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PROCEEDINGS OF THE MISSISSIPPI RIVER RESEARCH CONSORTIUM

VOLUME 41

MISSISSIPI RIVER RESEARCH CONSORTIUM, INC.

41st ANNUAL MEETING
30 APRIL – 1 MAY 2009
RADISSON HOTEL
LACROSSE, WISCONSIN

2008-2009 Board of Directors

Contents

PLATFORM PROGRAM
RADISSON HOTEL
THURSDAY, APRIL 30, 2009

7:50 – 8:00 AM Welcome and Announcements – **Roger Haro**, MRRC President

SESSION I – LANDSCAPE ECOLOGY AND LIMNOLOGY (Moderator: Nathan De Jager)

8:00 – 8:20 AM AN AUTOMATED LAND COVER CLASSIFICATION USING AERIAL PHOTOGRAPHS, LIDAR DATA AND SOILS DATA FOR TWO AREAS OF THE UPPER MISSISSIPPI RIVER

Cynthia Berlin[1] and Jennifer J. Dieck[2]. [1] Department of Geography and Earth Science, University of Wisconsin-La Crosse, La Crosse, WI 54601. [2] U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603.

8:20 – 8:40 AM PRELIMINARY ANALYSIS OF LAND COVER TRANSITIONS WITHIN SELECTED BACKWATER AREAS OF THE UPPER MISSISSIPPI RIVER FROM 1989 TO 2000

Joseph M. Riebe, J.C. Nelson, and Robin W. Tyser. Department of Biology, University of Wisconsin-La Crosse, 725 State Street, La Crosse, WI 54601.

8:40 – 9:00 AM EMERGING TECHNOLOGIES IN SPATIAL DATA COLLECTION AND PRODUCTION

Larry Robinson and Jennifer Dieck. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603.

9:00 – 9:20 AM SPATIAL GENETIC STRUCTURE OF PIN OAK POPULATIONS ALONG THE UPPER MISSISSIPPI RIVER

Brett Shreiner, Susan Romano, and Michael Romano. Western Illinois University, Macomb, IL 61455.

9:20 – 9:40 AM ECOSYSTEM METABOLISM IN THE UPPER MISSISSIPPI RIVER: THE ROLE OF LIGHT, NUTRIENTS, AND CONNECTIVITY TO THE MAIN CHANNEL

Jeffrey N. Houser[1], Lynn A. Bartsch[1], John F. Sullivan[2], William B. Richardson[1], and Brent C. Knights[1]. [1]USGS Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603. [2]Wisconsin Department of Natural Resources, 3550 Mormon Coulee Road
La Crosse, WI 54601.

9:40 – 10:00 AM USE OF IMAGING SPECTROSCOPY FOR WATER QUALITY ASSESSMENT OF THE MISSISSIPPI RIVER AND ITS MAJOR TRIBUTARIES IN MINNESOTA

Leif G. Olmanson[2,3], Marvin E. Bauer [2,3], and Patrick L. Brezonik [1]. Departments of Civil Engineering[1] and Forest Resources[2], and Remote Sensing and Geospatial Analysis Laboratory[3], University of Minnesota, 1530 Cleveland Avenue N. St. Paul, Minnesota, USA 55108.

10:00 – 10:20 AM **BREAK**

SESSION II – HUMAN DIMENSIONS AND MUSSELS (Moderator: Greg Sass)

10:20 – 10:40 AM A STUDY OF THE GENERAL PUBLIC'S PERCEPTIONS AND OPINIONS OF THE POOL EIGHT HABITAT PROJECT IN STODDARD WISCONSIN
Beth Flynn. Augustana College, Department of Geography, 639 38th St., Rock Island, IL 61201.

10:40 – 11:00 AM A MUSSEL SURVEY AND TRANSLOCATION IN THE IOWA RIVER, IOWA CITY, IOWA, SEPTEMBER 2006 AND 2007
Marian E. Havlik. Malacological Consultants, 3412 Levy Lane, La Crosse, WI 54601.

KEYNOTE PRESENTATION

11:00 – 11:50 AM USING FISH ASSEMBLAGES TO ASSESS THE ECOLOGICAL HEALTH OF THE UPPER MISSISSIPPI RIVER
John Lyons. Wisconsin Department of Natural Resources, 2801 Progress Road, Madison, WI 53716.

11:50 – 1:00 PM **LUNCH** (on your own)

SESSION III – AQUATIC VEGETATION AND INVERTEBRATES (Moderator: Yao Yin)

1:00 – 1:20 PM A GENERIC EMERGENT AQUATIC PLANT GROWTH MODEL AS A TOOL TO SUPPORT MANAGEMENT AND RESTORATION OF AQUATIC ECOSYSTEMS
Elly P.H.Best[1], William A. Boyd[1], and Kevin Kenow[2]. [1] U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS 39180. [2] U.S. Geological Survey, Upper Mississippi Science Center, La Crosse, WI 54602.

1:20 – 1:40 PM COMPARING SUBMERSED AQUATIC VEGETATION LEVELS FROM EMAP AND LTRMP SAMPLING DESIGNS
Brian R. Gray[1], Mark D. Holland[2] and Leigh Ann Starcevich[3]. [1]Upper Midwest Environmental Sciences Center, U.S. Geological Survey, La Crosse, WI. [2]Department of Statistics, University of Minnesota-Twin Cities, Minneapolis, MN. [3]Department of Statistics, Oregon State University, Corvallis, OR.

1:40 – 2:00 PM DEVELOPING BIOCRITERIA USING SUBMERSED MACROPHYTES FOR ASSESSING ECOSYSTEM HEALTH OF THE UPPER MISSISSIPPI RIVER
Heidi Langrehr[1] and Megan Moore[2]. [1] WI Department of Natural Resources, 2630 Fanta Reed Rd, La Crosse, WI 54603. [2] MN Department of Natural Resources, 1801 S. Oak St, Lake City, MN 55041.

2:00 – 2:20 PM USE OF δD AND $\delta^{18}O$ TO TRACE THE ORIGINS AND MOVEMENTS OF MACROINVERTEBRATES IN LARGE RIVER FLOODPLAIN WATER BODIES

David J. Myers[1], Matt R. Whiles[1], and Gregory W. Whitledge[2]. [1]Department of Zoology & Center for Ecology, Southern Illinois University, Carbondale, IL 62901. [2]Department of Zoology, Fisheries and Illinois Aquaculture Center, Southern Illinois University, Carbondale, IL 62901.

2:20 – 2:40 PM INITIAL INVESTIGATIONS INTO THE SUCCESS OF AN INVASIVE SNAIL (*BITHYNIA TENTACULATA*) AND ITS PARASITIC HITCHHIKERS

Gregory J. Sandland[1], Roger J. Haro[1], Benjamin Walker[1], and James P. Peirce[2]. [1]River Studies Center and [2]Mathematics Department, University of Wisconsin-La Crosse, La Crosse, WI 54601.

2:40 – 3:00 PM **BREAK**

SESSION IV – FISH ECOLOGY AND FOOD WEBS (Moderator: Matt O'Hara)

3:00 – 3:20 PM PLANKTONIC FOOD-WEB DEVELOPMENT IN LARGE RIVERS: LESSONS FROM EMAP-GRE

John H. Chick[1], John E. Havel[2], Paul A. Bukaveckas[3], Anthony K. Aufdenkampe[4], Ted Angradi[5], Dave Bolgrien[5] and Terri M. Jicha[6]. [1]Illinois Natural History Survey, University of Illinois, Brighton, IL. [2]Biology Department, Missouri State University, Springfield, MO. [3]Biology, Virginia Commonwealth University, Richmond, VA. [4]Stroud Water Research Center, Avondale, PA. [5]Office of Research and Development, Mid-Continent Ecology Laboratory, United States Environmental Protection Agency, Duluth, MN. [6]Office of Research and Development, Mid-Continent Ecology Division, United States Environmental Protection Agency, Duluth, MN.

3:20 – 3:40 PM BUILDING AN ECOLOGICAL TIME MACHINE: HISTORICAL PATTERNS OF FOOD WEB ATTRIBUTES IN THE UPPER MISSISSIPPI RIVER

Michael D. Delong[1] and James H. Thorp[2]. [1]Large River Studies Center, Biology Dept., Winona State University, Winona, MN 55987. [2]Kansas Biological Survey, Dept. Ecology and Evolutionary Biology, University of Kansas, Lawrence, KS 66047.

3:40 – 4:00 PM PRELIMINARY OBSERVATIONS ON FISH TISSUE LIPID QUANTITY AND QUALITY ASSOCIATED WITH SPATIAL PATTERNS IN THE DISTRIBUTION OF ASIAN CARP

William B. Richardson, Lynn A. Bartsch, **Steve Gutreuter**, Michelle R. Bartsch, Jonathan M. Vallazza and Brent C. Knights. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603.

4:00 – 4:20 PM HABITAT USE AND MOVEMENT OF JUVENILE LAKE STURGEON

Nicholas C. Bloomfield[1], Timothy W. Spier[1], Travis Moore[2], Brian Todd[2], Greg Snellen[3]. [1]Department of Biological Sciences, Western Illinois University, 1 University Circle, Macomb, IL 61455. [2]Missouri Department of Conservation, 653 Clinic Road, Hannibal, MO 63401. [3]Kentucky Department of Fish and Wildlife Resources, 1398 State Route 81 N, Calhoun KY, 42327.

4:20 – 4:40 PM FISH PASSAGE THROUGHOUT POOLS 20-26 OF THE UPPER MISSISSIPPI RIVER

Ron Brooks. Southern Illinois University, Fisheries and Illinois Aquaculture Center, Carbondale, Illinois 62901.

4:40 – 5:00 PM CHANGES IN FISH AND WATER QUALITY PARAMETERS DURING EXTREME FLOOD YEARS AND NON-FLOOD YEARS IN POOL 26 OF THE MISSISSIPPI RIVER

Ben J. Lubinski, Eric N. Ratcliff, Eric J. Gittinger, Lori S. Gittinger, and John H. Chick. Illinois Natural History Survey, Great Rivers Field Station, 8450 Montclaire Ave., Brighton, IL 62012.

5:00 – 6:00 PM **POSTER SESSION IN THE RADISSON HOTEL**

6:30 – 9:00 PM **BANQUET**

NOTES

RADISSON HOTEL
FRIDAY, MAY 1, 2009

8:20 – 8:30 AM Morning Welcome and Announcements – **Roger Haro,** MRRC President

SESSION V – FISH ECOLOGY (Moderator: Brian Ickes)

8:30 – 8:50 AM NIGHT-TIME SAMPLING OF LARVAL AND JUVENILE FISH IN MUD LAKE, POOL 11, OF THE UPPER MISSISSIPPI RIVER
Alan R. Butler, Matthew V. O'Brien, Kimberly M. Parsons, Steven A. Satterlee, Garrett J. Sheldon, Daniel J. Call, and Gerald L. Zuercher. Department of Natural & Applied Sciences, University of Dubuque, Dubuque, IA 52001.

8:50 – 9:10 AM FISH ASSEMBLAGES IN OFF-CHANNEL AREAS ALONG A HYDROLOGIC CONNECTIVITY GRADIENT IN THE UPPER MISSISSIPPI RIVER
Brent Knights[1], William Richardson[1], Andy Bartels[2], Jeff Houser[1], Lynn Bartsch[1], Michelle Bartsch[1], Jon Vallazza[1], Steve Gutreuter[1], and Robert Kennedy[1]. [1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54602. [2]Wisconsin Department of Natural Resources, La Crosse, WI 54602.

9:10 – 9:30 AM THE NATURE CONSERVANCY'S EMIQUON PRESERVE: RESETTING AND RESTORING THE THOMPSON LAKE FISH COMMUNITY
Nerissa N. Michaels[1], Greg G. Sass[1], Timothy W. Spier[2], Thad R. Cook[1], T. Matthew O'Hara[1], Kevin S. Irons[1], and Michael A. McClelland[1]. [1]Illinois River Biological Station, Illinois Natural History Survey, Institute of Natural Resource Sustainability, University of Illinois at Urbana-Champaign, 704 North Schrader Ave, Havana, IL 62644. [2]Department of Biology, Western Illinois University, 1 University Circle, Macomb, IL, 61455.

9:30 – 9:50 AM EVALUATION OF ELECTRIC FISH DISPERSAL BARRIERS IN THE CHICAGO SANITARY AND SHIP CANAL
Richard E. Sparks [1], Traci L. Barkley[2], Sara M. Creque[3], Sergiusz Czesny[3], John M. Dettmers[4], Jeramy Pinkerton[3], Karen M. Stainbrook[3], and Dan Zapf[3]. [1]National Great Rivers Research & Education Center, Godfrey, IL 62035. [2]Prairie Rivers Network, Champaign, IL 61820. [3]Illinois Natural History Survey, Lake Michigan Biological Station, Zion, IL 60099. [4]Great Lakes Fishery Commission, Ann Arbor, MI 48105.

9:50 – 10:10 AM **BREAK**

SESSION VI – WILDLIFE ECOLOGY (Moderator: Jennie Sauer)

10:10 – 10:30 AM SOUTHERN FLYING SQUIRREL ECOLOGY ALONG THE MISSISSIPPI RIVER IN EASTERN IOWA
Frances A. Eggers and Gerald L. Zuercher. Department of Natural and Applied Sciences, University of Dubuque, Dubuque, IA 52001.

10:30 – 10:50 AM POPULATION ASSESSMENT OF THE PRAIRIE RINGNECK SNAKE (*Diadophis punctatus arnyi* KENNICOTT): DOES THE MISSISSIPPI RIVER CREATE AN EFFECTIVE BOUNDARY TO GENE FLOW?
Melissa T. Roberts[1], Michael Romano[1], Brian Sloss[2], and Ryan Frankowiak[2]. [1]Western Illinois University, 1 University Circle, Department of Biological Sciences, Waggoner Hall, Macomb IL, 61455. [2]College of Natural Resources, University of Wisconsin-Stevens Point, 800 Reserve Street, Stevens Point, WI 54481.

10:50 – 11:10 PM IMPACT OF TRAP ORIENTATION AND PLACEMENT ON RIVER TURTLE CAPTURES
S. Andrew Satterlee and Gerald L. Zuercher. Department of Natural and Applied Sciences, University of Dubuque, Dubuque, IA 52001.

11:10 – 11:30 PM FLOODING EFFECTS ON PLANT DIVERSITY ALONG HYDROLOGIC GRADIENTS OF MISSISSIPPI RIVERINE ISLANDS
James E. Moore, Scott B. Franklin, and Jack W. Grubaugh. Department of Biology, 107 Ellington Hall, University of Memphis, Memphis, TN 38152.

11:30 – 12:30 PM **LUNCH**

12:30 – 1:30 PM **BUSINESS MEETING**

1:30 – 2:30 PM **RAFFLE AND SILENT AUCTION**

NOTES

POSTER PRESENTATIONS
RADISSON HOTEL
THURSDAY APRIL 30, 2009 12:00 PM – 6:00 PM
Authors Present 5:00 PM – 6:00 PM
(Listing by Topic)

LANDSCAPE ECOLOGY AND LIMNOLOGY

1) SHALLOW BATHYMETRIC MAPPING OF FLOODPLAIN WETLANDS TO ASSIST MANAGEMENT DECISIONS

Frank Nelson[1,] Kevin Borisenko[2], and David Ostendorf[1]. [1]Missouri Department of Conservation, Open Rivers/Wetlands Field Station, Jackson, MO 63755. [2]Missouri Department of Conservation, Central Office, Jefferson City, MO 65109.

2) SHALLOW BATHYMETRIC MAPPING OF BUFFALO CHUTE: EXAMINING CHANGE OVER TIME

Frank A. Nelson**, Jason W. Crites,** and David E. Ostendorf. Missouri Department of Conservation, Open Rivers and Wetlands Field Station, 3815 E. Jackson Blvd. Jackson, MO 63755.

3) CONSOLIDATION OF SAND AND ITS RELATIONSHIP TO THE DREDGING COMMUNITY

Brian R. Dorn and Dale H. Easley. 2005 Theisen Street, Dubuque Iowa 52001.

4) BUFFALO CHUTE SIDE CHANNEL RESTORATION PROJECT

Jason W. Crites and Robert A. Hrabik. Missouri Department of Conservation, Open Rivers and Wetlands Field Station, 3815 E. Jackson Blvd. Jackson, MO 63755.

5) WATER QUALITY IN BACKBONE STATE PARK, IOWA, AND POSSIBLE SOURCES OF CONTAMINATION

Oliver deSilva, Mariah Husheena, and Dale Easley. Department of Natural and Applied Sciences, University of Dubuque.

6) EXPLORING CAUSES FOR INCREASING NITRATE CONCENTRATIONS IN THE LOWER ST. CROIX RIVER

Brenda Moraska Lafrancois[1], **Byron Karns[2]**, Wade Miller[2], Brian Schuetz[2], Elizabeth Peterson[2], and William Daniels[1]. [1]National Park Service, St. Croix National Scenic Riverway, 401 N. Hamilton St., St. Croix Falls, WI 54024. [2]Science Museum of Minnesota, St. Croix Watershed Research Station, 16910 152nd St. North Marine, St. Croix, MN 55047.

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

Brenda Moraska Lafrancois[1], Suzanne Magdalene[2], and D. Kent. Johnson[3]. [1]National Park Service, Marine on St. Croix, MN 55047. [2]St. Croix Watershed Research Station, Marine on St. Croix, MN 55047. [3]Metropolitan Council Environmental Services, St. Paul, MN 55101.

8) THE TEMPORAL OCCURRENCE OF NITROGEN FIXATION ALONG A CHANNEL BACKWATER CONNECTIVITY GRADIENT IN NAVIGATION POOLS 6 AND 8 OF THE UPPER MISSISSIPPI RIVER

Samantha J. Klein[1], Lynn A. Bartsch[2], Jeanne L. Franz[1], Brent C. Knights[2], Jeff N. Houser[2], and William B. Richardson[2]. [1]Winona State University, Department of Chemistry, Winona, MN 55987. [2]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603.

HUMAN DIMENSIONS

9) THE VOLUNTEER STREAM MONITORING INTERACTIVE VERIFICATION PROGRAM AND OTHER WEB-BASED TOOLS

Claire A. Serieyssol[1], Moriya M. Rufer [2], Raymond W. Bouchard Jr. [3], Adam W. Sealock [4], and Leonard C. Ferrington Jr. [5]. [1]Water Resources Science, University of Minnesota, Saint Paul, MN 55108. [2]RMB Environmental Laboratories, Detroit Lakes, MN 56501. [3]Minnesota Pollution Control Agency, Saint Paul, MN 55155. [4]Metropolitan Council Environmental Services, Saint Paul, MN 55106. [5]Department of Entomology, University of Minnesota, Saint Paul, MN 55108.

INVERTEBRATES

10) ASSESSING DETERMINANTS OF NEAR-SHORE MACROINVERTEBRATE COMMUNITIES SURROUNDING A SUITE OF ISLANDS IN NAVIGATION POOLS OF THE UMR

William P. Gray, Roger J. Haro, and Gregory J. Sandland. River Studies Center, University of Wisconsin-La Crosse, La Crosse, WI 54601.

11) WOOD EXCAVATION BY COMMON NET-SPINNING CADDISFLIES: THE EFFECT OF WOOD TYPE

Roger J. Haro[1], Reid M. Northwick[1,2], William B. Richardson[2], and Samantha Olsen[1]. [1]River Studies Center, University of Wisconsin-La Crosse, La Crosse, WI 54601. [2]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54602.

12) INFLUENCE OF HABITAT ATTRIBUTES ON INVERTEBRATE STOICHIOMETRY IN A LARGE FLOODPLAIN RIVER

Samantha Papenfuss and Michael D. Delong. Large River Studies Center, Biology Department, Winona State University, Winona, MN 55987.

13) MICROCRUSTACEAN DYNAMICS ALONG A CHANNEL-BACKWATER CONNECTIVITY GRADIENT IN POOLS 6 AND 8 OF THE UPPER MISSISSIPPI RIVER

William Richardson[1], Brent Knights[1], Ben Campbell[1], Lynn Bartsch[1], Michelle Bartsch[1], Jeff Houser[1], Jon Vallazza[1], Steve Gutreuter[1], and Andy Bartels[2]. [1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54602. [2]Wisconsin Department of Natural Resources, La Crosse, WI 54602.

14) INFLUENCE OF HYDROLOGICAL RETENTION TIME ON COMMUNITY COMPOSITION OF RIVERINE ZOOPLANKTON

Jonelle E. Salzman [1], William B. Richardson [2], Michael D. Delong [1]. [1] Large River Studies Center, Biology Department, Winona State University, Winona, MN 55987. [2] U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54602.

FISH ECOLOGY

15) TEMPORAL PATTERNS OF FISH STOICHIOMETRY IN TWO GEOMORPHOLOGICALLY DISTINCT REGIONS OF THE UPPER MISSISSIPPI RIVER

Elizabeth Howe and Michael D. Delong. Large River Studies Center, Biology Department, Winona State University, Winona, MN 55987.

16) ASIAN CARPS IN THE MID-CONTINENT GREAT RIVERS

Kevin S. Irons[1], Duane C. Chapman[2], Michael A. McClelland[1], Timothy M. O'Hara[1], Greg G. Sass[1,] Jeff Thomas[3], and Mark S. Pearson[4]. [1]Illinois River Biological Station, Illinois Natural History Survey, Institute of Natural Resource Sustainability, University of Illinois at Urbana-Champaign, 704 North Schrader Avenue, Havana, IL 62644. [2]U.S. Geological Survey, 3200 New Haven Road, Columbia, MO 65201. [3]Ohio River Valley Water Sanitation Commission (ORSANCO), 5735 Kellogg Ave., Cincinnati, OH 45228. [4]Watershed Diagnostics Research Branch, US EPA Mid-Continent Ecology Division, 6201 Congdon Blvd., Duluth, MN 55804.

17) TROUT STOCKING IN IOWA COLD-WATER STREAMS: DOES IT IMPACT NATIVE FISH DIVERSITY?

Kayleen L. Keehner, Mikaela E. Tully, and Gerald L. Zuercher. Department of Natural and Applied Sciences, University of Dubuque, Dubuque, IA 52001.

18) EVALUATION OF POST-FLOOD CYPRINID RECOLONIZATION IN EASTERN IOWA COLD-WATER STREAMS

Mikaela E. Tully, Kayleen L. Keehner, and Gerald L. Zuercher. Department of Natural and Applied Sciences, University of Dubuque, Dubuque, IA 52001.

WILDLIFE ECOLOGY

19) BREEDING BIRDS OF THE UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE

Wayne E. Thogmartin[1], Eric J. Nelson[2], Timothy J. Fox[1], Lisa Reid[2], Douglas A. Olsen[1], and Eileen M. Kirsch[1]. [1]United States Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603. [2]United States Fish and Wildlife Service, Upper Mississippi River National Wildlife and Fish Refuge, Winona, MN 55987.

NOTES

PLATFORM PRESENTATION ABSTRACTS
ALPHABETICAL LISTING (by Presenting Author)

AN AUTOMATED LAND COVER CLASSIFICATION USING AERIAL PHOTOGRAPHS, LIDAR DATA AND SOILS DATA FOR TWO AREAS OF THE UPPER MISSISSIPPI RIVER

Cynthia Berlin[1] and Jennifer J. Dieck[2]

[1] Department of Geography and Earth Science, University of Wisconsin-La Crosse, La Crosse, WI 54601.
[2] U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603.

An object-oriented feature extraction approach is investigated for identifying land cover/use (LCU) for the lower two-thirds of Pool 5 and the Lake Odessa area of Pool 18 of the Upper Mississippi River. Feature Analyst software under the ArcGIS software platform is used to classify LCU types using different types of true color (TC) or color infrared (CIR) aerial imagery along with LIDAR data or soil survey data. The classification for Pool 5 includes the use of 8-inch/pixel TC and CIR digital aerial photography collected with a Microsoft UltraCamX and LIDAR data, whereas the classification for the Lake Odessa area of Pool 18 includes 1-meter TC and CIR orthophoto mosaics and soil survey data. Different types of imagery along with these ancillary data sets were used to evaluate the software's ability to improve classification of LCU types according to the mapping standards at UMESC. All LCU classes correspond to the Long Term Resource Monitoring Program General Wetland Vegetation Classification System.

Keywords: vegetation mapping, feature extraction, Feature Analyst, Upper Mississippi River, LIDAR

A GENERIC EMERGENT AQUATIC PLANT GROWTH MODEL AS A TOOL TO SUPPORT MANAGEMENT AND RESTORATION OF AQUATIC ECOSYSTEMS

Elly P.H. Best[1], William A. Boyd[1], and Kevin Kenow[2]

[1] U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS 39180.
[2] U.S. Geological Survey, Upper Mississippi Science Center, La Crosse, WI 54602.

A generic simulation model for growth of emergent aquatic vegetation is being developed. This model can be used to simulate emergent plant and tuber biomass under prevalent freshwater and marine environmental conditions at various climates. The model is bioenergetics-based, with light and temperature as driving variables, and current velocity, salinity, and nutrient limitation as potential auxiliary variables. The model includes descriptions of plant responses to (changes in) climate, environmental conditions, and management measures affecting the latter. The model will be calibrated for four perennial plant species of interest, notably *Sagittaria latifolia* (broadleaf arrowhead), *Schoenoplectus tabernaemontani* (softstem bulrush), *Sagittaria lancifolia* (fulltongue arrowhead), and *Spartina alterniflora* (smooth cordgrass). Both *Sagittaria latifolia* and *Schoenoplectus tabernaemontani* are important elements of the Upper Mississippi River System (UMRS) while *Sagittaria lancifolia* and *Spartina alterniflora* are important elements in wetlands of Coastal Louisiana. All these species are believed to regrow at a specific site in spring prevalently from rhizomes, with *S. latifolia* and *S. lancifolia* having an additional option to regrow from large subterranean tubers, and all species having the potential option to germinate from seeds at any site. The initial version of the model was calibrated for *S. latifolia*, using published historical data pertaining to *S. latifolia* vegetation in UMRS Pool 9, IA, in 1972. It was validated using unpublished field data pertaining to *S. latifolia* vegetation at Coon Creek within UMRS Pool 8, WI, in 2006.

Results of calibration runs agreed largely with respect to plant biomass, and indicated substantial potential rhizome production with tuber production that was about 30 percent of measured. Increasing the potential tuber growth rate by a factor of 3 increased tuber production to the measured level, but eliminated rhizome production, effectively limiting the vegetation to regrowth from tubers alone. Results of validation runs agreed well with plant biomass, but overpredicted tuber production. Interpretation by comparison of simulated and measured data was greatly impeded by the scarcity in data on seasonal changes in plant biomass, tuber density and –size, and relative scarcity of measured environmental data requiring large-scale interpolation and derivation of values pertaining to other sites within the same water body. Potential application of the model includes serving as a tool for water resource managers and planners (1) to support management and restoration of aquatic ecosystems, including wetlands; (2) for evaluation of the impacts of changes in climate and water quantity; and (3) for evaluation of the impacts of changes in water quality.

Keywords: emergent macrophyte, model, Mississippi River, management, restoration

HABITAT USE AND MOVEMENT OF JUVENILE LAKE STURGEON

Nicholas C. Bloomfield[1], Timothy W. Spier[1], Travis Moore[2], Brian Todd[2], and Greg Snellen[3]

[1]Department of Biological Sciences, Western Illinois University, 1 University Circle, Macomb, IL 61455.
[2]Missouri Department of Conservation, 653 Clinic Road, Hannibal, MO 63401.
[3]Kentucky Department of Fish and Wildlife Resources, 1398 State Route 81 N, Calhoun KY, 42327.

Twenty juvenile lake sturgeon (*Acipenser fulvescens*) were captured in fall 2007 through spring 2008 in pool 24 of the Mississippi River and fitted with Vemco ultrasonic transmitters. These were tracked manually (VR100) and through a network of passive receivers (VR2 and VR2W). These fish have used a variety of habitats, with repeated usage of some sites. Sand has been the preferred substrate. Several long range movements have been documented, coinciding with high river levels. In fall 2008, 30 fingerling lake sturgeon were fitted with transmitters and stocked at two sites along the Mississippi River. Thirty dummy transmitters were implanted and placed in a hatchery pond along with 42 control fish. Survival was similar between these two groups. Manual and passive tracking were performed to determine dispersal and habitat usage. Dike fields on inside bends were preferred. Sand was the preferred substrate. Wintering areas were determined for several fish. Data analysis will continue with the final report to be complete by summer.

Key Words: lake sturgeon, ultrasonic transmitter, substrate, VR100, VR2(W)

FISH PASSAGE THROUGHOUT POOLS 20-26 OF THE UPPER MISSISSIPPI RIVER

Ron Brooks

Southern Illinois University, Fisheries and Illinois Aquaculture Center, Carbondale, Illinois 62901.

Experimental fish passways are scheduled to be constructed at navigation dams 22 and 26 in the Upper Mississippi River (UMR). This study was initiated to collect pre-construction data that verifies individual fish passage through UMR locks and dams, the fishes' use of locks for movement among pools, and distances traveled. Species-specific movements and passage frequencies are described for fish tagged during spring 1996 through fall 2008. Stationary receivers (VR2, VEMCO, LTD) were set in the UMR above and below Lock and dams 19, 22 and 26 to monitor passage. Additional receivers were set in pools 21, 25, in the middle Mississippi River (MMR) and in tributaries including the Illinois, Missouri, and Meremac rivers. Fish species surgically inserted with sonic tags included the exotic Asian carp species (Silver and Bighead), three sturgeon species (Pallid, Lake, and Shovelnose), Paddlefish, White Bass, Blue Catfish, and Common Carp. The fish were collected and released above and below navigation dams 22 and 26. Our data indicates that all our study species were capable of moving through locks and dams, both up and down river, and passage frequency and periodicity is species dependent. Factors such as water levels, time of year, position of dam gates, and movement direction appear to affect passage ability. This and future data will be used in conjunction with hydroacoustic and Didson data in an attempt to compare fish passage among UMR pools before and after passway construction.

Keywords: Mississippi River, passage, passways, sonic transmitters, stationary receivers

NIGHT-TIME SAMPLING OF LARVAL AND JUVENILE FISH IN MUD LAKE, POOL 11, OF THE UPPER MISSISSIPPI RIVER

Alan R. Butler, Matthew V. O'Brien, Kimberly M. Parsons, Steven A. Satterlee, Garrett J. Sheldon, Daniel J. Call, and Gerald L. Zuercher

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Mud Lake, Mississippi River Pool 11, has undergone extensive modification in recent years to create improved habitat for the fish community. Major changes have included the development of a number of channels dredged to a depth of 6-8 feet, the construction of a dike that has isolated the lake from upstream river flow except for several cuts in the dike, and changes in the volume and rate of water flow through the lake. This study was conducted to provide information on the utilization of the modified lake by the fish community as spawning and nursery habitat. The lake was sampled in the spring and summer months of 2007 and 2008 using a larval/juvenile light-trapping technique. A total of 522 fish were captured, representing 10 families: Lepisosteidae, Clupeidae, Cyprinidae, Catastomidae, Ictaluridae, Atherinidae, Poeciliidae, Moronidae, Centrarchidae, and Percidae. Overall, the five most commonly collected species were the brook silverside (*Labidesthes sicculus*, 34.7% of total), bullhead minnow (*Pimephales vigilax*, 25.3%), emerald shiner (*Notropis atherinoides*, 24.1%), gizzard shad (*Dorosoma cepedianum*, 4.6%), and white bass (*Morone chrysops*, 3.6%). The brook silverside was the most frequently captured species in both 2007 and 2008. River conditions were considerably different in the two years, and the other four species in the top five varied greatly between the two years in terms of numbers captured. Two adult and one juvenile western mosquitofish, *Gambusia affinis*, were collected in 2008. These are the northernmost capture records for this species in the Mississippi River, to our knowledge. Future sampling efforts will be necessary to determine if a population of western mosquitofish has become established, as well as to determine if other species may be spawning here.

Keywords: Mississippi River, larval/juvenile fish, light-trap, Pool 11, *Gambusia affinis*

PLANKTONIC FOOD-WEB DEVELOPMENT IN LARGE RIVERS: LESSONS FROM EMAP-GRE

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We used survey data from the Upper Mississippi, Missouri, and Ohio rivers collected in 2004 – 2006 through the U.S. Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP) to examine the development of planktonic food-webs in these large rivers. Conceptual constructs for large rivers generally suggest limited development of planktonic food-webs in the main channels of these ecosystems. For example, the River Continuum Concept describes large rivers (i.e. > 8th order) as "semi lentic," whereas the Flood-Pulse Concept suggested there should be little autochthonous production in the main channel of floodplain-river systems. In contrast, our data revealed Chlorophyll-a levels in all three rivers that were comparable to eutrophic lakes. Additionally, both the Ohio and Upper Mississippi rivers had abundant zooplankton communities dominated by rotifers. Zooplankton abundance in the Missouri River was substantially less than the Ohio or Upper Mississippi River. A multivariate analysis combining EMAP data with GIS land-use data for the Upper Mississippi River suggests that inshore retention zones may be critical for the development of zooplankton communities. Our data suggests that planktonic food-webs in large rivers can be substantially more developed than previously thought. Conceptual frameworks for large rivers should be revised to include this potential. Further work is needed to determine the physical and biotic factors associated with the development of planktonic food-webs in these systems.

Keywords: food web, Mississippi River, Missouri River, Ohio River, phytoplankton, zooplankton

BUILDING AN ECOLOGICAL TIME MACHINE: HISTORICAL PATTERNS OF FOOD WEB ATTRIBUTES IN THE UPPER MISSISSIPPI RIVER

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Large floodplain rivers are among the most extensively modified and managed ecosystems in the world. Modifications for flood control, navigation, hydropower, and irrigation have drastically altered their natural hydrogeomorphic characteristics. There has been increasing interest over the past decade to restore some of the natural hydrogeomorphic features of large rivers. Unfortunately, there is a paucity of ecological data available for periods prior to modification from which to establish targets for rehabilitation. We used samples from fish, mussels, and snails from museum collections to obtain carbon and nitrogen stable isotope ratios for calculating the trophic position of four feedings guilds (planktivore, detritivore, invertivore, and piscivore) of fish. Trophic position, in contrast to the categorical application of trophic level, is a continuous measure of location on a food chain that incorporates omnivory in the determination of an animal's trophic status. Specimens used were originally collected from the Upper Mississippi River between Alma, Wisconsin and Dubuque, Iowa from 1880 through 2006. Data were analyzed for 5-yr intervals (i.e., 1930-1934, 1935-1939). Nitrogen isotope ratios of fish trophic guilds and molluscs increased from 1880-1884 until stabilizing 1950-1955. Trophic position, in contrast, was highly variable from the 1890s through 1940-1945. The latter period marked the highest observed trophic positions, which was also the first time-period following completion of the lock and dam system. Trophic position declined from 1945 until 1960, at which point trophic position increased until it reached an asymptote around 1990-1994. Differences in temporal trends of nitrogen isotope ratios vs trophic position suggest a change in ecosystem function over the period of record, specifically coinciding with changes in the hydrogeomorphology of the Upper Mississippi River following completion of the lock and dam system.

Keywords: food web, disturbance, lock and dam, trophic position, fish

SOUTHERN FLYING SQUIRREL ECOLOGY ALONG THE MISSISSIPPI RIVER IN EASTERN IOWA

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We investigated the habitat associations of southern flying squirrels, *Glaucomys volans*, at Mines of Spain Recreational Area, Dubuque County, Iowa. Specifically, we were interested in habitat features associated with presence and abundance. Southern flying squirrels are a "Species of Interest" within Iowa and they may be an indicator of forest maturity and health. Presence and abundance were assessed through live-trapping on three plots of differing habitat structure. Plots consisted of sixteen Hav-a-hart® chipmunk traps arranged in a 4 x 4 grid with an inter-trap distance of 25-meters. Traps were placed ~5-meters high in an attempt to decrease non-target species captures. In year 2, we eliminated one of the plots due to a complete absence of southern flying squirrels and habitat management change between trapping years. In addition, during the second year, we placed telemetry collars on three individuals in order to measure home ranges and assess movement patterns. There appears to be a relationship between presence and abundance of southern flying squirrels and the density and maturity of white oaks, *Quercus alba*. Telemetry data revealed a seasonal movement from the study area during mid-autumn.

Keywords: *Glaucomys volans*, southern flying squirrels, white oak, *Quercus alba*, telemetry

A STUDY OF THE GENERAL PUBLIC'S PERCEPTIONS AND OPINIONS OF THE POOL EIGHT HABITAT PROJECT IN STODDARD WISCONSIN

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Beginning in 1989, the Army Corps of Engineers along with the U.S. Fish and Wildlife Service (USFWS) and the Upper Mississippi Environmental Sciences Center (UMESC) began an island restoration project in Pool 8 of the Mississippi River. The pool is located within the Upper Mississippi River Valley Wildlife Refuge between the towns of Dresbach, MN and Genoa, WI. The particular site for the restoration project was a lake like stretch of the pool located just south of Brownsville, MN. The project was part of the Army Corps of Engineers, Environmental Management Program (EMP), which planned to restore, "many of the islands in pool 8 that had eroded or have disappeared since the construction of the lock and dam system along the Mississippi. This has increased wind fetch and associated turbidity in the backwater areas, resulting in a loss of valuable aquatic plant beds that migrating canvasback ducks use for food" (Army Corps of Engineers project description). Under the mandate of the federal EMP there was no authorization that specified including a human perspective study of the habitat project. This presented a unique opportunity for a follow-up study to be conducted to assess the perspectives and opinions of the stakeholders involved. The city of Stoddard, Wisconsin located along the banks of the Mississippi River in Vernon County in South Western Wisconsin was chosen as a representative sample of the towns being affected by the Habitat Project.

The collection of stakeholder opinions and perspectives began in August 2008, with an on-site study. Focusing on the following five aspects: knowledge of project, use of river, wildlife, ascetics, stakeholders impute. An expanded follow-up mail survey was conducted during December. The follow-up mailed survey was designed to garner a greater qualitative reading of stakeholder opinions. Preliminary results reveal that 91% of the mail survey respondents and 94 % of the verbal survey respondents reported that they were aware of the Habitat Project, 82% of mail survey respondents say that they recreate on the river, with fishing and boating being the most popular. Furthermore, those who responded said that their overall impression of the project was positive, rating the project at a 4 out of a 5.

Keywords: perspective, stakeholder, recreation, river, opinion

COMPARING SUBMERSED AQUATIC VEGETATION LEVELS FROM EMAP AND LTRMP SAMPLING DESIGNS

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Estimating levels of aquatic vegetation in large rivers is a focus of both the U.S. Environmental Protection Agency's Great Rivers Ecosystems component of the Environmental Monitoring and Assessment Program (EMAP) and the Long Term Resource Monitoring Program (LTRMP). Commonalities among sampling designs include the sampling instrument (a double-sided garden rake), that data are categorical and that EMAP's and LTRMP's target populations partly overlap. Differences include that EMAP's target populations encompass considerably longer river reaches, that EMAP's target populations are entirely rather than partially nearshore, that EMAP's sampling sites are larger in area, and that EMAP's sites incorporate multiple clusters of rake surveys ("stations"). These commonalities and differences suggest that: i) variation among sites will be larger under the EMAP design (presumes the effects of longer river reaches on habitat heterogeneity will trump that associated with sampling entirely nearshore); ii) estimated among-*site* variation under the LTRMP design will be larger than among-*station* variation under the EMAP design because a LTRMP site may be viewed as analogous to a sub-component of EMAP site; iii) the probability of SAV occurrence and of higher abundance levels will be greater under the EMAP design because of that design's larger site area and because sampling under that design occurs in nearshore conditions that favor submersed aquatic plant growth (i.e., often exhibit lower velocities and better light penetration); and iv) estimated detection probabilities will appear lower under the EMAP design because EMAP sites are larger. Comparisons of EMAP and LTRMP results from comparable reaches and years generally supports these inferences.

Keywords: EMAP-GRE, LTRMP, rake method, submersed aquatic vegetation

PRELIMINARY OBSERVATIONS ON FISH TISSUE LIPID QUANTITY AND QUALITY ASSOCIATED WITH SPATIAL PATTERNS IN THE DISTRIBUTION OF ASIAN CARP

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The planktivorous Asian carps have the potential to sequester large amounts of energy, carbon and essential biochemicals from the foodwebs of North American waters because large-bodied adults have no natural predators. Relatively few biochemicals are essential to vertebrates, and among them the essential omega-3 fatty acids EPA and DHA are produced, de novo, only by certain algae. Therefore the Asian carp, and especially the silver carp, have the potential not only to divert energy, but also induce deficiencies in the fatty acids necessary to maintain cell-membrane fluidity, neural function, and reproduction. Total lipid content, which is a measure of surplus energy stored by consumers, might also be sensitive to food-resource sequestration by the Asian carps. Dorsal muscle tissue of native planktivorous bigmouth buffalo, gizzard shad and paddlefish collected from Pool 26 of the Mississippi River, where Asian carp were abundant, averaged less than 5% lipid whereas those collected from Pool 8, where Asian carp were rare, averaged 7 to 15% lipid. Muscle tissue of the Asian carp from Pool 26 had similarly low lipid content suggesting that they may not be more efficient than native species in sequestering structural lipids. The essential omega-3 fatty acids were also reduced in muscle tissue from the native planktivores in Pool 26. The whole-body total lipid content of age-0 bluegill averaged approximately 15% from both Pool 8 and Pool 26.

Keywords: lipids, fatty acids, food webs, *Hypophthalmichthys nobilis*, *H. molitrix*

A MUSSEL SURVEY AND TRANSLOCATION IN THE IOWA RIVER, IOWA CITY, IOWA, SEPTEMBER 2006 AND 2007

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A mussel survey was conducted at a new bridge site on the Iowa River, Iowa City, Iowa, September 2006. Seventeen species were found, including site records for *Corbicula fluminea*. There were juveniles of 7 species. The mean density of quadrats on nine transects was 0.76 mussels/m^2; mussels were returned to their site of origin. Steep shoreline riprap created favorable mussel habitat in a number of areas. Pier placement didn't appear to be a problem since there were few mussels in the middle of the Iowa River. However, we recommended mitigation for expected construction impacts, particularly on state listed mussels. Depths were 0.5-1.0 m, with occasional deeper holes. Sporadic submerged rocks in the middle of the river are a hazard to boaters during low water levels.

A mussel translocation was conducted in the Iowa River at Iowa City, IA, September 2007. Among the 19 species of live mussels, 42 *Tritogonia verrucosa*, and three *Lampsilis teres anodontoides* were in the construction area. No federally endangered mussels were found. The first Iowa endangered *Ellipsaria lineolata* was found (at least since 1979 but probably since before 1925). Two species found alive in 2006 were not found in 2007. Two additional species were represented by empty shells only.

As mitigation, over 350 mussels were marked on one valve with either a numbered bee tag, or glue mark, and translocated by Iowa DNR to a site upstream. The DNR did not want to translocate the state endangered *L. t. anodontoides* since this species had not done well when previously translocated in the Iowa River. After working with the required markings, we felt that these might be scoured off prior to IADNR follow-up planned for 2008 (serious flooding occurred at Iowa City, June 2008). Therefore listed mussels were engraved with the same number on the opposite valve, while common mussels were engraved on the opposite valve with a hash-mark. In addition to the *L. t. anodontoides* being moved a short distance upstream, mussels recovered the last 1.5 days of the project were distributed to this same site, from the surface, at IA DNR's request.

Mussel populations have generally decreased throughout the Iowa interior. But the 27 species remaining throughout the length of the Iowa River are remarkable; 23 species have been recorded from Johnson County, Iowa since 2005. Large *Potamilus alatus* represented 25% of the live mussels. Based on age and size classes, most species appear to have minimal to moderate reproduction in Iowa City, IA.

Keywords: mussel distribution, Iowa River mussels, threatened and endangered mussels, unionid age and density data, mussel markings

ECOSYSTEM METABOLISM IN THE UPPER MISSISSIPPI RIVER: THE ROLE OF LIGHT, NUTRIENTS, AND CONNECTIVITY TO THE MAIN CHANNEL

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Large floodplain rivers consist of a diverse array of aquatic areas. Hydraulic connectivity of these areas with the main channel (MC) may affect important drivers of primary production. We investigated the effect of connectivity to the main channel on nutrient concentrations, water clarity, and rates of ecosystem metabolism. We measured nutrient concentrations, water column primary production (light/dark bottles), ecosystem metabolism (continuous in situ dissolved oxygen measurements), and water clarity at six sites across a gradient of connectivity with the MC in the Upper Mississippi River near La Crosse, Wisconsin. June total nitrogen concentrations increased with connectivity to the MC, whereas total phosphorus concentrations were inversely related to this connectivity. Water column net primary production rates were higher in the MC (mean: 4.9 g O_2 m^{-2} d^{-1}) than in backwaters (means: 2.8 to 3.9 g O_2 m^{-2} d^{-1}), but among backwater sites, production rates were not related to connectivity to the MC. In contrast, net ecosystem production was lower in the MC than in the backwaters. Our results suggest that connectivity to the MC more strongly affects nutrient concentrations than rates of ecosystem metabolism.

Keywords: primary production, ecosystem metabolism, chlorophyll, floodplain connectivity

FISH ASSEMBLAGES IN OFF-CHANNEL AREAS ALONG A HYDROLOGIC CONNECTIVITY GRADIENT IN THE UPPER MISSISSIPPI RIVER

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Off-channel areas (OCAs) are a biologically productive and diverse component of large floodplain rivers like the Upper Mississippi River. Restoration efforts focus on OCAs because of their ecological and recreational importance and degrading condition. System changes to accommodate commercial navigation have altered the hydrologic connectivity of OCAs to channels. Connectivity is a primary driver of the physical, biogeochemical, and biological regimes in OCAs that in turn regulate fish assemblages through physiological tolerances and foodweb interactions. Connectivity is often manipulated as part of restoration efforts.

To examine how connectivity affects these regimes and fishes, we sampled a broad suite of environmental variables and fish at 5 OCA sites spanning a gradient of connectivity, and 1 main channel border site (MCB) for reference. These sites were located in Navigation Pools 8 and 6 in the Upper Mississippi River. Two OCA sites (TWR and LLK) had low connectivity, two sites (RLK and STI) had moderate connectivity, and one site (STO) had high connectivity. This presentation focuses on how fish assemblages varied spatially and temporally across this connectivity gradient. Fish were sampled monthly at each site from July through September 2008 using standard Long Term Resources Monitoring Program electrofishing procedures. Multivariate analyses were used to compare fish assemblages by site and time period to determine if assemblages were related to connectivity.

Fish assemblages did not vary temporally except at LLK and STO where the September period differed from July and August periods. Fish assemblages generally varied across sites except at RLK and STI. These sites had the same assemblage (F) characterized by largemouth bass *Micropterous salmoides* , bluegill *Lepomis macrochirus*, yellow perch *Perca flavescens*, and spottail shiner *Notropis hudsonius*. The same assemblage (F) also occurred in STO and LLK in September when juveniles were less numerous than other months The LLK assemblage in July and August was dominated by young-of-the-year golden shiner *Notemigonus crysoleucas* and yellow perch suggesting it was a good nursery. At STO, located in the impounded portion of Pool 8, the July and August assemblage was characterized by redhorses (*Moxostoma sp*), freshwater drum *Aplodinotus grunniens* and adult largemouth bass. The TWR and MCB sites were most different from other sites. The TWR site was characterized by species tolerant of poor water quality including golden shiners, common carp *Cyprinus carpio*, bigmouth buffalo *Ictiobus cyprinellus*, black bullhead *Ictalurus melas*, yellow perch, and green sunfish *Lepomis cyanellus*. The MCB site was dominated by fluvial species including shiners (*Notropis sp*), adult and juvenile centrarchids, and shorthead redhorse *Moxostoma macrolepidotum*. This preliminary analysis suggests that connectivity can have significant effects on fish assemblages in OCAs.

Keywords: fish assemblage, connectivity, Upper Mississippi River

DEVELOPING BIOCRITERIA USING SUBMERSED MACROPHYTES FOR ASSESSING ECOSYSTEM HEALTH OF THE UPPER MISSISSIPPI RIVER

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Aquatic macrophytes are a critical driver of the ecology of the Upper Mississippi River (UMR). They are a vital source of food for waterfowl and aquatic mammals, critical habitat for fish and amphibians, and substrate for many invertebrates. Aquatic macrophytes also affect nutrient cycling, stabilize sediments from wind-induced resuspension and boat waves, and increase water clarity. Declines of submersed macrophytes have been linked to anthropogenic inputs such as nutrients and light-limiting suspended solids. Submersed macrophytes serve as a natural light meter, integrating clarity of river water over time scales of weeks to months. As such, submersed macrophytes can serve as a surrogate for factors that can limit light availability in aquatic ecosystems. Therefore, we have made an effort to develop biocriteria using submersed macrophytes to assess ecosystem health in the UMR.

Sampling was conducted from late July through August in 2006, 2007 and 2008 through a grant from the EPA's EMAP-GRE program. The study included the reach of the UMR that extends from Lower St. Anthony Fall's Lock and Dam in Minneapolis, MN to Lock and Dam 11 near Dubuque, IA. The study reach was divided into seven hydrologic assessment units that were segmented by major tributary inflows, with 100 longitudinally random sample points per unit per year. Once at a site, submersed macrophyte data was collected following standard procedures developed by Y. Yin in 2000 for the USGS Long Term Resource Monitoring Program's stratified random sampling. Sampling sites targeted aquatic locations between 0.2 m and 2 m in depth. Water velocity and transparency tube measurements were also recorded to relate these water quality parameters to submersed macrophyte presence and abundance. We chose to sample the main channel borders and side channels of the UMR because they are conducive to rapid data collection and are closely linked to tributary impacts. Using the data collected, we are testing a suite of submersed macrophyte attributes for range, responsiveness, relative scope of impairment and redundancy and will be presenting preliminary findings.

Keywords: submersed aquatic macrophytes, bioindicator, biocriteria, Upper Mississippi River, water clarity

CHANGES IN FISH AND WATER QUALITY PARAMETERS DURING EXTREME FLOOD YEARS AND NON-FLOOD YEARS IN POOL 26 OF THE MISSISSIPPI RIVER

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The Great Rivers Field Station has been monitoring fish populations and water quality parameters in Pool 26 of the Mississippi River since the early 1990's for the Long Term Resource Monitoring Program (LTRMP). In 2005 and 2006, low water conditions prevailed in Pool 26, and there was an absence of normal seasonal flooding. The monitoring program identified significant changes in fish and water quality parameters during this time. Fish sampling in 2006 revealed total catches of fish species including emerald shiner, skipjack herring, channel catfish, and smallmouth bass that were the highest since the program began. Water quality parameters such as Secchi depth, turbidity, chl-a, and suspended solids concentrations also changed during non-flood years. Normal spring flooding resumed in 2007 followed by a major flood event in 2008, allowing us to compare fish and water quality changes during this time to the two previous non-flood years. Our data showed that a different suite of fishes responded positively to flooding relative to those that responded well during non-flood years.

Keywords: LTRMP, Mississippi River, flood, fish, water quality

USING FISH ASSEMBLAGES TO ASSESS THE ECOLOGICAL HEALTH OF THE UPPER MISSISSIPPI RIVER

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Bioassessment based on fish, macroinvertebrate, or other biological assemblages, is widely used to evaluate the "health" of aquatic ecosystems in the Midwest. However, there is at present uncertainty over how to implement bioassessment in the Upper Mississippi River (UMR). I will review the process by which bioassessment indices are developed, applied, and interpreted, using fish assemblages as an example and with special emphasis on the unique challenges posed by the UMR. In particular, I will focus on three issues of contention for the UMR, the sampling methodology, the definition of a healthy fish assemblage, and the spatial scale at which the assessment index is developed and applied. There is a common misapprehension that the entire fish community must be inventoried for bioassessment, which would be extremely difficult for the UMR. In fact, only a subset assemblage of the fish community that is both vulnerable to capture and sensitive to environmental degradation need be sampled. Sampling methods should be standardized for this subset and the macrohabitat it occupies. A healthy UMR fish assemblage could be defined based on the estimated historical UMR assemblage, the best currently observed UMR assemblage, or assemblages in other less-modified large Midwestern rivers. I will argue that despite some unique attributes of the UMR, data from other less-modified rivers will improve the application and interpretation of bioassessment indices in the UMR. Given the size and complexity of the UMR, a single bioassessment index is probably not adequate for the entire river ecosystem, and I will present evidence supporting the need to develop macrohabitat-specific indices. Specifically, channel fish assemblages differ from off-channel (i.e., backwaters, sloughs) assemblages and require different sampling techniques and evaluation criteria. Although environmental impacts in one type of macrohabitat may influence the assemblage in another macrohabitat, I urge great caution in inferring the health of one macrohabitat based on bioassessment of another macrohabitat. In other words, bioassessment of channel areas should normally not be used to infer the condition of off-channel areas and vice versa. Initial studies suggest that bioassessment indices based on fish assemblages in channel macrohabitats may be applicable over the entire length of the UMR, although adjustments are needed to account for large-scale climate, geomorphology, and faunal gradients.

Keywords: bioassessment, Mississippi River, fish, index of biotic integrity, macrohabitat

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 farmed. Eighty years later the land was purchased by The Nature Conservancy with the intention to restore the lakes to their natural state; a fully functional floodplain labeled the Emiquon Preserve. In the spring of 2007, rotenone was applied to remaining agricultural ditches in an attempt 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 in accordance with historical accounts of native fishes once present in the lakes. Thus far, 29 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-November, 2007, and April-October, 2008. We collected a total of 1,290 fish comprised of 8 species during the 2007 sampling period, and 32,907 fish comprised of 15 species in 2008. Largemouth bass *Micropterus salmoides* comprised 90% of the total catch with a mean of 376 bass/ hour electrofishing in 2007. In 2008, largemouth bass represented 3.1% of the total catch with a mean of 100 bass/hour electrofishing. One invasive species, an individual adult common carp *Cyprinus carpio,* was collected while electrofishing in 2007, while one invasive species, YOY and adult goldfish *Carassius auratus,* were collected while electrofishing and fyke netting in 2008 suggesting rotenone survival or unintentional stocking. Unidentified Lepomis spp. (bluegill *L. macrochirus* or pumpkinseed *L. gibbosus* <40mm) dominated the total catch in 2008 comprising 76.5% of the total catch. Centrarchid diets were obtained using gastric lavage to determine the emerging food web, snorkeling surveys were conducted to determine habitat usage by fish species and size classes, and largemouth bass were Floy-tagged to determine growth rates, movement, and population size in 2008. Aquatic vegetation sampling was also conducted in 2008 and showed a community comprised of 14 species dominated by coontail *Ceratophyllum demersum.* The information gained from the fish and aquatic vegetation monitoring and supplemental research will help manage this system and provide future management recommendations for floodplain restoration efforts.

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

FLOODING EFFECTS ON PLANT DIVERSITY ALONG HYDROLOGIC GRADIENTS OF MISSISSIPPI RIVERINE ISLANDS

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Understanding how plant communities assemble is at the heart of restoration efforts, understanding response to disturbance (i.e. management), and understanding response to secular changes (eg. climate change). The reason we lack a general model of community dynamics, including community assembly is because of: 1) The overwhelming interactions among populations and 2) The overwhelming variability of disturbance effects. We used small islands of the Mississippi River to examine neutral and niche-based mechanisms of community assembly by examining plant community composition, structure, and diversity along a disturbance gradient (i.e., flooding). Elevations on five lower Mississippi River islands were surveyed and then corrected with the nearest river gage elevation to link island elevation with hydrological patterns. Historical data showed frequency of inundations ranged from 1.32 – 45.26 inundations/yr, with durations lasting from 12.8 – 70.4 days of inundation/yr. Six transects were placed on each island from fore side (main channel) waters edge to zee side (non-main channel) waters edge to encompass all elevations on the island. Two 1 x 2 m herbaceous vegetation plots were placed at every 1 m increase in elevation, with one randomly placed plot in the center of each elevational zone and the other plot positioned to ensure maximum diversity. Total diversity was regressed with island area and maximum elevation to determine if there were significant relationships. Larger islands tended to have greater elevational change, and the largest island with the greatest elevation change had the highest diversity. However, there were no relationships among total diversity and island area nor between total diversity and maximum elevation, suggesting islands may be acting independently. Nonparametric statistics were then used to test for significant differences in total diversity among elevations (hydrologic regimes), and between fore and zee sides. Zee sides had significantly greater diversity (random=58; high diversity=66) compared to fore sides (random=42; high diversity=53). The elevation with the greatest diversity for random and high plots was 2m elevation with diversity =20, corresponding to a hydrological regime of 37 inundations/year averaging 49 days inundation/year. The results show mid-elevations on islands have higher richness and % cover values. These results are consistent with the intermediate disturbance hypothesis. Experimental plots are being designed in order to examine niche vs. neutral controls on plant community assembly.

USE OF δD AND δ^{18}O TO TRACE THE ORIGINS AND MOVEMENTS OF MACROINVERTEBRATES IN LARGE RIVER FLOODPLAIN WATER BODIES

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Understanding energy and nutrient fluxes among floodplain water bodies and between rivers and their floodplains is essential for comprehending the dynamics of modern, altered river systems. Aquatic invertebrates may move between floodplain and river habitats deliberately (through emergence and dispersal) or through passive transport during flooding. These movements may represent significant fluxes of energy and nutrients. We assessed the usefulness of the stable isotopes of hydrogen and oxygen (D and ^{18}O respectively) for identifying the origins and movements of macroinvertebrates in Mississippi River floodplain water bodies. δD has been used to discriminate between terrestrial and aquatic contributions to aquatic food webs and has also proven useful as a natural marker for assessing fish movements between water bodies with distinct δD signatures. We sampled water and invertebrates from the Mississippi River channel, intermittent and permanent floodplain wetlands, and tributaries during 2007 and 2008. Results showed consistent relationships between δD and δ^{18}O signatures in invertebrate tissues and their home water bodies. We also investigated dietary effects on δD and δ^{18}O and the persistence of isotopic signatures in invertebrates that were removed from their home waters and raised in growth chambers. Results indicate that hydrogen and oxygen stable isotopes can be useful tools for assessing the origins of floodplain invertebrates and quantifying the relative inputs of different habitat types in large river systems to main channel food webs.

Keywords: stable isotopes, floodplains, macroinvertebrates, wetlands, food webs

USE OF IMAGING SPECTROSCOPY FOR WATER QUALITY ASSESSMENT OF THE MISSISSIPPI RIVER AND ITS MAJOR TRIBUTARIES IN MINNESOTA

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Minnesota has ~92,000 miles of rivers and streams, of which about 40 percent are estimated to be impaired. Airborne hyperspectral imagery or imaging spectroscopy has considerable potential to improve our ability to gather information on the spatial variability of water quality in these systems and may be especially useful in large, complex systems like the Mississippi and Minnesota Rivers. We have completed and evaluated results from three flights covering the major rivers of the Twin Cities Metropolitan Area. On August 19, 2004 high resolution (1-3 m), hyperspectral (35 bands) imagery were acquired with an AISA-Classic sensor over 65 km of six river segments. An AISA-Eagle Hyperspectral Imager with 2-m resolution and 97 contiguous bands (~2.5 nm from 435-724 nm and ~10 nm from 724-950 nm) was used to acquire imagery on 60 km of the Mississippi River from Spring Lake to Lake Pepin on August 15, 2005 and 100 km of the Mississippi River from the confluence of the Crow River to the confluence of the St. Croix River on August 30, 2007. For calibration, water samples were collected concurrently with the fly-overs. To provide a range of conditions for calibration, we focused these efforts around the confluences of major river systems with significantly different water quality characteristics. Samples were analyzed for total chlorophylls *a*, *b*, and *c*, pheophytin-corrected chlorophyll *a*, pheophytin *a*, total suspended solids, volatile suspended solids, and turbidity. Field measurements included turbidity tube and Secchi depth. This presentation will describe relationships found between spectral reflectance data and water quality characteristics, differences in water quality characteristics due to different flow conditions, and maps showing the complex interactions of sediment and algae in these river segments. In addition, we will discuss some practical issues related to planning and coordination of these complicated operations.

Keywords: hyperspectral imagery, imaging spectroscopy, river, water quality, airborne

PRELIMINARY ANALYSIS OF LAND COVER TRANSITIONS WITHIN SELECTED BACKWATER AREAS OF THE UPPER MISSISSIPPI RIVER FROM 1989 TO 2000

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Construction of the lock and dam system in the Upper Mississippi River (UMR) during the 1930s resulted in the formation of extensive backwater areas. The major concern regarding these areas was that allogenic succession would occur, whereby gradually accumulating sediments would eventually lead to the conversion of these diverse, productive aquatic habitats into more terrestrial habitats. However, as subsequent research has suggested, terrestrial habitats have actually decreased while open water habitats have increased. The main objective of this study was to examine specific landscape changes within selected backwater areas from 1989 to 2000 in order to determine the extent to which allogenic succession has or has not occurred. Study areas were selected and delineated using geographical information system (GIS) software for Pools 4 to 26 (excluding pool 15). The study areas were then converted to grids with a 10-m x 10-m cell size. Transition matrices were used to document the types and amounts of landscape changes occurring within the study areas. Preliminary analysis of the transition data indicates that the majority of transitions occurring within study areas were changes from a less flooded to a more flooded hydrology class (33 of 39 total study areas). This general trend was consistent for upper pools (4 to 13) as well as for lower pools (14 to 26). Also, the percentage of total study area classified as permanently flooded increased in 20 of the 22 pools analyzed. Thus, the preliminary results support previous studies that allogenic succession has not occurred during the time period considered in this study.

Keywords: Upper Mississippi River, backwater, allogenic succession, transition matrix, hydrology class

POPULATION ASSESSMENT OF THE PRAIRIE RINGNECK SNAKE (*Diadophis punctatus arnyi* KENNICOTT) DOES THE MISSISSIPPI RIVER CREATE AN EFFECTIVE BOUNDARY TO GENE FLOW?

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The genetic structure for many vertebrate species is dependent on the amount of gene flow in and out of a population. For the prairie ringneck snake, *Diadophis punctatus arnyi* Kennicott, a small fossorial snake species, the Mississippi River may play a role in the direction of gene flow. Since these snakes are small and not known to be aquatic, it can be inferred that the snakes do not pass genetic information across a barrier as vast as the Mississippi River. However, until examining the genetic structure of the population this cannot be assumed. Microsatellite DNA loci are highly variable neutral genetic markers that can be used to investigate the genetic structure of natural populations of organisms. By examining allelic variation at several microsatellite loci in snakes collected from Illinois with those collected from Iowa the genetic relatedness can be determined. Assignment testing can be done to determine if some snakes collected on one side of the Mississippi River have possible origins from populations genetically characterized on the opposite side of the river. We isolated 6 microsatellite loci from *D. p. arnyi* in order to genotype snakes on both sides of the Mississippi River. Preliminary data from microsatellite DNA amplified from snakes collected at the Alice L. Kibbe Field Station in Warsaw, IL (n = 34) show ample allelic variation for robust genetic analyses with numbers of alleles per locus ranging from 2 to 12. Mean expected heterozygosity (H_e) was 0.553 for the Kibbe sample. Microsatellite DNA from Iowa ringneck snakes and additional samples from Illinois were processed and data will be compared with the Kibbe sample. The knowledge gained from this research will lead to an increased understanding of the relationship and systematic status of the prairie ringneck snakes on both sides of the river and insights into their potential for dispersal

Keywords: prairie ringneck snake, gene flow, microsatellites, systematics, assignment testing.

EMERGING TECHNOLOGIES IN SPATIAL DATA COLLECTION AND PRODUCTION

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Digital technology has been the foundation of geographic information systems (GIS) and spatial data production from the beginning, but in recent years this technology has begun to revolutionize the data collection process as well. Medium-format and large-format digital cameras can document the earth up to 1-inch per pixel and have become the de facto standard for collection of aerial imagery. These cameras use state-of-the-art GPS navigation systems to collect and download precisely referenced images directly to massive on-board hard drives. Image header information contains detailed information about the image – date, time, shutter speed, focal length, latitude, longitude, elevation, the camera's precise position (roll, pitch, yaw) – and these readings are used by software to automatically reference the image to the earth's surface. Generating high-resolution elevation information has traditionally been a laborious and expensive endeavor but airborne laser scanners can quickly and relatively inexpensively collect centimeter-level elevation over large areas. Lasers in use today are fast enough to 'paint' the surface with spots one-foot apart and strong enough to generate multiple returns. This ability allows the user to accurately map not only the surface, but also the overstory and understory. GIS software and computer hardware are advancing just as rapidly. Small footprint, widescreen LCD monitors can now display digital aerial photography in stereo, effectively displacing manual stereoscopes as a better way to view and classify aerial photography. Since the digital photography is georeferenced, on-screen digitizing of the photos creates land cover/land use (LCU) data that is also georefernced, streamlining the spatial data workflow considerably. The Upper Midwest Environmental Sciences Center uses other advanced hardware and software to generate high-resolution, but highly-compressed aerial photo mosaics and digital elevation products. This presentation will demonstrate how advancements in digital technology are improving our ability to map and analyze the Upper Mississippi River System with greater detail, accuracy, and efficiency than ever before.

Keywords: GIS, spatial data, aerial photography, LIDAR, land cover/land use

INITIAL INVESTIGATIONS INTO THE SUCCESS OF AN INVASIVE SNAIL (*BITHYNIA TENTACULATA*) AND ITS PARASITIC HITCHHIKERS

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Bithynia tentaculata is an invasive aquatic snail that was introduced into the Great Lakes in the late 1800s. In 2002, it was discovered in the upper Mississippi River and since that time it has expanded its range southwards to Pool 11. In addition to the being a threat to native benthos, the snail also harbors 3 exotic parasite species that are responsible for the deaths of thousands of migrating waterfowl each year. Unfortunately, the specific factors that dictate the persistence and spread of both the snail and its parasites remain largely unknown. Over the last 8 months, we have utilized a combination of field-based approaches, experimental manipulations, and mathematical models to better understand this complex interaction. Results from this preliminary work suggest that *B. tentaculata* colonization may be restricted by particular habitat attributes and that the exotic parasites may enhance transmission to waterfowl by utilizing native snails as auxiliary hosts. The ecological and epidemiological consequences of these findings will be discussed.

Keywords: UMR, invasive organisms, parasites, waterfowl mortality, *Bithynia tentaculata*

IMPACT OF TRAP ORIENTATION AND PLACEMENT ON RIVER TURTLE CAPTURES

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Past research efforts on Mississippi River turtles by University of Dubuque student researchers have yielded inconsistent capture/recapture rates. We sought to compare trapping protocols (trap orientation and trap location) on river turtle captures within a backwater of 9-Mile Island in Pool 12 of the Mississippi River. We employed three trap orientations: A) all traps open toward shore, B) all traps open away from shore, and C) alternating traps open toward shore with traps open away from shore. Traps within each treatment were spaced four feet apart and connected by drift fencing that helped funnel turtles towards the trap openings. Drift fencing also was extended four feet from the edges of the terminal traps. Trap orientations were randomly assigend to three locations within the backwater: western edge, middle, and eastern edge. Although we successfully captured five species of river turtles within the backwater (*Apalone spinifera*, *Chelydra serpentina*, *Chrysemys scripta*, *Graptemys geographica*, and *G. ouachitensis*), only *Chrysemys scripta* were abundant throughout the study. Our data analysis will test the following null hypotheses: 1) there is no difference in river turtle captures between the different trap orientations and 2) there is no difference in river turtle captures between the different trap locations.

Keywords: turtles, *Chrysemys scripta*, trapping protocol

SPATIAL GENETIC STRUCTURE OF PIN OAK POPULATIONS ALONG THE UPPER MISSISSIPPI RIVER

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Pin oaks (*Quercus palustris*) are an important aspect of plant diversity in the Upper Mississippi River floodplain, but populations of this species are currently in decline. We applied six nuclear microsatellites to examine the spatial genetic structure of pin oaks within two stands along the Upper Mississippi River floodplain. The significance of these results will illustrate the distribution of gene flow throughout the extensive landscape of the upper Mississippi River. The evolution of this species during a century of flood disturbance and human alteration of the upper Mississippi River will provide significant preliminary insights concerning the molecular response to large-scale disturbances. This study will also help assess the genetic variety within populations of pin oaks to determine their possible future and the future implications to floodplain forests.

Keywords: pin oak, *Quercus palustris,* Mississippi River, genetic structure, microsatellites

EVALUATION OF ELECTRIC FISH DISPERSAL BARRIERS IN THE CHICAGO SANITARY AND SHIP CANAL

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Based on work described in more detail below, existing electric barriers in the Chicago Sanitary and Ship Canal by themselves are not likely to protect the Mississippi River from downstream movement of invasive fishes in the Great Lakes Basin. With improvements to the electric barriers and more attention to ways that invasive fishes could by-pass the barriers, including dispersal via the Des Plaines River and ballast water in inland barges, upstream movements of invasive fishes from the Mississippi Basin into the Great Lakes may be prevented, or at least delayed.

In 1990, the U.S. Congress authorized the Army Corps of Engineers to study barriers designed to prevent the downstream movement of round gobies (*Neogobius melanostomus*) and other harmful, invasive fishes from southern Lake Michigan through the Chicago canal system into the Mississippi River Basin (via the Illinois River, a tributary of the Mississippi). A demonstration electric barrier (Barrier 1) was activated too late (April 18, 2002) to block passage of round gobies, however it currently is the only barrier to upstream movement of Asian carps (*Hypophthalmichthys nobilis* and *H. molitrix*) from the Illinois River to Lake Michigan and has provided useful information for design of a second, improved barrier (Barrier 2) that is still being tested as of January 2009.

To assess the ability of Barrier 1 to prevent upstream passage of fish in the Chicago Sanitary and Ship Canal, we surgically implanted combined radio-and-acoustic transmitters in 130 common carp (*Cyprinus carpio*) and released them 20 m downstream of the barrier. Movements of these fish immediately upstream and downstream of the barrier were continuously monitored from April 2002 through December 2006 using fixed hydrophones and radio antennas to detect signals from the transmitters. In addition, 32 surveys were conducted with boat-mounted receivers within and beyond the 8.7-km reach bounded upstream by the electrical barrier and downstream by the Lockport Dam and Lock to locate transmitters that were out of range of the fixed receivers. The fixed receivers detected 109 of the 130 transmitters; most detections occurred within a few days after release of the fish. The tracking boat located 120 transmitters at least once and 100 at least twice.

Most transmitters remained well downstream of the barrier and upstream of the lock; however, one moved downstream beyond the lock, one passed upstream through the barrier, and four moved upstream within 60-400 m of the barrier after moving downstream. Three transmitters remained at the release point for their entire battery life, indicating that either the fish had died or the transmitters had been expelled. On two occasions, common carp were visually observed within half a meter of the surface (the limit of visibility) at the barrier. These fish were not observed to move beyond the downstream margin of the electric field. A traverse of the barrier occurred on 3 April 2003, at the same time as a tow was passing. The barge tow may have facilitated the fish's passage, either by entraining the fish or by distorting the electric field. The tracking boat detected the transmitter upstream of the barrier on 10 April 2003. The transmitter did not move more than 100 meters during its remaining battery life, indicating the fish was probably dead. After we reported the passage, Smith-Root, Inc. (operators of the electric barrier, under contract to the U.S. Army Corps of Engineers) increased the

strength of the electric field by 2X. There were no further passages of the electrical field by tagged common carp.

On 9 September 2008, 15 additional common carp were tagged and released between Barrier 1 and Barrier 2, which is located approximately 300 m downstream of Barrier 1. Both barriers operated together from 3-25 September 2008. The purpose of this release was to test the two barriers' ability to confine fish and prevent movement in both upstream and downstream directions.

On 13 September, heavy rains from remnants of Hurricane Ike caused severe flooding in northeastern Illinois and very high current velocities (1.5 m/sec) in the canal. One transmitter was located downstream of Barrier 2 before the storm, but there were no confirmed upstream movements of this transmitter, so the fish may have been dead. Several other transmitters were located 1.6-6.4 km downstream of Barrier 2 after the flooding. The path of transmitter 84, in particular, supports the conclusion that Barrier 2 does not prevent downstream movement of fishes, at least during high flows in the canal. Transmitter 84 was between the barriers before the storm, 2 km downstream of Barrier 2 after the storm, and subsequently made an upstream movement to a location just downstream of Barrier 2. The capture of two live salmon downstream of the barriers by an electrofishing crew on 24 September corroborated our observations of downstream passage of live fish.

As of September 2008 Asian carps had not been observed upstream beyond a point 48 km downstream of the barriers and thus may not have been in the vicinity of the barriers. Further testing and improvement of the barriers should be undertaken now, before the carp move closer to the barriers, to reduce the risk of upstream dispersal. Also, invasive fishes could by-pass Barriers 1 and 2 via flood overflows from the Des Plaines River which is adjacent to the Sanitary & Ship Canal. During and after the 13 September storm, the Des Plaines River was spilling into the canal well upstream of the two barriers. The Des Plaines joins the upper Illinois River downstream of the barriers and the Lockport Dam. Asian carps are likely to enter the Des Plaines soon.

Keywords: invasive fishes, barrier, Asian carps, Great Lakes, Mississippi River Basin

NOTES

SHALLOW BATHYMETRIC MAPPING OF BUFFALO CHUTE: EXAMINING CHANGE OVER TIME

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Buffalo Island Chute (side channel) is located along Middle Mississippi River (MMR), mile 24.5-26.3R. Channelization and maintenance of the 9 foot navigation channel has decreased the number and connectivity of side channels up and down the river. The goal of the Buffalo Chute Restoration Project is to increase connectivity of the side channel to the main river channel. The objectives are to physically alter structures in the chute to improve water quality, diversify habitat, and improve fish community structure and resiliency. Fish, water quality, and elevation data are being collected to quantify the changes before and after construction. Elevations were collected using boat mounted GPS depth sounders and exposed sandbars were mapped with GPS units and laser levels. All measurements were tied to the current river stage. Postponement of the restoration project allowed us to map the side channel's morphology at two different time periods pre-construction. Using ArcMap's Spatial Analyst extension we interpolated the elevations into two digital elevation models and subtracted them to detect the areas of change. Although floodplain processes have been drastically reduced outside the channelized banks, deposition and erosion are still at work within the active main channel and existing side channels. Our methodology was able to quantify and track these changes.

Keywords: Mississippi River, side channel, habitat rehabilitation, mapping, elevation, morphology

WATER QUALITY IN BACKBONE STATE PARK, IOWA, AND POSSIBLE SOURCES OF CONTAMINATION

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Backbone State Park, Iowa's first state park, is beautiful with towering limestone cliffs, a cool flowing trout stream and a large reservoir. Despite this fact, in recent years, swimming has been suspended in the lake due to large algae blooms leading to bacterial accumulation in the summer months. The purpose of this study then is to find a source for the algal blooms that have led to the suspension of swimming. The area of the study is Backbone State Park and the Maquoketa River watershed that leads into the reservoir. The first year of the project has been to collect background samples for comparison against future data and to identify potential source streams to be more closely studied later on. All sampling has been done with IOWATER testing supplies and include sampling for phosphorus, nitrates, nitrites, pH, DO, and similar water quality readings. At this point the data have shown elevated levels of phosphates in northern streams near the town of Strawberry Point. Further sampling is required to pinpoint a direct source.

Keywords: water quality, Backbone State Park, watershed, IOWATER, phosphorus

CONSOLIDATION OF SAND AND ITS RELATIONSHIP TO THE DREDGING COMMUNITY

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The United States Army Corps of Engineers (USACE) are in charge of dredging operations for America's rivers. The work is subcontracted through environmental grants and maintenance programs. Yearly, the USACE takes depth soundings to determine need for dredging. However, the locations of soundings may vary. Since the material being dredged is in a state of 100% saturation, weight is insufficient for quantifying the amount of material moved. In addition, the volume is dependent upon compaction. Thus, determining the volume of material dredged is not a trivial task.

In this case study, sand was dredged and moved to Lock and Dam #4 embankment to create a beach and to establish vegetation for wildlife and the local community. The USACE determined that approximately 35,000 CYDs were needed in this area. The contractor moved approximately 50,000 CYDs, as determined by truck counts. However, the USACE's use of the Philadelphia Method estimated considerable less was moved. In this study we show that the discrepancy results from the changed in volume from the in-situ condition of the sand to that after it was dredged, stored, and weathered.

Keywords: sand, dredging, Philadelphia Method, USACE, consolidation

ASSESSING DETERMINANTS OF NEAR-SHORE MACROINVERTEBRATE COMMUNITIES SURROUNDING A SUITE OF ISLANDS IN NAVIGATION POOLS OF THE UMR

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Relatively little is known about the structure of near-shore, aquatic macroinvertebrate communities surrounding islands of the upper Mississippi River (UMR). This is a significant shortcoming, especially in light of the fact that a number of invasive species such as the aquatic snail, *Bithynia tentaculata*, are currently establishing in the region. In order to address this issue, we sampled macroinvertebrate communities around a total of 16 islands spanning Pools 7 and 8 of the UMR during the summer of 2008. Collection sites were established based on their variability in characteristics such as age, channel position, proximity to river inlets, substrate profiles, water flow, and macrophyte densities. Macroinvertebrates were exhaustively sampled on a biweekly basis at 4 sites around each of the 16 islands. Organisms were identified and enumerated upon return to the laboratory. Pooled data demonstrate important spatial differences in taxonomic richness across sites. As an extension of this work we also investigated the association between *B. tentaculata* densities and taxonomic richness. Interestingly, regression analysis revealed a significant and negative relationship. The consequences of this relationship and the general variability of macroinvertebrate taxa in the UMR will be presented.

Keywords: UMR, islands, macroinvertebrate community structure, *Bithynia tentaculata*

WOOD EXCAVATION BY COMMON NET-SPINNING CADDISFLIES: THE EFFECT OF WOOD TYPE

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In 2007 we reported that net-spinning caddisflies in the upper Mississippi River (UMR) excavated exposed Masonite surfaces on Hester-Dendy artificial substrates (H-DAS). These findings suggested that given the historical levels of natural wood substrates throughout the UMR, caddisfly excavation may have been and may still represent a significant amount of organic processing and seston generation. Additional studies in the spring/summer of 2007 and 2008 examined the effect of wood type on hydropsychid excavating behavior. Modified H-DAS samplers were constructed using natural, unfinished wood plates [red oak (*Quercus rubra*) and poplar (*Poplus* sp.)] and deployed for colonization in main-channel border habitats of Pool 8. Although many samplers were lost during the extreme hydrological events of August 2007 and June 2008 in Pool 8, adequate H-DAS were retrieved to address our initial questions. Hydropsychids had excavated both wood types following a 93 day colonization period (June 30, 2008 – October 2, 2008). Excavated pits were larger in area and deeper on the poplar than on the red oak plates. Mean (± SE) breakdown rates (% loss· day^{-1}) were 0.211% ± 0.007% and 0.163% ± 0.006% for poplar and red oak, respectively.

Keywords: net-spinning caddisflies, Mississippi River, wood excavation, natural-wood substrates

TEMPORAL PATTERNS OF FISH STOICHIOMETRY IN TWO GEOMORPHOLOGICALLY DISTINCT REGIONS OF THE UPPER MISSISSIPPI RIVER

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Knowledge of nutrient balances of fishes of the Upper Mississippi River over the past century is important in identification of the effects of anthropogenic disturbances on ecosystem function. Two common causes of anthropogenic disturbance on the Upper Mississippi River are changes in water regulation and fertilization of fields, both of which will impact nutrient dynamics at both small and large spatial scales. Carbon, nitrogen, and phosphorous ratios were analyzed from a piscivore, *Sander canadensis* (sauger), and a planktivore, *Dorosoma cedepianum* (gizzard shad), to compare the differences between two geomorphologically distinct regions of the Upper Mississippi River from the past century. Museum specimens were used from for +100 km-ling sections of the Upper Mississippi River above and below Clinton, Iowa. Clinton, Iowa was used because there were two different periods of glaciations in this region, each leaving a unique impact on the landscape. Preliminary results for both above and below Clinton, Iowa showed carbon:nitrogen ratios of *Dorosoma cedepianum* were highly variable, whereas C:N ratios for *Sander canadensis* generally decreased from 1940 to 1995. Fluctuation in C:N appears to be more a function of natural variability within the system rather than in response to major disturbances. Variation in C:N over time was, however, greater in fish from below Clinton, which may be attributable to naturally and anthropogenically low lateral complexity of this portion of the river. Results of phosphorus analysis will be included in our formal presentation.

Keywords: carbon, fish, nitrogen, nutrients, phosphorus, stoichiometry

BUFFALO CHUTE SIDE CHANNEL RESTORATION PROJECT

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Natural resource agencies that manage the Middle Mississippi River identified Buffalo Island Chute as an ecologically important side channel in 2000, deeming it worthy of habitat rehabilitation. This chute is one of several island complexes that becomes isolated from the main channel during low river stages. The primary purpose of the Buffalo Chute Restoration Project is to increase connectivity of the side channel to the main river channel. The proposed rehabilitation work (to be completed in 2011) calls for notching both the downstream closing structures to bed elevation, dredging the sand plug at the lower end to bed elevation, constructing two short dikes perpendicular to the right descending bank of the side channel below the internal closing structure, and placing woody structures along the right descending bank in the upstream pooled portion of the side channel. The Open Rivers and Wetlands Field Station (ORWFS) initiated a pre-construction fish community (summer and winter) and water quality monitoring program that will be used to evaluate the proposed modifications to the chute complex. To date, two years of sampling have been conducted. For both years, fish samples were dominated by minnows (Cyprinidae) in both seasons. Species richness averaged 26 with the highest richness (N=40) in summer of year two and the lowest richness (N=26) in winter of year two. Species diversity estimates were higher in year one compared to year two, H' = 3.6 and 3.2, respectively. Similarly, Camargo's Index of Evenness was greatest in year one compared to year two, E' = 0.22 and 0.16, respectively. Water quality measurements were collected using a Hydrolab DS 5X datasonde and Van Dorn vertical sampler. Measurements were summarized for the two years of pre-construction monitoring.

Keywords: Mississippi River, side channel, habitat rehabilitation, Cyprinidae, Buffalo Chute

ASIAN CARPS IN THE MID-CONTINENT GREAT RIVERS

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Great river research has been ongoing by multiple federal, state, and multi-state organizations in the Upper Mississippi, Missouri, and Ohio rivers. Concurrently, expansion of Asian carps in the central US presents a huge challenge to resource managers. Together, these programs shed light upon our understanding of the various effects of non-native species. Invasive bighead *Hypophthalmichthys nobilis* and silver carp *H. molitrix* catches showed increasing populations in all of these rivers, with exponential increases in some reaches. Data from the Illinois River has documented reduced body condition in native planktivores (gizzard shad *Dorosoma cepedianum* and bigmouth buffalo *Ictiobus cyprinellus*) since the Asian carps invasion. A recent population estimate for silver carp highlights the concern regarding these fish, with an estimated 4,100 sub- and adult fish per river mile in La Grange Reach, Illinois River. Data throughout the rivers confirms a strong correlation among spawning success and hydrology. Further analysis of relative catch rates will allow for temporal and spatial comparisons. Wide ranging monitoring efforts and comparisons across geographical and/or political boundaries are essential for inter-jurisdictional fisheries management.

Keywords: bighead carp, Illinois River, gizzard shad, great rivers, status, Mississippi River, Missouri River, non-native, Ohio River, silver carp

EXPLORING CAUSES FOR INCREASING NITRATE CONCENTRATIONS IN THE LOWER ST. CROIX RIVER

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Nitrate loads from the upper Mississippi River Basin contribute to the Gulf Hypoxia problem, and nitrate management is becoming an important concern in the Midwest and Central U.S. Monitoring data from the Metropolitan Council indicate that nitrates in the St. Croix have increased since the mid-1970s, particularly at downstream monitoring stations in Lake St. Croix. Various factors may contribute to these trends, including increases in fertilizer application and runoff, changes in wastewater treatment practices, increases in regional nitrogen oxide emissions and atmospheric deposition, and changes in soil denitrification processes.

Stable isotope analysis can help identify sources of nitrogen and clarify the relative importance of wastewater versus fertilizer inputs. δ15N signatures are measureable in water and biota. We measured nitrate concentrations and investigated patterns in δ15N signatures in water (nitrate), phytoplankton, and zebra mussel tissue. We hypothesized that nitrate concentrations would increase from upstream to downstream in Lake St. Croix, that the δ15N signal in water and biota would reflect wastewater influence at upstream sites and fertilizer influence at downstream sites, and that the δ15N signal would show less seasonal variability in zebra mussels than in phytoplankton or water. In a related study, we are looking at 13C and 15N isotopes in zebra mussels and resident fish in an attempt to link fish species predation to the invasive mollusk.

We collected water samples for nitrate concentration and stable isotope analysis from seven Lake St. Croix sites (from near Arcola to near Prescott), from five tributaries (Brown's Creek, Valley Creek, Trout Brook, and the Willow and Kinnickinnic Rivers), and from two wastewater treatment plants (Hudson and St. Croix Valley, near Bayport). We sampled zebra mussels from the five lowermost St. Croix sites and phytoplankton from all mainstem St. Croix sites. We repeated the sampling five times from May to October 2008, capturing a range of hydrologic conditions.

Results from the first four sampling events indicate that mean nitrate-N concentrations for Lake St. Croix sites ranged from 0.12 mg/l near Stillwater and Bayport to 0.34 mg/l near Prescott. Mean tributary nitrate-N concentrations ranged from 0.73 mg/l in Brown's Creek to 5.49 mg/l in Valley Creek, and mean wastewater treatment plant concentrations were 4.98 mg/l and 13.98 mg/l for Hudson and Stillwater, respectively. Concentration results indicate that the pattern of increasing nitrate levels from upstream to downstream is caused mainly by inputs from lower tributaries to Lake St. Croix. Stable isotope analyses are underway, and preliminary results may be available by the conference.

Keywords: nitrates, zebra mussels, water quality, St. Croix River, stable isotope analysis

TROUT STOCKING IN IOWA COLD-WATER STREAMS: DOES IT IMPACT NATIVE FISH DIVERSITY?

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Trout stocking generates substantial revenue for the Iowa Department of Natural Resources and provides recreational opportunities for many. Not all cold-water streams in eastern Iowa receive trout during the annual stocking campaign. We sought to determine the impact of trout stocking on native fish diversity in cold-water streams in Dubuque County, Iowa. We sampled at least twice monthly from mid-June through late-October in three cold-water streams located within parks managed by the Dubuque County Conservation Board. Two of the streams are regularly stocked with brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), and rainbow trout (*Oncorhynchus mykiss*). The third stream served as a reference site for comparison. At each site, sampling locations were selected that contained a riffle, run, and pool. Sampling involved electro-shocking along both banks and midstream in an upstream direction for ~50-meters. In addition to fish community sampling, we also evaluated water quality using the basic IOWATER protocol for stream monitoring. We will present results from our analyses that compare fish community structure between stocked streams and the unstocked reference site. In addition we will consider the impact of abiotic factors on fish community structure.

Keywords: cold-water streams, native fish diversity, stocking, trout, water quality

THE TEMPORAL OCCURRENCE OF NITROGEN FIXATION ALONG A CHANNEL-BACKWATER CONNECTIVITY GRADIENT IN NAVIGATION POOLS 6 AND 8 OF THE UPPER MISSISSIPPI RIVER

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Nitrogen distribution is both spatially and temporally heterogeneous within the Upper Mississippi River (UMR). The distribution of dissolved inorganic nitrogen (DIN) is strongly affected by river elevation and therefore discharge. Highly connected sites receive frequent water exchanges from the main channel and have low water residence times (WRT) and higher DIN. Less connected or isolated sites have infrequent or absent water exchanges, increased WRT, and reduced dissolved inorganic nitrogen. Past work indicated that sites with no or low connectivity exhibit low water column DIN and likely low nitrogen to phosphorus (N:P) ratios that would favor the development of nitrogen fixing cyanobacteria, particularly during the summer low water period. To date, no published study has demonstrated the temporal or spatial context of nitrogen fixation in the UMR system. We conducted nitrogen fixation assays employing the acetylene reduction technique at 14-day intervals during the summer of 2008. Assays were conducted at six sites representing a gradient of connectivity. The sites ranged from a completely isolated backwater, to intermediate connectivity sites receiving limited flow from the main channel, to a main channel site within the Mississippi River. We also sampled water column nutrients and chlorophyll *a*. The highest nitrogen fixation rates (216 $\mu M\ C_2H_4 \cdot m^{-2} \cdot h^{-1}$) were observed in the isolated backwater (Trempealeau National Wildlife Refuge, TNWR) in late July, and were 4 to 20 fold those rates observed at other sites. Low rates (20 $\mu M\ C_2H_4 \cdot m^{-2} \cdot h^{-1}$) were observed in the main channel. Nitrogen fixation generally peaked in August and coincided with the period of cyanobacteria dominance in the river. The onset of the summer fixation was marked by declining N:P ratios prior to the chlorophyll *a* maxima. No threshold N:P ratio consistently predicted the onset of fixation. Generally, nitrogen-fixation in lakes is considered to be a late summer event when water temperatures are high, dissolved inorganic nitrogen is low, and N:P ratios are low favoring the development of cyanobacteria blooms. Our research supports this view, but also indicates that fixation had already occurred and was in decline by late May and June in the isolated backwater (TNWR) and our lowest intermediate connected site (Lawrence Lake). Ironically, Pool 8, a system estimated to transport ~80,000 terragrams per year of nitrogen, can at times be both spatially and temporally nitrogen limited for some autotrophic taxa.

Keywords: nitrogen fixation, acetylene reduction assay, N:P ratio, nitrogen phosphorus, nitrate, cyanobacteria, Lawrence Lake, Trempealeau National Wildlife Refuge

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

SHALLOW BATHYMETRIC MAPPING OF FLOODPLAIN WETLANDS TO ASSIST MANAGEMENT DECISIONS

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Understanding how topography structures habitat heterogeneity is an important factor for successful wetland planning, management, and restoration. Wetlands by nature are relatively "flat" compared to the surrounding landscape. These areas often do not have adequate elevation information because surveys lack detail or are non-existent. Priorities, logistics, and expenses are often limiting factors in obtaining this information. LIDAR is often too expensive to obtain and the vertical accuracy is $\pm$ 15 cm at best. Ground surveys through timber are typically slow and expensive. Utilizing handheld GPS and known water levels, we have developed a cost effective method of shallow bathymetry within small flooded wetlands. Tying this topographic information to the site hydrology can provide valuable information for wetland managers, i.e. flood coverage and frequency, habitat availability, and vegetation distribution. In this presentation we will illustrate the collection and use of such data and management implications for two green tree reservoirs in southeast Missouri and a passively managed early successional wetland connected to the Mississippi River.

Keywords: wetland, topography, mapping, green tree reservoir, management, bathymetry, hydrology

INFLUENCE OF HABITAT ATTRIBUTES ON INVERTEBRATE STOICHIOMETRY IN A LARGE FLOODPLAIN RIVER

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Large river systems are a mosaic of complex and diverse patches. It is important, therefore, to study these patches to better understand dynamics of the entire riverine landscape. A critical component in river health and diversity is the balance of critical elements flowing through the food web. This balance can be examined through analysis of the stoichiometry, or ratio of critical elements, of consumers. Patch dynamics of backwaters vary from main channel habitats, which should create differences in the stoichiometric composition of the invertebrates. Carbon and phosphorous compositions of invertebrates from both backwater and main channel habitats were used to identify the influences of habitat on the stoichiometric composition of invertebrates. Samples were collected from backwater and main channel habitats in Reach 6 on the Upper Mississippi River near Winona, Minnesota in July 2008. Specimens were collected and initially frozen. Seventy percent ethanol was added prior to sorting invertebrates to the lowest reasonable taxonomic level. Carbon content was determined using a TOC analyzer, while phosphorous content was quantified spectrophotometrically. Preliminary analysis indicates that algal grazers and omnivores have a higher carbon content in backwater habitats. Zebra mussels and predators showed no differences in carbon composition as a function of habitat. The lack of difference in carbon content of predaceous invertebrates may reflect their trophic status and greater flexibility in resource use. Analysis of phosphorous concentrations is ongoing and will be reported at in the formal presentation. Analysis completed to date suggests the presence of qualitative differences in nutrient availability for invertebrate consumers as a function of habitat.

Keywords: stoichiometry, carbon:phosphorus ratio, patch, invertebrate, food web

MICROCRUSTACEAN DYNAMICS ALONG A CHANNEL-BACKWATER CONNECTIVITY GRADIENT IN POOLS 6 AND 8 OF THE UPPER MISSISSIPPI RIVER

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Degree of connection of flood plain habitats with the main channel is hypothesized to exert large control over the ecology, biogeochemistry, and biology of the interacting habitats. Highly connected habitats tend to have shorter water residence time (WRT), greater nutrient supply and homeostasis, and potentially higher water column productivity. More isolated (low connectivity) habitats have longer WRT, greater variation in nutrient (esp. nitrogen) concentrations, and lower water column productivity but greater macrophyte productivity. During floods, water and nutrients are replenished and more isolated habitats may exhibit a bump in water column productivity. Microcrustacean zooplankton are important elements of the base of lake and river foodwebs, have relatively short generation times and fast growth rates, but are poor swimmers and tend to exhibit population suppression in systems with short WRT. We would expect their habitat-specific density to reflect degree of habitat connectivity. Here we report results of a study evaluating the effects of habitat connectivity on microcrustacean dynamics, nutrient and chlorophyll concentrations, and relative fish densities. We test the hypothesis that variation microcrustacean density is related to hydraulic connectivity and covarying factors. We expected that the slow swimming, bulky Cladocera would be most sensitive and the rapid swimming, stream-lined Copepoda least sensitive to WRT dynamics . Further, we expected mean nutrient concentrations would be highest in the most connected habitats.

We sampled microcrustacea (63 um mesh net – vertical hauls), water column nutrients (soluble and total P, nitrate, ammonium and total N), chlorophyll a, and total and volatile suspended solids, and fish (relative abundance) in 6 sites arrayed along a connectivity gradient. Sites, from least to most connected, included Lawrence Lake, Trempealeau NWR, Stoddard Island Complex – Inside, Round Lake, Stoddard Island Complex – outside, and Main Channel Border. Sites were sampled 5 – 7 times from May through August 2008.

Preliminary results show concentrations of soluble nutrients and suspended solids were more highly correlated to site-specific water velocity and river discharge in the more connected than more isolated sites. Zooplankton abundance was related to river discharge, and site-specific water velocity, and fish abundance; these relationships varied by site and sampling period. Hydraulically induced variation was strongest at the level of soluble and particulate material, and less so with microcrustacea. The response of microcrustacea to a connectivity gradient is complex and likely confounded by fish predation.

Keywords: connectivity, foodwebs, microcrustacea, nitrogen, phosphorus, Navigation Pool 8, Navigation Pool 6

INFLUENCE OF HYDROLOGICAL RETENTION TIME ON COMMUNITY COMPOSITION OF RIVERINE ZOOPLANKTON

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As organisms living in the water column, zooplankton are susceptible to the detrimental effects of current velocity and turbidity. The objective of this study is to test the hypothesis that the density and diversity of zooplankton (specifically Copepods and Cladocerans) will be reduced in river habitats exhibiting short hydrological retention time. Turbidity was used as a surrogate for hydrological retention time. Timed horizontal tows and vertical hauls of known distance were performed using Wisconsin nets (63-mm mesh) to sample zooplankton at 16 different sites of Reach 6 of the Upper Mississippi River. Sites were sampled on three dates, which had a range of river discharge. The 16 sites varied in vegetation, hydrological conditions, turbidity, and connectivity to the main channel. Samples were preserved after collection, then identified to species and enumerated. Regression analyses showed a significant negative correlation between turbidity and taxa richness ($R^2 = 0.17$, $p = 0.003$). A significant negative correlation between the total number of zooplankton L^{-1} and turbidity was also found ($R^2 = 0.23$, $p = 0.009$). Cluster analysis was performed to examine relationships between hydrological retention time and community composition. Cluster analysis showed six different groupings of sites, indicating six different types of community compositions. Groups matched well with turbidity, but community composition of grouped sites also appeared to be influenced by abundance of vegetation and current velocity. In conclusion, based on the regression analysis, we have found that zooplankton density and diversity was negatively affected by turbidity. We conclude that zooplankton community composition does change as a function of hydrological retention, but that other influences, such as predation, also account for differences in community composition of crustacean zooplankton.

Keywords: zooplankton, turbidity, hydrological retention, diversity, patch

THE VOLUNTEER STREAM MONITORING INTERACTIVE VERIFICATION PROGRAM AND OTHER WEB-BASED TOOLS

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Web interactions in the past decade have significantly increased. Students, faculty and independent learners use the web as a research tool either by researching an article or a Google search on a specific topic. In order to more widely disseminate our outreach products, the Chironomid Research Group at the University of Minnesota developed and posted to our website an interactive verification guide for aquatic macroinvertebrates of the Upper Midwest in December 2006. To date, more than 40,000 users from all 50 states and other 147 countries have visited and interacted with our program, and the number of times the website has been accessed is approaching 2 million hits. Use of the pages continues to grow daily and clearly demonstrates the acceptance of web based tools by citizen volunteers working with biomonitoring of aquatic systems.

Furthermore, due to the success of our verification pages, and as a means of extending to the different ethnic communities in the Twin Cities Region, we are now able with the support from the Minnesota Sea Grant Programs to translate our verification key into four other languages; Hmong, Mandarin, Somalie and Spanish. We expect these planned improvements to our website to bring a further increase in web interactions and provide an accessible resource for those who are not familiar with the English language and do not have extended access to research library collections.

Additionally, recent graduates from the Chironomid Research Group have developed and have now posted project-specific taxonomic keys to genus or species for the pupal exuviae of Chironomidae on our website. Even though these keys are specific to the students' individual research projects, collectively they provide a valuable resource for those interested in Chironomid taxonomy in streams and lakes in the Upper Midwest. Having them accessible on the web facilitates research and learning by professionals in other research labs. Both the Volunteer Stream Monitoring Interactive Verification Program and project-specific key to pupal exuviae are available at:
http://www.entomology.umn.edu/midge.

Keywords: aquatic invertebrate, Chironomidae, Upper Midwest, stream monitoring, water quality, verification, citizen volunteers

BREEDING BIRDS OF THE UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE

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Landbirds are an important trust resource of the United States Fish and Wildlife Service. The Upper Mississippi River National Wildlife and Fish Refuge is arguably the most important refuge for migrating birds in the upper midwestern United States. However, little is known about the landbird assemblages associated with the refuge. Thus, our objectives were to characterize the avian assemblages associated with seven main habitats within the Upper Mississippi River floodplain, with specific interest in identifying seasonal patterns, identify bioindicators of these seven habitats, discerning trends in focal bird species, visualize spatio-temporal patterns in observed counts, and test new methods for informing mapped patterns in species-habitat suitability. Avian point count data were collected in spring, summer, and fall seasons between 1994 and 2003. The total number of birds counted on the refuge was 88,025 from 1,785 point counts. Two hundred twelve species were recorded on the refuge, though rarefaction analyses suggests as many as 234 species may utilize the refuge at least in some parts of the year. We found little differentiation in the annual and seasonal composition of the avifauna. Habitat played the most important role in characterizing assemblages. The best surveyed habitats were bottomland hardwood and upland prairie. We found the broadest assemblage to be associated with bottomland hardwood, with 26 species comprising the top 90% of the spring community. The most common species in both spring and summer in bottomland hardwood were American Redstart, American Robin, and House Wren. Eastern Meadowlark, Field Sparrow, and Grasshopper Sparrows were indicators for upland prairie. Because of the broad overlap in some habitats, there were few species strongly indicative of other habitats. The refuge may be more efficient in managing for birds by consolidating their habitat descriptors into a narrow subset, combining, for instance, upland forest, upland bluff, and bottomland hardwood into a common forest category. We found credible declines in four species, the American Redstart, Gray Catbird, Swamp Sparrow, and Red-winged Blackbird, but these declines did not correspond with regional declines noted by the North American Breeding Bird Survey. An empirical Bayes update of species-habitat associations corresponded well with our assemblage analyses. These analyses suggested Great-crested Flycatcher, American Robin, Northern Oriole, and Song Sparrow exhibited the greatest generality among the species examined. Conversely, 30 of the 76 species were highly specialized, associated with only one habitat. The Upper Mississippi River and Great Lakes All-bird Joint Venture has identified the Upper Mississippi River as an important area for regional conservation of marsh breeding and non-breeding birds. Our analyses, however, also suggest that the refuge is an important site for landbird conservation, and thus can play a critical role in meeting the protection/maintenance targets of the Joint Venture. The Strategic Habitat Conservation doctrine of the United States Fish and Wildlife Service encourages the monitoring of conservation action. We recommend balancing intensive project-based monitoring against a surveillance aspect.

Keywords: assemblage analysis, bottomland hardwood, trend estimation, upland prairie

EVALUATION OF POST-FLOOD CYPRINID RECOLONIZATION IN EASTERN IOWA COLD-WATER STREAMS

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Following the massive flooding events of 2008 which impacted Iowa during the late spring/early summer, we sought to document the recolonization of cold-water streams by cyprinids. We sampled at least twice monthly from mid-June through late-October in three cold-water streams located within parks managed by the Dubuque County Conservation Board. Two of the streams are regularly stocked with trout by the Iowa Department of Natural Resources. At each site, sampling locations were selected that contained a riffle, run, and pool. Sampling involved electro-shocking along both banks and midstream in an upstream direction for ~50-meters. In addition to fish community sampling, we also evaluated water quality using the basic IOWATER protocol for stream monitoring. Our data analysis will be testing the following null hypotheses: 1) there will be no difference between sites in the pattern of cyprinid recolonization, 2) there will be no difference in cyprinid community structure within each site between sampling times, 3) there will be no difference in IOWATER measurements between sites through time, and 4) there will be no predictive value on cyprinid community structure by IOWATER measurements.

Keywords: cyprinids, flooding, recolonization

NOTES

MINUTES OF THE 2008 BUSINESS MEETING
ANNUAL MEETING OF THE MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.

25 April 2008

President Ickes called the business meeting to order at 1:50 PM. In attendance were Brian Ickes (President), Roger Haro (Vice President), Robert Miller (Secretary), and around 60 members of the Consortium.

President's Report

Acknowledgements

President Ickes presented a plaque and honorarium to the keynote speaker, Matthew Dacy, Director of the Mayo Clinic's Heritage Hall. The Dubuque conference planning committee members were recognized and thanked: Dr. Robert Miller, Dave Bierman, Dr. Andrea Bixler, Tom Boland, Dr. Dan Call, Mike Steuck. Thanks were also extended to Georgina Ardinger and Cammy Smith for their efforts in meeting registration; to Terry Dukerschein, Becky Kreilling, and Shelly Bartsch for conducting the raffle and securing raffle donations; to Tom Claflin for donating a custom fishing rod, to Brent Knights for donating an ice shanty; to David Kennedy, Patrick Costello, and Herb Lange for donating wildlife prints/photos; to TNT Gallery (Dubuque) for matting prints; and to the many Consortium members who donated their talents and additional raffle prizes. President Ickes thanked Ben Schlifer and Mike Caucutt from the Upper Midwest Environmental Sciences Center for their audiovisual support, and Brent Knights and Mike Caucutt for web support; and he expressed appreciation for the work of judges and moderators. Chelsea Ulm was acknowledged for her assistance in scanning past conference abstracts and building a searchable database for *Hydrobiologia* authors. President Ickes thanked the Upper Midwest Environmental Sciences Center and the Illinois Natural History Survey for providing travel support for individuals who helped run and support the annual meeting.

Minutes

President Ickes asked if there were any corrections to be made to the minutes of the 2007 meeting as presented in the 40th Annual Proceedings. In the listing of past officers, Jeff Arnold was added as President for 2003. The spelling of Marian Havlik's name was corrected. A motion to approve the minutes as corrected was made by R. Sparks, seconded by J. Wiener, and passed by the members present.

Meeting Attendance

President Ickes announced that the official meeting attendance for 2008 was 108 registrants, slightly lower than the 114 in 2007 and the same as the 108 in 2006. He noted that the number of posters increased over 2007 and there were almost as many platform presentations as in 2007, and he commended the varied and stimulating program presented during the meeting. President Ickes called attention to the notable success of the annual meeting, particularly in view of the fact that the Consortium " took it on the road" for the first time in many years and attracted participants from a broader area.

Awards

The award for best student platform presentation was presented by President Ickes to Bethany Dalrymple of Missouri State University. He presented the award for best student poster presentation to Bradley Austin of Fort Hays State University, Kansas. A student travel award and stipend of $200 was presented to Nerissa Michaels of the Illinois River Biological Station, Havana (Greg Sass, advisor) by President Ickes.

Note: due to a schedule conflict, a special award that had been planned for the Banquet was presented earlier, during Thursday's platform program. President Ickes presented the Consortium's **Friend of the River Award**, together with a commemorative plaque, to Marian E. Havlik, Malacological Consultants, La Crosse, WI, based on her many years of significant contributions to the Consortium and to knowledge of the Upper Mississippi River. This is the most significant award presented by the Mississippi River Research Consortium and it is awarded only on occasion to a particularly deserving individual.

Treasurer's Report

President Ickes called attention to the report submitted by Treasurer Neal Mundahl (*in absentia)* as listed on page 74 of the Proceedings. As the report shows, funding for the Consortium is holding steady. An added obligation this year for publishing the special issue in *Hydrobiologia* was noted, with the expectation that the costs of the publication will be recovered, and hopefully exceeded, by sales of the special issue. Also, expenses for this year's conference were marginally higher than in those years when the conference has been held in La Crosse. Those costs were covered through a slight increase in registration fees this year. A motion to accept the Treasurer's report was made by M. Havlik, seconded by M. Romano, and passed by the members present.

Old Business

Annual Meeting Dates

Future dates for the annual meeting will be April 30 and May 1, 2009, and April 22 and 23, 2010 at the Radisson Hotel in La Crosse, WI. The Board also entered into a contract with the Radisson Hotel for 2011 due to competition with another party for preferred dates, and the annual meeting in 2011 will be held on April 28 and 29. The Radisson Hotel in La Crosse is presently reserved for April 26 and 27, 2012 although a contract has not been signed.

Posting conference content on the MRRC website

President Ickes reviewed two recommendations that were made from the floor during the 2007 business meeting. The first was by Ken Lubinski, inquiring whether PowerPoint files from platform presentations could be posted to the MRRC website. The second was by Marian Havlik, inquiring whether past MRRC conference abstracts could be scanned and posted in a way so that they could be searched. Both ideas have proven difficult to implement. The MRRC website is hosted by USGS and USGS has to meet certain legal standards for the content it posts under the Americans with Disabilities Act. Essentially, content needs to be in a format that allows search engines to index every piece of

information in the content. Scanned abstracts are not conducive to this requirement and PowerPoint files would have to be specially formatted. We lack the time and resources to achieve these recommendations given present limitations. MRRC was able, with the help of volunteer Chelsea Ulm, to scan all past MRRC abstracts as image files, and build a searchable keyword database. Principally, only *Hydrobiologia* authors have used this resource to date, but it can be provided to anyone who may wish to have it. Send requests by e-mail to Brian Ickes.

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

New Business

National Great Rivers Research and Education Center – International Conference
Dr. John Chick presented information about an upcoming international conference to be sponsored by the National Great Rivers Research and Education Center in Alton/Godfrey, IL. The conference will be held August 11-13, 2009 at the Collinsville, IL Holiday Inn, and its topic is " Visions of a Sustainable Mississippi River: Merging Ecology, Economy, and Cultural Values". To highlight the potential of the conference, Dr. Chick presented a DVD: "The Confluence Field Station".

40th Anniversary Special Publication
Dr. Susan Romano reported on the progress being made on the special issue of *Hydrobiologia* being published. She summarized the project and the procedures being followed. The volume will feature a synthesis of Upper Mississippi River research provided by several authors, and it will be a valuable resource for researchers and managers. Consortium members were asked to purchase a copy for $ 64.50, and to recommend purchase to institutional libraries. Interest in the publication had been, of course, generated by the presentations of authors during the special Synthesis session earlier Friday, and by the round-table discussion with authors which followed.

Draft Amendment to MRRC Bylaws
President Ickes brought up for consideration the draft amendment to Article 6.01 (Annual Meeting) of the MRRC Bylaws that is listed on page 82 of the 2008 MRRC Proceedings. Mike Romano made a motion to approve the new language in the Bylaws; it was seconded by John Chick, and passed by the members present.

Should MRRC initiate a leadership role in fostering communication among major research institutions in the Upper Mississippi River basin?
President Ickes presented this matter, pointing out that it would be a means to grow the membership, a means to diversify geographic representation and discipline participation, a means to facilitate extended collaboration, and a means to identifying research priorities in the basin. Roger Haro noted that this would be a way to address issues raised at the round-table discussion during the Synthesis session. Ken Lubinski supported the concept, suggesting collaboration on modeling, as with the University of Iowa field station on pool 16 (represented by Doug Schroebelen from the station). The idea of charging a special committee with the task was raised. Chuck Theiling asked that Army Corps people be included. Marian Havlik supported the idea of forming a committee. Rip Sparks suggested John Tucker to serve on the committee, and proposed that this lead to a themed session at the next annual meeting. John Chick supported including liaison people from organizations. Marian Havlik suggested membership on the committee from each state and agency. Rick Anderson asked if people from the Lower Mississippi should be included, and several individuals responded yes. A motion to solicit volunteers for the committee was made by Roger Haro, seconded by Rip Sparks, and passed by the members present.

Executive Board Nominations and Election of Officers
President Ickes noted that Dr. Roger Haro would ascend to the Presidency of the MRRC for 2009; and that Dr. Robert Miller has completed his 2-year term as Secretary. The Executive Board nominated Dr. Greg Sass of the Illinois Natural History Survey for Vice President and Dr. Susan Romano of Western Illinois University for Secretary. President Ickes asked for additional nominations from the floor and none was offered. A motion to close nominations and elect Greg Sass Vice President and Susan Romano Secretary was made by Marian Havlik, seconded by Rick Anderson, and passed unanimously by the members present.

In accordance with MRRC bylaws, President Ickes turned the meeting over to the new President, Roger Haro.

President Haro presented Mr. Ickes with a plaque commemorating his year of service as the President of the MRRC. Mr. Ickes graciously accepted the plaque to rousing applause from the membership.

Other New Business
President Haro acknowledged the success of the Dubuque meeting and suggested that the MRRC consider holding an annual meeting at locations other than La Crosse in the future on an occasional basis. He also endorsed the communication project and the new committee to be formed to work on it. He asked that MRRC look for ways to include students more.

Terry Dukerschein suggested that MRRC consider supporting the work of students through member contributions toward student research expense, as in the form of a research scholarship. Marian Havlik recommended drafting an application form for this purpose.

Eric Gittinger proposed that MRRC consider meeting jointly with the UMRCC. Chuck Theiling suggested joint meetings with other organizations.

Adjournment

With no other items of new business coming forth, President Haro entertained a motion to adjourn made by Mike Romano and seconded by John Chick. The motion passed unanimously and President Haro adjourned the 2008 Business Meeting of MRRC at approximately 3 PM.

The following notes are offered as an addendum to the Business Meeting notes for the benefit of members who missed the 40th anniversary MRRC meeting.

NOTES FROM THE SYNTHESIS PROGRAM AT THE 2008 MRRC ANNUAL MEETING

1) **Points from individual presentation sessions**

- Importance of harvesting to increase diversity of tree species in floodplain forests
- Consistency in which many invertebrates are present, from Upper River to Lower River
- Need to institutionalize data sets for macroinvertebrates to avoid loss when individual researchers retire, key role in this for LTRMP
- Issue of data gaps, could more LTRMP stations help?
- Fish recognized as cradle of fish diversity, yet have higher level of threatened species
- Great rivers as the center of fish diversity on Earth, many have jurisdictional issues (run through several countries)
- Sequence in human uses of rivers has led to varied history of management, as advent of creel limits
- Broad scope of Upper Miss basin, great variation in conditions
- A framework for organizing studies of gradients needed (longitudinal-length of river, horizontal-channels, backwaters, etc.)
- Mapping species responses helps
- Role of managers in determining funding
- Need to continue specific data sets should be prioritized institutionally
- Overarching need: communicating the value of science
- Comparatively few herp studies on creeks and rivers
- Bioaccumulation in water snakes important
- Crucial to do long-term monitoring of herps, existing data mainly on geographic distribution
- Data exists for expansion of ranges by prairie species, as snakes

- Trends observed, as earlier nesting of turtles, resulting in an extra clutch (can produce large male bias)
- Importance of regulations highlighted by successful interventions (DDT, etc.)
- Data on metal pollution in Lake Pepin shows cadmium became important later than lead and mercury
- Influence of Clean Water Act (1972) obvious in data sets
- Important emerging contaminants (PFCs, PFOS, endocrine disrupting chemicals), patterns of transmission in natural populations little understood
- Success with "legacy" contaminants notable
- Residual effect in sediments, recovery slow
- Inadequate regulatory framework
- On verge of potential transition in river management
- Note increased funding on stream restoration in U.S., now over $1 billion
- Only about 7% of MRRC papers pertain to restoration, why not more?
- Approach has evolved toward **adaptive management**
- Helpful recent trend toward inclusion of ecological processes
- Suggestion: consider learning objective when evaluating projects
- Managers difficult to convince, resistant to change
- Need to get over "experimentation" fear for projects
- NESP as driving force (Corps work)
- Importance of justifying the costs of monitoring and restoration

2) Points from Round Table Discussion

a. WHAT ARE WE MISSING?

- Loss of human resource (students)
- Connectivity to the watershed

- International scope, holistic perspective (making more connections)
- Importance of managing invasives in our ecosystems
- Effects of endocrine disruptors on ecosystems
- Consideration of emergent properties and processes
- Lack of match between grant schedules and need for long-term studies
- Inadequate field station data archiving (possibility of National Mississippi River Museum & Aquarium archiving all river data?)
- Ecological economics
- Importance of loss of long-term data sets, how can funding to continue be maintained?
- Role of permitting and bureaucracy
- Need to properly assess restoration experiments
- Monitoring not recognized as valuable
- Simple system for sharing data sets needed
- Hard copies of data needed
- Importance of articulating **our** science to applications outside of our system
- Guidance needed as to what we should finalize in our products
- Question: how much will academic people want to be involved in NESP?
- Restoration work will require much greater knowledge about geomorphology

b. WHERE DO WE GO FROM HERE?

- Continue to support adaptive management, publicize success stories
- Work on resolving conflict with policies that impede progress
- Need for a common definition and approach (recognizing differences) to adaptive management
- R. Sparks on job of MRRC publication authors: don't overlook data from other river systems (as Rhine), work to interest an international audience, stress new equipment and methods coming out of Upper Miss (as data-logging networks along length)

- Key for publication: note tie-ins between data and global warming (as earlier nesting of turtles, expansion of ranges)
- Note long-term effects of extreme events (as 1993 flood)
- Mud Lake study (Steuck et al) as good example of adaptive management that combined engineering and learning
- Suggestion: pull out socioeconomic history (value of regulation, etc.) as separate chapter in publication
- Extrapolate to probable fate if environmental laws had not been passed
- Consider benefits of adding more LTRMP stations
- Networks of field stations could help fill in data gaps
- High-profile publications (as paper in **Science**) needed to attract political attention and funding
- Attempt to engage world community's interest
- Consider Nature Conservancy as partner
- Public awareness a key
- G.Enzler of National Mississippi River Museum & Aquarium offers help in outreach, getting message out
- Note attention the Everglades attract as national treasure
- McKnight Foundation is funding a campaign to raise awareness of Mississippi River

MISSISSIPPI RIVER RESEARCH CONSORTIUM
TREASURER'S REPORT
SUBMITTED BY NEAL D. MUNDAHL (5 MARCH 2009)

Accounts as of 30 June 2006			$10,806.29
Accounts as of 30 June 2007			$11,003.81
Transactions, 1 July 2007 to 30 June 2008			
INCOME			
	2008 Registration and dues	7019.00	
	2008 Raffle proceeds	900.00	
	2008 T-shirt sales	136.00	
	Book sales	1037.00	
	Interest	11.96	
Total		9103.96	
EXPENSES			
	2008 meeting-Museum and River Center	5952.05	
	2008 Proceedings	686.22	
	2008 Raffle prizes	196.23	
	2008 Awards	196.00	
	2008 Student Travel Awards	200.00	
	T-shirts	116.55	
	Postage, mailing, supplies	28.35	
	Corporation fee	10.00	
Total		7385.40	
Accounts as of 30 June 2008			$12,722.37
Transactions, 1 July 2008 to 1 March 2009			
INCOME			
	2008		
	Registation	440.00	
	Interest	6.01	
Total		446.01	
EXPENSES			
	Corporation fee	10.00	
Total		10.00	
Accounts as of 1 March 2009			$13,158.38
Accounts			
	Checking account	7174.91	
	Savings account	5983.47	

13158.38

MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.

BUSINESS MEETING AGENDA

1 May 2009, 12:30 PM
Radisson Hotel, LaCrosse, Wisconsin

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1. Call to Order

2. President's Report

   - Acknowledgments
   - Approval of 2008 minutes and Proceedings
   - 2009 attendance/participation growth information
   - Awards

3. Treasurer's Report – N. Mundahl

4. Old Business

   - Future Meeting Dates
   - 2010 Meeting in La Crosse, WI

5. New Business

   - Conference sponsored by the National Great Rivers Research and Education Center in August 2009 – J. Chick
   - 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

40th	2008	Grand River Center, Dubuque, IA	Mr. Brian Ickes Dr. Roger Haro Dr. Robert Miller Dr. Neal Mundahl

Meeting	Year	Location	Board of Directors
41st	2009	Radisson Hotel, La Crosse, WI	Dr. Roger Haro Dr. Greg Sass Dr. Susan Romano 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 2009

The following persons or institutions have contributed substantially to the planning, execution, support, and ultimately, the success of the 41st Annual Meeting of the Mississippi River Research Consortium. The 2008-2009 Board of Directors and Consortium members gratefully acknowledge their efforts.

Local Meeting Arrangements, Meeting Announcements, and Mailings

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

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

Roger Haro, University of Wisconsin-LaCrosse, LaCrosse, Wisconsin

Susan Romano, Western Illinois University, Macomb, Illinois

Registration Table

Cammy Smith, Illinois River Biological Station, Illinois Natural History Survey, Havana, Illinois

Benjamin Campbell, University of Wisconsin-LaCrosse, LaCrosse, Wisconsin

Poster Boards

University of Wisconsin – La Crosse River Studies Center, La Crosse, Wisconsin

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

Cammy Smith, Illinois River Biological Station, Illinois Natural History Survey, Havana, Illinois

Jim Lamer, Kibbe Biological Station, Western Illinois University, Warsaw, Illinois

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

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Raffle and Silent Auction Prizes

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

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Vacationland, Durango, IA

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