PROCEEDINGS OF THE
MISSISSIPPI RIVER RESEARCH CONSORTIUM
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PROCEEDINGS OF THE MISSISSIPPI RIVER RESEARCH CONSORTIUM

VOLUME 40

MISSISSIPI RIVER RESEARCH CONSORTIUM, INC.

40th ANNUAL MEETING
24-25 APRIL 2007
GRAND RIVER CENTER
DUBUQUE, IOWA

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Contents

PLATFORM PROGRAM
GRAND RIVER CENTER, MEETING ROOM 6
THURSDAY, APRIL 24, 2008

7:50 – 8:00 AM Welcome and Announcements – **Brian Ickes**, MRRC President

SESSION I – FISH (Moderator: Brent Knights, UMESC)

8:00 – 8:20 AM EFFECT OF ELECTROFISHING CONFIGURATION ON CRAPPIE IMMOBILIZATION SUCCESS AND INJURY
C.R. Dolan[1], L.E. Miranda[2], and T.B. Henry[3]. [1]Department of Natural Resources, Lake Darling Station, Brighton, IA 52540 [2]Mississippi Cooperative Fish and Wildlife Research Unit, Mississippi State, MS 39762 [3]Department of Fisheries and Allied Aquacultures, Auburn University, AL 36849

8:20 – 8:40 AM TESTING THE FUNDAMENTAL ASSUMPTION UNDERLYING THE USE OF LTRMP FISH DATA: DOES VARIATION IN LTRMP CPUE DATA REFLECT VARIATION IN THE ABUNDANCE OF FISHES
J.H. Chick[1], C.R. Dolan[1], E.N. Ratcliff[1], E.J. Gittinger[1], V.A. Barko[2] and B.S. Ickes[3]. [1]Illinois Natural History Survey, Great Rivers Field Station, 8450 Montclair Ave, Brighton, IL 62012 [2]Missouri Department of Conservation, Open River and Wetlands Field Station, 3815 E. Jackson Blvd., Jackson, MO 63755 [3]U. S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603

8:40 – 9:00 AM CENTRARCHID LATE FALL MOVEMENTS OBSERVED THROUGH ELECTROFISHING SURVEYS IN MISSISSIPPI RIVER POOLS 8, 10, AND 11
J. Webster and J. Janvrin. Wisconsin Department of Natural Resources, 3550 Mormon Coulee Road, La Crosse, Wisconsin, 54601

9:00 – 9:20 AM WINTER HABITAT USE BY BLUEGILL, CRAPPIE AND LARGEMOUTH BASS AND EVALUATION OF AN ENVIRONMENTAL MANAGEMENT PROGRAM HABITAT REHABILITATION AND ENHANCEMENT PROJECT
M. Steuck, D. Weiss and C. Schnitzler. Iowa Department of Natural Resources, Bellevue Fisheries Research & Management Station, 24143 Hwy 52, Bellevue, Iowa 52031

9:20 – 9:40 AM FIFTY YEARS OF THE LONG-TERM ILLINOIS RIVER FISH POPULATION MONITORING PROGRAM, 1957-2007
M.A. McClelland, G.G. Sass, T.R. Cook, K.S. Irons, T.M. O'Hara, C.S. Smith, N.N. Michaels, and M.R. Stroub. Illinois Natural History Survey, Illinois River Biological Station, 704 N. Schrader Ave., Havana, IL 62644

9:40 – 10:00 AM FISH ASSEMBLAGES IN OFF-CHANNEL AREAS OF THE UPPER MISSISSIPPI RIVER SYSTEM

B.C. Knights[1]**,** B. S. Ickes.[1], J.N. Houser[1], and M.C. Bowler[2] , [1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603 [2]Iowa Department of Natural Resources, 206 Rose Street, Bellevue, IA, 52031

10:00 – 10:20 AM **BREAK**

SESSION II – NON-NATIVE SPECIES (Moderator: Greg Sass, INHS)

10:20 – 10:40 AM IDENTIFICATION OF HABITAT CONDITIONS INFLUENCING NON-NATIVE ASIAN CARPS REPRODUCTION IN THE UPPER MISSISSIPPI RIVER SYSTEM

T.M. O'Hara, K.S. Irons, G.G. Sass, T.R. Cook, M.A. McClelland, N.N. Michaels, and M.R. Stroub. Illinois River Biological Station, Illinois Natural History Survey, 704. N. Schrader Ave., Havana, Illinois 62644

10:40 – 11:00 AM ENVIRONMENTAL AND ECONOMIC IMPACTS OF ASIAN CARPS IN THE ILLINOIS RIVER

G.G. Sass, T.R. Cook, K.S. Irons, M.A. McClelland, N.N. Michaels, T.M. O'Hara, and M.R. Stroub. Illinois River Biological Station, Illinois Natural History Survey, 704 North Schrader Avenue, Havana, Illinois 62644

KEYNOTE PRESENTATION

11:00 – 11:50 AM A PASSION FOR THE RIVER: MAYO AND THE MISSISSIPPI

Matthew D. Dacy, Director, Heritage Hall, The Museum of Mayo Clinic, Mayo Clinic, 200 First St. S.W., Rochester, MN 55905

11:50 – 1:00 PM **LUNCH** (on your own) **& BEHIND THE SCENES TOURS AT THE NATIONAL MISSISSIPPI RIVER MUSEUM AND AQUARIUM**

SESSION III – MUSSELS AND TURTLES (Moderator: Jennifer Sauer, UMESC)

1:00 – 1:20 PM POSSIBLE HYBRIDIZATION BETWEEN *GRAPTEMYS PSEUDOGEOGRAPHICA* AND *G. OUACHITENSIS* ALONG THE CEDAR RIVER, IOWA AND THE MISSISSIPPI RIVER

A. Huck, J. Lamer, S. Jenkins, and M. Romano. Western Illinois University Department of Biological Sciences Macomb, IL 61455

1:20 – 1:40 PM INVESTIGATION OF WATERBIRD DIE-OFFS ON THE UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE

J. Sauer[1]**,** R. Cole[2], J. Nissen[3] and E. Britton[4]. [1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, Wisconsin [2]U.S. Geological Survey, National Wildlife Health Center, 6006 Schroeder Rd, Madison, Wisconsin [3]U.S. Fish and Wildlife Service, Upper Mississippi River National Wildlife and Fish Refuge, 555 Lester Avenue, La Crosse, Wisconsin [4]U.S. Fish and Wildlife Service, Upper Mississippi River National Wildlife and Fish Refuge, 7071 Riverview Road, Thomson, Illinois

1:40 – 2:00 PM EVALUATION OF SAMPLING DESIGNS FOR ESTIMATING MUSSEL ABUNDANCES ASSOCIATED WITH HABITAT PROJECTS

J. Rogala[1], D. Smith[2], B. Gray[1], S. Zigler[1], and T. Newton[1]. [1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54602 [2]U.S. Geological Survey, Leetown Science Center, Kearneysville, WV 25430

2:00 – 2:20 PM SURPRISES AND CHALLENGES: ALLOCHTHONOUS DRIFT AND HYPORHEIC MUSSELS

Jim Eckblad
Department of Biology, Luther College, Decorah, IA 52101

2:20 – 2:40 PM FOLLOW-UP ON TRANSLOCATED *ALASMIDONTA MARGINATA* FROM THE SOUTH FORK OF THE ZUMBRO RIVER, ROCHESTER, MINNESOTA

M.E. Havlik. Malacological Consultants, La Crosse, WI 54601-4969

2:40 – 3:00 PM **BREAK**

SESSION IV – HYDROLOGY, WATER QUALITY AND PRIMARY PRODUCERS (Moderator: Eric Strauss, UW-L)

3:00 – 3:20 PM THREE DECADES OF WATER QUALITY CHANGE (1976-2005) IN THE MISSISSIPPI NATIONAL RIVER AND RECREATION AREA

S. Magdalene[1], B. Moraska Lafrancois[2], D.K. Johnson[3]**.** [1]St. Croix Watershed Research Station, Marine on St. Croix, MN 55047[2] National Park Service, Marine on St. Croix, MN 55047 [3]Metropolitan Council Environmental Services, St. Paul, MN 55101

3:20 – 3:40 PM THE LASTING EFFECTS OF THE GREAT MIDWEST FLOOD OF 1993 ON THE FLOODPLAIN FOREST OF THE UPPER MISSISSIPPI RIVER

Y. Yin[1], R. Cosgriff[2], D. Henderson[3], and J. Lundh[4]. [1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603 [2]Illinois Natural History Survey, Great River Field Station, Brighton, IL 62012 [3]Missouri Department of Conservation, Open Rivers Wetlands Field Station, Jackson, MO 63755 [4]US Army Corps of Engineers, Mississippi River Project Rock Island District, Pleasant Valley, IA 52767

3:40 – 4:00 PM THE POWER OF A RECORD RAIN EVENT AUGUST 18-19, 2007, POOLS 6-11, UPPER MISSISSIPPI RIVER
S. Giblin, T. Dukerschein, and H. Langrehr. WI Department of Natural Resources Mississippi River Monitoring Field Station, 2630 Fanta Reed Road, La Crosse, WI 54603

4:00 – 4:20 PM LOSS OF SOUTHERN WILD RICE POPULATIONS THROUGHOUT THE ILLINOIS RIVER VALLEY: NARROW PHYSIOLOGICAL TOLERANCES OR LOSS OF SUITABLE HYDROLOGICAL REGIMES?
B.R. Dalrymple[1], K.L. Dalrymple[2] and D.A. Wait[1]. [1]Department of Biology, Missouri State University, Springfield, Missouri 65897 [2]Wildlife Biologist, Annada, Missouri 63330

4:20 – 4:40 PM NORTH-TO-SOUTH POSITION OF COUNTIES ALONG THE MISSISSIPPI RIVER CORRELATED WITH SELECTED OUTCOMES
J. Hart. Sherman College of Straight Chiropractic, P.O. Box 1452, Spartanburg, SC 29304

4:40 – 5:00 PM OTOLITH MICROCHEMISTRY AND STABLE ISOTOPIC COMPOSITION AS INDICATORS OF ENVIRONMENTAL HISTORY FOR MIDDLE MISSISSIPPI RIVER FISHES
G.W. Whitledge and J.M. Zeigler. Fisheries and Illinois Aquaculture Center, Southern Illinois University, Carbondale, IL 62901-6511

5:00 – 6:00 PM **POSTER SESSION IN THE RIVERFRONT CONCOURSE**

6:30 – 9:00 PM **BANQUET & BEHIND THE SCENES TOURS AT THE NATIONAL MISSISSIPPI RIVER MUSEUM AND AQUARIUM**

NOTES

SPECIAL MRRC SYNTHESIS PROGRAM
{WHERE HAVE WE BEEN, WHERE ARE WE GOING?}
GRAND RIVER CENTER, MEETING ROOM 4
FRIDAY, APRIL 25, 2008

8:20 – 8:30 AM Morning Welcome and Announcements – **Brian Ickes,** MRRC President

SESSION V – A SYNTHESIS OF UPPER MISSISSIPPI RIVER RESEARCH (Moderator: Ron Rada, UW-L)

8:30 – 8:50 AM HYDROLOGIC AND HYDRAULIC DRIVERS OF THE UPPER MISSISSIPPI RIVER ECOSYSTEM
C. Theiling. U.S. Army Corps of Engineers, Rock Island District, PO Box 2004, Clock Tower Bldg., Rock Island, IL 61204

8:50 – 9:10 AM NUTRIENTS IN THE UPPER MISSISSIPPI RIVER: TRANSPORT, PROCESSING, AND EFFECTS ON THE RIVER
J.N. Houser and W.B. Richardson. USGS Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54601

9:10 – 9:30 AM SYTHESIS OF UPPER MISSISSIPPI RIVER SYSTEM VEGETATION: PAST, PRESENT, AND FUTURE
S.P. Romano[1], Y. Yin[2], M. Moore[3], and T. Cook[4]. [1]Institute for Environmental Studies, Western Illinois University-Quad Cities, Moline, Illinois 61265 [2]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603 [3]Mississippi River Field Station, Minnesota Department of Natural Resources, Lake City, MN 55401 [4]Illinois River Biological Station, Illinois Natural History Survey, Havana, Illinois 62644

9:30 – 9:50 AM 100 YEARS OF MACROINVERTEBRATE SAMPLING ON THE MISSISSIPPI RIVER: WHAT HAVE WE LEARNED?
R.V. Anderson[1], T.J. Newton[2], M. Whiles[3], and J.W. Grubaugh[4], [1]Dept of Biological Sciences, Western Illinois University, Macomb, IL [2]USGS, Upper Midwest Environmental Sciences Center, La Crosse, WI [3]Middle Mississippi River Wetland Field Station, Department of Zoology and Center for Ecology, Southern Illinois University, Carbondale, IL [4]Edward J. Meeman Biological Field Station, Department of Biology, University of Memphis, Memphis, TN

9:50 – 10:10 AM STUDYING AND MANAGING GREAT RIVER FISHERIES: THE UPPER MISSISSIPPI RIVER EXPERIENCE
B.S. Ickes[1] and J. Garvey[2]. [1]US Geological Survey, Upper Midwest Environmental Science Center, La Crosse, WI [2]Southern Illinois University, Carbondale, IL

10:10 – 10:30 AM HISTORICAL RESEARCH ON REPTILES AND AMPHIBIANS OF THE MISSISSIPPI RIVER: THE NECESSITY OF FUTURE LONG-TERM STUDIES

J.T. Lamer[1], J.K.Tucker[2], and M.A. Romano[1]. [1]Department of Biological Sciences, Western Illinois University, 1 University Circle, Macomb, IL, 61455 [2]Great Rivers Field Station, Illinois Natural History Survey, 8450 Montclaire Avenue, Brighton, Illinois 62012-2032

10:30 – 10:50 AM **BREAK**

SESSION V (Continued) – A SYNTHESIS OF UPPER MISSISSIPPI RIVER RESEARCH

(Moderator: Ron Rada, UW-L)

10:50 – 11:10 AM TOWARD A BETTER UNDERSTANDING OF TROPHIC DYNAMICS OF RIVER ECOSYSTEMS

M.D. Delong. Large River Studies Center, Biology Department, Winona State University, Winona, MN 55987

11:10 – 11:30 AM CONTAMINANTS IN THE UPPER MISSISSIPPI RIVER: HISTORIC TRENDS, PRESENT STATUS, AND EMERGING CONCERNS

J. Wiener and M.B. Sandheinrich. University of Wisconsin - La Crosse, River Studies Center, 1725 State Street La Crosse, Wisconsin 54601

11:30 – 11:50 AM ADVANCING RESTORATION SCIENCE ON THE UPPER MISSISSIPPI RIVER

K.S. Lubinski. U. S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603

11:50 AM – 12:50 PM ROUND TABLE WITH SYNTHESIS PLATFORM PRESENTORS

(Moderator: Susan Romano, WIU)

12:50 – 1:50 PM **LUNCH**

1:50 – 2:30 PM **BUSINESS MEETING**

2:30 – 3:10 PM **RAFFLE AND SILENT AUCTION**

3:10 – 4:10 PM **FORUM ON RESEARCH COLLABORATION WITH THE NATIONAL MISSISSIPPI RIVER MUSEUM & AQUARIUM**

NOTES

POSTER PRESENTATIONS
THE RIVERFRONT CONCOURSE
THURSDAY APRIL 24, 2008 12:00 PM – 6:00 PM
Authors Present 5:00 PM – 6:00 PM
(Listing by Topic)

WATER QUALITY

1) PARTNERSHIP IMPROVES REGIONAL DISPOSAL OF UNWANTED MEDICATIONS
M. Steingraeber[1], J. Kruse[2], and J. Gloyd[3]. U.S. Fish and Wildlife Service, National Fish and Wildlife Conservation Office, Onalaska, WI 54650 [2]Mayo Health System, Franciscan Skemp Healthcare, La Crosse, WI 54601 [3]La Crosse County Solid Waste Department, Hazardous Materials Program, La Crosse, WI 54601

2) WATER CHEMISTRY MONITORING ON UPPER CATFISH CREEK, MANAGING FOR WATER QUALITY
B. Bohnsack[1], O. deSilva[1], F. Eggers[1], K. Keehner[1], T.M. O'Brien[1], W. O'Brien[1], T. Rickertsen[1], A. Satterlee[1], P. Schwartz[1], M. Tully[1], **M. Sinton**[1], and E. Schmechel[2]. [1]Department of Natural and Applied Sciences, University of Dubuque, Dubuque, IA 52001 [2]Dubuque Soil and Water Conservation District, Epworth, IA 52045

3) LONG-TERM TRENDS IN ILLINOIS RIVER WATER QUALITY: REFLECTIVE OF GLOBAL CHANGES?
T.R. Cook, K.S. Irons, M.A. McClelland, G.G. Sass, T. M. O'Hara, N.N Michaels and M.R. Stroub. Illinois River Biological Station, Illinois Natural History Survey, 704 North Schrader Avenue, Havana, Illinois 62644

4) THE EFFECTS OF SEDIMENT DRYING AND REWETTING ON NITROGEN CYCLE PROCESSES IN A SMALL STREAM IN THE KANSAS RIVER WATERSHED
B.J. Austin[1], E.A. Strauss[2]. [1]Department of Biological Sciences, Fort Hays State University, 600 Park St. Hays, Kansas 67601 [2]University of Wisconsin – La Crosse, River Studies Center, 1725 State Street La Crosse, Wisconsin 54601

5) NITRATE UPTAKE IN A VEGETATED BACKWATER LAKE IN THE UPPER MISSISSIPPI RIVER: RESULTS OF IN SITU CHAMBER EXPERIMENTS WITH ADDITIONS OF 14NO3- and 15N-NO3- TRACER
W. Richardson[1], R. Kreiling[1], L. Bartsch[1], J. Cavanaugh[2], W. James[3], and E. Strauss[4]. [1]US Geological Survey Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Rd., La Crosse, WI [2]US Department of Agriculture Natural Resource Conservation Service, St. Peter, MN [3]US Army Corps of Engineers Eau Galle Limnological Research Center, Spring Valley, WI [4]University of Wisconsin, Department of Biology, Rivers Studies Center, La Crosse, WI

PRIMARY PRODUCERS AND FLOODPLAIN FORESTS

6) INVASIVE PLANT COMMUNITIES IN MISSISSIPPI RIVER FLOODPLAIN FORESTS: A COMPARISON BETWEEN MATURE, REFORESTED, AND NATURALLY REGENERATING STANDS

V.A. Barko[1,2], L.L. Battaglia[3], and D.E. Henderson[1]. [1]Open Rivers and Wetlands Field Station, Missouri Department of Conservation, Jackson, MO 63755 [2]John A. Logan College, 700 Logan College Rd., Carterville, IL 62918 [3]Department of Plant Biology, Southern Illinois University, Carbondale, IL 62901

7) MONITORING THE PHYTOPLANKTON COMMUNITY DURING A WETLAND RESTORATION AT TNC'S EMIQUON NATURE PRESERVE, HAVANA, IL

S.T. Meiers[1], S.E. Jenkins[1], A. Ruskell[1], S. McClure[2], and H. Williamson[1]. [1]Department of Biology, Western Illinois University, 1 University Circle, Macomb, IL 61455 [2]The Nature Conservancy, Havana, IL

8) TEMPORAL CHANGES IN ORIGIN OF ESSENTIAL INORGANIC NUTRIENTS ASSOCIATED WITH PRIMARY PRODUCERS IN A LARGE RIVER ECOSYSTEM

A. Hefty and M.M. Delong. Large River Studies Center and Biology Department, Winona State University, Winona, Minnesota 55987

BENTHOS

9) EVALUATION OF THE TOXICITY OF BIOBULLETS AND BIOBULLET DEGRADATION PRODUCTS TO ZEBRA (*DREISSENA POLYMORPHA*) AND BLACK SANDSHELL MUSSELS (*LIGUMIA RECTA*)

J.J. Rach[1] and D. Aldridge[2]. [1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin 54603 [2]Cambridge University, Cambridge, United Kingdom CB2 3RA

10) SECONDARY PRODUCTION OF TWO DOMINANT MACROINVERTBRATES INHABITING MAIN-CHANNEL BORDER AND BACKWATER AREAS OF THE UPPER MISSISSIPPI RIVER

R. Haro[1], R. Northwick[1,2] and W. Richardson[2]. [1]University of Wisconsin - La Crosse, River Studies Center, 1725 State Street La Crosse, Wisconsin 54601 [2]US Geological Survey, Upper Midwest Environmental Science Center, La Crosse, WI 54603

11) INVESTIGATING THE FACTORS MODULATING SPECIES INVASIONS AND DISEASE OUTBREAKS IN THE UPPER MISSISSIPPI RIVER

G.J. Sandland and B.A. Walker. Department of Biology and the River Studies Center, University of Wisconsin - La Crosse, La Crosse, WI 54601

12) δD AND δ18O AS TRACERS OF MACROINVERTEBRATE ORIGINS AND MOVEMENTS IN MISSISSIPPI RIVER FLOODPLAIN WATER BODIES

D.J. Myers[1], M.R. Whiles[1] and G.W. Whitledge[2]. [1]Department of Zoology and Center for Ecology, Southern Illinois University, Carbondale, IL 62901-6501 [2]Department of Zoology, Fisheries and Illinois Aquaculture Center, Southern Illinois University, Carbondale, IL 62901-6511

FISH

13) SEASONAL FLUCTUATIONS IN PLASMA STEROID CONCENTRATIONS, EGG DIAMETERS, AND GONADAL STAGE IN SHOVELNOSE STURGEON

M.T. Stahl, A.M. Kelly, and G.W. Whitledge. Department of Zoology, Fisheries and Illinois Aquaculture Center, Southern Illinois University, Carbondale, IL 62901

14) LIGHT TRAP STUDY OF LARVAL AND JUVENILE FISH FROM MUD LAKE (UPPER MISSISSIPPI RIVER, POOL 11)

A. Butler and D. Call. Department of Natural & Applied Sciences, University of Dubuque, Dubuque, IA 52001

15) HABITAT USE AND MOVEMENT OF JUVENILE LAKE STURGEON IN THE MISSISSIPPI RIVER

N.C. Bloomfield[1], T.W. Spier[1], and T. Moore[2]. [1] Western Illinois University, Department of Biological Sciences, Macomb, IL 61455 [2]Missouri Department of Conservation, Hannibal, MO 63401

16) THE NATURE CONSERVANCY'S EMIQUON PRESERVE: RESETTING AND RESTORING THE THOMPSON LAKE FISH COMMUNITY

N.N. Michaels[1], G.G. Sass[1], T.W. Spier[2], T.R. Cook[1], T.M. O'Hara[1], K.S. Irons[1], M.A. McClelland[1], and M.R. Stroub[1]. [1]Illinois River Biological Station, Illinois Natural History Survey, 704 North Schrader Ave, Havana, IL 62644 [2]Department of Biology, Western Illinois University, 1 University Circle, Macomb, IL, 61455

17) FISH POPULATION DYNAMICS OF ANNUALLY-FLOODED SEASONALLY-ISOLATED BACKWATER LAKE OF THE ILLINOIS RIVER

M.R. Stroub and G.G. Sass. Illinois River Biological Station, Illinois Natural History Survey, 704 N. Schrader Avenue, Havana, Illinois 62644

FOOD WEBS

18) HISTORICAL ANALYSIS OF CHANGES OF RIVERINE PROCESSES IN THE ILLINOIS RIVER THROUGH USE OF STABLE ISTOTOPE RATIOS

K.M. Delahanty[1], M.D. Delong[1], J.H. Thorp[2], and J.R. Anderson[3]. [1]Large River Studies Center, Biology Department, Winona State University, Winona, MN 55987 [2]Kansas Biological Survey, Dept. Ecology and Evolutionary Biology, University of Kansas, Lawrence, KS 66407 [3]Large River Studies Center, College of Science and Engineering, Winona State University, Winona, MN 55987

19) HISTORICAL PERSPECTIVE OF THE TROPHIC STRUCTURE OF THE LOWER OHIO RIVER USING STABLE ISOTOPES

L. Rice[1], M.D. Delong[1], J.H. Thorp[2], and J.R. Anderson[3] [1]Large River Studies Center, Biology Department, Winona State University, Winona, MN 55987 [2]Kansas Biological Survey, Department of Ecology and Evolutionary Biology, University of Kansas, Lawrence, KS 66407 [3]Large River Studies Center, College of Science and Engineering, Winona State University, Winona, MN 55987

20) TEMPORAL SHIFTS IN UPPER MISSISSIPPI RIVER FOOD WEB DYNAMICS IN RELATION TO HUMAN DISTURBANCES

L.M. McIntosh[1], M.D. Delong[1], J.H. Thorp[2], and J.R. Anderson[3]. [1]Large River Studies Center, Biology Department, Winona State University, Winona, MN 55987 [2]Kansas Biological Survey, Department of Ecology and Evolutionary Biology, University of Kansas, Lawrence, KS 66407 [3]Large River Studies Center, College of Science and Engineering, Winona State University, Winona, MN 55987

21) FISH DIET DIFFERENCES BETWEEN TWO DIVERSE RIVER ECOSYSTEMS

E.M. Eng and M.D. Delong. Large River Studies Center, Winona State University, Winona, MN 55987

22) USING STABLE ISOTOPES TO MEASURE CHANGES OVER TIME IN THE MINIMALLY DISTURBED ST. CROIX RIVER: A POTENTIAL GUIDE TO REHABILITATION

D.J.Crawford[1], M.D. Delong[1], J.H. Thorp[2], and J.Anderson[3]. [1]Large River Studies Center, Biology Department, Winona State University, Winona, MN 55987 [2]Kansas Biological Survey, Department of Ecology and Evolutionary Biology, University of Kansas, Lawrence, KS 66407 [3]Large River Studies Center, College of Science and Engineering, Winona State University, Winona, MN 55987

TURTLES

23) A TURTLE COMMUNITY ON 9-MILE ISLAND IN THE UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE

P.B. Schwartz, J.W. Meyer, A.R. Butler, M. O'Brien, F.A. Eggers, and G.L. Zuercher. Department of Natural and Applied Science, University of Dubuque, 2000 University Avenue, Dubuque, IA 52001

WATER FOWL AND MAMMALS

24) CREATION OF AN INTEGRATED WATERBIRD DATABASE FOR THE UPPER MISSISSIPPI RIVER SYSTEM AND ITS POTENTIAL VALUE

M.S. Meier[1] and P.J. Heglund[2]. [1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603 [2]U.S. Fish and Wildlife Service, Region 3 Biological Monitoring and Database Team, La Crosse, WI 54603

25) SOUTHERN FLYING SQUIRRELS (*GLAUCOMYS VOLANS*) IN A PROTECTED AREA ALONG THE MISSISSIPPI RIVER IN EASTERN IOWA

F.A. Eggers[1], P.B. Schwartz[1], A.R. Butler[1], G.L. Zuercher[1], and W. Buchholtz[2]. [1]Department of Natural and Applied Sciences, University of Dubuque, 2000 University Avenue, Dubuque, IA 52001 [2]Mines of Spain Recreation Area, E.B. Lyons Interpretive Center, 8991 Bellevue Heights Road, Dubuque, IA 52003

NOTES

TESTING THE FUNDAMENTAL ASSUMPTION UNDERLYING THE USE OF LTRMP FISH DATA: DOES VARIATION IN LTRMP CPUE DATA REFLECT VARIATION IN THE ABUNDANCE OF FISHES

John H. Chick[1], Chad R. Dolan[1], Eric N. Ratcliff[1], Eric J. Gittinger[1], Valerie A. Barko[2] and Brian S. Ickes[3]

[1]Illinois Natural History Survey, Great Rivers Field Station, 8450 Montclair Ave, Brighton, IL 62012
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Most of the techniques available for sampling fishes, including all those used in the Long Term Resource Monitoring Program (LTRMP), provide catch-per-unit-effort data as an indicator of abundance. An underlying assumption of the use of CPUE data is that a relationship exists between CPUE and the actual abundance (numbers of biomass per unit area) of fishes. In general, the relation between CPUE and abundance is depicted as a linear relationship of the form:

$$C/E = qN$$

Where:
C/E = catch per unit effort for a particular species
N = is the true abundance (i.e., number per area) for that species, and
q = is the gear-specific catchability coefficient.

We test for relationships between CPUE data from LTRMP day electrofishing with density estimates from block-net rotenone sampling in backwater habitats. The project was conducted at two reaches of the UMRS: 1) Pool 26, and 3) the La Grange Reach of the Illinois River. At each reach, multiple backwater lakes were selected for sampling based on a minimum size of 5 hectares and sufficient depth to allow sampling. Within each backwater, three ¼ acre block nets were be deployed in random locations, and fish within the nets were sampled using rotenone. Potassium permanganate was applied outside of the nets to deactivate rotenone leaking through the mesh. On the same day the three block nets were deployed, three day electrofishing samples were made at random locations following standard LTRMP methodology. This allowed us to use regression analysis to test for a linear relationship between CPUE from day electrofishing with density and biomass estimates from block net sampling, using each backwater lake as replicates.

Keywords: fish sampling, day electrofishing, Long Term Resource Monitoring Program, backwater lakes, Mississippi and Illinois rivers

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LOSS OF SOUTHERN WILD RICE POPULATIONS THROUGHOUT THE ILLINOIS RIVER VALLEY: NARROW PHYSIOLOGICAL TOLERANCES OR LOSS OF SUITABLE HYDROLOGICAL REGIMES?

Bethany R. Dalrymple[1], Kenneth L. Dalrymple[2] and D. Alexander Wait[1]

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Due to the extensive historical range of naturally occurring populations of Southern wild rice, *Zizania aquatica* L. *var aquatica*, it has been suspected that this species maintains a plastic physiological tolerance for a wide range of water and soil conditions; however, little basic edaphic and biological information has been recorded in primary literature. Records from the Illinois Natural History Survey of the late 1930s and early 1940s indicate that natural wild rice populations were quite common in the backwater lakes throughout the Illinois River Valley. Shortly after the installation of the lock and dam system along the Illinois River, these populations were no longer a part of the landscape until August of 2001, when a drawdown of Spring Lake near Pekin, Illinois, revealed a few thousand wild rice plants. Seeds were collected from that population in 2001 for study. After several seasons of preliminary experimentations to assess germination and hydrology requirements, we were able to produce plugs for transplant. The purpose of this study was to determine the range of physiological tolerances in this Illinois River Valley ecotype. Plugs of wild rice were planted at 15 different sites within the Illinois River Valley during the 2007 growing season and water, sediment and plant growth were monitored monthly. These 15 sites encompassed a wide range of water and sediment conditions. Water pH of the sites ranged between 5.6 and 11.1. Oxidation reduction potentials ranged between -168mV and 412mV. Sediment pH ranged between 5.0 and 7.8. All sites produced reproductive populations with average seed viability between 85% and 95%. Results of this study have led us to conclude that this ecotype of *Z. aquatica* L. var. *aquatica* does in fact maintain a wide range of physiological tolerance and the loss of naturally occurring populations in the Illinois River Valley is most likely the product of an altered hydrological regime in the main channel which has subsequently raised water levels and increased turbidity in the backwater lakes and wetlands that once supported *Z. aquatica*. Currently, we are conducting a controlled study to better understand the effects of water depth and turbidity on the germination success of this species. These studies contribute to a better understanding of the basic ecological growth requirements for this plant, which are critical in determining its restoration to the backwater lakes and wetlands that it once so abundantly inhabited.

Keywords: Southern wild rice (*Zizania aquatica* L. var *aquatica*), physiological tolerance, Illinois River Valley, backwater lakes, hydrology

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EFFECT OF ELECTROFISHING CONFIGURATION ON CRAPPIE IMMOBILIZATION SUCCESS AND INJURY

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Continuous direct current (DC) and pulsed direct current (PDC) of varying frequency and pulse width, are commonly used to immobilize and collect crappie *Pomoxis* spp. in freshwater. However, little information is available about minimum thresholds required for immobilization relative to electrofishing configuration, and how these relate to incidence of injury. We investigated the effect of escalating power densities on immobilization and injury of black crappie *P. nigromaculatus* for DC and various PDC configurations. Forced swimming toward the electrodes was observed in crappie exposed to DC, but less so for fish treated with PDC. Minimum power densities required to immobilize crappie ranged from 0.09 to 6.5 mW/cm^3, and depended on pulse frequency and width. Injury, including hemorrhages, vertebral damage, and mortality, averaged 5 and 28 % at power densities below and above the immobilization thresholds, respectively. However, level of injury also depended on pulse frequency and width.

Keywords: crappie, electrofishing configuration, minimum thresholds, immobilization, injury

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SURPRISES AND CHALLENGES: ALLOCHTHONOUS DRIFT AND HYPORHEIC MUSSELS

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If one studies a dynamic system like the Upper Mississippi River for over three decades it's probably not too unusual to have findings that were unexpected. In my 35-years as a river biologist, there were two outcomes that stand out in this regard. First, the magnitude of biotic transport out of backwater habitats into the main channel was greater than expected. This allochthonous drift, as has also been shown for drift within other streams, was quite different over a 24-hour day; *Hydra* and *Hyallela* were in transport during day samples, while misc. fish fry and macroinvertebrates were in transport at night. Second, both juvenile and adult mussels were found in a streams hyporheic zone (3 to 12 inches below the surface), a region seldom sampled in quantitative mussel studies. Both mussel numbers and species richness were greater in the hyporheic zone than in the upper 3 inches of the cobble substrate. These two surprises suggest some challenges, both in terms of equipment and sampling schedules.

Keywords: drift, hyporheic zone, macroinvertebrates, mussels, sampling

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THE POWER OF A RECORD RAIN EVENT AUGUST 18-19, 2007, POOLS 6-11, UPPER MISSISSIPPI RIVER

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Record rainfalls August 18-20 caused extreme flooding and damage in Pools 6 through 11 of the upper Mississippi River as well as in associated tributaries in Wisconsin, Minnesota, and Iowa. Seven lives were lost in flood-related events; washouts and mudslides caused millions of dollars worth of damage. Long Term Resource Monitoring Program (LTRMP) data collected at fixed water quality sites in Navigation Pool 8 indicated Dissolved Oxygen levels below the standard of 5.0 mg/L were common even in the main channel. Eight of the seventeen fixed LTRMP water quality sites sampled in Navigation Pool 8 produced the highest turbidity values recorded in the history of the Long Term Resource Monitoring program with periods of record at sites dating back as far as 1988. Additionally, new records were set at 8 of 10 non-tributary sites regularly sampled. Records were established despite sampling 2-4 days following the record precipitation. New records for low Secchi depth readings and total suspended solids, 2 other parameters relating to water clarity, were also set. EMAP-GRE vegetation data collected by Wisconsin DNR crews documented storm effects from Pools 6-11 in continuous random sampling of main channel borders and large major side channels from late July through early September, 2007. Turbidity tube readings taken before the August 18-20 rains were significantly clearer than those taken during the week following the events. Turbidity tube data also demonstrated how the turbid water moved downstream into areas previously unaffected by the rains. This “cloud” of muddy water moving downstream was detected by LTRMP field station crews as far south as Alton, IL. The degree to which this event persisted as well as the magnitude to which previous records were broken at a number of sites illustrates the severity of this event. Adequate sampling frequency (biweekly monitoring) will be important to increase the probability of capturing these system changing events in the future, particularly with concerns about the cumulative effects of climate change-related phenomena on the horizon.

Keywords: Mississippi River, water quality, flood event, turbidity

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NORTH-TO-SOUTH POSITION OF COUNTIES ALONG THE MISSISSIPPI RIVER CORRELATED WITH SELECTED OUTCOMES

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A previous report indicated that the outcomes of cancer mortality, educational attainment (bachelor's degree or higher), and per capita income had a tendency to worsen, from north-to-south, for people in *states* (n = 10) along the Mississippi River. The present report focuses on these outcomes in regard to *counties* along the Mississippi River. Both east and west River border counties (n = 45 and 42 counties respectively) were assessed. Comparison counties on both sides of the River, toward the middle of the states, were also assessed (n = 42 comparison counties on the east and 38 comparison counties on the west). In addition, counties "split" by the River (n = 26 counties [17 in Minnesota and 9 in Louisiana]) were analyzed as a group. Each county was ranked according to its north-to-south position in ascending order (northern most = "1") and correlated with the outcomes. The significance for the correlation coefficient was set with a 2 tailed p-value of < 0.05. Because the data were ranked, and did not display a normal distribution, the Spearman test was used for the correlations. The *strongest* and *weakest* correlations are reported as follows. Cancer mortality rates increased the most, from north-to-south, in west River border counties ($r = 0.751$, $p = 0.000$) while its weakest correlation was observed in east comparison counties ($r = 0.045$, $p = 0.7$). Educational attainment decreased the most, from north-to-south, in west River border counties ($r = -0.554$, $p = 0.000$) while its weakest correlation was observed in east River border counties ($r = -0.138$, $p = 0.3$). Income decreased the most, from north-to-south, in west River border counties (-0.779, $p = 0.000$) while its weakest correlation was observed for split counties ($r = 0.063$, $p = 0.7$). In conclusion, counties along the *west River border* showed the strongest correlations for a worsening of all three outcomes compared to the other county regions. This region (west River border counties) showed the closest resemblance to previous north-to-south outcome correlations for *states*. Future research should seek to determine why people in west River border counties showed a stronger correlation for a worsening of these outcomes, from north-to-south, compared to the other county regions.

Keywords: Mississippi River, county, north, south, outcomes, correlation.

FOLLOW-UP ON TRANSLOCATED *ALASMIDONTA MARGINATA* FROM THE SOUTH FORK OF THE ZUMBRO RIVER, ROCHESTER, MINNESOTA

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Prior to construction of a new forcemain, six sites were surveyed in 2005 within two miles of the South Fork of the Zumbro River, downstream of Silver Lake Dam, Rochester, MN. Each site was sampled from 30 m upstream to 61 m downstream of the proposed pipe centerlines. River widths ranged from 15-46 m, while depths were mostly 1 m or less. The substrata were mostly cobble and gravel, with sand increasing as we moved downstream. Mussel translocations were done in 2006 at four sites chosen for forcemain crossings. Although densities averaged a low 0.05/m^2 from all sites, nearly 20.3% of the mussels were living *Alasmidonta marginata*, a state endangered species, likely the highest concentration in Minnesota. All living mussels were collected, including *Lasmigona costata* (2.0%) and *L. compressa* (1.8%), both Minnesota special concern species. There was modest reproduction of most of the nine living species. Minnesota listed mussels (24.1%) were externally aged, measured for length and height, and etched with unique numbers on both anterior valves, while common mussels were hash-marked on both anterior valves. Over 600 mussels were translocated to an area between Site 1 and Silver Lake Dam: 404 (18.6% T & E mussels) were from Site 1, the largest area; 136 (44.8% T & E mussels) were from Site 2, while 33 (10.9% T & E mussels), and 31 mussels (21.9% T & E mussels) were found at Sites 3 and 4 respectively. At least nine fish species were identified from Site 1, the most productive mussel area. In September 2006 gravid *A. marginata* were collected for host fish studies.

During follow-up, 9 August 2007, 211 mussels were recovered from the Translocation Site: 81 hand-planted/numbered mussels, 70 hash-marked mussels, and 60 un-marked mussels (including five listed mussels). There was a 95.3% survival of the three numbered, listed mussel species, and 85.7% survival of the hash-marked common mussels. One of the reported host fish species, *Catostomus commersoni*, white sucker, was reportedly seen by divers. Follow-up studies will be repeated in 2008.

	Site	Numbered	Marked	Un-marked	Total
1	*Pyganodon grandis*		11		
2	*Anodontoides ferussacianus*		1		
3	*Strophitus undulates*		28		
4	***Alasmidonta marginata***	**70**	**2**	**5**	**77**
5	***Lasmigona costata***	**9**		**1**	**10**
6	***Lasmigona compressa***	**2**			**2**
7	*Lasmigona complanata*			D	Dead
8	*Toxolasma parvus*				
9	*Lampsilis siliquoidea*				
10	*Lampsilis cardium*		28		
	Total live mussels:	81	70	60	211
	Total listed mussels	81	2	6	89
	Total live mussel species	3	6	6	7
	Total dead mussels	5	10	16	31

Keywords: mussel distribution, Mississippi River tributary mussel species, threatened and endangered mussels, unionid age and density data

POSSIBLE HYBRIDIZATION BETWEEN *GRAPTEMYS PSEUDOGEOGRAPHICA* AND *G.* OUACHITENSIS ALONG THE CEDAR RIVER, IOWA AND THE MISSISSIPPI RIVER

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Graptemys ouachitensis (Ouachita Map Turtle) were once considered a subspecies of *G. pseudogeographica* (False Map Turtle) until Vogt elevated it to full species level in 1993. It was mentioned that the two species would hybridize and that the resulting offspring would look intermediate in appearance between the two species. Another study in 1994 by Lamb et al. using mtDNA placed *G. ouachitensis* as a subspecies of G. *pseudogeographica*.

In 2005, a study was done on the Cedar River, Iowa to assess turtle diversity. Turtles were trapped at two sites; one on the upper Cedar River near Waverly, IA and the other lower Cedar River site was near Moscow, IA. All map turtles captured at the upper Cedar River site were identified as *G. pseudogeographica* based on appearance. Map turtles captured at the lower Cedar River site had an appearance in between *G. pseudogeographica* and *G. ouachitensis*. *G. pseudogeographica* are distinguished from other map turtles by a yellow backwards L or swoosh behind the eye. There are no large blotches or spots on the head. *G. ouachitensis* are distinguished from other map turtles by three blotches on the head. There is a yellow backwards L or swoosh behind the eye (larger than *G. pseudogeographica*) a spot below the eye, and a spot below the mouth line. The eyes are also yellow whereas the eyes of *G. pseudogeographica* are more green.

In 2006, a genetic study was conducted at the previous two sites and also on the Mississippi River in pool 13 (Sabula IA) and pool 19 (Keokuk, IA). *G. pseudogeographica* was captured at the upper Cedar River site and at the Mississippi River pool 13 site, *G. ouachitensis* was captured at the Mississippi River pool 19 site, and an intermediate between *G. pseudogeographica* and *G. ouachitensis* was captured at the lower Cedar River site. Morphological measurements were taken along with tail tissue for microsatellite analysis. Conclusions about hybridization between *G. pseudogeographica* and *G. ouachitensis* will be presented based upon morphological and genetic data. These data will be used to assess the taxonomic status of *G. ouachitensis*.

Keywords: *Graptemys pseudogeographica*, *Graptemys ouachitensis*, hybridization, microsatellite, Cedar River, IA

CENTRARCHID LATE FALL MOVEMENTS OBSERVED THROUGH ELECTROFISHING SURVEYS IN MISSISSIPPI RIVER POOLS 8, 10, AND 11

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Backwater fisheries habitat has been included as one of the objectives for many habitat restoration projects on the Upper Mississippi River. Design of projects with backwater fisheries habitat objectives includes an evaluation of various project and pool scale factors that may be influencing the fisheries use in the area (i.e. physical and chemical factors affecting spawning, juvenile, and adult survival throughout the year). One of the seasonal habitat needs that has been identified as being degraded, or lacking, for many of the backwater fisheries projects has been centrarchid overwintering (OW) habitat, defined as aquatic areas that meet the following winter conditions: water depths > 1.2 m, velocities < 0.01 m/sec, water temperature > 1 degree C, dissolved oxygen $\geq$ 5.0 mg/l. Past radio telemetry studies have indicated bluegills *Lepomis macrochirus* and largemouth bass *Micropterus salmoides* may utilize large sections of the pools before "migrating" to OW sites. Therefore, summertime and early fall surveys most likely provide a poor representation of utilization of OW habitats. Quantifying wintertime fisheries utilization of the aquatic habitats by active sampling is difficult to impossible due to ice coverage. Therefore, managers have used fall electrofishing as an indicator of centrarchid OW habitat use and quantification of that usage. The objective of our pilot study was to determine if fall catch per unit effort (CPUE) of centrarchids changes as fish move into OW habitat. Electrofishing surveys were repeated weekly throughout the fall of 2007 to determine centrarchid movement into OW areas in navigation pools 8, 10, and 11 of the Upper Mississippi River. Ten known centrarchid OW areas of varying quality were surveyed; four in Pool 8, four in Pool 10, and two in Pool 11. Four weekly electrofishing runs were conducted at all sites except one that was visited three times, resulting in a total of 39 runs varying in length from 8 min to 35 min (average = 24 min) for a total effort of 15.43 hours. Centrarchids were measured to the nearest 0.1 inch T.L. in Pools 8 and 10. In Pool 11, the bluegill T.L. was measured into 0.5 in bins and other centrarchid T.L. measured into 1.0 in bins. Other fish species encountered during the surveys were captured and documented. The surveys were conducted between 10/11/2007 and 11/27/2007 intending to encompass the autumnal migration into the overwintering areas occurring before ice formation. The data shows an inverse relationship between weekly average bluegill CPUE in OW areas and October-November main channel water temperature ($R^2 = 0.97$). The median CPUE of bluegills was significantly lower at warmer water temperatures (>10°C) than at colder water temperatures (<5.5°C) ($P<0.05$). However, the exact temperature threshold eliciting movement into OW areas is not discernable from our data.

Keywords: Centrarchids, Mississippi River, overwintering habitat, movement, bluegill

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FISH ASSEMBLAGES IN OFF-CHANNEL AREAS OF THE UPPER MISSISSIPPI RIVER SYSTEM

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Off-channel areas (OCAs) are central to the productivity and diversity of large floodplain river systems like the Upper Mississippi River System (UMRS). Habitat enhancement efforts focus on OCAs because of their ecological and recreational importance and degrading condition. System changes to accommodate navigation and agriculture in the floodplain and watershed of the UMRS have altered the physical, biogeochemical, and biological regimes of OCAs. These altered regimes are the new environmental template that regulates UMRS fish assemblages.

Past research on fish communities in the UMRS has primarily focused at the navigation pool scale and homogenized responses at smaller spatial scales. We hypothesized that 1) important sources of heterogeneity in select indices of physical and biological features exist at smaller scales within the UMRS, and 2) spatial patterns in select sub-assemblages of UMRS fish communities can be explained by spatial differences in environmental conditions in OCAs. We modeled existing UMRS observational data from the Long Term Resource Monitoring Program to describe fish assemblage associations with environmental conditions at OCA scales.

Six "major" fish assemblage types were identified amongst 35 OCAs studied from Pools 4, 8, and 13 in the Upper Mississippi River and La Grange Pool in the Illinois River. As with previous studies, spatial patterns of assemblage type were evident at the pool scale. Only one of six major assemblages was represented in OCAs from more than one pool. However, multiple assemblages occurred in a single pool and some of those were more similar to assemblages in other pools than to assemblages in the same pool; this pattern was primarily explained by major differences in assemblage between OCAs in upper and lower portions of some pools. Fish assemblages ranged from those typically associated with degraded conditions dominated by common carp and freshwater drum (i.e., OCAs in upper Pool 4) to those reflective of a good recreational fishery dominated by centrarchids (i.e., OCAs in lower and middle Pool 8 and 13). The assemblage in OCAs of the La Grange Pool was dominated by fishes characteristic of turbid reservoirs including common carp, smallmouth buffalo, black and white crappies, white bass, freshwater drum, and gizzard shad. The environmental variables most closely related to assemblage types in OCAs included total suspended solids, proportion of surface area greater than 1 meter deep, and total nitrogen concentration.

This research suggests that environmental conditions at scales smaller than pool influence fish assemblages. Further it suggests that OCAs in upper Pool 4 may be the most degraded of those examined, possibly caused by high turbidity, sedimentation, and nutrients. The fish assemblage can be viewed as a manifestation of a broad array of physical and biological processes in an OCA, and as such, a good indicator of system condition under a process-based management approach as proposed by a regional science panel in the UMRS.

Keywords: fish assemblage, off-channel area, environmental factors, Upper Mississippi River System

THREE DECADES OF WATER QUALITY CHANGE (1976-2005) IN THE MISSISSIPPI NATIONAL RIVER AND RECREATION AREA

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The Mississippi National River and Recreational Area (MNRRA) spans a 116 km stretch of the Mississippi River in the Twin Cities Metropolitan Area. Although many agencies monitor Mississippi River water quality, none has analyzed or interpreted the data with specific respect to MNRRA. To understand park-specific water quality trends, we compiled thirty years of Metropolitan Council monitoring data (1976-2005) for six Mississippi River sites, a nearby Minnesota River site, and the Metropolitan Wastewater Treatment Plant outflow. Data showed strong spatial trends, with increasing concentrations of nutrients and sediments from upstream to downstream, and strong temporal trends, with significant decreases (as per seasonal Kendall trend tests) in the flow-adjusted concentrations of most nutrients, total suspended solids, and turbidity over the period of record at all sites. Only nitrate concentrations increased significantly over time. Water quality in MNRRA appears highly sensitive to changes in both wastewater treatment and tributary inputs.

Keywords: water quality, trends, nutrients, sediments, Twin Cities Metropolitan Area

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FIFTY YEARS OF THE LONG-TERM ILLINOIS RIVER FISH POPULATION MONITORING PROGRAM, 1957-2007

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Fishes of the Illinois River have been monitored since 1957 through the Long-Term Illinois River Fish Population Monitoring Program. Fish data has been collected annually in six reaches by AC electrofishing in a fixed site sampling design. We examined fish collections over all sampling years to test for trends in total catches and catch rates, spatial and temporal changes in catch, species collections, spatial and temporal species composition and structure, and selected species. We have collected 191,042 fishes representing 97 species and seven hybrids resulting in a catch rate of 202 fish per hour of electrofishing. Community analyses revealed changes over time in species composition and structure in the upper three reaches of the river from a community dominated by common carp and goldfish to one with centrarchids and greater fish species diversity. Species diversity also increased throughout the river over time, even with the exclusion of introduced species. Important sportfishes such as bluegill and largemouth bass catches have shown considerable increase over time in many areas, while common carp catches decreased. Largemouth bass catches have declined in the La Grange and Alton reaches since 1991. Prior to 1991, catches of largemouth bass had increased since 1965. The trends observed may reflect positive effects of rehabilitation efforts throughout the Illinois River. While catch declines of largemouth bass in the La Grange and Alton reaches are alarming, our collections highlight the importance of long-term data sets and the ability to detect trends spanning multiple decades. Results from our long-term monitoring program may guide future Illinois River rehabilitation efforts.

Key words: Illinois River, electrofishing, fish population, population monitoring, long-term data

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IDENTIFICATION OF HABITAT CONDITIONS INFLUENCING NON-NATIVE ASIAN CARPS REPRODUCTION IN THE UPPER MISSISSIPPI RIVER SYSTEM

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Since 2000, the La Grange Reach of the Illinois River has boasted the highest densities of invasive bighead *Hypophthalmichthys nobilis* and silver carp *H. molitrix* (henceforth, Asian carps) within the Upper Mississippi River System (UMRS). While precise cues and habitat conditions that trigger Asian carps spawning events are mostly unknown, hydrologic and fisheries data collected by the Long Term Resource Monitoring Program (LTRMP) and other sources may provide insights for Asian carps expansion, establishment, and sustainability in the UMRS. In this study, we tested for the influences of abiotic habitat conditions (e.g. water temperature, river discharge, river stage, dissolved oxygen, conductivity) on young-of-year Asian carps catches (surrogate for successful spawning) in the La Grange Reach of the Illinois River. Our preliminary results suggest that increased catches of young-of year Asian carps are correlated with summer water temperatures and flood pulses. Increased catch rates of young-of year Asian carps lagged approximately 2 weeks from peak summer river discharge and stage events. Drought years in 2002 and 2005 (i.e. no summer flood) showed little or no Asian carps reproduction, while 2007 (i.e. three summer flood) had three distinct Asian carps spawning events as evidenced by young-of year catches. Although preliminary, our examination of the La Grange Reach will be expanded to other regional trend areas of the LTRMP with Asian carps present (Open River, Pool 26) to test for similarities or differences in reproductive cues. Ultimately, this research may inform managers in uninvaded portions of the UMRS in regards to whether appropriate conditions and cues exist for Asian carps establishment and sustainability.

Keywords: Bighead Carp, Silver Carp, Illinois River, temperatures, expansion

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EVALUATION OF SAMPLING DESIGNS FOR ESTIMATING MUSSEL ABUNDANCES ASSOCIATED WITH HABITAT PROJECTS

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Freshwater mussels (Unionoidea) are among the most imperiled of all taxonomic groups. Conservation of native mussels is of great importance to resource managers in the Upper Mississippi River (UMR), and there are concerns about the unintended consequences of proposed habitat projects (HREPs) on mussels. Unfortunately, we do not currently have the ability to rigorously assess the importance of the loss of mussels as a result of HREPs, as estimates of mussel abundances at both the HREP (e.g., around the footprint of a proposed project) and poolwide scales are urgently needed. We used computer simulations that incorporated variance estimates from recent mussel surveys in the UMR to evaluate various sampling designs for suitability in obtaining relative density and population estimates at HREP and poolwide scales. Simulated data were run through various sampling designs to determine which designs maximized relative efficiency and minimized sampling effort and cost. We also estimated the costs and precision of estimating mussel abundances within 5, 10 and 20% of the true population. Sampling was simulated for 18 populations ranging in density from 0.001mussels/m^2 to 1.5 mussels/m^2 and varying in spatial gradient and clustering. Adaptive designs were most efficient for densities ≤0.05 mussels/m^2. Adaptive designs increased the rate that occupied quadrats were encountered by a factor of 3 to 6 over conventional designs. For densities of 0.01 mussels/m^2, the probability of species detection did not exceed 0.9 until sample size exceeded 1000 regardless of design. These results can be used by resource managers to select the sampling design that most likely suits their needs.

Keywords: freshwater mussels, Mississippi River, sampling designs

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ENVIRONMENTAL AND ECONOMIC IMPACTS OF ASIAN CARPS IN THE ILLINOIS RIVER

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Non-native bighead *Hypophthalmichthys nobilis* and silver carps *H. molitrix* have been captured in the La Grange Reach of the Illinois River through routine Long Term Resource Monitoring Program sampling since 1995 and 1998, respectively. Since 2000, bighead and silver carps numbers and biomass have increased greatly. At present, these carps likely dominate the fish community of the Illinois River. Because of the miniscule filtering capabilities of these carps and the great leaping ability of silver carps, the presence of these species is of environmental and economic concern. Environmentally, bighead and silver carps may compete with other native planktivores for food, limit recruitment of sportfishes, and disrupt native food webs. For example, research conducted by the Illinois River Biological Station suggests declines in body condition of native gizzard shad and bigmouth buffalo coincident with increases in abundance of Asian carps. In addition, catches of the Centrarchidae fish complex (bass, sunfishes) continue to decline in the La Grange Reach. Economically, bighead and silver carps can positively and negatively effect river cities and users. Negatively, bighead and silver carps damage commercial fishing gears and may decrease catchability of lucrative species, such as buffalo and catfish. In addition, the risk of injury to recreational users of the Illinois River has increased substantially with the explosion of silver carps and river users may choose not to participate or spend money on river related activities. Because bighead and silver carps feed at the bottom of the food chain and reach large sizes, developing markets and commercial fishing may be the most viable option for controlling these species. Despite uncertainties of the environmental and economic impacts of Asian carps in the Illinois River, precautionary and proactive approaches to develop commercial fishing markets, fund the electric barrier, and prevent the spread of Asian carps to the Great Lakes should be of utmost concern.

Keywords: Asian carps, bighead carp, exotic species, Illinois River, silver carp

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INVESTIGATION OF WATERBIRD DIE-OFFS ON THE UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE

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Since 2002, there have been major waterbird mortality events every spring and fall in Lake Onalaska (Navigation Pool 7 of the Upper Mississippi River) located near La Crosse, Wisconsin. This area is part of the Upper Mississippi River National Wildlife and Fish Refuge (Refuge) and lies within the Mississippi Flyway, through which an estimated 40 percent of the continent's waterfowl migrate. Recently, bird mortality has spread south to Pools 8, 9, and 11 on the Refuge—about 125 miles downstream from Pool 7. Total bird mortality on the Refuge is estimated at 32,000–40,000 birds, primarily lesser scaup (*Aythya affinis*) and American coots (*Fulica americana*). Three trematodes (*Sphaeridiotrema globulus*, *Cyathocotyle bushiensis,* and *Leyogonimus polyoon*) that use the faucet snail (*Bithynia tentaculata*) as an intermediate host were found to infect and kill the waterbirds. The faucet snail was introduced into the United States from Europe in the late 1800s and first recorded on the Upper Mississippi River in 2002. Because the Refuge is a major spring and fall stop-over area for waterfowl in the Mississippi Flyway, concerns were raised that the snail and trematodes may be spreading to other waterfowl stop-over areas on the river. Sampling for faucet snails was conducted in 2005–2007 in select areas in Pools 4–9 (excluding Pool 5a which is located between Pools 5 and 6), 11, and 13. Faucet snails were found in all the sampled pools. To our knowledge, these are the first records of faucet snails and associated trematodes beyond those found in Pool 7, Lake Onalaska. Waterbird die-offs are becoming a Refuge-wide problem. Information obtained through research and monitoring, including the identification of the origin of infections in snails and birds and the role various environmental factors have on this process, should help guide managers to develop effective mitigation and control measures.

Keywords: *Bithynia tentaculata,* scaup, coots, Upper Mississippi River, *Sphaeridiotrema globulus*, *Cyathocotyle bushiensis,* and *Leyogonimus polyoon*

WINTER HABITAT USE BY BLUEGILL, CRAPPIE AND LARGEMOUTH BASS AND EVALUATION OF AN ENVIRONMENTAL MANAGEMENT PROGRAM HABITAT REHABILITATION AND ENHANCEMENT PROJECT

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Thirty to forty bluegill, crappie and largemouth bass were radio tagged annually near different backwater lakes on the Upper Mississippi River (UMR) and most recently in Mud Lake and Sunfish Lake in lower Pool 11, UMR. Mud and Sunfish Lakes are completed Environmental Management Program Habitat Rehabilitation and Enhancement Projects. Fish were radio tagged in the fall and tracked using radio telemetry to determine habitat use through the winter until ice out. All fish were externally radio tagged by attaching the transmitter to several dorsal spines. The majority of the movement of radio tagged fish was <1-3 river miles. Radio-tagged fish moved from main channel border to backwater lakes or side channels as fall progressed into winter. Backwater lake habitat exhibited shallower water, higher water temperatures and little current compared to main channel, main channel border or side channel habitats. Preliminary analysis of movement from two years of telemetry data in Mud Lake and Sunfish Lake show that by decreasing flows through the project area, fish use has increased.

Keywords: Mississippi River, winter habitat, bluegill, crappie, largemouth bass, radio telemetry, habitat rehabilitation and enhancement project

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OTOLITH MICROCHEMISTRY AND STABLE ISOTOPIC COMPOSITION AS INDICATORS OF ENVIRONMENTAL HISTORY FOR MIDDLE MISSISSIPPI RIVER FISHES

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Knowledge of environments used by fish throughout their life history is important for management and conservation of riverine fish populations and habitats. Naturally occurring stable isotope and trace elemental markers in otoliths have emerged as powerful tools for determining natal origins and environmental history of fishes (including early life stages) in a variety of marine and freshwater environments. Otoliths maintain a permanent record of chemical "signatures" from environments in which a fish has lived; associating otolith biochronology with changes in otolith stable isotopic and elemental composition enables retrospective description of environmental history for individual fish. However, no studies have examined the applicability of this technique in large floodplain rivers in the U.S. Our study evaluated otolith microchemistry and stable isotopic composition as tools for determining environmental history of fishes in the middle Mississippi and lower Illinois Rivers, their tributaries, and associated floodplain lakes. Fishes were collected from 21 sites and water samples obtained from 26 sites during summer and fall 2006 and spring 2007. Otolith and water samples were analyzed for stable oxygen isotopic composition ($\delta^{18}O$) and concentrations of suite of trace elements; otoliths were also analyzed for $\delta^{13}C$. Results indicated that tributaries, floodplain lakes, and the Illinois and Mississippi Rivers have distinct isotopic and elemental signatures. Tributaries on the Missouri and Illinois sides of the middle Mississippi River can also be distinguished by their elemental and isotopic fingerprints. Otoliths reflected differences in water chemistry among large river, tributary, and floodplain lake habitats. Results indicate that otolith microchemistry and stable isotope analyses can be applied to accurately determine natal origins and describe environmental history of fishes in the middle Mississippi and lower Illinois Rivers.

Keywords: otolith chemistry, middle Mississippi River, tributaries, floodplain lakes, fish

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THE LASTING EFFECTS OF THE GREAT MIDWEST FLOOD OF 1993 ON THE FLOODPLAIN FOREST OF THE UPPER MISSISSIPPI RIVER

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A survey conducted in 1995 revealed massive tree mortality in the aftermath of The Great Midwest Flood of 1993. Some of the 1995 survey plots were resurveyed in 2006. The data reveal continued massive tree mortality after 1995 in Pools 17, but not in Pool 26 and the Open River. Light-seeded species, such as silver maple, eastern cottonwood, and black willow, and green ash regenerated abundantly. Oak and hickory seedlings remained rare in the understory. As of 2006, the density of samplings (2-10 cm in diameter) greatly exceeded the sapling density before the flood. However, the density of trees (>= 10 diameter) recovered to pre-flood level only in the Open River but not in Pools 17 and 26. On the basis of relative stem density among the species before and after the flood, the flood provided a competitive advantage to green ash in Pool 26, and to cottonwood and black willow in the Open River.

Keywords: flood, tree mortality, Mississippi River

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100 YEARS OF MACROINVERTEBRATE SAMPLING ON THE MISSISSIPPI RIVER: WHAT HAVE WE LEARNED?

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From "plagues" of mayflies to "infestations" of zebra mussels, macroinvertebrates have long been a recognized major biotic component of the Mississippi River (MR). Since the beginning of MRRC, over 250 papers on macroinvertebrates from the MR have been presented at the Consortium's meetings. Topics of these papers can be grouped into 4 major categories: macroinvertebrate habitat association, native bivalve mussels, key macroinvertebrate species particularly fingernail clams and burrowing mayflies, and the invasive zebra mussel. The presentations have covered over 100 years of data collection from the 1907 mussel survey of the Mississippi River (Stansbery 2002) to recent studies of benthic production and fingernail clam life history (Eckblad et al. 2007). Macroinvertebrate research on the MR has indicated consistent macroinvertebrate community composition and development relative to habitat type. However, the MR is a dynamic system and the native communities are affected by changes in the system, such as sedimentation, human activities, naturally occurring large scale events, changes in the areal extent of aquatic macrophyte beds, and inputs from backwaters and tributaries. Over the past 100 years, native freshwater mussels have declined both in species composition and density, perhaps as a result of changes in the natural flow regimes, human exploitation and modification of the river, habitat alterations, and invasive species. Fortunately, there has been some progress in recovery of native mussels, as culturing techniques for reestablishing populations have become more successful. Fingernail clams and burrowing mayflies have been used as biological monitors of environmental conditions in a number of studies. Studies examining the uptake and sequestering of heavy metals and various organic compounds have occurred in the MR which have resulted in changes in management plans for these organisms. Fingernail clam populations have been shown to fluctuate greatly in response to environmental changes and resulting models are helping to interpret cause and effect relations. Although the MR contains several invasive species, the zebra mussel has received the most attention. Their rapid spread, direct competition with native mussel species, affect on production of macroinvertebrate communities, and problems associated with human use of the river have led to increased research and monitoring. Recently observed zebra mussel population fluctuations indicate an environmental adjustment which may stabilize at a sustainable level. Future studies need to examine what this level may be. Macroinvertebrates are a fundamental component of the MR ecosystem and they can be used as an effective model for tracking environmental changes.

Keywords: macroinvertebrates, native mussels, fingernail clams, burrowing mayflies, zebra mussels

TOWARD A BETTER UNDERSTANDING OF TROPHIC DYNAMICS OF RIVER ECOSYSTEMS

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Members of the Mississippi River Research Consortium have been considering the nature of trophic dynamics. Direct studies of riverine food webs are relatively new to both river science and the MRRC, but the history of the MRRC includes numerous studies that touch on the function of river ecosystems. The study of trophic dynamics dates to the second meeting of the MRRC, where Pahl and Varchman described the diet of three species of game fish. Studies linked to trophic processes appeared sporadically in the intervening years, including biomass and abundance of primary producers, bacterial production, and secondary production of benthic invertebrates. The late 1980s and early 1990s marked an effort to test the prevailing theory of riverine function of the time, the flood pulse concept. This is exemplified by examination of the FPC during and following the 1993 flood. Experimental studies added to our understanding of food webs and the interaction of a non-native species and temporal conditions. The development and application of other methodologies, such as stable isotopes, have expanded our understanding or riverine food webs further still. Application of stable isotopes of potential food sources and consumers brought the realization that the food web of the Upper Mississippi, like so many other large rivers world-wide, is supported by autochthonous production. Other techniques, such as fatty acids, have found their way into presentations at MRRC and the annual meeting will continue to see our understanding of riverine food webs expand as river scientists expand their study of the temporal and spatial dynamics of trophic processes.

Keywords: history, food web, trophic, experiment, isotope, fatty acid, ecosystem theory

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NUTRIENTS IN THE UPPER MISSISSIPPI RIVER: TRANSPORT, PROCESSING, AND EFFECTS ON THE RIVER.

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Nutrient concentrations and loads in the Upper Mississippi River (UMR) have been substantially affected by changes in land use, climate, hydrology, and river management/engineering over the last century. An important consequence of these changes is the contribution of nutrients from the UMR to the hypoxic zone in the Gulf of Mexico. The sources of nutrients in the basin and the factors that control their input to the river have received much study. Past research has generally focused on nutrient inputs to the river (e.g. the relationship between catchment characteristics nutrient export to the river) and the effects of nutrient outputs from the river on the Gulf of Mexico. As a result, many aspects of nutrient inputs to, and outputs from, the river are reasonably understood. Less work has been done on the effects of in-river processes on nutrient retention, cycling, and transformation. Also, the effects of elevated nutrient loads and changes in hydrology (e.g. hydrologic connectivity) on the functioning of river ecosystems and the biota they contain are poorly understood. Less understood local effects of increased nutrient inputs likely include increased hypoxia in off channel areas, excessive phytoplankton and cyanobacterial production, and accumulation of nitrogen and phosphorus in sediments. Recent research on nitrogen cycling has emphasized the linkages between river hydrology, geomorphology and connectivity among aquatic areas as determinants of biogeochemical process rates and N removal. Recent research on riverine primary productivity has suggested (1) a strong relationship exists between nutrient concentrations in channels and rates of planktonic productivity; (2) backwater algal community structure is linked to N:P ratios that are largely related to hydrologic connectivity and river stage. Evidence from the UMR and other large rivers suggests that to understand the processing of nutrients within the river we need to better incorporate spatial and temporal patterns in hydrologic connectivity.

Keywords: Nitrogen, Phosphorus, eutrophication, denitrification, primary production

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STUDYING AND MANAGING GREAT RIVER FISHERIES: THE UPPER MISSISSIPPI RIVER EXPERIENCE

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The largest rivers on Earth, herein termed Great Rivers, are notoriously difficult to study and manage, yet represent a nexus of freshwater fish diversity on the planet. Future conservation of freshwater fish diversity on the planet will depend, in large part, on the effectiveness of Great River research and the efficacy of Great River management. In our paper, we will discuss issues that challenge and presently constrain effective Great River fisheries research and management. In doing so, we will use the Upper Mississippi River as a case study given its status as perhaps the best studied and most intensively engineered Great River in the world. Our presentation will begin with a retrospective, time-sequenced history (> 100 years) of fishery research topics, research methods, and management techniques used in the basin. We will follow this with a presentation of selected contemporary case studies that pose vexing, yet pressing, research and management challenges. Finally, we will discuss future directions in Great River fisheries research and management.

Keywords: Mississippi River, Illinois River, fisheries research, fisheries management

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HISTORICAL RESEARCH ON REPTILES AND AMPHIBIANS OF THE MISSISSIPPI RIVER: THE NECESSITY OF FUTURE LONG-TERM STUDIES

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Reptiles and amphibians represent a significant component of the Mississippi River and associated habitats. Based on sampling at Great Rivers Field Station, turtle biomass makes up a substantial amount of the fauna present within backwater lakes along the lower Illinois River. For instance, in Lower and Middle Swan Lake alone, 88,000 to 300,000 red-eared sliders, *Trachemys scripta elegans*, are estimated to occupy the lake at any one time based on long-term mark and recapture data. Nevertheless, amphibian and reptile fauna have largely been overlooked in studies along the Mississippi River. For example, in the 40-year history of the Mississippi River Research Consortium, no herpetology studies appeared until the 20th meeting in 1988 when Michael Pappas and Bruce Brecke presented a paper entitled, "A field study of Blanding's turtle, *Emydoidea blandingii*, at Weaver Dunes, Wabasha County, Minnesota". It was another 7 years before a frog survey at the Mark Twain National Wildlife Refuge was presented (Bernstein et al. 1995). Since that time, herpetological studies have gradually increased and become a staple at the consortium. However, the recent declines in both amphibians and reptiles coupled with global climate change demand that increased efforts to monitor these animals be made. For example turtles may be particularly sensitive to changing climates because they have temperature dependent sex determination (TS). Studies conducted at the Great Rivers Field Station examined hatchlings, reproductive ecology, and population demography of the red-eared slider (*Trachemys scripta elegans*) in aquatic habitats of the lower Illinois River in Jersey and Calhoun Counties, Illinois between 1994 and 2007. In initial studies, the sex ratio was balanced but became progressively more male biased with the passage of time. Large cohorts of newly recruited males seem to underlie the increasing male bias. Recruitment more than doubled between 2001 and 2006 and these turtles were strongly male biased. In part, this change reflects the increased male bias among hatchlings and a pattern of increasing reproductive output. Climatic warming may have driven the demographic changes observed. A period of warming at the site (0.12 ºC per year between 1992 and 2006) has allowed females to lay more eggs by lengthening the nesting season by about three weeks. Increasing the length of the nesting season allows females to lay an extra clutch, which may account for the increased recruitment. This clutch is laid when soil temperatures are relatively low explaining the male bias in newly recruited turtles. The impact of the increased number of male turtles on the population is uncertain. However, female condition has declined about 7% between 1994 and 2006 suggesting that an effect may be occurring. Dramatic changes in range have also been observed in some species. Conant and Collins (1998) reported that the green treefrog, *Hyla cinerea*, extended into extreme southern Illinois. We have documented large choruses of green treefrogs in Jersey County, IL some 110 km north of the previous northernmost record for this species in Illinois as well as 12 other reptile and amphibian species that have had apparent northern migrations based on newly discovered records. Additional examples and suggestions for reptile and amphibian monitoring will be presented.

Keywords: reptiles, amphibians, Mississippi River, global warming, *Trachemys scripta*, *Hyla cinerea*, temperature sex determination

ADVANCING RESTORATION SCIENCE ON THE UPPER MISSISSIPPI RIVER.

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The Water Resources Development Act of 2007 has set the stage for dramatic acceleration and expansion of ecosystem restoration activities on the Upper Mississippi River. Whereas the Environmental Management Program (EMP) established in 1986 initially called for a 10-year program of restoration and monitoring at an annual level of $19 million, the new Navigation and Ecosystem Sustainability Program (NESP) may, pending full appropriations, lead to the expenditure of $1.58 billion for ecosystem restoration activities over the program's first 15 years. New areas of work permitted under NESP include fish passage structures at dams, and 35,000 acres of floodplain restoration. Restoration work completed under the EMP answered many questions about habitat project design, but the expected increase in restoration scope and activity under NESP demands a similar increase in our commitment to program accountability. The need to objectively and quantitatively document progress toward river ecosystem goals provides numerous opportunities to advance river restoration science. Of the many complex questions that must be addressed, two stand out: 1) how much restoration is enough? and 2) how should the program's successes be measured and communicated? Science can't provide the full answers to these questions, but it must play a role in the generating the evidence needed to explore them. A Science Panel, convened to provide suggestions to the NESP partners for implementing an adaptive management approach, has begun bridging gaps that exist between such academic concepts of ecosystem sustainability, health, structure, function, and their operational equivalents. Of great importance is the need to link modifications to physical and hydraulic river attributes with all of their ecological consequences, and site or project measures to reach and systemic scales. In addition to management objectives, the commitment to an adaptive approach will require the establishment of learning objectives, which in turn will allow more restoration projects to function as experiments, and which will guide monitoring activities and the development of predictive models. Standing in the way of these potential advances however, is the long-standing criticism by many managers that the costs of restoration science would be better spent on more projects. Polarization on this issue may be increasing, and the NESP partners must find a way to integrate science (learning) and management (restoration actions) to assure they will complement and support each other rather than being seen as competing program elements.

Keywords: Upper Mississippi River, adaptive management, restoration science, Navigation and Ecosystem Sustainability Program

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SYTHESIS OF UPPER MISSISSIPPI RIVER SYSTEM VEGETATION: PAST, PRESENT, AND FUTURE

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Historical accounts of the Upper Mississippi River (UMR) indicate a diverse environment of inundated floodplains, numerous channels, and temporary ponds. These supported high species richness of both submersed (23+spp) and emergent (22 – 80+spp) aquatic vegetation. Following construction of the locks and dams in the 1930's, the floodplains became permanently flooded, allowing submersed and emergent aquatic vegetation to flourish in these vast new shallow aquatic areas. Impoundments resulted in the loss of the natural hydrograph, and increased sedimentation, wave action, and nutrient enrichment. Aquatic vegetation began to disappear on the UMR under the impacts of these stressors. Recent studies of aquatic vegetation conducted on the UMR have shown that species richness of submersed macrophytes (21spp) and emergent vegetation (14 – 80+spp) has decreased very little from pre lock and dam conditions. However, abundance of aquatic macrophytes has been drastically reduced and species composition has been highly altered.

The Illinois River was also historically abundant in aquatic vegetation, particularly submersed aquatic vegetation (SAV), in the lower Illinois River and connected floodplain backwaters during the early 1900's. However, as early as 1915, lush beds of SAV began to disappear from the backwater lakes and the main-stem river following the diversion of Lake Michigan waters to the Illinois River. By the 1950's, SAV had almost completely disappeared from these habitats within the Illinois River. Recent studies indicate an increase in SAV in the upper Illinois River, in the Dresden Pool, south of Joliet, Illinois. Currently, virtually no submersed, rooted floating-leaved, or non-rooted floating-leaved vegetation is found further downstream within the Marseilles and Starved Rock Pools of the upper Illinois River, and within main stem river habitats of lower Illinois River pools, including La Grange Pool. Lack of SAV within these lower Illinois River pools may be explained through longitudinal variability in river condition among pools. Water clarity is greater and water levels are more stable in the upper Illinois River pools compared to the lower pool. Future research should focus on determining limiting and promoting factors for SAV establishment and growth along a longitudinal gradient of pools in the Illinois River.

The silver maple – American elm forest extends throughout the floodplains of the UMR System. Historically, some forest removal occurred because steamboats were fueled by wood, primarily from the accessible forests that lined the river system. Agricultural expansion followed the harvest and clearing of the floodplain forest. Over 50% of the river floodplain was converted to agriculture in some areas as agricultural levees were built for water control. Currently, most floodplain forests are less diverse, dominated by silver maple. Some recent changes in floodplain forest species composition between the mouth of the Missouri River and the mouth of the Ohio River were caused by the Great Midwest Flood of 1993. During the flood, floodplain forests were inundated at unusually high water levels and for a rare and lengthy duration throughout the growing season. The flood reduced tree density, killing particularly small and weak trees, and less water tolerant species such as hackberry and pin oak. This provided an opportunity for eastern cottonwood and black willow to regenerate in this

portion of the Mississippi River. Floodplain forests above the mouth of the Missouri River continue to be dominated by silver maple. Future floodplain forest research should include studies of species composition changes related to flooding, management, river and land use, groundwater loss, and changes in temperature and precipitation related to global warming.

Keywords: vegetation, Mississippi River, forest, submersed, emergent

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HYDROLOGIC AND HYDRAULIC DRIVERS OF THE UPPER MISSISSIPPI RIVER ECOSYSTEM

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River hydrology, in the broadest sense, is perhaps the strongest driver of floodplain river ecosystems. Hydrologic and hydraulic (H&H) processes drive sediment transport which shapes the channels and backwaters of aquatic habitats and forms the terrestrial geomorphic template that supports diverse plant and animal communities. River flow also transports dissolved nutrients and organic matter, including large woody debris, coarse and fine particulates, gametes, eggs, larvae, and invertebrates. H&H processes are important factors determining plant and animal habitats, especially soil moisture gradients ranging from permanent aquatic to rarely flooded and that support a range of aquatic to terrestrial upland plant species in relatively distinct community types along inundation gradients. Rheophylic fishes and macroinvertebrates exploit swift channels, while lentic fishes use off-channel aquatic habitat, and diving/swimming birds eat plants, invertebrates, or fishes in deepwater while dabblers and waders eat plants, seeds, invertebrates, amphibians, and fishes in shallow water and mudflats. Low flow H&H zonation changes with flooding, and mobile critters migrate with floodwaters to exploit seasonal habitats.

UMR hydrology is well understood with regard to navigation and flood control, but less well understood from an ecological perspective. River hydraulics have been used since the mid-19th Century to shape a deep and stable main navigation channel by clearing and constricting the channel. Large scale flood control and floodplain drainage and development started in the late 19th Century. Low flow river stage regulation to maintain a minimum 9-ft navigation channel was achieved by a network of 37 low-head navigation dams. Upland development has change the rate and volume of runoff that reaches the mainstem. Each of these developments has caused significant ecological change, sometimes with very different effects depending on location along the 1,200 miles of river or the lateral channel-floodplain gradient.

River ecologists and conservationists have recommended naturalizing the hydrologic regime with regard to five ecologically relevant characteristics: magnitude, frequency, duration, timing, and rate of change. These parameters are described systematically for the UMR because there is wide availability of river discharge and stage data. Long term discharge and stage data spanning pre and post development are available for nine gauges throughout the system. Each navigation reach also has three or more gauges to assess post dam, riverine to lentic hydrologic gradients in impounded reaches. River stage-discharge modeling has been used to estimate floodplain inundation for flood protection for decades, and the ecological significance of flooding has been generally described, but UMR flood inundation mapping has not been evaluated for ecological significance. Recent flood inundation analysis on high resolution topographic data has greatly increased opportunities to expand pilot study analyses. Historic assessments of flood inundation to assess change due to development has also not been completed, but appropriate map and hydrologic data are widely available and demonstrations have been extremely informative. The five ecologically relevant hydrologic characteristics can also be applied to area of inundation when it is clearly mapped over floodplain elevation data. River hydraulic characteristics operate at fine scales and can vary widely with river discharge. Advanced 2-dimensional hydraulic models developed for many river reaches have been used to design navigation

and ecosystem restoration features, and only recently to describe freshwater mussel habitat. These models can be used more widely to estimate habitat availability, material transport capacity, and other ecosystem processes in other river reaches.

Keywords: hydrology, hydraulics, inundation mapping, ecohydrology, floodplain river

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CONTAMINANTS IN THE UPPER MISSISSIPPI RIVER: HISTORIC TRENDS, PRESENT STATUS, AND EMERGING CONCERNS

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The Upper Mississippi River receives contaminants from agricultural, industrial, municipal, and residential sources, including potentially toxic metals, pesticides, synthetic industrial compounds, and many other chemicals. Contamination of the river with mercury and lead rapidly followed settlement of the basin by Caucasian immigrants in the mid 1800s. Concentrations of contaminants from industrial sources and sewage treatments plants are generally greatest in reaches within and downstream of metropolitan urban areas. Lake Pepin, a natural lake extending 75-110 km downstream from the Twin Cities metropolitan area (Minneapolis-St. Paul, MN), traps particles and associated contaminants, decreasing the transport of potentially harmful pollutants from the metropolitan area, the Minnesota River basin, and other upstream sources into the reach of River downstream from the lake.

Certain contaminants–including methylmercury, PCB, DDT and its degradation products–readily bioaccumulate and can biomagnify to harmful concentrations in organisms in upper trophic levels of aquatic food webs. Contamination of the aquatic food web with PCB was the probable cause of a sudden decline in populations of mink (*Mustela vison*) on the Upper Mississippi River National Wildlife and Fish Refuge during 1959-1965. Institutional responses to bioaccumulative contaminants have included reduction of point-source discharges and issuance of fish-consumption advice. The federal Clean Water Act, passed in 1972, has effectively reduced discharges of certain industrial pollutants from point sources to the river, thereby decreasing the exposure of fish and wildlife to compounds, such as PCB and methylmercury. The decline in PCB contamination of riverine fish after the ban on their production and related efforts to reduce the release of PCB into the environment was followed by the gradual recovery of mink populations in the Refuge. Similarly, the abundance of fish-eating birds, such as bald eagles (*Haliaeetus leucocephalus*) and double-crested cormorants (*Phalacrocorax auritus*), along the river corridor has increased since the banning of DDT and other eggshell-thinning insecticides, paralleling national population trends for these species.

Some sources of contaminants, particularly nonpoint sources, are not subject to the regulatory provisions of the Clean Water Act. Much of the basin is intensively cultivated for corn and soybean production, and tributary streams receive agricultural chemicals and their degradation products via surface runoff and groundwater flow, acting as point sources of agricultural chemicals to the main-stem river. The Upper Mississippi River basin upstream of its confluence with the Missouri River contributes much or most of the load of many pesticides present in the Mississippi River, even though the flow of the Upper Mississippi at that location is only about one-fifth of that from the entire Mississippi River basin.

Hundreds of recently synthesized chemicals from multiple sources enter the river, and the behavior and potential ecotoxicological effects of many of these compounds in aquatic systems are largely unknown. Emerging contaminants (e.g., perfluorochemicals, pharmaceuticals, personal care products) and recently discovered mechanisms of adverse biological effects (e.g., endocrine disruption) pose substantial continuing challenges for scientists and environmental managers concerned with the ecological health of this complex ecosystem.

Keywords: bioaccumulation, ecotoxicology, emerging contaminants, reproductive effects, spatial patterns, temporal trends

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NOTES

THE EFFECTS OF SEDIMENT DRYING AND REWETTING ON NITROGEN CYCLE PROCESSES IN A SMALL STREAM IN THE KANSAS RIVER WATERSHED.

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Changing environmental conditions and increased water consumption has transformed many historically perennial stream systems into intermittent systems. Multiple drying and wetting events throughout the year may impact many stream processes. Two such processes, nitrification and denitrification, are also key components of the nitrogen cycle. During summer 2007, an experimental stream constructed adjacent to the Saline River in Western Kansas was used to determine the effects of desiccation and rewetting of stream sediment on nitrification and denitrification potentials. Mean nitrification and denitrification rates in sediment not dried (controls) were 0.431 ± 0.017 μg NO_3^--N/cm^2/h and 0.926 ± 0.106 μg N_2O-N/cm^2/h, respectively. As sediment samples dried, nitrification rates decreased. Sediments dried less than seven days recovered within one day of being rewetted. Denitrification rates were not negatively affected by one day of drying, while samples dried greater than one day experienced reduced rates of denitrification. Denitrification in sediments dried seven days or less recovered by day seven of being rewetted. Rates in sediments dried greater than seven days did not fully recover, for either process, even after 28 days of being rewetted. These results demonstrate that alterations in stream's hydrology can significantly affect nitrogen cycle processes.

Keywords: nitrification, denitrification, desiccation, nitrogen cycling

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INVASIVE PLANT COMMUNITIES IN MISSISSIPPI RIVER FLOODPLAIN FORESTS: A COMPARISON BETWEEN MATURE, REFORESTED, AND NATURALLY REGENERATING STANDS

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Large tracts of bottomland hardwood forests within the south central and southeastern United States were cleared for agriculture, fuel wood, and timber during the last century, resulting in declines five times greater than for other hardwood forest types in the United States. Many tracts of bottomland hardwood forests within the Mississippi River System that were not cleared have been degraded. Many restoration practices have focused on afforestation without clear objectives, long-term monitoring of success, or the effect of invasive non-native plant species. In general, few studies have addressed the threat of exotic plant species to restoration success. We hypothesized that disturbed but restored stands would have greater exotic richness than mature, closed stands. We also expected that passively restored, naturally regenerating stands would harbor more exotics than actively reforested stands where canopy closure may be faster. Our main objective was to investigate these relationships within bottomland hardwood stands of the Mississippi River Ecosystem bordering Missouri and Illinois. Across all forest types, a total of 34 exotic species composing five growth forms were identified. Exotic plant communities within mature stands differed from those within reforested stands ($R = 0.107$, $p = 0.033$); no other differences among exotic communities were detected. Reforested sites also had greater exotic species richness, and exotic:native ratios than mature and natural regeneration stands. Our findings suggest that reforested bottomland stands in this region are vulnerable to exotic plant invasion. Multiple stand entries, as well as planting of herbaceous cover species, are common in active restorations in the region and may contribute to exotic species establishment and proliferation. Considerations should be made in these stands to employ methods to reduce this risk by planting native cover crops and minimizing anthropogenic disturbances.

Keywords: bottomland hardwoods, exotic species, floodplain, invasive species, restoration

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HABITAT USE AND MOVEMENT OF JUVENILE LAKE STURGEON IN THE MISSISSIPPI RIVER

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Lake Sturgeon (*Acipenser fulvens*) were largely extirpated from the Mississippi River from overfishing around the beginning of the 20th century. The Missouri Department of Conservation has been stocking fingerlings into the Missouri and Mississippi Rivers since 1984. Previous studies have showed that adult and sub-adult fish are highly mobile, appear to have seasonal movements, use a variety of habitats, and repeatedly use certain sites. The purpose of this study is to determine to what extent these characteristics apply to juvenile fish, as well as continuation of studies examining adult fish. Fishing commenced in October and ran through November in Pool 24. A total of 14 juvenile fish were implanted with sonic transmitters averaging 620 mm and 2.0 kg, and an additional three adults were tagged as well averaging 1219 mm and 10.8 kg. Six more juveniles will be tagged this spring when more favorable fishing conditions return. Manual tracking has located all of these fish on at least one occasion, usually with a bottom preference of sand. We have no documentation of fish leaving the pool. A network of passive receivers spread out along the Mississippi River will aid in studying long distance movements as data comes in.

Keywords: Lake Sturgeon, extirpated, sonic transmitters, manual tracking, passive recievers

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LIGHT TRAP STUDY OF LARVAL AND JUVENILE FISH FROM MUD LAKE (UPPER MISSISSIPPI RIVER, POOL 11)

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Mud Lake is a lake in lower Pool 11 that was recently deepened in areas by dredging to provide improved habitat for overwintering fish. In this study, a light trap technique was deployed at night on 16 occasions between June 25 and September 10, 2007, to collect larval and juvenile fish for the purpose of obtaining a preliminary assessment of the lake as spawning/nursery habitat. A trap was deployed for 0.5 hr. each at several locations at two depths, one approximately 0.3 m below the surface and the other approximately 0.3 m above the bottom. Several samples were also collected where the trap was left in place overnight. A total of 102 fish were collected, representing nine families: Lepisosteidae, Clupeidae, Cyprinidae, Catastomidae, Ictaluridae, Atherinidae, Moronidae, Centrarchidae, and Percidae. Larval or juvenile fish that were identified included the following: longnose or shortnose gar (*Lepisosteus* sp.), gizzard shad (*Dorosoma cepedianum*), a species of shiner (*Notropis* sp.), bullhead minnow (*Pimephales vigilax*), quillback (*Carpiodes cyprinus*), channel catfish (*Ictalurus punctatus*), brook silverside (*Labidesthes sicculus*), white bass (*Morone chrysops*), bluegill (*Lepomis macrochirus*), and logperch (*Percina caprodes*). The brook silverside was the most commonly captured species (50% of total), followed by white bass (19%) and *Notropis* shiners (9.8%). Traps set near the surface captured a higher proportion of the total than those set deeper. Five of six brook silversides collected on July 3rd possessed single pouched outgrowths, primarily in the abdominal region below the stomach and presumably caused by a parasite. The traps also collected numerous insects, dominated in number by the water boatman (Order Hemiptera, Family Corixidae). A crustacean fish parasite (fish louse, *Argulus* sp.), was collected as a free-swimming organism on two occasions. This preliminary study has demonstrated the utility of the light trap technique for collecting immature fish in the Mississippi River, and for assessing areas as spawning and nursery habitat. Expansion of the trapping effort by inclusion of additional trapping methods, an extended trapping season, daylight trapping, and increased trapping hours overall would likely add to the list of fish species that are spawning and developing in Mud Lake.

Keywords: larval fish, light trap, Mississippi River, Pool 11, habitat

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LONG-TERM TRENDS IN ILLINOIS RIVER WATER QUALITY: REFLECTIVE OF GLOBAL CHANGES?

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Climate change and invasive species introductions are among the most widely publicized and debated topics concerning our environment today. Nevertheless, understanding the impacts of these changes are often difficult. River monitoring programs, such as the Long Term Resource Monitoring Program (LTRMP, 1989-present) and the Long Term Illinois River Fish Monitoring program (LTEF, 1957-present) have proven useful for detecting spatial and temporal changes within the Illinois River. We used two water quality metrics (temperature and chlorophyll *a*) and fisheries data from the LTRMP and LTEF data sets to test for trends in and potential impacts of global climate change on a regional scale. We also tested for the influences of invasive species on water quality. Preliminary analysis of bi-weekly, LTRMP fixed site sampling data indicates an increase in average water temperature of 1.5 ̊C within the Illinois River at Havana between 1992 and 2006. Results from the LTEF water temperature data show similar trends from 1979 to 2006. Our preliminary results also suggest no correlation among invasive carps catches and chlorophyll *a* concentrations Continued collection and analysis of regional long-term data sets may play a pivotal role in documenting and understanding the global impacts of climate change.

Keywords: Illinois River, invasive species, Long Term Illinois River Fish Monitoring Program, Long Term Resource Monitoring Program, water quality

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USING STABLE ISOTOPES TO MEASURE CHANGES OVER TIME IN THE MINIMALLY DISTURBED ST. CROIX RIVER: A POTENTIAL GUIDE TO REHABILITATION

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Throughout the course of human history, populations have dwelled alongside the banks of many fertile rivers. Technological advances and increasing human population size have taken their toll on large rivers globally. Human impacts have drastically altered the ecosystems of these rivers by, but not limited to, pollution, alterations, impediments, and introduction of exotic species. Altering ecosystems and introducing foreign species to non-native habitats can cause many unforeseen problems. Troubles arise in the question of restoring these habitats: In what capacity can an ecosystem be returned to its natural state and also, what was the natural state before a particular disturbance occurred? Museum specimens of fish, freshwater mussels, and gastropods were analyzed for carbon and nitrogen stable isotope ratios to calculate food chain length by trophic position. Nitrogen and carbon isotopic ratios in the St. Croix River from the 1880's through the end of the 20th century have been consistent compared to other rivers in the Mississippi River basin. Minimal environmental disturbances have occurred in the St. Croix River over the past 60 yr and, as a result, little change has occurred in specimen isotope levels during that time. Stable isotopic ratios from the St. Croix River can be used as an accepted reference measure. Correlations with isotopic changes in other rivers with man induced alterations to the other rivers can serve as a means for assessing the extent of change and potential for rehabilitation in these complex and dynamic ecosystems.

Keywords: St. Croix River, disturbance, food chain, museum samples, rehabilitation

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HISTORICAL ANALYSIS OF CHANGES OF RIVERINE PROCESSES IN THE ILLINOIS RIVER THROUGH USE OF STABLE ISTOTOPE RATIOS

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Over the past century, large river ecosystems have gone through great changes in their hydrology and morphology as a result of human development and exploitation of resources. The objective of this study was to observe changes through time in food web structure throughout the Illinois River and to what extent human activity has caused such changes. Stable isotope ratios of fish were used to examine potential changes in trophic relationships as a result of human disturbance over a 140-yr period. Tissue samples were collected and removed from museum specimens and returned to the Large River Studies Center to be prepared for shipment to the North Carolina State University Isotopic Laboratory for determination of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios. Preliminary data exhibit a progressive increase in both $\delta^{13}C$ and $\delta^{15}N$ from the late 19th century to the middle of the 20th century followed by a decrease in both isotopic levels from the 1960s to 1980s. This rise may suggest the increase in organic pollution, causing changes in trophic levels toward benthic algae as a result of human activity. Furthermore, the decrease seen in the 1980s for both $\delta^{13}C$ and $\delta^{15}N$ may serve as an indicator of the potential to rehabilitate the Illinois River ecosystem since the timing of this change coincides with water quality and improved sanitation efforts resulting from the Clean Water Act of 1972.

Keywords: stable isotopes, trophic relationships, organic pollution, Illinois River, human development

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SOUTHERN FLYING SQUIRRELS (*GLAUCOMYS VOLANS*) IN A PROTECTED AREA ALONG THE MISSISSIPPI RIVER IN EASTERN IOWA

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In Iowa, southern flying squirrels, *Glaucomys volans*, are considered a species of "Special Concern". Soutehrn flying squirrel abundance is officially "Uncommon" within Iowa and the population trend is "Unknown". Although their reported distribution includes all but the extreme northwest corner of Iowa, there are relatively few records for the species within the state. Anecdotal information from several local people suggested that few southern flying squirrels remain in eastern Iowa. We sought to assess southern flying squirrel populations and habitat associations within the Mines of Spain Recreation Area (MoSRA) along the Mississippi River (Pool 12) in eastern Iowa. We live-trapped southern flying squirrels on three plots within MoSRA for approximately twelve weeks during the months of July, August, September, and October. In addition, we collected vegetation data for each plot. Our goal was to determine presence/absence, abundance, spatial needs, activity pattern, seasonal movements, and habitat characteristics. We were successful in capturing 11 individuals (3 female and 8 male) on 2 of the 3 plots, thus establishing presence of southern flying squirrels in the area. However, a failure to recapture individuals and to capture subsequent new individuals late in the season limited our outcomes. We will summarize the habitat associations and provide suggestions for future research.

Keywords: *Glaucomys volans*, habitat, Iowa, Southern Flying Squirrel

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FISH DIET DIFFERENCES BETWEEN TWO DIVERSE RIVER ECOSYSTEMS

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Stable isotope ratio and gut content analyses can be used together to give information on fish diet. Stable isotopes show what has been assimilated into diet and can provide an estimate of trophic position, whereas gut contents show what a fish has consumed recently. The objective of this study was to use these two methods to assess trophic status of fish with a possible application for examining the relationship between lateral complexity and trophic structure in river ecosystems. We analyzed gut contents and stable isotope ratios from samples taken in October 1993 of the Upper Mississippi River and lower Missouri River. These rivers differ significantly in lateral complexity. The lower Missouri River has been altered to become a self-scouring, single channel to ease navigation. The Upper Mississippi River still retains natural hydrologic conditions despite some modifications. Only the Upper Mississippi seasonally overflows its banks and rejuvenate its floodplain. Percent abundance of each representative food type was compared to stable isotope data from previously published work. The stomachs of many fish examined were empty, making it difficult to test the validity of stable isotope data. However, available gut content data corresponded well with stable isotope data. The results of the stable isotope gut comparisons show fish in the more laterally complex Upper Mississippi River had greater $\delta^{15}N$ values while fish in the Missouri River had greater $\delta^{13}C$ values. There was a large difference in the trophic position for specific feeding guilds. Invertivores, planktivores and omnivores all had substantially higher trophic positions in the Upper Mississippi River. These findings suggest fish living in a laterally complex river ecosystem are able to feed at a higher trophic level, probably due to the greater availability of resources from the greater diversity of habitat patches present in laterally complex riverine landscapes.

Keywords: fish diet, gut content, stable isotope ratio, Upper Mississippi River, Missouri River

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SECONDARY PRODUCTION OF TWO DOMINANT MACROINVERTBRATES INHABITING MAIN-CHANNEL BORDER AND BACKWATER HABITATS IN THE UPPER MISSISSIPPI RIVER

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Large rivers, such as the upper Mississippi River (UMR), are among the most productive freshwater ecosystems. Macroinvertebrate production is a primary energy pathway to riverine fish. Much of our existing understanding of macroinvertebrate standing crops in the UMR has been derived from sampling soft sediments; however, many macroinvertebrates are unable to colonize these highly disturbed habitats in the main channel of the UMR. Current channel alignment structures and other natural hard substrates (e.g., tree roots, logs and branches) may provide stable, alternative habitats that support greater levels of macroinvertebrate production. We investigated the colonization and secondary production rates for macroinvertebrates on stable substrates in the UMR. In addition, we sampled macroinvertebrates from 4 adjacent backwater lakes (Lawrence Lake, Round Lake, Target Lake, and an impounded, open-water habitat near Stoddard, WI) to compare the level of secondary productivity between the high-flow main-channel habitats and low-flow contiguous backwater habitats. The backwater habitats varied in their connectivity to the main channel of the UMR. In the spring and summer 2006, Hester-Dendy artificial substrates (HDAS), consisting of 14 Masonite® discs with a total area of 0.16 m^2, were placed at 3 locations (UMR River Miles 691.6, 693.3, and 699.8) along alignment structures. We also sampled backwater invertebrates from a standard area of 0.06 m^2 with a Gillespie-Brown (G-B) sampler. Three HDAS and 2 G-B samples were collected from each location approximately once every 4 weeks. Using image analysis software, video microscopy and empirical area-to-weight relationships, over 17,000 individual macroivertebrates were identified and measured for size. Water temperature, an important factor affecting macroinvertebrate growth and production, varied during the study period and between habitat types, but not among sites within habitats. Filter-feeding caddisflies *Hydropsyche orris* and *Cheumatopsyche campyla* (Hydropsychidae: Trichoptera) dominated the macroinvertebrate colonists on the HDAS in both number and biomass. Standing crop increased rapidly between June and July across all sites and peaked in August then declined in September. Colonization rates were greatest, averaging 200 to 325 individuals m^{-2} d^{-1}, in June and then monotonically declined to 37.5 to 56.3 individuals m^{-2} d^{-1} by September. Annual production rates for *H. orris* from UMR River Mile sites 691.6, 693.3, and 699.8 were 379.2, 350.9 and 246.6 g dry weight m^{-2} yr^{-1}, respectively. The amphipod *Hyalella azteca* (Amphipoda: Talitridae) dominated the macroinvertebrate community in the backwater habitats in both number and biomass. Standing crops peaked in July across all backwater sites. Annual production rates for *H. azteca* increased with habitat connectivity and ranged between 21.1 and 45.8 g DW m^{-2} yr^{-1}. These initial findings suggest that colonization and production rates for filter-feeding caddisflies on channel alignment structures and, potentially, natural, snag habitats, represent a much larger source of secondary production for main channel areas in the UMR than originally thought. Rates of production for *H. azteca* were greater in well-connected backwater habitats. Both habitats are likely sources of food for main-channel fish, however, the mode and rates of delivery are likely to differ substantially.

Keywords: secondary production, Upper Mississippi River, habitat connectivity, large river habitats

TEMPORAL CHANGES IN ORIGIN OF ESSENTIAL INORGANIC NUTRIENTS ASSOCIATED WITH PRIMARY PRODUCERS IN A LARGE RIVER ECOSYSTEM

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Phytoplankton within a large river ecosystem are an integral part of the food web. Previous studies have shown that the carbon and nitrogen isotopic ratios of phytoplankton fluctuate in response to variation in the hydrology of the Upper Mississippi River, which may have an effect on food web interactions. We propose that these hydrologically driven changes are a result of shifts in the nature of inorganic nitrogen and carbon available to phytoplankton for growth and reproduction. Stable isotope ratios and concentrations of inorganic carbon and nitrogen were used to determine changes over time in backwater and main channel habitats in Reach 6 of the Upper Mississippi River. Samples were collected Aug and September 2006 and March – August 2007. Both nitrate concentrations and stable isotope ratios decreased in 2006, but were their highest in April 2007. They continued to decline for the remainder of the study period. Nitrate concentrations and isotopic ratios were lowest in closed backwaters, whereas no differences were evident between main channel and open backwater sites. Between-habitat differences were also observed for inorganic carbon, although not as profound as changes observed for nitrate. This study demonstrates that temporal changes in the characteristics of inorganic nutrients do occur in the riverscape of the Upper Mississippi River as both as function of habitat and time. We suggest that closed backwaters show a marked difference from open backwaters and the main channel because they are isolated from the delivery of nutrients afforded to open backwaters as a result of strength of connectivity to the main channel.

Keywords: nitrate, inorganic carbon, temporal, hydrology, stable isotope

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TEMPORAL SHIFTS IN UPPER MISSISSIPPI RIVER FOOD WEB DYNAMICS IN RELATION TO HUMAN DISTURBANCES

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Humans rely heavily on river systems, yet the biological processes of river ecosystems are poorly understood. The Upper Mississippi River has been adversely affected by human disturbances since early settlements. The river serves as an important transportation route for commerce, and numerous locks and dams have been built to maintain navigation channels. The introduction of non-native species also has the potential to have altered ecosystem function. This study attempts to address the extent to which human activities have changed the food web structure of the Upper Mississippi River. Stable isotopes provide a way of looking at temporal changes in the trophic dynamics of the river. Fish muscle tissue and mollusc shell samples were collected from preserved museum specimens. Stable isotope ratios of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) were obtained to determine food web characteristics of the river. Shifts in $\delta^{13}C$ ratios suggest a change in the basal resources of the food chain. There is a slight increase in $\delta^{13}C$ ratios indicating a shift from pelagic to benthic food sources. Between 1900 and 1960 rates of $\delta^{15}N$ increased dramatically for all samples, suggesting that the trophic positions may have shifted higher in the food web. These shifts correlate with the construction of the navigation dams and land use changes over the last 100 yr. Stable isotope ratios of $\delta^{13}C$ and $\delta^{15}N$ have increased over time, and the changes in food web dynamics appear to correlate with anthropogenic disturbances to the river ecosystem.

Keywords: Upper Mississippi River, Food Web, Stable Isotopes, Historical Perspectives, Human Disturbances

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CREATION OF AN INTEGRATED WATERBIRD DATABASE FOR THE UPPER MISSISSIPPI RIVER SYSTEM AND ITS POTENTIAL VALUE

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The Environmental Management Program (EMP) partnership has an interest in the status and trends of waterfowl, shorebirds, and wading birds that use the Upper Mississippi River System (UMRS) throughout the year. Although many waterbird monitoring projects have been undertaken or are ongoing in many areas by state and Federal agencies along the UMR, much of the information was not easily accessible to river managers and biologists who must develop future waterbird management plans and management actions. In collaboration with U.S. Fish and Wildlife Service Region 3 Biologists, we compiled long-term and historical waterbird data collected by National Wildlife Refuges and their cooperators along the UMRS. These data were combined into a single database (Microsoft Access 2003) along with additional abiotic information that might relate to species occurrence or abundance (e.g., geographic location, river mile, area of survey unit, disturbance, etc.). Funding for this work was provided by the Long Term Resource Monitoring Program (LTRMP; a component of the EMP) and the majority of data was generously contributed by the Upper Mississippi River National Wildlife and Fish Refuge, the Mark Twain National Wildlife Refuge Complex, and the Illinois River National Wildlife Refuge Complex. One important benefit of the waterbird database is that it provides an electronic repository for waterbird data collected on the Upper Mississippi River allowing resource managers to create reports or graphs for such things as changes in waterbird numbers over time, species lists, migration phenology, etc. Our primary objective was to summarize the waterbird data to determine if they can be used to track status and trends of various waterbird species or groups of species. The database could also potentially be used to assess the value of UMR management efforts, such as EMP and Habitat Rehabilitation and Enhancement Projects, to migrating and breeding waterbirds. Another possibility is correlating the waterbird data with other LTRMP data (e.g., vegetation, invertebrates) to see if additional trends emerge involving waterbird habitat use on the UMRS. The long-term goals of the LTRMP are to understand the River system, determine resource trends, develop management alternatives, manage information, and develop useful products. While there are currently no long-term plans for maintaining the database, it contains a wealth of information that could contribute to reaching the goals set forth by the EMP and LTRMP if the partners will commit to its support and management.

Keywords: database, National Wildlife Refuge, status and trends, Upper Mississippi River, waterbirds

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MONITORING THE PHYTOPLANKTON COMMUNITY DURING A WETLAND RESTORATION AT TNC'S EMIQUON NATURE PRESERVE, HAVANA, IL.

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A long-term phytoplankton monitoring project is being conducted in conjunction with other monitoring projects (vascular plants, fish, birds, mammals, etc.) as a wetland is restored at The Nature Conservancy's Emiquon Nature Preserve near Havana, IL, on the Illinois River. The area was originally the most productive freshwater fishery in the continental US, but was drained and converted to farmland in the early 1900's by the then owners. TNC purchased the land over 15 years and is now in the process of restoring the wetland. Various monitoring projects are being carried out to determine how the various communities change as the wetland is restored. Water samples from 3 "Thompson Lake" sites, 3 "Flagg Lake sites", and the Illinois River are collected monthly, and the phytoplankton in 1.0 ml are counted and identified to genus (and species, when possible). Data analysis will be preformed to determine if and how the communities change across time.

THE NATURE CONSERVANCY'S EMIQUON PRESERVE: RESETTING AND RESTORING THE THOMPSON LAKE FISH COMMUNITY

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Thompson and Flag lakes, located in Fulton County, Illinois, were historically known as two of the most productive backwater lakes of the Illinois River. In the early 1920's, Thompson and Flag lakes were leveed from the Illinois River, drained, and used for agricultural land. Eighty years later the land was purchased by The Nature Conservancy with plans to restore the lakes to their natural state: a fully functional floodplain labeled the Emiquon Preserve. In the spring of 2007, rotenone was applied in attempts to rid the existing waters of invasive and nuisance fish species. The remnant farm ditches and the newly reformed Thompson Lake were then stocked with desirable fishes by the Illinois Department of Natural Resources following historical accounts of native fishes once present in the lakes. Thus far, 24 fish species have been stocked at the Emiquon Preserve. The Illinois Natural History Survey's Illinois River Biological Station has conducted preliminary fish and aquatic vegetation monitoring on Thompson Lake since its restoration. We used a multiple gear approach to sample the fish population in Thompson Lake from July thru November, 2007. Aquatic vegetation sampling was limited to visual presence/absence and species observations to ensure low levels of disturbance during the first year of restoration. We also collected a total of 1,290 fish comprised of 8 species during this sampling period. Largemouth bass *Micropterus salmoides* contributed to 90% of the total catch with a mean of 376 bass/ hour electrofishing. One invasive species, an individual adult common carp *Cyprinus carpio*, was collected while electrofishing suggesting rotenone survival or unintentional stocking. Future sampling efforts will be intensified by implementing a stratified random sampling approach with supplemental fixed sites. Additional research will include snorkeling surveys to determine fish habitat usage and fish diet analyses to characterize the emerging food web. The information gained from the fish and aquatic vegetation monitoring and supplemental research will help manage and provide future management alternatives regarding restoration efforts.

Keywords: backwater lake, Emiquon Preserve, floodplain, Illinois River, restoration, The Nature Conservancy

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δD AND $\delta^{18}O$ AS TRACERS OF MACROINVERTEBRATE ORIGINS AND MOVEMENTS IN MISSISSIPPI RIVER FLOODPLAIN WATER BODIES

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The stable isotope of hydrogen (D) is a useful tool for discriminating between terrestrial and aquatic contributions to aquatic food webs. δD has also been used in migration studies of terrestrial organisms, and has been proposed for use as a natural marker for assessing fish movement between water bodies with distinct δD signatures. Stable oxygen isotope ratios ($\delta^{18}O$) have proven useful as natural markers in freshwater bivalve shells and in paleoenvironmental studies. We assessed the usefulness of δD and $\delta^{18}O$ for identifying the origins and movements of macroinvertebrates in Mississippi River floodplain water bodies. We sampled water and invertebrates from the Mississippi River, intermittent and permanent floodplain wetlands, and tributaries in the summer of 2007. Results showed consistent relationships between δD and $\delta^{18}O$ signatures in invertebrate tissues and their home water bodies. Results also showed no significant difference in $\delta^{18}O$ ratios of invertebrates with open or closed respiratory systems. Further development of hydrogen and oxygen stable isotopes as tools for assessing the origins of invertebrates will help in quantifying the relative inputs of different habitat types in large river systems to main channel food webs, and may also prove useful for analyses of freshwater food webs in general.

Keywords: Stable Isotopes, Macroinvertebrates, Floodplain Connectivity, Ecological Tracers, Food Webs

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EVALUATION OF THE TOXICITY OF BIOBULLETS AND BIOBULLET DEGRADATION PRODUCTS TO ZEBRA (*DREISSENA POLYMORPHA*) AND BLACK SANDSHELL MUSSELS (*LIGUMIA RECTA*)

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Currently, there is no known effective method to eliminate or prevent zebra mussels (*Dreissena polymorpha*) from colonizing native mussels. There are potential chemical agents that could reduce zebra mussel populations, however, these agents may be toxic to other aquatic organisms and are cost prohibitive due to the immense volume of water contained in natural lakes and streams. Microencapsulation of chemicals that could be selectively toxic to zebra mussels and not harm unionid mussels would be an important tool in controlling zebra mussel infestations on native mussels. A commercially available microencapsulated product termed "BioBullets" has shown promise as an ingestible pellet that is toxic to zebra mussels and breaks down into nontoxic constituents. The BioBullet product has the potential to be used in both natural and industrial environments to control zebra mussels in defined areas. Preliminary research conducted at the Upper Midwest Environmental Sciences Center has generated information on toxicity of BioBullets and its breakdown products to zebra and black sandshell (*Ligumia recta*) mussels in standardized bioassay tests. Ten adult zebra or black sandshell mussels were placed in individual aquaria in a flow-through test system. There were six replicates for each BioBullet and BioBullet degradation solution treatment group (24 aquaria) and three control replicates of each species (6 aquaria). BioBullets were delivered over a 24 hour period to each aquarium by a belt fish feeder. The BioBullet degradation solution was delivered over a 24 hour period by a peristaltic pump to each aquarium. The mortality rate of zebra mussels exposed to BioBullet and BioBullet degradation solution was 65% and 30%, respectively. Black sandshell mussels suffered no mortality in either of the treatments. Black sandshell mussels ingested the BioBullets and expelled the bullets in their pseudo-feces. Zebra mussels ingested the pellets and did not expel the bullets as pseudo-feces. Biobullets appear to have potential as a selective toxicant for removing zebra mussels co-habitating with native mussels. However, further Biobullets toxicity tests should be conducted with other native mussel species and their various life stages.

HISTORICAL PERSPECTIVE PF TROPHIS STRUCTURE OF THE LOWER OHIO RIVER USING STABLE ISOTOPES

Lindsey Rice[1]**,** Michael D. Delong[1], James H. Thorp[2], and Jeffrey R. Anderson[3]

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[3]Large River Studies Center, College of Science and Engineering, Winona State University, Winona, MN 55987

Most recently have we seen and studied the profound effects humans have on ecosystems. The lower Ohio River ecosystem has been vastly influenced by the actions of humans (locks and dams, agricultural runoff, and urban/industrial discharge) for decades. This study is an in-depth examination to determine how and to what extent human disturbances have affected riverine trophic positions and length of food chain of the lower Ohio River. Museums contain specimens (fish, freshwater snails, and freshwater mussels) from present to historic time periods and we can use tissue from these specimens to identify changes in stable isotope ratios of carbon and nitrogen in order to help determine changes/shifts in trophic levels. The nitrogen ratio increased around 1970 for piscivores but stayed rather consistent for the other trophic positions. Carbon stable isotope ratios slowly decreased from 1920 to 2000. Trends in both nitrogen and carbon stable isotope ratios may be correlated with human disturbances and its effect on the river's natural ecosystem. The data collected will not only address the extent of the changes in the ecosystem/food webs, but may also give consideration as to if the river's ecosystem is past the point of rehabilitation.

Keywords: food web, stable isotope, food chain, disturbance, temporal

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NITRATE UPTAKE IN A VEGETATED BACKWATER LAKE IN THE UPPER MISSISSIPPI RIVER: RESULTS OF IN SITU CHAMBER EXPERIMENTS WITH ADDITIONS OF $^{14}NO_3^-$ AND $^{15}N\text{-}NO_3^-$ TRACER.

William Richardson[1], [1]Rebecca Kreiling, [1]Lynn Bartsch, [2]Jennifer Cavanaugh, [3]William James and [4]Eric Strauss

[1]US Geological Survey Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Rd., La Crosse, WI
[2]US Department of Agriculture Natural Resource Conservation Service, St. Peter, MN
[3]US Army Corps of Engineers Eau Galle Limnological Research Center, Spring Valley, WI
[4]University of Wisconsin, Department of Biology, Rivers Studies Center, La Crosse, WI

Backwater lakes of floodplain rivers are active sites for nitrate removal through bacterial denitrification, assimilation by bacteria, periphyton, and macrophytes, and possibly burial. Recent research has shown bacterial denitrification to be an important contributor to nitrate retention (loss) in the carbon-rich backwaters of the Upper Mississippi River (UMR) – particularly in carbon-rich backwaters. Denitrification in backwaters tends to be limited by the delivery of nitrate from nitrate-rich main channels; high, post flood nitrate concentrations in backwaters decline to near non-detectable levels in a matter of weeks. The role of macrophytes and associated periphytic communities in the mass balance of nitrogen is poorly understood in these habitats.

To improve our understanding of the role of macrophytes in nitrogen cycling, we conducted two sets of *in situ* chamber experiments (n=8) in Third Lake of the Pool 5 Finger Lakes complex. We added both $^{14}NO_3^-$ (4 concentrations from 0 to 7.5 mg $\cdot L^{-1}$) and a stable isotope of nitrate ($^{15}N\text{-}NO_3^-$, chambers enriched to δ5000) to determine nitrate uptake rate and the biological uptake compartment (sediment, macrophyte, epiphyton, or water column). Experiments were conducted in late June and late July in 2005, under contrasting water temperature and rates of nitrate loading. Independent estimates of sediment denitrification and nitrification were conducted just prior to the chamber experiments.

We estimated NO_3^- uptake by vegetation (primarily *Ceratophyllum*) as 168, epiphyton as 16.5, and sediment 4.2 mg-N $\cdot m^{-2} \cdot d^{-1}$. NO_3^- uptake rates in control chambers were then averaged over the two experiments and extrapolated over the area of backwater covered with macrophytes to determine lake-wide NO_3^- uptake by macrophyte beds. The total uptake by macrophyte beds in Third Lake was 206.2 mg-N $\cdot m^{-2} \cdot d^{-1}$, and was extremely close (74 %) to that estimated by James et al. 2007 using mass-balance techniques. These two independent estimates of nitrate retention in floodplain river backwaters show 1) the importance of macrophytes for nitrate retention relative to sediments, and 2) that aquatic vegetation is critical for N retention during the growing season when much of the N transport occurs. What is less well understood are the N loss processes occurring during macrophyte decomposition and remineralization following autumnal senescence.

Keywords: nitrate uptake, biogeochemistry, macrophytes, periphyton, sediment, backwater lakes, $^{15}N\text{-}NO_3^-$ tracer, chamber experiment, mass-balance

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INVESTIGATING THE FACTORS MODULATING SPECIES INVASIONS AND DISEASE OUTBREAKS IN THE UPPER MISSISSIPPI RIVER

Gregory J. Sandland and Benjamin A. Walker

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Aquatic invasive species are rapidly altering the structure of native communities across North America, which has important consequences for species diversity, conservation policy, and ultimately, national economics. One of the key hotspots for aquatic invasions has been the Great Lakes system where over 50 species have been introduced over the last 30 years. *Bithynia tentaculata* is an invasive aquatic snail that has recently spread from the Great Lakes into the Upper Mississippi River. Range expansion has generated 2 disconcerting patterns in the river: First, the snails appear to dominate the mollusk community, and second, the snail transmits exotic parasites that kill waterfowl by the thousands. Unfortunately, even though *B. tentaculata* and its parasites are directly disrupting general ecosystem stability and economics in the Upper Midwest, little is actually known about the factors responsible for snail colonization and parasite transmission. Using a series of field surveys, semi-natural experiments and laboratory manipulations we are attempting to 1) determine how competition and infection influence *B. tentatculata* establishment, and 2) understand the role that other aquatic species play in transmitting these exotic parasites to birds. Preliminary data suggest that native aquatic species may be extremely important in exotic parasite persistence and transmission to waterfowl. Results from this research will instrumental in the development of management models aimed at curbing the spread of this invasive host-parasite association.

Keywords: *Bithynia tentaculata,* competition, infection influence, Upper Mississippi River, parasite transmission, waterfowl

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A TURTLE COMMUNITY ON 9-MILE ISLAND IN THE UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE

Phylicia B. Schwartz, Jeremy W. Meyer, Alan R. Butler, Matthew O'Brien, Frances A. Eggers, and Gerald L. Zuercher

Department of Natural and Applied Sciences, University of Dubuque, 2000 University Avenue, Dubuque, IA 52001.

We live-trapped river turtles on 9-Mile Island in Pool 12 of the Mississippi River as part of a larger river turtle assessment project. We captured 58 individuals representing five species during our study: 43 *Chrysemys picta* (painted turtle), 10 *Graptemys geographica* (common map turtle), 2 *Chelydra serpentine* (snapping turtle), 2 *Apalone spinifera* (spiny softshell turtle), and 1 *Trachemys scripta* (red-eared slider). The majority of captured *C. picta* were adult males (58%) followed by adult females (30%) and juvenile males (12%). Despite maintaining traps in the same locations, we were successful in recapturing only 2 *C. picta* during the course of our study. The successful capture of an adult male *T. scripta* is noteworthy. The presence of *T. scripta* in this year's sample argues that future sampling should be done in an effort to document a possible range expansion as well as temporal changes in river turtle community structure. We will provide a summary of our results and compare morphological data between adult male, adult female, and juvenile male *C. picta*.

Keywords: *Apalone spinifera*, *Chelydra serpentina*, *Chrysemys picta*, Iowa, Mississippi River

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WATER CHEMISTRY MONITORING ON UPPER CATFISH CREEK, MANAGING FOR WATER QUALITY.

Bethany Bohnsack[1], Oliver deSilva[1], Frances Eggers[1], Kayleen Keehner[1], Matthew O'Brien[1], William O'Brien[1], Tanner Rickertsen[1], Andrew Satterlee[1], Phylicia Schwartz[1], Mikaela Tully[1], **Mark Sinton**[1], and Eric Schmechel[2]

[1]Department of Natural and Applied Sciences, University of Dubuque, Dubuque, IA 52001
[2]Dubuque Soil and Water Conservation District, Epworth, IA 52045.

Over the past few years, local officials have noted an increase in flash flooding on Catfish Creek (a tributary that runs through the City of Dubuque, and enters the Mississippi) and a decrease in water quality. The headwaters of Catfish Creek, which once supported a naturally reproducing brook trout population, (classified as a cold-water stream) has degraded to the point it can no longer sustain a healthy population. Dubuque has grown rapidly over the past few decades, thus increasing runoff, sedimentation, and non-point source pollution, all believed to be causes of the degrading water quality in Catfish Creek. This past fall, students identified 8 different transects along Catfish Creek to start monitoring water quality. Students would take samples of Catfish Creek every other week. Along with performing IOWATER monitoring at each site, students took 2 samples (from each site) and returned to the University of Dubuque's chemistry lab for further analysis. Students researched 5 different parameters including: Total Suspended Solids (TSS), Water ($CaCO_3$) Hardness, Metals, Organics, and Phosphates. After identifying and comparing data throughout the watershed, students presented on the water quality of Catfish Creek, causes for impairment, and methods or practices that could be implemented to help clean and restore the Upper Catfish Creek Watershed.

Keywords: Catfish Creek, Water-Quality, Chemical Analysis, Trout, Cold-Water

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SEASONAL FLUCTUATIONS IN PLASMA STEROID CONCENTRATIONS, EGG DIAMETERS, AND GONADAL STAGE IN SHOVELNOSE STURGEON

Michael T. Stahl, Anita M. Kelly and Gregory W. Whitledge

Department of Zoology, Fisheries and Illinois Aquaculture Center, Southern Illinois University, Carbondale, IL 62901.

Fishing pressure on shovelnose sturgeon *Scaphirhynchus platorynchus* in the Mississippi River drainage basin has increased substantially as a result of the importation ban of beluga sturgeon caviar into the U.S. and high caviar prices. Knowledge of seasonal changes in reproductive status would be valuable for shovelnose sturgeon management, but temporal variation in blood steroids and vitellogenin (VTG; an egg protein precursor) have not been examined in middle Mississippi River shovelnose sturgeon. The objective of this study was to determine whether egg diameters and blood steroid and VTG concentrations differ among months and fish ages for shovelnose sturgeon captured from the middle Mississippi River. Shovelnose sturgeons were harvested monthly from the middle Mississippi River between river miles 77 and 125 from October 2005 to February 2007. Physical analyses of harvested sturgeon consisted of measuring length and weight, collecting blood and female gonad samples, and pectoral spines for aging. Plasma steroid concentrations (17β-estradiol (E_2) and testostosterone (T)) were determined by radioimmunoassay (RIA), while VTG concentrations were determined using ELISA. Oocyte diameter and number were recorded from gonad sub-samples and polarization indices were calculated for mature black eggs. Mean fecundity for black egg females was 20277 ± 7570 eggs and increased with fish age. Oocyte diameters increased with reproductive stage, fish size, and age. Shovelnose sturgeon ≤ age 8 had uniformly low hormone concentrations, while fish ≥ age 9 exhibited a broad range of blood steroid concentrations, indicating that maturity likely occurs at around age 9. Plasma estradiol and testosterone concentrations peaked in April and October, while plasma VTG concentrations peaked during March and September. These results are consistent with previous studies which indicated that female sturgeon may spawn during spring and fall in the middle Mississippi River.

Keywords: Mississippi River, Shovelnose Sturgeon, Sex Hormones, Vitellogenin, Oocytes

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PARTNERSHIP IMPROVES REGIONAL DISPOSAL OF UNWANTED MEDICATIONS.

Mark Steingraeber[1], Joseph Kruse[2], and Jeff Gloyd[3]

[1]U.S. Fish and Wildlife Service, National Fish and Wildlife Conservation Office, Onalaska, WI 54650
[2]Mayo Health System, Franciscan Skemp Healthcare, La Crosse, WI 54601
[3]La Crosse County Solid Waste Department, Hazardous Materials Program, La Crosse, WI 54601

In western Wisconsin, representatives of the U.S. Fish and Wildlife Service, Mayo Health System, Gundersen Lutheran Health System, and La Crosse County met early in 2007 to discuss the need to establish a safe and effective means for county residents to dispose of unwanted medications. This diverse team developed a plan for a medicine turn-in program that would utilize the infrastructure and compliment the services of an existing county-operated facility that accepts unwanted household hazardous materials (HHM) from residents and businesses, at little or no cost, throughout the year. This HHM service is also provided to others in southwest Wisconsin, southeast Minnesota, and northeast Iowa. The County Board of Supervisors unanimously approved the plan and authorized HHM staff, in cooperation with the Sheriff's Department, to develop and implement a medication collection and disposal program that: meets local, state, and federal regulations; uses an environmentally sound means to dispose of collected medications; and operates on a permanent basis. The sheriff subsequently deputized four HHM employees with the authority to accept and dispose of unwanted medications, including controlled substances. Deputized staff began to accept medications at the HHM facility on 1 June. The program filled seven 55-gallon drums with 2,180 pounds of bulk medications for disposal in its first three months of operation and collected more than 2.5 tons of unwanted medications by years' end. La Crosse County HHM staff also served as the disposal vendor at one-day medicine collections for residents of six nearby Wisconsin counties during 2007 and plan to expand this service to residents of Houston County, Minnesota, in 2008. This is the first permanent medication collection program in Wisconsin and one of only a few in the nation. The noteworthy success of this recently established program presents a model for the development of similar partnerships to raise awareness of the need to safely collect and dispose of unwanted medications in other portions of the country.

Keywords: medications, collection, disposal, partnership, household hazardous materials

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FISH POPULATION DYNAMICS OF ANNUALLY-FLOODED SEASONALLY-ISOLATED BACKWATER LAKE OF THE ILLINOIS RIVER

Matt Stroub and Greg G. Sass

Illinois River Biological Station, Illinois Natural History Survey, 704 N. Schrader Avenue, Havana, Illinois 62644

Connectivity and isolation from rivers may be major drivers of fish community composition in backwater lakes. Matanzas Lake is a seasonally-isolated backwater lake of the La Grange reach of the Illinois River. Matanzas Lake was flooded and connected to the Illinois River from late February to mid-May, 2007. From mid-May to present, Matanzas Lake has been isolated from the Illinois River. Weekly, we used a multiple-gear approach to sample the fish community of Matanzas Lake both pre- and post-isolation from the Illinois River. We used single and tandem fyke nets, trammel nets, experimental gill nets, and day electrofishing at fixed sites to assess the fish community of Matanzas Lake over time. All fish captured were identified to species, measured, and weighed. Basic water quality information (e.g. water temperature, dissolved oxygen) was also collected at all fixed sites on each sampling date. Our objectives were threefold: 1) to test for differences in fish species community composition and catch rates from Matanzas Lake pre- and post-isolation from the Illinois River; 2) to test for differences in fish species diversity among the La Grange Reach of the Illinois River and Matanzas Lake; and 3) to identify unique fish species to Matanzas Lake. Electrofishing catch rates of the ten most common fishes, except emerald shiner *Notropis atherinoides Rafinesque*, were greater during isolation from the Illinois River. Eight of ten fish species showed statistically greater electrofishing catch rates. Fish species diversity of Matanzas Lake in 2007 was greater than the 17 year LTRMP fish species diversity average of the La Grange reach of the Illinois River. There was also six species of fish that we considered unique to Matanzas Lake, orange spotted sunfish *Lepomis humilis,* grass pickerel *Esox americanus vermiculatus,* mooneye *Hiodon tergisus,* Yellow Bass *Morone mississippiensis*, red shiner *Notropis lutrensis and* green sunfish x bluegill. We are uncertain if conductivity to the main stem river has affect on the fish diversity and fish community of these important backwater lakes.

MINUTES OF THE 2007 BUSINESS MEETING
ANNUAL MEETING OF THE MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.

13 April 2007

President Chick called the business meeting to order at 2:10 PM. In attendance were Brian Ickes (Vice President), Robert Miller (Secretary), Neal Mundahl (Treasurer), and 60 members of the Consortium.

President's Report

Student Travel Stipends
President Chick presented travel stipends of $200??? to Jeff Koch of Iowa State University, Alexander Levchuk of the Illinois Natural History Survey, and Jonathan Remo of Southern Illinois University.

Recognition of Junior Poster Participants
President Chick, Randy Hines, and Jeff Hansen honored the students from Longfellow Middle School for their participation in the junior poster session.

Acknowledgements
President Chick presented a plaque and honorarium to the keynote speaker, Dr. Richard Sparks. Thanks were extended to Georgina Ardinger and Cammy Smith for their efforts in meeting registration; to Terry Dukerschein for conducting the raffle and securing raffle donations; to Tom Claflin for donating a custom fishing rod; to Sara Lubinski for donating a pastel portrait of Brownville, MN boathouses; and to the many Consortium members who donated their talents and additional raffle prizes. President Chick also acknowledged the help of audiovisual support from the Upper Midwest Environmental Sciences Center, and expressed appreciation for the work of judges and moderators. President Chick thanked Randy Hines and the staff of Longfellow Middle School for organizing and conducting the junior poster session.

Minutes
President Chick asked if there were any corrections to be made to the minutes of the 2006 meeting as presented in the 39th Annual Proceedings. Under Acknowledgements, David Kennedy made a donation of decoys; however David's name was misspelled. A motion to approve the minutes as corrected was made by M. Delong, seconded by B. Richardson, and passed by the members present.

Meeting Attendance
President Chick announced that the official meeting attendance for 2007 was 114 registrants, slightly higher than the 108 in 2006. He noted a large increase in the number of platform presentations, from 19 to 35. He commended the varied and stimulating program presented during the meeting.

Awards
President Chick presented the award for best student platform presentation to Alexander Levchuck of the Illinois Natural History Survey, Great Rivers Field Station, Brighton, IL. He presented the award for best student poster presentation to Deepshika Ramanan of Winona State University, Winona, MN.

Treasurer's report
President Chick called attention to the report submitted by Treasurer Neal Mundahl as listed on page 77 of the Proceedings. As the report shows, funding for the Consortium is holding steady. A motion to accept the Treasurer's report was made by M. Romano, seconded by T. Newton, and passed by the members present.

Old Business

Annual Meeting Dates
Future Dates for the annual meeting will be April 24 and 25 in 2008 at the Grand River Center in the Port of Dubuque, IA; April 30 and May 1, 2009, and April 22 and 23, 2010 at the Radisson Hotel in La Crosse, WI. The Board will attempt to schedule the 2011 and 2012 meetings at the Radisson in La Crosse also.

Update on the 2008 Meeting in Dubuque
Secretary Miller reported on arrangements that have been made for the 40th Anniversary Annual Meeting that will be held April 24 & 25, 2008 in Dubuque, IA. The main location, where sessions will meet, is the Grand River Center in the Port of Dubuque. Thursday night's banquet will be held at the National Mississippi River Museum and Aquarium in the Port, where behind-the-scenes tours of rearing and holding areas are being arranged. A block of rooms at special rates has been reserved at the Grand Harbor Resort and Waterpark, which is attached to the Grand River Center. A local arrangements committee, chaired by Secretary Miller, is finalizing details. Following a discussion at which members expressed strong support for the Dubuque meeting, a short audiovisual presentation on the Museum was shown.

President Chick asked for old business items from the floor and none was brought forth.

New Business

Trailblazer Award
President Chick introduced Mary Schaefer, Deputy Secretary of the Wisconsin DNR, who presented a Governor's Trailblazer Award to member Marian Havlik on behalf of Wisconsin Governor Jim Doyle. The award cited Marian Havlik's many years of operating a river-based company and her authorship of hundreds of papers and reports. Her accomplishments as an entrepreneur were noted as representing improvements in economics for women in Wisconsin. In accepting the award, Marian expressed delight in the progress that has been made and excitement about the potential of new research that is being conducted.

International Society for River Science
President Chick called on Mike Delong to report on the new society. Mike noted a 30-year history of holding triennial Great Rivers meetings, and pointed out that this led to the formation of the society, in which scientists from 6 continents take part. The first issue of the society's journal was published this year. Jim Thorp is serving as the society's first president. The International Society for River Science plans to hold meetings on each continent; the next will be in June 2009 in St. Petersburg, Florida.

40th Anniversary Special Publication
President Chick asked Susan Romano to speak about progress being made on the publication, which was called for at the 2006 meeting. The Board has asked Susan to serve as editor of the publication.

Susan reported that the current plan is to review research that has been presented at MRRC meetings. A working group of experts from within the Consortium membership have been asked to contribute papers on specific areas of research. The assembled papers will inform current members regarding research progress that has been made during the years that the Consortium has existed. Each author will also present at the Anniversary meeting in Dubuque. The idea of publishing the papers in a specific journal is being actively pursued.

Executive Board Nominations and Election of Officers

President Chick noted that Brian Ickes would become the President of the MRRC. Neal Mundahl has agreed to continue as Treasurer, and the Executive Board has nominated Roger Haro for Vice President. President Chick asked for additional nominations from the floor and none were offered. A motion to elect the individuals nominated for office was made by Ken Lubinski and seconded by Mike Delong. The members present elected Roger Haro Vice President unanimously.

In accordance with MRRC bylaws, President Chick turned the meeting over to the new President, Brian Ickes.

President Ickes presented Dr. Chick with a plaque commemorating his year of service as the President of the MRRC. Dr. Chick graciously accepted the plaque.

Other New Business

President Ickes introduced the topic of special symposia to be held jointly with MRRC annual meetings. Specifically, a focus on the Long Term Resource Monitoring Program (LTRMP) was suggested at the 2008 meeting as an appropriate subject for a symposium. Jeff Houser made the point that a focus on scientific topics is preferable to a focus on programs for symposium topics, and there seemed to be support among the members present for that position, recognizing that the LTRMP is represented very well by research presented at MRRC meetings. President Ickes suggested withdrawing the idea of an LTRMP symposium, and the members agreed. Mike Delong called for other ideas for future symposia.

Marion Havlik suggested an official from the Mayo Clinic in Rochester, MN as a prospective keynote presenter in 2008. She described the important environmental work sponsored by the Mayo brothers, specifically the support of a unique population of "giant" Canada geese that survives in Minnesota lakes. President Ickes stated that this would be considered for a keynote speaker at a future meeting.

Neal Mundahl announced that Winona State University would host a meeting of the North American Prairie Conference in August of 2008. The 5-day meeting will include many field trips, and its theme is "The Prairie Meets The River".

Ken Lubinski suggested posting PowerPoint presentations from MRRC meetings on the MRRC Website.

Marion Havlik asked about scanning in abstracts from all previous MRRC Proceedings to the Website.

With no other items of new business coming forth, President Ickes entertained a motion to adjourn made by John Chick and seconded by Mike Delong. The motion passed unanimously and President Ickes adjourned the 2007 business meeting of MRRC at approximately 3PM.

MISSISSIPPI RIVER RESEARCH CONSORTIUM
TREASURER'S REPORT
SUBMITTED BY NEAL D. MUNDAHL (1 MARCH 2008)

Accounts as of 30 June 2005			$10,911.21
Accounts as of 30 June 2006			$10,806.29
Transactions, 1 July 2006 to 30 June 2007			
INCOME			
	2007 Registration and dues	6019.50	
	2007 Raffle proceeds	1178.00	
	2007 T-shirt sales	191.00	
	Interest	11.91	
Total		7400.41	
EXPENSES			
	Radisson Hotel - 2007 meeting	5212.53	
	2007 Proceedings	679.95	
	2007 Raffle prizes	175.00	
	2007 Awards	150.00	
	2007 Student Travel Awards	565.00	
	T-shirts	169.00	
	Postage, mailing, supplies	241.41	
	Corporation fee	10.00	
Total		7202.89	
Accounts as of 30 June 2007			$11,003.81
Transactions, 1 July 2007 to 1 March 2008			
INCOME			
	Interest	6.02	
Total		6.02	
EXPENSES			
	Corporation fee	10.00	
Total		10.00	
Accounts as of 1 March 2008			$10,999.83
Accounts			
	Checking account	5028.31	
	Savings account	5971.52	
		10999.83	

MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.

BUSINESS MEETING AGENDA

25 April 2008, 1:50 PM
Grand Harbor Resort, Dubuque, Iowa

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1. Call to Order

2. President's Report

   - Acknowledgments
   - Approval of 2007 minutes and Proceedings
   - 2008 attendance/participation growth information
   - Awards

3. Treasurer's Report – N. Mundahl in *absentia*

4. Old Business

   - Future Meeting Dates
   - 2009 Meeting in La Crosse, WI

5. New Business

   - Conference sponsored by the National Great Rivers Research and Education Center in August 2009 – J. Chick
   - New river resources available (MN DNR Stream Habitat Program)– A. Childers in *abstentia*
   - 40th Anniversary Special Publication update – S. Romano
   - Executive board nomination
   - Election of officers
   - Passing of the Presidency
   - Other new business

6. Adjournment

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.

BYLAWS OF THE MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.

ARTICLE I: NAME, PURPOSES AND DUTIES

1.01 Incarnation
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, 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 Purpose
The purposes of the organization shall be as follows:

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

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

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

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

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

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

ARTICLE 2: OFFICES

2.01 Principal and Business Offices.
The corporation may have such principal and other offices, either in or out of the State of Wisconsin as the Board of Directors may designate or as the business of the corporation may require from time to time.

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

ARTICLE 3: OFFICERS AND BOARD OF DIRECTORS

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

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

3.03 Removal From Office.
Any officer may be removed by the Board of Directors whenever in its judgment the best interests of the corporation shall be served thereby, but such removal shall be made without prejudice to the contract rights of any person so removed. Election or appointment shall not of itself create contract rights. An officer may be removed from office by affirmative vote of a majority of the Board of Directors, taken at a meeting by the Board of Directors for that purpose. A director may resign at any time by filing a written resignation at the registered office. Any officer who is absent from three (3) consecutive meetings of the Board shall, unless excused by action of the Board, cease to be a member of the Board of Directors and shall be removed forthwith.

3.04 Meetings.
The Board of Directors shall meet on the times and dates to be established by them but at least once during the annual meeting. Meetings of the Board of Directors may be called by or at the request of any officer. The president or secretary may fix the place of the meeting and if no other place is designated or fixed the place of the meeting shall be at the principal business office of the corporation

in the State of Wisconsin. Telephone conference calls can be used in place of regular meetings except during the annual meeting.

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

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

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

3.08 Vacancy.
Any vacancy occurring in the Board of Directors because of death, resignation, removal, disqualification, or otherwise shall be filled as soon as possible by the majority action 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 and compensate and give directives to an executive officer. Said executive director shall not be considered as a member of the Board of Directors.

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

(a) Act as chairperson of the Board and of any executive committee,
(b) Appoint all committees unless otherwise specified by the Board,
(c) Be executive on behalf of the Board of all written instruments except as provided or directed by the Board,
(d) Be responsible for the agenda to be used at the meeting,

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

The vice-president shall:

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

The secretary shall:

(a) Keep the minutes of the meetings of the Board,
(b) See to it that all notices are fully given in accordance with the provisions of the bylaws,
(c) Be custodian of the records of the Board,
(d) Perform all duties incident to the office of the secretary of the Board, and such other duties as from time to time may be assigned by the president of the Board.

The treasurer shall:

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

3.11 Other Assistance to Acting Officers.

The Board of Directors shall have the power to appoint any person to act as an assistant to any officer, or agent for the corporation in his stead, or to perform the duties of such officer when for any reason it is impractical for such officer to act personally, and such assistant or acting officer or other agent so appointed by the Board of Directors shall have the power to perform all of the duties of the office to which he or she is so appointed to be assistant or 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 is 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 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 except in situations when the Board identifies an alternative location for special occasions. The time of the meeting shall be established by the Board of Directors and announced at the previous annual meeting. Reports of officers and committees shall be delivered at the meeting. The Board of Directors shall be elected from those individuals nominated by the Nominating Committee and those nominated from the floor with prior consent of the nominee. All persons attending the annual meeting shall be required to pay membership dues for that year and be a member of the organization in order to participate. Notice of the annual meeting shall be sent in writing to all members.

6.01a. *Keynote Speaker* - The Board of Directors shall invite a keynote speaker to address the membership at each annual meeting. A 60 minute time slot shall be allocated for the keynote speaker's address, including a question and answer period.

6.01b. *Student Travel Awards* - The Board of Directors shall advertise for and select graduate and undergraduate students for travel awards for attending the annual meeting and presenting a platform presentation. Criteria of selection of students for the awards shall be based on academic achievements and the scientific contribution of the student's project to the field of river ecology. The number of awards provided shall be determined each year based on the applicant pool and annual budget.

6.01c (draft). *Special symposia* - The Board of Directors may advertise and assemble special symposia within the annual conference program with the following limitations: a) symposia shall not be scheduled concurrently with standard conference sessions; b) symposia shall not exceed ½ day within the annual conference program; c) symposia subject matter shall be proposed by the Board to the membership 1 year or more in advance; and d) the membership must move to adopt the proposal and vote in majority favor of the proposal.

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

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

Meeting	Year	Location	President
1st	1968*	St. Mary's College, Winona, 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. Joesph 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
			Board of Directors
15th	1982	Radisson Hotel, La Crosse, WI	Dr. Richard Anderson Dr. Dave McConville Dr. Jim Wiener

Meeting	Year	Location	Board of Directors
-----	1983	No Meeting	----------
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
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 Holland Dr. Mike Winfrey
20th	1988	Univ. of Wisconsin-La Crosse, La Crosse, WI	Mr. John Pitlo Mr. Verdel Dawson Dr. Nani Bhowmik
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

Meeting	Year	Location	Board of Directors
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 Resorts, La Crosse, WI	Mr. Mark Steingraeber Dr. Melinda Knutson Dr. William Richardson Dr. Neal Mundahl
31st	1999	Yacht Club Resorts, La Crosse, WI	Dr. Melinda Knutson Dr. Richard Anderson Mr. Brent Knights Dr. Neal Mundahl

Meeting	Year	Location	Board of Directors
32nd	2000	Radisson Hotel, La Crosse, WI	Dr. Richard Anderson Dr. Yao Yin Mr. Brent Knights Dr. Neal Mundahl
33rd	2001	Radisson Hotel, La Crosse, WI	Dr. Yao Yin Mr. Brent Knights Dr. Michael Romano Dr. Neal Mundahl
34th	2002	Radisson Hotel, La Crosse, WI	Mr. Brent Knights Mr. Jeff Arnold Dr. Michael Romano Dr. Neal Mundahl
35th	2003	Radisson Hotel, La Crosse, WI	Dr. Michael Romano Mr. Jim Fischer Dr. Neal Mundahl
36th	2004	Radisson Hotel, La Crosse, WI	Dr. Michael Romano Dr. Mark Pegg Mr. Jim Fischer Dr. Neal Mundahl
37th	2005	Radisson Hotel, La Crosse, WI	Dr. Mark Pegg Dr. Michael Delong Mr. Lynn Bartsch Dr. Neal Mundahl
38th	2006	Radisson Hotel, La Crosse, WI	Dr. Michael Delong Dr. John Chick Mr. Lynn Bartsch Dr. Neal Mundahl
39th	2007	Radisson Hotel, La Crosse, WI	Dr. John Chick Mr. Brian Ickes Dr. Robert Miller Dr. Neal Mundahl

Meeting	Year	Location	Board of Directors
40th	2008	Grand River Center, Dubuque, IA	Mr. Brian Ickes Dr. Roger Haro Dr. Robert Miller Dr. Neal 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.

ACKNOWLEDGMENTS 2008

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Local Meeting Arrangements, Meeting Announcements, and Mailings

Georginia Ardinger, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

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

Roger Haro, University of Wisconsin, La Crosse, Wisconsin

Robert Miller (Retired), University of Dubuque, Dubuque, Iowa

Chelsea Ulm, University of Wisconsin, La Crosse, Wisconsin

Dave Bierman, IA DNR, Bellevue

Andrea Bixler, Clarke College, Dubuque

Tom Boland, IA DNR(Retired), Dubuque

Dan Call, U.of Dubuque, Dubuque

Mike Steuck, IA DNR, Bellevue

Program and Proceedings

Roger Haro, University of Wisconsin, La Crosse, Wisconsin

Brian S. Ickes, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Robert Miller (Retired), University of Dubuque, Dubuque, Iowa

Registration Table

Georginia Ardinger, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Cammy Smith, Illinois Natural History Survey, Havana, Illinois

T-shirt Logo Design

Heidi Imker, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Visual Aids, Poster Arrangements, and Awards

Ben Schlifer, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Richard Anderson, Western Illinois University, Macomb, Illinois

Michael Romano, Western Illinois University, Macomb, Illinois

Robert Miller (Retired), University of Dubuque, Dubuque, Iowa

Pam Thiel, U.S. Fish and Wildlife Service, Onalaska, Wisconsin

Sales and Arrangements (Raffle and T-shirt)

Terry Dukerschein, Wisconsin Department of Natural Resources, La Crosse, Wisconsin

Georginia Ardinger, 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

Becky Kreiling, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Robert Miller (Retired), University of Dubuque, Dubuque, Iowa

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

Website

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

Platform Session Moderators

Greg Sass, Illinois River Biological Station, Illinois Natural History Survey, Brighton, Illinois

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

Jennifer Sauer, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Eric Strauss, University of Wisconsin, La Crosse, Wisconsin

Ron Rada, University of Wisconsin, La Crosse, Wisconsin

Museum Tours

Lee Jackson, National Mississippi River Museum and Aquarium, Dubuque, Iowa

Banquet Facilities

National Mississippi River Museum and Aquarium, Dubuque, Iowa

Photography

Terry Dukerschein**, Wisconsin Department of Natural Resources, Onalaska Field Station, Onalaska, Wisconsin**

Georgina Ardinger, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

Raffle and Silent Auction Prizes

Tom Claflin, T.O.C. Fishing Rods, **La Crosse, Wisconsin, 54601**

Sarah Jahn, Fossil, Inc., Dallas/Fort Worth, Texas

Dave Bosanko, University of Minnesota, Isanti, Minnesota

Terry Dukerschein**, Wisconsin Department of Natural Resources, Onalaska Field Station, Onalaska, Wisconsin**

Vacationland, Durango, IA

Hawkeye Boat Sales, Dubuque, IA

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