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PROCEEDINGS OF THE

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PROCEEDINGS OF THE MISSISSIPPI RIVER RESEARCH CONSORTIUM

VOLUME 31

MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.

31ST ANNUAL MEETING
22-23 APRIL 1999
YACHT CLUB RESORTS
LA CROSSE, WISCONSIN

Contents

PLATFORM PROGRAM
MISSISSIPPI ROOM
THURSDAY, APRIL 22, 1999

8:00 AM — WELCOME AND INTRODUCTIONS, **Melinda Knutson**, MRRC President

8:30- 9:30 AM — **KEYNOTE**
LINKING GULF OF MEXICO HYPOXIA WITH MISSISSIPPI RIVER NUTRIENTS. **Nancy Rabalais.**
Louisiana University Marine Consortium.

9:30-10:00 AM — **BREAK**

SESSION I - VEGETATION AND THE RIVER COMMUNITY
(Moderator: Tom Dunstan)

10:00-10:20 AM — AQUATIC VEGETATION IN THE UPPER MISSISSIPPI AND ILLINOIS RIVERS: CHANGES FROM 1991 TO 1998 IN THIRTY-TWO BACKWATER AREAS. **Yao Yin**[1], Heidi Langrehr[2], and Sara Rogers[3]. [1] University of Tennessee, Knoxville, TN 37996; [2] Wisconsin Department of Natural Resources, Onalaska, WI 54650; [3] U.S. Geological Survey, Upper Midwest Environmental Science Center, La Crosse, WI 54603.

10:20-10:40 AM — FOREST COMMUNITY RESPONSE TO LARGE-SCALE FLOOD DISTURBANCE. **Robert J. Cosgriff**[1], John C. Nelson[1], and Yao Yin[2]. [1] Illinois Natural History Survey, LTRMP Great Rivers Field Station, 4134 Alby Street, Alton, IL 62002; [2] Environmental Management Technical Center, U.S. Geological Survey, Onalaska, WI 54650.

10:40-11:00 AM — AQUATIC VEGETATION CHANGES DUE TO A DRAWDOWN IN A BACKWATER POND ON THE UPPER MISSISSIPPI RIVER. **Heidi A. Langrehr**[1] and Joseph H. Wlosinski[2]. [1] Wisconsin Department of Natural Resources, 575 Lester Avenue, Onalaska, WI 54650; [2] U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603.

11:00-11:20 AM — SMALL MAMMAL METAPOPULATION DYNAMICS IN A RECENTLY ESTABLISHED MITIGATION WETLAND. **Christina Kocer.** Environmental Sciences Program, University of Dubuque, 2000 University Avenue, Dubuque, IA 52001.

11:20-11:40 AM — DOES VEGETATION AFFECT THE HARVEST OF MUSKRATS ON THE UPPER MISSISSIPPI RIVER NATIONAL WILDIFE AND FISH REFUGE? Laurie B. Wlosinski[1] and **Joseph H. Wlosinski**[2]. [1] Upper Mississippi River National Wildlife and Fish Refuge, 51 East Fourth Street, Room 101, Winona, MN 55987; [2] U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603.

11:40- 1:00 PM — **LUNCH** (on your own)

SESSION II - THE LAKE PEPIN PHOSPHORUS STUDIES (Moderator: Kent Johnson)

1:00- 1:20 PM ENVIRONMENTAL STUDIES OF PHOSPHORUS IN THE UPPER MISSISSIPPI RIVER, 1994-1998. **D. Kent Johnson.** Environmental Monitoring and Assessment Section, Metropolitan Council Environmental Services, Mears Park Centre, 230 East Fifth Street, St. Paul, MN 55101.

1:20- 1:40 PM LAKE PEPIN SEDIMENT HISTORY. **Daniel R. Engstrom** and James E. Almendinger. St. Croix Watershed Research Station, Science Museum of Minnesota, Marine on St. Croix, MN 55047.

1:40- 2:00 PM PHOSPHORUS SOURCES AND LAKE PEPIN WATER QUALITY. **William F. James**[1], John W. Barko[1,2], Harry L. Eakin[1], and D. Kent Johnson[3]. [1]USAE Waterways Experiment Station, Eau Galle Aquatic Ecology Laboratory, Spring Valley, WI 54767; [2]USAE Waterways Experiment Station, Environmental Laboratory, Vicksburg, MS 39180; [3]Metropolitan Council Environmental Services, Mears Park Centre, 230 East Fifth Street, St. Paul, MN 55101.

2:00- 2:20 PM PHOSPHORUS SOURCES AND UPPER MISSISSIPPI RIVER WATER QUALITY. **Michael L. Meyer** and Scott Schellhaass. Environmental Monitoring and Assessment Section, Metropolitan Council Environmental Services, Mears Park Centre, 230 East Fifth Street, St. Paul, MN 55101.

2:20- 2:40 PM ADVANCED EUTROPHICATION MODELING OF THE UPPER MISSISSIPPI RIVER. **Edward J. Garland**[1], James J. Szydlik[1], Catherine E. Larson[2], and Dominic M. Di Toro[1,3]. [1]HydroQual, Inc., 1 Lethbridge Plaza, Mahwah, NJ 07430; [2]Metropolitan Council Environmental Services, 230 East Fifth Street, St. Paul, MN 55057; [3]Manhattan College, Manhattan College Parkway, Bronx, NY 10471.

2:40- 3:10 PM **BREAK**

SESSION III - MUSSELS AND OTHER MACROINVERTEBRATES
(Moderator: Mike Romano)

3:10- 3:30 PM THE EFFECT OF STORMWATER RUNOFF ON BENTHIC MACROINVERTEBRATE COMMUNITY STRUCTURE IN TRIBUTARIES OF THE LOWER MISSISSIPPI RIVER. **Jack W. Grubaugh**, S.T. Nawrocki, and K.J. Maier. Department of Biology, University of Memphis, Memphis, TN 38152.

3:30- 3:50 PM TWO YEARS OF FOLLOW-UP AFTER A 1996 UNIONID TRANSLOCATION FROM AN AREA INFESTED WITH *DREISSENA POLYMORPHA* (PALLAS 1771), MISSISSIPPI RIVER MILE 697.5, HWY 14/61 BRIDGE, LA CROSSE, WI. **Marian E. Havlik.** Malacological Consultants, 1603 Mississippi Street, La Crosse, WI 54601-4969.

3:50- 4:10 PM METAPOPULATION DYNAMICS OF ZEBRA MUSSELS IN THE ILLINOIS RIVER. **James A. Stoeckel**[1], Daniel W. Schneider[2], K. Douglas Blodgett[1], Lori A. Soeken[1], Kip E. Stevenson[1], and Ted E. Snider[1]. [1]Illinois Natural History Survey, LTRMP Field Station, Havana, IL 62644; [2]Department of Urban and Regional Planning and Illinois Natural History Survey, University of Illinois, Champaign, IL 61820.

4:10- 4:30 PM GENETICS OF ZEBRA MUSSELS IN THE MISSISSIPPI RIVER REVISITED. **Angela Nealand** and Michael A. Romano. Dept. of Biological Sciences, Western Illinois University, Macomb, IL 61455.

4:30- 6:00 PM POSTERS

6:00- 8:00 PM BANQUET

PLATFORM PROGRAM
MISSISSIPPI ROOM
FRIDAY, APRIL 23, 1999

SESSION IV - RIVER SEDIMENTS/NUTRIENT BALANCE (Moderator: Todd Koel)

8:30- 8:50 AM DEVELOPMENT OF AN IN SITU MODEL FOR THE TOXICOLOGICAL EVALUATION OF SEDIMENTS IN LARGE RIVERS. **K.J. Maier**, P.M. Blanner, S.M. Davis, K.D. Drake, S.T. Nawrocki, and Jack W. Grubaugh. Department of Biology, University of Memphis, Memphis, TN 38152.

8:50- 9:10 AM CHANGES IN SEDIMENT PENETRATION DUE TO A DRAWDOWN AT LIZZY PAULS POND ON THE UPPER MISSISSIPPI RIVER. **Greg J. Egan** and Joseph H. Wlosinski. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603.

9:10- 9:30 AM NITROGEN MASS BALANCE BUDGET FOR THE UPPER MISSISSIPPI RIVER BASIN. **Dennis M. Wasley**[1,2], D.M. Soballe, D.R. Deuschle[1,2], and R.J. Haro[2]. [1] U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, P.O. Box 818, La Crosse, WI 54602-0818, USA; [2] River Studies Center, Department of Biology and Microbiology, University of Wisconsin-La Crosse, La Crosse, WI 54601, USA.

9:30- 9:50 AM EFFECTS OF SOILS, RIPARIAN ZONES, AND HYDROLOGY ON NUTRIENTS, HERBICIDES, AND BIOLOGICAL RELATIONS IN MIDWESTERN AGRICULTURAL STREAMS. **Stephen D. Porter**[1], Mitchell A. Harris[2], and Stephen K. Sorenson[3]. U.S. Geological Survey, Water Resources Division, [1] Box 26046, MS406, Denver, CO 80225; [2] 221 North Broadway Avenue, Urbana, IL 61801; [3] 12201 Sunrise Valley Drive, MS412, Reston, VA 20192.

9:50-10:10 AM THE PRESETTLEMENT UPPER MISSISSIPPI RIVER VALLEY: A LOOK AT THE PAST TO IDENTIFY AND RESTORE ENDANGERED NATURAL COMMUNITIES. **John C. Nelson**[1] and Kenneth S. Lubinski[2]. [1] Illinois Natural History Survey, Great Rivers Field Station, 4134 Alton, IL 62002; [2] Upper Midwest Environmental Sciences Center, 575 Lester Avenue, Onalaska, WI 54650.

10:10-10:30 **BREAK**

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

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

SESSION V - SWIMMING VERTEBRATES (Moderator: Dave Day)

1:00- 1:20 PM ASSESSING THE RISK OF *MYXOBOLUS CEREBRALIS*, THE CAUSATIVE AGENT OF SALMONID WHIRLING DISEASE, BECOMING ESTABLISHED IN THE GREAT LAKES REGION. **Martin J. Collins**[1], Daniel R. Sutherland[1], Becky A. Lasee[2], Scott T. Cooper[1], and Diane Waller[3]. [1]Department of Biology, University of Wisconsin-La Crosse, La Crosse, WI 54601; [2]U.S. Fish and Wildife Service, La Crosse Fish Health Center, Onalaska, WI 54650; [3]Human Services Division, Western Wisconsin Technical College, La Crosse, WI 54601.

1:20- 1:40 PM FISH PASSAGE THROUGH DAMS ON THE UPPER MISSISSIPPI RIVER. **Daniel B. Wilcox**[1] and Joseph H. Wlosinski[2]. [1]St. Paul District, U.S. Army Corps of Engineers, Environmental Resources Section, 190 5th Street East, St. Paul, MN 55101; [2]U.S. Geological Survey, Upper Mississippi Environmental Sciences Center, 575 Lester Drive, Onalaska, WI 54650.

1:40- 2:00 PM ENTRAINMENT MORTALITY OF ADULT FISH CAUSED BY COMMERCIAL TOWBOATS IN THE UPPER MISSISSIPPI RIVER SYSTEM. **Steve Gutreuter**[1], John M. Dettmers[2], and David H. Wahl[3]. [1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603; [2]Illinois Natural History Survey, Lake Michigan Biological Station, Zion, IL 60099; [3]Illinois Natural History Survey, Kaskaskia Biological Sciences, Sullivan, IL 61951.

2:00- 2:20 PM HABITAT FIDELITY IN RED-EARED SLIDERS IN UPPER POOL 20, MISSISSIPPI RIVER. **Kathy L. Rangen,** Richard V. Anderson, and Michael A. Romano. Dept. of Biological Sciences, Western Illinois University, Macomb, IL 61455.

2:20- 2:40 PM THE GENETIC TALE OF TURTLE TAILS. **Mandy L. Fross,** Michael A. Romano, and Richard V. Anderson. Dept. of Biological Sciences, Western Illinois University, Macomb, IL 61455.

2:40- 3:00 PM **BREAK**

SESSION VI - FLYING VERTEBRATES (Moderator: Jack Grubaugh)

3:00- 3:20 PM BALD EAGLE FORAGING PERCH DISTRIBUTION AT LOCK AND DAM 19, MISSISSIPPI RIVER. **Brian P. Kraskiewicz** and Thomas C. Dunstan. Dept. of Biological Sciences, Western Illinois University, Macomb, IL 61455.

3:20- 3:40 PM CEDAR GLEN WINTERING BALD EAGLE COMPLEX AT LOCK AND DAM 19, MISSISSIPPI RIVER. **Thomas C. Dunstan.** Dept. of Biological Sciences, Western Illinois University, Macomb, IL 61455.

3:40- 4:00 PM GREAT BLUE HERON FLUSHING DISTANCES ALONG THE SHORELINE OF UPPER POOL 20, MISSISSIPPI RIVER. **Robert L. Connour II**[1] and Thomas C. Dunstan[2]. [1]Knox College, Galesburg, IL 61401; [2]Dept. of Biological Sciences, Western Illinois University, Macomb, IL 61455.

4:00- 4:20 PM **STUDENT PAPER AWARDS**

N O T E S

POSTER PRESENTATIONS
THURSDAY, 22 APRIL 1999, 4:30-6:00 PM

FISH PREDATION EFFECTS ON ZEBRA MUSSEL (*DREISSENA POLYMORPHA*) COLONIZATION IN POOL 8 OF THE UPPER MISSISSIPPI RIVER. **Michelle R. Bartsch**, Lynn A. Bartsch, and Steve Gutreuter. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603.

DETECTING CHANGES IN CHANNEL CATFISH (*ICTALURUS PUNCTATUS*) POPULATIONS WITHIN THE LONG TERM RESOURCE MONITORING PROGRAM'S STUDY POOLS. **Randy Burkhardt**. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, Onalaska, WI 54650.

INFLUENCES OF LOCK AND DAM OPERATION ON PATTERNS OF FLOODPLAIN FOREST SPECIES COMPOSITION AND GROWTH ALONG THE UPPER MISSISSIPPI RIVER, POOL 12. **Michelle M. Cripps**. Environmental Sciences Program, University of Dubuque, 2000 University Avenue, Dubuque, IA 52001.

LONGITUDINAL PATTERNS ON INVERTEBRATE PRODUCTION (*DREISSENA POLYMORPHA*) IN THE UPPER MISSISSIPPI RIVER. **Sarah E. Curl, Myra L. Kunas**, and Michael D. Delong. Large River Studies Center and Biology Department, Winona State University, Winona, MN 55987.

FRESHWATER MUSSEL - FISH INTERACTIONS IN THE SUPERIOR NATIONAL FOREST AND CANNON RIVER WATERSHED, MN. **Stacy DeRuiter**. Biology Department, St. Olaf College, 1520 St. Olaf Ave., Northfield, MN 55057.

TERMINAL BODY SIZE FOR *GLOSSOSOMA INTERMEDIUM* (TRICHOPTERA: GLOSSOSOMATIDAE): VARIATION WITHIN AND AMONG POPULATIONS FROM SOUTHESTERN WISCONSIN STREAMS. **Deric R. Deuschle** and Roger J. Haro. River Studies Center, Department of Biology and Microbiology, University of Wisconsin-La Crosse, La Crosse, WI 54601.

A COMPARISON OF STREAM SEGMENT AND QUADRAT MUSSEL SAMPLING TECHNIQUES. **Timothy L. Dickson**. Biology Department, St. Olaf College, Northfield, MN 55057.

CHANGES IN VEGETATION FROM 1975 TO 1992 IN BACKWATERS OF NAVIGATION POOLS 4 AND 13, UPPER MISSISSIPPI RIVER. **Jennifer J. Dieck**[1,2] and Rob W. Tyser[1,2]. [1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Rd., La Crosse, WI 54603; [2]University of Wisconsin-La Crosse, Department of Biology/Microbiology, 1725 State Street, La Crosse, WI 54601.

HEALTH ASSESSMENTS OF WILD FISH IN THE MIDWEST. Becky A. Lasee, **Audrey L. Dikkeboom**, John M. Whitney, Terrence J. Ott, and Kenneth Phillips. La Crosse Fish Health Center, U.S. Fish & Wildlife Service, Onalaska, WI 54650.

LOCATION-SPECIFIC EFFECTS ON GROWTH OF ZEBRA MUSSELS IN THE UPPER MISSISSIPPI RIVER. **Timothy B. Doyle, Kristen M. Mack**, and Michael D. Delong. Large River Studies Center and Biology Department, Winona State University, Winona, MN 55987.

POSTER PRESENTATIONS
THURSDAY, 22 APRIL 1999, 4:30-6:00 PM

THE INFLUENCE OF EXTRINSIC FACTORS ON SEDIMENTATION RATES AND SEDIMENT TYPES IN THE CATFISH CREEK WATERSHED, DUBUQUE, IOWA. **Robert Duffy**. Environmental Sciences Program, University of Dubuque, 2000 University Avenue, Dubuque, IA 52001.

DISTRIBUTION OF WILD RICE (*ZIZANIA AQUATICA L.*) IN THE FLOODPLAIN OF NAVIGATION POOL 8, UPPER MISSISSIPPI RIVER (UMR), 1975, 1989, 1991-1997. **J. Therese Dukerschein**. Wisconsin Department of Natural Resources Long Term Resource Monitoring Program (LTRMP) Field Station, 575 Lester Avenue, Onalaska, WI 54650.

SEASONAL AND LOCATION EFFECTS ON THE GROWTH OF BLUEGILL, *LEPOMIS MACROCHIRUS*, IN THE UPPER MISSISSIPPI RIVER. **Joshua Fye** and Michael D. Delong. Large River Studies Center and Biology Department, Winona State University, Winona, MN 55987.

HISTORICAL LANDCOVER CHANGES ALONG POOL 26 OF THE UPPER MISSISSIPPI RIVER DUE TO HUMAN MODIFICATIONS BEGINNING IN 1816. **Lawra Grabowski**, Jeffrey L. Stone, Robert J. Cosgriff, and John C. Nelson. Illinois Natural History Survey, Great Rivers Field Station, 4134 Alby Street, Alton, IL 62002.

SEASONAL-AND HABITAT-SPECIFIC GROWTH OF SHORTHEAD REDHORSE IN THE UPPER MISSISSIPPI RIVER. **Carey Hale** and Michael D. Delong. Large River Studies Center and Biology Department, Winona State University, Winona, MN 55987.

FISH COMMUNITY RESPONSE TO REOPENING OF THE EAST RIVER SIDE CHANNEL AND ISLAND CONSTRUCTION AS PART OF THE UPPER PEORIA LAKE HABITAT REHABILITATION PROJECT (HREP). **Kevin S. Irons**, Todd M. Koel, T. Matt O'Hara, and Mike J. Perfetti. Illinois Natural History Survey, LRTMP Field Station, 704 N. Schrader Ave., Havana, IL 62644.

VEGETATION RESPONSE TO EXPERIMENTAL DRAWDOWNS ON POOLS 5 AND 9 OF THE UPPER MISSISSIPPI RIVER. **Kevin P. Kenow**, Carl E. Korschgen, Randy K. Hines, Jean M. Stancill, James E. Lyon, Larry R. Robinson, and Joseph H. Wlosinski. U.S. Geological Survey, Biological Resources Division, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603.

SURVEY OF SMALL MAMMALS IN WET MEADOW HABITAT OF THE UPPER MISSISSIPPI RIVER FLOODPLAIN. **Kellie A. Kroc**. University of Wisconsin-La Crosse, La Crosse, WI 54601.

TEMPORAL VARIATION OF GLYCOGEN IN TWO POPULATIONS OF *AMBLEMA PLICATA PLICATA*: RIVERINE AND RELOCATED. **Emy M. Monroe** and Teresa J. Naimo. U.S. Geological Survey, Upper Mississippi Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603.

POSTER PRESENTATIONS
THURSDAY, 22 APRIL 1999, 4:30-6:00 PM

SEASONAL PATTERNS IN WATER QUALITY AT A MARINA WELL (MASSEY MARINA, DUBUQUE COUNTY, IOWA) ALONG THE UPPER MISSISSIPPI RIVER, POOL 12. **Jessica Montana** and Jamie Toscetti. Environmental Sciences Program, University of Dubuque, 2000 University Avenue, Dubuque, IA 52001.

FINGERNAIL CLAM (SPHAERIIDAE) DENSITIES AND DIVING DUCK USE IN THE UPPER MISSISSIPPI RIVER LOWER POOL 8. Randy Burkhardt[1], **Jennifer S. Sauer**[1], Lara Hill[2], and Shawn Weick[1]. [1]U.S. Geological Survey, Upper Midwest Environmental Science Center, Onalaska, WI 54650; [2]U.S. Fish and Wildlife Service, Onalaska, WI 54650.

MOVEMENT OF BROWN TROUT (*SALMO TRUTTA*) IN BIG MILL CREEK, NEAR BELLEVUE, IOWA. **Michael Spears**, Matt Calvert, and Ben Wollenzien. Environmental Sciences Program, University of Dubuque, 2000 University Avenue, Dubuque, IA 52001.

POPULATION DYNAMICS OF COMMON SHINERS (*NOTROPIS CORNUTUS*) IN THE LITTLE MAQUOKETA RIVER NEAR DURANGO, IOWA. **Justin Sternes.** Environmental Sciences Program, University of Dubuque, 2000 University Avenue, Dubuque, IA 52001.

EFFECTS OF DREDGE MATERIAL PLACEMENT ON MACROINVERTEBRATE COMMUNITIES. **Kip E. Stevenson**, Todd M. Koel, and K. Douglas Blodgett. Illinois Natural History Survey, LTRMP Field Station, 704 S. Schrader Ave., Havana, IL 62644.

MUSSEL DISTRIBUTION AND ABUNDANCE IN THE CANNON RIVER WATERSHED AND SUPERIOR NATIONAL FOREST, MN. **Gary E. Wagenbach**[1], M.C. Swift[2], Stacy DeRuiter[2], Timothy L. Dickson[2], C. Harbison[1], and G. Jesperson[1]. [1]Biology Department, Carleton College, Northfield, MN 55057; [2]Biology Department, St. Olaf College, Northfield, MN 55057.

SMALL MAMMAL METAPOPULATION DYNAMICS IN A RECENTLY ESTABLISHED MITIGATION WETLAND-MOVEMENTS IN HABITAT PATCHES. **Matthew Watters**, Chris Kirkpatrick, and Ann Weckbeck. Environmental Sciences Program, University of Dubuque, 2000 University Avenue, Dubuque, IA 52001.

IN SITU EXPERIMENTAL GROWTH STUDIES OF HYDROPSYCHIDAE IN THE UPPER MISSISSIPPI RIVER. **A. E. Zaletel, B. L. Hulbert**, and M. D. Delong. Large Rivers Study Center and Biology Department, Winona State University, Winona, Minne 55987.

ASSESSING THE RISK OF *MYXOBOLUS CEREBRALIS*, THE CAUSATIVE AGENT OF SALMONID WHIRLING DISEASE, BECOMING ESTABLISHED IN THE GREAT LAKES REGION.

Martin J. Collins[1], Daniel R. Sutherland[1], Becky A. Lasee[2], Scott T. Cooper[1], and Diane Waller[3].
[1] Department of Biology, University of Wisconsin-La Crosse, La Crosse, WI 54601; [2] U.S. Fish and Wildife Service, La Crosse Fish Health Center, Onalaska, WI 54650; [3] Human Services Division, Western Wisconsin Technical College, La Crosse, WI 54601.

Whirling disease is a chronic inflammatory disease of salmonids caused by the non-indigenous myxozoan parasite, *Myxobolus cerebralis*, which is believed to have evolved in Eurasia as a parasite of brown trout *Salmo trutta*. This parasite has an indirect life cycle that consists of two hosts--a salmonid fish and an aquatic oligochaete, *Tubifex tubifex*. A unique spore stage develops in each host that is infective to the other host. Whirling disease was first diagnosed in the USA in 1958 and has since spread to 22 states. Severe losses of self-sustaining rainbow trout *Onchorynchus mykiss* populations have occurred in Colorado, Montana, and Utah in recent years. These declines have stimulated increasing concern of potential ecological and economic impacts that could arise with the introduction of *M. cerebralis* into the Great Lakes region. In order to assess risk of establishment, it is necessary to determine the oligochaete community structure of the Great Lakes region. It is also important to determine if the parasite is already present in these waters. Previous testing has not indicated that the parasite is present; however, traditional methods of detection have generally lacked sensitivity. Traditional methods for detecting *M. cerebralis* in salmonids are generally time consuming, expensive, and are specific to a particular life cycle stage of the parasite. Presently, there is a need for a faster and more cost-effective methods that is capable of detecting all life cycle stages of the parasite. DNA-based tests, such as the polymerase chain reaction (PCR), have the potential to solve many of these problems. PCR was incorporated in this project to evaluate the presence/absence of *M. cerebralis* in Wisconsin waters. Up to thirty fish of each inhabiting salmonid species were collected from inland Wisconsin streams, and tributaries and inshore areas of both Lake Michigan and Lake Superior. In addition, two known *M. cerebralis* positive streams in Michigan (Au Sable River-North Branch and Manistee River-North Branch) were also sampled. Results indicated Wisconsin waters that were tested are currently uninfected with the parasite. As expected, fish in the two Michigan streams tested positive (26/30 brook trout *Salvelinus fontinalis* and 4/7 brown trout in the Au Sable River-North Branch, and 23/30 brook trout in the Manistee River-North Branch). However, these streams are not suffering the severe losses of wild trout populations relative to the Rocky Mountain states. Several factors may account for this, which include life histories of the salmonid hosts, abundance/distribution of *T. tubifex*, water temperatures, host strain (immunity), host stress levels, spore loads, and potentially other factors that have yet to be determined. Presently, the only means of preventing infection remains controlling the spread of the parasite into previously uninfected streams.

Keywords: Whirling disease, *Myxobolus cerebralis*, salmonid, Great Lakes, oligochaete, *Tubifex tubifex*, myxozoan, parasite, polymerase chain reaction, PCR

GREAT BLUE HERON FLUSHING DISTANCES ALONG THE SHORELINE OF UPPER POOL 20, MISSISSIPPI RIVER.

Robert L. Connour II[1] and Thomas C. Dunstan[2].
[1] Knox College, Galesburg, IL 61401; [2] Department of Biological Sciences, Western Illinois University, Macomb, IL 61455.

Great Blue Herons (*Ardea herodias*) are common residents along the Mississippi River near Lock and Dam 19. Foraging and resting herons share shorlines and adjacent open water areas with humans involved in commercial and recreational activites. Previously, it was unclear as to what extent these human activities had on heron behavior. This study identified and tested the likelihood of heron disturbance by human operated motorboats typical of those used daily for water related recreational purposes (boating, fishing, skiing, etc.) at the site. Flushing distances (N = 239) of herons from the Mud Island Rookery area were recorded during seven weekly field trips during the late breeding season from 29 August to 30 October 1998. Intial shoreline locations of resting or foraging herons were recorded, and heron flushing distances as measured from the boat with a Bushnell laser range finder were noted. Herons were stimulated into flight by the approach of an 18-foot Jon boat powered by a 25 horsepower outboard engine. The boat path was usually parallel to and within 10 to 50 meters of the shoreline and moved at a speed from 8 to 15 mph. Seventy-six percent (N = 181) of the herons tolerated an approach distance greater than 121 meters before flushing, 53 percent (N = 126) tolerated approaches greater than 91 meters, and all herons flushed beyond 20 meters. Typically, heron activity was interrupted prior to flushing and various disturbance behaviors such as hiding, posturing, and pre-flight movements were noted.

Keywords: Great Blue Heron, flushing distances, Upper Pool 20, Mississippi River

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FOREST COMMUNITY RESPONSE TO LARGE-SCALE FLOOD DISTURBANCE.

Robert J. Cosgriff[1], John C. Nelson[1], and Yao Yin[2].
[1] Illinois Natural History Survey, LTRMP Great Rivers Field Station, 4134 Alby Street, Alton, IL 62002;
[2] Environmental Management Technical Center, U.S. Geological Survey, Onalaska, WI 54650.

Floodplain forest communities are adapted to survive moderate frequency, moderate intensity and short duration flooding when it occurs during plant dormancy. However, forest mortality increases as flood frequency, intensity or duration increases and when flooding occurs during the growing season. In 1993, a long duration and high intensity flooding event inundated the floodplain forests along Pool 26 of the Upper Mississippi River System and along the Lower Illinois River. The flood lasted for 195 days, throughout much of the growing season. We determined that the resulting forest mortality was community, species and size specific. Mixed forests suffered substantially greater tree mortality than maple-ash and oak forests. This was due, in part, to the high density and mortality (94%) of hackberry (*Celtis occidentalis*) trees inhabiting mixed forests. Saplings were more susceptible to flood induced mortality than trees (72% for saplings and 45% for trees across all forest communities). Oak forest saplings had better survivorship than saplings in the maple-ash and mixed forests. Hackberry, pin oak (*Quercus palustris*), cottonwood (*Populus deltoides*), and American elm (*Ulmus americana*) trees had higher mortality than the average (46%) across all forests (91%, 57%, 57%, and 49%, respectively). Overcup oak (*Quercus lyrata*), green ash (*Fraxinus pennsylvanica*), box elder (*Acer negundo*), and silver maple (*Acer saccharinum*) trees showed better survivorship (mortalities of 19%, 23%, 42%, and 42%, respectively). The seedling strata of all three forest communities was eradicated. However, prolific seedling germination occurred after the flood. Silver maple seedlings showed astonishing responses with a density of 258,599 seedlings/ha, 74,760 seedlings/ha and 9,280 seedlings/ha on maple-ash, mixed and oak forests, respectively. Other dominants included American elm (32,970 seedlings/ha across all forests) and green ash (21,933 seedlings/ha across all forests). Total seedling density was forest community dependent with a total of 365,700 seedlings/ha (maple-ash), 144,012 seedlings/ha (mixed) and 95,545 seedlings/ha (oak). We also described the herbaceous stratum. Tickseed sunflower (*Bidens aritosa*), smartweed (*Polygonum spp.*) and rice cutgrass (*Leersia oryzoides*) dominated the herbaceous cover of all three forest communities. Tickseed sunflower was the most dominant member of the herbaceous strata with an average cover of 36% and a frequency of 73% across all forest communities. The results suggest that the flood of 1993 was a severe disturbance event influencing species composition and recruitment in three floodplain forest communities. Large-scale flooding events, such as the flood of 1993, are generally considered natural and maybe a driving force of species, community and landscape successional patterns. However, at some level a large-scale disturbance event will significantly alter a system to the point that a return to a previous condition would require an extensive amount of time or be unlikely.

Keywords: flood disturbance, floodplain forest, Mississippi River, succession, community dynamics

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CEDAR GLEN WINTERING BALD EAGLE COMPLEX AT LOCK AND DAM 19, MISSISSIPPI RIVER.

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In 1970, Cedar Glen, a 4-acre "bowl" formed by erosion in Keokuk limestone bluffs of Valmyrian Age, and a total of 182 acres of mixed hardwood forest, were purchased by the Illinois Chapter of the Nature Conservancy in cooperation with Western Illinois University as the nation's first dedicted and managed bald eagle night roost for migrating and wintering bald eagles. Reserach and management at the site has continued through the winter of 1998 and involved: 1. Additional land acquisition; 2. No-trespass seasons and zones; 3. Vegetation management; 4. Artificial perch structures; 5. Eagle habitat use; 6. Eagle food habits and foraging behavior; 7. Eagle population characteristics and dynamics; and 8. Eagle interactions with humans.

The presentation chronicles the 30-year history, and details the development of the present 1,800-acre Bald Eagle wintering complex and multiple use area from River Mile (RM) 358 upstream to RM 364.5 at Lock and Dam 19, Keokuk, IA and Hamilton, IL.

Keywords: bald eagle, Mississippi River, night roost, chronicle

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CHANGES IN SEDIMENT PENETRATION DUE TO A DRAWDOWN AT LIZZY PAULS POND ON THE UPPER MISSISSIPPI RIVER.

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Water levels were lowered at Lizzy Pauls Pond during the summer of 1997. One of the objectives of the project was to dry and consolidate bottom sediments. The U.S. Army Corps of Engineers performed the drawdown as part of a Habitat Rehabilitation and Enhancement Project for the Upper Mississippi River. Lizzy Pauls Pond is in Pool 5, cover 21 hectares, and is connected to the River by a culvert.

Sediments were measured with an *in situ* penetrometer in the summer of 1996 (pre-project) and again in the spring of 1998 (post-project). A total of 131 sample sites were established on a 40 X 40-m grid. The pond was divided by 40 m transects both north/south and east/west with a sampling site being established at each intersection. Sediment penetration was measured in triplicate for each of three penetrometer cones of different weights and diameters. An adjoining backwater area was also sampled as a control. It had 30 sample sites on a similar grid. The drawdown commenced on June 24, 1997, and continued until mid-October. The maximum drawdown amount was 0.42 m.

We performed four paired *t* tests for each cone at each site sampled. The four tests were a combination of drawdown or control and areas sampled in less than or greater than 0.42 m. None of the four test showed conclusive results. Either the difference for all three pins had different signs or the tests were not significant. We also performed a regression analysis on the difference in penetrometer readings for the 131 sites between the two years using depth as the independent variable. That analysis showed a significant trend ($\alpha = 0.05$), with penetration being greater with an increase in depth. However, the regression for each cone had an R2 value below 0.24. Also, two transects across Lizzy Pauls Pond, that measured the elevation of the sediment/water interface in 1996 and 1998, showed little change.

Results may have been inconclusive for a number of reasons. The drawdown was not as great as originally planned. Based on sampling depths, we estimated that only 15 of the 131 sample sites were dried for any portion of the drawdown period. The summer of 1997 was also wetter than normal. A total of 62 cm of rainfall fell on 51 days during the drawdown, causing some dewatered areas to again be flooded. A number of springs also fed the pond. In addition, all sites were vegetated which may also have had an effect on penetrometer results.

Keywords: drawdown, penetrometer, sediment, Upper Mississippi River

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LAKE PEPIN SEDIMENT HISTORY.

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Long-term changes in sediment and phosphorus loading to the Upper Mississippi River were quantified from an array of 25 sediment cores from Lake Pepin (Pool 4), a large natural impoundment downstream of the Minneapolis/St. Paul metropolitan area. Cores were dated and stratigraphically correlated using ^{210}Pb, ^{137}Cs, ^{14}C, magnetic susceptibility, pollen analysis, and loss-on-ignition. All cores show a dramatic increase in sediment accumulation beginning with European settlement in 1830. Accumulation rates are highest and show the greatest post-settlement increases in the upper end of the lake. Present-day sediment-phosphorus concentrations are roughly twice those of pre-settlement times, and the Fe/Al-bound fraction makes up a greater portion of the total. Diatom assemblages record a marked increase in nutrient availability over the last 200 years, changing from clear-water benthic forms and mesotrophic planktonic taxa in pre-settlement times to exclusively planktonic assemblages characteristic of highly eutrophic conditions today. Lake-water total-phosphorus concentrations (total-P), estimated by weighted averaging regression and calibration, increased from 50 to 200 μg/l during this period. Sediment loading to Lake Pepin from the Upper Mississippi River has increased by an order of magnitude since 1830. Modern fluxes are about 900,000 metric tons annually, and are more than 80% detrital mineral matter. About 17% of the lake's volume in 1830 has been replaced by sediment, and at current accumulation rates the remainder will be filled in another 340 years. Phosphorus accumulation in Lake Pepin sediments has increased 15-fold since 1830, rising from 60 to 900 metric tons annually. This rise represents a seven-fold increase in phosphorus loading from the Mississippi River coupled with more efficient retention of phosphorus inflows by bottom sediments. More efficient trapping of phosphorus in Lake Pepin over the last century resulted from higher rates of sediment burial. The most dramatic changes in nutrient and sediment inputs to Lake Pepin have occurred since 1940, although gradual increases began shortly following European settlement. Sediment and phosphorus accumulation rates rose sharply between 1940 and 1970 and then leveled off, while lake-water total;-P concentrations and inflows increased continuously up to the present.

Keywords: Upper Mississippi River, Lake Pepin, paleolimnology, phosphorus, sediment cores

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THE GENETIC TALE OF TURTLE TAILS.

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Migration and movement has long been defined in terms of gene flow, however little has been done to correlate actual animal movement through radiotelemetry and capture-recapture studies with genetic evidence. As part of a project to correlate gene flow and movement among *Trachemys scripta*, the slider turtle, protein starch gel electrophoresis was conducted on turtles near Lock and Dam 19. Three distinct locations were trapped with tail biopsies taken from the resulting turtles. Electrophoresis conducted on these samples showed preliminary results which indicate a high degree of genetic differentiation between the three subpopulations. Fst, which measures such differentition, was high with a value of .247, showing a great deal of genetic difference between turtle populations. This further indicates that little gene flow occurs between subpopulations of the *Trachemys scripta*. This coupled with turtle movement as documented by radiotelemetry and capture-recapture studies indicates a high degree of site fidelity among slider turtles with little breeding between populations.

Keywords: reptiles, genetics, turtles

ADVANCED EUTROPHICATION MODELING OF THE UPPER MISSISSIPPI RIVER.

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An advanced mathematical model has been developed to evaluate the effectiveness of point and nonpoint source controls for achieving water quality objectives in Pools 2, 3, and 4 of the Upper Mississippi River. The three-dimensional, time variable model includes linked hydrodynamic, sediment transport, and eutrophication components. The eutrophication component is a descendent of the Chesapeake Bay eutrophication model and includes a sediment flux submodel, which calculates nutrient fluxes to the water column in response to the deposition of particulate organic matter. In this study, particulate inorganic phosphorus was added to the eutrophication kinetics to account for the transport, settling, and resuspension of sorbed inorganic phosphorus. Resuspension and settling rates are calculated in the sediment transport component. The model was calibrated with data collected over a range of hydrological conditions during a 12-year period, from 1985 through 1996. Approximately 90 percent of phosphorus inputs to the study area enter the Upper Mississippi River in Pool 2. The Metropolitan Wastewater Treatment Plant (Metro Plant), a 220-mgd facility operated by Metropolitan Council Environmental Services, accounted for approximately 22 percent of the total phosphorus (TP) discharged to the study area between 1985 and 1996. In the low flow year of 1988, however, the Metro Plant contributed almost 50 percent of the TP load. Nonpoint sources contributed approximately 50 percent of the TP loads, on average. In high flow years, nonpoint sources contribute nearly two-thirds of the TP loads to the study area; however, in low flow years nonpoint sources contribute less than 20 percent of the TP loads. In order to evaluate the response to nutrient controls, the model needed to be capable of determining the effect of high phosphorus inputs from nonpoint sources under highflow conditions, such as 1986, on subsequent low flow years (i.e., 1987 through 1989). Sources of TP to the sediment include settling organic matter and phosphorus sorbed to nonvolatile suspended solids. Model results indicate that the average solids trapping efficiencies of Pools 2, 3, and 4 are 23, 7, and 69 percent, respectively. Phosphorus trapping in Lake Pepin is computed in 10 of the 12 years modeled. In the low flow years of 1987 and 1988, however, vertical stratification produced hypoxic or anoxic conditions in the lower waters of the lake, resulting in substantial releases of inorganic phosphorus (PO4) from the sediment. Model results reproduce the dramatic increase in PO4 through Lake Pepin that was observed during the summer of 1988. The calibrated model was used to simulate future water quality conditions for the next 24 years under several scenarios of nutrient loading reductions from point and nonpoint sources. Three scenarios of point source phosphorus controls were evaluated, representing point source TP reductions of between 67 and 89%. Two nonpoint source control scenarios, developed by the Minnesota Pollution Control Agency, were run in combination with the point source reductions. The nonpoint source scenarios were developed on a seasonal basis and specified as a function of river flow. The magnitude of the nonpoint source TP reductions ranged from 0 to 43%. During the summer months in Lake Pepin, these combinations of point and nonpoint source phosphorus reductions produce decreases in ambient PO4 of as much as 50 to 70%; however, decreases in average summer chlorophyll-*a* concentrations of more than 15% are only achieved in the low flow years, equivalent to 1987-1989, and never exceed 26%. In most years, the projected PO4 levels do not impose significant nutrient limitations on algal growth. By imposing a strict mass balance on both the water column and the sediment, the modeling analysis includes the effect of current nutrient inputs, as well as inputs that reached the sediment in prior years. The multi-year simulation allows the response of the system to be computed over a range of hydrologic and point and nonpoint source loading conditions.

Keywords: Upper Mississippi River, eutrophication model, phosphorus, point source, nonpoint source

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THE EFFECT OF STORMWATER RUNOFF ON BENTHIC MACROINVERTEBRATE COMMUNITY STRUCTURE IN TRIBUTARIES OF THE LOWER MISSISSIPPI RIVER.

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Evaluating impacts of urban stormwater runoff on river ecosystems is becoming an increasingly significant issue in river ecology and an important environmental issue for local, state, and federal regulatory agencies. In order to assess stormwater impacts to Tennessee tributary systems of the Lower Mississippi River, we sampled macroinvertebrate communities associated with both natural and artificial substrates in the Wolf and Nonconnah Rivers, the two primary receiving waters for Memphis stormwater runoff. Additionally, we collected water samples from both systems as well as from a rural reference site during high-water conditions associated with a storm event. Macroinvertebrate community composition was greatly reduced as sites below stormwater inputs relative to upstream sites and a reference site. Ambient toxicity evaluations (EPA *Ceriodaphnia dubia* tests) of water collected from these systems during storm events has resulted in complete (100%), acute (<24 hr) mortality, in samples collected from the lower Nonconnah River. Results suggest that stormwater inputs may have a profound effect on riverine biota and are a critical consideration for the management and protection of urban river systems.

Keywords: stormwater, large rivers, ambient toxicity assessment, community structure

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ENTRAINMENT MORTALITY OF ADULT FISH CAUSED BY COMMERCIAL TOWBOATS IN THE UPPER MISSISSIPPI RIVER SYSTEM.

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Many large rivers are used as transportation corridors for barges and other large commercial vessels. The propellers of towboats that push barges may have diameters exceeding 2.5 m and can entrain and kill adult fish. We developed a method to estimate entrainment mortality of large riverine fishes and applied it to the Mississippi and Illinois rivers. Our estimation method combined quantitative trawl sampling and a hydrodynamic model of the diffusion of entrained water in river channels. Gizzard shad *Dorosoma cepedianum* was the only killed species detected in specialized entrainment sampling, and our estimate of entrainment mortality is 9.5 fish per km of towboat travel with an 80% confidence interval of 3.8-22.8 fish/km. We also conducted ambient bottom trawling to estimate abundance of live fish, and observed additional recently killed gizzard shad, shovelnose sturgeon *Scaphyrhynchus platorhynchus* and smallmouth buffalo *Ictiobus bubalus*. We developed ancillary estimates of entrainment mortality rates of shovelnose sturgeon and smallmouth buffalo based on the estimate for gizzard shad and on the distribution of numbers of killed fish of each species in the combined ambient and entrainment samples. For shovelnose sturgeon and smallmouth buffalo, we estimate that 2.4 fish of each species are killed per km of towboat travel with 80% confidence intervals of 0-6 fish/km. Because total annual tow distances are large, entrainment cannot be eliminated as an important source of mortality for gizzard shad, shovelnose sturgeon and smallmouth buffalo.

Keywords: mortality, commercial navigation, entrainment, estimation, modeling, fish, estimation, barges, towboats, Illinois River, Mississippi River

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TWO YEARS OF FOLLOW-UP AFTER A 1996 UNIONID TRANSLOCATION FROM AN AREA INFESTED WITH *DREISSENA POLYMORPHA* (PALLAS 1771), MISSISSIPPI RIVER MILE 697.5, HWY 14/61 BRIDGE, LA CROSSE, WI.

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This mussel translocation was probably the first to be conducted in an area heavily impacted by *D. polymorpha*, 6-44 mm long. In July and August 1996, prior to riprap placement around three bridge piers, 12710 unionids (27 species) including five endangered *Lampsilis higginsi* and 589 species status unionids, such as 41 *Ellipsaria lineolata*, 29 *Arcidens confragosus*, and 245 *Pleurobema sintoxia*, were translocated. Mean densities were Pier 6, 2.8/m2 (22 sp.); Pier 7, 0.07/m2 (12 sp.); Pier 8, 10.65/m2 (27 sp.). Depths were 4-9 m. *Amblema plicata* was 39.75% of the fauna. At Piers 6 and 7 there were small numbers of *D. polymorpha* on most unionids, but at Pier 8, downstream of a grain dock, the substrata was covered with *Dreissena* 25-75 mm deep. Up to 120 or more were on 80% of the mussels which greatly slowed unionid recovery. Many unionids were nearly covered with *D. polymorpha*, but few unionids were fresh-dead. A saving factor may be the strong current at Pier 8, on the outside of a large bend in the river. Some unionids were devoid of *D. polymorpha* but had byssal threads. Processing time was doubled by hand stripping visible *D. polymorpha* before each shell was marked on both lower anterior valves. Debris was buried in a landfill. Site I, 0.4 mi downstream of the bridge, was used for translocation of most of the common species. Site II, 4 miles upstream, was used for status unionids. Recent Mississippi River records included three *Alasmidonta marginata* and four *Lasmigona costata* found at 6-9 m, probably depth records for these small stream species.

Special status unionids were doing well 6 October 1996; 50 small *D. polymorpha* were on one dead *Libumia recta*. On 16-19 September 1997 follow-up was done at both Translocation Sites. Up to 60 small *D. polymorpha* were removed from most marked shells. Site I marked shell density = 8.1/m2 (93.7% survival); resident density = 14.5/m2. Site II marked shell density = 6.2/m2 (93.6% survival); resident density - 11.6/m2. At Site II 337 (58.8%) of the numbered special status mussels were found (96.8% survival) including one *L. higginsi*. In 1997, *L. recta* had a 90.2% survival rate (in addition to one found dead October 1996). Two-year follow-up at Site II, 25 June 1998, 98.4% of 308 special status unionids survived. 40% of *L. higginsi* were recovered. Two species seem most affected by hand-translocation. Only 82.6% of 29 *A. confragosus* survived after 2 years. At a similar nearby project two of four *L. recta* were dead after one year. Others have reported *L. recta* laying on the substrata, therefore these species should be allowed to dig in on their own rather than being hand planted. After two years 98.5% of *P. sintoxia* still survived. Commercial *M. nervosa* had 96% survival after one year. In 1998 all 56 *M. nervosa* recovered were alive (100% survival). Natural mortality appears to be 1-2%/year. Removing *Dreissena* buys time, thus enhancing unionid reproductive potential.

Keywords: unionid tranlocation, *Dreissena polymorpha*, endangered unionids, Mississippi River, commercial mussel species

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PHOSPHORUS SOURCES AND LAKE PEPIN WATER QUALITY.

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As one component of the 1994-1998 environmental studies of phosphorus sponsored by the Metropolitan Council Environmental Services (MCES) of St. Paul, MN, and with partial funding from MCES, the U.S. Army Corps of Engineers (USAE) examined suspended seston and phosphorus dynamics in the Upper Mississippi River (UMR) and naturally-impounded Lake Pepin during a three-year period (1994-96). The study focused on the external and internal phosphorus loading processes which may be contributing to impaired water quality conditions in Lake Pepin during low-flow periods. The Minnesota River, located ≈60 miles upstream of Lake Pepin, accounted for most of the annual and summer suspended seston and total phosphorus loads. The Metropolitan Wastewater Treatment Plant (Metro Plant), located ≈50 miles upstream of Lake Pepin, accounted for much of the annual soluble reactive phosphorus (SRP) loading to the UMR. Lake Pepin retained a substantial portion of the summer suspended seston load, and was also a sink for total phosphorus. While total phosphorus concentrations generally decreased in Lake Pepin from the headwaters to the outflow, SRP exhibited a trend of increasing concentration from headwaters to outflow, with net SRP export during the summer. This spatial SRP trend suggests the occurrence of internal phosphorus loading from lake sediments, and/or phosphorus transformations in the water column from particulate to soluble phases. Internal diffusive phosphorus flux from profundal sediments, estimated in laboratory incubation systems under different temperature and redox conditions, averaged ≈7.5 mg m^{-2} d^{-1} in the summer, with predominately oxic conditions during all three years. Internal sediment phosphorus flux accounted for 30 to 56% of the net SRP export from the lake during the summer. Recently-deposited sediments in Lake Pepin also had a relatively high equilibrium phosphorus concentration (EPC) and native adsorbed phosphorus pool at equilibrium. During the summer, SRP concentrations in flows entering Lake Pepin were lower than the EPC due to dilution effects by the St. Croix River, located 10 miles upstream of the lake. This indicates a strong potintial for phosphorus desorption from suspended seston entering the lake. When converted to a rate of internal phosphorus loading, estimated phosphorus desorption from suspended seston ranged from 2.3 to 3.7 mg m^{-2} d^{-1}. When incorporated into the overall phosphorus budget for Lake Pepin, phosphorus desorption from suspended seston potentially accounted for 25% to nearly 40% of the measured internal phosphorus load (i.e., diffusive plus kinetic) to the lake. As such, this may be an important internal flux that is not commonly included in the phosphorus budgets of lakes.

Keywords: Upper Mississippi River, Lake Pepin, external phosphorus loading, internal phosphorus loading

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ENVIRONMENTAL STUDIES OF PHOSPHORUS IN THE UPPER MISSISSIPPI RIVER, 1994-1998.

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The issue of phosphorus in the Upper Mississippi River came to the forefront during the 1987-1988 drought in the Upper Midwest. Low river flows and an abundance of phosphorus combined to create excessive algal blooms in Lake Pepin (Pool 4) during the summer of 1988. These algal blooms caused unsightly 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 from Lake Pepin. The 220 mgd facility provides advanced secondary treatment and discharges to mid-Pool 2 of the Mississippi River in St. Paul, MN. Minnesota state statutes require municipal wastewater facilities to remove phosphorus to 1 mg/1 where the discharge is directly to or affects a lake or reservoir. After the 1987-1988 drought, a question arose about the effect of Metro Plant phosphorus on the water quality of Lake Pepin and Spring Lake, a smaller lake in lower Pool 2. To address this question, a study was conducted in 1990-1992 by MCES and several cooperating agencies. The study reached a number of conclusions: 1. The Upper Mississippi River, Pools 2-4, contains an abundance of phosphorus in the water column and sediment bed; 2. The Metro Plant is only one of numerous point and nonpont sources of phosphorus; 3. Phosphorus reductions at the Metro Plant alone will result in little short-term reduction of algal blooms in Lake Pepin; 4. Basin-wide phosphorus reductions are needed before long-term improvements in water quality will be achieved. Despite these findings, a number of unresolved issues remained. Low river flows did not occur during the study period, leaving an inadequate data set for targeted conditions. Much data were collected on phosphorus loadings, but not much was known about the fate and transport of phosphorus in the river--in particular, the role of sediment in transporting phosphorus. Finally, the study found that internal loading of phosphorus in Lake Pepin was important, but more research was needed on release rates and mechanisms. In 1993, the NPDES permit for the Metro Plant was reissued with several phosphorus requirements, including an effluent limit of 4.0 mg/l, implementation of phosphorus removal in 25% of the wastestream, and continuing environmental studies of phosphorus. From 1994 to 1998, additional studies were conducted to determine the effect of phosphorus 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), and to project the water quality benefits to the river of reduced phosphorus loadings. The five major components of the 1994-1998 environmental studies of phosphorus were as follows: 1. "Citizen Monitoring of Lake Pepin and Spring Lake", conducted by the Minnesota-Wisconsin Boundary Area Commission to evaluate water quality goals from the user perspective; 2. "Phosphorus Sources and Upper Mississippi River Water Quality", conducted by the MCES to analyze historical river data; 3. "Phosphorus Sources and Lake Pepin Water Quality", conducted by the U.S. Army Engineers Waterway Experiment Station to analyze nutrient and seston fluxes and phytoplankton dynamics; 4. "Lake Pepin Sediment History", conducted by the Science Museum of Minnesota to study changes in sediment and phosphorus loadings over the past 200 years; and 5. "Advanced Eutrophication Modeling of the Upper Mississippi River", conducted by HydroQual, Inc. to project water-quality improvements under various phosphorus management strategies. Four of the studies are presented after this introduction. The 1994-98 environmental studies of phosphorus lend additional support to the conclusions of the earlier study and provide further insights on phosphorus, sediment, and algal dynamics in the Upper Mississippi River, Pools 2-4. The need for phosphorus removal at the Metro Plant has been identified, and biological phosphorus removal will be employed to meet an annual effluent limit of 1.0 mg/1 by 2005. However, long-term improvements in Lake Pepin water quality will only be achieved through additional basin-wide reductions in phosphorus loadings from both point and nonpoint sources.

Keywords: Upper Mississippi River, Lake Pepin, phosphorus, eutrophication, water quality

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SMALL MAMMAL METAPOPULATION DYNAMICS IN A RECENTLY ESTABLISHED MITIGATION WETLAND.

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The reclamation of land for subsequent use in the construction of mitigation wetlands has increased throughout the Upper Mississippi River Valley. Monitoring of the spread of natural populations into previously unoccupied habitat is an important step in the determination of the success or failure of the project. Small mammal populations are key in the establishment of terrestrial vertebrate ecosystems.

We censused the small mammal populations and habitat use in the Schmitt Island Wetland Area, Dubuque, Iowa each fall since 1994, as well as Spring 1995 and 1997. Our initial hypothesis was that small mammal species density would be similar in the two major habitat types, forest and grassland, and the ecotone area between. We tested for differences in population numbers and structure between these habitat types, using a mark-recapture study. In 1996, we expanded the project to include the use of PIT tags for detecting overwinter survival and movement. We found that the major species using the area was the northern deer mouse, *Peromyscus maniculatus*, although populations of the meadow vole, *Microtus pennsylvanicus* increased in late fall.

We examined the long-term data in light of metapopulation theory. We determined that the study area probably represents a source for deer mice populations (births equal to or greater than deaths) and a sink for voles, undergoing periodic extinctions. We were also interested in home range size and any changes in population structure. Small mammal habitat use was heaviest in the ecotone and woods areas. Little use of the grassland habitat was recorded. The primary dispersers into the area initially were subadult males based on recorded sizes and weights, although pregnant females were captured in the Fall 1996. Females were quite common in 1997. The small number of recaptures indicates a large population of deer mice in the area. Also of interest is the lack of voles in the grassland area. This suggests that recolonization has only just begun for this species following the summer floods of 1993 and the 1997-98 spring floods.

Keywords: small mammals, metapopulations, Peromyscus, Microtus, PIT tags, succession

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BALD EAGLE FORAGING PERCH DISTRIBUTION AT LOCK AND DAM 19, MISSISSIPPI RIVER.

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Bald Eagle foraging perch site locations along the shores of the Mississippi River near Lock and Dam 19, (River Mile (RM) 358 to RM 364.5) were identified during 70 censuses from 21 November 1998 to 27 March 1999. Adult and immature eagles were counted and perch sites located twice weekly via one-hour long roadside censuses along the Illinois shore upstream and across the Keokuk, IA - Hamilton, IL automobile bridge and downstream along the Iowa shore.

The winter eagle population increased in January to a season peak count of 432 birds on 14 January 1999 after which the population declined but peaked again at 359 eagles on 24 January 1999. The population decreased in February to 39 eagles on the 21st, but increased to 107 eagles on the 26th, before dwindling to less than 10 birds at the close of the field season on 27 March 1999.

The perch locations of foraging eagles was influenced by the presence or absence of river ice cover, with more expansive shoreline distribution during open water periods of winter. During greatest ice conditions eagles gathered about open water created by the activity of the old (est. 1913) lock and dam and the hydroelectric plant, and included adequate perch trees in the Illinois owned Montebello Park and adjacent natural and artificial perches, and the IL Chapter of the Nature Conservancy's island night roost and day perch areas. The dispersion of perched eagles was clumped (not random or uniform) along the shores, and directly related to the presence of large cottonwood and silver maple trees. Eagle foraging perch use was significanly greater on the Illinois shore than on the Iowa or Missouri shores.

Keywords: bald eagle, foraging, perch site, Mississippi River

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AQUATIC VEGETATION CHANGES DUE TO A DRAWDOWN IN A BACKWATER POND ON THE UPPER MISSISSIPPI RIVER.

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Water level management is used by the U.S. Army Corps of Engineers (Corps) as well as other state and federal agencies to stimulate vegetative growth. To date, however, little opportunity existed for this management action on the Upper Mississippi River National Wildlife and Fish Refuge. In 1997 the Corps St. Paul District, as part of a Habitat Rehabilitation and Enhancement Project, lowered water levels at Lizzy Pauls Pond (LPP), a backwater located in Pool 5 near the Wisconsin bluffs. One of the project goals was to increase vegetation. Aquatic vegetation surveys were conducted during the summers of 1996 (pre-drawdown) and 1998 (post-drawdown). Transects were established at 40-m intervals on a north/south grid. Presence or absence of aquatic species was recorded at each grid intersection (sample site) using both visual and a rake drag in three quadrats. The survey was also performed at an adjoining control site that was not dewatered. Relative abundance was calculated for each sample site, representing presence or absence in each of the three quadrats, with a paired comparisons t-test used to test for significance. In LPP, 15 aquatic plant species were recorded in 1996 and 20 in 1998. In the control location, there were 14 aquatic plant species in 1996 and 1998. Species richness for submersed plants increased the same amount in both LPP and the control (9 in 1996; 12 in 1998). The percent frequency of submersed species was greater than 95% in all years and locations. Coontail (*Ceratophyullum demersum* L.) was the dominant submersed species in all years and locations (>80%). For emergents, species richness and percent frequency increased in LPP (5 species, 17% in 1996; 7 species, 35% in 1998) but decreased in the control (4 species, 21% in 1996; 1 species, 4% in 1998). Stiff arrowhead (*Sagittaria rigida* Pursh.), the dominant emergent species in both years (14% in 1996; 25% in 1998), as well as rice cutgrass (*Leersia oryzoides* (L.) Swartz; 0% to 16%) and wild rice (*Zizania aquatica* L.; 2% to 15%) increased from 1996 to 1998 in LPP. Smartweed (*Polygonum* spp.) was the dominant emergent in the control site in 1996 (18%). The only emergent recorded in 1998 was wild rice (4%). White water lily (*Nymphaea odorata* Ait.), the only rooted floating-leaved species recorded, increased in percent frequency in both LPP and the control. Submersed and floating-leaved species showed no difference in response between the drawdown and the control site. Emergents, however, increased in species richness and percent frequency in the drawdown site, but decreased in both in the control site. The increase in relative abundance at Lizzy Pauls Pond was significant (α = 0.05) but the decrease at the control was not.

Keywords: aquatic vegetation, drawdown, Mississippi River, water level management

DEVELOPMENT OF AN IN SITU MODEL FOR THE TOXICOLOGICAL EVALUATION OF SEDIMENTS IN LARGE RIVERS.

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In situ testing methods have been proven an effective tool for the evaluation of ambient water and sediment toxicity. While numerous studies have demonstrated the efficiency of *in situ* techniques, there exists a need for the development and validation of *in situ* testing methods for use in large river systems. This project addresses this issue and presents an *in situ* model for assessing ambient water and sediment toxicity in large rivers. *In situ* exposure chambers were designed to allow maximum water flow and sediment contact. Preliminary validation of the exposure chambers was conducted in Payne's Pond at the Meeman Biological Field Station. The test organisms used were the amphipod, *Hyalella azteca*, and the fathead minnow, *Pimephales promelas*. Test organisms were exposed to water and sediments for four days. Preliminary results indicate 100% survival for fathead minnows under the test conditions. The mesh size was too large to contain the amphipods, so accurate survival data could not be obtained. The preliminary results indicate that the apparatus will be suitable for *in situ* testing in large rivers where relatively slow currents and fine substrates are present. Future studies will validate the results of an *in situ* sediment toxicity evaluation using the current triad approach (analytical screening, laboratory sediment toxicity testing, and benthic invertebrate community level analyses) in McKellar Lake, a Mississippi River embayment.

Keywords: large rivers, toxicity testing, *in situ*, ambient toxicity assessment

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PHOSPHORUS SOURCES AND UPPER MISSISSIPPI RIVER WATER QUALITY.

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The Metropolitan Council Environmental Services (MCES) River Monitoring Program, established in 1976, monitors the water quality of the Mississippi, Minnesota, and St. Croix Rivers in the Twin Cities Metropolitan Area. For the period 1976 to 1996, total phosphorus (TP), soluble reactive phosphorus (SRP), total suspended solids, (TSS), and chlorophyll-*a* were examined at three key locations: the Mississippi River at Lock and Dam No. 1 (Pool 1), and near the mouths of the Minnesota and St. Croix Rivers. FLUX was used to estimate annual and monthly TP and TSS loads. Information on phosphorus loads from point sources was compiled from the MCES, Minnesota Pollution Control Agency, and the Wisconsin Department of Natural Resources. Landuse varies greatly among the three river basins. The Minnesota River Basin (16,988 mi^2) is dominated by row crops with extensive tile drainage; the Mississippi River Basin (19,884 mi^2) is a mix of forest, row crops, and pasture/grass; and the St. Croix River Basin (7,722 mi^2) is dominated by forest and pasture/grass. The Mississippi River had the highest mean annual flow (9,248 cfs), followed by the Minnesota River (6,274 cfs) and the St. Croix River (5,531 cfs). However, mean annual runoff was highest in the St. Croix Basin (9.67 in), followed by the Mississippi Basin (6.31 in) and the Minnesota Basin (5.04 in). The percentage of mean annual runoff was very high in the St. Croix Basin (31.0%), followed by the Mississippi Basin (22.4%) and the Minnesota Basin (16.8%). In all three rivers, mean monthly flow is highest in April, with flows declining steadily through the summer. However, Minnesota River summer flows do not decline as rapidly as summer flows in the other two rivers, possibly due to the displacement of perennial vegetation with annual row crops. Flow-weighted mean annual TSS concentrations and loads were very high in the Minnesota River (93.3 mg/L, and 623 million metric tons/yr, respectively), lower in the Mississippi River (19.4 mg/L, and 155 million metric tons/yr, respectively), and very low in the St. Croix River (5.4 mg/L, and 24 million metric tons/yr, respectively). Annual TSS yields from the Minnesota, Mississippi, and St. Croix River Basins were 134, 28, and 13 lb/ac/yr, respectively. Inorganic content of the TSS in the Minnesota, Mississippi, and St. Croix Rivers was 89, 69, and 50 percent, respectively. Rankings of the three rivers were similar for average TP concentrations and loads: 1) Minnesota River (0.32 mg/L and 1,565 metric tons/yr); 2) Mississippi River (0.10 mg/L and 889 metric tons/yr); and 3) St. Croix River (0.05 mg/L and 262 metric tons/yr). In the same order, phosphorus yields for the three were 0.33, 0.16, and 0.14 lb/ac/yr. Monthly TSS and TP loads from the St. Croix River were highest in April, following the pattern of an undisturbed, natural system. In the Minnesota and Mississippi Rivers, monthly loads peaked in June as well as April, possibly another outcome of the displacement of perennial vegetation with annual row crops. In the Minnesota River Basin, monthly precipitation and rainfall erosivity indices are relatively constant from June through August; however, as the row crop canopy closes and evapotranspiration rates increase in late summer, flows and loads decrease dramatically. During the near-normal flow years of 1994-1996, nonpoint sources contributed 51% of the TP load and point sources contributed 49% of the TP load upstream of Lock and Dam No. 3 (Pool 3). The two largest sources of TP were the Minnesota River Basin (35%) and Metropolitan Wastewater Treatment Plant (28%). Wastewater treatment plants (WWTPs) discharge phosphorus at a relatively constant rate throughout the year, while phosphorus loads from nonpoint sources vary directly with precipitation and runoff. As a consequence, point sources dominate TP loads during low river flows, and nonpoint sources dominate during high river flows.

Keywords: Water quality, suspended solids, phosphorus, landuse, point source, nonpoint source

GENETICS OF ZEBRA MUSSELS IN THE MISSISSIPPI RIVER REVISITED.

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Accidental introduction of the zebra mussel, *Dreissena polymorpha*, into the Mississippi River and its tributaries has caused many problems. Problems have included blocked water intake pipes, which can be economically disastrous to companies. More recently, Krumanocker (1996) used isozyme analysis to potentially identify two additional dreissenid species: the quagga mussel, *Dreissena bugensis*, and the dark false mussel, *Mytilopsis leucophaeata*. Up until now, research aimed at controlling these pests assumed the presence of just one species, *D. polymorpha*. It is essential to determine whether more than one species is present in order to deal appropriately with the problem. A preliminary study used techniques established by Baldwin et al. (1996) using N1aIV, an endonuclease, to cut the PCR amplified cytochrome oxidase subunit I (COI) into fragment patterns distinct for zebra mussels, quagga and dark false mussels. This study seemed to confirm the presence of 2 of the possible 3 species in the Mississippi River. We have obtained quagga mussels from Canada as a control for DNA restriction patterns and isozyme analyses of genetic structure. An isozyme survey of allelic variation from Illinois River populations of dreissenids have positively confirmed the presence of quagga mussels. Preliminary isozyme restriction patterns of PCR amplified fragments from Krumanocker's population and Canadian mussels will be compared. Additionally, isozyme analysis will compare the genetic structure among all sampled populations.

Keywords: genetics, zebra mussels, Mississippi River

THE PRESETTLEMENT UPPER MISSISSIPPI RIVER VALLEY: A LOOK AT THE PAST TO IDENTIFY AND RESTORE ENDANGERED NATURAL COMMUNITIES.

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Using historical records of the U.S. General Land Office (GLO), we reconstructed a picture of the presettlement Mississippi River valley and its natural habitats. GLO records contain plat maps showing the location and extent of former prairies, timberlands, marshes, swamps, rivers, and lakes. These maps were computerized into a geographic information system to help identify and quantify natural habitats occurring just prior to European-American settlement along several navigation pools of the Upper Mississippi River (UMR). Concurrent with computer mapping, we complied bearing tree data from GLO surveyor's field notes to reconstruct the composition and structure of former timberlands on islands, floodplains, terraces, and adjacent uplands of the UMR.

Knowing as much as possible about the presettlement baseline characteristics of the UMR is important. For example, reconstructions along pools 26, 25, 24, 22, 17, and 13 indicate prairie was the dominant community type on floodplains. Timberlands were restricted to islands, the margins of the Mississippi River and its tributaries, and to the valley slopes. Tree density and composition estimates of these timberlands indicate oak savanna and oak woodland communities were once important features on floodplain and adjacent uplands, while closed-canopy forests of flood tolerant taxa prevailed on the islands. These findings contradict the long held perception that forests once dominated the bottomlands of the UMR valley.

The presettlement mosaic of prairies, woodlands, savannas, and forest has led to a new hypothesis regarding the maintenance of floodplain habitats. Fire disturbance has long been regarded as a principal factor responsible for the distribution of plant communities in the uplands of the Midwest. In contrast, flood disturbance has long been recognized as the primary disturbance mechanism affecting community dynamics along river bottoms. However, it is likely that both fire and flood disturbance helped shape and maintain the diversity of presettlement habitats along the bottomlands of the UMR valley. Fires probably swept across bottomland prairies, particularly those growing on higher elevations that became dry in early autumn. First disturbance could explain why forests did not take-over floodplain prairies in the centuries prior to the GLO surveys. Fires originating in the bottomlands would have swept up the valley slopes helping to maintain oak woodlands, savannas, and hill prairies in the adjacent uplands. On lower elevations of the floodplain and along the river, its tributaries and islands - flooding was the principal disturbance mechanism that maintained marshlands and forests.

Today, like so much of the Midwest, the UMR landscape is nearly devoid of its former prairies due to agriculture and urban developments. Some small prairies can be found on the floodplain, but the current limited status of this community and its associated savannas and woodlands should be a primary concern for natural resource managers.

Keywords: presettlement, floodplain, disturbance, fire, flood, Mississippi River

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EFFECTS OF SOILS, RIPARIAN ZONES, AND HYDROLOGY ON NUTRIENTS, HERBICIDES, AND BIOLOGICAL RELATIONS IN MIDWESTERN AGRICULTURAL STREAMS.

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Chemical, biological, and habitat conditions were characterized in 70 streams in the Midwest Corn Belt region during August 1997, as part of the U.S. Geological Survey's National Water Quality Assessment (NAWQA) Program. The study was designed to evaluate algal and macroinvertebrate responses to high agricultural intensity in relation to nonpoint sources of nutrients and herbicides, characteristics of basin soils, wooded-riparian vegetation, and hydrology. Concentrations and forms of nutrients, herbicides and their metabolites, and seston constituents varied significantly with regional differences in soil drainage, ground-water and surface-water relations, density of riparian trees, and preceding hydrologic conditions. Dissolved nitrate concentrations were relatively low in streams with high diel productivity. Stream productivity was positively correlated with seston (phytoplankton) chlorophyll concentrations, which were significantly larger in streams in areas with poorly drained soils and low riparian-tree density. Concentrations of dissolved phosphorus were low in streams where periphyton biomass was high. Periphyton biomass was relatively larger in streams with clear water and low abundances of macroinvertebrate scrapers and collector-gatherers. Periphyton biomass decreased rapidly with modest increases in the abundance of macroinvertebrate scrapers. Differences in dissolved oxygen, dissolved organic carbon, and stream velocity explained much of the variance in macroinvertebrate community structure. The total number of macroinvertebrate species and number of mayfly, caddisfly, and stonefly (EPT) taxa were largest in streams with relatively large periphyton biomass in areas with moderately-well drained soils and high riparian-tree density.

Keywords: algae, stream productivity, macroinvertebrates, agricultural intensity, landscape factors

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HABITAT FIDELITY IN RED-EARED SLIDERS IN UPPER POOL 20, MISSISSIPPI RIVER.

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In order to determine habitat movements among red-eared sliders (*Trachemys scripta elegans*), three sites of upper Pool 20 (near Keokuk, Iowa) on the Illinois shoreline of the Mississippi River were investigated. Open river just south of Lock and Dam 19, Eagle Island Slough, and a blind slough (backwaters area) were trapped from May through September 1998. Typically, all three areas were trapped simultaneously with six traps set in each habitat. A total of 40 red-eared sliders (females, $n=22$; males, $n=9$, melanistic males, $n=7$) were captured during this time. Radio telemetry was used to further the analysis. A total of 14 transmitters of low frequency (49 MHZ) were affixed to turtles, 6 of which were captured in the blind slough, the remaining 8 were captured in Eagle Island Slough. Those turtles originally found in Eagle Island Slough remained; however, the turtles originally tagged with transmitters in the blind slough were eventually found in the Eagle Island Slough. This transition occurred between 14 August and 20 August 1998. Interestingly, the radio-tagged sliders appear to form a clumped distribution within the slough (especially evident later in the season).

Keywords: turtles, movement, radio telemetry, habitat fidelity, Mississippi River, red-eared slider

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METAPOPULATION DYNAMICS OF ZEBRA MUSSELS IN THE ILLINOIS RIVER.

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The zebra mussel (*Dreissena polymorpha*) has had profound impacts on the ecology of aquatic ecosystems it has invaded. Despite the evident problems caused by the zebra mussel, we still lack ecosystem-level control strategies. However, in river ecosystems, the population structure of the zebra mussel itself may facilitate it's control. Zebra mussels in the Illinois River likely function as a metapopulation (a system of local populations connected by recruitment). Zebra mussel veligers produced at one site are quickly carried downriver by water currents. Thus, recruitment at a given site in the river is primarily dependent upon larvae produced by upriver populations. If the production of upriver veligers ceases, or if veligers drifting by the site are too young to settle out, the adult zebra mussel population at that site will eventually die out.

Since 1994, researchers at the Illinois Natural History Survey have been utilizing metapopulation theory in an attempt to understand and develop control strategies for zebra mussel populations in the Illinios River. Preliminary results show a considerable number of veligers enter the Illinois River waterway from Lake Michigan. In 1997, up to 12 million veligers/s (887 veligers/L) passed through the Chicago Harbor Lock and Dam, and up to 1.4 million veligers/s (152 veligers/L) passed through the T.J. O'Brien Lock and Dam. In the Illinois River, highest mortality during the veliger stage seems to occur during the transition from D-stage to veliconcha (umbonal) stage. Growth rates ranging from 7 to 13μm/day have been recorded as veligers drift downriver. Coupled with historical flow data, these growth rates yield minimum traveling distances of 95-190 miles. We are currently analyzing settling plate data from weekly and monthly samples to determine average settling size and settling rate at four sites along a 170 mile stretch of the Illinois River waterway. Additional sets of plates were also deployed, retrieved, and returned to the water at each of these four sites. Zebra mussels which had settled on these photo-plates were tagged and photographed in order to estimate growth and mortality rates of juvenile-adult zebra mussels.

Conservation biologists have long used metapopulation theory to understand the role of reserves in population viability. One of the most common questions in metapopulation biology is "...whether species X, present in the current set of patches, would still persist if some patches were removed or their area reduced." Results from this study will be used to help develop a metapopulation model for zebra mussels in the Illinois River waterway. The opposite of conservation recommendations may then be applied to help control zebra mussel populations in riverine environments.

Keywords: zebra mussel, metapopulation, veliger, recruitment, dispersal

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NITROGEN MASS BALANCE BUDGET FOR THE UPPER MISSISSIPPI RIVER BASIN.

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We used nitrogen and streamflow data from the Long Term Resource Monitoring Program, the U.S. Geological Survey and other sources to calculate average annual loads of total nitrogen, ammonia and nitrate + nitrite (NO_x) for twenty-seven tributaries of the upper Mississippi River. Average annual tributary loads were summed and compared with average annual loads of the Mississippi River at Alton, IL. The selected tributaries covered 90% of the upper Mississippi River Basin. Thus, total nitrogen inputs were adjusted to compensate for the unmonitored portion of the basin. Approximately 95% of the total nitrogen at Alton could be accounted for from tributary loads and Mississippi River loads upstream of impoundment. Smaller scale navigational pool budgets on pools 4, 8 and 13 indicate that total nitrogen is conserved as it passes through these pools. Tributary inputs of NO_x) and ammonia exceed loads at Alton indicating that some of the inorganic nitrogen delivered from the tributaries is being converted to organic nitrogen. Conversion of NO_x) and ammonia to organic nitrogen is inconclusive in navigational pool scale budgets. Typically, NO_x) and ammonia loads have higher residual variance due to their volatile concentration shifts while TN loads have lower residual variance due to the conservative nature of total nitrogen concentrations. Different collecting agencies and varying periods of tributary data also increased uncertainty associated with this budget of the upper Mississippi River. This budget offers a preliminary estimate of the nitrogen dynamics of a large river system, and establishes a framework for understanding the nitrogen dynamics of the upper Mississippi River.

Keywords: Nutrients, Mississippi River, Nitrogen, Mass Balance, Watershed

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FISH PASSAGE THROUGH DAMS ON THE UPPER MISSISSIPPI RIVER.

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The Upper Mississippi River (UMR) is impounded by a series of 29 navigation dams which restrict fish movements in the river system. Design characteristics and operation of most UMR navigation dams allow both upriver and downriver fish passage. Downriver fish passage can occur through the locks and the gated sections of the dams. Some fish may pass upriver through the navigation locks, but the locks do not provide favorable pathways for upriver fish passage. Opportunity for upriver fish passage is dependent upon hydraulic conditions at the dams, fish behavior, and fish swimming abilities. We examined historic fish mark/recapture and telemetry data to identify fish species and conditions under which fish pass through the dams. We found information on 126 UMR fish mark/recapture and telemetry studies and were able to obtain at least some original data from 84 of the studies. Less than 10 percent of the marked fish were recaptured. Ten of the studied fish species were found to move through at least one dam. Of the 5,253 marked fish recaptured in all studies, 87 percent were recaptured in the same pool where marked, 8 percent moved upriver through at least one dam, and 5 percent moved downriver. We examined head at the dams during time periods when the marked fish were at large. We could not estimate the head during passage through dams for most of the marked fish because of their long periods at large. We could estimate the head within one foot for 68 of the marked fish that moved through dams. Of these, only five moved in a downriver direction. Of the 63 marked fish that moved upriver, 55 passed through dams when the head was less than 0.3 m. We investigated hydraulic conditions through the dam gate openings using information from a physical hydraulic model and with standard hydraulic equations. We reviewed the literature on migration behavior and swimming performance of 25 migratory fishes in the UMR. Through analysis of the fish mark/recapture data, hydraulic conditions at the dams, fish behavior and swimming performance information, we estimated probability of opportunity for upriver passage through UMR dams by different UMR adult fishes. Most of the UMR navigation dams present semipermeable barriers to upriver passage, with fish passage opportunity varying markedly between dams and fish species. We identified the dams that present the greatest barriers to fish passage. Operational changes and structural modifications at UMR navigation dams are possible and may improve opportunity for fish passage throughout the UMR.

Keywords: fish passage, Mississippi River, dams, fish movement, aquatic habitat

DOES VEGETATION AFFECT THE HARVEST OF MUSKRATS ON THE UPPER MISSISSIPPI RIVER NATIONAL WILDIFE AND FISH REFUGE?

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We used regression analysis to compare the number of muskrats (*Ondatra zibethicus*) harvested on the Upper Mississippi River National Wildlife and Fish Refuge (Refuge) with acres of vegetation at various levels of resolution. The Refuge encompasses most of the wetland areas from Pools 4 through 14. Muskrat harvest data were available on a per pool basis for the 1990 and 1992 through 1997 trapping seasons. Vegetation acreages on the Refuge were obtained from the 1989 Geographic Information System land cover/land use database developed by the Long Term Resource Monitoring Program. That database was developed from 1:15,000 aerial color infrared photographs and extensive ground-truthing.

The first level of resolution for vegetation was 142 species or specie groups as classified, although many of these groups were absent from some or all pools. The next level of resolution contained all classes of either *Scirpus, Sagittaria,* or *Typha*, species commonly associated with muskrats. The 142 species groups were then combined into classes: submergents, submergent/rooted floating aquatics, submergent/rooted floating emergents, rooted floating aquatics, rooted floating aquatics/emergents, emergents, emergents/grasses forbs, and grasses/forbs. Various combinations of these groups were also investigated. Regression analyses were performed for muskrat harvest using both the 1990 season or the average harvest for all seven seasons against each of these groupings. For the eight vegetation classes we also performed a stepwise multiple regression using acres of vegetation and the average size of a stand as independent variables. Significance for all tests was set at the $\alpha = 0.05$ level.

In general, regressions using the seven-year average muskrat harvest produced a stronger relationship than the 1990 harvest data. The best relationships at the species or specie groups level were for *Sagittaria* and *Scirpus*. Both relationships were significant and had R^2 values of 0.67 and 0.89, respectively. The relationships for most of the other species or specie groups were not significant. Any grouping containing *Typha* alone was not significant, but all groupings with *Sagittaria* and/or *Scirpus* were. The R^2 values for the latter groupings ranged between 0.76 and 0.83. Submergent/rooted floating aquatics, rooted floating aquatics/emergents, and emergents showed significant relationships and R^2 values between 0.71 and 0.83. We found that the majority of the predictive capability from the stepwise multiple regression models was due to the number of acres of vegetation. Average stand size was not a good predictor in our models.

Keywords: muskrat, *Ondatra zibethicus*, Upper Mississippi River, Upper Mississippi River National Wildlife and Fish Refuge, vegetation

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AQUATIC VEGETATION IN THE UPPER MISSISSIPPI AND ILLINOIS RIVERS: CHANGES FROM 1991 TO 1998 IN THIRTY-TWO BACKWATER AREAS.

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Aquatic vegetation data, including submersed and floating-leaved species collected under the Long Term Resource Monitoring Program of the Upper Mississippi River System, were analyzed. The data were collected from 32 backwater areas in five separate stretches named after the U.S. Army Corp of Engineers navigation pools, Pools 4, 8 and 13 on the Mississippi River and La Grange and Alton pools on the Illinois River. Aquatic vegetation was surveyed twice a year in May-June and July-August, respectively, from 1991 to 1998. During each survey the occurrence of aquatic species was recorded at individual sites at 15- or 30-m intervals along transects in the 32 backwater areas. Most of the transects were established in 1991 and a few were added in later years. Transects in each backwater area are usually parallel lines of equal distance (50 to 200 m) apart. Our objective was to identify important changes, especially the trend(s) of the changes. We have identified several distinct trends. In upper Pool 4 (above Lake Pepin), aquatic vegetation has been declining since 1991. In lower Pool 4 (below Lake Pepin), aquatic vegetation was declining from 1991 to 1995, and the trend of declining was broken in 1997 and 1998. In Pools 8 and 13, aquatic vegetation has been stable or increasing since 1994. As of 1998, aquatic vegetation in Pools 8 and 13 are at or near their best conditions recorded since 1991. In La Grange and Alton Pools, aquatic vegetation was rare in contiguous backwater areas as a rule; and the detrimental effects of rare floods were obvious.

Keywords: aquatic vegetation, trend, Mississippi River, Illinois River, LTRMP

FISH PREDATION EFFECTS ON ZEBRA MUSSEL (*DREISSENA POLYMORPHA*) COLONIZATION IN POOL 8 OF THE UPPER MISSISSIPPI RIVER.

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We assessed the effects of fish predation on zebra mussel colonization in Navigation Pool 8 of the Upper Mississippi River (UMR), from May 13 to October 05, 1998. Concrete block samplers were deployed at 18 randomly chosen sites in the main channel border, with six sites in the upper, middle, and lower reaches of the pool. Two blocks were deployed at each site, one of which was enclosed in a cage; the other block was uncaged. At the end of the 145-d colonization period, zebra mussels were found at all sites. Densities (number/m^2) of zebra mussels were higher on caged blocks than uncaged blocks ($P < 0.01$). However, the magnitude of these differences was affected by pool reach ($P < 0.01$). Mean mussel density was reduced by 76, 98, and 38% in the upper, middle, and lower pool reaches, respectively. Similarly, biomass (g dry wt/m^2) of zebra mussels was higher on caged blocks than uncaged blocks ($P = 0.04$), but no reach effect was detected ($P = 0.48$). Mean mussel biomass on uncaged blocks, relative to caged blocks, was reduced by 66% pool-wide. Zebra mussels were consumed by at least five fish species (redhorse suckers, *Moxostoma* spp.; common carp, *Cyprinus carpio*; bluegill, *Lepomis macrochirus*; quillback carpsucker, *Carpiodes cyprinus*; flathead catfish, *Pylodictis olivaris*) in Pool 8 of the UMR. Fish were electroshocked at or near the sites where blocks were located, during three sampling periods (June 15-July 31, August 1-September 14, September 15-October 31), and their gut contents were qualitatively examined for the presence of zebra mussel shell fragments. Gut analysis was performed on a total of 154 fish, 91 of which contained shell fragments. Of the fish species with zebra mussels in their gut, the highest frequencies of predation were from redhorse suckers (59%) and common carp (35%). Our preliminary results suggest that fish predation may already be having an effect on zebra mussel demographics in Pool 8 of the UMR.

Keywords: zebra mussel, Upper Mississippi River, predator exclusion cage, density

DETECTING CHANGES IN CHANNEL CATFISH (*ICTALURUS PUNCTATUS*) POPULATIONS WITHIN THE LONG TERM RESOURCE MONITORING PROGRAM'S STUDY POOLS.

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Field staff of the Long Term Resource Monitoring Program (LTRMP) has collected randomly sampled fish data in Mississippi River Pools 4, 8, 13, 26, an open river reach, and La Grange Pool of the Illinois River since 1993, but the ability to use these data to detect trends or changes in fish populations has not been quantified. To address this issue, a power analysis was completed using "pool-wide" catch-per-unit-effort (*Cf*) means from the LTRMP channel catfish data. The power analysis calculated the ability to detect a 10% or 30% annual change in the pool-wide *Cf* mean produced by several gears; day electrofishing, fyke netting, mini fyke netting, seining and large and small hoop netting. Power of detection varied with pool location and year, but generally the LTRMP day electrofishing and large and small hoop netting data will detect a 30% annual change in channel catfish within a 96% probability (average; all pools). In La Grange Pool, Open River reach, and Pool 26, a 10% annual change in channel catfish population sampled by day electrofishing or large or small hoop netting had a detection probability of 74% (average; 1993 omitted). In the northern study pools (4, 8, 13) where channel catfish are less abundant, a 10% population annual change had a 50% probability of detection (average; 1993 omitted). Of all of the LTRMP gears used, day electrofishing was the most consistent and had the greatest probability of detecting annual channel catfish population changes (10% changes = 75% probability; 30% changes = 96% probability) in all pools.

Keywords: channel catfish, fish, Mississippi River, Long Term Resource Monitoring Program, *Ictalurus punctatus*

INFLUENCES OF LOCK AND DAM OPERATION ON PATTERNS OF FLOODPLAIN FOREST SPECIES COMPOSITION AND GROWTH ALONG THE UPPER MISSISSIPPI RIVER, POOL 12.

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A great deal of attention has been focused on the influence of the navigation lock and dam system on the Upper Mississippi River Ecosystem. Most of the attention has been directed at the aquatic system, primarily the role of the hydrosystem in increasing sedimentation in the back waters. Relatively little attention has been paid to effects on the adjacent floodplain forest. The historic and evolutionary processes are those of a flood-pulse system. The area is inundated for a relatively short time period in early spring, and plant species are adapted to this wet period, generally through some form of tolerance or dormancy.

The modifications to the hydrosystem caused by navigation lock and dam operation are potentially severe. The impoundment of water behind the dams to operate the lock system causes alterations in the flooding regime of the forests near the locks and dam. As an example, the operations of the Columbia Lock and Dam on the Ouachita River has been implicated in the die-off of one species of oak and its replacement by another water-tolerant form in D'Arbonne National Wildlife Refuge in northeastern Louisiana.

This study analyzes the effects of Lock and Dam 12 near Dubuque, Iowa, on the adjacent floodplain forest community. Study and control sites were established at two sites, one behind Lock and Dam 11 and the other approximately one mile downstream (judged to be out of the influence of the lock and dam). Data collection consisted of line transects, quadrats, tree identification, core samples, soil samples, air temperature, depth to water table, and nearest neighbor analysis.

1) Short-term effects of lock and dam operation
 a) Changes in water table height and soil moisture were measured and compared at the study site just upstream of the lock and dam and the control site below the lock (midway down pool 12) and further correlated with pool heights obtained from the U.S. Army Corps of Engineers.
 b) Forest age information - the relative abundance of tree ages was compared at each site to determine the intensity of disturbance encountered at each site. Core samples were taken from mature trees and growth information calculated. Growth rates from each site were also compared to determine long-term, sublethal effects of altered hydrosystem characteristics.

Keywords: Lock and Dam operation, floodplain, composition and growth, Mississippi River, Pool 12

LONGITUDINAL PATTERNS ON INVERTEBRATE PRODUCTION (*DREISSENA POLYMORPHA*) IN THE UPPER MISSISSIPPI RIVER.

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Navigational dams have created dramatic changes in the flow patterns of the upper Mississippi River. Within each reach of the river, there are now three separate hydrological patterns: high velocity (just below a dam), normal velocity (middle of reach), and low velocity (just before dam). The purpose of this study was to assess the effect of location in a navigation reach on secondary production of a benthic invertebrate. Four rock samples were hand-collected from below dam, middle reach, and above dam locations in reaches 5 and 6. Samples were bagged and preserved in 70% ethanol for later processing. Zebra mussels were removed from rocks and separated into 2-mm size classes. Rocks were measured for determination of surface area. Secondary production was estimated using the instantaneous growth method. Size-class specific growth rates were determined using growth rates of mussels attached to clay tiles (refer to poster by Doyle et al.). New cohorts began to appear in late July and continued to be evident through the completion of the study in late October. Differences were evident in secondary production, with production highest in the middle areas of the reaches.

Keywords: navigation, secondary production, Mississippi River, zebra mussel, *Dreissena polymorpha*

FRESHWATER MUSSEL - FISH INTERACTIONS IN THE SUPERIOR NATIONAL FOREST AND CANNON RIVER WATERSHED, MINNESOTA.

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Freshwater mussels (Unionoidea) are an important group of aquatic environmental indicator species. Their value as indicators has generated significant interest in the factors affecting mussel distribution and abundance. I investigated the effect of one such factor, fish distribution, on the mussel faunas of ten lakes in the Superior National Forest (SNF) (near Ely, MN) and the Cannon River watershed (south-central MN). Mussel larvae, or glochidia, are obligate parasites on specific host fishes, and mussels cannot reproduce unless their fish hosts are present. I compared mussel distribution data from summer 1998 and summer 1987 with DNR records of fish distributions for the same sites. My analysis showed that host fish distributions did not influence mussel distributions in the SNF lakes. In the Cannon River watershed, however, my results suggest that distribution of the pink heelsplitter (*Potamilus alatus*) was limited by distribution of its host fish, the freshwater drum (*Aplodinotus grunniens*).

Keywords: Unionids, mussel distribution, fish distribution, *Potamilus alatus, Aplodinotus grunniens*

TERMINAL BODY SIZE FOR *GLOSSOSOMA INTERMEDIUM* (TRICHOPTERA: GLOSSOSOMATIDAE): VARIATION WITHIN AND AMONG POPULATIONS FROM SOUTHESTERN WISCONSIN STREAMS.

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Glossosoma intermedium is a common, often numerically dominant, caddisfly found in many spring-fed streams. Previous research suggest that *G. intermedium* completes two generations per year: a short summer generation and a longer winter generation. Being holometabolous, *G. intermedium* passes through several distinct developmental stages. Immature larvae construct portable stone cases and graze on periphyton. At the end of the larval stage, individuals anchor their cases to cobbles and construct a protected cocoon. In the cocoon, individuals pass through a pre-pupa, pupa, and pharate-adult stage before emerging from the water as terrestrial adults. Post-larval individuals do not feed, therefore larval growth determines terminal body size. Body size is often used as a measure of fitness because of its influence on survivorship, male reproductive success, and female fecundity. We examined the variation in body size within and among populations of *G. intermedium*. Benthic samples were collected monthly between March and November 1996 from seven streams in the unglaciated, or "driftless" area of southwestern Wisconsin. We chose to concentrate our analyses on the pharate-adult stage. We chose to concentrate on this stage because it is the last stage before emergence from the aquatic environment and sex determination is possible. Using an image analysis system (OPTIMAS®) we measured the body size (area as mm^2) of 465 individuals. Mean body size significantly differed among populations. We observed a negative correlation between larval density and terminal body size in several, but not all populations. Winter pharates were 31% larger than summer pharates. Unlike *G. nigrior*, a sister species found in Michigan, female *G. intermedium* tended to be larger than males. Maximum body size was 344% larger than the minimum body size. This study suggests that terminal body size in *G. intermedium* is extremely plastic.

Keywords: caddisflies, body size, life history, stream ecology

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A COMPARISON OF STREAM SEGMENT AND QUADRAT MUSSEL SAMPLING TECHNIQUES.

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The importance of freshwater mussels in river ecosystem dynamics and as environmental indicators and endangered species is well recognized. Well designed, rapid methods of sampling mussels are needed. We tested the more traditional method of $1m^2$ quadrat searches against 10 m long bank-to-bank searches. Using data collected during the summer from local streams we calculated how well the two sampling techniques measured mussel density, mussel richness (total number of species present), and mussel aggregation. We found that quadrats required more samples for a particular level of precision in density estimates than did 10m searches, however 10m searches may still be more time-consuming. A better estimate of species richness is provided by 10m searches, and 10m searches also tended to detect uniform distributions, while quadrats tended to detect clumped distributions within the same population. Ten meter long bank-to-bank searches appear to be a viable alternative to quadrat sampling.

Keywords: Unionids, sampling, quadrat, stream-segment, richness

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CHANGES IN VEGETATION FROM 1975 TO 1992 IN BACKWATERS OF NAVIGATION POOLS 4 AND 13, UPPER MISSISSIPPI RIVER.

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Color infrared aerial photographs were used to detect change in aquatic vegetation from 1975 to 1992 in backwaters of Navigation Pools 4 and 13 of the upper Mississippi River. The study areas selected were Big Lake in Navigation Pool No. 4 and Potters Marsh in Navigation Pool No. 13. The color infrared aerial photographs were interpreted, transferred, digitized, and then analyzed with geographic information system software. Transferring was completed via a manual zoom transfer scope with 1:24,000 USGS quadrangle topographic maps (enlarged to a scale of 1:15,000) or 1:12,000 USGS digital orthophoto quarter quadrangles. Objectives of the study were to determine if successional changes in vegetation have occurred and to determine how different water level disturbance regimes have affected vegetation diversity between 1975 and 1992. Water level fluctuations in the two study sites were very different. From 1974 to 1996, average water levels from April 1-August 31 in Potters Marsh were more stable than average water levels in Big Lake. This was primarily because Potters Marsh was shielded from water fluctuations with its position relative to the Lock and Dam No. 13, while greater fluctuations in water elevation occurred in Big Lake because of it position downstream from the mouth of the Chippewa River. Changes in vegetation cover classes and diversity of vegetation types were examined in each backwater study site. Some successional trends occurred in Potters Marsh, but none were observed in Big Lake. In addition, vegetation cover in 1992 was significantly different from that in 1975 in Big Lake, but not in Potters Marsh. The greatest amount of change in vegetation occurred among rooted-floating and emergent vegetation in both study sites. In particular, relatively large changes in cover occurred within *Nelumbo, Nymphaea, Sagittaira, Scirpus,* and *Sparganium*. However, from 1975 to 1992, these changes were not uniform between sites. Vegetation diversity (H') was similar between study sites. However, between 1975 and 1992, the diversity of vegetation in Big Lake increased slightly, whereas, the diversity of vegetation in Potters Marsh decreased slightly. Vegetation differences between these study sites may in part be attributed to the greater variation in water elevation at the Big Lake. We hypothesize that changes in vegetation may be related to yearly variation in water elevation and that successional trends may be occurring at a rate slower than previously predicted.

Keywords: Geographic Information Systems, vegetation, succession, flood pulse, Mississippi River

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HEALTH ASSESSMENTS OF WILD FISH IN THE MIDWEST.

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The La Crosse Fish Health Center is one of nine federal fish health laboratories, and provides fish health inspection and diagnostic services to federal, state, and tribal agencies in the Midwest. In 1997, a National Wild Fish Health Survey (WFS) was initiated by the federal fish health laboratories and the Washington Office (U.S. Fish and Wildife Service) to determine the distribution of selected fish pathogens (bacterial, parasitic, and viral) in wild populations. Target bacterial pathogens selected for the survey in Region 3 include: *Aeromonas salmonicida* (causative agent of furunculosis), *Citrobacter freundii, Edwardsiella ictaluri* (enteric septicemia), *E. tarda* (*E. tarda* septicemia), *Renibacterum salmoninarium* (bacterial kidney disease), and *Yersinia ruckeri* (enteric redmouth disease). Viral pathogens include: channel catfish virus (CCV), infectious pancreatic necrosis virus (IPNV), infectious hematopoietic necrosis virus (IHNV), *Onchorynchus masou* virus (OMV), viral hematopoietic septicemia virus (VHS), and white sturgeon herpesvirus 2 (WSHV2). Parasite pathogens include: *Bothriocephalus acheilognathi* (Asian tapeworm) and *Myxobolus cerebralis* (whirling disease). Standard laboratory procedures (based on American Fisheries Society guidelines) and advanced molecular techniques (Polymerase Chain Reaction, PCR) were used to identify pathogens. Through September 1998, over 2,700 fish (37 species) from 51 sites in 10 states have been examined. Extensive sampling of fish from the Mississippi River (Pools 4, 7, and 9) has been done due to a lack of information regarding health of these fish. To date, target pathogens identified include IPNV (1 fish species, 1 site), *M. cerebralis*, (3 species, 2 site), *R. salmoninarum* (21 species, 26 sites) and *Y. ruckeri* (2 species, 2 sites). Survey results from the nine health centers will be entered into a National Fish Health Data Base which will be Internet-world wide web accessible.

Keywords: fish diseases, fish bacteria, fish viruses, fish parasites, Mississippi River

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LOCATION-SPECIFIC EFFECTS ON GROWTH OF ZEBRA MUSSELS IN THE UPPER MISSISSIPPI RIVER.

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Navigational dams have created dramatic changes in the flow patterns of the upper Mississippi River. Within each reach of the river, there are now three separate hydrological patterns: high velocity (just below a dam), normal velocity (middle of reach), and low velocity (just before dam). Since zebra mussels rely, to a degree, on food that passes by them, water velocity may play an important role in the growth of zebra mussels. The purpose of this study was to assess the effect of location in navigational reaches on the growth rate of zebra mussels in the upper Mississippi River. A total of 36 tiles were deployed into Reaches 5 and 6 of the upper Mississippi River, with 6 tiles being placed in each section (top, middle, bottom) of a reach. The tiles were set at a depth of 2-m, with a weight holding them down while a float showed their position. A total of 16 zebra mussels from 4 different size classes (covering a range of 4-30 mm total length) were initially glued to specific sites on the tiles. The length and location of these mussels were recorded monthly. Location on a tile and total length were also recorded for any zebra mussels that colonized tiles during the 6 months of sampling. Preliminary results indicate that growth rates were highest for zebra mussels less than 10 mm. As the size classes got larger, the growth rates of zebra mussels declined, with increasing size producing an inverse relationship between size class and growth rate. Preliminary results also indicate that the overall growth rates of the zebra mussel were the highest in the bottom of the reaches, followed by middle and then top. Conclusions from this study demonstrate that there is evidence of a location effect on the primary growth rates of zebra mussels in reaches 5 and 6 of the upper Mississippi River.

Keywords: navigation, growth, Mississippi River, zebra mussel, *Dreissena polymorpha*

THE INFLUENCE OF EXTRINSIC FACTORS ON SEDIMENTATION RATES AND SEDIMENT TYPES IN THE CATFISH CREEK WATERSHED, DUBUQUE, IOWA.

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The watershed of Catfish Creek, a tributary of the Mississippi River, near Dubuque, Iowa, encompasses both urban/suburban and rural areas. We are interested in analyzing the influence of such activities as subdivision construction and development, agricultural practices, commercial development, industrial, and other activities, on the types and volumes of sediments entering into the watershed. Sediment cores were taken at locations above and below designated activities and were typed as to mineral content. Integrated sediment samples were also taken at the designated sites and correlated with concurrent streamflows.

Keywords: Catfish Creek, sediments, industrial, residential, agricultural, commercial

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DISTRIBUTION OF WILD RICE (*ZIZANIA AQUATICA* L.) IN THE FLOODPLAIN OF NAVIGATION POOL 8, UPPER MISSISSIPPI RIVER (UMR), 1975, 1989, 1991-1997.

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Wild rice (*Zizania aquatica* L.), a valuable food for humans and wildlife, is an annual grain that has been harvested by native American for centuries. On the Upper Mississippi Fish and Wildlife Refuge (UMFWR), no harvesting by humans is permitted. In 1989 and 1991-1997, the LTRMP monitored wild rice and other floating-leaved and emergent aquatic plants in Pool 8, UMR, UMFWR, by using ground-truthed and interpreted 1:15,000 color-infrared aerial photography. No wild rice coverages larger than the minimum mapping unit of one acre were delineated by LTRMP staff in 1989, 1991, 1992, or 1993. Coverages of wild rice increased to 365 acres of pure (361 acres) or mixed (4 acres) stands of wild rice in Pool 8 in 1994. Also in 1994, wild rice was observed in the field and delineated on photos in Lawrence Lake, a backwater where it had not been previously observed by LTRMP staff, but had been delineated on photos taken in 19754. Wild rice continued to appear in Blue Lake, Target Lake, and Lawrence Lake in 1995-1997, totaling 577 acres of pure (48 acres) or mixed (529 acres) stands in 1995; 536 acres of pure (96 acres) or mixed (440 acres) stands in 1996; and 466 acres of pure (161 acres) or mixed (305 acres) stands in 1997. Literature reports indicated wild rice is an annual that can survive for several years in a dormant, viable seedbank until conditions are favorable for growth. In this case, the flood of 1993 may have created favorable conditions in Pool 8 and, according to field observations, anecdotal reports, and interpreted photos, in some locations north of Pool 8 on the UMFWR.

Keywords: *Zizania aquatica*, wild rice, Mississippi River, aquatic vegetation, distribution

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SEASONAL AND LOCATION EFFECTS ON THE GROWTH OF BLUEGILL, *LEPOMIS MACROCHIRUS*, IN THE UPPER MISSISSIPPI RIVER.

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Two primary models have described trophic dynamics of large rivers. The flood pulse concept relies on the predictable, annual inundation of the floodplain for much of the secondary production in large rivers. Predictable floods are typically a spring event in temperate large rivers. The riverine productivity model emphasizes the role of instream primary production in the generation of new biomass, thus making it more a summer-fall process. The objective of this study was to determine if bluegill growth differed as a function of: (1) whether fish were found in side channel or backwater habitats; and (2) time of the year. Fish were collected in early spring, summer, and late fall with a boat electroshocker. Length and weight was measured for each fish and scales were removed. Scales from fish collected in the spring were used to establish age classes. Measurements were taken from the last annuli to the outer edge of the scale on fish collected in the summer and fall. Measurements were made using an ocular micrometer. Preliminary analysis indicates greater growth in the last half of the year. Growth rates were similar for bluegills found in side channel and backwater habitats, indicating growth occurs at about the same rate in both habitats. Data for largemouth bass and smallmouth bass will be included with this presentation if time permits completion of analysis.

Keywords: growth, fish, habitat, season, Mississippi River, bluegill, *Lepomis macrochirus*

HISTORICAL LANDCOVER CHANGES ALONG POOL 26 OF THE UPPER MISSISSIPPI RIVER DUE TO HUMAN MODIFICATIONS BEGINNING IN 1816.

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We used geographic information system spatial databases from 1816, 1891, 1931, 1975, and 1989 to present a time series analysis of landcover changes occurring along Pool 26 of the upper Mississippi River. Our poster begins by describing the presettlement (1816) conditions of the river and its floodplain using accounts by early explorers, land surveyors, and settlers. At this time, the Pool 26 floodplain was covered by prairies, while forest communities occurred on islands and the margins of the main river channel and along tributaries. Oak woodlands and some savannas occurred near the margins of prairies. During the next 75 years most of the original prairies were converted to agriculture, although some wet prairies remained within private hunting areas. Forest clearing for agriculture was limited during this time period, but timber harvesting for home building, heating and steamboat fuel was common. Over the next 40 years, the remaining floodplain prairies were plowed under, while some forested areas on islands and along the Mississippi River were cleared for agriculture as well. During this time period, the river itself was beginning to be modified with wing dams, revetments, and private levee building activities. In 1938, Lock and Dam 26 was completed at Alton, Illinois. The dam permanently inundated the lowest elevations of the floodplain. The most pronounced changes in landcover due to the dam occurred along the lower Illinois River with the creation of Swan Lake and Stump Lake. Prior to impoundment, these lakes were forest and marsh wetlands. Concurrent with dam construction was the creation of the Mark Twain National Fish and Wildlife Refuge which includes lands along the lower Illinois River. Ecosystem management practices on state and federal lands along Pool 26 should attempt to restore some of the plant communities most severely impacted during the last 180 years. Emphasis should be placed on restoration of bottomland prairies and their associated oak woodlands and savannas because these communities have been almost completely eliminated from Pool 26.

Keywords: presettlement, landcover, Mississippi River, restoration

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SEASONAL-AND HABITAT-SPECIFIC GROWTH OF SHORTHEAD REDHORSE IN THE UPPER MISSISSIPPI RIVER.

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Two primary models that describe trophic dynamics in large river are the Flood Pulse Concept (FPC) and the River Productivity Model (RPM). The major difference between these two models is the timing of production in the river. The FPC is flood-oriented and is, therefore, associated with the spring season for the upper Mississippi River. The RPM emphasizes autochthonous production and is, therefore, associated with the summer and autumn seasons. The objective of this study was to: (1) determine if seasonal growth of fish could be measured by using the annuli of scales obtained from the fish; and (2) to examine the habitat-specific differences in growth. Fish samples were taken near shore at main, side and backwater sites through the months of April to October using a boat electroshocker. Length, weight, and scales were taken for each fish. Growth of shorthead redhorse (*Moxostoma macrolepidotum*) was determined from analysis of scales. Fish collected in the spring were used to establish age classes and initial size. Measurements were taken from the last annuli to the outer edge of the scale on fish collected in the summer and fall. Preliminary results suggest that growth is similar between the main and side channel habitats, and that growth is higher in the latter part of the growing season, in conjunction with peak periods of primary production.

Keywords: fish, growth, habitat, seasonal patterns, Mississippi River, redhorse, *Moxostoma macrolepidotum*

FISH COMMUNITY RESPONSE TO REOPENING OF THE EAST RIVER SIDE CHANNEL AND ISLAND CONSTRUCTION AS PART OF THE UPPER PEORIA LAKE HABITAT REHABILITATION PROJECT (HREP).

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Bioresponse monitoring of the Upper Peoria Lake HREP site began in 1991 with the collection of baseline fish community data using standard Long Term Resource Monitoring Program (LTRMP) methods. Construction of the HREP began in 1994 and had four objectives, including: 1(reopening the lower end of the East River which became blocked by sediment deposition in the mid 1960's, 2) increasing side channel habitat in the study areas, 3) construction of a barrier island across Upper Peoria Lake to reduce wind generated waves, reducing resuspension of sediments and increasing depth, and 4) creation of forested wetland management area. Following construction, we made fish collections during 1997 and 1998 to determined the bioresponse of fish populations to the project. Pre- and post-construction sampling utilized several gear types, including hoop nets, fyke nets, gill nets, trawling, seining, and electrofishing. The collections at eight sites during 1991 and 1992 accounted for 43,734 fish including 50 species and 2 hybrids. A total of 10 sites were sampled post-construction during 1997 and 1998. The two additional sites consisted of one in each of two areas created by HREP construction. Post-construction sampling accounted for 116,628 fish including 71 species and 2 hybrids. We examined variation in catch-per-unit-effort (CPUE) of several important riverine species among pre- and post-construction sites to determine effects of the HREP on Illinois River fish communities.

Keywords: Illinois River, fish communities, habitat rehabilitation, side channel restoration

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VEGETATION RESPONSE TO EXPERIMENTAL DRAWDOWNS ON POOLS 5 AND 9 OF THE UPPER MISSISSIPPI RIVER.

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A Small Scale Drawdown Habitat Rehabilitation and Enhancement Project was developed by the U.S. Army Corps of Engineers for the purpose of preserving, protecting, and enhancing backwater fish and migratory bird habitat on the Upper Mississippi River National Wildlife and Fish Refuge. The project used water level management techniques to promote the growth of aquatic vegetation. Aquatic habitat improvement objectives to meet fisheries and migratory bird management goals were (1) to increase the areal extent, interspersion, density, and species composition of macrophyte beds, and (2) to decrease suspended solids concentrations. The specific management objective of this project was to implement a low-cost drawdown of a backwater area to dry and consolidate bottom sediments and, thereby, to increase the area of emergent and submersed aquatic vegetation by natural seed germination. The assemblage of plants that develop on exposed substrate at a given site depends on a variety of factors including seed availability, substrate characteristics, timing of the drawdown, rate of drawdown, environmental conditions at the time of drawdown and throughout the period of seedling growth, and competition among plants. River managers desire information on the relationship among these factors and resulting species composition and productivity for planning future drawdowns on the Upper Mississippi River. The objective of this study was to develop methods for assessing vegetative response to experimental small-scale drawdowns on Lizzy Pauls Pond (Pool 5) and Peck Lake (Pool 9) backwater areas of the Upper Mississippi River. Of specific interest were species composition, density, and seed production of vegetation that developed on exposed substrates. We relate these findings to the seedbank present at each study site, timing of drawdown, and selected substrate characteristics.

Keywords: drawdown, Mississippi River, seedbank, vegetation response, water level management

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SURVEY OF SMALL MAMMALS IN WET MEADOW HABITAT OF THE UPPER MISSISSIPPI RIVER FLOODPLAIN.

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Small mammals were surveyed in a wet meadow habitat of the Upper Mississippi River floodplain by live trapping in late July and August 1998. Two trapping grids were established at Halfway Creek wet meadow area of the Upper Mississippi National Wildlife and Fish Refuge, near Midway, WI. One grid of 25 traps set one meter apart was placed in a section of meadow that was burned in May. The other grid of 50 traps was established on an unburned section. The trapping was conducted for a total of 8 trap nights on the burned and 14 trap nights on the unburned plots. Meadow voles (*Microtus pennsylvanicus*) were the most abundant species captured on both the burned (35) and unburned (57) sites. Seven short-tailed shrews (*Blarina brevicauda*) were captured, all at the unburned site. Meadow jumping mice (*Zapus hudsonius*), a species previously not reported in La Crosse County, was captured in both grids in very small numbers. Physical characteristics such as sex, reproductive condition, and weight of individual animals were examined and compared between plots.

Keywords: *Blarina brevicauda, Microtus pennsylvanicus*, small mammals, wet meadow, *Zapus hudsonius*

TEMPORAL VARIATION OF GLYCOGEN IN TWO POPULATIONS OF *AMBLEMA PLICATA PLICATA*: RIVERINE AND RELOCATED.

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Glycogen has been shown to be an indicator of stress in unionids, yet little is known about temporal variation of glycogen in mussels. We measured glycogen in foot and mantle tissue of *Amblema plicata plicata* (Say, 1817) about monthly for 2 years in two groups of mussels. The first group was sampled directly for the Upper Mississippi River (riverine) and the second group was removed from the River and placed into an artificial pond for 20 months (relocated) before analysis. In both groups, glycogen concentrations in foot and mantle tissue (mg/g dry weight) varied substantially over time. However, fluctuation in glycogen was greatest in the riverine mussels, where glycogen varied 72% in mantle (182 to 660 mg/g) and 52% in foot (87 to 181 mg/g) tissue within a given year. Conversely, in the relocated group, glycogen concentrations in both tissues declined by about 50% in the first two months after relocation but varied little thereafter. In addition, we observed tissue-specific differences in glycogen in the riverine group, but not in the relocated group. Peak concentrations of glycogen in mantle tissue from the riverine group differed considerably between years. The substantial temporal variation in glycogen in the riverine mussels probably paralleled periods of reproductive activity in this short-term brooder, whereas the variation in the relocated mussels likely resulted from the initial stress associated with relocation. These data suggest that the energetic status of relocated unionids is substantially altered and does not appear to recover for up to 20 months after relocation.

Keywords: Unionids, glycogen, Mississippi River, *Amblema plicata plicata*, relocation

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SEASONAL PATTERNS IN WATER QUALITY AT A MARINA WELL (MASSEY MARINA, DUBUQUE COUNTY, IOWA) ALONG THE UPPER MISSISSIPPI RIVER, POOL 12.

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Abiotic water quality variables (turbidity, pH, specific conductance, and temperature of water from Massey Marina and the County of Dubuque Department of Parks and Recreation's well on the property were analyzed and compared. This was done to monitor compliance with Iowa Law, verifying that the well is located a safe distance from the Marina, and was not subject to river water intrusion. This would necessitate moving the well. Samples were taken on a weekly basis, from early November 1996 to the present time.

It was found that the above parameters did not differ significantly, except for turbidity, between water from the two sources. The problem for compliance lies in the parameters themselves. It is expected that specific conductance and pH should be similar, given the geologic province of the region. The differences in turbidity suggest there was no intrusion from the Mississippi River into the well water source. Sampling has been expanded to include other groundwater sources as controls.

Keywords: water quality, well, Mississippi River, compliance, contamination

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FINGERNAIL CLAM (*SPHAERIIDAE*) DENSITIES AND DIVING DUCK USE IN THE UPPER MISSISSIPPI RIVER LOWER POOL 8.

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Fingernail clam densities in Mississippi River Lower Pool 8 have been relatively low from 1992-1997 (0-211.5 m^{-2}; data collected by the Long Term Resource Monitoring Program). However, data collected from fall/winter sampling in lower Pool 8 indicated that fingernail clam densities significantly ($P<0.05$) increased during 1998, reaching densities as high as 8,519 m^{-2}. More importantly for diving ducks, these clams were available as a food source during the 1998 fall migration. In mid-November of 1997, diving duck counts on Pool 8 were low (total = 710; data collected by the U.S. Fish and Wildlife Service). With the increase of fingernail clams, diving duck total counts increased to 45,420 in Pool 8 during mid-November of 1998. The direct cause of the increase in fingernail clam densities is not completely understood. Recent findings however, suggest that flow and water depth may play an important role in determining fingernail clam location and densities, but we need to further verify the causal relationships.

Keywords: fingernail clam, diving duck, Mississippi River, macroinvertebrate, *Musculium transversum*

MOVEMENT OF BROWN TROUT (*SALMO TRUTTA*) IN BIG MILL CREEK, NEAR BELLEVUE, IOWA.

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To protect wild populations of trout in some Iowa streams, it is necessary to determine movement patterns of the population to better establish stream-specific regulations. In conjunction with the Iowa Department of Natural Resources, we radio-tagged brown trout from a wild population in the upper end of Big Mill Creek, near Bellevue, Iowa, to determine their yearly movement patterns. We measured a number of habitat variables at each location, including habitat type, temperature, dissolved oxygen, percent cover, substrate, and bank height. This information will be used to determine the appropriate regulations to protect this population from over-exploitation.

Keywords: brown trout, radiotelemetry, fishing regulations, winter movement patterns

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POPULATION DYNAMICS OF COMMON SHINERS (*NOTROPIS CORNUTUS*) IN THE LITTLE MAQUOKETA RIVER NEAR DURANGO, IOWA.

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We marked 25 common shiners (*Notropis cornutus*) using numbered visual implant tags, in a stretch of riffle/pool habitat in the Little Maquoketa River near Durango, Iowa. The population was re-sampled several times to provide estimates of population size, structure, movement, and mortality during the winter and early spring.

Keywords: common shiner, visual implant tags, populations size and structure, winter movement patterns

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EFFECTS OF DREDGE MATERIAL PLACEMENT ON MACROINVERTEBRATE COMMUNITIES.

Kip E. Stevenson, Todd M. Koel, and K. Douglas Blodgett.
Illinois Natural History Survey, LTRMP Field Station, 704 S. Schrader Ave., Havana, IL 62644.

The U.S. Army Corps of Engineers Rock Island District is responsible for the operation and maintenance of a 9-foot-deep navigation channel on the Illinois River (RM 80.0-327.0). Maintenance often requires removal of accumulated sediments; hydraulic dredging is often used with bankline placement of dredged material. Impacts of this dredged material on benthic macroinvertebrate communities is not well documented or understood. The major purpose of this study was to determine if there were differences in benthic macroinvertebrate abundances between sites which had received dredged material placement and those which had not. We sampled benthic macroinvertebrate communities in main channel borders of La Grange Reach of the Illinois River to compare densities (organisms/m^2) between (1) sites that had received dredged material placement and those that had not, and (2) among sites that had received dredged material placement in different years. We also compared macroinvertebrate densities on different substrates. During May/June 1997 we used a stratified random design to sample 161 sites, collecting three ponar grabs at each site. Sites were stratified by the year they had last received dredged material placement (i.e., 1996, 1995, 1994, 1984-1992, 1941-1969, or never). Overall densities of target macroinvertebrates (mayflies, midges, fingernail clams, Asiatic clams, zebra mussels, and other) were low (1.97/m^2), probably because many insect larvae had already emerged and recruitment had not yet taken place. During November 1997 we used a similar stratified random design to collect 15 ponar grabs at each of 35 sites, and we identified and enumerated target macroinvertebrates (mayflies, midges, fingernail clams, Asiatic clams, zebra mussels, dragonflies, unionid mussels, snails, and other). These sites had received dredged material placement in 1997 (P97 sites), 1996 (P96 sites), or never (NP sites). Mean densities of all target organisms combined were higher in November samples than they were in the May/June samples (5.21/m^2 versus 1.07/m^2). During our field collections we classified sampled substrates into one of four substrate classes (silt/clay, silt/clay with sand, sand with silt/clay, and sand) by visual inspection and touch, and we compared densities of target macroinvertebrates among the four classes. Overall, densities of most target organisms were higher in silt/clay substrates than they were in those identified as containing significant proportions of sand (silt/clay with sand, sand with silt/clay, and sand).

Keywords: Illinois River, macroinvertebrate, dredged material, substrate, ponar grab

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MUSSEL DISTRIBUTION AND ABUNDANCE IN THE CANNON RIVER WATERSHED AND SUPERIOR NATIONAL FOREST, MINNESOTA.

Gary E. Wagenbach[1], M.C. Swift[2], Stacy DeRuiter[2], Timothy L. Dickson[2], C. Harbison[1], and G. Jesperson[1]. [1] Biology Department, Carleton College, Northfield, MN 55057; [2] Biology Department, St. Olaf College, Northfield, MN 55057.

We studied the distribution and abundance of mussels in the Cannon River (4 sites) and its tributaries (5 sites) and in 10 lakes in the Range River watershed in Superior National Forest. In the Cannon River we found 12 species (12 and 8 at trunk and tributary stations, respectively). The most commonly encountered species was *Lasmigona complanata* (11 stations) followed by *Pyganodon grandis* (8), *Lampsilis siliquoidea* (7), and *Potamilus alatus* (6). We also collected *Anodontoides ferussacianus* (6), *Lasmigona compressa* (5), *Elliptio dilatata* (4), *Liqumia recta* (3), *Actinonaias carinata* (2), *Pleurobema sintoxia* (2), *Lampsilis cardium* (1), and *Strophitus undulatus* (1). Individual trunk stations had higher species richness (9, 7, and 6 species) than tributary stations (6 or fewer species). Distribution and abundance were not clearly related to physical or chemical parameters in the Cannon River watershed. In lakes in the Range River watershed we found two species (*P. grandis*, 8 lakes; *Utterbackia imbecilis*, 2 lakes). Both species were found in two lakes. Abundance varied tremendously among lakes and appeared to be related to the availability of appropriate habitat and the effects of poisoning prior to trout stocking. The distribution of *Utterbackia* may be related to historical fish stocking.

Keywords: Unionid, Cannon River, Superior National Forest, lakes, abundance

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SMALL MAMMAL METAPOPULATION DYNAMICS IN A RECENTLY ESTABLISHED MITIGATION WETLAND-MOVEMENTS IN HABITAT PATCHES.

Matthew Watters, Chris Kirkpatrick, and Ann Weckbeck.
Environmental Sciences Program, University of Dubuque, 2000 University Avenue, Dubuque, IA 52001.

The reclamation of land for subsequent use in the construction of mitigation wetlands has increased throughout the Upper Mississippi River Valley. Monitoring of the spread of natural populations into previously unoccupied habitat is an important step in the determination of the success or failure of the project. Small mammal populations are key in the establishment of terrestrial vertebrate ecosystems.

In conjunction with on-going small mammal population studies, we censused the small mammal populations and habitat use on a small "island" between the Schmitt Island Wetland Area, Dubuque, Iowa and the adjacent Peosta Channel of the Mississippi River during Fall 1998. Our hypothesis was that this area represented a "sink" for deer mice, *Peromyscus maniculatus*, migrating from the adjacent floodplain forest. The "island" (so-called because of its relatively isolated nature) comprised two major habitat types, forest and grassland. We determined population numbers, structure, and movement with a mark-recapture using PIT. We found populations to be small, consisting of mostly subadult males (considered to be the major dispersers in deer mouse populations).

We examined the long-term data in light of metapopulation theory. We determined that the study area probably represents a sink for deer mice populations (births equal to or greater than deaths) probably undergoing periodic extinctions. The area is often cut off by flooding, at which times it becomes a true island. As well, the adjacent movement corridors are narrow and of poor quality.

Keywords: small mammals, metapopulations, Peromyscus, PIT tags, succession

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IN SITU EXPERIMENTAL GROWTH STUDIES OF HYDROPSYCHIDAE IN THE UPPER MISSISSIPPI RIVER.

A. E. Zaletel, B. L. Hulbert, and M. D. Delong.
Large Rivers Study Center and Biology Department, Winona State University, Winona, Minnesota 55987.

An abundant species in large river, Hydropsychidae, are found in highly oxygenated, flowing habitats of the upper Mississippi River. The objective of this study was to test the feasibility of *in situ* growth chambers in determining the growth rates of a major invertebrate group, Hydropsychidae. Four frames were constructed of PVC piping, each containing three plexiglass growth chambers. Oxygen was supplied to each chamber using an air compressor and air tubes. Baffles were installed to regulate water flow throughout each chamber. Small, medium, large size groups of larval Hydropsychidae were collected and separated into the appropriate growth chamber. This created a 4 x 3 experimental design. Representatives of each size group were preserved, with measurements from these individuals providing the starting size. Starting September 1, 1998, subsequent samples were collected weekly from each chamber. Interoccular distance was measured and recorded for each individual as a means of determining growth. The results indicate that the growth rate of all three size-groups grew at about the same rate during the first week. The smallest size-group (containing mostly second instar larvae) continued to grow at a rate slightly higher than the other groups throughout the experiment. The successful conclusion of this study demonstrated that *in situ* experiments could be performed to determine growth of invertebrates inhabiting a large river.

Keywords: growth, experiment, Mississippi River, Hydropsychidae

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RESOLUTION OF RESPECT FOR DR. JACOB VERDUIN

BIOGRAPHICAL SKETCH

Dr. Jacob Verduin, past president and one of the founding members of the Mississippi River Research Consortium, passed away March 30, 1997 (Easter morning) at age 84. Dr. Verduin had a long and distinguished career as a teacher and scholar of aquatic ecology.

In 1916, when Dr. Verduin was two years old, his parents moved from his birthplace in Sioux County, Iowa, to the Rosebud Reservation in South Dakota, where he grew up. His autobiographical book, *The Rosebud I Remember*, vividly captures his experiences there. At age 19 he returned to northwest Iowa where he worked as a farm hand for two years. He then entered a junior college in Orange City. In 1937 he transferred to Iowa State College (now Iowa State University) in Ames where re received his B.S., M.S., and Ph.D. degrees. His graduate degrees were earned under the tutelage of Dr. W.E. Loomis. He received a broad education in sciences and math, majoring in botany and plant physiology and minoring in math, physics, chemistry, bacteriology, and zoology. His graduate studies were interrupted for nearly 4 years when he served in the Naval Reserve during W.W. II. He completed his Ph.D. in 1947.

During his career he was on the faculties at the University of South Dakota at Vermillion, Ohio State University F.T. Stone Laboratory at Put-In-Bay, Ohio, Bowling Green State University in Ohio, and Southern Illinois University at Carbondale. He retired from SIU-C in 1984. During his life he published more than 50 scientific papers on a wide variety of topics. He is particularly known for his work in aquatic productivity.

Dr. Verduin served as president of the Mississippi River Research Consortium in 1975, when the meetings were held in Monmouth, Illinois.

Dr. Verduin met his future wife, Bethy Anderson, in 1941 while he was attending the Plant Hormone Institute at Connecticut College for Women in New London. They were married in July of 1942. They had five children. Beth died a few years before him.

Dr. Verduin was a low-key person, not given to self-aggrandizement. He went about his work with an air of quiet confidence; he was a very good man. After spending some time with Dr. Verduin, one tended to regain one's confidence in the human race.

RESOLUTION

WHEREAS Dr. Verduin passed away on Easter morning, 1997, and

WHEREAS Dr. Jacob Verduin had a long and distinguished career as a teacher and scholar of aquatic ecology, and

WHEREAS Dr. Verduin is a past president and founding member of the Mississippi River Research Consortium,

NOW THEREFORE BE IT RESOLVED that the members of the Mississippi River Research Consortium express our sadness at the passing of Dr. Verduin, that we declare our gratitude for his service as past president of the Mississippi River Research Consortium, and that we recognize him for his many contributions to aquatic science.

MINUTES OF THE 1998 BUSINESS MEETING
ANNUAL MEETING OF THE MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.

24 April 1998

The meeting was called to order at 11:15 by Mark Steingraeber (President). Melinda Knutson (Vice-President), Neal Mundahl (Treasurer), and William Richardson (Secretary), and about 75 other members were present. President Steingraeber moved to approve the 1997 Minutes (M/S/P).

President Steingraeber acknowledged Vice President Melinda Knutson for her efforts toward organizing this years conference; Neal Mundahl, Treasurer, for handling registration responsibilities; Bill Richardson, Secretary, for efforts toward writing and mailing a letter to Congressional Senators and Representatives in support of the Environmental Management Program, and mailings associated with the 1998 Annual Meeting; and Rick Anderson for contributing and setting up boards for the Poster Session. Georginia Ardinger was acknowledged for her help with on-site registration, and the aquatic science students from UW-La Crosse who served as projectionists. Finally, people judging student platform and poster presentation, moderating sessions, and fund raising were thanked.

The awards for the 1998 meeting were presented. *Best student platform paper* was awarded to: **Deric Deuschle** (with Kenneth McElroy and Roger Haro) entitled **"Influence of nonpoint source sedimentation of Glossosoma sp. foraging behavior in southwestern Wisconsin streams"**.

Best student poster was awarded to: **Dennis Wasley** (with David Soballe and Roger Haro) entitled: **"Seasonal and annual variations of nitrogen loads in Pools Eight and Thirteen of the upper Mississippi River"**.

President Steingraeber introduced Dr. Mike Romano who then made a presentation in support of the nomination of Dr. Richard V. Anderson, Department of Biological Sciences, Western Illinois University, for the 1998 "Friend of the River" Award. Dr. Anderson's many years of research on the Mississippi River, support of student research and interaction, and significant contributions to river science made Dr. Anderson a logical and easy choice for this award.

Dr. Anderson accepted the award. president Steingraeber thanked Mike for his presentation.

Treasurer's Report
Treasurer Mundahl reported that the MRRC is solvent and a report is included in the Proceedings of the 1997 meeting.

Delong: Suggested handing out figures before the presentation.

Steve Zigler: Figures are also difficult to place on the Website.

Havlik: What format would be acceptable.

Dukerschein: ASCII text is good.

Knutson: The easiest format would be WordPerfect or MS Word. Formatting is a particular problem for italicized text which are lost in ASCII text format.

Steingraeber: Would an earlier call for all abstract submissions allow for more time to fix such problems? Details (of submissions and formatting) should be worked out (by the Executive Committee).

Havlik: Made a motion to keep formatting of abstracts as they were (i.e., allow submission of figures).

A show of hands defeated this motion. The proposal to disallow figures stands.

New Business

Friend of the River Award. President Steingraeber noted that the Executive Committee traditionally nominated and chose a candidate for the Friend of the River Award, and that in succeeding years this should be a more democratic process that included nominations from the members of the Consortium. For that reason the 1998 registration forms included a ballot for next years Friend of the River Award.

Election of Officers. Nominations for Vice-president were: Rick Anderson and Brent Knights. Nominations for Secretary included: Lynn Bartsch, Brent Knights and Diane Waller. Nominations were closed by M/S/P. Ballots for the election of Vice President and Secretary were distributed and collected. Brent Knights was elected Secretary, Rick Anderson elected Vice President.

President Steingraeber thanked the Executive Committee for the last years efforts and turned over the meeting to incoming President Melinda Knutson.

President Knutson thanked Mark for last year's work and presented him with a certificate of appreciation from the MRRC.

Time and Place. The 1999 Annual meeting will be held April 22-23. No discussion.

Joe Wlosinksi recommended we establish minimum facility requirements for the Poster Session, as he was unsatisfied with this year's situation.

Terri Dukerschein asked if the change in hotel ownership impacted the cost of the meeting. President Steingraeber said "slightly".

M/S/P acceptance of the 1997-98 treasurer's report.

Old Business

Community outreach. President Steingraeber reported a large number of groups were contacted for meeting promotion. The response was good, as shown by the large number of items in the raffle. No outlying schools (except one negative response), however, responded to Steingraeber's invitation to participate in the Meeting. Next year the focus should be on local high schools.

Website. Terri Dukerschein acknowledged that Sandy Brewer tallied the survey responses; Kim Wyland (St. Mary's University intern) wrote most of the HTML script; Mike Caucutt (Western Wisconsin Technical College intern) did most of the updating. Send further updates to Dukerschein. Dave Bergstedt (EMTC network administrator) conducted administrative work. The Website received heavy use and was worth the effort.

President Steingraeber thanked Terri for her report and mentioned there was a Committee sign-up and that the Website committee needed volunteers. Melinda Knutson noted a need to add abstracts to the Website, and help will be needed to complete this task.

Mailing List. President Steingraeber mentioned that the mailing list currently contains about 500 names and is updated periodically.

Logo. President Steingraeber distributed a "cleaner" version of the logo on letterhead.

Marion Havlik noted the mussel was upside-down.

Steingraeber said that had been fixed.

Rick Anderson noted plant (water lily) was not correct, the leaf should be complete.

Steingraeber said the plant would be fixed.

Abstract Format. Melinda Knutson reported that figures were still permitted; only three people submitted figures. She proposed no longer allowing the submission of figures due to the difficulty of transmitting figures electronically, as well as problems associated with formatting in the final Proceedings.

Mike Delong agreed.

M. Havlik: Wanted to continue allowing figures; suggesting to e-mail the abstract, and surface mailing the figures.

Scott Whitney: Thought graphs were a positive contribution.

Knutson: Re remodeling of the facility had not occurred as promised by the hotel management, and that the Hotel worked hard to accommodate us. Secretary Knights will work on describing minimum facility requirements as suggested by Wlosinski.

Chuck Theiling: The posters were up for too short a period for adequate viewing.

Knutson: Posters could stay up all night, at the presenters discretion. In the future we should consider keeping posters up for two days.

Rick Anderson: What was the actual cost of the meeting?

Steingraeber: We won't know until the end of the day.

Anderson: What are these costs and what are the costs of other locations, in order to make a decision about other locations.

Ron Rada: At the Radisson nearly all rooms are free if all meals are taken at the Radisson. State rates are available at about $52.00/night; regular room rates are about $60.00/night. Rates at our current location are $54.00/night.

Theiling: In the past rates were much higher (at other facilities).

Teresa Naimo: In the past, Radisson had poor facilities for poster presentations - that's changed now.

Motion: The Executive Committee should check the feasibility of using other sites for future meetings. M/S/P

Ron Rada had several announcements:

1. The joint meeting of Midwest Society of Environmental Toxicology and Chemistry (SETAC) and the Wisconsin Chapter of the American Water Works Society would be

meeting in La Crosse, March 24-26, 1999, at the Radisson Hotel and Convention Center. Rada is looking for input from the MRRC because of the overlap between these groups. Ideas pertaining to the Program, particularly focusing on the Mississippi River and it's watersheds, would be welcome. Midwest SETAC heavily supports students participation through the presentation of travel awards (ten awards given) that also cover the cost of meeting registration and hotel. Best platform and poster awards cover the cost to make the presentation at the annual National meeting.

2. The University of Wisconsin-La Crosse, in cooperation with the Upper Mississippi Science Center, are making a bid to host the Annual meeting of the North American Benthological Society in La Crosse, in June, 2001. William Richardson and Roger Haro are co-chairs of the Program Committee. Ron Rada and Penny Tiedjte are co-chairs of the Local Arrangements Committee. We are looking for program ideas.

Knutson: If the Lower Mississippi River Research Consortium (LMRRC) gets off the ground the MRRC should have a joint meeting with them.

Wlosinski: We would have to change the By-laws if the meeting area changed.

Knutson: We could change the By-laws. I think it would be a good idea to have a combined meeting to increase the exchange of ideas and collaboration.

Eric Nelson: The Board should evaluate this proposal.

Mike Delong: We could alternate years (for meetings with the LMRRC) or have some other pattern.

Other New Business:

Chuck Theiling: The Board should write a letter in support of Reauthorization of the LTRMP (Long Term Resource Monitoring Program).

John Wetzel: He is already putting together a letter that will be endorsed by other area groups including the Audubon Society, Minnesota Boundary Commission, and the La Crosse Area River Folk. He could add the MRRC to the first mailing. After that, Wetzel could sent the information contained in the letter to the MRRC Board for distribution to the membership. Letters from individuals are most effective.

Knutson: This information could be placed on our Website.

Linda Leake: Such form letters can't be placed on a Federally supported Website.

Theiling: Moved that the MRRC Board write a letter to Congress supporting the Reauthorization of the LTRMP. M/S/P

The raffle was held.

President Knutson motioned to adjourn. Motion M/S/P. Meeting adjourned at 12:20.

Members volunteered for committee work as follows:
Program: Mike Dewey, Brent Knights, Mark Steingraeber
Posters: Tom Pellett, Mark Steingraeber
Awards: Tom Pellett
Sales: Mike Dewey, Mark Steingraeber, Bob Gaugush
Website: Terry Dukerschein, Georginia Ardinger

MISSISSIPPI RIVER RESEARCH CONSORTIUM
TREASURER'S REPORT - SUBMITTED BY NEAL D. MUNDAHL
1 MARCH 1999

Accounts as of 30 June 1996		$ 4,942.54
Accounts as of 30 June 1997		$ 2,841.95

Transactions, 1 July 1997 to 30 June 1998

INCOME		
1997 Registration and dues	$ 2,126.49	
1998 Registration and dues	$ 7,965.00	
1998 Raffle proceeds	$ 370.00	
T-shirt sales	$ 500.00	
Book sales	$ 5.00	
Interest	$ 68.91	
Total	$11,035.40	
EXPENSES		
Corporation fee	$ 10.00	
Yacht Club Resorts (1998 meeting)	$ 5,486.65	
1998 Proceedings	$ 570.26	
1998 Raffle prizes	$ 30.00	
T-shirts	$ 715.00	
Mailing costs	$ 485.78	
Printing costs	$ 177.15	
Supplies	$ 38.09	
1998 Officer awards	$ 10.28	
1998 Best paper/poster awards	$ 105.00	
Total	$ 7,628.21	
Accounts as of 30 June 1998		$ 6,249.14

Transactions, 1 July 1998 to 1 March 1999

INCOME		
Interest	$ 46.00	
Total	$ 46.00	
EXPENSES		
Corporation fee	$ 10.00	
Supplies	$ 21.00	
Printing costs	$ 92.90	
Mailing costs	$ 151.81	
Total	$ 275.71	
Accounts as of 1 March 1999		$ 6,019.43

Accounts

Checking account	$ 1,079.04
Savings account	$ 4,940.39
Total	$ 6,019.43

MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.
BUSINESS MEETING AGENDA

23 APRIL 1999, 11:00 A.M.
YACHT CLUB RESORTS, LA CROSSE, WISCONSIN

1. Call to Order

2. President's Report

   - Approval of 1998 minutes
   - Acknowledgments for 1999 meeting
   - Friend of the River Award
     (Student awards to be announced at end of day)

3. Treasurer's Report

4. Old Business

   - Procedures Manual revised
   - Historical summary of MRRC
   - Friend of the River Awards, Resolutions of Respect
   - Archives established
   - Other

5. New Business

   - Executive board nominations
   - Election of officers
   - Time and place of 1999 annual meeting
   - Keynote speaker
   - 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 within or without the State of Wisconsin as the Board of Directors may designate or as the business of the corporation may require from time to time.

2.02 Registered Office

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

ARTICLE 3: BOARD OF DIRECTORS

3.01 General Powers, Responsibility, and Number

The business and affairs of the corporation shall be managed by its Board of Directors. It shall be the responsibility of the Board to carry out the objectives of the organization and to jointly organize, hold, and preside over the annual meeting. The Board of Directors of the corporation shall consist of an elected president, vice-president, secretary, and treasurer.

3.02 Election and 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

*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. Calvin R. Fremling

Recipient of the 1992 MRRC "Friend of the River" Award
Presented by Neal Mundahl

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

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

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

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

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

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

Dr. Thomas O. Claflin

Recipient of the 1993 MRRC "Friend of the River" Award
Presented by Ronald G. Rada
River Studies Center, University of Wisconsin-La Crosse, WI

As you all know, this the 25th Annual Meeting of the Mississippi River Research Consortium. To help commemorate this benchmark in its history, the MRRC wanted to publicly recognize an individual who exemplifies the Spirit of the Consortium - including science, service, and education.

The Consortium has selected Dr. Thomas Claflin of the River Studies Center, at the University of Wisconsin-La Crosse to receive this award.

I would like to thank the MRRC for giving me the honor and privilege of presenting the award to Tom. Before I do, however, I would like to say a few words about him.

After earning his Ph.D. degree from the University of South Dakota in 1966, he joined the Department of Biology at University of Wisconsin-La Crosse and immediately began to study the River.

In 1968, he and a few other colleagues (including Cal Fremling) had the vision to create the MRRC. The first meeting was held in the basement of the home of Cal McNabb in Winona - it has grown and matured into one of the finest regional scientific societies in the country.

Because of his early work on the River, University of Wisconsin-La Crosse created the River Studies Center in 1972 with Tom as its Director.

Tom rapidly became recognized as an expert in river ecology. This is evidenced by the fact that upon invitation he has:

Presented testimony to the United States Senate on the state of river in the U.S., and

served as an expert witness in national river-related court cases such as the Lock and Dam 26 and Tennessee Tom Bigbee Projects.

He is now involved in an exchange program with Russian scientists to compare the Mississippi and Volga, two of the great rivers of the world.

As an educator, Tom has served as the major advisor to many aquatic graduate students at University of Wisconsin-La Crosse. He and his students are responsible for establishing many of the initial data bases on the River.

He has also advised many undergraduate students working on river research projects. A good example is the poster presentation earlier this afternoon that he co-authored with Aaron Schmidt and Pam Vetter.

Through his limnology class at University of Wisconsin-La Crosse and his lectures and workshops to environmental groups, he has literally "turned on" hundreds of people to Aquatic Biology and to the significance of the Mississippi River.

I could go on with many more examples of Tom's contribution, however, let me just summarize with one final statement.

In addition to being one of the co-founders of the Consortium, Dr. Claflin has long been spokesman and an altruistic advocate for the River. Moreover, he has earned our respect as a distinguished river biologist and has been a fine colleague and a mentor to many of us.

Accordingly, on behalf of the MRRC, I am proud to present him this award.

The inscription reads: "Mississippi River Research Consortium, Inc. recognizes Thomas O. Claflin. As an original founder of the Mississippi River Research Consortium, an active river researcher, and an educator of river scientists, we the membership of MRRC wish to recognize your efforts during this 25th Annual Meeting of MRRC. 4/22/93

Ms. Pam Thiel

Recipient of the 1997 MRRC "Friend of the River" Award
Presented by J. Therese Dukerschein

It is the MRRC Executive Board's great pleasure to present the 1997 "Friend of the River" Award to Pam Thiel, who is currently the Project Leader for the U.S. Fish and Wildlife Service (USFWS) Fisheries Resource Office at La Crosse, Wisconsin. Pam has truly been someone whose heart is in the right place for the river, for the people of the river, and for the creatures that inhabit the river.

She has been:

a friend who has not been afraid to take risks,
a friend who has taken stands on important issues,
a friend who has not backed down, even when backing down might have seemed the most politically expedient alternative at the time,
a friend who has had the courage to break trail and lead, but also,
a friend who has had the wisdom to smooth the path by educating and building solid consensus along the way.

Born and raised in Ottawa, Illinois, Pam earned a Bachelor of Science in Biology from Illinois Wesleyan University. Mussels have been one of her career-long interests, and it is my understanding her interest in them was sparked during a year of graduate school at Florida State University. She came north to finish her Master's degree in Biology at the University of Wisconsin-La Crosse's River Studies Center, finishing in 1974.

Pam has worked in a variety of settings, ranging from a private consulting firm (WAPORA, 1975076) to state agencies and federal agencies. She also taught briefly at University of Wisconsin-La Crosse and started her well-known work with fish and mussels as a Limited Term Employee (LTE) with the Wisconsin Department of Natural Resources (WDNR) in 1978. When she took a permanent position as Assistant Fisheries Manager in Prairie Du Chein in 1982, she was the first female field biologist hired into a permanent fisheries position in the WDNR. Later jobs with the WDNR included Habitat Coordinator and Fisheries Manager in the La Crosse area office.

Federal positions Pam has held in the USFWS prior to her current position have included work with protocols for standardizing nets, at what is now the Upper Mississippi Science Center (circa 1980), and also work as Long Term Resource Monitoring Program Invertebrate Specialist (1991-93) at the Environmental Management Technical Center.

Her significant accomplishments on the upper Mississippi River System (UMRS) include:

1) advocacy and contributions to the knowledge of commercial and endangered mussels of the UMRS,

2) contributions to the knowledge of commercial, sport, endangered, and exotic fish of the UMRS,

3) vast improvement and standardization of Bass Tournament Regulations on the UMRS, through her efforts in increase survival of fish during tournaments,

4) contributions in planning, design, and implementation of the Lake Onalaska (Pool 7) Habitat Rehabilitation Project, and

5) set-up and initial implementation of the LTRMP invertebrate monitoring component.

Significant and dedicated service to professional and public organizations involving the river, including, "River Folks" (as a founder and first officer), past MRRC Executive Board Member, active member of the Upper Mississippi River Conservation Committee's Fisheries Technical Section and Mussel Ad Hoc Committee, and active La Crosse Sierra Club member.

Finally, as leader, role model, and trail blazer for the many women who have worked on the river after her, Pam has left a smooth trail.

Pam, we are truly grateful from your contributions as a "Friend of the River" - April 24, 1997.

Dr. Richard V. Anderson

Recipient of the 1998 MRRC "Friend of the River" Award
Presented by Dr. Michael A. Romano

Dr. Richard V. Anderson grew up as a kid in Sidney, Nebraska who spent time collecting horny toads, rocks and other curiosities that drove his mother to distraction. Despite his mother's reservations, this personality trait has served him extremely well. After high school, he attended Chadron University in Nebraska, but quit to join the Navy. Rick served for four years in San Diego, Camp LeJeune, and Bethesda Naval Hospital. He was attached to the Marines and later the Sea Bees as a corpsman. He briefly attended college at Western State College in Gunnison, Colorado in 1970. He then attended Northern Illinois University and married his wife, Arline in 1971. Rick graduated from Northern in 1974 and his first son, Russ, was born. He continued at Northern until 1975, when he received his Master's degree and son number two, Michael was born. He earned his Ph.D. from Colorado State University at Fort Collins in 1978 where, you guessed it, son number three, Ted, was born. Rick did a Post Doc at the Natural Resource Ecology Laboratory until finally coming to Western Illinois University in 1979.

Rick once told me that he had the choice to do research at a large federally funded laboratory for more money than he was offered at Western. I asked him why he chose Western. He replied simply, I wanted to teach and do research. That dedication has paid off handsomely. Rick has published over 70 research papers (at my last count), 30 or more technical reports, and given at least 160 presentations. He has received at least 60 grants and contracts. The majority of this work have involved the Mississippi River and its tributaries. He was involved in the NSF LTER site in Illinois for several years until the Illinois site was discontinued. Afterwards he was a Director of one of the early LTRM sites from 1988 to 1990 near Alton, Illinois.

In terms of teaching, he is equally distinguished. Besides teaching countless undergraduates in regular classes at Western, Rick has had at least 35 graduate students and over a dozen honors students complete theses. Richard Anderson truly epitomizes the term "scholar". Rick is generally considered one of the best, if not the best, instructor in our Department. I known that there are outstanding people at this conference who were former students. I know that they would all attest to Rick's excellence as an educator.

Did I mention the fact that Rick has been Director of the Kibbe Life Science Field Station at Warsaw, Illinois since 1987? Actually when Rick became Director at Kibbe it was the perfect administrative position for him. I believe he has used that position really as an excuse to be near the river as much as possible. He teaches courses out there every summer and hosts a variety of visitors to Kibbe year round. It is really here that one sees Rick in his element. He relishes the opportunity to show a class how to polliwog for mussels or set traps for turtles. In every case he gets his feet wet along with everyone else and exhibits truly boyish enthusiasm for the river. He displays a fierce intellectual curiosity to learn everything about large river ecology and a passionate obsession to share that knowledge with anyone who will listen. When you have been with Rick on the river, you will never look at the river the same way again. Because of the passion and enthusiasm that Richard Anderson has conveyed to each and every student and each and every colleague, he is this year's recipient of the "Friend of the River" Award.

ACKNOWLEDGEMENTS 1999

The following persons or institutions have contributed substantially to the planning, execution, support, and ultimately, the success of the 31st Annual Meeting of the Mississippi River Research Consortium. The 1998-1999 board of Directors gratefully acknowledges their involvement.

Local Meeting Arrangements, Meeting Announcements, and Mailings

Georginia Ardinger, U.S. Geological Survey, Long Term Resource Monitoring Program, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Melinda Knutson, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Neal Mundahl, Department of Biology, Winona State University, Winona, Minnesota

Brent Knights, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Mary Stefanski, U.S. Fish and Wildlife Service, Upper Mississippi River Fish and Wildife Refuge, Onalaska, Wisconsin

Mark Wenger, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Program and Proceedings

Richard Anderson, Department of Biological Sciences, Western Illinois University, Macomb, Illinois

Registration Table

Georginia Ardinger, U.S. Geological Survey, Long Term Resource Monitoring Program, Upper Midwest Environmental Sciences Center, la Crosse, Wisconsin

Mike Dewey, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Poster and Display Arrangements

Richard Anderson, Department of Biological Sciences, Western Illinois University, Macomb, Illinois

Jon Duyvejonck, Upper Mississippi River Conservation Committee, Rock Island, Illinois

Mark Sandheinrich, Department of Biology/Microbiology, University of Wisconsin-LaCrosse, La Crosse, Wisconsin

Visual Aids

Aquatic Science Students, Department of Biology/Microbiology, University of Wisconsin-La Crosse, La Crosse, Wisconsin

Mark Sandheinrich, Department of Biology/Microbiology, University of Wisconsin-LaCrosse, La Crosse, Wisconsin

Raffle and Prizes

The Freighthouse Restaurant - 2-$15.00 Gift Certificates

Yacht Club Resorts - Weekend Family Vacation Package

Mr. D's Restaurant & Bakery - Gift Certificate

Tom Claflin - Handtied Trout/Salmon Flies

Dave Kennedy - Wildlife Prints

Kurt Welke - Prairie Seeds

Kroner Tru-Value Hardware - Chicago Cutlery Knives

The Company Store - 2 Down Pillows

Anderson/Lubinski/Duyvejonck - Duck Print & Stamp

Sales and Arrangements

Mark Steingraeber, U.S. Fish and Wildlife Service, Onalaska, WI

Mike Dewey, U.S. Geological Survey, Upper Midwest Environmental Science Center, La Crosse, WI

Robert Gaugush, U.S. Geological Survey, Upper Midwest Environmental Science Center, La Crosse, WI

Platform Session Moderators

Thomas C. Dunstan, Department of Biological Sciences, Western Illinois University, Macomb, Illinois

Kent Johnson, Metropolitan Council Environmental Services, Mears Park Centre, St. Paul, Minnesota

Michael Romano, Department of Biological Sciences, Western Illinois University, Macomb, Illinois

Todd Koel, Illinois Natural History Survey, LRTMP Field Station, Havana, Illinois

Dave Day, Illinois Department of Natural Resources, Division of Fisheries, Springfield, Illinois

Jack Grubaugh, Department of Biology, University of Memphis, Memphis, Tennessee

Website

Therese Dukerschein, Wisconsin Department of Natural Resources, Long Term Resource Monitoring Program, Onalaska, Wisconsin

Mike Caucutt, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Brent Knights, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Linda Leake, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Dave Bergstedt, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

MRRC Members and Executive Board

Judges for Student Presentations

Lynn Bartsch, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Michelle Bartsch, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Randy Hines, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Emy Monroe, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Mike Dewey, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Brent Knights, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Steve Zigler, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Michael Romano, Department of Biological Sciences, Western Illinois University, Macomb, Illinois

Jack Grubaugh, Department of Biology, The University of Memphis, Memphis, Tennessee

Thomas Dunstan, Department of Biological Sciences, Western Illinois University, Macomb, Illinois