PROCEEDINGS OF THE
MISSISSIPPI RIVER RESEARCH CONSORTIUM

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PROCEEDINGS OF THE MISSISSIPPI RIVER RESEARCH CONSORTIUM

VOLUME 32

MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.

32ND ANNUAL MEETING
13-14 APRIL 2000
RADISSON HOTEL
LA CROSSE, WISCONSIN

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PLATFORM PROGRAM
HOTEL BALLROOM
THURSDAY, APRIL 13, 2000

8:00- 8:20 AM WELCOME AND INTRODUCTIONS
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SESSION I - HREP/LTRM STUDIES
(Moderator: Todd Koel)

8:20- 8:40 AM EXAMPLES OF HABITAT REHABILITATION AND ENHANCEMENT PROJECTS CONSTRUCTED IN THE UPPER MISSISSIPPI RIVERS. **Jeffrey A. Janvrin.** Wisconsin Department of Natural Resources, 3550 Mormon Coulee Road, La Crosse, WI 54601.

8:40- 9:00 AM POPULATION ASSESSMENT OF LARGEMOUTH BASS IN THE UPPER MISSISSIPPI RIVER SYSTEM BY THE LONG TERM RESOURCE MONITORING PROGRAM. **Kevin S. Irons**[1], Todd M. Koel[2], T. Matt O'Hara[1], and Michael McClelland[1]. [1] Illinois Natural History Survey, Long Term Resource Monitoring Program, Havana Field Station, 704 North Schrader Avenue, Havana, IL 62644; and [2] Minnesota Department of Natural Resources, Mississippi Monitoring Station, 1801 South Oak Street, Lake City, MN 55041.

9:00- 9:20 AM RELATIONSHIP OF HYDROLOGICAL REGIME TO LARVAL FISH/ZOOLPLANKTON PRODUCTION IN A MOIST SOIL MANAGEMENT UNIT. **James A. Stoeckel**[1], Kevin S. Irons[1], Ted E. Snider[2], and Kristy C. Boggs[1]. [1] Illinois Natural History Survey, Long Term Resource Monitoring Program, Havana Field Station, 704 North Schrader Avenue, Havana, IL 62644; and [2] Illinois State Water Survey, P.O. Box 697, Peoria, IL 61652.

9:20- 9:40 AM FACTORS INFLUENCING THE COMMUNITY STRUCTURE AND DISTRIBUTION OF ZOOPLANKTON IN LAKE CHAUTAUQUA. **Kristy C. Boggs**[1,2], James A. Stoeckel[1], and Richard V. Anderson[2]. [1] Illinois Natural History Survey, Long Term Resource Monitoring Program, Havana Field Station, 704 North Schrader Avenue, Havana, IL 62644; and [2] Department of Biological Sciences, Western Illinois University, 1 University Circle, Macomb, IL 61455.

9:40-10:00 AM TRIBUTARY CONTRIBUTIONS OF NUTRIENT LOADS AND SUSPENDED SOLIDS TO THE ILLINOIS RIVER SYSTEM. **Jeff L. Arnold** and Dustin W. Gallagher. Long Term Resource Monitoring Program, Havana Field Station, 704 North Schrader Avenue, Havana, IL 62644.

10:00-10:20 AM **BREAK**

SESSION II - LTRM VEGETATION STUDIES
(Moderator: Yao Yin)

10:20-10:40 AM DIVERSITY OF FLOODPLAIN FORESTS OF LA GRANGE REACH (RM 80-158), ILLINOIS RIVER, FOLLOWING SIGNIFICANT DISTURBANCE. **Michelle M. Cripps** and Thad R. Cook. Illinois Natural History Survey, Long Term Resource Monitoring Program, Havana Field Station, 704 North Schrader Avenue, Havana, IL 62644.

10:40-11:00 AM A PROFILE OF SUBMERSED AQUATIC VEGETATION ON NAVIGATION POOL 4 OF THE UPPER MISSISSIPPI RIVER SYSTEM. **Megan Moore**. Minnesota Department of Natural Resources, Mississippi River Monitoring Office, 1801 South Oak Street, Lake City, MN 55041.

11:00-11:20AM A PROFILE OF SUBMERSED AQUATIC VEGETATION ON POOL 8 OF THE UPPER MISSISSIPPI RIVER SYSTEM. **Heidi Langrehr.** Wisconsin Department of Natural Resources, 575 Lester Avenue, Onalaska, WI 54650.

11:20-11:40 AM STRATIFIED RANDOM SAMPLING OF SUBMERSED AQUATIC VEGETATION ON POOL 13, UPPER MISSISSIPPI RIVER SYSTEM, FROM 1998 TO 1999. **Theresa Blackburn.** Mississippi Monitoring Station, Iowa Department of Natural Resources, 206 Rose Street, Bellevue, IA 52031.

11:40-12:00 N SIMULATED SUBMERSED AQUATIC VEGETATION DYNAMICS FROM 1988 TO 1999 IN POOL 8, UPPER MISSISSIPPI RIVER. **Yao Yin**[1], Jim Rogala[1], Dayong Zhang[2], and John Sullivan[3]. [1] U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54602; [2] Beijing Normal University, Beijing, China; and [3] Wisconsin Department of Natural Resources, La Crosse, WI 54601.

12:00- 1:20 PM **LUNCH** (On your own)

SESSION III - BIOTA
(Moderator: Jeff Arnold)

1:20- 1:40 PM DISPERSAL AND SURVIVAL OF JUVENILE PEREGRINE FALCONS DURING A RESTORATION PROJECT IN DUBUQUE, IA. **Irene M. Barry** and Larkin A. Powell. Department of Biology and Environmental Science, University of Dubuque, 2000 University Avenue, Dubuque, IA 52001.

1:40- 2:00 PM FALL LOCAL MOVEMENTS, HABITAT USE, AND POPULATION DYNAMICS OF TUNDRA SWANS ON THE UPPER MISSISSIPPI RIVER. **Erik M. Thorson** and James A. Cooper. Department of Fisheries and Wildlife, University of Minnesota, St. Paul, MN 55108.

2:00- 2:20 PM POPULATION DECLINE AND POTENTIAL NEGATIVE IMPACTS ON COMMON LOON (*GAVIA IMMER*) PRODUCTIVITY AT POKEGAMA LAKE, UPPER MISSISSIPPI RIVER. **Thomas C. Dunstan.** Department of Biological Sciences, Western Illinois University, 1 University Circle, Macomb, IL 61455.

2:20- 2:40 PM DISPERSION AND FORAGING BEHAVIOR OF GREAT BLUE HERONS (*ARDEA HERODIAS*) DURING FLOODSTAGE IN UPPER POOL 20, MISSISSIPPI RIVER. **Jeremy E. Guinn** and Thomas C. Dunstan. Department of Biological Sciences, Western Illinois University, 1 University Circle, Macomb, IL 61455.

2:40- 3:00 PM THE ROUND GOBY: AN UNWELCOME INVADER TO THE MISSISSIPPI RIVER BASIN. **Mark T. Steingraeber** and Pamella A. Thiel. U.S. Fish and Wildlife Service, Fishery Resources Office, 555 Lester Avenue, Onalaska, WI 54650.

3:00- 3:20 PM **BREAK**

3:20- 3:40 PM CORRELATION OF GENETIC STRUCTURE OF *TRACHEMYS SCRIPTA*, RED-EARED SLIDER, POPULATIONS WITH RADIOTELEMETRY STUDIES OF TURTLE MOVEMENT. **Michael A. Romano**[1], Mandy L. Fross[2], Kathleen L. Rangen[1], Richard V. Anderson[1], and Michelle L. Gutierrez[1]. [1] Department of Biological Sciences, Western Illinois University, 1 University Circle, Macomb, IL 61455; and [2] U.S. Geological Survey, Columbia Environmental Research Center, 4200 New Haven Road, Columbia, MO 65201.

3:40- 4:00 PM 1999 CRAYFISH DISTRIBUTION SURVEY OF THE ST. CROIX NATIONAL SCENIC RIVERWAY, ST. CROIX AND NAMEKAGON RIVERS, MINNESOTA AND WISCONSIN. **Byron N. Karns**, Robin Maercklein, and Randy Ferrin. St. Croix National Scenic Riverway, National Park Service, St. Croix Falls, WI 54024.

4:00- 4:20 PM UNIONID MUSSELS OF DREDGE CUTS AND PLACEMENT SITES, POOLS 11-22. **Jim Eckblad.** Department of Biology, Luther College, Decorah, IA 52101.

4:20- 4:40 PM DO JUVENILE UNIONIDS LIKE SAND? A 1996 UNIONID TRANSLOCATION AT A SITE WITH A MODERATE *DREISSENA POLYMORPHA* (PALLAS 1771) INFESTATION, MISSISSIPPI RIVER MILE 725.8, T.H. 43 BRIDGE, WINONA, MINNESOTA/WISCONSIN. **Marian E. Havlik.** Malacological Consultants, 1603 Mississippi Street, La Crosse, WI 54601-4969.

5:00- 6:30 PM **POSTERS**

6:30- 8:30 PM **BANQUET**

PLATFORM PROGRAM
HOTEL BALLROOM
FRIDAY, APRIL 14, 2000

SESSION IV - ECOHYDROLOGY
(Moderator: Joe Wlosinski)

8:30- 8:50 AM ECOHYDROLOGY OF THE ILLINOIS RIVER: DEVELOPMENT OF CRITERIA FOR OPERATIONS OF THE LA GRANGE AND PEORIA LOCKS AND DAMS. **Todd M. Koel**[1,2] and Richard E. Sparks[3,4]. [1] Minnesota Department of Natural Resources, Mississippi Monitoring Station, Lake City, MN 55041; [2] U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603; [3] Water Resources Center, University of Illinois at Urbana-Champaign, Urbana, IL 61801; and [4] Illinois Natural History Survey, Long Term Resource Monitoring Program, Havana Field Station, 704 North Schrader Avenue, Havana, IL 62644.

8:50- 9:10 AM A MODEL FOR ANNUAL STREAMFLOW IN THE UPPER MISSISSIPPI BASIN BASED ON SOLAR IRRADIANCE. **Charles A. Perry**. U.S. Geological Survey, 4821 Quail Crest Place, Lawrence, KS 66049.

9:10- 9:30 AM ANALYSIS OF GAGE RECORDS TO IDENTIFY AND QUANTIFY CHANGES WITH "INDICATORS OF HYDROLOGICAL ALTERATION" (IHA) SOFTWARE. **Chuck Theiling**[1], Scot Johnson[2], and Joseph H. Wlosinski[1]. [1] U. S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603; and [2] Minnesota Department of Natural Resources, 1801 South Oak Street, Lake City, MN 55041.

9:30- 9:50 AM INCREASED FLOODING PORTENDS INCREASED DISTURBANCE FOR FLOODPLAIN FORESTS. **Joseph H. Wlosinski** and Yao Yin. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603.

9:50-10:10 AM EFFECT OF FLOODPLAIN VEGETATION ON FLOOD MANAGEMENT: CASE STUDY OF THE UPPER EMBARRAS RIVER. **Matthew J. Hoffman**[1] and David Soong[2]. [1] Department of Civil and Environmental Engineering, University of Illinois at Urbana-Champaign, Urbana, IL 61801; and [2] Illinois State Water Survey, 2204 Griffith Drive, Champaign, IL 61820.

10:10-11:30 AM **BUSINESS MEETING**

11:30- 1:00 PM **LUNCH**

SESSION V - NUTRIENTS-TRIBUTARIES PROBLEMS
(Moderator: Lynn Bartsch)

1:00- 1:20 PM DENITRIFICATION IN THE UPPER MISSISSIPPI RIVER: THE ROLE OF NITRATE DELIVERY AND SEDIMENT CARBON. **W. Richardson**, E. Strauss, E. Monroe, L. Rabuck, L. Bartsch, and D. Soballe. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603.

1:20- 1:40 PM THE ROLE OF RESERVOIRS IN NITROGEN TRANSPORT IN THE UPPER MISSISSIPPI RIVER BASIN. **Dennis M. Wasley**[1,2] and David Soballe[1]. [1] U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603; and [2] River Studies Center, University of Wisconsin-La Crosse, La Crosse, WI 54601.

1:40- 2:00 PM EFFECTS OF PHOSPHORUS LOADINGS ON THE WATER QUALITY OF THE UPPER MISSISSIPPI RIVER, LOCK AND DAM NO 1. THROUGH LAKE PEPIN. Catherine E. Larson, **D. Kent Johnson**, Rececca J. Flood, Michael L. Meyer, Terrie J. O'Dean, and Scott M. Schellhaass. Metropolitan Council Environmental Services, Environmental Planning and Evaluation Department, 230 East Fifth Street, St. Paul, MN 55101-1633.

2:00- 2:20 PM CONSERVATION TILLAGE PRACTICES AND THE BIOLOGICAL INTEGRITY OF TRIBUTARY STREAMS OF THE UPPER MISSISSIPPI RIVER. **Roger J. Haro**[1], Andrew F. Burgess[1], and Prasanna H. Gowda[2]. [1] River Studies Center, University of Wisconsin-La Crosse, La Crosse, WI 54601; and [2] Department of Soil, Water and Climate, University of Minnesota-Twin Cities Campus, 1991 Upper Bufford Circle, St. Paul, MN 55108.

2:20- 2:40 PM RECREATIONAL BOAT WAVE IMPACTS ON ST. CROIX RIVER SHORELINES. **Scot Johnson**[1], Randy Ferrin[2], Wendy Griffin[3], Deborah Konkel[4], and David Pitt[5]. [1] Minnesota Department of Natural Resources, 1801 South Oak Street, Lake City, MN 55041; [2] National Park Service, 401 Hamilton Street, St. Croix Falls, WI 54024; [3] Washington County Soil and Water Conservation District, 1825 Curve Crest Boulevard, Room 101, Stillwater, MN 55082; [4] Wisconsin Department of Natural Resources, 1300 West Clairemont, Eau Claire, WI 54201; and [5] University of Minnesota, 110 Architecture Building, 89 Church Street SE, Minneapolis, MN 55455.

2:40- 3:00 PM RESTORATION OF THE LOWER WHITEWATER RIVER. **Tim Schlagenhaft.** Minnesota Department of Natural Resources, 1801 S. Oak St., Lake City, MN 55041.

3:00- 3:20 PM **BEST STUDENT PAPER AWARDS**

NOTES

POSTER PRESENTATIONS
THURSDAY, APRIL 13, 2000, 10 AM - 7 PM
Authors Present 5 - 6 PM
(Listing by topic)

BIRDS

DISPERSAL AND HABITAT USE OF JUVENILE PEREGRINE FALCONS DURING A RESTORATION PROJECT IN DUBUQUE, IA. **Dan J. Calvert** and Larkin A. Powell. Department of Biology and Environmental Science, University of Dubuque, 2000 University Avenue, Dubuque, IA 52001.

FISH

EFFECTS OF ABIOTIC FACTORS ON CHANNEL CATFISH *ICTALURUS PUNCTATUS* POPULATIONS IN THE ILLINOIS RIVER. **Kathryn A. Emme**[1], Dr. Kenneth Cramer[1], and Kevin S. Irons[2]. [1] Department of Biology, Monmouth College, 700 East Broadway, Monmouth, IL 61462; and [2] Illinois Natural History Survey, Long Term Resource Monitoring Program, Havana Field Station, 704 North Schrader Avenue, Havana, IL 62644.

AN ASSESSMENT OF FISH COMMUNITIES AT THE LA GRANGE AND PEORIA LOCKS AND DAMS ON THE ILLINOIS RIVER. **T. Matt O'Hara**, Kevin S. Irons, and Michael McClelland. Long Term Resource Monitoring Program, Havana Field Station, 704 North Schrader Avenue, Havana, IL 62644.

MAMMALS

SMALL MAMMAL POPULATION SIZE AND HABITAT USE IN WHITE PINE AND HARDWOOD HABITATS IN WHITE PINE HOLLOW STATE PRESERVE, IOWA. **Aaron Kremer** and Larkin A. Powell. Department of Biology and Environmental Science, University of Dubuque, 2000 University Avenue, Dubuque, IA 52001.

SMALL MAMMAL METAPOPULATION DYNAMICS IN A RECENTLY ESTABLISHED MITIGATION AREA. **Ann Weckback**, Chris Kirkpatrick, Tina Kocer, Matthew Watters, Shannon Kass, Parisa Hajaliakbari, and Stacey Svoboda. Environmental Science Department, University of Dubuque, Dubuque, IA 52001.

MUSSELS

LONG TERM CHANGES IN MUSSEL POPULATIONS OF THE ST. CROIX RIVER. Thomas W. Hermanson, Leda A. Cunningham, Katie G. Esse, Jensen C. Hegg, **Mark C. Hove**, Jennifer L. Mann, and Daniel J. Hornbach. Macalester College, Biology Department, 1600 Grand Avenue, St. Paul, MN 55105.

TAXONOMIC IDENTIFICATION OF FRESHWATER MUSSELS OF THE ST. CROIX RIVER THROUGH DNA ANALYSIS. Megan Albert, Cynthia Harrison, James G. Straka, **Mark C. Hove**, and Daniel Hornbach. Departments of Biology and Chemistry, Macalester College, St. Paul, MN 55105.

THE EFFICACY OF MUSSEL RELOCATION AS A RESOURCE MANAGEMENT TOOL: AN EXPERIMENT IN THE ST. CROIX RIVER. Leda A. Cunningham, Daniel J. Hornbach, and **Mark C. Hove**. Biology Department, Macalester College, 1600 Grand Avenue, St. Paul, MN 55105.

MUSSELS (continued)

ZEBRA MUSSEL VELIGER SUPPLY AND SETTLEMENT IN THE ILLINOIS RIVER. **Angela Nealand**[1], James A. Stoeckel[1], and Daniel W. Schneider[2]. [1] Center for Aquatic Ecology, Illinois Natural History Survey, Long Term Resource Monitoring Program, Havana Field Station, 704 North Schrader Avenue, Havana IL 62644; and [2] Department of Urban and Regional Planning and Illinois Natural History Survey, University of Illinois at Urbana-Champaign, Champaign, IL 61820.

PRELIMINARY FINDINGS FROM A SURVEY OF UNIONID MUSSEL POPULATIONS OF THE STREAMS OF THE IOWA DRIFTLESS REGION. **Brett J. Ostby** and Jim Eckblad. Department of Biology, Luther College, Decorah, IA 52101.

MACROINVERTEBRATES OTHER THAN MUSSELS

ASSOCIATION BETWEEN ANNUAL HYDROLOGICAL PATTERNS AND INVERTEBRATE PRODUCTIVITY IN A LARGE RIVER. **Denise Bruesewitz** and Michael Delong. Large River Studies Center, Biology Department, Winona State University, Winona, MN 55987.

TEST FOR COMPETITIVE INTERACTIONS BETWEEN ZEBRA MUSSELS AND HYDROPSYCHID CADDISFLIES. **Jessica Konz, Kristin Mack**, and Michael Delong. Large River Studies Center, Biology Department, Winona State University, Winona, MN 55987.

WATER QUALITY

DIURNAL STUDY IN LAKE PEPIN NAVIGATION CHANNEL. Arthur L. Howard[1], **Robert Burdis**[2], and M. A. Engen[1]. [1] Department of Chemistry, Winona State University, Winona, MN 55987; and [2] Minnesota Department of Natural Resources, 1801 South Oak Street, Lake City, MN 55041.

FECAL COLIFORM AND *ESCHERICHIA COLI* CONTAMINATION IN PRAIRIE CREEK WATERSHED. **Ildiko Holschuh**, Gary E. Wagenbach, and Debby Walser-Kuntz. Carleton College, 300 N. College Street, Northfield, MN 55057.

NITRATE UPTAKE BY FORESTED FLOOD PLAIN SOILS OF THE BLACK RIVER, LA CROSSE, WISCONSIN. **Rebekka Steidler**[1,2], Emy Monroe[1], and William Richardson[1]. [1] U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54602; and [2] Department of Chemistry, Winona State University, Winona, MN 55987.

COMPARISON OF SEVERAL MAJOR ION CONCENTRATIONS IN TWO ADJACENT MISSISSIPPI RIVER TRIBUTARIES. **Jamie Tosetti** and Kurt Hartman. Department of Environmental Science, University of Dubuque, Dubuque, IA 52001.

VEGETATION

RELATIONSHIPS OF TREE SPECIES TO ENVIRONMENTAL FACTORS IN PRESETTLEMENT FORESTS IN THE LA CROSSE, WISCONSIN AREA. **Nicole M. Hartz**[1,2] and Robin W. Tyser[1,2]. [1] U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603; and [2] River Studies Center, University of Wisconsin-La Crosse, WI 54601.

CHANGES IN A SAND PRAIRIE PLANT COMMUNITY AFTER APPLYING A NATIVE SEED MIXTURE. **Jason A. Veldboom**[1], Kristen K. Kamla[1], Robin W. Tyser[1,2], and Melinda G. Knutson[3]. [1] Department of Biology, University of Wisconsin-La Crosse, La Crosse, WI 54601; [2] River Studies Center, University of Wisconsin, La Crosse, La Crosse, WI 54601; and [3] U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603.

TRIBUTARY CONTRIBUTIONS OF NUTRIENT LOADS AND SUSPENDED SOLIDS TO THE ILLINOIS RIVER SYSTEM

Jeff L. Arnold and Dustin W. Gallagher.
Long Term Resource Monitoring Program, Havana Field Station, 704 North Schrader Avenue, Havana, IL 62644.

Recently, considerable attention has been focused on hypoxia in the Gulf of Mexico. Excess nutrient loading from the Mississippi River basin is being blamed for this situation. Due to liberal fertilizer application and intensive agricultural practices, Illinois contributes large amounts of nutrients and sediments to the Illinois and Mississippi River systems. Beginning in 1989, the Illinois Natural History Survey's Long Term Resource Monitoring Program began monitoring various limnological parameters on the La Grange reach of the Illinois River. Water passing through this reach is derived from a basin area of approximately 24,648 mi^2. In 1993, monitoring effort was expanded to include the five Illinois River tributaries of Quiver (261 mi^2), Mackinaw (1,140 mi^2), La Moine (1,315 mi^2), Spoon (1,860 mi^2), and Sangamon (5,420 mi^2) Rivers with a total drainage area of 10,031 mi^2. Monthly and annual nitrogen, phosphorus, and suspended solids loads were calculated for each tributary. Preliminary results indicate that, on average, Sangamon River contributed the highest nitrogen and phosphorus loads with a maximum load occurring in 1993. At this time, the annual nitrogen load was calculated at 60,000 metric tons and the annual phosphorus load was calculated at 4,000 metric tons. However, when comparing nutrient loads in relation to basin size, the Mackinaw and Spoon Rivers contributed more nitrogen and phosphorus. In 1993, the Mackinaw River emptied approximately 16 metric tons/mi^2/year of nitrogen and 1.8 metric tons/mi^2/year of phosphorus into the Illinois River while Spoon River discharged approximately 12 metric tons/mi^2/year of nitrogen and 2.0 metric tons/mi^2/year of phosphorus. By comparison, the Sangamon River emptied approximately 10 metric tons/mi^2/year of nitrogen and .6 metric tons/mi^2/year of phosphorus into the Illinois River. Spoon River was also the primary contributor of suspended solids into the Illinois River system. In 1993, approximately 9,500,000 metric tons/year of suspended solids entered La Grange reach from the entire river basin. Of this total, nearly 4,500,000 metric tons/year originated from the Spoon River basin.

Keywords: Illinois River, hypoxia, nutrient loads, suspended solids, nitrogen

DISPERSAL AND SURVIVAL OF JUVENILE PEREGRINE FALCONS DURING A RESTORATION PROJECT IN DUBUQUE, IA

Irene M. Barry and Larkin A. Powell.
Department of Biology and Environmental Science, University of Dubuque, 2000 University Avenue, Dubuque, IA 52001.

In the largest single restoration effort in Iowa to date, 21 juvenile peregrine falcons (*Falco peregrinus*) were released by the Iowa Department of Natural Resources from a natural cliff near Eagle Point Park in Dubuque, Iowa during summer 1999. We used radio-telemetry and observations of color-marked birds at the hack site to estimate daily survival rates and dispersal dates. Falcons were released in a staggered manner from mid-June until late-July. Older falcons remained at the site longer than at previous urban releases and interacted with the younger falcons. Although we had planned to use aerial telemetry to track radio-marked falcons after they left the hack site, all radio -marked falcons remained at the hack site at least until they removed their leg-mounted radio transmitters. Community interest in the project was high; the three mortalities confirmed during the summer were discovered and reported by citizens near the release site. Prior concerns about great-horned owl predation were unfounded at this release site, as no mortalities were attributed to these predators.

Keywords: peregrine falcon, *Falco peregrinus*, Mississippi River cliffs, dispersal, survival

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STRATIFIED RANDOM SAMPLING OF SUBMERSED AQUATIC VEGETATION ON POOL 13, UPPER MISSISSIPPI RIVER SYSTEM, FROM 1998 TO 1999

Theresa Blackburn.
Mississippi Monitoring Station, Iowa Department of Natural Resources, 206 Rose Street, Bellevue, IA 52031.

In 1998, the Long Term Resource Monitoring Program initiated a stratified random sampling protocol to monitor submersed aquatic vegetation (SAV) in the Upper Mississippi River System (UMRS). The primary objective of the monitoring is to determine the status and trends of SAV within target pools of the UMRS. During each summer in 1998 and 1999, SAV data were collected in Pool 13 at 550 sites randomly distributed within shallow aquatic areas ($<=3$ m in 1998 and $<=2.5$ m in 1999). The shallow aquatic areas were classified into 7 habitat strata including contiguous and isolated backwaters, main and side channel borders and the impounded area. Data collected included both visual observation and rake samples. The data enable us to construct a profile of SAV in each habitat stratum and in the entire Pool 13.

Frequency of SAV remained about the same throughout Pool 13 in 1998 and 1999. Isolated backwaters contained the most SAV in both 1998 and 1999. Fifteen species of SAV were encountered in Pool 13 in both 1998 and 1999 with thirteen species occurring in contiguous backwater strata in 1998 and thirteen species occurring in the impounded area in 1999. Coontail (*Ceratophyllum demersum*) and sago pondweed (*Potamogeton pectinatus*) were the most frequently encountered and abundant species in both years in most strata. Coontail was not sampled at main channel boarder sites in 1999. Coontail and sago pondweed were distributed throughout the entire pool. Eurasian milfoil (*Myriophyllum spicatum*), wild celery (*Vallisneria americana*) and water stargrass (*Heteranthera dubia*) were not found in backwater isolated strata and were distributed only in the lower half of the pool.

Keywords: submersed aquatic vegetation, Upper Mississippi River, trend analysis, stratified random sampling, Long Term Resource Monitoring Program

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FACTORS INFLUENCING THE COMMUNITY STRUCTURE AND DISTRIBUTION OF ZOOPLANKTON IN LAKE CHAUTAUQUA

Kristy C. Boggs [1,2], James A. Stoeckel [1], and Richard V. Anderson [2].
[1] Illinois Natural History Survey, Long Term Resource Monitoring Program, Havana Field Station, 704 North Schrader Avenue, Havana, IL 62644; and [2] Department of Biological Sciences, Western Illinois University, 1 University Circle, Macomb, IL 61455.

Lake Chautauqua is a backwater lake of the Illinois River near Havana, IL. It is divided by a cross dike into northern (Kikunessa) and southern (Wasenza) pools and is managed by the US Fish and Wildlife Service as part of the Illinois River Refuges. In 1992 it was selected as a site for a Habitat Rehabilitation and Enhancement Project (HREP) by the Environmental Management Program for the Upper Mississippi River System. As part of the HREP the Illinois Natural History Survey conducted a study of the larval fish production in the Wasenza Pool. Zooplankton in Wasenza Pool were examined to determine the food base available to larval fish. This study is a more detailed look at the zooplankton community that was examined for the HREP study. In this study we determined the community structure and how it changed throughout the season. We then attempted to correlate these changes to changes in environmental factors such as water temperature, dissolved oxygen, turbidity, water depth, and degree of connection between the lake and river to determine what effect, if any, these factors have on community structure. Three fixed sites were established in open water areas of the lake and zooplankton was sampled weekly from 4-21-98 to 7-27-98. These samples were counted and identified during the summer of 1999. Rotifers and cladocerans were identified to at least the genus level and in many cases to species. Copepods were identified to suborder. The density and diversity of zooplankton for the entire limnetic portion of the lake was determined by averaging the 3 sites together. During analysis of samples it was noted that on some dates there were great differences in abundance between sites. The previously mentioned factors and larval fish distribution are currently being examined to determine if any of these factors are responsible for the differences between sites.

Keywords: zooplankton; Lake Chautauqua, backwater lake, Illinois River

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DIVERSITY OF FLOODPLAIN FORESTS OF LA GRANGE REACH (RM 80-158), ILLINOIS RIVER, FOLLOWING SIGNIFICANT DISTURBANCE

Michelle M. Cripps and Thad R. Cook.
Illinois Natural History Survey, Long Term Resource Monitoring Program, Havana Field Station, 704 North Schrader Avenue, Havana, IL 62644.

The floodplain forests of the Illinois River have been subject to developmental disturbance since modern European settlement. Logging, changes in hydrology, and conversion to agriculture have had significant effects on the composition of floodplain forests. The 1993 flood, which lasted almost the entire growing season, gives us the unique opportunity to study the effects of another significant disturbance to this very important ecosystem. Random quadrat sampling at 46 sites throughout the La Grange Reach of the Illinois River (RM 80-158) revealed mature tree mortality ranged between 0% and 100% at each site with an average of 24.7% mortality per sampling site. Trees in smaller diameter classes had a higher mortality than larger diameter classes. The average density of trees per hectare dropped from 203 to 146 due to the flood. Simpson's Diversity Index showed only a slight decrease in species diversity. Importance Values indicated Silver Maple (*Acer saccharinum*) to be the most important mature tree species and to have increased in dominance after the 1993 flood. Willow species, the second most abundant species, decreased in dominance. Pecan (*Carya illinoensis*), the only mast species encountered, was found in very low numbers. Of the 15 species found during sampling, 6 can be considered rare species.

Keywords: floodplain forest, Illinois River, La Grange Reach, species diversity, 1993 flood

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POPULATION DECLINE AND POTENTIAL NEGATIVE IMPACTS ON COMMON LOON (*GAVIA IMMER*) PRODUCTIVITY AT POKEGAMA LAKE, UPPER MISSISSIPPI RIVER

Thomas C. Dunstan.
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A long-term study of common loon (*Gavia immer*) breeding behavior and productivity was conducted on Pokegama Lake from 1978 to 1999 in the Upper Mississippi River drainage region of northern Minnesota. Pokegama Lake is a relatively large body of water with small creeks flowing in and out, in addition to one major outlet that is composed of a series of smaller named lakes connected to the Mississippi River upstream of two dams, one for flow management and the other for industrial purposes. The lake is essential habitat for breeding and non-breeding loons. Baseline data from the breeding seasons of both 1978 and 1978 identified 13 active loon breeding territories that produced 23 young from 13 successful territories for an average of 1.8 young per active (successful) territory. The number of loon nesting territories, successful territories and productivity have declined over 21 to the 1998 and 1999 results of 3 young from 3 successful territories for 1.0 young per successful territory in each year. A seasonal chronology of negative impacts which included changes in water level, shoreline development by humans and degradation of loon breeding habitat, and man-caused activities that impacted loon behavior and essential activities were identified and detailed.

Keywords: Common Loon, *Gavia immer*, negative impacts, productivity, behavior

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UNIONID MUSSELS OF DREDGE CUTS AND PLACEMENT SITES, POOLS 11-22

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Field sampling was conducted in 1998 from 36 former dredge cuts and placement sites to evaluate unionid mussel colonization of areas impacted by channel maintenance dredging. The 36 sites included 12 with active dredge cuts or placement within the past 5 years, 12 within 5 to 10 years, and 12 with greater than 15 years. Maps of each site with GIS coordinates were provided by the Rock Island District, Corps of Engineers. A total of 693 live mussels were taken during 142 10-minute diver searches at these sites. An additional 91 live mussels were taken during ten 10-minute diver searches of two potential re-handling sites in Pool 18. The 784 live mussels included 23 different unionid species; an additional 8 individuals, from 6 different sites and 5 different species, were recorded as recent dead mussels. Data from this study, in general, supported the hypothesis that colonization of dredge sites by mussels may occur within the first five years, failed to detect significant differences between different aged sites, and failed to support the contention that colonization is correlated with years since the site was last active. When presence/absence frequencies were included in the analysis, mussel colonization was associated with substrate composition, water depth, and current velocity.

Keywords: unionid mussels, Mississippi River, dredge cuts, colonization, Pools 11 to 22

DISPERSION AND FORAGING BEHAVIOR OF GREAT BLUE HERONS (*ARDEA HERODIAS*) DURING FLOODSTAGE IN UPPER POOL 20, MISSISSIPPI RIVER

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Heron dispersion and foraging behavior were studied from 9 May to May 24, 1999 at a Great Blue Heron (*Ardea herodias*) rookery in Upper Pool 20 of the Mississippi River near Keokuk, Iowa. During late spring 1999 heavy rains produced higher than usual water levels in this part of the pool that influenced heron foraging activity and distribution during the nestling stage of the breeding season. During this period heron dispersal throughout the study area was determined to be non random. A total of 497 heron locations were identified during this study, and of these 261 herons were determined to be foraging. The use of specific foraging techniques was related to the flood stage environment. Eighty percent of foraging herons observe showed a preference for foraging (search phase) from on top of low snags rather than foraging by the more common shoreline wading or open water flight methods used during "normal" seasonal pool levels. Additional implications of high water on heron foraging methods will be detailed.

Keywords: Great Blue Herons, *Ardea herodias*, wading birds, Mississippi River, foraging behavior, flood stage

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CONSERVATION TILLAGE PRACTICES AND THE BIOLOGICAL INTEGRITY OF TRIBUTARY STREAMS OF THE UPPER MISSISSIPPI RIVER

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Land-use practices associated with intensive agriculture in the Upper Mississippi River (UMR) Basin greatly alter aquatic ecosystems, both locally and in receiving waters thousands of kilometers downstream (the Gulf of Mexico). Large-scale best management practices, such as conservation tillage, are effective for preserving on-site soil resources. However, their off-site benefits to local stream ecosystems are not well documented. We estimated sediment erosion rates for 32 subwatersheds in two major UMR tributary basins (Lower Minnesota River, Minnesota and the Maquoketa River, Iowa) from tillage practice data derived from LANDSTAT TM images and from additional spatial data required by the Universal Soil Loss Equation. In 1998, we sampled benthic macroinvertebrate communities and evaluated local stream conditions in the downstream reaches of each subwatershed. We developed Benthic Macroinvertebrate Indices of Biological Integrity (BM-IBI) for each basin and determined scores for all reaches. The linear relationship between BM-IBI scores and estimates of sediment erosion rate were statistically significant, however, our study basins exhibited opposite trends. In both basins, BM-IBI scores were positively related to the percentage of upstream area under conservation tillage. Results suggest that large-scale changes in agricultural land-use practices can affect the local biological integrity of streams even in highly disturbed basins.

Keywords: Mississippi River tributaries, tillage practices, benthic macroinvertebrates

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DO JUVENILE UNIONIDS LIKE SAND? A 1996 UNIONID TRANSLOCATION AT A SITE WITH A MODERATE *DREISSENA POLYMORPHA* (PALLAS 1771) INFESTATION, MISSISSIPPI RIVER MILE 725.8, T.H. 43 BRIDGE, WINONA, MINNESOTA/WISCONSIN

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A unionid translocation from 9 bridge piers (total area 3221 m^2), September 1996, yielded 6129 unionids (23 species, mean density 1.9/m^2) in a primarily sand substrata. No federally listed unionids were found but 2% represented 7 Minnesota and Wisconsin endangered, threatened and special status species. Most of 82 *Obovaria olivaria* (Rafinesque 1820) were juveniles. *Ellipsaria lineolata* (Rafinesque 1820) (1), *Pleurobema sintoxia* (Rafinesque 1820) (4), *Ligumia recta* (Lamarck 1819) (12), and *Utterbackia imbecillis* (Say 1829) (11), were also represented by juveniles. Other special status species were *Arcidens confragosus* (Say 1829) (2), and *Megalonaias nervosa* (Rafinesque 1820) (2). Moderate numbers of visible *Dreissena polymorpha* (Pallas 1771) were removed prior to translocation.

Translocation follow-up 18 September 1997, showed an overall survival of 93.98% (94.74% of numbered special status unionids, and 91.18% of hash-marked common unionids). Spring 1997 high water apparently caused habitat changes since 5-7.5 cm of sand had accumulated over much of the sand, gravel, and mud substrata found at the Translocation Site in 1996. In 1997 most unionids were nearly buried in packed sand. The 1997 mean density of hash-marked common unionids from 32-0.25 quadrats at the translocation site was 4.25/m^2 (11 species); the density of unmarked unionids was 17.25/m^2. Besides hash-marked unionids in quadrats, 38 numbered and 185 hash-marked unionids were found during random searches, for a follow-up total of 250 live and 16 dead marked unionids (4.34% of translocation total). Twelve unmarked special status unionids were found during follow-up: *Arcidens confragosus* (1), *Pleurobema sintoxia* (5), and *Obovaria olivaria* (6). Both at this translocation site, and at a similar translocation site near La Crosse WI, the species that seems most affected by translocation is *Ligumia recta*). We have 7059 the impression that this species would do better if it were placed on the substrata rather than being planted, since there was no other obvious cause of the mortality seen for that species (2 or 4 numbered specimens dead). Others have reported seeing *L. recta* lying of the substrate. Many marked special status unionids, particularly young *Obovaria olivaria* (Rafinesque 1820), clearly showed growth, with 5 mm of growth after the 1996 translocation (a false rest or interruption ring). In 1997 there was another 5mm of growth after the winter rest ring. There was good recruitment and growth in spite of obvious impacts from high water, spring 1997. Only small numbers of *D. polymorpha* were found in 1997. This exotic species does not appear to have seriously impacted the Translocation Site, possibly because of the sand substrata and the large number of buried juvenile unionids.

Keywords: juvenile unionids, unionid habitat, unionid translocation, Mississippi River, *Dreissena polymorpha*

EFFECT OF FLOODPLAIN VEGETATION ON FLOOD MANAGEMENT: CASE STUDY OF THE UPPER EMBARRAS RIVER

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Recently buffer strips have been considered as one of the preferred Best Management Practices (BMPs) for watershed management in controlling sediment and pollutant loads from entering streams. Buffer strips also are known to be natural habitat. Though still are research agenda, documentation regarding the benefits on water quality and biology is available and some design specifications are outlined. However, little detailed analysis has been done to investigate the hydraulic effects of buffer strips.

Buffer strips are applied to floodplains. Changing floodplain characteristics can affect flood stages and thus impact local economics, alter flood frequency and therefore floodplain insurance, and impact the extent of riparian biomass and prominent stream geomorphologic properties. This paper demonstrates how vegetated floodplains can affect stream carrying capacity by translating floodplain vegetation into Manning's roughness coefficients. In that sense, the sizes of the tree, growing seasons (leaf masses), planing arrangement, and placement can all affect the n values and therefore flood stages.

The authors applied different techniques for determining floodplain n values augmentated by trees and shrubs. Among different techniques they concluded proper methods for young and mature trees. In addition, the sensitivity of flood plain n values to vegetation characteristics was considered. The authors were able to identify what information is critical for obtaining accurate capacity predictions.

The results were applied to a HEC-RAS model for the Upper Embarras River in Central Illinois. The authors tested a scenario considering the hydraulic implications if restoration of riparian buffer strips was from young to mature forest. The hydraulic capacity of the same reach at different points in vegetation succession was determined. In this way, the effect on flooding of riparian forest buffer strip creation near population centers can be estimated. The HEC-RAS model results were then developed Hydraulic Performance Graphs and flood levels resulting from different vegetation schemes are mapped. This methodology can be applied for purposes such as flood mitigation and wetland determination.

Keywords: floodplain, vegetation, buffer strips, hydraulic capacity, hydraulic performance graph

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POPULATIONS ASSESSMENT OF LARGEMOUTH BASS IN THE UPPER MISSISSIPPI RIVER SYSTEM BY THE LONG TERM RESOURCE MONITORING PROGRAM

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The Long Term Resource Monitoring Program (LTRMP) for the Upper Mississippi River System (UMRS) includes six field stations located in five states. Since the inception of the program in 1989, > 25,000 largemouth bass have been collected and measured from backwaters, side channels, and other aquatic habitats using multiple gear types. Information on the biology and life history of largemouth bass in this system has been documented by several researchers. However, this is one of the first studies regarding this species which has been conducted on a systemic scale. Largemouth bass catches have varied from 1,123 during the flood year of 1993 to a high of 7,028 during 1995, with an average of 62% of age-zero fishes (< 100 mm) collected from shorelines of contiguous backwaters. Recruitment and growth in the UMRS was closely associated with the hydrological regime, especially in southern reaches where water levels were highly variable. Length-frequency distributions indicated that cohort size was greater during years with high waters. Largemouth bass also exhibited a flood-pulse advantage, and had improved growth when waters approximate the natural flow regime of the river. Reaches with the most diverse channel and off-channel habitats have the most prolific bass populations in this system.

Keywords: Illinois River, Mississippi River, largemouth bass, populations, Long Term Resource Monitoring Program

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EXAMPLES OF HABITAT REHABILITATION AND ENHANCEMENT PROJECTS CONSTRUCTED IN THE UPPER MISSISSIPPI RIVER

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Several types of Habitat Rehabilitation and Enhancement Projects (HREPs) have been constructed in the Mississippi River as one element of the Upper Mississippi River System Environmental Management Program (UMRS-EMP). These projects are planned through an interagency team over a period of several years. The planning team established goals and objectives for these HREPs based on their location within a pool and the habitat types targeted.

Features of HREPs that have been constructed include: islands, moist soil units, backwater dredging, flow introduction/reduction, side channel modifications, bank stabilization and vegetation. However, the majority of projects constructed along Wisconsin's portion of the Mississippi River involved island construction and/or dredging.

Island projects often focus on providing improved environmental conditions to promote the growth of aquatic vegetation. Islands improve environmental conditions for aquatic plants by reducing wave resuspension of fine materials thereby improving light penetration in localized areas. Other objectives for island projects may include: providing predator-free waterfowl and turtle nesting habitat, concentrate the flow of water to promote scour of surrounding area, and disposal sites for material dredged from backwaters.

Backwater dredging projects often focus on improving protected off-channel lacustrine habitat, which usually focuses on restoring or enhancing overwintering conditions for centrarchids. Spoil from the dredge cuts has been used to construct islands or provide topsoil for revegetation of historic channel maintenance disposal sites.

Project design criteria, construction techniques, project monitoring results and lessons learned for projects constructed along Wisconsin's portion of the Upper Mississippi River will be presented.

Keywords: island restoration, EMP, Mississippi River, habitat rehabilitation and enhancement, dredging

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EFFECTS OF PHOSPHORUS LOADINGS ON THE WATER QUALITY OF THE UPPER MISSISSIPPI RIVER, LOCK AND DAM NO. 1 THROUGH LAKE PEPIN

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During the 1988 drought, low river flows and high nutrient levels led to excessive algal blooms in Lake Pepin (Pool 4), accompanied by surface scums, bad odors, low oxygen levels, and localized fish kills. The Metropolitan Wastewater Treatment Plant (Metro Plant), owned and operated by the Metropolitan Council Environmental Services (MCES) is the largest point source of phosphorus upstream of Lake Pepin. In 1990-92 and 1994-1998, MCES and its partners conducted studies to determine the effect of phosphorus (P) loadings from the Metro Plant and other sources on the water quality of the Mississippi River, specifically algal blooms in Lake Pepin and Spring Lake (Pool 2).

The 1994-98 study had six major components. The Science Museum of Minnesota examined sediment cores from Lake Pepin to estimate historical changes in sediment and P loadings and diatom communities. The University of Minnesota studied historical trends in agricultural practices and wastewater discharges to relate human activities to loading changes. MCES assessed a 21-year water-quality database to determine sources and patterns of sediment, P, and chlorophyll loadings. The U.S. Army Engineers conducted limnological studies of Lake Pepin to analyze nutrient and seston fluxes. The MN-WI Boundary Area Commission lead a volunteer monitoring program to evaluate water quality from the users' perspective. HydroQual, Inc. developed an advanced model to project future water-quality conditions under various P management strategies.

Over the past 200 years, algal communities in Lake Pepin have changed from clear-water benthic and mesotrophic planktonic taxa to mostly planktonic assemblages characteristic of highly eutrophic conditions. The major factors are likely increased P concentrations and decreased light. P loadings to the lake have increased more than five-fold to over 4000 mt/yr. Wastewater discharges and fertilizer applications are the likely causes. P concentrations in Lake Pepin have increased approximately four-fold, from 50 to 200 μg/L. Sediment loadings have increased ten-fold for 850,000 mt/yr, most likely due to increases in row-crop acreage.

Currently, nutrients are abundant in the Mississippi River, Lock & Dam 1 through Lake Pepin, and rarely decline to concentrations low enough to limit algal growth. When physical and hydrological conditions are favorable, severe nuisance algal blooms occur especially in lower Pool 2 and Lake Pepin. During periods of low river flows, point sources contribute the majority of P loads upstream of Lake Pepin (e.g., 89% in 1988). However, at high flows, nonpoint sources dominate P loads (e.g., 75% in 1993). At average flows, P loads are roughly split between point and nonpoint sources. The Metro Plant contributed 20% of the TP and over 40% of the SRP during the past two decades. Nonpoint-source loads were highest in the Minnesota River. Only a small fraction of P is retained in Pools 2-4; most is flushed through and transported downstream. During 1985-96, the overall P retention rate in Lake Pepin was 10%. In all 12 years, Lake Pepin was a net sink of particulate P and a net source of SRP. Internal SRP loading represented 10% of the total SRP loading to Lake Pepin during this 12-year period. The fraction climbed to a third in low flow years and two-thirds in low flow summers.

In a future low flow summer, water-quality conditions in Lake Pepin would improve somewhat under the P reduction strategies tested. P concentrations would decrease dramatically but would remain high enough to support excessive algal growth. Even with P removal to 1.0 mg/L at point sources and moderate controls at nonpoint sources, algal levels in Lake Pepin would remain excessive (i.e., viable chlorophyll $a >$ 30 μg/L) over half of the summer. The main benefit would be to reduce peak algal levels during low flow periods. Biological P removal will be fully implemented at the Metro Plant by the end of 2003. However, long-term improvements in water quality will only be achieved through basin-wide reductions in P loadings from point and nonpoint sources.

Keywords: Mississippi River, Lake Pepin, phosphorus, algae, water quality

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RECREATIONAL BOAT WAVE IMPACTS ON ST. CROIX RIVER SHORELINES

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From the Apple River delta downstream to Stillwater, Minnesota is a reach of the St. Croix River that is very popular with recreational power boaters. Scenic bluffs border multiple channels, wooded islands and remote backwaters of this federally designated Wild and Scenic River. Growing concern by river managers and users regarding the potential impacts associated with boating activities led to a number of ongoing field investigations which began in 1995. Field investigations included recreational boat use and distribution, island geomorphic changes, qualitative shoreline assessments, quantitative shoreline surveys, controlled recreational boat wave measurements, normal boating activity measurements, wind-generated wave measurements, normal and flood flow velocity measurements and shoreline vegetation surveys. Highlights from the investigations include:

Since 1969, small wooded islands downstream of the Apple River have lost area and have become more fragmented. The majority of shorelines classified as experiencing medium and high erosion rates were in the main navigation channel. Boat waves and foot-traffic trampling were associated with net shoreline erosion at 9 of the 17 locations surveyed. In controlled boat runs, maximum wave heights of 0.4 feet were determined to surpass a sediment mobilization threshold. The sediment mobilization threshold was verified by measuring normal boating activity effects. Turbidity was only temporarily elevated by boat wave action because shoreline sediments were predominately sand size particles. Wing-generated waves measured on a windy day were much less than the 0.4 feet sediment mobilization threshold and were considered only a minor contributing influence to the observed shoreline erosion. Shoreline vegetation surveys suggested that boat waves and trampling resulted in more bare soil and fewer species of perennial plants. Recreational boat waves and foot-traffic trampling were found to be major contributing influences to the observed shoreline erosion. Overall recreational boating used increased from the 1960s through the 1970s and leveled off in the mid 1980s. Since 1983 boating densities have been high enough to trigger river management policy that includes the study and/or implementation of surface water use regulations.

Keywords: recreation, boating, shoreline, erosion, St. Croix River

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1999 CRAYFISH DISTRIBUTION SURVEY OF THE ST. CROIX NATIONAL SCENIC RIVERWAY, ST. CROIX AND NAMEKAGON RIVERS, MINNESOTA AND WISCONSIN

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The purpose of this survey was to determine the extent of the distribution of the exotic rusty crayfish (*Orconectes rusticus*) and native crayfish on the St. Croix National Scenic Riverway. Previous surveys conducted over the past twelve years (Langlois, 1995; Hobbs and Jass, 1988; Helgen, 1988), indicates three native crayfish species have been found to inhabit the Riverway. These studies, coupled with Park records, suggest a marked increase in rusty crayfish densities, and a noticeable reduction or elimination of native crayfish species. In order for Park Resource Managers to determine what, if any, action could be taken with respect of *O. rusticus*, density and distribution of St. Croix-Namekagon River crayfish should be obtained.

Nineteen sampling locations were selected on the St. Croix and Namekagon Rivers north of Stillwater, Minnesota (12 on the St. Croix ≈ ten mile intervals and 7 of the Namekagon ≈ fifteen mile intervals). The trapping site at each location was determined by the best suitable habitat. All traps were placed in the river via land, at a depth no greater than 70cm. Traps are standard minnow traps with one entrance kept at 2.5 cm, the other widened to 4 cm (this is to reduce crayfish size bias). Bait consisted of rank cow liver. Traps were tagged with name, address and phone, and staked into the substrate for 24 to 48 hours. Additionally, dip net and hand searches augmented collection efforts. Information gathered included, site/location GPS & legal description; substrate; current speed; water depth; vegetation; air/water temperature; crayfish species; carapace length; sex; form; number(s) collected; non-target species/incidental catch. After site and crayfish information was recorded, one voucher (per sex) for each native and all the exotic species were preserved using 10% formalin. The remaining native species were returned to their collection site. Vouchers were deposited at the Bell Museum, University of Minnesota, in St. Paul.

Eighty-seven crayfish were collected from fourteen locations on the St. Croix and Namekagon Rivers (eight on the St. Croix, six on the Namekagon), during the late summer of 1999. Fifty specimens were retained as vouchers. Of thirty-six crayfish collected from the St. Croix, all but two were *P. rusticus*. *Orconectes virilis* was found at two locations along the upper stretch of the St. Croix River. Fifty-one crayfish were collected on the Namekagon: forty-three *Orconectes propinquus*, and eight *O. virilis*. The eight *O. virilis* were taken virtually throughout the Namekagon. *O. rusticus* were not found on the Namekagon River. *O. rusticus* seem to be pervasive and appear locally abundant on the middle third of the St. Croix River. No native crayfish species were discovered below the confluence with the Namekagon. No rusty crayfish were found above the confluence. *O. propinquus* were widespread on the Namekagon, and at one location collected in large numbers. Collecting more than one species per location happened only once, on the upper Namekagon. A rain event during trapping on the upper St. Croix may have affected results along this stretch.

Orconectes rusticus and *O. propinquus* have been shown to hybridize and produce sexually viable offspring. In fact, the crosses appear to be more successfully than either parent, and backcrossing does occur (William Perry, pers. comm.). Therefore, continuing to survey for ranges of all Riverway crayfish species, and limiting the spread of *O. rusticus* (esp. by human means), seems paramount if native crayfish are to remain in the St. Croix and Namekagon River.

Keywords: St. Croix River, crayfish, exotic species, distribution, invasion

ECOHYDROLOGY OF THE ILLINOIS RIVER: DEVELOPMENT OF CRITERIA FOR OPERATIONS OF THE LA GRANGE AND PEORIA LOCKS AND DAMS

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The hydrologic regime of the Illinois River has been severely altered over the past 100 years by many factors. Locks and dams located at several locations along the river to allow commercial navigation have the ability to regulate water surface elevations and flow. This study was initiated to relate changes in surface elevation to biotic productivity of the river, and to establish target criteria for operations of locks and dams. Utilizing long-term records of daily river stage, we developed ecologically-meaningful hydrological parameters for eight gage locations along the Illinois River. Variability in stage magnitudes, durations, frequencies, timings, and rates of change of pulse events were related to inter-annual variability of a long-term fisheries dataset from a survey beginning in 1957. Reversals in surface elevation, maximum stage levels, and high pulse durations were the most important parameters influencing abundances of age-zero fishes in our annual collections. Smallmouth buffalo (*Ictiobus bubalus*), white crappie (*Pomoxis annularis*), freshwater drum (*Aplodinotus grunneins*), and white bass (*Morone chrysops*) were most abundant in our samples during years which approximated the natural flow regime. Of the 31 hydrologic parameters developed for the entire water year from an Illinois River gage site on La Grange Reach, only five post-diversion means were within established target criteria based on the historic, pre-diversion range of variation, from 1879 to 1899. The highest degree of hydrologic alteration over the past 100 years was for minimum stage levels, low pulse count, rates of river rise and rates of river decline. Operations of the La Grange and Peoria locks and dams should be modified so water level variability will approximate that of the late 1800s, when fish and wildlife resources were abundant on this great river.

Keywords: large river fishes, hydrology, floodplain connectivity, water level variability, ecosystem management

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A PROFILE OF SUBMERSED AQUATIC VEGETATION ON POOL 8 OF THE UPPER MISSISSIPPI RIVER SYSTEM

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In 1998, the Long Term Resource Monitoring Program initiated a stratified random sampling protocol to monitor submersed aquatic vegetation (SAV) in the Upper Mississippi River System. The primary objective of the monitoring is to determine the status and trends of SAV within target pools. During the summers of 1998 and 1999, SAV data was collected in Pool 8 at randomly chosen sites (550 in 1998, 600 in 1999) distributed within shallow aquatic areas (< = 3 m in 1998 and < = 2.5 m in 1999). The shallow aquatic areas were classified into 5 habitat strata including contiguous and isolated backwaters, main and side channel borders, and impounded. Data collected included both visual and rake samples. Percent frequency was calculated by dividing the number of sites containing SAV by the total number of sites. The data enable us to construct a profile of SAV in Pool 8 as well as in each habitat stratum.

Overall, Pool 8 showed an increase in SAV from 1998 (50%) to 1999 (57%). Fifteen species were recorded in 1998 and 1999 with the highest number recorded in contiguous backwaters (13 and 14 respectively). Isolated backwaters contained the most SAV in both years followed closely by contiguous backwaters. Isolated backwaters showed a decrease in SAV from 1998 to 1999 while all other strata increased. Canadian waterweed (*Elodea canadenis* Michx.) and coontail (*Ceratophyllum demersum* L.) were the most frequently encountered species in both years. Coontail was the most abundant species in isolated and contiguous backwaters in 1998 and 1999. Canadian waterweed was most abundant in 1998 in impounded and side channel border sites while water stargrass (*Heteranthera dubia* [Jacq.] MacM.) was most abundant in 1999. Wild celery (*Vallisneria americana* Michx.) dominated the main channel border stratum in 1998 and sago pondweed (*Potamogeton pectinatus* L.) dominated in 1999. Coontail, Eurasian watermilfoil (*Myriophyllum spicatum* L.), and sago pondweed were distributed throughout the pool. Wild celery, however, was limited to the lower half of the pool.

Keywords: submersed aquatic vegetation, Mississippi River, trend analysis, distribution

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A PROFILE OF SUBMERSED AQUATIC VEGETATION ON NAVIGATION POOL 4 OF THE UPPER MISSISSIPPI RIVER SYSTEM

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In 1998, the Long Term Resource Monitoring Program initiated a stratified random sampling protocol to monitor submersed aquatic vegetation (SAV) of the Upper Mississippi River System (UMRS). The primary objective of the monitoring is to determine the status and trends of SAV within target pools of the UMRS. During each summer in 1998 and 1999, SAV data were collected in Pool 4 at 550 randomly distributed sites within shallow aquatic areas ($<= 3$ m in 1998 and $<= 2.5$ m in 1999). The shallow aquatic areas were classified into seven habitat strata including isolated backwaters, main channel border, side channel border, upper Lake Pepin (a tributary delta lake), lower Lake Pepin, contiguous backwaters above Lake Pepin and contiguous backwaters below Lake Pepin. The data enable us to construct a profile of SAV in each habitat stratum and in the entire Pool 4.

Pool 4 showed a slight decrease in the overall relative abundance of SAV between 1998 and 1999; however, the number of sites where SAV occurred remained stable. Isolated backwaters contained the greatest abundance of SAV in both years. The most frequently encountered species among all strata in Pool 4 in both years was coontail (*Ceratophyllum demersum* L.). In general, strata above Lake Pepin (upper Pool 4) were sparsely vegetated and had low species richness, with sago pondweed (*Potamogeton pectinatus* L.) as the predominate species; whereas strata below Lake Pepin (lower Pool 4) were more abundantly vegetated and had high species richness. A total of 16 species were found in 1998 and 15 species in 1999, with the largest number recorded in the contiguous backwaters of lower Pool 4 (13 and 13 in 1998 and 1999, respectively). Pool 4 species richness is similar to that of Pools 8 and 13, and higher than that of Pool 26 and La Grange on the Illinois River. Overall frequency of occurrence of SAV in Pool 4 is slightly lower than Pools 8 and 13, but higher than Pool 26 and La Grange.

Keywords: submersed vegetation, aquatic plants, Mississippi River, trend analysis, stratified random sample

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A MODEL FOR ANNUAL STREAMFLOW IN THE UPPER MISSISSIPPI BASIN BASED ON SOLAR IRRADIANCE

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Annual streamflow in the upper Mississippi River basin demonstrates an apparent connection to annual solar-irradiance variations. The relation is associated with the amount of solar energy available for absorption by the tropical Pacific Ocean and the subsequent effects this stored energy has on mid-latitude atmospheric circulation and precipitation occurrence. The suggested physical mechanism for this relation includes varying solar-energy input that creates ocean-temperature anomalies in the tropical ocean. The temperature anomalies are transported northward by ocean currents to locations where ocean and atmospheric processes can modify jet-stream patterns. These patterns affect jet-stream location and characteristics downwind over North America, which affect the occurrence of precipitation and, ultimately, the amount of streamflow in the upper Mississippi River basin. The relation provides an opportunity to estimate the annual streamflow of the upper Mississippi River. A multivariate model using solar-irradiance variations and the previous year's basin precipitation explains nearly one-half of the annual streamflow variability. When data for only La Nina years are considered, the model explains more than two-thirds of the variability since 1950.

Keywords: annual streamflow, Upper Mississippi basin, solar irradiance

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DENITRIFICATION IN THE UPPER MISSISSIPPI RIVER: THE ROLE OF NITRATE DELIVERY AND SEDIMENT CARBON

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Models of nitrate loading to the Gulf of Mexico from the Upper Mississippi River suggests nitrate passes conservatively from the upper river to the Gulf. Yet, the Upper Mississippi River basin contains large expanses of riparian wetlands and vegetated backwater lakes hypothetically capable of supporting substantial eodenitrification. We initiated studies to test this hypothesis in a 27 km reach of the Mississippi River, near La Crosse, Wisconsin. During October 1999, we sampled 60 sites, equally distributed across an organic carbon gradient. At each site we measured denitrification, total sediment organic carbon, porewater and exchangeable NH_4^+ and NO_3^-; in the overlying water we measured NH_4^+ and NO_3^-. Isolated backwaters tended to have the lowest mean denitrification rates (14.9 mg N/m2/d + 4.28 SE), lowest surface water NO_3^- and highest sediment carbon and NH_4^+ concentrations; conversely, sediments near large channels tended to have the highest rates (43.0 mg N/m2/d + 9.3 SE) and lower sediment carbon. In high sediment carbon areas, denitrification = 4.8 (surface water NO^x) + 0.11 (sediment carbon) -0.37; $r^2 = 0.72$, $p = 0.0001$. Monitoring data supports our contention that much of the area with the highest denitrification potential is hydrologically isolated from the NO_3 source. Denitrification across the entire reach would likely increase by increasing connectivity between the main channel and backwaters during summer and fall.

Keywords: nitrogen, denitrification, connectivity, ammonia, sediment carbon

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CORRELATION OF GENETIC STRUCTURE OF *TRACHEMYS SCRIPTA*, RED-EARED SLIDER, POPULATIONS WITH RADIOTELEMETRY STUDIES OF TURTLE MOVEMENT

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Over the past 3 years turtle communities of an open river, slough and backwater site in upper Pool 20, Mississippi River have been evaluated. Seven species of turtles were found to occur in these habitats but density and species composition varied significantly among the habitats. The open river site was dominated by softshell turtles, particularly the smooth softshell turtle. The slough had the greatest diversity with all 7 species of turtles collected in the habitat with the red-eared slider occurring most abundantly. While only 4 species of turtles have been collected from the backwater, 3 of the species, red-eared slider, western painted turtle and common snapping turtle, were all abundant. Mark/recapture data and radio telemetry indicate a high degree of habitat fidelity with individuals remaining in or returning to a specific location. Genetic data based upon allozyme variation also indicate strong fidelity to a specific geographic territory by female red-eared sliders. This has management implications since disruption of habitats extensively used by turtles may greatly alter the turtle community present.

Keywords: turtle communities, mark/recapture data, radio telemetry, habitat fidelity, allozyme variation

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RESTORATION OF THE LOWER WHITEWATER RIVER

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During 1957 an approximately 4.5 mile reach of the lower Whitewater River was bypassed to allow construction of the Dorer Pools, a series of small impoundments managed for waterfowl in the Whitewater Wildlife Management Area. The bypassed reach confined the Whitewater River between dikes, resulting in less frequent inundation of the flood plain which contributed to increased sediment movement into Weaver Bottoms, an important backwater of the Mississippi River. At the time of construction, the impacts of stream channelization were not well understood. The Whitewater River was suffering from intensive agricultural changes in the watershed, and had become wide, shallow, and too warm to support trout, and the channelization project was not considered to have detrimental effects.

Changes in land use in the watershed, however, slowly improved stream physical conditions and water quality resulting in improved fish populations. The lower Whitewater River, immediately upstream of the channelized reach, now supports a trout population averaging 300 adults/mile. The channelized reach, however, remained wide and shallow with predominately sand substrates, and supported a population of less than 10 trout/mile.

During 1999, the lower Whitewater River was restored to portions of its historical channel by diverting flow at two sites, and by constructing an approximately ½ mile "new" channel. Stream length increased by over a mile, with slightly over 3 miles were converted from a channelized ditch to a natural meandering stream. Fish habitat was greatly improved due to increased woody debris cover and greater diversity of depths and substrates in the historical channel. Natural channel bank elevations were lower than the channelized portion allowing the river to inundate portions of the flood plain more frequently, which should increase the number of seasonal wetlands and reduce impacts to Weaver Bottoms by distributing more of the sediment load within the flood plain.

This project was experimental and was the largest stream restoration attempted in Minnesota to date. Construction of the "new" channel was especially challenging, and resulted in a much improved understanding of stream geomorphology. Stream physical conditions and fish populations will continue to be monitored. The project was a cooperative effort between several DNR divisions, and was funded by the Minnesota legislature at a total cost of $510,000. This project may have application to other tributaries of the Mississippi River.

Keywords: flood plain, restoration, channelization, trout, Mississippi River, Weaver Bottoms

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THE ROUND GOBY: AN UNWELCOME INVADER TO THE MISSISSIPPI RIVER BASIN

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The round goby (*Neogobius melanostomus*) is a small, benthic-oriented fish native to the Black and Caspian Seas of Eurasia that was introduced to North America in Lake St. Clair a decade ago. Round goby are now present at shoreline sites in all of the Great Lakes. Members of the southern Lake Michigan population have also expanded their range at least 43 miles inland along the Illinois Waterway System (IWS) at an annual rate that appears to have increased dramatically since 1998. The goby-inhabited reach of the IWS in metropolitan Chicago now comprises the uppermost 13% of this 333-mile navigation corridor that flows diagonally across Illinois from Lake Michigan to the Mississippi River. The round goby is thus poised to spread, perhaps rapidly, to other states in mid-America via the Mississippi River and its many tributaries. This aquatic nuisance species (ANS) has the potential to upset riverine food webs, out-compete native species for preferred habitats, increase contaminant bioavailablity, and adversely impact recreational and commercial fisheries. To slow the further downstream movement of round goby and other nuisance species of fish from Lake Michigan to the Mississippi River basin, as well as to serve as an impediment to other nonindigenous fish moving upstream from the Mississippi River drainage to the Great Lakes basin, Congress appointed the U.S. Army Corps of Engineers to lead an interagency advisory panel in selecting and implementing the most appropriate ANS dispersal barriers for the IWS. A non-lethal, vertical gradient electrified barrier was chosen for the first phase of a round goby demonstration project here and will be installed at a site on the Chicago Ship and Sanitary Canal (river mile 296.5) near Romeoville, Illinois by mid-2000. Since 1996, the U.S. Fish and Wildlife Service has also led interagency efforts to determine the downstream leading edge of the round goby's distribution and its relative abundance in the IWS. Theses annual surveillance efforts will continue after the barrier is operational to evaluate its efficacy. Once an ANS becomes locally established, as the round goby has in the Chicago area, an integrated ecosystem management approach with agency and public cooperation is required to address the multi-faceted issues that can arise in tying to contain these unwelcome invaders.

Keywords: aquatic nuisance species, dispersal barriers, Illinois Waterway System, range expansion, round goby

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RELATIONSHIP OF HYDROLOGICAL REGIME TO LARVAL FISH/ZOOPLANKTON PRODUCTION IN A MOIST SOIL MANAGEMENT UNIT

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Moist-soil units are typically managed to provide food for migrating waterfowl but may also provide valuable habitat for larval fish production. From 1996-1998, we monitored larval fish and zooplankton production in Wasenza Pool of Lake Chautauqua (a floodplain lake of the Illinois River). We hypothesized that flood height and duration would have a strong effect on larval fish/zooplankton dynamics. At one extreme, extended flooding may allow for high initial fish production while at the same time suppressing zooplankton production via continual flushing by zooplankton-poor, sediment-rich river water. At the other extreme, if levees are not overtopped, limited access to the lake by adult fish may result in low spawning success, but zooplankton production may be high. In 1996 and 1998, the Wasenza Pool levees were overtopped almost continuously from May through July. In 1997 water levels never rose above flood stage during this same time period. Preliminary analysis indicated increased production of larval fish in the high-water years of 1996 and 1998. Varied hydrological regimes may result in trade-offs, with fewer fish but better food resources being produced in low-water years, and higher (initial) fish production but reduced food resources during high water years.

Keywords: larval fish, zooplankton, floodplain, hydrology, Illinois River

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ANALYSIS OF GAGE RECORDS TO IDENTIFY AND QUANTIFY CHANGES WITH "INDICATORS OF HYDROLOGIC ALTERATION" (IHA) SOFTWARE

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River hydrology, as measured by changing discharges and water levels (stage), is the rhythm to which floodplain flora and fauna have found opportunities to evolve, survive, and proliferate. As one of the primary drivers of the riverine ecosystem, changes in the hydrologic regime can alter aquatic habitats and their biotic inhabitants. Fortunately, two of the longest data sets pertaining to the Upper Mississippi River System are river discharge and stage. Until recently, use of these data sets by river scientists to evaluate changes in river hydrology were limited by available analytical methods and knowledge of ecologically relevant metrics. Recent developments in scientific understanding of large river ecosystems has lead to the development of the Indicators of Hydrologic Alteration (IHA) software by The Nature Conservancy's Biohydrology Program. Here we present initial results from our application of the IHA software to the Upper Mississippi River System discharge and stage data sets.

The IHA analysis calculates 33 statistical measurements for 5 ecologically relevant parameters: magnitude, duration, timing, frequency, and rate of change. The IHA software uses linear regression techniques in trend analysis and uses parametric or percentile statistics to calculate a pre- versus post-impact comparison called the IHA Analysis. In addition, the IHA software can be used to apply what is termed the "Range of Variability Approach" (RVA) to assess whether the post-impact statistics are outside the range of natural pre-impact conditions. The RVA can be used to determine if alternative water regulation is needed to move the system toward a more naturalized flow regime.

Discharge data are available from the U.S. Geological Survey at 21 (14 active) gage locations, and stage data are available from the U.S. Army Corps of Engineers at 160 (135 active) gage locations. Data collection for most stations were started in the 1930's, but daily data are available in electronic form for a few stations as far back as the late 1800's. Records for gages distributed throughout the Upper Mississippi River were converted into the IHA format with SAS. Changes at most stations included a reduction in the number and duration of low pulses, an increase in the number of high pulses, an increase in the number of reversals, and an increase in the rate of fall. Critical examination of the IHA software output is required to interpret the results for any given gage in light of differences along the length of the system, tributary inputs, and intra and inter pool water regulations.

Keywords: Upper Mississippi River, hydrology, statistical analysis, Indicator of Hydrologic Alteration, IHA, gage records

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FALL LOCAL MOVEMENTS, HABITAT USE, AND POPULATION DYNAMICS OF TUNDRA SWANS ON THE UPPER MISSISSIPPI RIVER

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Tundra Swan (*Cygnus columbianus*) use of the Upper Mississippi River (Pools 4-9) has increased dramatically over the past 10 years. This reach of the river is a major fall stopover site hosting over 20% of the Eastern Population. The main objectives of this study were to examine local movements, habitat use, and population dynamics of swans using this area in fall with telemetry and survey data. A total of 43 adults were radio-marked in the fall of 1998 and 1999. These swans were tracked with aircraft and telemetry vehicles. Locations were used to describe daily and seasonal movements, as they relate to open and closed areas and the pools within the study area. Estimated locations will be overlaid on land cover/use, bathymetry, and land/water GIS coverages to investigate differences in use and availability. Weekly aerial survey flights were flown to estimate cygnet and total swan numbers through the use of ocular estimates and videography. Survey data will be used to determine swan use-days, peak counts, cygnet:adult ratios, and population changes throughout the fall. Preliminary analysis indicates a general movement out of the closed areas at night during the duck hunting season. Radio-marked birds used a number of different sites, and many showed a southward movement within the study area throughout the fall. The length of stay for these swans was roughly 30 days, indicating little turnover in this stopover site's population. The cygnet:adult ratio within the study area was significantly higher than the ratio for the entire Eastern Population.

Keywords: Tundra Swan, *Cygnus columbianus*, telemetry, aerial surveys, GIS

THE ROLE OF RESERVOIRS IN NITROGEN TRANSPORT IN THE UPPER MISSISSIPPI RIVER BASIN

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Nitrogen from the Mississippi River has been implicated in ecological declines in the Gulf of Mexico; factors that influence nitrogen transport in this river system are thus of considerable interest. We used average basin concentrations and input-output analyses to examine the influence of impoundments on nitrogen transport in the Upper Mississippi River system.

In our first approach, we compared total nitrogen concentrations from the lower end of drainage basins that were approximately 200 km². We found that basins without impoundments typically had double the nitrogen concentration of nearby impounded basins.

To examine the role of impoundments in greater detail, we estimated total nitrogen input and output for several mainstem and tributary impoundments with data from state and federal agencies. We found a strong connection between nitrogen retention/removal and hydraulic residence time. Reservoirs with median hydraulic residence times greater than about 50 days were effective traps for nitrogen input, but trapping efficiency dropped sharply at lower residence times. Mainstem reservoirs (i.e. pools) of the Upper Mississippi and Illinois Rivers, with residence times on the order of 2-3 days, retained/removed only about 0-5% of total nitrogen inputs. An exception was Lake Pepin. With a median residence time of 9 days, this natural impoundment removed 1% of the total nitrogen input. Tributary impoundments with longer residence times trapped a greater portion of their input loads. For example. Coralville Reservoir, on the Iowa River, had a median hydraulic retention time of 14 days and retained approximately 12% of the total nitrogen load. Lake Shelbyville, a reservoir on the Kaskaskia River in Illinois, had a median hydraulic retention time of 190 days and retained approximately 50% of the annual total nitrogen input.

Nitrogen retention by short-residence (<35 day) impoundments may be hampered by their pattern of nitrogen delivery. Nitrogen removal seems to be most effective at higher nitrogen concentrations, but in short-residence impoundments the highest nitrogen concentrations coincide with high flow and minimal residence time. Periods of increased residence time, when these impoundments might be effective traps, are typically associated with minimal inflow concentrations of total nitrogen. Long-residence reservoirs (median hydraulic residence time >50 days) can be effective removers of nitrogen, but such systems are relatively rare in the Upper Mississippi River Basin.

Keywords: Mississippi River, nitrogen, reservoirs, denitrification, budgets

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INCREASED FLOODING PORTENDS INCREASED DISTURBANCE FOR FLOODPLAIN FORESTS

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Investigations after the 1993 flood on the Upper Mississippi River revealed a strong correlation between flood duration and mortality of trees on the floodplain. In areas near St. Louis, Missouri, mortality of mature trees, measured in 1994, was 37%, mortality of 2-10 cm diameter saplings was 80%, and no seedlings survived. We investigated changes on flood characteristics and here discuss the potential effects of such changes on floodplain forests. This analysis is limited to areas between the levees.

We studied three water surface elevation gages from the Upper Mississippi River System (UMRS) that have a nearly complete daily record for 99 years or more; Muscatine, Iowa (1901-1998), St. Louis, Missouri (1861-1998), and Valley City on the Illinois River (1885-1998). We examined trends in flood heights, flood duration, and flood frequency. Although the data were extremely variable, significant trends in all three factors were evident at all three stations. The average flood height, from linear regression analysis, is now about 1.5 meters higher than when these data were first collected. Flood frequencies are also greater. After dividing the record for each station into two equal periods, we calculated the number of floods that occurred in each period. Twenty floods occurred at St. Louis during the early 69 year period and 33 during the later years. Numbers of floods increased from 14 to 28 at Muscatine (57 year periods) and from 18 to 37 at Valley City (49 year periods). The 10 greatest floods, as measured by water surface elevations, occurred in the later period at all three stations. Flood duration was also longer in the latter periods. Linear regression showed that the number of days above flood stage in a year increased between 18 and 35 days over the period of record.

We believe that these changes in the hydrograph will lessen forest regeneration after major floods, because seedlings and saplings fully submersed for a week usually suffer 100% mortality. With floods now occurring twice as often and having a longer duration, seedling success is lower. Higher floods will also negatively affect a larger area of the floodplain. We predict that flood-tolerant and faster growing species will start to dominate higher and higher elevations, and modern forest canopies will be more open than their historical counterparts. Forest restoration can be improved by incorporating these results in future planning efforts.

Keywords: Upper Mississippi River, hydrology, floods, flood-plain forest

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SIMULATED SUBMERSED AQUATIC VEGETATION DYNAMICS FROM 1988 TO 1999 IN POOL 8, UPPER MISSISSIPPI RIVER

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We developed a logistic regression model to predict the probability that submersed aquatic vegetation would occur on a site based on light condition, flow velocity, wind fetch, and number of dewatered days at the site over the course of the growing season. The light variable in the model is the number of days when more than 1% of sunlight could penetrate through water column to reach the bottom. The flow velocity variable in the model is the average-depth flow velocity computed with the FastTABS Model developed by the U.S. Army Corps of Engineers when river discharge is set at 90,000 cubic feet per second. The wind fetch variable in the model is the distance over open water from the site to the nearest land mass. The number of dewatered days variable in the model is the number of days when water depth at the site was less than 5 inches (12.7 cm). Model coefficients were derived by conducting regression analyses using the submersed aquatic vegetation data collected in 1998 by the Long Term Resource Monitoring Program of the Upper Mississippi River System, and light penetration coefficient data collected by the Wisconsin Department of Natural Resources. Using the bathymetric-, flow velocity-, and wind fetch GIS coverages created by the Upper Midwest Environmental Science Center, and light penetration coefficients provided by the Wisconsin Department of Natural Resources, we predicted the annual distribution of submersed aquatic vegetation from 1988 to 1999. The predicted submersed aquatic vegetation dynamics over the period was tested against remote-sensing data collected in 1989, 1991, 1994, and 1998; and field data collected in 1999. The model has displayed great potentials as a planning and simulation tool for natural resource management in the Upper Mississippi River System.

Keywords: Upper Mississippi River, submersed aquatic vegetation, model, distribution, dynamics

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ASSOCIATION BETWEEN ANNUAL HYDROLOGICAL PATTERNS AND INVERTEBRATE PRODUCTIVITY IN A LARGE RIVER

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The annual hydrograph of the upper Mississippi River exhibits a predictable pattern of greatly elevated discharge during the spring and a smaller rise in the fall in response to late-summer rains. Although the autumnal rise in discharge does not inundate the floodplain, it reconnects slack water areas to the river. Previous studies have suggested that reproduction and secondary production of some invertebrates reaches a peak in the fall, coinciding with increased river discharge. This study examined data collected over 5 years to determine if recruitment of zebra mussels was correlated with the magnitude of increased discharge in the autumn. We compared the number of 0-4 mm long zebra mussels colonizing 15x15 cm unglazed ceramic tiles from 15 August-15 November in each year to average daily discharge over the same period using linear regression. Results indicate there is a strong positive relationship between magnitude of autumn discharge and the number of new zebra mussels colonizing the tiles. We propose that the small autumn increase in discharge provides food supplements by reconnecting highly productive areas of the river to less productive habitats, thus allowing for greater mussel production following this event. These benefits may be evident among other riverine invertebrates.

Keywords: hydrograph, abiotic factors, zebra mussel, Mississippi River, experiment

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DIURNAL STUDY IN LAKE PEPIN NAVIGATION CHANNEL

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Lake Pepin serves as a recreational and commercial use waterway on the Upper Mississippi River. Various agencies have ongoing river-monitoring programs that collect data weekly or bi-weekly primarily during daylight hours on Lake Pepin. The existing research programs and data collection procedures do not support the gathering of data during a complete 24-hour period on Lake Pepin. The Minnesota DNR in Lake City worked in conjunction with Winona State University collecting data hourly during a 13-day period in August of 1999 at Upper Mississippi River mile 771.2. Dissolved oxygen and temperature profiles at 1-meter intervals were sampled hourly each day. Surface and bottom water chemistry samples were also taken twice a day. Diurnal fluctuations, stratification, chemical, and physical relationships are examined.

Keywords: Mississippi River, diurnal, dissolved oxygen, dissolved inorganic mixture, soluble reactive phosphorus, flourometric chlorophyll

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DISPERSAL AND HABITAT USE OF JUVENILE PEREGRINE FALCONS DURING A RESTORATION PROJECT IN DUBUQUE, IA

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In the largest single restoration effort in Iowa to date, 21 juvenile peregrine falcons were released by the Iowa Department of Natural Resources from a natural cliff near Eagle Point Park in Dubuque, Iowa during summer 1999. We used radio-telemetry and observations of color-marked birds at the hack site to determine habitat use. Telemetry proved very ambiguous near the cliff site, although daily observations could be determined with triangulation from 200-300 m distance. All radio-marked falcons shed their long-mounted radios within 1 day to 2 weeks, creating the need to find a new attachment method for the 2000 field season. Falcons were released in a staggered manner from mid-June until late-July. Older falcons remained at the site longer than at previous urban releases and interacted with the younger falcons. Thus, efforts to determine post-dispersal habitat use with aerial telemetry were not possible. Falcons released at power plants and urban buildings throughout Iowa have not used cliff habitat during the juvenile year, the Dubuque falcons perched and fed on the cliffs. We used Global Positioning System units to determine telemetry locations, and we complied habitat use data on Arc/View.

Keywords: peregrine falcon, *Falco peregrinus*, Mississippi River cliffs, dispersal, habitat use, GIS

THE EFFICACY OF MUSSEL RELOCATION AS A RESOURCE MANAGEMENT TOOL: AN EXPERIMENT IN THE ST. CROIX RIVER

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Increasing threats to the native mussel community in the St. Croix River (*e.g.* bridge construction, zebra mussel outbreaks) make it necessary to study the efficacy of relocating mussels to less-threatened parts of the river. To determine the effects of relocation on mussel growth and survival, a three-year *in situ* experiment was conducted at Wild River State Park, Minnesota. In 1997 a 25 m^2 study grid containing 25 cells was placed near the confluence of the St. Croix and Sunrise rivers (reference site), and another was placed at the eastern boat launch at Wild River State Park (relocation site). Each cell was randomly assigned one of the following treatments: 1) double resident mussel density, 2) addition of 10 pimplebacks, 3) addition of 10 spikes, 4) addition of 10 pocketbooks, and 5) control (no manipulation occurred during the first year). In 1997 mussels were collected from the reference site, placed into study grids, and individuals from the first four treatments were measured, weighed, and marked. In 1998 and 1999 mussels were measured and weighed. Those found without a number were recorded as "new" and marked, those missing from the 1998 census were logged as "missing", and the rest were logged as "recovered", "control", or "dead" as applicable to their status. Preliminary examination of data indicates no difference in growth or mortality between treatments. Mortality was low (5%) compared to similar studies (Cope and Waller 1995). Results suggest that relocating mussels to similar habitats may be an effective strategy for conserving mussel populations living in potentially harmful parts of the St. Croix River.

Keywords: unionid, relocation, St. Croix River

EFFECTS OF ABIOTIC FACTORS ON CHANNEL CATFISH *ICTALURUS PUNCTATUS* POPULATIONS IN THE ILLINOIS RIVER

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Beginning in 1990 the Illinois Natural History Survey's Havana Field Station has monitored fish populations in the La Grange Reach of the Illinois River as part of the Long Term Resource Monitoring Program (LTRMP). The LTRMP uses a multiple gear approach in sampling fish communities from 6 key reaches of the Upper Mississippi River System (UMRS). This study focuses on channel catfish, *Ictalurus punctatus*, sampled by day electrofishing in La Grange Reach of the Illinois River. Seven abiotic factors including turbidity, temperature, conductivity, dissolved oxygen, depth class, velocity, and river stage were analyzed to see if they had any effect on the location and number of channel catfish. Abiotic data from 1999 day electrofishing sites were compared to the same type of data measured from 1995-1998. Conductivity and dissolved oxygen levels were on average higher in 1999 while turbidity, depth classes, velocity, and river stage averages were greater from 1995-1998. Pearson correlations analyzed each abiotic factor versus total channel catfish caught. Except for 1999, velocity and dissolved oxygen showed mostly weak negative correlations with the largest being -.275 from 1995-1998 river stages. Velocity and dissolved oxygen values (.064 and .099 respectively) showed positive but weak relationships. River stage negatively affected catfish catches more than any of the other abiotic factors, possibly a result of gear efficiency more than biologic response of the catfish. The abiotic factors acting alone, however, did not how any significant correlation with location of large catches of catfish.

Keywords: channel catfish, Illinois River, abiotic factors, correlation, Long Term Resource Monitoring Program

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RELATIONSHIPS OF TREE SPECIES TO ENVIRONMENTAL FACTORS IN PRESETTLEMENT FORESTS IN THE LA CROSSE, WISCONSIN AREA

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Recent investigations have used records from the pre-1850 General Land Office (GLO) survey to reconstruct vegetation patterns in the Upper Mississippi River (UMR) valley that existed in the presettlement era. These studies suggest that present forests are more closed than presettlement forests and more dominated by single species. In addition, they have documented the profound effects of impoundment and urbanization on forest in the UMR valley. Questions that remain to be addressed include roles that disturbance, including fire and flooding, played in the structure and regeneration of presettlement forests in the UMR floodplain. In addition, relationships of presettlement forests to important environmental factors such as slope and elevation have not been well defined. In this study, we use a geographical information systems (GIS) approach to assess distribution patterns of several tree species, including ash (*Fraxinus* spp.), maples (*Acer* spp.), and oaks (*Quercus alba, Q. velutina,* and *Q. macrocarpa*), that were commonly recorded by GLO surveyors in the La Crosse, WI area. Spatial data for tree species were derived from section and quarter section information provided by the Wisconsin DNR and from witness tree data transcribed from GLO records. Spatial data for environmental factors (slope, aspect, and elevation) were derived from a digital elevation model. Preliminary inspection of our results suggests that important differences exist among species with respect to these environmental factors. Further analyses will clarify these patterns and consider the possible role that fire played in maintaining floodplain forests.

Keywords: presettlement forests, Mississippi River, GIS, DEM, disturbance

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FECAL COLIFORM AND *ESCHERICHIA COLI* CONTAMINATION IN PRAIRIE CREEK WATERSHED

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Water quality in the upper Mississippi watershed is being jeopardized by pollution from dysfunctioning septic systems, feedlot run-off, and improperly managed fields. Prairie Creek was found in a 1999 MPCA study to have very high levels of fecal coliform. This study provides a detailed description of the extent of contamination in a portion of the watershed. Weekly sampling, during the summer of 1999, for fecal coliform concentrations was conducted using membrane filtration on m-FC agar. Further analysis for the presence of *Escherichia coli* was done using Chromagar *E. coli*[R] medium. No naturally occurring water sources were below the public water quality health standard of 200 coliform/100 mL, and most counts exceeded those of the MPCA 1999 study. *E. coli* composed on average 85% of the fecal coliform counts. The source for the contamination remains unknown, and further research and education in the local community about water quality are needed.

Keywords: *Escherichia coli*, contamination, Prairie Creek

TEST FOR COMPETITIVE INTERACTIONS BETWEEN ZEBRA MUSSELS AND HYDROPSYCHID CADDISFLIES

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Numerous studies have documented the abiotic and biotic effects of zebra mussels in the Great Lakes. In contrast, only a limited amount of research has been published documenting the same effects in river ecosystems. Students working in the Large River Studies Center since 1993 have observed that the abundance of some invertebrate fauna is negatively affected by increasing zebra mussel densities. Of particular note is a possible negative effect on hydropsychid caddisflies, an abundant and potentially important aquatic insect larvae in terms of biomass generated and potential as a food source for fish. This study was designed to test observations that zebra mussels may negatively affect hydropsychid caddisflies experimentally. Zebra mussels were attached to unglazed clay tiles using aquarium sealant at three densities: no mussels, low densities (= 500 mussels/m^2), and high densities (= 1,500 mussels/m^2). Four replicates were placed at each of four sample sites in Reach 6 of the upper Mississippi River. One tile for each treatment (n = 4) was removed from each site monthly. Tiles were returned to the lab, examined for newly colonized mussels and cleaned to remove caddisflies. Hydropsychid caddisflies were identified and counted. Preliminary analysis of samples suggest there was no relationship between zebra mussel and hydropsychid densities. Results of this study, however, may be inconclusive because of the loss of mussels attached to tiles.

Keywords: zebra mussel, competition, biotic effects, experiment, Mississippi River

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SMALL MAMMAL POPULATION SIZE AND HABITAT USE IN WHITE PINE AND HARDWOOD HABITATS IN WHITE PINE HOLLOW STATE PRESERVE, IOWA

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The Driftless Area in northeastern Iowa contains rugged landforms and thus more forests than other land areas in Iowa. White Pine Hollow State Preserve, at 812-acres, is perhaps the most unfragmented upland forest in Iowa. The mature oak (*Quercus* Sp.) and maple (*Acer sp.*) forests, swiftly flowing streams, and the largest natural white pine (*Pinus strobus*) stands in Iowa provide diverse habitats that result in a similarly diverse community of biota, including small mammals. We used small live traps arranged in 57-trap web design to determine population size and habitat use of small mammals in White Pine Hollow. Two trap webs each were placed in white pine and upland hardwood habitat, and we used transect trap lines in riparian zones. We also placed a 3-legged 8-foot drift fence in pine and hardwood habitats to supplement our trap captures. We inserted PIT tags under the skin of captured individuals for recapture information. Our species capture list in August 1999 included: deer mouse (*Peromyscus maniculatus*), white-footed mouse (*Peromyscus leucopus*), pine, or woodland vole (*Pitymys pinetorum*), Southern flying squirrel, (*Glaucomys volans*), least shrew (*Cryptotis parva*), shorttail shrew (*Blarina brevicauda*), and Eastern chipmunk (*Tamian striatus*). The pine vole is an endangered species in Iowa, and the Southern flying squirrel is found only in large forest tracts such as White Pine Hollow State Preserve.

Keywords: Driftless Area, small mammals, endangered species, White Pine Hollow, *Pinus strobus*

LONG TERM CHANGES IN MUSSEL POPULATIONS OF THE ST. CROIX RIVER

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Population dynamics of freshwater mussels (Unionidae) were observed since 1991 at three locations in the St. Croix River. Mussel communities were assessed quantitatively and qualitatively to calculate density, species richness, and age structure to identify long-term trends. Mussels and substrate were collected from at least 100 0.25 m^2 quadrats at each location. Substrate was separated into 5 size classes and all mussels were identified and measured. From these measurements, population density and community diversity were calculated at each location and compared to past sampling years. At Franconia mussel density decreased from 10.44 mussels/m^2 in 1991 to 9.76 mussels/m^2 in 1995, and 4.52 mussels/m^2 in 1999. Species richness decreased from 26 species in 1991 to 19 species in 1995, and 15 species in 1999. One endangered winged mapleleaf mussel was found in quantitative samples in 1995. At Wild River State Park, mussel density decreased from 37.36 mussels/m^2 in 1993 to 29.56 mussels/m^2 in 1996 continuing to decline to 21.08 mussels/m^2 in 1999. Species richness decreased from 21 species in 1993 to 18 species in 1996, and remained the same in 1999. At Prescott, Wisconsin mussel density decreased from 7.8 mussels/m^2 in 1994 to 5.64 mussels/m^2 in 1999, while species richness declined from 21 to 18 species. One Higgins' Eye (*Lampsilis higginsi*) was found in both 1994 and 1999. In addition we found two invasive bivalve species at Prescott: one live zebra mussel attached to a threeridge (*Amblema plicata*) as well as one Asian clam (*Corbicula fluminea*). We will statistically analyze these data to determine if these trends are significant and warrant management action.

Keywords: unionid, demographics, St. Croix River

ZEBRA MUSSEL VELIGER SUPPLY AND SETTLEMENT IN THE ILLINOIS RIVER

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Zebra mussels (*Dreissena polymorpha*) will probably never be completely eliminated from U.S. waterways, but there is hope that their population may be reduced in river systems. Zebra mussels in the Illinois River likely function as a metapopulation (a system of local populations connected by dispersal). Adult populations are dependent upon an upstream veliger supply since internal recruitment is limited by river currents. Because of this dependence, zebra mussels might be controlled by preventing the influx of veligers. An important question to investigate is how tightly this influx is linked to settlement.

In order to explore this link, we monitored larval supply and settlement rates during 1999 at two fixed sites on the Illinois River near Havana (river miles 115 and 121.1). Larval supply was estimated by means of 30 liter samples collected 0.25 m off the bottom of the river. Settlement was monitored on both a weekly and a monthly basis using racks of ten three-inch diameter clear PVC plates. Post-settlement survivorship and growth was measured using a photoplate sampler comprised of a rack of eight six-inch square PVC plates. These plates were photographed and returned to the water throughout the season. Natural communities were allowed to develop on these plates to limit disturbances and allow normal settlement. The three methods could then be compared to find the most accurate measure of settlement.

The only major settlement event occurred during a three week period from mid May to mid June. Preliminary results indicate that the different sampling methods show different attachment rates and that settlement is highly variable between replicates. Higher than normal levels of umbonal veligers were present in zooplankton samples during the settlement event. We are currently investigating the size composition of the larval flux, evaluating settlement on the photoplate samplers, and analyzing weekly and monthly settlement results.

Keywords: zebra mussel, Illinois River *Dreissena polymorpha*, metapopulation

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AN ASSESSMENT OF FISH COMMUNITIES AT THE LA GRANGE AND PEORIA LOCKS AND DAMS ON THE ILLINOIS RIVER

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The La Grange lock and dam (RM 80.0) and Peoria lock and dam (RM 157.8) are first and second of a series of seven locks and dams that extend up the Illinois River from its mouth near Grafton, Illinois, to the Des Plaines River near Chicago, Illinois. In 1991, staff at the Illinois Natural History Survey's Havana field station, as part of the Long Term Resource Monitoring Program (LTRMP), began sampling the tailwater area of Peoria lock and dam and four years later the tailwater area of La Grange lock and dam was added. The fixes site at the La Grange lock and dam was added to assess the fish communities at the two lock and dam sites. The area directly downstream of the locks and dams are designated as tailwater stratum (TWZ) and they are two fixed sites sampled in conjunction with the stratified random fish sampling throughout the La Grange reach. The two TWZ sites are sampled six times from 15 June and ends 31 October. The sampling season is further separated into three time periods (spring, summer, fall) which are 45 days in duration. Each TWZ site is sampled twice every time period and has received approximately the same amount of gear effort since 1995. Gears used to sample TWZ sites are large and small hoopnets, fyke nets, "mini" fyke nets, day and night electrofishing and trawling. Since 1995, data confirms Peoria TWZ is higher in diversity and total abundance (62; 66,683) compared to the La Grange TWZ (58; 17,308). Also, the La Grange and Peoria TWZ data will be compared to several stratums within the La Grange reach and four Mississippi River TWZ sites that are sampled by the LTRMP.

Keywords: Illinois River, tailwaters, fish communities, Long Term Resource Monitoring Program

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PRELIMINARY FINDINGS FROM A SURVEY OF UNIONID MUSSEL POPULATIONS OF THE STREAMS OF THE IOWA DRIFTLESS REGION

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The Iowa driftless region is an area of 9,000 km² in the northeastern corner of Iowa which is drained by relatively old entrenched meandering streams. The Upper Iowa River and Turkey River are the largest of these streams and they empty into Pools 9 and 11, respectively, of the Upper Mississippi River. From June to September, 1999, 138 sites were surveyed from the Upper Iowa River and Turkey River, and their main tributaries. Sites were surveyed by hand using a 10-meter bank-to-bank procedure. 135 live mussels from 10 species (8 genera) were recorded during this survey. Species diversity and abundance of mussels were greatest near the source of these streams and declined downstream.

Keywords: unionid mussels, Iowa streams, driftless region, Upper Iowa River, Turkey River

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NITRATE UPTAKE BY FORESTED FLOOD PLAIN SOILS OF THE BLACK RIVER, LA CROSSE, WISCONSIN

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While patterns of nitrogen loading to the Gulf of Mexico are well documented, little is known about nitrogen cycling in the Mississippi River. This is particularly true for the Upper Mississippi River where some connectivity between main channel and backwaters still exists. The preliminary work reported here is part of a larger study by scientists from the U.S. Geological Survey's Upper Midwest Environmental Sciences Center to more fully understand the nitrogen cycle in the Upper Mississippi River (UMR). The purpose of this work was 1) to measure rates of nitrate (NO_3) uptake by sediments from UMR; and 2) to test the hypothesis that dissolved organic carbon (DOC) is a limiting factor in the uptake of nitrate from overlying water by sediments. Carbon limitation was tested by 1) evaluating nitrate uptake rates in sediments along a suspected sediment carbon gradient, and 2) by testing the effect of controlled carbon enrichment on the sediment uptake of NO_3 from overlying water. During July and August 1999 sediment cores were collected from a forested flood plain adjacent to the Black River, a tributary of the UMR, at La Crosse, WI. The transect ran perpendicular to the Black River along a suspected carbon gradient from dry flood plain forest, through a wet slough, a dry sand dike (natural), and into the Black River proper. Nitrate uptake experiments were conducted and sediment carbon was measured on these cores; cores taken later from along this same transect were used to measure nitrate uptake with two DOC amendments, glucose as a labile carbon source, and leaf leachate as a ubiquitous source of carbon in the river. Nitrate uptake in sediments along this transect ranged from 0.14-0.90 mg NO_3/L/hr and sediment carbon (by loss on ignition) ranged from <1-29%. Nitrate uptake was greater in sediments with higher carbon content. For example, sediments in the wet sough had the highest carbon content (29%) and the highest nitrate uptake rates (0.9 mg NO_3/L/hr); sediments with the lowest carbon content (0.3%) had the lowest uptake rates (0.14 mg NO_3/L/hr). Sediments from the river channel, however, had low carbon content (0.98%) and high uptake rates of 0.71 mg NO_3/L/hr. Carbon amendments did increase uptake rates of some sediments. For example, uptake rates in sediments from the dry sand dike and the dry flood plain forest showed an increase in rates when both forms of DOC were added. Sediments from the sand bar and floodplain forest sites, *without carbon amendment*, had nitrate uptake rates of 0.08 and 0.06 mg NO_3/L/hr respectively, and rates increased to 0.44 and 0.74 mg NO_3/L/hr in the carbon amended sediments. Nitrate uptake rates in river sediments were unaffected by carbon amendment: rates were 0.06 mg NO_3/L/hr without amendment, and 0.49 and 0.64 mg NO_3/L/hr with glucose and leaf leachate amendments. These results suggest that: 1) floodplain sediments may represent a significant sink for nitrate but uptake rates vary with sediment carbon content and location, and 2) rates of nitrate uptake from low carbon floodplain sediments are likely carbon limited.

Keywords: nitrate uptake, floodplain forest, Black River, carbon, sediment

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TAXONOMIC IDENTIFICATION OF FRESHWATER MUSSELS OF THE ST. CROIX RIVER THROUGH DNA ANALYSIS

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Freshwater mussels are an important component of freshwater ecosystems, storing energy that otherwise would be lost downstream, while serving as good ecological indicators and food sources for other organisms. They are a highly diverse family of organisms that are rapidly declining in species richness and abundance. Mussels undergo a period of parasitic encystment on fish hosts during the larval (glochidial) stage of their life cycle. A better understanding of host- parasite relationships would be highly beneficial to mussel conservation; however, mussels in the glochidial stage are very small and therefore extremely difficult to identify. In this project, we use the polymerase chain reaction (PCR) and restriction fragment length polymorphism (RFLP) techniques on the ITS-1 region of the mussel genome in an attempt to identify genetic markers for each species. To do this, genomic DNA is extracted from adult mussel specimens, the ITS-1 region is amplified using PCR and the amplified DNA digested with a selected array of restriction enzymes. Our goal is to create an identification key based on these genetic markers for all the mussel species of the St. Croix River. The resulting taxonomic key may be used to unambiguously identify mussels while in their glochidial forms. To date, DNA patterns have been recorded for 22 mussel species. Currently, we are working on expanding this database, and refining our protocols to make identification more accurate and efficient. Our data thus far suggests that the mussel species of the St. Croix River can indeed be distinguished using this technique, and that these methods may serve as a valuable tool for mussel conservationists.

Keywords: genetic markers, unionid, St. Croix River

COMPARISON OF SEVERAL MAJOR ION CONCENTRATIONS IN TWO ADJACENT MISSISSIPPI RIVER TRIBUTARIES

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Two tributary streams of the Mississippi River in Dubuque County, Iowa, were selected for comparison of land use practices in their watersheds and concentrations of several major ions in the streams. Samples of water were collected in each of the two streams, as well as in the Mississippi River and an adjacent inlet. The ions that were analyzed by ion chromatography included nitrate, phosphate, sulfate, and chloride. Measurements of conductivity were compared to the individual and total ion concentrations. The measurements of major ions in the two streams were evaluated relative to the surrounding land use practices in the two watersheds.

Keywords: ions, nutrients, ion chromatography, land use

CHANGES IN A SAND PRAIRIE PLANT COMMUNITY AFTER APPLYING A NATIVE SEED MIXTURE

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Given their vulnerability to human disturbance, sand prairies in the north central region of the U.S. are recognized as having high conservation value. Though techniques for restoring tallgrass prairies in this region are fairly well documented, relatively little is known about the restoration of sand prairies. Remnant species found on the grounds of the Upper Midwest Environmental Sciences Center (UMESC) in La Crosse, WI suggest that this site was once a sand prairie. In June 1997, the U.S. Fish and Wildlife Service seeded 7 acres at UMESC with a seed mix that included 27 species of native grasses and forbs. After seeding, invasive woody species were removed and their stumps were chemically treated to inhibit resprouting. Seeded areas were occasionally mowed during summer months. A 2500-m^2 (50-m X 50-m) portion of this area was sampled in early September from 1997-99 using 50 randomly placed 20-cm X 50-cm quadrat frames. Within each frame, plant species were recorded and the percentage canopy coverage of each species was estimated. We recorded the occurrence of 36 species in the study area, including 11 graminoids and 24 forbs. The exotic grass, *Poa pratensis* (Kentucky bluegrass), has remained the most dominant graminoid (mean coverage = 38.7%) during the sample period. Several native graminoids have also been commonly recorded, e.g., *Bouteloua curtipendula* (side-oats grama) and *Sorghastrum nutans* (Indian grass), though coverage of these species was much lower the *P. pratensis*. Most commonly sampled forbs included *Ambrosia psilostachya* (western ragweed) and *Solidago* spp. (goldenrod). Additional analyses will describe trends in community diversity and will assess the general conservation value of this flora compared to other prairies in Wisconsin. Results obtained from this study will be used to propose management alternatives for the restoration of sand prairies in this region.

Keywords: sand prairie, prairie restoration, *Poa pratensis*, exotic species, native seed mixture

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SMALL MAMMAL METAPOPULATION DYNAMICS IN A RECENTLY ESTABLISHED MITIGATION AREA

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The reclamation of land for the purposes of establishing mitigation wetlands has recently increased throughout the Mississippi River Valley. Small mammals are keystone species, and by monitoring their presence in a newly established wetland the success of the project may be determined.

We censused the small mammal populations and habitat use in the Schmitt Island Wetland Area, Dubuque, Iowa each fall since 1994, as well as the spring of 1995 and 1997. Our initial hypothesis was that small mammal species density would be the same in all three seral areas being studied (prairie, ecotone, and forest). We tested for differences in population numbers and structure between the habitat types using a mark-recapture study. In 1996, the study was expanded to include the use of PIT tags in order to detect overwintering survival and movement. The major species inhabiting the study area include *Peromyscus maniculatus* (northern deer mouse), *Microtus pennsylvanicus* (meadow vole), and *Blarina brevicauda* (short-tailed shrew).

Long term data were examined in light of metapopulation theory. We determined that while in past years the study area represented a source for deer mouse populations and a sink for voles, in 1999 the study area was a source for all three species. The primary dispersers in the area were initially subadult males based on recorded size and weight, although in 1996 and 1997 pregnant females were found. The number of recaptures indicates large populations of the studied species. The lack of captures towards the end of the study in 1999 indicates a high mortality or dispersal rate. This could be due to a type of larva which we found embodied under the skin of multiple deer mice.

Keywords: *Peromyscus maniculatus, Microtus pennsylvanicus, Blarina brevicauda,* mitigation wetland, population densities

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The Mississippi River Research Consortium: Looking Back at the Start of a New Millennium

Richard V. Anderson
1999-2000 President, MRRC Board of Directors

In 1968 a group of academicians met at St. Mary's College in Winona, MN to present data from research projects on the Mississippi River and to discuss proposed river projects. This was the first formal meeting of the Mississippi River Research Consortium (MRRC). A group which had been formed to promote research on the Mississippi River and to establish a line of communication between river researchers spread throughout the Mississippi River states. The organizations founders hoped that these objectives would be facilitated by holding an annual meeting where research results could be reported. Many of the founders such as K. D. Carlander, T. O. Claflin, C. R. Fremling, W. Hilsenhoff, G. W. Kaufman, W. Starrett, and J. Verduin, to mention just a few, have long and distinguished careers as aquatic ecologist whose research careers often focused on the Mississippi River. They developed a constitution and set of by-laws for the MRRC, the foundation of which still provides direction for the organization today. The organization attracted a large number of members. A March 1970 membership list has 304 names from 11 different states compared to approximately 390 today. In 1970, Minnesota and Wisconsin had the greatest number of members with 86 and 89 respectively. This was followed by Illinois with 56, Iowa with 40 and Missouri with 21. The remaining 6 states had 6 or fewer members. As an aside, you might note that dues were $1, currently they are $65 including the registration and meals at the annual meeting. Many of the initial meetings focused on a particular issue and included a panel discussion with expert panel members as part of the meeting itinerary. For example, at the second annual meeting, a panel composed of people from the Army Corps of Engineers, Bureau of Sports Fisheries and Wildlife, UMR Refuge Manager, Izaak Walton League, and Missouri Department of Conservation discussed the biological effects of a 12-foot channel. The 10th annual meeting (1977) had a panel discussion on the Mississippi River to the year 1999 and a panel at the 11th annual meeting dealt with endangered species of the UMR.

Most of the founders and active participants in the early meetings of MRRC were from academic institutions. Consequently, most of the papers presented at the meetings were authored and presented by professors or their students. Of the 22 papers presented during the first 3 meetings for which we have records (2nd, 3rd, and 5th meeting, Fig. 1) all but 3 were presented by authors from colleges or universities. Interestingly 10 different colleges and universities from Illinois, Iowa, Wisconsin, and Minnesota were represented on the 19 papers. By 1975, the 8th annual meeting, this trend began to change. Increased participation by state and federal agencies and by private companies, particularly power companies, began to occur with over half of the presentations at the 8th annual meeting authored by

individuals employed by these agencies. This trend has continued through the current meeting. Still, most authors are from academic institutions followed by state agencies and private companies (Fig. 2). Representatives of over 52 academic institutions from 17 states have presented papers at annual meetings.

Based on papers presented at the first few annual meetings and the 1970 membership list, individuals from 5 states Illinois, Iowa, Minnesota, Missouri, and Wisconsin dominated the meetings. While the number of states with representatives presenting papers at the annual meeting has increased since the early meetings (Fig. 3), the trend of most participants coming from the 5 upper Mississippi River states has continued (Fig. 4). Since the beginning of MRRC, representatives of 28 states, Washington DC, and 3 foreign countries have presented papers at annual meetings. The state of Mississippi has been added to the list of dominant states. Interestingly Illinois, Minnesota, and Wisconsin have had participating attendees at all but one of the annual meetings for which we have records (through this years meeting that is 26 annual meetings).

Participation, at least in terms of number of papers presented, remained modest until the 14th annual meeting held at the Ramada Inn, La Crosse, WI (Fig. 1). Prior to this meeting, 2 meetings had been canceled and attendance had begun to decline. Increased participation was a result of increased river research through basin studies which involved not only academic institutions but also state and federal agencies and an increased effort to advertise the organization and its objectives. The number of presentations at the 14th annual meeting more than tripled from the previous meeting. Another major change that came out of the 14th meeting was the decision to always hold the annual meeting in LaCrosse, WI. Prior to 1981 the meeting location rotated between academic institutions. Usually the institution hosting the meeting was the home of the current MRRC President. Thus the meeting location had ranged from St. Cloud, MN, to Quincy, IL. The organizational framework was also changed at this time. A 3 member Executive Committee took over the responsibility for organizing the annual meeting. This structure was changes in 1985 when the membership voted to change the Executive Committee to a Board of Directors with the 3 members being designated as President, Vice-president, and Secretary-Treasurer. Each position had specific responsibilities. Meeting participation continued to grow and in 1991 an additional member was added to the Board of Directors by splitting the responsibilities of the Secretary-Treasurer into 2 position. The work load of preparing for the annual meetings and communication with the membership is now spread between the elected board members, a necessity as the size of the meeting has increased.

Another change in the annual meeting first took place in 1988 when posters were added as a format for data presentation (Fig. 1) The popularity of poster presentations is indicated by the fact that they now account for over 30% of the papers presented at the annual meeting. The other advantage of poster presentations has been that more papers can be presented at the annual meeting while still meeting within a 2 day time frame which the membership seems to prefer. With the increase in paper presentations, the number of authors participating in the annual meetings has also increased (Fig. 5). Over the last 6

annual meetings an average of over 120 authors have participated in each meeting. In the 26 annual meeting for which we have records a total of 880 authors have presented papers. Of those, over 600 authors presented papers at only 1 annual meeting (Fig. 6). Only 12 authors have presented papers at 10 or more meetings and only 1 author has presented papers at over 20 meetings. This reflects the continued participation by a large number of students with a base of senior instructors or agency staff who have longterm research programs on the river. It also reflects the trend toward multiply authors papers. Many authors on papers presented at the annual meetings may be listed on several papers (Fig. 7). One individual has been senior author on 28 different papers and one individual has been a senior or coauthor on 60 different papers. Research on the Mississippi River often requires a team approach and multiply authored paper recognizes that many people may be involved in a particular project.

The annual meetings continue to attract participants with a wide variety of interests. Over 350 different topics have been the subject of papers presented at the annual meetings. While these papers have covered everything from accidification to walleye the location of the research has been predominantly the upper Mississippi River (UMR) with almost 80% of the 892 paper from 26 meetings focusing on the UMR (Fig. 8). Pool 8 of the UMR has received the most coverage with 89 papers dealing with data collected from this river reach (Fig. 9). The next most studied pool has been Pool 19 with 68 papers reporting on this river reach. With the exception of Pool 19, those navigation pools where Longterm Resource Monitoring stations are located have all had significant coverage. Members of this program have become important contributors to the annual meetings. However, the number of navigation pools which have at least some coverage during the annual meetings has increased throughout the life of MRRC (Fig. 10). Interestingly all 27 navigation pools were included in at least one paper during the 23rd annual meeting in 1991.

The objectives of the founders of the MRRC, as stated in the organizations constitution is to establish and promote communication between river researchers, to encourage and organize pure and applied research on the Mississippi River, and to encourage cooperation between institutions working for the improvement of the River. Using an annual meeting as the primary vehicle for those objectives has resulted in a robust organization with high diversity. Membership includes individuals from many parts of the country, working in many different institutions or agency, and doing research on a wide variety of topics. There is a high level of communication through the annual meeting and the organization continues to play a significant role in education. It provides information for the public as well as river research and an opportunity for young river scientist to experience peer evaluation of their research results. We can look forward to the new millennium with hope and optimism that springs from the strength of a well founded organization that has as its focus the Mississippi River.

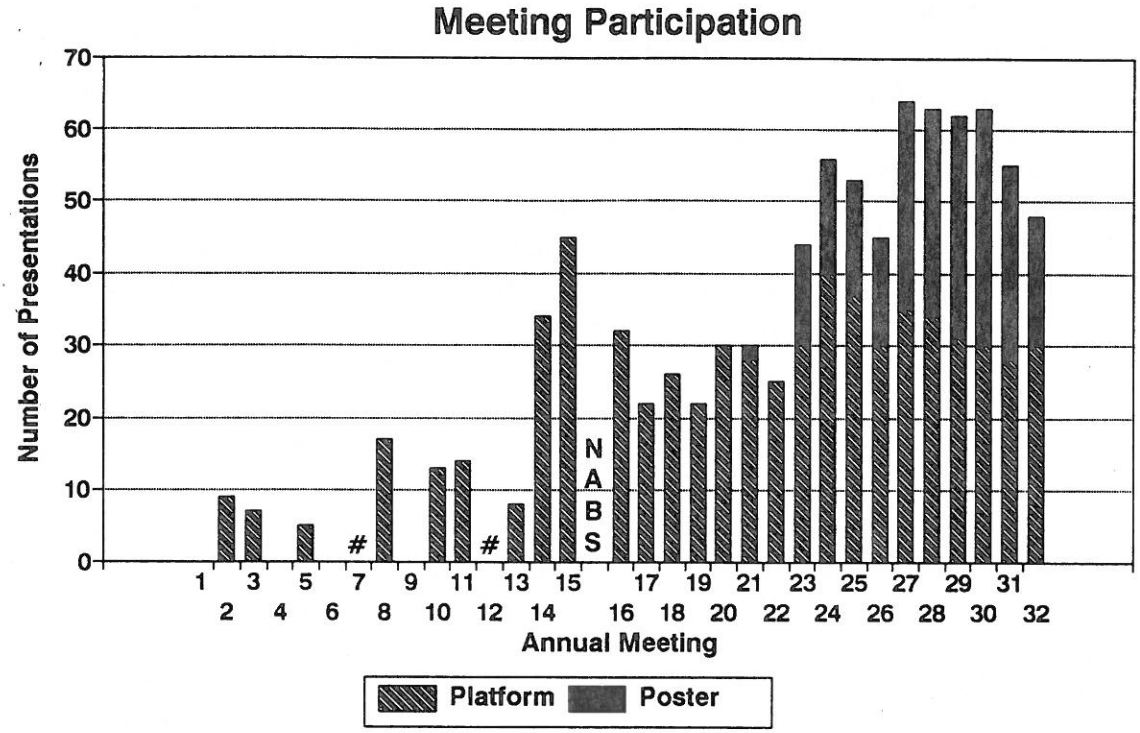

Figure 1. Number of presentations at each of the annual meetings. In this and future figures the # sign indicates canceled meetings and NABS indicated the year the annual meeting was not held since the North American Benthological Society met in LaCrosse.

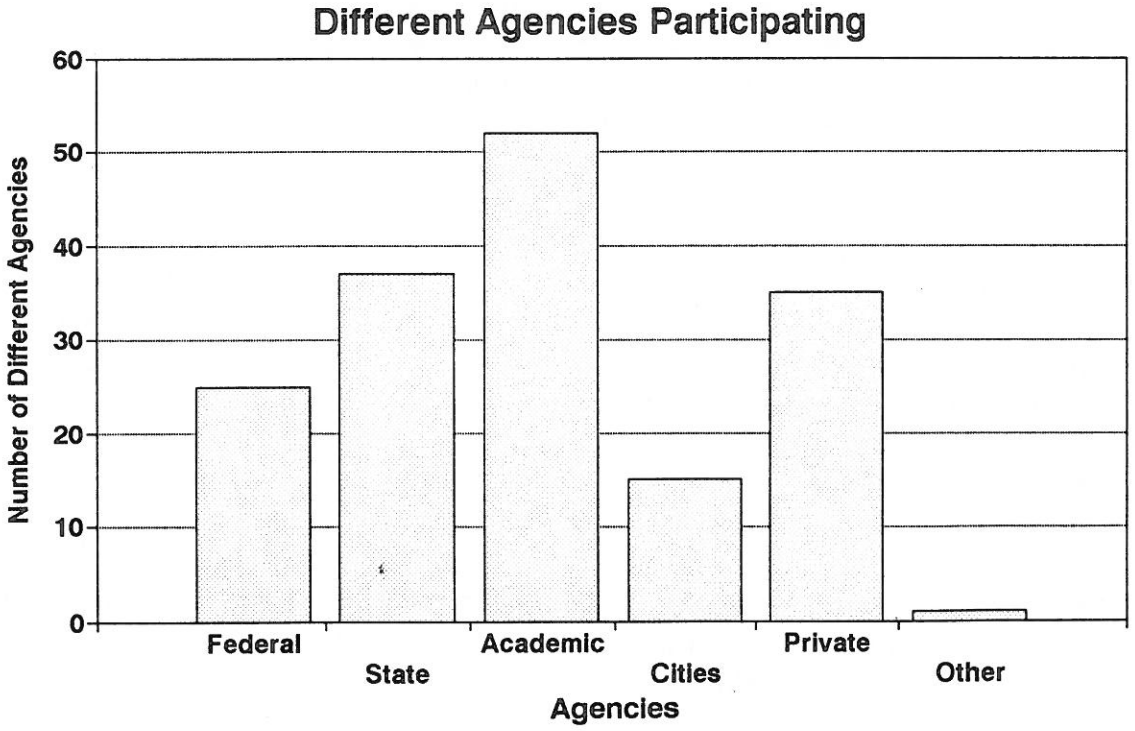

Figure 2. Number of different groups within broad categories of institutions or agencies represented at the annual meetings.

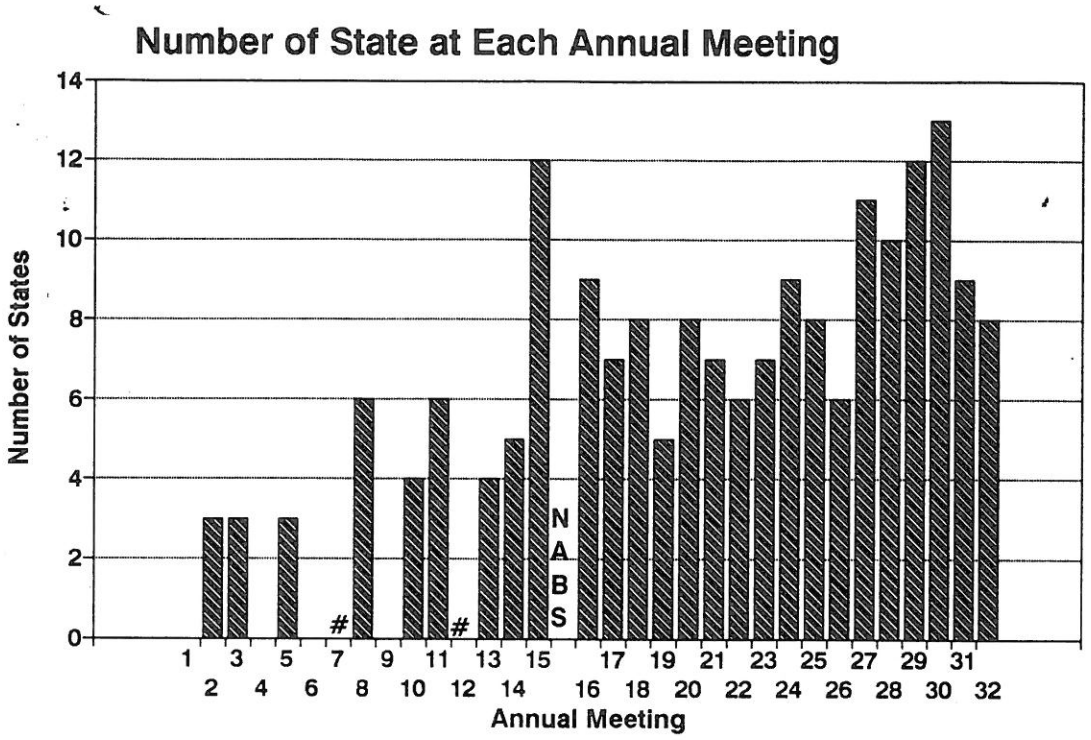

Figure 3. Number of different states represented at each of the annual meetings.

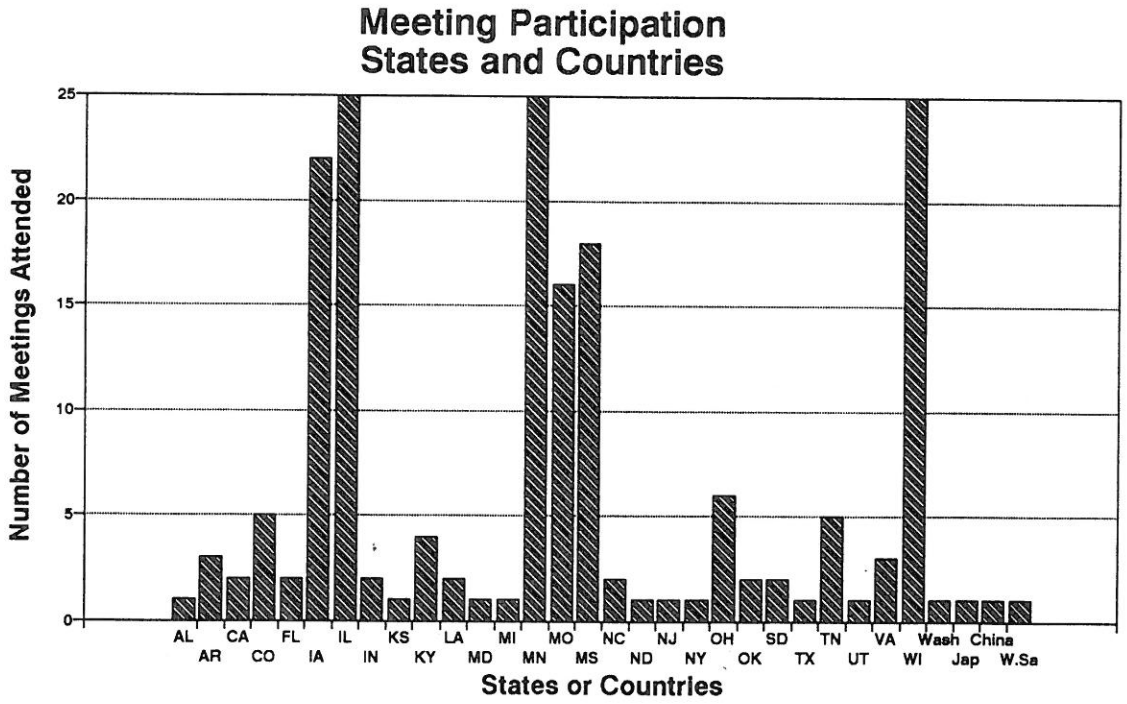

Figure 4. List of states from which annual meeting participants have come and the number of meetings at which each state was represented.

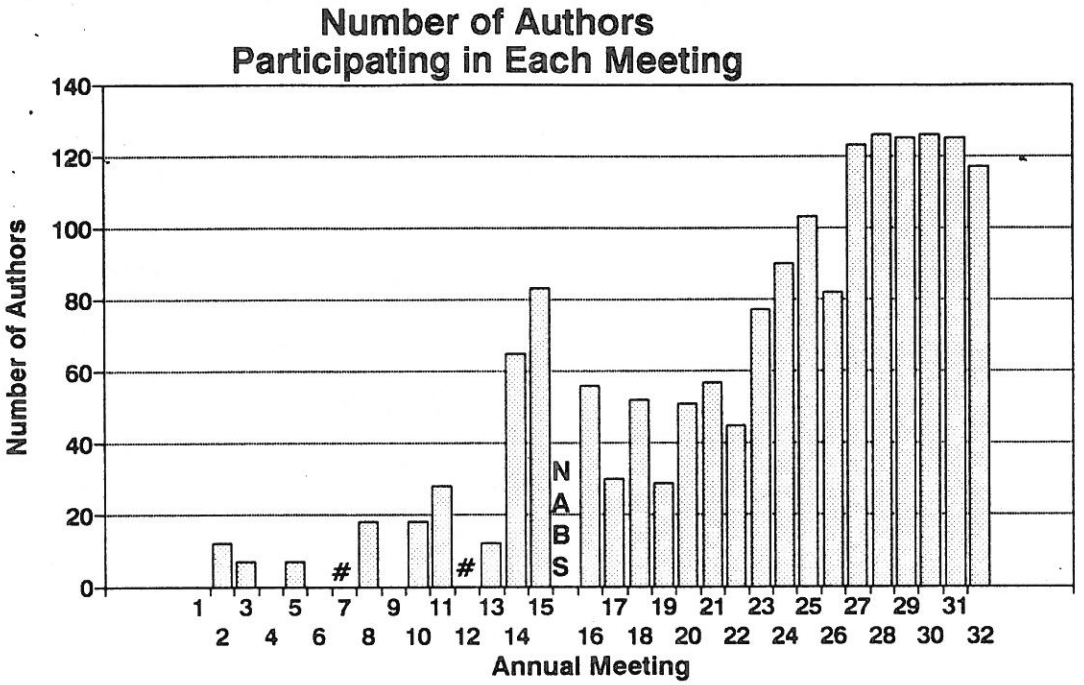

Figure 5. Number of different authors on presentations at each of the annual meetings.

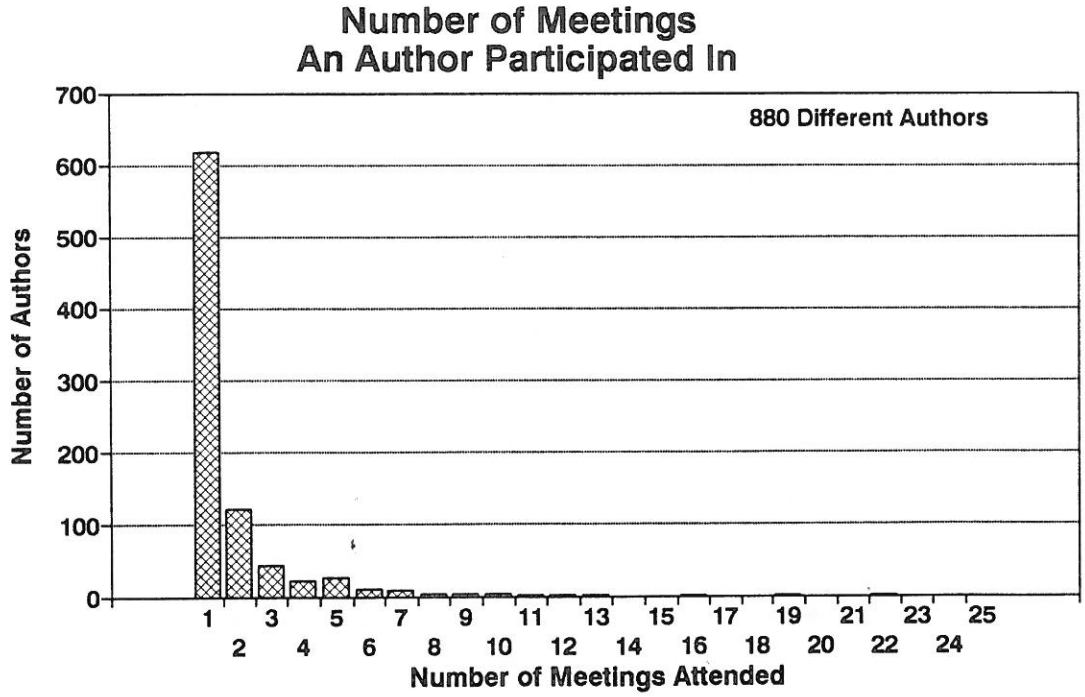

Figure 6. Number of annual meetings an author participated in.

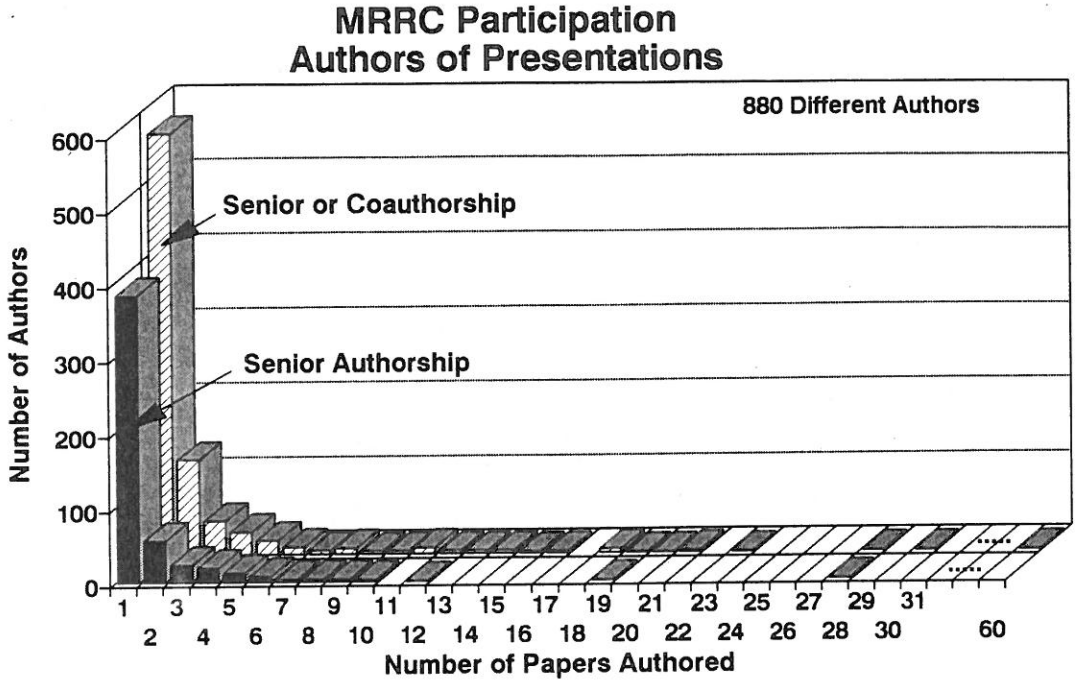

Figure 7. Number of different presentations senior authored or senior and coauthored by meeting participants.

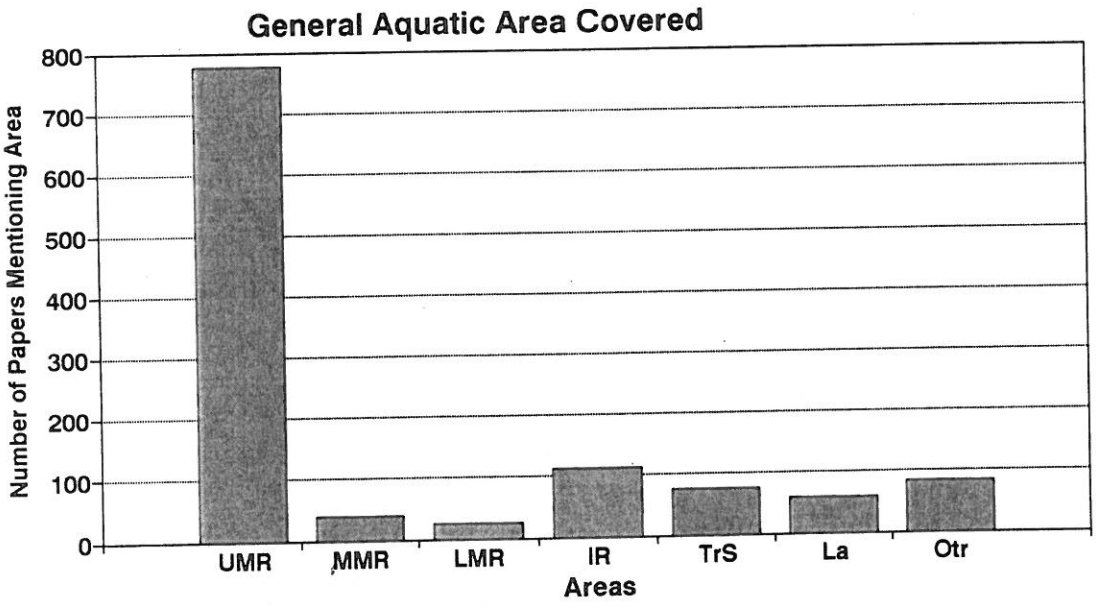

Figure 8. Number of meeting presentations dealing with each general aquatic area. UMR = Upper Mississippi River, MMR = Middle Mississippi River, LMR = Lower Mississippi River, IR = Illinois River, TrS = Tributary Stream, La = Lakes, and Otr = Other rivers or experimental conditions.

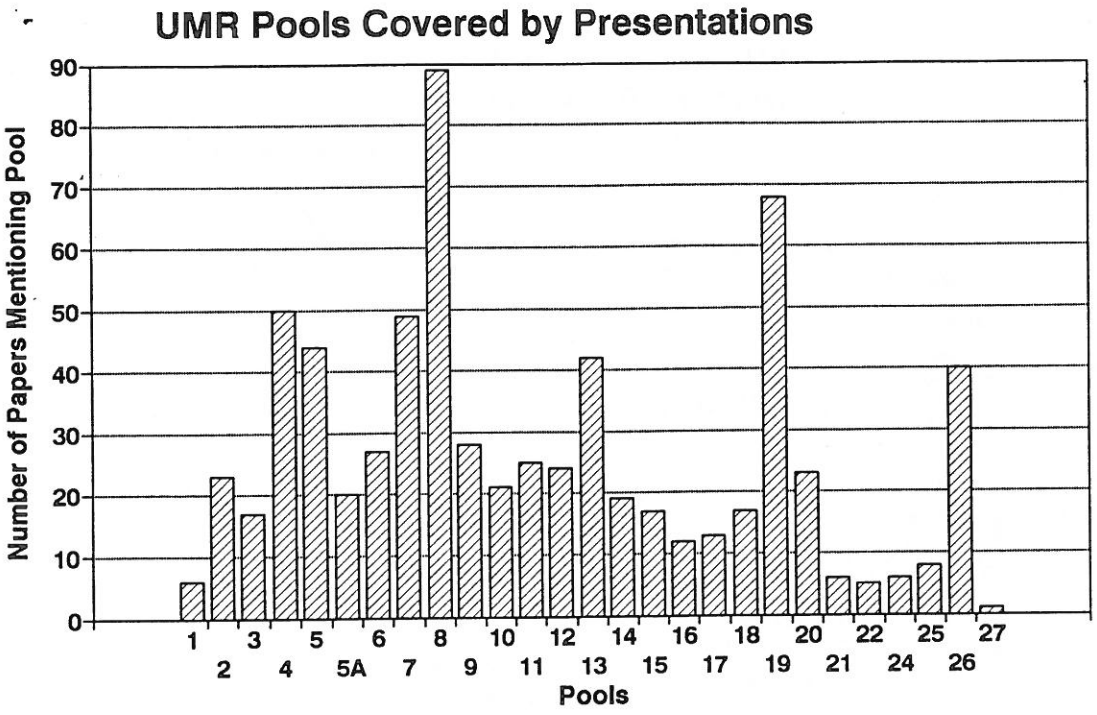

Figure 9. Number of annual meeting presentations dealing with each of the navigation pools of the upper Mississippi River.

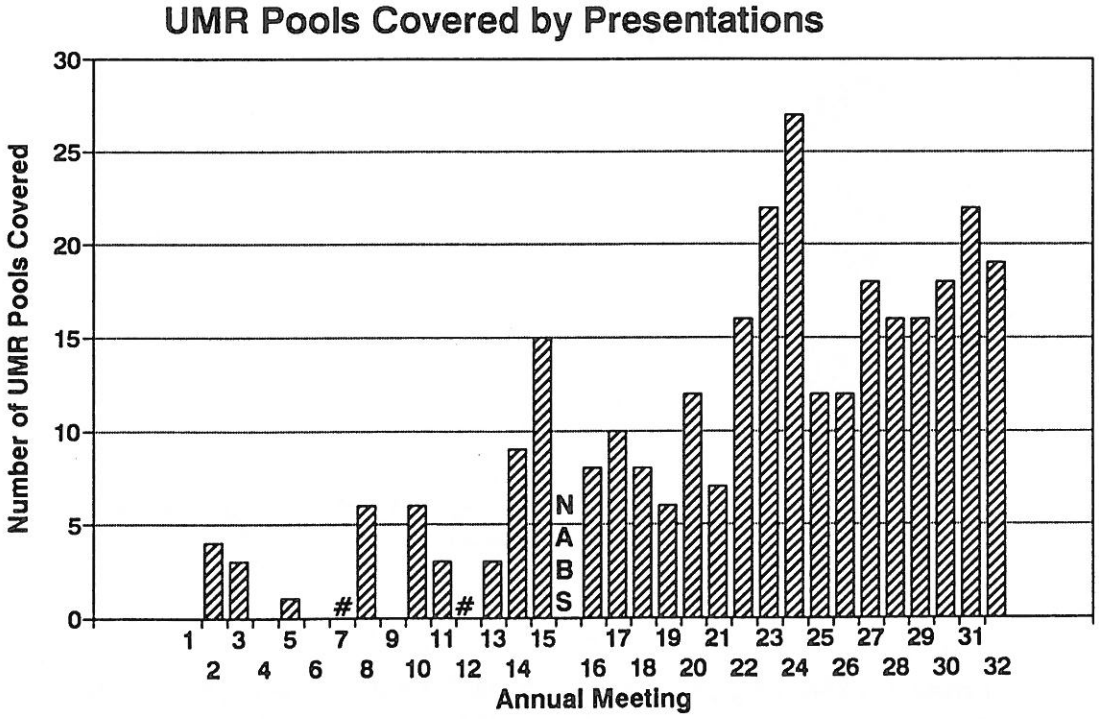

Figure 10. Number of different navigation pools of the upper Mississippi River covered by presentations at each of the annual meetings.

MINUTES OF THE 1999 BUSINESS MEETING
ANNUAL MEETING OF THE MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.

23 April 1999

The meeting was called to order at 10:36 by Melinda Knutson (President). Richard Anderson (Vice-President, Neal Mundahl (Treasurer), and Brent Knights (Secretary), and about 50 other members were present. President Knutson moved to approve the 1998 Minutes as printed in the Proceedings. (M/S/P)

President Knutson acknowledged Vice President Richard Anderson for his efforts on the great program for this year's Annual meeting; thanks to Brent Knights (Secretary) and Mary Stefanski (USFWS-Upper Mississippi River Refuge) for their efforts on press releases, and Brent Knights for letters to Congressional staff in support of the LTRMP and other mailings; thanks to Neal Mundahl (Treasurer), Georginia Ardinger (UMESC), and Mike Dewey (UMESC) for organizing the registration table; thanks again to Richard Anderson and Jon Duyvejonck for bringing poster boards: thanks to Mark Steingraeber for organizing this year's Raffle; thanks to Terry Dukerschein and Mike Caucutt for maintaining our web page; thanks again to Dave Kennedy for serving as the official photographer at the annual meeting; thanks to the River Studies Center students from UW-La Crosse for serving as projectionists. Finally, thanks to the people judging student platform and poster presentations and moderating sessions. President Knutson pointed out that other acknowledgments can be found in the Proceedings.

President Knutson introduced Terry Dukerschein who then presented MRRC's 1999 "Friend of the River" award to Dr. Ronald G. Rada, Associate Dean of the College of Allied Health and Science at the University of Wisconsin-La Crosse. Dr. Rada's efforts on Mississippi River research and his inspirational methods of teaching and mentoring students, many of whom have become managers and researchers on the River, made Dr. Rada a clear choice for this award.

Dr. Rada accepted the award on behalf of all of the "Friends of the River" he has work with on Mississippi River issues over the years. He emphasized that his efforts have been collaborative and that he is deeply honored to be recognized as a "Friend of the River".

Treasurer's Report

Treasurer Mundahl reported that the MRRC is solvent and a report is included in the Proceedings of the 1999 meeting.

No questions regarding the Treasurers Report came from the membership.

M/S/P acceptance of the 1998-1999 Treasurer's Report.

Old Business

Procedures Manual. President Knutson noted that the MRRC Procedures Manual, used to guide the Executive Board in planning the Annual Meeting and specifying the Board's duties, was updated this year.

"Friend of the River". President Knutson pointed out that the presentation text from past "Friend of the River" awards was printed in the 1999 Proceedings and will serve as a record of these presentations. Presentation text from future "Friend of the River" awards will be printed in the Proceedings for the Annual Meeting the year following the presentation. President Knutson also pointed out the "Friend of the River" award is not an annual award, that nominations are made by MRRC members, and then must be approved by the MRRC Executive Board.

Resolution of Respect. President Knutson noted that the Resolution of Respect for Dr. Verdiun is printed in the 1999 proceedings. Dr. Verdiun was a past President and founding member of the MRRC and had a distinguished career as a teacher and scholar of aquatic ecology. President Knutson encouraged the members to make Resolutions of Respect for other passing members as appropriate.

Archive established. President Knutson noted that an MRRC Archive has been established at the Upper Midwest Environmental Sciences Center - West Campus for important documents and materials and past them on to the incoming Secretary.

Wildlife related legislation. President Knutson distributed a fact sheet from the Iowa Department of Natural Resources on several versions of new legislation being proposed to fund wildlife related research. She encouraged members to read the fact sheet and write letters of support to Congress for the new legislation.

New Business

Election of Officers. Nominations for Vice President were: Yao Yin and Todd Koel. Neal Mundahl was the only nominee for Treasurer. Nominations were closed by M/S/P. Ballots for the election of Vice President and Treasurer were distributed and collected. yao Yin was elected Vice President and Neal Mundahl was elected Treasurer.

President Knutson turned over the meeting to incoming President Richard Anderson.

President Anderson thanked Melinda for last year's work and presented her with a certificate of appreciation from the MRRC.

Time and Place. President Anderson called for discussion on the possibility of moving the meeting from the Yacht Club to the Radisson for the 2000 meeting. He noted that the costs were comparable between the two sites. Maybe a $2 to $3 increase per person at the Radisson. Dates available at the Radisson were April 13-14, and dates available at the Yacht Club were April 19-20 or April 26-27.

Joe Wlosinski: The rooms available for platforms are very good at the Radisson. Does the Radisson have a good room for posters?

President Anderson: The Radisson has done some remodeling and now has available rooms for poster presentations.

Mike Dewey: Does the Radisson have an area outdoors for serving our banquet?

President Anderson: The Radisson can facilitate an outdoor meal but would prefer to serve the banquet indoors.

President Anderson: Dates are getting tight here (Yacht Club) and there (Radisson). The MRRC might want to consider booking two years in advance instead of one.

Ron Rada: SETEC conference at the Radisson went very well. Poster were set up in the Radisson Center next to the hotel. Radisson staff were extremely responsive to conference needs, and the SETEC conference was a complex meeting including concurrent platform sessions, a poster session, and a banquet.

Jon Duyvejonck: What are the room rates at the Radisson?

President Anderson: about the same as the Ramada Resorts (Yacht Club). $52 single, $62 double.

Joe Wlosinski: Did you (Anderson) check on available dates in the out year (2001)?

President Anderson: No. Any more discussion? None. Could we have a show of hands for those in favor of having next year's meeting at the Radisson on April 13 and 14. (33 voted in favor). Could we have a show of hands for those in favor of having the meeting at the Yacht Club during one of the two available time slots. (7 voted in favor). Next year's Annual Meeting of the MRRC will be held April 13 and 14, 2000 at the Radisson Hotel in La Crosse, Wisconsin. I'll call and confirm this with the Radisson.

Joe Wlosinski: Joe moved to have the Board look into the possibility of booking the Annual Meeting site two years in advance instead of one year. (M/S/P)

MRRC Historical Document. President Anderson informed the membership that he is in the process of contacting founders and others to help him create a historical account of the MRRC. The document would be printed as an addendum to next year's Proceedings if it is completed by then. Rick requested that others with knowledge or materials concerning MRRC history contact him.

Joe Wlosinski: Tom Claflin gave me some historical documents, including letters and other materials from early meetings. I passed these on to the incoming Secretary when I left office.

President Anderson: We will look for that material. The new archive will help prevent the loss of historical documents.

Keynote Speaker. President Anderson asked for feedback on this year's keynote speaker. Is this something the members would like to see at future meetings? Do you have any suggestions on possible speakers?

Members spoke in favor of keynote speakers. They liked this outside perspective, like that presented by Dr. Nancy Rabalais.

President Anderson asked for a show of hands from those in favor of inviting keynote speakers to future meetings. (The members present were unanimously in favor of a keynote speaker at future meetings.) President Anderson asked that members contact the Board with suggested speakers.

Other New Business. President Anderson called for other new business. None from the members. President Anderson announced the Vegetation Symposium to be held this fall in La Crosse, WI. He noted that there is a flyer available on the Symposium at the registration table.

EMP Letters of Support. Dave Kennedy recommended that the MRRC again write a letter of support for the Environmental Management Program and send it to Legislators. President Anderson confirmed that a letter of support would be sent.

Announcements:

President Anderson announced that student platform and poster awards would be presented at the end of the meeting instead of now. This was done to allow the program to be organized by topic.

Ron Rada announced that the bid for the 2001 NABS meeting in La Crosse at the Radisson Hotel was won, and the Dr. Bill Richardson, Dr. Roger Haro, and himself would be coordinating the program. He asked members interested to contact the coordinators with suggestions for session topics.

President Anderson called for a motion to adjourn. M/S/P. Meeting adjourned at 11:26.

Members volunteered for committee work as follows:

Program: Joe Wlosinski, Mike Dewey
Posters: None
Awards: None
Sales: Terry Dukerschein, Mike Dewey, Mark Steingraeber, Tom Pellet
History/Archive: Melinda Knutson

MISSISSIPPI RIVER RESEARCH CONSORTIUM
TREASURER'S REPORT - SUBMITTED BY NEAL D. MUNDAHL
1 MARCH 2000

Accounts as of 30 June 1997		$2,841.95
Accounts as of 30 June 1998		$6,249.14
Transactions, 1 July 1998 to 30 June 1999		
INCOME		
1999 Registration and Dues	$8,380.00	
1999 Raffle proceeds	$ 499.00	
T-shirt sales	$ 140.00	
Book sales	$ 5.00	
Interest	$ 88.36	
Total	$9,112.36	
EXPENSES		
Corporation fee	$ 10.00	
Yacht Club Resorts (1999 meeting)	$4,765.31	
1999 Proceedings	$ 200.00	
1999 Raffle prizes	$ 49.42	
1999 Keynote speaker expenses	$ 901.83	
Mailing costs	$ 330.50	
Printing costs	$ 242.60	
Supplies	$ 21.00	
1999 Best paper/poster awards	$ 110.00	
Total	$6,630.66	
Accounts as of 30 June 1999		$8,730.84
Transactions, 1 July 1999 to 1 March 2000		
INCOME		
Interest	$ 62.03	
Total	$ 62.03	
EXPENSES		
Corporation fee	$ 10.00	
Printing costs	$ 76.20	
Mailing costs	$ 169.74	
Total	$ 255.67	
Accounts as of 1 March 2000		$8,537.20
Accounts		
Checking account	$ 287.42	
Savings account	$8,249.78	
Total	$8,537.20	

MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.
BUSINESS MEETING AGENDA

14 April 2000, 10:30 A.M.
Radisson Hotel, La Crosse, Wisconsin

1. Call to Order

2. President's Report
   - Approval of 1999 minutes
   - Acknowledgments for 2000 meeting
   - Historical Summary MRRC
   - Procedures Manual

3. Treasurer's Report

4. Old Business
   - Long term booking of meetings - dates
   - Keynote speakers - need input from membership
   - Letters of support

5. New Business
   - Executive board nominations
   - Election of officers
   - Time and place of future meetings
   - Other

6. Adjournment (raffle immediately following)

Business Meeting Notes

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 by-laws.

2. The by-laws of this organization shall designate the officers and standing committees, the provisions for the election of officers, the conduct of meetings, and for any other matters which are necessary for the government of this organization.

ARTICLE III. MEMBERSHIP AND DUES

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

ARTICLE IV. AMENDMENTS

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

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

ARTICLE 1: NAME, PURPOSE, AND DUTIES

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

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

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

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

1.02 The purpose of the organization shall be as follows:

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

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

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

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

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

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

ARTICLE 2: OFFICES

2.01 Principal and Business Offices

The corporation may have such principal and other offices, either 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 reside 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 Term 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 notice or verbal notice delivered personally, by phone, mailed, or given by telegram to each director at the 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 of 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/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 Boards 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.

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 is so appointed to be assistant or as 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 at the previous annual meeting. Reports of officers and committees shall be delivered. The Board of Directors shall be elected from those individuals nominated by the Nominating Committee and those nominated from the floor with prior consent of the nominee. All persons attending the annual meeting shall be required to pay membership dues for that year and be 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.

Updated April 1999

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

Meeting	Year	Location	President
1st	1968	St. Mary's College, Winona, MN	Brother George Pahl
2nd	1969	Wisconsin State Univ., La Crosse, WI	Dr. Thomas Claflin
3rd	1970	Winona State College, Winona, MN	Dr. Calvin Fremling
4th	1971	St. Cloud State College, St. Cloud, MN	Dr. Joseph Hopwood
5th	1972	Loras College, Dubuque, IA	Dr. Joseph Kapler
6th	1973	Quincy College, Quincy, IL	Rev. John Ostdiek
7th	1974*	No Meeting	-
8th	1975	Monmouth College, Monmouth, IL	Dr. Jacob Verduin
9th	1976	St. Mary's College, Winona, MN	Mr. Rory Vose
10th	1977	Winona State University, Winona, MN	Dr. Dennis Nielsen
11th	1978	Univ. Wisconsin-La Crosse, La Crosse, WI	Dr. Ronald Rada
12th	1979*	Cancelled	Dr. Edward Cawley
13th	1980	Loras College, Dubuque, IA	Dr. Edward Cawley
14th	1981	Ramada Inn, La Crosse, WI	Mr. Michael Vanderford
			Executive Committee
15th	1982	Radisson Hotel, La Crosse, WI	Dr. Richard Anderson Dr. Dave McConville
____	1983	No Meeting	Dr. Jim Wiener
16th	1984	Radisson Hotel, La Crosse, WI	Dr. Ken Lubinski Ms. Rosalie Schnick Dr. Miles Smart
17th	1985	Radisson Hotel, La Crosse, WI	Mr. Ray Hubley Dr. John Nickum Ms. Pam Thiel
			Board of Directors
18th	1986	Radisson Hotel, La Crosse, WI	Dr. Jim Eckblad Dr. Carl Korschgen Dr. Jim Peck
19th	1987	Univ. of Wisconsin-La Crosse, La Crosse, WI	Mr. Hannibal Bolton Dr. Leslie Hollard Dr. Mike Winfrey
20th	1988	Univ. of Wisconsin-La Crosse, La Crosse, WI	Mr. John Pitlo Mr. Verdel Dawson Dr. Nani Bhowmik

Meeting	Year	Location	Board of Directors
21st	1989	Holiday Inn, La Crosse, WI	Dr. Larry Jahn Mr. Jerry Rasmussen Dr. Bill LeGrande
22nd	1990	Island Inn, La Crosse, WI	Mr. Doug Blodgett Dr. John Ramsey Mr. John Sullivan
23rd	1991	Holiday Inn, La Crosse, WI	Mr. Kent Johnson Dr. Mike Romano Dr. Joe Wlosinski
24th	1992	Holiday Inn, La Crosse, WI	Dr. Richard Anderson Mr. Mike Dewey Mr. Kent Johnson Dr. Joe Wlosinski
25th	1993	Holiday Inn, La Crosse, WI	Dr. Richard Anderson Dr. Teresa Naimo Mr. Charles Theiling Dr. Joe Wlosinski
26th	1994	Holiday Inn, La Crosse, WI	Dr. Teresa Naimo Dr. Mark Sandheinrich Mr. Charles Theiling Dr. Neal Mundahl
27th	1995	Holiday Inn, La Crosse, WI	Dr. Mark Sandheinrich Mr. Rob Maher Dr. Michael Delong Dr. Neal Mundahl
28th	1996	Holiday Inn, La Crosse, WI	Dr. Mark Sandheinrich Ms. Therese Dukerschein Dr. Michael Delong Dr. Neal Mundahl
29th	1997	Holiday Inn, La Crosse, WI	Ms. Therese Dukerschein Mr. Mark Steingraeber Dr. William Richardson Dr. Neal Mundahl
30th	1998	Yacht Club Resort, La Crosse, WI	Mr. Mark Steingraeber Dr. Melinda Knutson Dr. William Richardson Dr. Neal Mundahl
31st	1999	Yacht Club Resort, La Crosse, WI	Dr. Melinda Knutson Dr. Richard Anderson Mr. Brent Knights Dr. Neil Mundahl

Meeting	Year	Location	Board of Directors
32nd	2000	Radisson Hotel, La Crosse, WI	Dr. Richard Anderson Dr. Yao Yin Mr. Brent Knights Dr. Neil Mundahl

*The proceedings of the annual meetings of the Mississippi River Research Consortium, Inc. have been published since 1968. Volumes 7 and 12 were not published, as annual meetings were not convened in 1974 and 1979, respectively.

Dr. Ronald G. Rada

Recipient of the 1999 MRRC "Friend of the River" Award
Presented by Terry Dukerschein

I've known Dr. Ron Rada since 1986, when I started grad school at UW-La Crosse. It has been a challenge to fit what this energetic man has done for the Mississippi River, it's tributaries, and it's people, on one or two pages. I'm not sure exactly when Ron's river work started - he grew up on a farm north of the Missouri River in south-central South Dakota, where a love for learning was instilled by an exceptional teacher in a country school. In 1968, he earned a Bachelor of Science (Biology major, Chemistry minor) at the University of South Dakota in Springfield, South Dakota. I'm not going to assume it was a rough school - all I know is that the State of South Dakota, for whatever reasons, decided to convert it to a prison a few years ago, and I'm glad Ron got out when he did. Ron intended to teach high school, but fortunately for us, an astute mentor talked him into going on to grad school, an option he admits he had not really considered much until then. In 1970, he earned an MA in Biology concentrating in Aquatic Biology at the University of South Dakota, Vermillion, South Dakota. His master's thesis was titled "Distribution and Abundance of Zooplankton and Phytoplankton in Big Bend and Oahe Reservoirs on the Missouri River." From Vermillion, he and his wife Jane moved to Bozeman, Montana, where Ron earned his doctoral dissertation. "An Investigation into the Trophic Status of Canyon Ferry Reservoir, Montana" from Montana State University. In a state full of spectacular outdoor recreation opportunities, Canyon Ferry Reservoir on the upper Missouri River is a popular area. As a former Montanan who once enjoyed a wonderful day there with my family, I would like to thank Ron for his work on Canyon Ferry and other streams and rivers in Montana. After a year as an environmental biologist/limnologist at Duke Power Company Environmental Laboratories in Charlotte, North Carolina, Ron returned briefly to Montana in the summer of 1975. He completed post-doctoral work with the Montana Cooperative Fisheries Unit on the impact of coal strip mining on the Tongue River Reservoir of southeastern Montana.

In 1975 Ron joined the faculty at the University of Wisconsin-La Crosse (UW-L) as an Associate Professor of Biology, and by 1981 he was a full professor. He co-directed the River Studies Center at UW-La Crosse from 1979 to 1997. During this time he also participated in the private sector as a consultant on two major legal cases. In 1982 he helped evaluate the effects of the Quad Cities Nuclear Generating Station in Pool 14 of the upper Mississippi River. Also in 1982, as a consultant to a Washington DC law firm, he evaluated potential effects of navigation with the Tennessee Tom Bigbee Waterway.

In June of 1997, Ron began his present job as an Associate Dean of the College of Allied Health and Science at UW-La Crosse. Though his teaching duties have decreased and his administrative duties have increased, he continues to maintain an active role in river research and in improving learning opportunities in science for students of all ages. It would be impossible to rank the influence of Ron's teaching

against the influence of his research as contributions to the Mississippi River and its tributaries, for both have been considerable. As a mentor guided him towards grad school, so he as an award-winning teacher has guided many in this room and elsewhere into the discipline of aquatic science with empathy, imagination, and intelligence. He is not only a good teacher, he is a great coach: he knows how to empower people to do their best. He's such an enthused coach that some of us have ended up doing the running as well as the science, for as many of you know, Ron is a disciplined and accomplished marathon runner in his spare time. I'd like to add a personal note here--he is patient and realistic when giving pointers to the athletically impaired. Whether Ron has coached us on athletic performance or professional performance, he has done so with tact and vision. Each of us here has reached our present state on involvement with the Mississippi River in a unique way. On that path, Ron has directly or indirectly influenced many.

In the area of research, Ron has collaborated with others to garner well over $1.5 million dollars of funding related to the Mississippi River, it's tributaries, or improving techniques in aquatic science. His research specialties included mobilization and transport of contaminants, nutrient studies, and phycology. He has authored or co-authored numerous river related, peer reviewed publications, and has authored or co-authored countless river related presentations at professional meetings. He has been a past vice-president and president of MRRC and was instrumental in keeping it alive during the late 1970's. He is a founder of the Midwest SETAC Chapter and has served in leadership positions at the national or regional level in SETAC, NABS, and Sigma Xi. He has been a member of numerous other professional organizations related to research in aquatic science and has served as a peer reviewer for several leading national and international journals in the field of environmental pollution. Ron has been formally involved advising well over 70 graduate and undergraduate students at UW-La Crosse and he has mentored and advised many additional students on research projects. Since 1989, he has also served as adjunct graduate faculty member in the Department of Animal Ecology at Iowa State University and has advised graduate students there.

Between 1990 and 1995, Ron added an international dimension to his river work when he was a participant in the US/USSR cooperative Research in the Field of Environmental Protection, with a project titled "Assessment of Complex Anthropogenic Impacts on Ecosystems of Reservoirs and Rivers." Ron has wholeheartedly devoted a great deal of time and energy to the Mississippi River, it's tributaries, and its people, and I think this energetic man will continue to do so. When others put their feet up and talk of "decompressing" after a conference which Ron has helped to organize and run, Ron flashes them his unassuming smile (with just a hint of mischief) and says, "Decompressing? I'm not decompressing. This is just my normal pace." Truly, he lives up to the title of this award, and I am pleased to name Dr. Ron Rada as MRRC's 1999 "Friend of the River."

ACKNOWLEDGEMENTS 2000

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