recta	169	2.03%	0.23	7	
13 Lampsilis radiata luteola	179	2.15%	0.24	6	J
14 Lampsilis ventricosa	183	2.20%	0.25	5	J
TOTAL LIVING UNIONIDS:	8336	100%			
MEAN DENSITY/m2:			11.3		

* = WISCONSIN THREATENED SPECIES

FIGURE 1. SPECIAL 1.0 m2 TRANSLOCATION QUADRAT, WOLF RIVER, WI.

WEST ^UPSTREAM^ (NORTH) EAST

UPPER LEFT QUADRAT: 25 UNIONIDS PUSHED OR WIGGLED IN NEARLY FLUSH WITH SUBSTRATA. EACH VALVE MARKED WITH: /_\ (TRIANGLE).	UPPER RIGHT QUADRAT: 25 UNIONIDS PLACED IN PIT MADE BY DIVER'S FINGER, FLUSH WITH SUBSTRATA. MARKED "L" ON EACH VALVE.
LOWER LEFT QUADRAT: 25 UNIONIDS PLACED IN SUBSTRATA, IN PIT MADE BY TROWEL. MARKED "T" ON EACH VALVE.	LOWER RIGHT QUADRAT: 25 UNIONIDS, MARKED "X" ON EACH VALVE, LAID ON SUBSTRATA.

WEST DOWNSTREAM (SOUTH) EAST

FACTORS CONTRIBUTING TO FLUCTUATIONS IN BLUE-GREEN ALGAL ABUNDANCES IN A SHALLOW PRAIRIE LAKE. Mark T. Lesinski and David R. German, U.S. Fish and Wildlife Service, National Fisheries Research Center, La Crosse, WI 54602 and Water Resources Research Institute, South Dakota State University, Brookings, SD 57007

Located in nutrient rich glacial soils of eastern South Dakota, the Oakwood Lakes system is shallow, wind mixed, and highly productive. Here, we investigated relationships of zooplankton and nutrients to fluctuations in blue-green algae. Multiple regression and principle component analysis were used to infer foodweb and nutrient linkages. Biomass of large cladocerans were inversely related to the biomass of filamentous blue-greens, primarily *Aphanizomenon flos-aquae*. To a lesser extent, cyclopoids and diaptomids were inversely related to filamentous blue-greens. Nitrogen:phosphorus ratios were positively related to filamentous blue-greens. In this system dominated by blue-green algae, herbivorous zooplankton appear to be able to exert some control on the standing stock of blue-green algae independent of nutrient regimes.

A SPATIAL ASSESSMENT OF FISH COLLECTION SITES IN POOL 8, UPPER MISSISSIPPI RIVER. David R. McConville, Department of Biology, Saint Marys College of Minnesota, Winona, MN & USFWS, Environmental Management Technical Center, Onalaska, WI 54650

Fish data has been collected at 17 locations in Pool 8 since 1989. These locations, representing 10 different ecotypes were sampled under the auspices of the Long Term Research Monitoring Program (LTRMP).

The goal of this project has been to utilize spatial analyses tools to gain an understanding of the spatial character in the immediate proximity of sampling locations. In particular, this project shows how a geographic information systems analysis (GIS) can add additional detail which might be used to help analyze and understand fisheries data. Additionally, it shows how GIS can help assess and quantify spatial heterogeneity within the river system.

Data layers queried included 1989 and 1991 six class land cover coverages, a 10 class bathymetry coverage, and a seven class sediment coverage. The data layers were derived from the EMTC's spatial database for Pool 8. To understand the spatial character, concentric rings of 100 meters radius, 200 meters radius, and 300 meter radius were generated around the geocoordinate center of each site.

Preliminary analyses indicates that substantial spatial diversity exists. This is shown to be both within and between ecotypes as well as temporally between years. As this project continues, it is hoped that new understandings of the intricacies and workings of the Mississippi River ecosystem and its inhabitants will be unraveled.

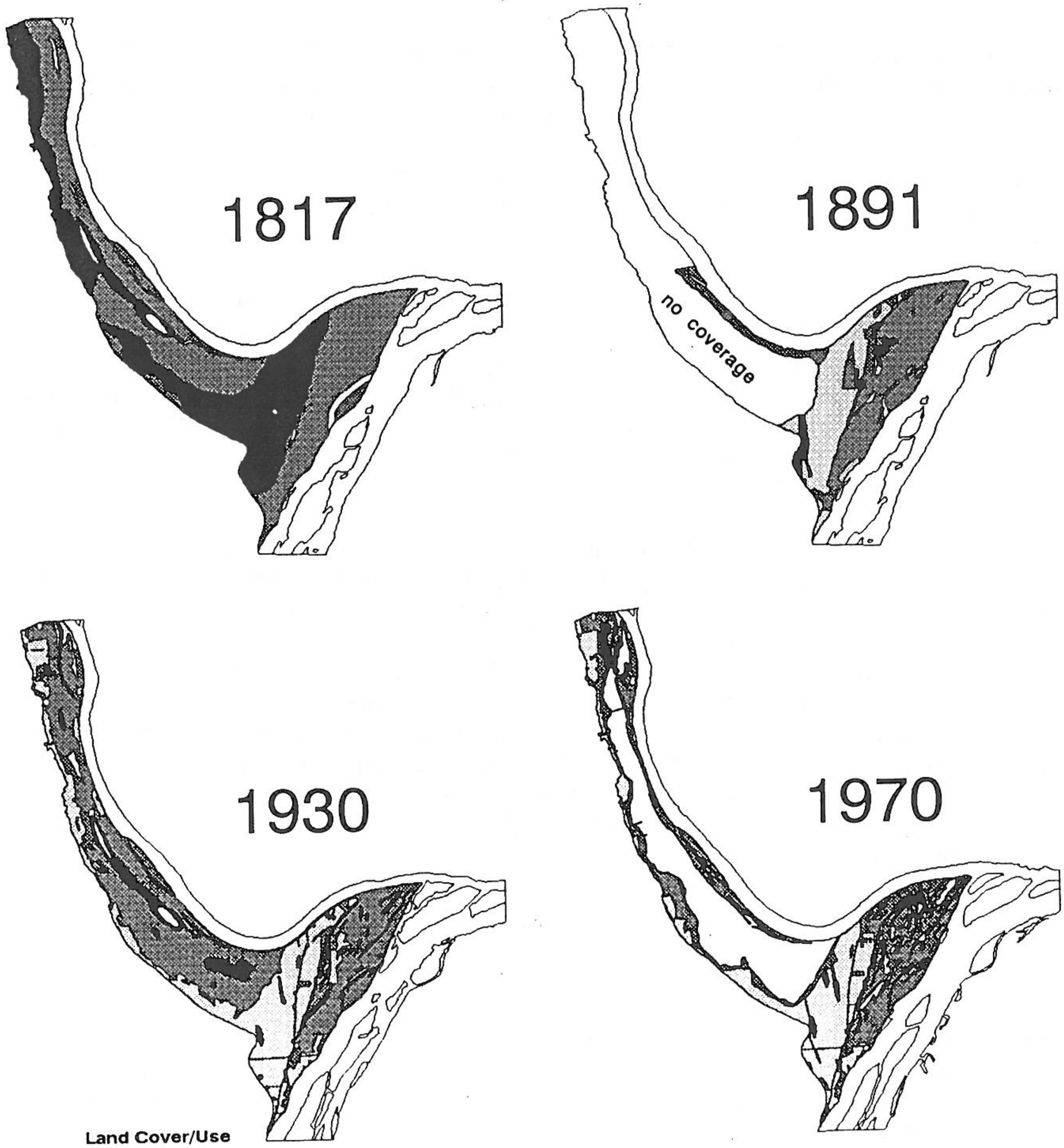
PRESETTLEMENT AND PRESENT FLOODPLAIN VEGETATION AT THE CONFLUENCE OF THE ILLINOIS AND MISSISSIPPI RIVERS. John C. Nelson[1], Anjela Redmond[1], Sara Rogers[2], and Richard E. Sparks[3], [1]Illinois Natural History Survey, Long Term Resource Monitoring Program, Pool 26 Field Station, P.O. Box 368, West Alton, MO 63386, [2]U.S. Fish & Wildlife Service, Environmental Management Technical Center, Onalaska, WI 54650, and [3]Illinois Natural History Survey, River Research Laboratory, Forbes Biological Station, P.O. Box 599, Havana, IL 62644

Witness trees recorded in the original land surveys of township and section lines (1815-1817) were used to study the composition and map the distribution of the presettlement floodplain vegetation at the confluence of the Illinois and Mississippi Rivers. Forest measurements from 1992 were compared to presettlement composition to evaluate change. A Geographic Information System (GIS) map of the probable presettlement land cover was prepared from plat maps, survey records, and other early maps and compared to GIS land cover maps from 1891, 1930, and 1970.

Results indicate that forest composition and general land cover types have changed substantially over the past 175 years (Fig. 1). Bottomland hardwood forests and prairie plant communities dominated the presettlement floodplain area (56% and 41%, respectively). Today's forest cover is reduced to 35 percent because permanent inundation of floodplain occurred as water levels rose with the completion of Lock and Dam 26 in 1938. Prairie plant communities were reduced to only a fraction of their former distribution due to their conversion to agriculture prior to 1891. The outstanding feature of today's forest is the dominance of silver maple (*Acer saccharinum* L.) which comprises 41 percent of standing timber, while in the presettlement forest it only accounted for 10 percent. This increase is likely due to logging, changes in the hydrologic regime, and the elimination of fire from the floodplain environment.

CUSTOM GRAPHICAL USER INTERFACES AS A MEANS TO SIMPLIFY THE USE OF HIGH END GEOGRAPHIC INFORMATION SYSTEM SOFTWARE. Douglas A. Olsen, U.S. Fish and Wildlife Service, Environmental Management Technical Center, 575 Lester Avenue, Onalaska, WI 54650

Because of the focus of high end geographic information system (GIS) software on functionality, not usability, many potential users are not able to take advantage of what GIS has to offer. Using the Arc Macro Language to develop custom graphical user interfaces allows users with little or no GIS experience to access the power of the ARC/INFO GIS. These interfaces can be custom tailored to the needs of different individuals or organizations using different subsets of commands to create an infinite variety of GIS applications.



GIS Land Cover/Use Change (acres)

Land cover/use	1817	□1891	1930	1970
Bottomland hardwood forest	4694.3	2140.8	4933.8	2930.8
Wet or dry prairie	3402.6	210.3	693.2	517.4
Agriculture	0.0	1254.3	2569.0	2047.6
Water	274.9	281.6	170.0	2876.0

□ note: 1891 coverage incomplete

Figure 1: Geographic Information System (GIS) maps and area calculations showing land cover/use change from presettlement (1817) to the present (1970).

LONG TERM RESOURCE MONITORING PROGRAM, HAVANA FIELD STATION: A SOURCE OF INFORMATION. Susan Peitzmeier-Romano, K. Douglas Blodgett, Paul T. Raibley, Steven W. Stenzel, and Richard E. Sparks, Illinois Natural History Survey, Havana LTRMP Field Station, P.O. Box 546, Havana, IL 62644

In September 1989, the Illinois Natural History Survey's Havana Field Station initiated data collection on La Grange Pool of the Illinois River in conjunction with the Long Term Resource Monitoring Program (LTRMP) for the Upper Mississippi River System (UMRS). The Havana Field Station is one of six such LTRMP facilities on the UMRS. A major objective of the LTRMP is to provide managers and researchers with information needed to maintain the UMRS as a viable multiple-use large river ecosystem. Our monitoring efforts are focused on four resource components of the river: water quality, fish, vegetation, and invertebrates.

Water quality parameters, the physical-chemical characteristics of the water, indicate environmental conditions that directly influence faunal and floral communities within the river system. Currently, we collect water quality data at 25 sites representing 6 habitat types along the pool and in associated backwaters of the Illinois River.

We use five sampling methods (electrofishing, hoop- and trap-netting, seining, and trawling) to monitor fish community and population parameters at 15 collection sites representing 6 habitat types along the pool. Data such as fish abundance, catch rates, length distributions, species composition, and species richness are used to help detect and understand trends in riverine fish populations.

Two complementary methods are used to monitor seasonal and annual changes in vegetation: transect sampling and aerial photograph interpretation. Transect sampling provides high resolution for species composition and density of plant species and communities. Using color infrared aerial photography, the locations of plant taxa for all vegetation of La Grange Pool and floodplain are identified. Resulting maps are transferred into a computerized geographic information system which facilitates data analyses such as calculating total areal coverage for each taxon and habitat group. This information can be used for studying ecological changes in the Illinois River and assessing fish and wildlife habitat.

Invertebrate monitoring was initiated in the spring of 1991, when samplers were designed, constructed, and deployed to monitor the impending invasion of the exotic zebra mussel. In 1992, the invertebrate program was expanded to include sampling benthic communities. Ponar grab samples from throughout La Grange Pool were analyzed for mayfly larvae and fingernail clams--indicator organisms important in aquatic food chains.

Having a trained, well-equipped staff on the river has provided opportunities to investigate resource questions beyond those defined by the LTRMP. Other projects conducted by Havana Field Station staff include focused studies on zebra mussels, largemouth bass, and wildcelery reestablishment, as well as habitat rehabilitation projects on Peoria Lake and Lake Chautauqua.

After the computerization and quality assurance/quality control process is complete, all LTRMP data are available upon request. For additional information contact the Team Leader, Havana LTRMP Field Station.

AQUATIC PLANT INTRODUCTION AND NATURAL COLONIZATION - HIGHWAY 35 MITIGATION POND, POOL 8 UPPER MISSISSIPPI RIVER. James R. Ramsey, 2907 Holly Place, La Crosse, WI 54601

During May 1992, a volunteer project involving the planting of aquatic plants was initiated on the Highway 35 Mitigation Pond, Pool 8 Mississippi River, south of La Crosse, Wisconsin. As shown in Figure 1, the Mitigation Pond was constructed in the late summer of 1991, and the site comprises an immediate area of approximately 2.54 acres containing a nominal ponded water area of 1.45 acres. The pond, while adjacent to Mormon Coulee Creek, is generally fed by direct rainfall runoff from its small immediate watershed except in very high water conditions of the creek when limited overflows can occur.

This project involved the initial introduction of the two beneficial aquatic plants, sago pondweed and marsh smartweed. Other beneficial aquatic plants were introduced in the fall of 1992. In addition to the aquatic plants introduced, a documentation of natural colonization of aquatic and moist soil plants was accomplished as listed in Table 3. Secondarily, observations of pond water levels were monitored during the first growing season; use of the pond site were noted for waterfowl and deer; and some preliminary indications of colonization by aquatic animal and fishery life were obtained.

Of the two initial aquatics introduced, the sago pondweed showed generally good growth and spreading; however, the marsh smartweed was less dramatic in its growth pattern. The natural colonization of plants identified five submerged and eleven moist soil plants. The shoreline trees, namely cottonwood and sandbar willow, were very well represented in the natural colonization. The additional aquatic and moist soil plants introduced in the fall of 1992 were longleaf pondweed, wild celery, two strains of wild rice, and Walter's millet. Wild millet, nodding smartweed, and rice cutgrass were also enhanced with a supplemental planting in the fall of 1992. Even though one Hooded Merganser and duckling were present in the early summer, usage by waterfowl, herons, and furbearing animals were limited during the summer and fall of 1992. However, as the available plant and animal food base increases, usage is anticipated to increase proportionately. This pond has the potential to be a educational site for aquatic studies.

The project is associated with Special Use Permit 32572-10565, U.S. Fish and Wildlife Service, Upper Mississippi River, La Crosse, Wisconsin District.

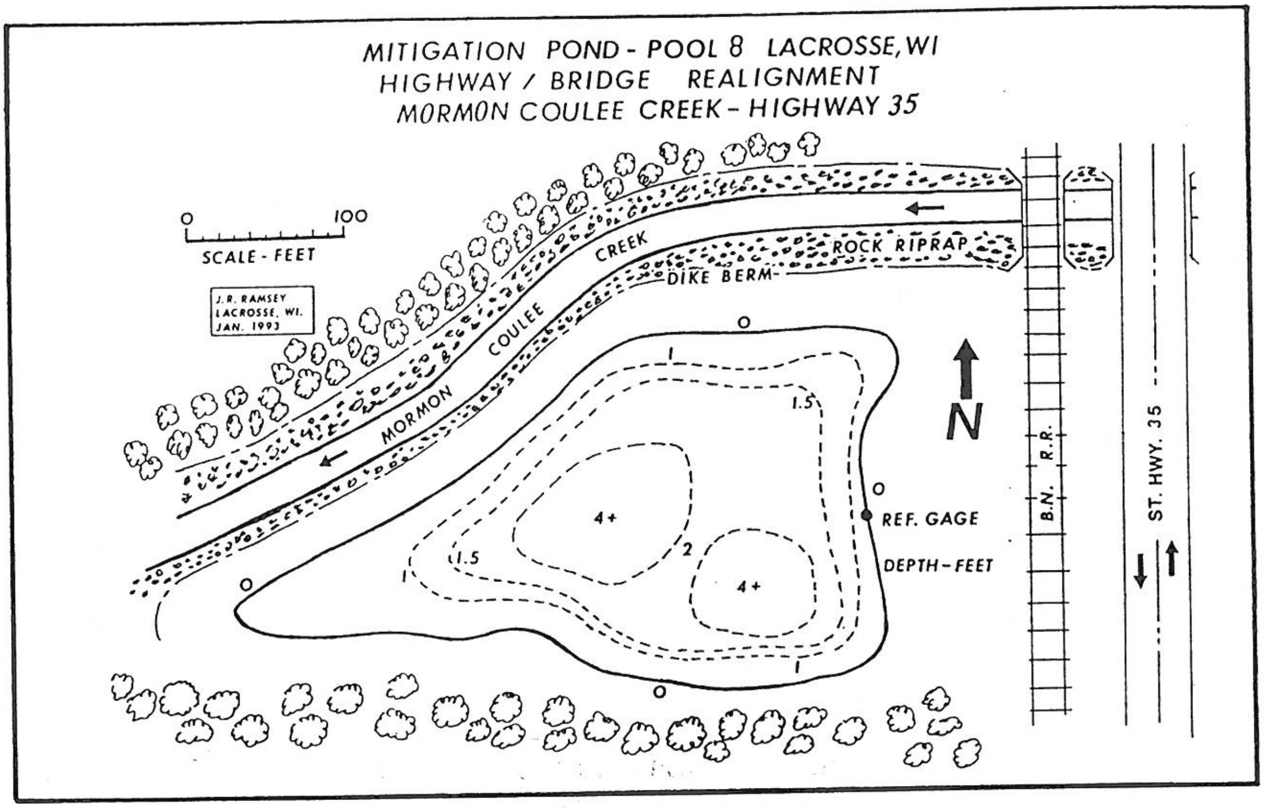


Figure 1. Mitigation Pond Site

NATURAL COLONIZATION:		
	SUBMERGED/FLOATING -	Bushy Pondweed (Naias flexilis)
		Common Duckweed (Lemma minor)
		Curly Pondweed (Potamogeton crispus)
		Elodea (Elodea canadensis)
		Green Algae (Chlorphyceae)
	EMERGENT/MOIST SOIL -	Barnyard Grass / Wild Millet (Echinochloa crusgalli)
		Broadleaf Water Plantain (Alisma plantago - aquatica)
		Cocklebur (Xanthium orientale)
		Common Cattail (Typha latifolia)
		Common Spikerush (Eleocharis palustris)
		Nodding Beggarticks (Bidens cernua)
		Nodding Smartweed (Polygonum lapathifolium)
		Pigweed/Water Hemp (Acnide altissima)
		Reed Canary Grass (Phalaris arundinacea)
		Rice Cutgrass (Leersia oryzoides)
		Wapato Duck Potato (Sagittaria latifolia)
	TREES -	Sandbar Willow (Salix exigua)
		Eastern Cottonwood (Populus deltoides)
INTRODUCED (May - Oct., 1992):		
	SUBMERGED/FLOATING -	Longleaf Pondweed (Potamogeton nodosus)
		Sago Pondweed (Potamogeton pectinatus)
		Wild Celery (Vallisneria spiralis, amer.)
	EMERGENT/MOIST SOIL -	Marsh Smartweed (Polygonum coccineum)
		Walter's Millet (Echinochloa walteri)
		Wild Rice -Lg. Grain (Zizania aquatica, var. interior)
		Wild Rice -Sm. Grain (Zizania aquatica)

Table 3. Mitigation Pond - Plant Species, Summer/Fall 1992, Located within or Below Gage "0" Water Level of Pond

EFFECTS OF COMMON CARP AND OTHER FISH ON MACROINVERTEBRATES IN A MISSISSIPPI RIVER BACKWATER. Mark Rogaczewski[1] and Steve Gutreuter[2], [1]Department of Biology and Microbiology, University of Wisconsin-La Crosse, La Crosse, WI 54601 and [2]U.S. Fish & Wildlife Service, Environmental Management Technical Center, 575 Lester Avenue, Onalaska, WI 54650

Common carp *Cyprinus carpio* are known to reduce densities of aquatic macroinvertebrates. However, effects of carp seem specific to particular conditions and there is considerable variation in results. Most studies have focused on lentic systems, wherein it is widely accepted that fish exert both top-down and bottom-up effects on other trophic levels. The importance of biotic mechanisms associated with top-down and bottom-up effects is less clear for large river ecosystems. We examined the potential effects of common carp and other fish on the density and size distribution of aquatic macroinvertebrates in Lawrence Lake, a 256-ha backwater in Pool 8 of the Mississippi River. This research was performed coincident with a study of effects of carp on water chemistry and aquatic macrophytes, wherein twelve 25-m^2 wire mesh (2.54-cm chicken wire) pens and four 25-m^2 unenclosed reference sites were erected. Four pens, selected at random, were stocked with 10 carp, and another four control pens were not stocked. We sampled benthic macroinvertebrates using a 232-cm^2 petite Ponar Grab just prior to removing fish at the completion of the experiment. Three grab samples were collected from each of the high density (10 carp) and control pens, and from two of the reference sites. The samples were sorted in the field and organisms were returned to the laboratory for identification, enumeration, and measurement of total length (chironomids only).

The average densities of macroinvertebrates were highest in the control pens and lowest in the pens containing high densities of common carp (Table 1). Densities of odonates, chironomids, ceratopogonids, and the total benthic community were significantly ($P \leq 0.05$) lower in the high carp treatment than in the control pens. There was also weaker evidence ($P \leq 0.10$) that densities of oligochaetes, odonates, and ceratopogonids were lower in reference than in control sites (Table 1) indicating that the fish community in Lawrence Lake modified densities of these macroinvertebrates. The mean lengths of chironomids did not differ among treatments. Our results indicate that common carp and other fish may have important effects on macroinvertebrates in backwaters of the Mississippi River.

Table 1. Average densities (N/m^2) of benthic macroinvertebrates collected in petite Ponar Grab samples from 25-m^2 pens and reference sites in Lawrence Lake, a backwater in Pool 8 of the Mississippi River. Control pens excluded large fish and were not stocked with common carp. Reference sites were not enclosed and allowed free access by fishes in Lawrence Lake. The high density treatment was approximately 10 fish.

	Carp treatment (No. samples)		
Taxon	Control (12)	Reference (6)	High (12)
Oligochaeta	136	36*	72
Hirudinea	0	0	4
Amphipoda	14	7	14
Plecoptera	18	0	4
Ephemeroptera	4	0	4
Odonata	11	0*	0**
Chironomidae	1,828	884	198**
Ceratopogonidae	75	0*	0**
Other Diptera	29	0	0
Total macroinvertebrates	2,116	927	294**

*$P \leq 0.10$ for Dunnett's experiment-wise test of differences between non-control and control treatments using the pens-nested-within-treatments mean square for error.
**$P \leq 0.05$, for test as above.

THE VERTICAL DISTRIBUTION OF FOSSIL FINGERNAIL CLAMS IN SELECTED BACKWATER AREAS IN NAVIGATION POOL NO. 8, UPPER MISSISSIPPI RIVER. Aaron Schmidt, Pamela Vetter, and Thomas Claflin, Department of Biology and Microbiology, University of Wisconsin-La Crosse, La Crosse, WI 54601

The relatively recent disappearance of the fingernail clam *Musculium transversum* from several pools of the upper Mississippi River has caused concern among biologists. A study conducted in Pool 8 in 1977 demonstrated fingernail clam populations exceeding $2500/m^2$. By 1989 these populations had declined to less than $20/m^2$ in the same areas. The objective of our study was to estimate the actual time of their disappearance. We collected core samples from Pool 8 in the same areas as sampled in the 1977 and 1989 studies. The cores were collected to a depth of approximately 20-40 cm and divided into 1-cm sections. Each section is being examined for remnant clam shells and analyzed for Cesium-137 to date the sediment. Preliminary data indicate that remnant shells are unevenly distributed in the cores. The maximum depths at which shells were found vary between 20 and 36 cm. Cesium dating analyses are ongoing at this time.

MONITORING OF A SMALL MAN MADE WETLAND ON A UPPER MISSISSIPPI ISLAND. Brad Stermer, Jason Hute, Marykay Tabor, and Judith Smith, Department of Biology/Environmental Science, University of Dubuque, Dubuque, IA 52001

Destruction of valuable palustrine wetlands along the Mississippi River is sometimes inevitable. Due to federal and state regulations, wetland losses are often required to be mitigated on an acre per acre basis and occasionally higher replacement value. Construction of wetlands is a relatively new and growing science with minimal literature available concerning freshwater riverine systems. To compensate for the loss of a disturbed eight acre palustrine wetland to a highway overpass project, an eight acre wetland complex was created by the city of Dubuque and the Iowa Department of Natural Resources, in September of 1991. Project site was located in Pool 12, at river mile 581, on Schmitt Memorial Island. Monitoring of the new wetland began in October 1991 to document water quality, benthic organisms, vegetation and fish and wildlife response to the project. Preliminary data collections indicate sporadic dissolved oxygen readings in both summer and winter (Fig 1). Aquatic invertebrate samples collected by Ekman dredge revealed a sand substrate mixed with silt and low numbers of aquatic invertebrates (Fig 2). Attempts to establish submergent and emergent vegetation failed due to bird and mammal activity. Weekly observations indicate seasonal use of the area by waterfowl and passerine birds (Table 1). Fish sampling during the fall of 1992 documented 19 different species but low population numbers (Fig 3). Continued monitoring will allow further evaluation of the wetland area and its value to fish and wildlife.

PHOTOTROPIC RESPONSE OF LARVAL AND JUVENILE NORTHERN PIKE. Steven J. Zigler and Michael R. Dewey, U.S. Fish and Wildlife Service, National Fisheries Research Center, P. O. Box 818, La Crosse, WI 54602

Young-of-the-year northern pike prefer vegetated habitats that are difficult to sample with standard towed gears. Light traps can be effective for sampling larval fishes in dense vegetation, given positive phototaxis of fish. We evaluated the phototropic response of young northern pike *Esox lucius* by comparing the catches of larvae and juveniles obtained with plexiglass traps deployed with a chemical light stick versus traps deployed without a light source (controls). Traps were fished weekly in a laboratory raceway containing young-of-the-year northern pike from late April to late May 1991. We also fished light traps in late May in a pond containing juvenile northern pike. In the laboratory tests, catches of protolarvae (11 mm to 14 mm total length) and mesolarvae (15 mm to 20 mm total length) in traps with light were 11 to 35 times greater than catches in control traps. The catch of juvenile northern pike (25 mm to 66 mm total length) in field and laboratory experiments was 3 to 15 times greater in traps with light than in control traps, even though the body width of the larger juveniles was similar to that of entrance slots of the traps. Larval and juvenile northern pike were positively phototropic; thus, light traps should be an effective gear for sampling young-of-the-year northern pike for at least 6 weeks after hatching.

1993 BUSINESS MEETING AGENDA
MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.
25TH ANNUAL MEETING

FRIDAY APRIL 23, 1993
11:00 AM

HOLIDAY INN, LA CROSSE, WISCONSIN

1. Call to Order

2. Announcements and Acknowledgements
    a. Presentation of 1992 Best Paper Awards

3. Secretary's Report
    a. Approval of the Minutes of the 1992 Business Meeting

4. Treasurer's Report
    a. Final 1992 Financial Report
    b. Preliminary 1993 Financial Report

5. Old Business
    a. MRRC Procedures Manual
    b. Other

6. New Business
    a. Nomination and Election of the 1993-1994 Board of Directors
    b. Meeting Notice for the 26th (1994) Annual Meeting
        1. April 19-21 (TWT), 1994 at the Radisson Inn, LaCrosse, WI?
    c. Meeting Format
        1. Length of meeting
        2. Length of presentations
        3. Number of papers presented by an author
        4. Rejection of abstracts?
        5. Poster versus platform format
        6. Quality and date of submission of abstracts
    d. Support of 1994 Large Rivers Conference
    e. Results of Logo Contest
    f. Other?

7. Adjourn

MINUTES OF THE BUSINESS MEETING, 24th ANNUAL MEETING OF THE MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC., MAY 1, 1992

1. **CALL TO ORDER**
   The meeting was called to order at 1:00 PM by President Kent Johnson. Vice President Rick Anderson, Treasurer Joe Wlosinski, and Secretary Mike Dewey, along with approximately 50 members, were in attendance.

2. **ANNOUNCEMENTS AND ACKNOWLEDGEMENTS**
   The President acknowledged everyone who helped prepare the Consortium during the year and those participating in the meeting including moderators, presenters, and judges.

3. **SECRETARY'S REPORT**
   Jim Wiener moved, Ray Hubley seconded, and those present unanimously agreed to approve the minutes of the 1991 (23rd) Annual Business Meeting, as presented in the 1992 Proceedings.

4. **TREASURER'S REPORT**
   Joe Wlosinski, as part of the registration package, distributed the Treasurer's report that presented a financial summary through March, 1992. Because all the bills and income from the 1992 Annual Meeting have not been received, a final report for 1991-1992 is not yet available. As of March 1992, $3,467.45 was available in the Consortium account. David Kennedy moved, Mike Romano seconded, and those present unanimously agreed to accept the Treasurer's report.

5. **OLD BUSINESS**
   A. Historical Set of MRRC Proceedings - Joe Wlosinski presented a summary of the status of the historical records of the proceedings and recommendations from the Board of Directors. These recommendations were to (1) follow the recommendations of the 1990 work group for future proceedings, which is to print a volume number on the cover and allow extended abstracts and figures; (2) encourage researchers to publish in peer reviewed journals; (3) create three sets of known Proceedings: the library at the National Fisheries Research Center-La Crosse, the library of the Upper Mississippi River Conservation Committee, and a copy to be kept by the MRRC Secretary; and (4) distribute future Proceedings to 19 locations. Mike Romano moved, Jim Wiener seconded, and those present unanimously agreed to accept the recommendations of the Board of Directors.

   B. MRRC Procedures Manual - Rick Anderson announced that a draft manual has been prepared and has received some review. Copies of the draft were available at the meeting for review. This copy will be formalized after all comments have been received and consolidated. A copy will be available at the next meeting for use and, if necessary, modified by future directors.

   C. Reports on Congressional Activities
      1. David Kennedy reported that no present action is being taken to close any Corps of Engineers offices. No decisions will be made until Congress has addressed the issue in a deliberate manner.

2. David Kennedy reported that the Environmental Management Program has received full funding for the next cycle. However, because of savings and slippage funds taken off by the COE and the effects of inflation, there is some concern for the present funding levels. Congressman Gunderson may ask Congress to reduce the savings and slippage funds taken by the Corps.
3. Ray Hubley reported on the status of the Large River Research Initiative. This is now part of HR 4169, the Cooperative Interjurisdictional Rivers Resources Act, that was introduced this year by Congressman Gunderson and other co-sponsors. A status report and copy of the bill was distributed by Ray Hubley.
4. Doug Blodgett moved and Rip Sparks seconded a motion to have the Board of Directors write letters to congressmen supporting the Interjurisdictional Rivers Bill. The motion was approved unanimously by the members present.
5. Doug Blodgett moved, and Mike Romano seconded a motion to have the Board of Directors send letters to congressmen to support full funding for EMP and eliminate the savings and slippage funds that reduce the funding available. The motion was unanimously approved by the members present.

D. Co-sponsorship of Annual MRRC Meetings - Kent Johnson encouraged participating agencies, institutions, and organizations to consider co-sponsorship of future MRRC meetings, to help defray meeting expenses. Kent Johnson acknowledged the support of the three co-sponsors of the 24th Annual Meeting: Western Illinois University, the Metropolitan Waste Control Commission, and the Environmental Management Technical Center, for their financial support and assistance in helping with the MRRC.

E. Joint Meeting of MRRC and UMRCC - Joe Wlosinski reported that, at this time, it is not possible to have a joint meeting with the Upper Mississippi River Conservation Committee because of the 50th anniversary meeting of the UMRCC that is already planned for 1994 in Wisconsin. The major problem with a joint meeting between these groups has to do with location. The UMRCC rotates their annual meeting between five states of the Upper Mississippi. The bylaws of the MRRC state that the meeting will be held every year in La Crosse, Wisconsin.

6. **NEW BUSINESS**

A. Nomination and Election of the 1992-1993 Board of Directors - The nomination committee was made up of the 1991-1992 Board of Directors. The nominations were:

1. Teresa Naimo for Vice-President for a one-year term followed by a one-year term as President.
2. Chuck Theiling for Secretary, for a two-year term.

The current Vice-President, Rick Anderson, will become President for one year.

The President asked for nominations from the floor. Tom Claflin presented a motion, seconded by Pam Thiel to accept the recommendations of the Nominating Committee. The motion was unanimously passed.

B. Meeting Notice and Format for the 1993 (25th) Meeting - Kent Johnson announced that preliminary contacts have been made with the Holiday Inn for having next year's meeting on April 22-23. Members were asked for their input on the meeting format and facilities for the 1992 meeting. The following points were made:

Doug Blodgett - there were problems with viewing the screen and perhaps this situation could be modified by rearranging the screen in the meeting room.

John Sullivan - perhaps the meeting should be held at a site where the screen could be higher and more visible. Also, the meeting format may have to be adjusted as the size of the Consortium increases.

Joe Wlosinski - the price of the Radisson was checked last year and found to be significantly greater than the Holiday Inn.

Nani Bhowmik - the Days Inn may be a possibility.

Donna Wilson - the meeting rooms at the Days Inn are not large enough for a meeting like the Consortium.

Rip Sparks and Nani Bhowmik - concurrent sessions would not allow for members to hear all presentations which would not be a desirable situation. It may be necessary to not accept all abstracts submitted.

Jim Wiener - consider enhancing and enlarging the poster session.

Steve Gutreuter - schedule the poster session in conjunction with a social event. Also, consider the possibility of returning to 15-minute presentations.

Marian Havlik - presented a motion, seconded by Joe Wlosinski, and agreed upon unanimously that the MRRC purchase material and construct more poster boards for future poster sessions.

Rip Sparks - the maintenance section of the Illinois Natural History Survey may be able to help construct poster boards over the winter.

Ron Rada - the aquatic sciences club at University of Wisconsin-La Crosse may be able to help construct poster boards.

It was agreed that the Board of Directors will consider all the suggestions in planning the 1993 meeting.

C. Other Business - Marian Havlik outlined the procedures that the Corps of Engineers is using for preparing an environmental impact assessment for increasing a barge docking facility at Prairie du Chien.

7. **ADJOURNMENT**

The meeting was adjourned at 12:55 PM.

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 objective 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 bylaws.

2. The bylaws 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 bylaws of the MRRC may be amended by an affirmative vote of two-thirds of the eligible voting members present at the annual meeting.

BYLAWS OF THE MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.

ARTICLE I: NAME, PURPOSES, 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 purposes 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 in or out 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: OFFICERS AND BOARD OF DIRECTORS

3.01 General Powers, Responsibility, 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 carry out the objectives of the organization and to jointly organize, hold, and preside over the annual meeting. The Board of Directors of the corporation shall consist of an elected president, vice-president, secretary, and treasurer.

3.02 Election and Terms of Officers.
Each Board member will be elected for a two year term after the 1991 election. In odd numbered years a treasurer and a vice-president will be elected, with at least one being a representative of either a state or federal agency. In even numbered years a secretary and a vice-president will be elected, with at least one being a representative of an academic institution. After a vice-president serves for one year, he or she shall become president for the next year. In 1991 all four officers will be elected. The term for president and secretary elected in 1991 will be for one year. The term for the treasurer elected in 1991 will be for two years. The vice-president elected in 1991 will become president in 1992. The term of each officer begins at the annual meeting.

3.03 Removal From Office.
Any officer 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. An officer may be removed from 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. Any officer who is absent from three (3) consecutive 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.

3.04 Meetings.
The Board of Directors shall meet on the times and dates to be established by them but at least once during the annual meeting. 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. Telephone conference calls can be used in place of regular meetings except during the annual meeting.

3.05 Notice; Waiver.
Notice of such meetings of the Board of Directors shall be given by written or verbal notice delivered personally, by phone or mailed or given by telegram to each director at such address or telephone number as such director shall have designated with the secretary, not less than ten (10) days, or a number of days to be decided by the Board, 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, or any regular or special meeting of the Board of Directors need be specified in the notice or waiver.

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 Conduct of Meetings.
The president, and in his or 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.

3.08 Vacancy.
Any vacancy occurring in the Board of Directors because of death, resignation, removal, disqualification, or otherwise, shall be filled as soon as possible by the majority action of the Board. If the president vacates office, the vice-president shall become president and the Board shall fill the vice-president position. A vacancy shall be filled for the unexpired portion of the term.

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

3.10 Duties of Officers.
All officers have the responsibility of carrying out the objectives of the organization, assisting in the organization of the annual meeting, and preparing a Procedures Manual for the organization. In addition:

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.

The vice-president shall:

(a) Perform the duties and exercise the functions of the president at the request of the president and when so acting shall have the power of the president,
(b) Be responsible for the preparation and updating of the Procedures Manual for the organization,
(c) Perform such other duties as delegated by the president.

The secretary 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.

The treasurer shall:

(a) Be responsible for financial record keeping and assessment of dues as established by the Board of Directors,
(b) Supervise the preparation of the annual budget,
(c) Receive all funds paid to the organization and shall pay all bills incurred by the Consortium,
(d) Perform other duties as from time to time may be assigned by the president.

3.11 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 or she is so appointed to be assistant or to which he or she is so appointed to act, except as such powers may be otherwise defined or restricted by the Board of Directors.

ARTICLE 4: MEMBERSHIP AND DUES

4.01 Membership and Eligibility.
Membership to include anyone interested in the research and study of the 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: COMMITTEES

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

5.02 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 6: MEETING OF MEMBERSHIP

6.01 Annual Meeting.
The annual meeting of the organization shall be held in La Crosse, Wisconsin. The time of the meeting shall be established by the Board of Directors and announced at the previous annual meeting. Reports of officers and committees shall be delivered at the meeting. 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.

6.02 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.

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

ARTICLE 7: AMENDMENTS

7.01 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	Year	Location	President
1st	1968	St. Mary's College, Winona	Brother George Pahl
2nd	1969	Wisconsin State Univ., La Crosse	Dr. Thomas Claflin
3rd	1970	Winona State College, Winona	Dr. Calvin Fremling
4th	1971	St. Cloud State College, St. Cloud	Dr. Joseph Hopwood
5th	1972	Loras College, Dubuque	Dr. Joesph Kapler
6th	1973	Quincy College, Qunicy	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-La Crosse	Dr. Ronald Rada
12th	1979	Cancelled	Dr. Edward Cawley
13th	1980	Loras College, Dubuque	Dr. Edward Cawley
14th	1981	Ramada Inn, La Crosse	Mr. M. Vanderford
			Executive Committee
15th	1982	Radisson Hotel, La Crosse	Dr. Richard Anderson Dr. Dave McConville Dr. Jim Wiener
16th	1984	Radisson Hotel, La Crosse	Dr. Ken Lubinski Ms. Rosalie Schnick Dr. M. Smart
17th	1985	Radisson Hotel, La Crosse	Mr. Ray Hubley Dr. John Nickum Ms. Pam Thiel
			Board of Directors
18th	1986	Radisson Hotel, La Crosse	Dr. Jim Eckblad Dr. Carl Korschgen Dr. Jim Peck
19th	1987	Univ. of Wisconsin-La Crosse	Mr. Hannibal Bolton Dr. Leslie Holland Dr. Mike Winfrey

Meeting	Year	Location	Board of Directors
20th	1988	Univ. of Wisconsin-La Crosse	Mr. John Pitlo Mr. Verdel Dawson Dr. Nani Bhowmik
21st	1989	Holiday Inn, La Crosse	Dr. Larry Jahn Mr. Jerry Rasmussen Dr. Bill LeGrande
22nd	1990	Island Inn, La Crosse	Mr. Doug Blodgett Dr. John Ramsey Mr. John Sullivan
23rd	1991	Holiday Inn, La Crosse	Mr. Kent Johnson Dr. Mike Romano Dr. Joe Wlosinski
24th	1992	Holiday Inn, La Crosse	Dr. Richard Anderson Mr. Mike Dewey Mr. Kent Johnson Dr. Joe Wlosinski
25th	1993	Holiday Inn, La Crosse	Dr. Richard Anderson Dr. Teresa Naimo Mr. Charles Theiling Dr. Joe Wlosinski

ACKNOWLEDGEMENTS

The following persons or institutions have contributed substantially to the planning, execution, support, and ultimately, the success of the 25th Annual Meeting of the Mississippi River Research Consortium. The 1992-1993 Board of Directors gratefully acknowledges their involvement.

Local Meeting Arrangements, Meeting Announcements, and Mailings

Teresa Naimo, U.S. Fish and Wildlife Service, National Fisheries Research Center, La Crosse, Wisconsin
Chuck Theiling, Illinois Natural History Survey and Long Term Resource Monitoring, Pool 26, West Alton, Missouri
Joe Wlosinski, U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, Wisconsin

Program and Proceedings

Teresa Naimo, U.S. Fish and Wildlife Service, National Fisheries Research Center, La Crosse, Wisconsin

Registration Table

Georginia Ardinger, U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, Wisconsin
Virginia Stefanez, U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, Wisconsin

Poster and Display Arrangements

Ronald Rada, River Studies Center, University of Wisconsin-La Crosse, La Crosse, Wisconsin
Jennifer Sauer, U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, Wisconsin
Joe Wlosinski, U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, Wisconsin

Visual Aids

Robert Kennedy, U.S. Fish and Wildlife Service, National Fisheries Research Center, La Crosse, Wisconsin
Doug Betz, U.S. Fish and Wildlife Service, National Fisheries Research Center, La Crosse, Wisconsin

Raffle Prizes

Rick Anderson, Western Illinois University, Macomb, Illinois
Dave Kennedy, U.S. Fish and Wildlife Service, National Fisheries Research Center, La Crosse, Wisconsin
La Crosse Footwear, Inc., La Crosse, Wisconsin

Platform Session Moderators

W. Gregory Cope, U.S. Fish and Wildlife Service, National Fisheries Research Center, La Crosse, Wisconsin
Daniel Hornbach, Department of Biology, Macalaster College, St. Paul, Minnesota
Kevin Kenow, U.S. Fish and Wildlife Service, Northern Prairie Wildlife Research Center, Section of Lake States Ecology, La Crosse, Wisconsin
Teresa Naimo, U.S. Fish and Wildlife Service, National Fisheries Research Center, La Crosse, Wisconsin
Bill Richardson, U.S. Fish and Wildlife Service, National Fisheries Research Center, La Crosse, Wisconsin
Sara Rogers, U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, Wisconsin
Mark Sandheinrich, River Studies Center, University of Wisconsin-La Crosse, La Crosse, Wisconsin
Pam Thiel, U.S. Fish and Wildlife Service, Fishery Resources Office, Winona, Minnesota

Judges for Best Paper Awards and Best Poster Award

Rick Anderson, Western Illinois University, Macomb, Illinois
Doug Blodgett, Illinois Natural History Survey, Havana, Illinois
Dave Day, Illinois Department of Conservation, Aledo, Illinois
Steve Gutreuter, U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, Wisconsin
Cecil Jennings, U.S. Fish and Wildlife Service, National Fisheries Research Center, La Crosse, Wisconsin
Carl Korschgen, U.S. Fish and Wildlife Service, Northern Prairie Wildlife Research Center, Section of Lake States Ecology, La Crosse, Wisconsin
Bill Richardson, U.S. Fish and Wildlife Service, National Fisheries Research Center, La Crosse, Wisconsin
Sara Rogers, U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, Wisconsin
Mike Romano, Western Illinois University, Macomb, Illinois
Dave Soballe, U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, Wisconsin
Rip Sparks, Illinois Natural History Survey, Havana, Illinois
Pam Thiel, U.S. Fish and Wildlife Service, Fishery Resources Office, Winona, Minnesota
Dan Wilcox, U.S. Army Corps of Engineers, St. Paul District, St. Paul, Minnesota

Cover Art

Craig Phillips, Silver Springs, Maryland