

**PROCEEDINGS OF THE
MISSISSIPPI RIVER RESEARCH CONSORTIUM**

VOLUME 44

26-27 April – 2012



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**PROCEEDINGS OF THE MISSISSIPPI RIVER
RESEARCH CONSORTIUM**

VOLUME 44

MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.

44th ANNUAL MEETING
26 – 27 APRIL 2012
RADISSON HOTEL
LACROSSE, WISCONSIN

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Early History of the Mississippi River Research Consortium

By Tom Claflin, Professor *emeritus*
University of Wisconsin-La Crosse

The idea of forming an association of Mississippi River researchers was first embraced by Cal Fremling, Brother George Pahl, Clarence McNabb, and I during the autumn of 1967. Cal Fremling had been a faculty member at Winona State for 10 years or so by that time and had published a number of papers on Mississippi River mayflies. Brother George Pahl was the chair of the Department of Biology at St. Mary's College (now University) and had conducted a number of research projects on mussels. Clarence McNabb was a botanist and faculty member at St. Mary's and maintained a research program on aquatic vegetation. He was also instrumental in establishing the St. Mary's Riverside Research Lab in Homer, MN. During that summer of 1967 I had taught classes in Limnology and Ichthyology at St. Mary's College. I had recently finished grad school and a post-doc fellowship only a year or so before, so I was truly the rookie in that bunch. However, we all worked together and became friends as well as colleagues during that memorable summer in the 60s.

The four of us obviously had some common professional interests and we frequently discussed river issues. We all came to realize that prior to that time, Minnesota, Wisconsin, Illinois and Iowa had largely ignored the Mississippi River by focusing their efforts and resources on inland lakes and other resources. The river bordering their states was regarded as a conduit for navigation and a convenience for the disposal of unwanted domestic and industrial wastes. Granted, the Upper Mississippi River Wildlife and Fish Refuge had been created prior to this, but management techniques had not developed to where they are today. As often as not, the refuge was simply watched rather than managed. The river was basically managed for navigation.....period. Finally, when NEPA and NEPA amendments were passed in 1969 and 1970, the public as well as decision makers began to develop an interest in the river. We saw our role as one of making them aware of the integral roles played by rivers within the ecosystem. At the same time, scientists around the world were discovering and describing many of the unique aspects of river systems. The late 60s and 70s were truly exciting times for river science and scientists.

One evening in August or September of 1967, probably over a few beers from the local *Winona Bub's Brewery*, the four of us gathered, I think, around Cal Fremling's kitchen table and discussed the formation of what would become the MRRC. We envisioned it as a vehicle whereby interested scientists and policy makers could meet annually to discuss problems and ways to promote a public awareness of river issues. We also wanted students to be an integral part of the organization since we were all in the education business. We struggled a bit with names at first. We considered names such as "association" and "organization" and "society" but thought all implied too much structure and formality. On the contrary, we envisioned annual meetings that would be structured, yet informal enough to create a comfort zone for professionals, students, and lay persons alike. When "consortium" was mentioned, I remember Clarence McNabb saying something like: "Consortium..... kind of sounds shady. Let's use it!"

So we did. The first meeting was held in Winona the following year; and I can assure you that none of us thought that 43 years later it would still be a vibrant and relevant organization.

The common denominator of that group was an abiding concern for the Mississippi River. I hasten to add that during those early years, as the relative newcomer, I learned a great deal about river ecology from these gentlemen. For that I will always be grateful. Although the other three "founders" are no longer with us, I continue to be assured that the strength and depth and longevity of MRRC is due to the hard work of countless persons through the years and is also a tribute to the forward thinking of people like Cal. I am glad to have had the opportunity to be a part of it.



PLATFORM PROGRAM

Radisson Hotel – Ballroom B (All Sessions)
La Crosse, Wisconsin
Thursday, 26 April 2012
(*Student Presenters)

7:30 – 7:40 AM Welcome and Announcements – **Susan Romano**, MRRC President

SESSION I – RIVER ECOSYSTEM STUDIES (Moderator: Jeffrey Houser)

7:40 – 8:00 AM HYDROLOGY: SHAPING ECOSYSTEM CHARACTER AND FOOD WEB STRUCTURE

***Munique C. Reid**, Michael A. Reid, and Martin C. Thoms, Riverine Landscapes Research Laboratory, Geography and Planning, University of New England, Armidale, New South Wales, Australia 2350

8:00 – 8:20 AM CAUSES AND CONSEQUENCES OF ABUNDANT DUCKWEED AND FILAMENTOUS ALGAE IN BACKWATER LAKES OF THE UPPER MISSISSIPPI RIVER NEAR LA CROSSE, WISCONSIN

Jeffrey N. Houser¹, Shawn M. Giblin², William F. James³, Heidi A. Langrehr², James T. Rogala¹, John F. Sullivan⁴, Brian R. Gray¹, ¹US Geological Survey Upper Midwest Environmental Sciences Center, La Crosse, WI 54603, ²WDNR Mississippi River Monitoring Field Station, La Crosse, WI 54603, ³ERDC Eau Galle Aquatic Ecology Laboratory, Spring Valley, WI 54767, ⁴Wisconsin Department of Natural Resources, La Crosse, WI 54601

8:20–8:40 AM TEMPORAL AND SPATIAL EVALUATION OF FACTORS INFLUENCING FREE-FLOATING PLANT BIOMASS, DISTRIBUTION AND COMPOSITION WITHIN UPPER MISSISSIPPI RIVER BACKWATERS

Shawn M. Giblin¹, John F. Sullivan², Jeffrey N. Houser³, Heidi A. Langrehr¹, James T. Rogala³, Benjamin D. Campbell¹, ¹WDNR Mississippi River Monitoring Field Station, La Crosse, WI 54603, ²Wisconsin Department of Natural Resources, La Crosse, WI 54601, ³US Geological Survey Upper Midwest Environmental Sciences Center, La Crosse, WI 54603

8:40 – 9:00 AM STOICHIOMETRIC ANALYSIS OF THE RELATIONSHIP BETWEEN THE CASE GRAZING CADDISFLY, *Glossosoma Intermedium*, AND ITS PERIPHYTON RESOURCES

***Robert Mooney**, Eric Strauss, and Roger Haro, River Studies Center, University of Wisconsin - La Crosse, La Crosse, WI 54601

9:00 – 9:20 AM GEOMORPHOLOGICAL COMPLEXITY AS A DETERMINANT OF ECOSYSTEM FUNCTION AND APPLICATION OF FOOD CHAIN LENGTH IN RIVER MANAGEMENT
Michael D. DeLong, Large River Studies Center, Biology Department, Winona State University, Winona, MN 55987

9:20 – 9:40 AM **BREAK (HOTEL FOYER)**

SESSION II – ASIAN CARP (Moderator: Brent Knights)

9:40 – 10:00 AM RECRUITMENT SOURCES OF BIGHEAD AND SILVER CARPS IN THE ILLINOIS RIVER
***Jacob Norman**, and Greg Whitledge, Fisheries and Illinois Aquaculture Center, Southern Illinois University, Carbondale, IL 62901-6511

10:00-10:20 AM VARIATION IN GILL RAKERS OF SILVER CARP (*Hypophthalmichthys molitrix*) AND GIZZARD SHAD (*Dorosoma cepedianum*) FROM THE ILLINOIS, JAMES AND WABASH RIVERS, USA
***Liza R. Walleser**^{1,2}, Jon J. Amberg¹, Mark B. Sandheinrich², Mark P. Gaikowski¹, and David R. Howard², ¹Upper Midwest Environmental Sciences Center, La Crosse, WI 54603. ²University of Wisconsin – La Crosse, La Crosse, WI 54601

10:20–10:40 AM INCORPORATING APPLIED AND BASIC APPROACHES TO EVALUATE THE EFFECTS OF ASIAN CARP ON NATIVE FISHES
Quinton E. Phelps, Justin R. Seibert, Jason W. Crites, David P. Herzog, David E. Ostendorf, Joseph W. Ridings, and Robert A. Hrabik, Open Rivers and Wetlands Field Station, Missouri Department of Conservation, Jackson, Missouri, USA 63755

10:40-11:00 AM FAT FOOD, LEAN FISH: WHAT'S UP IN THE ILLINOIS RIVER?
Brent Knights, William Richardson, Steve Gutreuter, Lynn Bartsch, Michelle Bartsch, Jon Vallazza, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603

KEYNOTE PRESENTATION

11:00-11:50 AM CONSERVATION BY THE CUP (OF WATER): HOW INDIRECT DNA SURVEILLANCE OF SPECIES DISTRIBUTIONS MAY LEAD TO IMPROVED RESOURCE MANAGEMENT
Christopher L. Jerde, University of Notre Dame, Environmental Change Initiative, Notre Dame, IN, 46556-0369

11:50 – 1:20 PM **LUNCH** (on your own)

SESSION III – WILDLIFE ECOLOGY (Moderator: Lisa Maas)

- 1:20 – 1:40 PM GIS ANALYSIS OF BALD EAGLE NESTING HABITAT ON THE UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE
Lisa Maas, U.S. Fish and Wildlife Service, Upper Mississippi River National Wildlife & Fish Refuge, McGregor District, McGregor, IA 52157
- 1:40 – 2:00 PM FLOODPLAIN FORESTS: WHY THEY ARE IMPORTANT FOR THE INDIANA BAT (*Myotis sodalis*) IN IOWA AND ILLINOIS
***Eric S. Schroder**¹ and Susan P. Romano^{1,2}, ¹Department of Biological Sciences, Western Illinois University, Macomb, IL 61455, ²Institute for Environmental Studies, Western Illinois University, Macomb, IL 61455
- 2:00 – 2:20 PM HOME RANGE AND MOVEMENTS OF MALE SOUTHERN FLYING SQUIRRELS (*Glaucomys volans*) IN EASTERN IOWA
***Tori M. Ballweg**, Kyle Redmond, Chelsie E. Cruise, Elizabeth G. Bainbridge, Christine M. Grannis, Gabrielle D. Gronau, Gerald L. Zuercher, and David E. Koch, Department of Natural and Applied Sciences, University of Dubuque, Dubuque, Iowa 52001
- 2:20 – 2:40 PM FACTORS ASSOCIATED WITH RIVER TURTLE CAPTURES AT 9-MILE ISLAND IN POOL 12 OF THE UPPER MISSISSIPPI RIVER FISH AND WILDLIFE REFUGE
***Mark R. Hennessy** and Gerald L. Zuercher, Department of Natural and Applied Sciences, University of Dubuque, Dubuque, Iowa 52001

2:40 – 3:00 PM **BREAK (HOTEL FOYER)**

SESSION IV – HABITAT RESTORATION AND MANAGEMENT STUDIES (Moderator: Megan Moore)

- 3:00 – 3:20 PM TOPOGRAPHIC DIVERSITY INDEX FOR FLOODPLAIN FOREST RESTORATION BENEFIT ASSESSMENT AT THE HURON ISLAND HREP
Charles Theiling, Mike Siadak, Lucie Sawyer, Nathan Richards, and Jon Schultz, U.S. Army Corps of Engineers, Rock Island District, Economic and Environmental Policy Branch, Rock Island, IL 61204-2004
- 3:20 – 3:40 PM INTERACTIVE EFFECTS OF HERBIVORY AND FLOODING ON TREE RECRUITMENT IN AN UPPER MISSISSIPPI RIVER FLOODPLAIN FOREST RESTORATION
Benjamin J. Cogger¹, Nathan R. De Jager², Meredith Thomsen¹, ¹University of Wisconsin-La Crosse, La Crosse, Wisconsin 54601, ²USGS Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin 54603

- 3:40 – 4:00 PM **EFFECTS OF STREAM DIVERSION ON OXYGEN DYNAMICS AND MACROINVERTEBRATE COMMUNITY STRUCTURE AND FUNCTION IN A SOUTHERN ILLINOIS AGRICULTURAL WATERSHED**
Heidi M. Rantala¹, E. A. Scholl¹, A. K. Kennington¹, M. R. Whiles¹, and G. Wilkerson², ¹Department of Zoology and Center for Ecology, Southern Illinois University Carbondale, Carbondale IL, 62901, ²Department of Civil and Environmental Engineering, Southern Illinois University Carbondale, Carbondale IL, 62901
- 4:00-4:20 PM **ASSESSMENT OF AQUATIC VEGETATION RESPONSE TO ISLAND RESTORATION IN LOWER POOL 8 OF THE UPPER MISSISSIPPI RIVER**
Jeff Janvrin¹ and Heidi Langrehr², ¹ Wisconsin DNR, La Crosse, WI 54601, ² Wisconsin DNR, La Crosse, WI 55603
- 4:20-4:40 PM **RELATIVE ABUNDANCES AND FEEDING HABITS OF BOWFIN, GAR, AND LARGEMOUTH BASS AT THE EMIQUON PRESERVE AND REELFOOT LAKE: CAN PARTICULAR NATIVE FISH SPECIES ASSEMBLAGES CONTROL INVASIVE COMMON CARP?**
***Todd D. VanMiddlesworth**^{1,2}, Greg G. Sass³, Bradley A. Ray⁴, and Timothy W. Spier², ¹Illinois Natural History Survey, Illinois River Biological Station, Havana, IL 62644, ²Western Illinois University, Department of Biological Sciences, Macomb, IL, 61455, ³Wisconsin Department of Natural Resources, Boulder Junction, WI, 54512. ⁴University of Tennessee at Martin, Department of Agriculture, Geosciences, and Natural Resources, Martin, TN, 38238
- 4:40 – 6:10 PM **POSTER SESSION IN THE RADISSON HOTEL FOYER**
- 6:30 – 9:00 PM **BANQUET – RADISSON BALLROOM A**

**Radisson Hotel – Ballroom B (All Sessions)
Friday, 27 April 2012**

8:00 – 8:10 AM Morning Welcome and Announcements – **Susan P. Romano**, MRRC President

SESSION V – ENVIRONMENTAL CHEMISTRY, PHYSIOLOGY AND MODELING
(Moderator: Brian Gray)

8:10—8:30 AM MAPPING THE SPATIAL DISTRIBUTION OF LEAD SHOT IN THE LA
CORSE RIVER MARSH

Colin Belby, Nicole Feldmeier, Ryan Perroy, Department of Geography and
Earth Science, University of Wisconsin – La Crosse, La Crosse, WI 54601

8:30 – 8:50 AM MOVEMENTS OF FISH PATHOGENS WITH INTERSTATE SHIPMENTS
OF BAITFISH

Corey A Puzach¹, Gary Jagodzinski², Rebekah L McCann¹, ¹U.S. Fish and
Wildlife Service, La Crosse Fish Health Center, Onalaska WI 54650, ²U.S.
Fish and Wildlife Service, Law Enforcement, Onalaska WI 54650

8:50 – 9:10 AM ZEQUANOX™: A POTENTIAL SOLUTION TO ZEBRA MUSSELS, BUT
WHAT DOES IT MEAN TO ENDEMIC MUSSELS AND FISHES?

J.A. Luoma¹, **Kerry L. Weber**¹, M.P. Gaikowski¹ and D.A. Mayer², ¹Upper
Midwest Environmental Sciences Center, La Crosse, WI 54603, ²New York
State Museum, Cambridge, NY 12816

9:10 – 9:30 AM MODELING RIVER AND STREAM TEMPERATURE USING DATA
COLLECTED AT DIFFERENT SPATIAL LOCATIONS AND
IRREGULAR POINTS IN TIME

Brian R. Gray¹, James R. Rogala¹, Dale M. Robertson² and Jeffrey N.
Houser¹, ¹Upper Midwest Environmental Sciences Center, US Geological
Survey, La Crosse, WI 54603, ²Wisconsin Water Science Center, US
Geological Survey, Middleton, WI 53562

9:30 – 9:50 AM ECOHYDRAULIC TOOLS USING OPENFOAM—A HYDRODYNAMIC
COMPARISON OF OPENFOAM WITH COMMERCIAL SOFTWARE,
TIME OF RESIDENCE, AND SPECIES TRANSPORT

***Oscar M. Hernandez**, Douglas J. Schnoebelen, Marcela S. Politano.
IHR Hydroscience & Engineering, University of Iowa, Iowa City, IA 52242

9:50 – 10:20 AM **BREAK – HOTEL FOYER**

SESSION VI – AQUATIC ORGANISMS (Moderator: Shawn Giblin)

10:20-10:40 AM MUSSEL COMMUNITY DISTRIBUTION ALONG 9-MILE ISLAND IN POOL 12 OF THE UPPER MISSISSIPPI RIVER
***Lisa A. LaBudde**, Adam R. Hoffman, and Gerald L. Zuercher, Department of Natural and Applied Sciences, University of Dubuque, Dubuque, Iowa 52001

10:40-11:00 AM WEST SIDE LEVEE MUSSEL SURVEY BETWEEN McCOLLISTER BLVD. - CRANDIC RR BRIDGES, IOWA RIVER, IOWA CITY, IA, SEPT. 2011
Marian E. Havlik, Malacological Consultants, La Crosse, WI 54601-6609

11:00-11:20 AM POTENTIAL EFFECTS OF CLIMATE CHANGE ON JUVENILE MUSSELS: STUDIES ON SURVIVAL, GROWTH AND PHYSIOLOGY
***Alissa Ganser**¹, Teresa Newton², and Roger Haro¹, ¹University of Wisconsin–La Crosse, River Studies Center, La Crosse, WI 54601, ²U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603

11:20-11:40 AM EARLY LIFE HISTORY AND HABITAT USE OF AGE-0 BLUE CATFISH IN THE UNIMPOUNDED MIDDLE MISSISSIPPI RIVER
***Justin R. Seibert**, Quinton E. Phelps, Jason W. Crites, David P. Herzog, David E. Ostendorf, Joseph W. Ridings, and Robert A. Hrabik, Open Rivers and Wetlands Field Station, Missouri Department of Conservation, Jackson, Missouri, USA 63755

11:40-12:00 PM ZOOPLANKTON COMMUNITY COMPOSITION IN LAKE ST. CROIX AND ABOVE ST. CROIX FALLS DAM INDICATE HIGH SUSCEPTIBILITY TO INVASIVE *HYPOPHthalmichthys* SPECIES
Toben Lafrancois¹, David VanderMeulen², Byron Karns³, ¹St. Croix Watershed Research Station, Marine on St. Croix, MN 55047, ²National Park Service, Great Lakes Inventory and Monitoring Network, St. Croix Falls, WI 54024, ³St. Croix National Scenic Riverway, St. Croix Falls, WI 54024

12:00–1:00 PM **LUNCH – BALLROOM A**

1:00-2:30 PM **BUSINESS MEETING, RAFFLE AND SILENT AUCTION–BALLROOM B**

POSTER PRESENTATIONS

RADISSON HOTEL

THURSDAY APRIL 26, 2012 12:00 PM – 6:10 PM

Authors Present 4:40 – 6:10 PM

(Listing by Topic, *Student presenters)

AQUATIC ECOLOGY

- 1) **STREAM HEALTH AND RESTORATION WORKSHOPS AND RESOURCES – MN DNR**
Amy Childers, MN Department of Natural Resources, Fergus Falls, MN 56537
- 2) **HIGH TEMPORAL RESOLUTION NITRATE MONITORING AND EFFECTS OF WATER LEVEL MANIPULATION ON WATER QUALITY AT LAKE ODESSA**
Caroline A. Davis¹, Doug Schnoebelen¹, Larry Weber¹, Cathy Henry², and Andy Robbins³, ¹Lucille A. Carver Mississippi Riverside Environmental Research Station, University of Iowa, Muscatine, IA 52761. ²U.S. Fish and Wildlife Service, Port Louisa National Wildlife Refuge, Wapello, IA 52653. ³Iowa Department of Natural Resources, Odessa Wildlife Unit, Wapello, IA 52653
- 3) **THE EFFECTS OF MACROPHYTES ON ORGANIC MATTER RETENTION IN STREAM ECOSYSTEMS**
***Stephanie A. Gatyas**, Eric A. Strauss, University of Wisconsin-La Crosse, La Crosse, WI 54601
- 4) **CITIZENS PROVIDE QUALITY BIOLOGICAL DATA FOR ASSESSING STREAMS**
Jacklyn Gautsch, Iowa Department of Natural Resources, Iowa City, IA 52242
- 5) **SPATIAL AND TEMPORAL PATTERNS OF PHYTOPLANKTON CHLOROPHYLL IN A LARGE RIVER ECOSYSTEM**
***Jacob A. Heier**¹, Michael D. DeLong¹, and William B. Richardson², ¹Large Rivers Studies Center, Biology Department, Winona State University, Winona, MN, 55987. ²US Geological Survey Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Rd., La Crosse, WI 54603
- 6) **ASSESSMENT OF THE RUSH-PINE CREEK WATERSHED, SOUTHEASTERN MINNESOTA, USING FISH AND BENTHIC INVERTEBRATE INDICES OF BIOTIC INTEGRITY**
***Darcy E. Mundahl** and Neal D. Mundahl, Department of Biology, Winona State University, Winona, MN 55987

- 7) **VALIDATION OF THERMAL MODELS TO PREDICT THE MASS EMERGENCE OF MAYFLIES FROM THE UPPER MISSISSIPPI RIVER**
Mark Steingraeber, U.S. Fish and Wildlife Service, Fish and Wildlife Conservation Office, Onalaska, WI 54650

FISH ECOLOGY

- 8) **COMPETITIVE INTERACTIONS BETWEEN SILVER CARP AND NATIVE FISHES: A PROPOSED IN-SITU MESOCOSM EXPERIMENT**
***Edward F. Culver**, John H. Chick, Great Rivers Field Station Alton, Illinois 62024, Illinois Natural History Survey, University of Illinois, Champaign IL 61820
- 9) **TRENDS IN COMMERCIAL ROE HARVEST IN THE MISSOURI AND MISSISSIPPI RIVERS FROM 1945-2010**
***Ryan N. Hupfeld**, Quinton E. Phelps, and David P. Herzog, Open Rivers and Wetlands Field Station, Missouri Department of Conservation, Jackson, Missouri 63755
- 10) **ASIAN CARP IN THE UPPER MISSISSIPPI – JUMP STARTING A RESPONSE PLAN**
Byron Karns¹, John Anfison², and Tim Schlagenhalf³, ¹National Park Service, St. Croix National Scenic Riverway. ²National Park Service, Mississippi National River and Recreation Area. ³Minnesota Department of Natural Resources, Lake City, Minnesota 55041
- 11) **NUTRITION AND CONDITION OF INVASIVE SILVER CARP ACROSS LARGE ILLINOIS RIVERS: CAN STRESS AND NUTRITION INFLUENCE ESTABLISHMENT?**
***Stephanie A. Liss**^{1,2}, Greg G. Sass³, and Cory D. Suski¹, ¹University of Illinois at Urbana-Champaign, Urbana, Illinois 61801; ²Illinois Natural History Survey, Champaign, Illinois 61820; ³Wisconsin Department of Natural Resources, Boulder Junction, Wisconsin 54512
- 12) **EFFECTS OF HABITAT IMPROVEMENT ON SIZE, CATCH RATE, AND CONDITION OF BROWN TROUT ANGLER IN A DRIFTLESS AREA STREAM**
Trevor O. Kjos and **Neal D. Mundahl**, Department of Biology, Winona State University, Winona, MN 55987
- 13) **MOVEMENT PATTERNS OF TROUT IN CATFISH CREEK**
***Aaron J. Matthews**, Marcus Prull, David E. Koch, and Gerald L. Zuercher, Department of Natural and Applied Sciences, University of Dubuque, Dubuque, Iowa 52001
- 14) **ASIAN CARP TASTE TEST**
Quinton E. Phelps, Open Rivers and Wetlands Field Station, Missouri Department of Conservation, Jackson, Missouri 63755

- 15) **PRESENCE OF PADDLEFISH AND LAKE STURGEON ABOVE AND BELOW MISSISSIPPI RIVER LOCK AND DAM 5A**
 *Mark A. Ross and Joshua J. Lallaman, Saint Mary's University of MN, Department of Biology, Winona, MN 55987
- 16) **EVALUATION OF SILVER CARP AGES DERIVED FROM SEVEN BONY STRUCTURES IN MIDWESTERN U.S. RIVERS**
 *Justin R. Seibert and Quinton E. Phelps, Open Rivers and Wetlands Field Station, Missouri Department of Conservation, Jackson, Missouri, USA 63755
- 17) **AN INVESTIGATION OF FISH COMMUNITY AND WATER QUALITY COMPOSITIONS IN AN ISOLATED SIDE CHANNEL OF THE UPPER MISSISSIPPI RIVER**
 Molly J. Sobotka, Quinton E. Phelps, Jason W. Crites, David P. Herzog, and Robert A. Hrabik, Open Rivers and Wetlands Field Station, Missouri Department of Conservation, Jackson, Missouri, USA 63755
- 18) **TRAWLING ON THE LA GRANGE REACH OF THE ILLINOIS RIVER: A BRIEF SUMMARY OF 18 YEARS OF LTRMP DATA AND INTRODUCTION OF THE MINI-MISSOURI TRAWL**
 Levi E. Solomon, Blake C. Ruebush, and Thad R. Cook, Illinois River Biological Station, Illinois Natural History Survey, 704 N Schrader Ave. Havana, IL 62644
- 19) **SAUGER LIFE HISTORY IN THE LOWER PORTION OF THE UPPER MISSISSIPPI RIVER**
 *Kasey Yallaly, Quinton E. Phelps, Sara J. Tripp, Justin R. Seibert, and David P. Herzog, Open Rivers and Wetlands Field Station, Missouri Department of Conservation, Jackson, Missouri, USA 63755

FRESHWATER MUSSELS

- 20) **ASSESSING THE THREAT AND PREDATOR CONTROL OF A NON-NATIVE, AQUATIC INVADER (ZEBRA MUSSEL, *Dreissena polymorpha*) IMPACTING ENDANGERED NATIVE MUSSEL RESOURCES IN THE ST. CROIX NATIONAL SCENIC RIVERWAY (SACN): AN UPDATE**
 Michelle Bartsch¹, William Richardson¹, Lynn Bartsch¹, Steve Zigler¹, Byron Karns², and Brenda Moraska Lafrancois³. ¹USGS, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603 ²National Park Service, St. Croix Falls, WI 54024, ³National Park Service, St. Croix Watershed Research Station, St. Croix, MN 55047
- 21) **HYDRAULIC VARIABLES AS A PREDICTOR OF MUSSEL DENSITY IN THE SYLVAN SLOUGH OF THE UPPER MISSISSIPPI RIVER, POOL15**
 *Janelle Gothner, Devon Bassett, and Scott Fick, Department of Geography, Augustana College, Rock Island, IL 61201

- 22) **MUSSEL SURVEY OF UPPER SYLVAN SLOUGH, POOL 15**
 *Danielle Joerger, Danna Jenson, Luke Clayton, Carlisle Evans-Peck, Kara Noonan, and Aaron Trost, Augustana College, Rock Island, IL 61201
- 23) **IMPACT OF A LOW HEAD DAM ON FRESHWATER MUSSEL DISTRIBUTION AND RICHNESS IN THE LOWER ROCK RIVER**
 *Austin D Larson and Devon Di Iorio, Department of Geography, Augustana College, Rock Island, IL
- 24) **ZEBRA MUSSEL (*Dreissena polymorpha*) COLONIZATION AND DISTRIBUTION AMONG NATIVE FRESHWATER MUSSELS IN POOL 12 OF THE MISSISSIPPI RIVER**
 *Shelby L. Marr, Lisa A. LaBudde, Adam R. Hoffman, and Gerald L. Zuercher, Department of Natural and Applied Sciences, University of Dubuque, Dubuque, Iowa 52001

LANDSCAPE ECOLOGY

- 25) **ADVANCES IN VEGETATION MAPPING USING 3D DESKTOP TECHNOLOGY AND FIELD COMPUTERS**
 Jennifer Dieck, Larry Robinson, and Andrew Strassman, U. S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603
- 26) **MEASURING THE SPATIAL DISTRIBUTION OF LEAD CONTAMINANTS IN THE LA CROSSE RIVER MARSH**
 *Sara Erickson, Colin Belby and Ryan Perroy, Geography Department, University of Wisconsin – La Crosse, La Crosse, WI, 54601
- 27) **CURVE FIT: A PIXEL LEVEL RASTER REGRESSION TOOL**
 Timothy J. Fox and Nathan R. De Jager, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603
- 28) **GEOMORPHOLOGICAL COMPLEXITY AS A DETERMINANT OF FISH COMMUNITY STRUCTURE IN A RIVER NETWORK**
 *Christopher Milham and Michael D. Delong, Large River Studies Center, Biology Department, Winona State University, Winona, MN 55987
- 29) **EFFECT OF HABITAT FRAGMENTATION ON GENETIC DIVERSITY OF NATIVE ORCHIDS IN THE UPPER MISSISSIPPI RIVER WATERSHED**
 *BreAnn Nesteby, Chasity Hall, Rasika G. Mudalige-Jayawickrama, and David E. Koch, Department of Natural and Applied Sciences, University of Dubuque, Dubuque, Iowa 52001.

- 30) **TERRESTRIAL LIDAR AND BATHYMETRIC DATA INTEGRATION AND POTENTIAL APPLICATION FOR THE UPPER MISSISSIPPI RIVER**
Jason J. Rohweder, James T. Rogala, Joseph W. Jakusz, Jenny L. Hanson, and Larry R. Robinson, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603
- 31) **ZOOPLANKTON COMMUNITY DYNAMICS ACROSS A LARGE RIVER MOSAIC**
***Jarrod R. Sackreiter**¹, Michael D. DeLong², and William B. Richardson²
¹Large River Studies Center, Biology Department, Winona State University, Winona, MN 55987; ²US Geological Survey Upper Midwest Environmental Sciences Center, La Crosse, WI 54603
- 32) **TWO-DIMENSIONAL HYDRODYNAMIC SIMULATION OF POOL SCALE EFFECTS OF ISLAND RESTORATION ACTIVITIES IN UPPER MISSISSIPPI RIVER POOL 8**
***Brice E. Stafne**, Douglas J. Schnoebelen, and Larry J. Weber, IIHR – Hydroscience & Engineering, University of Iowa, Iowa City, IA 52242
- 33) **TROPHIC PATTERNS OF FISH ACROSS PATCH TYPES OF A LARGE FLOODPLAIN RIVER**
***Travis J. Viker** and Michael D. DeLong, Large Rivers Studies Center, Biology Department, Winona State University, Winona, MN, 55987

WILDLIFE ECOLOGY

- 34) **IMPACT OF NITROGEN COMPOUNDS ON SALAMANDER HATCHING SUCCESS AND ONTOGENY**
***Bridgette Fidler**, Gerald L. Zuercher, and Adam R. Hoffman, Department of Natural and Applied Sciences, University of Dubuque, Dubuque, Iowa 52001
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***Reese J. Glaser**, ***Heidi S. Hickey**, and Neal D. Mundahl, Department of Biology, Winona State University, Winona, MN 55987
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***Christine M. Grannis**, Tori M. Ballweg, Gabrielle D. Gronau, Colin Waldorf, Elizabeth G. Bainbridge, Chelsie E. Cruise, and Gerald L. Zuercher, Department of Natural and Applied Sciences, University of Dubuque, Dubuque, Iowa 52001

- 37) **SOUTHERN FLYING SQUIRREL (*Glaucomys volans*) HABITAT IN AN EASTERN IOWA FOREST ALONG THE UPPER MISSISSIPPI RIVER**
 ***Gabrielle D. Gronau**, Colin Waldorf, Elizabeth G. Bainbridge, Tori M. Ballweg, Christine M. Grannis, David E. Koch, and Gerald L. Zuercher, Department of Natural and Applied Sciences, University of Dubuque, Dubuque, Iowa 52001
- 38) **DETERMINING CRITICAL HABITAT OF THE RIVER OTTERS (*Lontra canadensis*) AT THE UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE USING TRAIL CAMERA MONITORING TECHNIQUES**
 ***Brandon M. Gross**¹ and Jeanette Thomas¹, ¹Western Illinois University – Quad Cities, Moline, IL 61265
- 39) **MANAGING HABITAT IN MOIST SOIL UNITS OF THE UPPER MISSISSIPPI RIVER FLOODPLAIN THROUGH FLOODED SOIL MANIPULATIONS IN THE FACE OF A CHANGING CLIMATE**
Mick D. Hanan¹, Brian Loges², and Jason Wilson¹, ¹U.S. Fish and Wildlife Service, Great River and Clarence Cannon National Wildlife Refuges, Annada, MO 63330. ² U.S. Fish and Wildlife Service, Two Rivers National Wildlife Refuge, Brussels, IL 62013
- 40) **COMPLIANCE OF BOATERS WITH THE BIG LAKE VOLUNTARY AVOIDANCE AREA, POOL 4, UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE & FISH REFUGE – WINONA DISTRICT**
 ***Joshua A. Morrissey**¹, Kyle Slifka², Lisa Reid², Brian Pember², Mary Stefanski², and Neal D. Mundahl¹, ¹Department of Biology, Winona State University, Winona, MN 55987, ²Upper Mississippi River National Wildlife & Fish Refuge, Winona, MN 55987
- 41) **MONITORING DISTURBANCE TO WATERFOWL IN AN UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE CLOSED AREA**
Lisa A. Reid, U.S. Fish and Wildlife Service, Upper Mississippi River National Wildlife and Fish Refuge – Winona District, Winona, MN 55987
- 42) **AERIAL SURVEYS OF WATERFOWL ON THE UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE**
Brian Stemper, USFWS, Upper Mississippi River National Wildlife and Fish Refuge, Winona, MN 55987
- 43) **CONSERVATION AND MANAGEMENT OF THE IMPERILED ORNATE BOX TURTLES (*Terrapene ornata*) AT THE UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE**
Jeramie Strickland¹, Ed Britton¹, Eric Tomasovic¹, Russell Engelke¹, Charles Tucker², David Delaney³, ¹U.S. Fish and Wildlife Service, Thomson, IL 61285. ²Missouri State University, Department of Biology, Springfield, MO 65897. ³U.S. Army Construction Engineering Research Laboratory, Champaign, IL 61820

44) **PLANTING A TREE: EXPOSING HIGH SCHOOL STUDENTS TO ECOLOGICAL RESEARCH WITH REPTILES**

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45) **MONITORING OF COLONIAL NESTING WATERBIRDS ON THE UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE**

Stephen Winter¹ and Eric Nelson², ¹USFWS, Upper Mississippi River National Wildlife and Fish Refuge, Winona, MN 55987, ²USFWS, Upper Mississippi River National Wildlife and Fish Refuge - retired

PLATFORM PRESENTATION ABSTRACTS
ALPHABETICAL LISTING BY PRESENTING AUTHOR
(*Student Presenter)

HOME RANGE AND MOVEMENTS OF MALE SOUTHERN FLYING SQUIRRELS (*Glaucomys volans*) IN EASTERN IOWA.

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A lack of information about the basic ecology of southern flying squirrels (*Glaucomys volans*) within the state of Iowa is likely responsible for their status within the state as a “Species of Special Concern.” We began studies on southern flying squirrels at Mines of Spain Recreation Area (MoSRA; a state park) in eastern Iowa in 2007. The initial years of study were focused solely on established population demographics. This past year we initiated a radio-telemetry study on movements and spatial patterns of southern flying squirrels within the park. Beginning in mid-August, we attached transmitters to four male flying squirrels, captured on three different transects from different parts of the park. After their release, squirrels were located nightly, when possible, until the beginning of December. One flying squirrel yielded only a few locations before disappearing from the study site while the remaining three flying squirrels were routinely located during the entirety of the transmitter life. The area used by each flying squirrel greatly surpasses the reported areas of use for southern flying squirrels. In addition, the area used by each individual shifted temporally during the tracking period. Finally, these three flying squirrels exhibited consistent patterns of range contraction toward the end of the tracking period. We will present a snapshot of the spatial ecology of male southern flying squirrels and comment on possible southern flying squirrel distribution along the Mississippi River in eastern Iowa forests.

Keywords: *Glaucomys volans*, Iowa, radio-telemetry, southern flying squirrel

MAPPING THE SPATIAL DISTRIBUTION OF LEAD SHOT IN THE LA CORSE RIVER MARSH

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An estimated 9,000 non-military shooting ranges exist in the U.S., many of which likely present a source of lead contamination because they have operated for decades with limited removal of spent munitions. The La Crosse River Marsh (LRM) is the former site of the La Crosse Gun Club, which operated a large trap-shooting range between 1932-1963 along the LRM’s south shore. During this period of activity, significant quantities of lead shot were discharged into the LRM. Due to limited information on the legacy effects of trap shooting in the LRM, we sought to 1) quantify and map the spatial distribution of lead shot in the sediments, and 2) determine whether lead is mobilizing away from the buried shot. Sediment cores were collected from 27

sites distributed throughout the former gun club's potential shot fall zone. All cores were X-rayed to quantify lead shot abundance and a subset was analyzed via X-ray fluorescence (XRF) to quantify sediment (shot-free) lead concentration. X-ray images of the cores indicate the presence of lead shot at 21 of the 27 sites, reaching a maximum concentration of ~49,000 pellets/m². It is estimated that 1.9 hectares of the marsh contain a significant quantity of lead shot (>10,000 pellets/m²) stored in the sediment. The depth of lead shot burial varies across the shot fall zone from a few centimeters to tens of centimeters below the surface. Lead concentrations generally paralleled shot abundance, and a maximum lead concentration in the sediment of 22,750 ppm was found. High concentrations (>2000 ppm) of lead in sediment above the minimum depth of shot burial indicate lead may be migrating toward the sediment-water interface. Findings from this research will guide ongoing investigation on lead bioaccumulation in the LRM and its potential toxicological effects.

Keywords: lead, soil contamination, wetlands, X-rays, XRF

INTERACTIVE EFFECTS OF HERBIVORY AND FLOODING ON TREE RECRUITMENT IN AN UPPER MISSISSIPPI RIVER FLOODPLAIN FOREST RESTORATION

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Large herbivores are major drivers of ecosystem structure and function because most populations exceed historical carrying capacities. Although much is known about the role white-tailed deer play in upland forests, much less is known about how these animals might modify aboveground plant growth and community composition in frequently flooded riparian wetland forests.

Exclosures constructed along an elevation gradient at a floodplain forest restoration site south of La Crosse, WI indicated that herbivory cut the height growth of cottonwood and silver maple seedlings in half (from 60 cm yr⁻¹ to 30 cm yr⁻¹) regardless of elevation. The survival of cottonwood seedlings was reduced by herbivory regardless of elevation and the survival of silver maple seedlings depended on both herbivory and elevation (and the interaction between the two). The strongest effect of herbivory was observed at higher elevation sites where deer increased mortality by approximately 60%. Ash and willow species were not affected by herbivory or flooding, which may explain observed shifts in plant community composition away from silver maple and toward ash and willow at low elevation sites.

Results suggest that flooding exerts primary control over plant growth and community composition at lower elevation sites, while herbivory and flooding jointly regulate these properties at higher elevation sites. Understanding where transitions from abiotic to biotic control of plant community dynamics occurs across the broader UMR floodplain is critical to regional-scale forest management efforts.

Keywords: forest, mortality, recruitment, silver maple, white-tailed deer,

GEOMORPHOLOGICAL COMPLEXITY AS A DETERMINANT OF ECOSYSTEM FUNCTION AND APPLICATION OF FOOD CHAIN LENGTH IN RIVER MANAGEMENT

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Studies of trophic structure in streams and rivers have frequently strove to identify critical drivers of food chain length (FCL). Spatially-based variables examined have included, but are not limited to, basin area, channel width, and sediment characteristics; however, linkages between these measures and FCL have been tenuous. This study compared FCL of rivers to basin area, a valley-scale measure of ecosystem size and to measures of geomorphological complexity, scaled at the level of function process zones and reaches. Analysis of the importance of geomorphic complexity employed a cumulative measure of complexity and the individual geomorphological measures. FCL had a linear relationship to basin area; however, the pattern was of FCL decreasing as basin area increased. In contrast, FCL increased with greater geomorphic complexity. The linkage between FCL and geomorphological complexity was enhanced when the complexity of an extensively leveed location was corrected to reflect only the portion of the river valley actively connected to the river. Greater physical complexity provides greater potential for primary production and inputs of other basal resources. Another consideration is the potential for a greater diversity of niches laterally and longitudinally within the riverine landscape. This relationship can also be applied in assessing the ecological impact of river modification on functional attributes of river ecosystems and monitoring of rehabilitation efforts.

Keywords: complexity, heterogeneity, trophic structure, trophic position, rivers

POTENTIAL EFFECTS OF CLIMATE CHANGE ON JUVENILE MUSSELS: STUDIES ON SURVIVAL, GROWTH AND PHYSIOLOGY

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Native freshwater mussels are a diverse, but imperiled fauna and may be especially sensitive to increasing water temperatures because of their patchy distribution, limited mobility, limited dispersal, larval dependence on host fish, and the fact that they already inhabit fragmented landscapes. Recent research suggests that many mussel species may currently be living near their upper thermal limits. We tested the hypothesis that elevated water temperatures (20, 25, 30, and 35°C) will adversely affect the survival and physiology (i.e., heart rate and growth rate) of 2 month-old juveniles (*Lampsilis abrupta*, *Lampsilis siliquoidea*, *Megaloniais nervosa*, and *Obovaria olivaria*) in 28-d laboratory tests. The 28-d LT50s (lethal temperature affecting 50% of the population) ranged from 19.9 to 30.0°C across species. Heart rates varied greatly ranging from 9 to 27 beats/min and generally decreased with increasing temperature. Heart rate also varied across species and over time and may be a sensitive indicator sublethal indicator of

thermal stress. Growth rates differed significantly across temperature, time, and species, but the magnitude of this effect was small. Given that the LT50s are environmentally relevant temperatures in Midwestern rivers, mussels may move vertically or horizontally in sediments to seek thermal refuge. Estimates of upper thermal tolerances in native mussels is urgently needed because elevated water temperatures, caused by global climate change, industrial effluents, drought, or land development, could further challenge imperiled mussel communities. These data are being used in a downscaled global climate change model to forecast species responses to climate change and to develop strategies to mitigate adverse effects.

Keywords: freshwater mussel, climate change, physiology, survival, thermal stress

TEMPORAL AND SPATIAL EVALUATION OF FACTORS INFLUENCING FREE-FLOATING PLANT BIOMASS, DISTRIBUTION AND COMPOSITION WITHIN UPPER MISSISSIPPI RIVER BACKWATERS

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Duckweed (Lemnaceae) and filamentous algae are free-floating plants which can form dense surface mats resulting in a host of ecosystem and recreational use impairments. While much of the research regarding the effects of excessive nutrient input to the Mississippi River has focused on hypoxia in the Gulf of Mexico, the overabundance of free-floating plants represents an important local eutrophication effect. This study sought to identify factors driving free-floating plant production within Upper Mississippi River backwaters by examining free-floating plant biomass and nutrient content in conjunction with a suite of chemical and physical parameters. Similar to prior studies, free-floating plant tissue nutrient concentrations were significantly correlated with water column nutrient concentrations. Analysis of free-floating plant tissue nutrient concentrations and ratios ranged from values suggesting phosphorus limitation early in the growing season to values suggesting nitrogen limitation late in the growing season. Backwaters with a low degree of connection to the main channel exhibited values more suggestive of nitrogen limitation than highly connected backwaters. There were clear seasonal trends in free-floating plant biomass through the growing season in response to chemical and physical triggers. Dramatic increases or decreases in free-floating plant biomass were observed when particular chemical and physical thresholds were surpassed. These thresholds were identified for total phosphorus, total nitrogen, water temperature, water depth, water velocity, aquatic macrophyte cover, and pH. Free-floating plant proliferation is of keen interest to river enthusiasts and appears to be shaped by a number of complex inter-relationships.

Keywords: Mississippi River, free-floating plants, duckweed, nitrogen, phosphorus, connectivity

MODELING RIVER AND STREAM TEMPERATURE USING DATA COLLECTED AT DIFFERENT SPATIAL LOCATIONS AND IRREGULAR POINTS IN TIME

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River and stream temperature is typically modeled using time series from single, fixed locations. For such studies, diurnal effects and serial correlation may be modeled using standard methods. We address the more difficult case of modeling river temperature from temperature samples obtained from single visits to multiple spatial locations, and do so using summer water temperature data collected by UMR-EMP Long Term Resource Monitoring from the main channel of the 120 km La Grange reach of the Illinois River. We developed a model that permits unexplained variation at the observation scale to vary by year, and that permits simultaneous modeling of associations at the scales of observation (e.g., time/solar radiation associations), day (e.g., daily average temperature or cloud cover associations) and year (e.g., mean discharge association). Allowing for variation in covariates at observation and day scales permits correction of daily and annual means for variation in time of sampling (which may vary importantly across years). Day of month (confounded with mean river kilometer) was associated with approximately 65% of daily variation in temperature while time of day (confounded with spatial location) was associated with approximately 25% of variation in temperature within days. To date, methods to fully distinguish temporal from spatial components, given the complex sampling design and relatively small annual sample sizes ($n = 35$), have proven elusive.

Keywords: solar radiation, water temperature

WEST SIDE LEVEE MUSSEL SURVEY BETWEEN McCOLLISTER BLVD. - CRANDIC RR BRIDGES, IOWA RIVER, IOWA CITY, IA, SEPT. 2011

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A quantitative and qualitative mussel survey was conducted on marked transects 250 feet apart for the West Side Levee Project, September 26, 2011. The survey extended 3000 feet along the west side of the Iowa River from the McCollister Boulevard Bridge north to the CRANDIC Railroad Bridge, Iowa City, Johnson County, Iowa. Among the 159 mussels (16 species) found alive were 12 pistolgrip mussels, *Tritogonia verrucosa* (7.5%), and one yellow sandshell, *Lampsilis teres anodontoides*, both Iowa Endangered species. Also found in the area to be impacted by levee construction and riverbank riprap were two young *Obovaria olivaria*, hickorynut, each about three years of age. One of these hickorynuts was clearly *O. olivaria*, while the other one may have been another species with similar morphological features. No adult federally endangered mussel species, such as Higgins eye, *Lampsilis higginsii* were found. The Havlik Biotic Index was 105, or good.

Unique numbers were engraved on both lower valves of listed mussels after being measured for length, height, and externally aged. Common mussels were also engraved with hash marks on both lower valves. No additional species were represented by empty shells. All

mussels were translocated to two sites on the east side of the Iowa River. The downstream site was where Napoleon Lane runs perpendicular to an outside bend on the east side of the Iowa River, just upstream of a new outfall pipe and riprap. The upstream site was also on the east side of the Iowa River, near a natural rocky substrate opposite stake #2250 and a storage unit/telephone pole on the west side of the Iowa River. It rained during the second portion of the mussel survey, so it was more difficult to obtain an accurate location for the upstream translocation site. Most of the mussels were found from 1000 - 2000 feet upstream of the McCollister Boulevard Bridge, with minimal mussels being found near both bridges. Most adult mussels were very large.

Mussel populations have generally decreased throughout the interior of Iowa, but at least 23 species have been recorded downstream of the Coralville Dam, Johnson County, Iowa, since 2005. Based on the age and size classes seen, most species appear to have minimal to moderate reproduction at the sites from McCollister Boulevard - CRANDIC Railroad Bridges over the Iowa River, Iowa City, Iowa.

Keywords: Iowa River mussel species, Iowa listed mussels, Unionidae, construction impacts on mussels

FACTORS ASSOCIATED WITH RIVER TURTLE CAPTURES AT 9-MILE ISLAND IN POOL 12 OF THE UPPER MISSISSIPPI RIVER FISH AND WILDLIFE REFUGE

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We have studied the river turtle community at 9-Mile Island in Pool 12 of Mississippi River for several years. Each year brings a different set of climatic and environmental variability our study site in the Upper Mississippi River Fish and Wildlife Refuge. During the past three years we have sampled river turtles between June and September when the local river stage was less than 12-feet. Six species of turtles have been captured during this project. The site is consistently dominated by painted turtles (*Chrysemys picta*), with both common snapping turtles (*Chelydra serpentina*) and spiny softshell turtles (*Apalone spinifera*) also occurring regularly. Other species also captured at 9-Mile Island, although far less common includes common map turtle (*Graptemys geographica*), Ouachita map turtle (*G. ouachitensis*), and false map turtle (*G. pseudogeographica*). Several factors have been assessed to evaluate their relationship to turtle captures. High river stages, which have been common during the study, may affect the distribution and abundance of some species of turtles. Despite the extreme variability experienced at the study site, some patterns have emerged. We have documented a negative relationship between catch-per-unit-effort and trap nights and a positive relationship between turtle captures and moon phase, trending towards the full moon. We also have examined the relationship of precipitation and daily temperatures (high and low) on capture success as well as the compounding impact of cloud cover on moon phase. The annual abundance of *C. picta* has allowed for population estimation and we have detected a negative trend during our study.

Keywords: *Chrysemys picta*, moon phase, river turtles, trap nights

ECOHYDRAULIC TOOLS USING OPENFOAM—A HYDRODYNAMIC COMPARISON OF OPENFOAM WITH COMMERCIAL SOFTWARE, TIME OF RESIDENCE, AND SPECIES TRANSPORT.

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Understanding the hydrodynamics of complex ecological systems plays an important role in managing ecosystems for sustainability. In order to explain the first principles processes that influence the physical processes in ecosystems, Computational Fluid Dynamic (CFD) models are tools that can play an important role. One of those tools is OpenFOAM, a free open source CFD software package. This modeling package provides great flexibility to implement different physical processes for a particular purpose. In the present study three applications are presented. The first one presents a hydrodynamic comparison between the OpenFOAM model (Reynolds Average Navier-Stokes equations (RANS), steady flow with $k-\epsilon$ turbulent standard model) with the commercial software FLUENT in a Pool 8 of the Mississippi River, near La Crosse, WI. The comparison successfully shows that OpenFOAM is able to reproduce the main flow patterns in the Pool. The second application (RANS, steady flow, $k-\epsilon$ model for turbulence and particle transport) shows the calculation of Residence Time (RT) by using neutrally buoyant particles released at the inlet of the Pool. The results show an excellent agreement of the TR with the one obtained with FLUENT. The last application shows the implementation of a generic passive scalar transport in a cavity. This last application shows potential future applications of OpenFOAM towards a comprehensive ecohydraulic and chemical model. These applications illustrate that OpenFOAM is a promising platform to link water-quality and hydrodynamics, critical for complex ecological models. In particular, the coupling between hydrodynamic and chemical processes in environmental applications will enhance our understanding of the physical processes involved in ecological modeling and help managers to take optimal actions for future work

Keywords: OpenFOAM, Time of Residence, ecohydraulics, Mississippi River, species transport

CAUSES AND CONSEQUENCES OF ABUNDANT DUCKWEED AND FILAMENTOUS ALGAE IN BACKWATER LAKES OF THE UPPER MISSISSIPPI RIVER NEAR LA CROSSE, WISCONSIN.

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Effects of high nutrient input on large rivers have received less attention compared to effects on lakes, estuaries, and coastal areas. One possible consequence of high nutrient input to rivers is the formation of thick surface mats of free floating plants (FFP) composed mainly of duckweed (e.g., *Lemna* spp.) and filamentous algae. Such mats can reduce light penetration, submersed

aquatic vegetation growth and dissolved oxygen concentrations. We investigated the causes and consequences of FFP abundance by comparing ten backwater lakes in Navigation Pool 8 of the Upper Mississippi River (UMR) near La Crosse, Wisconsin, that varied in their connectivity to the main channel. There was a positive association between connectivity and water column nitrate (NO₃-N) concentration, phosphorus (P) release from the sediments under anoxic conditions, and NO₃-N flux to the sediments. Across all backwaters, rates of sediment P and N (as NH₄-N) release were generally high. Thus, rates of hydraulic input and sediment release were important factors affecting nutrient input to the water column in these backwaters. There was a positive, but weak, correlation between water column nutrient concentration and FFP abundance suggesting that nutrient availability at times affected FFP abundance. However, water column nutrient concentrations were generally high, and FFP tissue was nutrient rich. Thus, the eutrophic condition of the UMR appeared favorable for supporting abundant FFP in many of the backwater lakes studied here. The expected negative effect of abundant FFP on submersed aquatic vegetation was not observed, but rather there was a positive association between FFP and submersed vegetation abundance. This positive association suggests that facilitation of FFP accumulation by submersed vegetation was the dominant mechanism of interaction. Areas with abundant FFP exhibited relatively low dissolved oxygen concentrations. These results illustrate a number of complex connections among connectivity, nutrient cycling, FFP, submersed macrophytes, and dissolved oxygen concentrations in the backwaters of a large, floodplain river.

Keywords: Duckweed, filamentous algae, eutrophication, floodplain lakes, nutrients

ASSESSMENT OF AQUATIC VEGETATION RESPONSE TO ISLAND RESTORATION IN LOWER POOL 8 OF THE UPPER MISSISSIPPI RIVER

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Pool 8 was formed in 1937 through impoundment of the Upper Mississippi River (UMR) to facilitate commercial navigation. Impoundment permanently submerged most floodplain landforms except for higher elevation areas associated with natural river levees. Island restoration in Lower Pool 8 of the UMR began in the summer of 1989. Over 97 hectares of islands have been restored between 1989 and 2011 through funding provided under authorization of the UMR Environmental Management Program. The islands partially restore several sediment transport and flow distribution functions of natural river levees. Additionally, the restored islands address the affects of wave action on aquatic plant communities within the “shadow zone” on the lee side of the islands.

Goals for the Pool 8 Islands Habitat Rehabilitation and Enhancement Projects, Phases I, II and III included: Preserve and enhance the existing aquatic plant beds for fish & wildlife habitat; Improve habitat conditions for backwater fish species with an emphasis on habitat for Centrarchids; Increase high quality waterbird habitat and then maintain; Enhance habitat for riverine fish species and mussel; Increase habitat for other wildlife (i.e. turtle nesting habitat, mammals (primarily beaver, mink, and muskrat), reptiles, and amphibians); Improve conditions for the reestablishment of roosting habitat for species such as bald eagles and other raptors.

Our study objective was to assess aquatic vegetation response to island restoration in the Pool 8 Islands, Phase III, project area. 2005 – 2011 UMR Restoration - Long Term Resources Monitoring stratified random aquatic vegetation sampling points were assigned as either “project” or “control.” A wind fetch model developed by USGS Upper Midwest Environmental Sciences Center was used to delineate the portions of Lower Pool 8 where restored islands were predicted to produce wind fetch lengths of < 1,500 meters. Remaining areas were treated as a control. Yearly frequency of occurrence of perennial and annual emergent vegetation indicates a gradual decline pre project (2005 – 2008) for control and project with an increase then stabilization from 2009 – 2011, which corresponds to when larger areas of the study area would have been influenced by restored islands. Rooted floating leaved aquatic vegetation frequency of occurrence indicates an increase within the project area, while there was little change over time within the control. Submersed vegetation frequency of occurrence appeared stable at >90% over time for the project area, however, a 20% increase was observed in the control beginning in 2009.

Keywords: Mississippi River, island restoration, aquatic vegetation, project assessment, Upper Mississippi River Restoration - Environmental Management Program

CONSERVATION BY THE CUP (OF WATER): HOW INDIRECT SURVEILLANCE OF SPECIES DISTRIBUTIONS USING ENVIRONMENTAL DNA MAY LEAD TO IMPROVED RESOURCE MANAGEMENT

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Finding rare or elusive species is one of the most difficult tasks facing resource managers. In particular, finding new incursions of invasive species to eradicate is challenging, especially if individuals return to locations and reestablish new populations. Similarly, identifying and protecting habitats that shelter threatened and endangered species is extremely difficult if the monitoring and surveillance technique has the potential to harm the very individuals the effort is attempting to protect—such is the case with many netted aquatic species. Environmental DNA, or eDNA, is a new approach to species surveillance, which uses detections of cellular material sloughed into the water from aquatic organisms to infer presence. This detection method has the ability to detect new invaders, and monitor threatened and endangered species without risk of harm. Recently, the eDNA approach was used in the Great Lakes to detect the incipient invasion of bighead and silver carp, two species plaguing much of the Mississippi River for the last 30 years. Environmental DNA surveillance is also being applied to the upper Mississippi watershed as well as to other Mississippi River invasive species, such as northern snakehead and black carp. Additionally, the technology offers the potential to guide protection of native species, such as paddlefish and sturgeon by offering a non-intrusive detection and surveillance mechanism. Technological advances in the eDNA method will be relevant to landscape level conservation management by advancing beyond a search for one or two target species with the ability to identify entire communities of species, estimate species richness, and assess biodiversity. In this talk, the background of eDNA application is discussed, with thorough treatment of the search for

Asian carp, and the potential of this novel technique to conservation management of diverse aquatic communities is considered.

Keywords: Asian carp, Biodiversity, Detection methods, Environmental DNA

FAT FOOD, LEAN FISH: WHAT'S UP IN THE ILLINOIS RIVER?

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Growing evidence suggests that Asian carp are negatively impacting native fish planktivores. Diet overlap and reduced condition, lipids and essential fatty acids have been documented for gizzard shad, bigmouth buffalo and paddlefish in the presence of Asian carp. We examined lipid content and fatty acid profiles as indices of seston quality and consumer health at sites with (carp) and without Asian carp (no-carp). We found that lipids and essential fatty acids were abundant ($\mu\text{g/L}$) and of high quality ($\mu\text{g/mg}$) in the seston at carp sites relative to no-carp sites. However, lipids and fatty acids in gizzard shad, a native planktivore, showed the opposite (negative) response. Our previous study contrasting carp and no-carp sites indicated that this negative effect also applied to two other native planktivores, bigmouth buffalo and paddlefish. Further, comparisons with other studies indicated that the Asian carp in the Illinois and Mississippi Rivers (Pool 26) had abnormally low lipid and fatty acid concentrations. We hypothesize that these seemingly contradictory results (fat food, lean fish) might be explained by differences in macro zooplankton abundances between carp and no-carp sites. Lower abundances of macro zooplankton in the Illinois River and Pool 26 as compared to Pool 8 have been reported previously. Lower abundance of zooplankton might result from the relatively high abundance of native planktivores, and now non-native planktivores (Asian carp), in these reaches. Macro-zooplankton is known to be a rich source of lipids and essential fatty acids for consumers, including fish. Further, it is well documented that gizzard shad become more reliant on detritus-based food sources (lower in lipids and fatty acids) as zooplankton abundance is reduced. The degree to which other native planktivore fishes switch between detritus-based versus planktonic-based food sources is less known.

Keywords: Asian carp, gizzard shad, planktivores, zooplankton, detritus, Mississippi River, Illinois River

MUSSEL COMMUNITY DISTRIBUTION ALONG 9-MILE ISLAND IN POOL 12 OF THE UPPER MISSISSIPPI RIVER

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Mussels are important water quality indicators and serve as key components in the diet of terrestrial and aquatic animals. The decline of freshwater mussels in the Mississippi River has been well chronicled. We explored mussel distribution patterns near 9-Mile Island in Pool 12 of the Mississippi River during the summers of 2010 and 2011. Collected specimens were identified, measured, checked for *Dreissena polymorpha* (zebra mussel) colonization, marked, and released to the same section of the transect from which they were caught. In the first year of the study, a total of 728 individual mussels, representing fifteen species, were caught and catalogued. The two most captured species, *Amblema plicata* (threeridge; n= 476) and *Fusconaia flava* (wabash pigtoe; n = 176), varied widely in *D. polymorpha* colonization as 72% of *A. plicata* had associated *D. polymorpha* while only 17% of the *F. flava* had associated *D. polymorpha*. In the second year of the study, a total of 212 mussels were captured representing nine species. Similar to the previous year's data, the two most captured species were *A. plicata* (n = 118) and *F. flava* (n = 57) these species again varied widely in *D. polymorpha* colonization. The captures of *Quadrula fragosa* (winged mapleleaf; n = 1), *Cyclonaias tuberculata* (purple wartyback; n = 4), and *Arcidens confragosus* (rock pocketbook; n = 2) and were especially notable as *Q. fragosa* is federally endangered, *C. tuberculata* is threatened in Iowa, and *A. confragosus* is uncommon/rare for this stretch of the Mississippi River.

D. polymorpha colonization ranged from 0 to 100% depending on species and time sampled. *D. polymorpha* colonization was much more prevalent on *A. plicata* than on *F. flava*. Nearly 10% of our captures this year were recaptures, however none of the recaptures (n = 19) had *D. polymorpha* associated with them. Mussel distribution in correlation with sediment chemistry parameters such as total organic matter and bulk density were analyzed to determine if specific patterns exist. Water chemistry parameters were also analyzed at the monitored sites to test how the parameters of total suspended solids and total dissolved phosphorus might affect mussel distribution. Species diversity indices, (Simpson's, D_s , and Shannon's, H'), for five sites with adequate captures suggested two patterns from the preliminary study: 1) sites with large numbers of captures have lower diversity and 2) the west side of the island (opposite the main channel) has higher diversity. Horn's community similarity index (C_H) reveals that sites on the east side of the island are more similar to each other than either is to the west side site. Further investigations will continue to examine recolonization by *D. polymorpha* as well as the dynamics of mussels near 9-Mile Island.

Keywords: mussels, sediment chemistry, Pool 12 Upper Mississippi River, *Dreissena polymorpha*

ZOOPLANKTON COMMUNITY COMPOSITION IN LAKE ST. CROIX AND ABOVE ST. CROIX FALLS DAM INDICATE HIGH SUSCEPTIBILITY TO INVASIVE *HYPOPHTHALMICHTHYS* SPECIES

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Lake St. Croix is a high retention, lake-like region of the St. Croix River formed just upstream of its confluence with the Mississippi near Prescott, WI. Recent eDNA testing and captured specimens have confirmed that this area is under immediate threat of colonization by *Hypophthalmichthys molitrix* and *H. nobilis*. These species have reduced standing crops of zooplankton in similar systems, with long term impacts on the food web structure, reducing populations of native fishes. This study set out to a) determine baseline information on zooplankton composition of Lake St. Croix; b) establish and test monitoring protocol for this particular site that could be easily integrated with existing monitoring programs; and c) test whether there are refugia for zooplankton species above the dam at St. Croix Falls, WI. Sampling sites were chosen to correspond with long term monitoring by the Great Lakes Inventory and Monitoring Network of the National Park Service. Three sites on Lake St. Croix and one in the pool above the dam were sampled monthly in 2010 and 2011. Physical parameters were not significantly different between sites but did change over time, as expected. Results from 2010 show zooplankton species richness, biomass, and community composition were significantly different between sites. Two pools (at Stillwater, MN, and just upstream from Prescott, WI) were not significantly different from each other, but consistently supported more crustaceans, more total species, and high biomass than the site above the dam. A site near the I-94 bridge with low retention time fell between the two groups. The Stillwater and Prescott sites supported medium to large crustaceans as well as large crops of rotifers and protozoa, but the site above the dam is dominated by only protozoa and rotifers at significantly lower densities. These results are a cause for concern because the pool above the dam, which would be protected from *Hypophthalmichthys* spp. invasion, will not act as a re-population source for zooplankton in the Lower St. Croix River.

Key words: zooplankton, *Hypophthalmichthys*, Lake St. Croix, biomonitoring, invasive species

GIS ANALYSIS OF BALD EAGLE NESTING HABITAT ON THE UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE

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The Upper Mississippi River National Wildlife & Fish Refuge (Refuge) harbors one of the highest concentrations of Bald Eagles (*Haliaeetus leucocephalus*) in the contiguous United States. Nesting eagle populations in Pool 9 are greater than those associated with any other Refuge pool (pools 4-14). The Refuge has monitored eagle nesting activity for over 20 years,

recording geographic locations of individual nests and documenting trends in eagle populations through time. I explored the relationship between bald eagle nesting habitat and land cover type on the Refuge using the Refuge's bald eagle nesting database and GIS (Geographic Information Systems). I used land cover data available from USGS' Long Term Resource Monitoring Program to quantify the proportion of major land cover types in all Refuge pools and in Pool 9. I also quantified the proportion of habitat types surrounding bald eagle nests and compared these to the proportions of habitat types surrounding random points in all Refuge pools. A comparison of the land cover types associated with nests versus random points will provide the Refuge with insight on which habitats are important to nesting bald eagles and should be protected, enhanced, or restored. Comparing land cover types across pools will provide insight on eagle distribution and nesting density on the Refuge. Future work will expand these analyses to other pools encompassed by the Refuge.

Keywords: Bald Eagles, GIS, Upper Mississippi River National Wildlife & Fish Refuge, Nesting Habitat, Mississippi River

STOICHIOMETRIC ANALYSIS OF THE RELATIONSHIP BETWEEN THE CASE GRAZING CADDISFLY, *GLOSSOSOMA INTERMEDIUM*, AND ITS PERIPHYTON RESOURCES

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The dome-cased caddisfly, *Glossosoma intermedium*, is a herbivore that inhabits midwestern cold-water streams in high abundance. Larvae feed primarily on periphyton covering cobble and can strongly regulate periphyton biomass. When periphyton resources reach low levels, *G. intermedium* graze on the cases of conspecific larvae. We hypothesized the grazing system between *G. intermedium* and its algal resources represents "consumer-driven nutrient recycling". Throughout autumn 2010 and winter 2011, three streams in western Wisconsin were sampled and total nitrogen (N) and total phosphorus (P) concentrations were determined for stream water, *G. intermedium* larvae, excretia, streambed cobble periphyton, and periphyton adhering to the cases. The N:P of streambed periphyton at two study sites suggested P limitation (194:1, 38:1), however; N:P of case periphyton at the same two sites did not suggest P limitation (7:1, 11:1). Our results suggest that high P in *G. intermedium* excretia allows periphyton colonizing the cases to avoid P limitation. This alternative surface may, in turn, serve as an important supplemental periphyton resource for *G. intermedium* and the entire grazing community.

Keywords: *Glossosoma intermedium*, nutrient cycling, periphyton, ecological stoichiometry, invertebrate

RECRUITMENT SOURCES OF BIGHEAD AND SILVER CARPS IN THE ILLINOIS RIVER

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Knowledge of recruitment sources for Asian carps inhabiting the Illinois River would be valuable for directing population reduction efforts intended to supplement electrical barriers in the Chicago Sanitary and Ship Canal and limit the probability of Asian carps invading the Great Lakes. However, the extent to which Asian carps in the Illinois River are derived from recruits from within the Illinois River itself versus immigrants from the Mississippi and Missouri rivers is unknown. Asian carp are also known to use connected floodplain lakes during early life, but the contribution of these habitats to Asian carp recruitment in the Illinois River is also unknown. The objectives of this study were to identify natal environment of adult Asian carps in the Illinois River using stable isotope and trace element analyses of otolith cores. Water and Asian carp otolith Sr:Ca and $\delta^{18}\text{O}$ are both strongly correlated, consistent with other fish species. Most fish used river channel rather than floodplain lake habitats during early life. The majority of adult silver carp originated in the Illinois River, although approximately 20% were immigrants from the Missouri and middle Mississippi Rivers. In contrast, bighead carp were primarily lifetime residents of the Illinois River. Our results suggest that efforts to substantially reduce Asian carp abundance in the Illinois River drainage should continue to focus on the Illinois River itself, but may need to be expanded to include the Mississippi and Missouri Rivers for sustainable control of silver carp.

Keywords: bighead carp, silver carp, *Hypophthalmichthys*, otolith chemistry, Illinois

INCORPORATING APPLIED AND BASIC APPROACHES TO EVALUATE THE EFFECTS OF ASIAN CARP ON NATIVE FISHES

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Understanding fish community interactions is a critical component of large river ecology, especially the interactions of nonindigenous fishes on native fauna. Non-native large bodied planktivores are capable of posing deleterious effects to large river ecosystems. In particular, the effects of silver carp on native planktivorous large river fishes such as bigmouth buffalo and gizzard shad have received little attention despite the apparent relevance. As such, the objective of this study was to understand the interactions of silver carp with bigmouth buffalo and gizzard shad (i.e., native planktivores) in the free-flowing stretch of the Upper Mississippi River (a.k.a., the Middle Mississippi River, MMR). Specifically, we used data collected for the Long Term Resource Monitoring program (LTRM) throughout the MMR from 1992-2008 and from controlled experiments to evaluate trends in both non-native and native planktivores population attributes. Our results suggest that non-native planktivore relative abundance has increased while relative abundance of native planktivorous fishes has declined. Specifically, the gizzard

shad and bigmouth buffalo have shown precipitous declines in abundance while silver carp have dramatically increased. As a quantitative measure of a limiting resource, we found that silver carp condition has remained fairly consistent while bigmouth buffalo and gizzard shad condition has declined. Correspondingly, the results of our controlled mechanistic experiments suggest that silver carp may be able to exclude native fishes via exploitative competition. Based on the results of this study, silver carp are likely negatively influencing native planktivorous fishes (e.g., creating a limiting resource through competition), and because of this management efforts should be directed at reducing silver carp abundance to subsequently rehabilitate native planktivores.

Keywords: bigmouth buffalo, gizzard shad, planktivore, silver carp

MOVEMENTS OF FISH PATHOGENS WITH INTERSTATE SHIPMENTS OF BAITFISH

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In the fall of 2009, four baitfish companies were charged with violating the Lacey Act by importing bait fish from outside the state without valid import permits and health certificates. Sentencing included fines, probation, up to two random facility pathogen surveys per year, and random testing of monthly bait imports for two years. The two year study concluded in December of 2011 with 54% of the cases testing positive for one or more viruses. Golden Shiner Virus (GSV), Fathead Minnow Nidovirus, and several uncharacterized viruses were isolated. Research is currently being conducted in cooperation with the University of Minnesota-Veterinary Diagnostic Laboratory, and University of Wisconsin-La Crosse on these novel viruses, and at least three different novel viruses have been isolated to date. The study also detected two certifiable bacteria (*Renibacterium salmoninarum*, and *Aeromonas salmonicida*) present in the baitfish, and several parasites of concern.

Keywords: baitfish pathogens, fish viruses, fish bacteria, fish parasites, fish health

EFFECTS OF STREAM DIVERSION ON OXYGEN DYNAMICS AND MACROINVERTEBRATE COMMUNITY STRUCTURE AND FUNCTION IN A SOUTHERN ILLINOIS AGRICULTURAL WATERSHED

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The Cache River, Illinois, has undergone intensive watershed alteration, including diversion of the upper section to the Ohio River. This diversion fragmented the basin into two sub-watersheds, the upper Cache River (UCR) and lower Cache River (LCR). As a result, the LCR

receives only a fraction of its historical water inputs from upstream reaches, exacerbating the frequency and duration of low-flow periods and associated oxygen stress. Restoring a dynamic flow regime to the LCR through hydrologic reconnection of the two river segments has become a restoration goal for watershed managers. In an effort to predict potential ecological responses to reconnection and associated enhanced flows in the LCR, we examined the influence of flow on snag-dwelling and drifting macroinvertebrates in both sections of the river. We also compared whole stream metabolism estimates, sestonic and benthic chlorophyll-*a* concentrations, and sediment respiration rates in the UCR and LCR to understand the effects of watershed fragmentation on oxygen dynamics. Additionally, we explored the effects of duckweed cover on water column light and oxygen profiles, as thick mats of this macrophyte accumulate across areas of the LCR during low flows, likely intensifying hypoxia. We conducted a series of laboratory flume experiments in an effort to examine mechanisms by which duckweed could be dispersed by increased flows in the LCR. Average velocity associated with snag habitats was higher in the UCR (0.11 m/s) compared to the LCR (0.03 m/s, $p < 0.001$). Although macroinvertebrate abundance on snag habitats was higher in the LCR ($p < 0.05$), biomass did not differ between reaches because mean organism size was larger in the UCR. Both EPT and passive filter feeder biomass were significantly higher in the UCR ($p < 0.001$). However, only passive filter feeders were positively correlated with velocity ($r = 0.61$), indicating differential responses to velocity gradients. Drifting invertebrate communities differed significantly between the UCR and LCR ($p < 0.05$), with higher zooplankton biomass in the LCR and higher insect biomass in the UCR. Net ecosystem metabolism estimates ranged from -17 to -0.1 g O₂/m²/d and were explained by differences in community respiration ($r^2 = 0.76$, $p < 0.01$), as opposed to gross primary production. Estimates of sestonic (1.1 and 10.5 mg/l) and benthic chlorophyll-*a* (49 and 72 mg/m²) concentrations were higher in the LCR ($p < 0.01$), as was sediment respiration ($p < 0.01$). Dissolved oxygen concentrations and light penetration were both significantly lower in areas with 100% duckweed cover relative to areas with no cover ($p < 0.0001$). Results of the flume experiments indicated that isolated duckweed patches traveled downstream at the same velocity as surface water in the channel, whereas channel-spanning mats ~4.5 cm thick remained intact until a threshold velocity of ~0.07 m/s. At this point, the mats traveled downstream at approximately the same velocity as the surface water. Results suggest there will be numerous positive ecological responses to hydrologic reconnection of the UCR and LCR, and will be used to guide restoration efforts in the watershed.

Keywords: restoration, macroinvertebrate, oxygen, duckweed, flow

HYDROLOGY: SHAPING ECOSYSTEM CHARACTER AND FOOD WEB STRUCTURE

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Australian Dryland River systems have extremely variable flow regimes and complex interactions between riverine components via longitudinal and lateral hydrologic connectivity. Hydrology is acknowledged as essential for maintaining ecological functioning. It is also

understood that hydrology is scalar, operating over various spatial and temporal scales. Despite recognition of these relationships, we struggle to predict and quantify biotic responses to environmental flow management. Lack of a clear understanding of the scalar relationships between hydrology and ecosystem structure and function, coupled with the variable and complex nature of these systems, makes determining appropriate and sustainable environmental flows a pressing water management issue.

An increasingly utilised tool for describing and evaluating the ecological state of river-floodplain ecosystems is the applications of food web analysis, which can be derived through stable isotope signatures of biotic components. Functional indicators such as food webs are ideal for highly variable river systems because they reflect the base-level interactions which form the foundation of ecosystem processes and therefore give a meaningful indication of ecosystem condition.

The hierarchical approach used in this study reveals that several features of hydrology operating at two temporal scales influence food web structure at two levels of ecosystem organisation. Features of long-term hydrology including flow variability and duration of connections, affect variables that summarise food web structure: food chain length, mean trophic position and omnivory. In contrast, short-term flow pulse hydrology affects the trophic assemblage within overall food web structure. Identifying hierarchical correlations between hydrology and food web structure will provide a better understanding of the functional dynamics of rivers and aid in the development of meaningful and successful flow management strategies.

Keywords: food web structure, hydrology, scale, hierarchy, Australian dryland rivers

FLOODPLAIN FORESTS: WHY THEY ARE IMPORTANT FOR THE INDIANA BAT (*Myotis sodalis*) IN IOWA AND ILLINOIS

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Over the last few years, many bat populations have been drastically reduced due to natural and anthropomorphic causes. Of major concern is the Indiana bat (*Myotis sodalis*) due to its endangered species status. The population of Indiana bats residing in Iowa and Illinois increases in the summer as they migrate to form maternity colonies underneath the sloughing bark of trees. Mapping of spatial distributions of Indiana bat habitat in Iowa and Illinois revealed significant clustering. Detailed habitat surveys of Indiana bat maternity colonies disclosed distance between maternity colonies and habitat type as variables of primary importance in Indiana bat summer habitat selection. One of two habitat types maternity colonies occupied was floodplain forest. It is believed that floodplain forests are of vital importance to *M. sodalis* maternity colonies due to its ability to provide roost trees. From this research, it is hoped that *M. sodalis* habitat can be more easily identified and protected.

Keywords: Indiana bat, *Myotis sodalis*, floodplain forests, maternity colonies, riparian

EARLY LIFE HISTORY AND HABITAT USE OF AGE-0 BLUE CATFISH IN THE UNIMPOUNDED MIDDLE MISSISSIPPI RIVER

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Recently there has been a growing interest in the management of blue catfish populations due to increased recreational and commercial fishing. However, blue catfish early-life history traits are relatively unknown and may profoundly influence management decisions. Therefore, we sought to evaluate age-0 blue catfish early life demographics (abundance, hatch time, and growth) and habitat use in an unimpounded reach of the Mississippi River during 2002-2010. We trawled several locations, collecting 7,373 age-0 blue catfish (10 to 144 mm total length) and relative abundance varied across years. Blue catfish hatch timing varied across years (30-70 d), generally beginning in June and ending in August. Age-0 blue catfish growth rates differed among years (i.e. ~0.7-1.5 mm/d). In terms of macrohabitat use, catch rates of young blue catfish were highest in side channels and around islands while main channel features were infrequently used. Furthermore and in relation to mesohabitat use, age-0 blue catfish frequently occupied moderate velocity (i.e., 0.3-0.4 m/s), shallow depths (i.e., 1-4 m), and sand substrate. Knowledge of these early life characteristics plays a vital role in the management of blue catfish.

Keywords: blue catfish, macrohabitat, mesohabitat

TOPOGRAPHIC DIVERSITY INDEX FOR FLOODPLAIN FOREST RESTORATION BENEFIT ASSESSMENT AT THE HURON ISLAND HREP

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The Upper Mississippi River System was transformed from a free-flowing, floodplain river to a shallow draft navigation system with the implementation of the 9-Foot Channel Project in 1940. Throughout the system impoundment inundated river reaches upstream from each dam and reduced water level variation also. Impoundment effects are most pronounced at the dam and diminish upstream and the influence on groundwater is similar. Increased groundwater elevation inundated the tree root zone, killing intolerant species and promoting flood tolerant communities throughout the system.

Habitat change following impoundment included loss of nearly all the sand bars and mudflats in the active channel and increases in aquatic area. In the Iowa River Reach where Huron Island is located the number of island-side channel complexes was reduced from 12 to only 6 in 70 years. Large island-side channel complexes are important because they were dynamic environments supporting high forest diversity. Information from presettlement data show that silver maple was the dominant species at Huron Island, but there were also many other tree species and habitat classes present. Silver maple forests cover most of the islands today and they are less diverse, even aged, and denser than in the past. The likely future without

management intervention is succession to reed canary grass which is encroaching on forests system-wide.

Island topographic diversity is important because different plant communities occur within specific flood zones, and lack of physical diversity can lead to low plant community diversity. The Topographic Diversity Index (TDI) is an integrated GIS mapping and hydrologic analysis that incorporates terrestrial elevation, river bathymetry, and river stage duration and frequency analyses to estimate the terrestrial area that occurs within flood zones during the growing season. The Hydrologic Engineering Center – Ecosystem Functions Model (HEC-EFM) was used to assess growing season stage duration and exceedance probability for pre-dam and post dam reference periods. The spatial benefit metric calculated in GIS is acres within specific flood zones that are relevant to the survival and distribution of trees. The ratio of the pre-dam area in the 50, 33, 25, and 10 percent exceedance probability zones flood zones are the reference to which the other scenarios were compared. The TDI can be used to analyze many scenarios to estimate effort required to achieve restoration objectives.

Keywords: Forest Restoration, Hydrology, Environmental Benefit Analysis, Reference Condition

RELATIVE ABUNDANCE AND FEEDING HABITS OF BOWFIN, SPOTTED GAR, AND LARGEMOUTH BASS AT THE EMIQON PRESERVE AND REELFOOT LAKE: CAN NATIVE FISH SPECIES CONTROL INVASIVE COMMON CARP?

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In 2011, we sampled Reelfoot Lake to better understand why this aquatic ecosystem has not become dominated by invasive common carp *Cyprinus carpio*. Reelfoot Lake is similar to the Emiquon Preserve in that they are both shallow, disconnected floodplain lakes which contain bowfin *Amia calva*, spotted gar *Lepisosteus oculatus*, largemouth bass *Micropterus salmoides*, and common carp. However, these lakes differ in that Reelfoot Lake is over 100 years old, while the Emiquon Preserve is only 5 years old. We used standardized pulsed-DC electrofishing at random and fixed sites to assess the fish communities and the diet contents of bowfin, spotted gar, and largemouth bass in both lakes. Our catch-per-unit effort data suggests that largemouth bass relative abundance at Reelfoot Lake was 23.6 fish/hr, but was 26.5 fish/hr at the Emiquon Preserve. Bowfin (6.7 fish/hr) and spotted gar (6.9 fish/hr) relative abundances at Reelfoot Lake were higher than bowfin (0.5 fish/hr) and spotted gar (0.3 fish/hr) relative abundances at the Emiquon Preserve. The relative abundance of the invasive common carp (6.8 fish/hr) was approximate to those of bowfin and spotted gar at Reelfoot Lake, whereas the relative abundance of common carp (2.4 fish/hr) was greater than those of bowfin and spotted gar at the Emiquon Preserve and is increasing rapidly. Our bowfin, spotted gar, and largemouth bass diet analyses suggest they may not be selecting for young-of-year common carp as a prey type. So these

species might not be directly influencing common carp via predation but perhaps indirectly through other paths.

Keywords: Emiquon Preserve, Reelfoot Lake, electrofishing, fish population, diet analysis

VARIATION IN GILL RAKERS OF SILVER CARP *HYPOPHthalmichthys MOLITRIX* AND GIZZARD SHAD *DOROSOMA CEPEDIANUM* FROM THE ILLINOIS, JAMES AND WABASH RIVERS, USA.

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Controlling populations of silver carp *Hypophthalmichthys molitrix* may be possible by developing piscicides captured in microparticles that are selectively filtered from the water. The size of particles removed by filter-feeding fishes, like silver carp, is dependent upon the structure of their gill rakers. Understanding the morphology in gill rakers of silver carp and how they differ from native filter-feeding fish may help design piscicide-laden microparticles and improve their specificity. Confocal microscopy was used to compare intra- and inter-species variation in gill raker morphology of silver carp and native gizzard shad *Dorosoma cepedianum*. Gill arches from silver carp and gizzard shad were collected from the Mississippi River Basin (Illinois River and Wabash River) and Missouri River Basin (James River) in spring, summer, and fall 2011. Gill rakers of silver carp were comprised of circular and elliptical pores, whose size correlated with fish length and did not generally differ among sites or seasons. Gill raker morphology suggested that the size of particles removed from the water column by silver carp during feeding is dependent upon the size of the fish and not location or season. Gill rakers of gizzard shad, conversely, formed linear spaces that did not correlate with fish length but did differ among sites and seasons, suggesting that the size of particles removed by gizzard shad may be population-dependent and vary with location and time. These morphological differences in gill rakers of silver carp and those of gizzard shad suggested there may be the potential for designing particles to target specific sizes of silver carp, regardless of season or location. Some populations of gizzard shad could be impacted by these particles while other gizzard populations may be less susceptible.

Keywords: Asian carp, gill raker, filter-feed, piscicide, confocal

ZEQUANOX™: A POTENTIAL SOLUTION TO ZEBRA MUSSELS, BUT WHAT DOES IT MEAN TO ENDEMIC MUSSELS AND FISHES?

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Imperiled native unionid mussel populations are further threatened by invasive dreissenid mussels. The New York State Museum Field Research Laboratory (NYSM-FRL) began researching dreissenid mussel control in the early 1990's and discovered that *Pseudomonas fluorescens* (Pf-CL145A), a common soil bacterium, produces toxins that target the digestive gland of dreissenids and could prove effective in controlling zebra mussels, *Dreissena polymorpha*. Since the discovery, the NYSM-FRL, the USGS Upper Midwest Environmental Sciences Center and the USFWS Genoa National Fish Hatchery have been researching the use of Pf-CL145A to enhance native unionid mussel rehabilitation efforts. The first commercial formulation of Pf-CL145A was registered with the U.S. Environmental Protection Agency in 2011 for use in closed-water systems. A series of non-target laboratory trials were conducted with candidate open-water spray dried (SDP) and freeze-dried (FDP) formulations of Pf-CL145A to determine non-target animal effects on various lifestages (glochidia, juvenile and sub-adult) of seven unionid mussel species endemic to the Great Lakes and Upper Mississippi River basins. Understanding the potential effects of these new formulations is critical to evaluate the safety of potential open water treatments for controlling dreissenid mussels. Glochidia and newly metamorphosed juvenile mussels were exposed to various concentrations of Pf-CL145A for 24 h and evaluated for survival. Survival was determined as valve closure upon exposure to NaCl in glochidia and as foot movement, heartbeat or ciliary movement in juveniles. The effect of Pf-CL145A on the survival of glochidia of *Lampsilis cardium*, *L. higginsii*, *L. siliquoidea*, *Megaloniais nervosa*, *Obovaria olivaria*, *Actinonaias ligamentina*, and *Ligumia recta* was determined using SDP and FDP formulations. Similarly, the effect of Pf-CL145A on the survival of juveniles of *L. siliquoidea*, *M. nervosa*, *O. olivaria*, and *A. ligamentina* was determined. The potential risk to these and other native mussel species will be discussed. Research will continue to examine the effects of Pf-CL145A formulations on the remaining species and lifestages of native unionid mussels and on ten fish species endemic to the Great Lakes and Upper Mississippi River basins. Additionally, research is planned for field efficacy studies using a new mobile research laboratory in three different locations in WI and MN.

Keywords: Unionid restoration, Zebra mussels, *Dreissena polymorpha*, Upper Mississippi River basin

POSTER PRESENTATION ABSTRACTS

ALPHABETICAL LISTING BY PRESENTING AUTHOR

(*Student Presenter)

ASSESSING THE THREAT AND PREDATOR CONTROL OF A NON-NATIVE, AQUATIC INVADER (ZEBRA MUSSEL, *Dreissena polymorpha*) IMPACTING ENDANGERED NATIVE MUSSEL RESOURCES IN THE ST. CROIX NATIONAL SCENIC RIVERWAY (SACN): AN UPDATE

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Recent invasion of the St. Croix National Scenic Riverway (SACN) by zebra mussels (ZM: *Dreissena polymorpha*) is likely to severely impact the diversity and abundance of the rivers' native unionid mussel population. In 2010, National Park Service monitoring documented that 89% of the native mussels in the lower reaches of SACN (Prescott area) were infested with ZM. However, there is also evidence to suggest that benthivorous fish are using ZM as a food source. Our research objectives were to quantify the effects of the ZM invasion in the SACN by assessing 1) the direct impacts of encrustation and indirect effects of competition for food resources on native adult and juvenile mussels; 2) the extent of ingestion of ZM by local populations of benthivorous fish; and 3) efficacy of mitigation efforts through mechanical removal of ZM by hand-scrubbing native mussels. During 2011, *in-situ* fish predation on juvenile *Lampsilis siliquoidea* (n=300), and on ZM colonizing adult *Amblema plicata* (n=180) was assessed in two enclosure experiments using open-top (accessible to fish) and closed-top (inaccessible to fish) wire-mesh corrals. For each experiment, corrals were placed in low (Stillwater), medium (Prescott) and high (St. Croix Bluffs) ZM density areas. Juvenile mussel recovery was 48% at Stillwater, 96% at St. Croix Bluffs, and 100% at Prescott and survival of recovered juveniles was 98, 99, and 100%, respectively. Growth was significantly different among sites ($P < 0.001$) with lowest growth occurring at St. Croix Bluffs and the highest at Prescott. Adult mussel recovery across the three sites was 93% and survival of recovered mussels was 92%. Growth decreased ($P < 0.001$) from Stillwater, St. Croix Bluffs, and Prescott, respectively. There was no treatment effect (caged vs. uncaged) on growth at a given site. Analyses of foot tissue from adults (lipid, fatty acid profile, glycogen) and juveniles (lipid, fatty acid profile, isotopic signature) will be completed in 2012 and used to evaluate sublethal effects of ZM and food web linkages. Seston, chlorophyll *a*, and total suspended and volatile solids samples were collected to assess the food quality and quantity available for both adult and juvenile native mussels across the ZM density gradient. Guts of benthivorous fish (n=695) were sampled in 2010 and 2011 to assess species-specific consumption of ZM in each sub-basin of Lake St. Croix. During spring 2010, *A. plicata* (n=60 per site) were placed in paired open-top corrals at Prescott and St. Croix Bluffs, and either periodically scrubbed-free of ZM (in spring and fall) or continuously fouled by ZM. Overall, mussel recovery was 93% and survival of recovered mussels was 98%. Growth of mussels at Prescott was less than St. Croix Bluffs

($P < 0.001$), however, there were no treatment effects (scrubbed vs. unscrubbed) on growth at a given site.

Keywords: zebra mussels, native mussels, St. Croix River, fish predation, fatty acids

STREAM HEALTH AND RESTORATION WORKSHOPS AND RESOURCES – MN DNR

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The MN DNR Stream Habitat Program offers workshops and a variety of resources that focus on stream function, health, and restoration. The Science of Healthy Waters workshops focus on a specific topic such as ditching or dams, present: a) the science underlying integrative, system-based watershed management, b) the problems, issues and barriers hampering our ability to protect and restore watershed health and c) alternative approaches for accomplishing goals of clean water, improved fish and wildlife habitat and reduction of flood damages and erosion. Stream Health and Restoration Workshops teach the basic functions and processes of rivers, the Rosgen method of stream classification, how to assess and monitor stream health, and natural channel design river restoration. The Watershed Assessment Tool is an online resource which includes: a) an interactive mapping interface with 40+ natural resource data layers relevant to watershed health, b) detailed explanations of important concepts and c) *new* watershed health indices and scores that measure and compare the health of Minnesota's 81 major watersheds. Understanding Our Streams and Rivers is a developing brochure series that addresses the five components of stream health, the causes of stream instability and resultant streambank erosion and various restoration approaches. Reconnecting Rivers: Natural Channel Design in Dam Removal and Fish Passage is a book written by Luther Aadland that documents river restoration and reconnection projects that have helped restore stream health and connectivity throughout MN. Healthy Rivers: A Water Course is a free program (online or CD) that explores the ecology and stewardship of river systems - ideal for educating youth or concerned citizens. This interactive program features numerous photos, audio and video clips, maps, internet links and references. The program presents the science of rivers, the value of rivers, case studies and guidance for getting involved and making informed choices.

Keywords: education, mapping, outreach, river science

COMPETITIVE INTERACTIONS BETWEEN SILVER CARP AND NATIVE FISHES: A PROPOSED *IN-SITU* MESOCOSM EXPERIMENT.

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Two species of Asian carp, bighead carp *Hypophthalmichthys nobilis* and silver carp *Hypophthalmichthys molitrix*, were introduced to the United States in the 1970s and have established reproducing populations in the Upper Mississippi River System (UMRS). The diets of Asian carp consist primarily of zooplankton and phytoplankton. Paddlefish *Polyodon*

spathula a native filter feeder, also depend on zooplankton as a food source. Data from the Long Term Resource Management Program (part of the U.S. Army Corps of Engineers Environmental Management Program for the UMRS) shows a clear exponential increase in the population sizes of silver carp in the Illinois River and lower portion of the Upper Mississippi River. With this increase in silver carp abundance, it is important to determine if there are potential competitive interactions between them and paddlefish. Previous research documented competition for prey between juvenile bighead carp and juvenile paddlefish, but no experiments have been conducted to examine competitive interactions between paddlefish and silver carp. We propose to test for competition for prey between paddlefish and silver carp using *in situ* mesocosms. The use of *in situ* mesocosms will allow our experiments to be conducted within the natural ecosystem, limiting the experimental artifacts that can occur in a laboratory setting.

Keywords: Asian carp, paddlefish, gizzard shad, mesocosm, competition

HIGH TEMPORAL RESOLUTION NITRATE MONITORING AND EFFECTS OF WATER LEVEL MANIPULATION ON WATER QUALITY AT LAKE ODESSA

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Lake Odessa is a Mississippi River backwater lake system within the Odessa Wildlife Complex managed by the U.S. Fish & Wildlife Service and Iowa Department of Natural Resources for the primary purpose of habitat enhancement, protection, and restoration for migratory waterfowl and resident wildlife. Water control structures located at the inlet and outlet of Lake Odessa allow for water level manipulation to satisfy habitat management objectives. The effects of artificially manipulating water levels on water quality at Lake Odessa, however, have not been fully described. Here, we report on the results of a near-real-time, continuous water quality monitoring effort at Lake Odessa to investigate spatial and temporal nitrate trends associated with controlled inflow/outflow conditions. During Fall 2011, *in situ* real-time water quality sensors were deployed at Lake Odessa and adjacent Mississippi River Pool 17 to measure nitrate, turbidity, dissolved oxygen (DO), pH, specific conductance, and water temperature at a 20-30 minute interval. Preliminary results show a decreasing spatial trend in nitrate from inlet (up to 2.2 mg/L as N) to outlet (<0.5 mg/L as N), resulting in a gradient of nitrate concentrations from upstream to downstream within Lake Odessa. The high frequency measurement of nitrate allows for observation of finer-scale patterns, such as subtle diurnal variations in nitrate concentration as well as the immediate response to precipitation-related events. Temporal nitrate concentrations at the lake sites appear to be directly related to trends in nitrate loading delivered by the river at the inlet. Results from this investigation are consistent with previous studies showing reduced nitrate loads re-entering the river from backwater areas. The results of this study can be used by resource managers to evaluate the effects of water level manipulation and water retention on water quality, while meeting their habitat management goals. In addition, continuous water quality measurements provide an important dataset for linking water quality and hydrodynamic modeling in ongoing research by the University of Iowa's Lucille A. Carver Mississippi

Riverside Environmental Research Station (LACMRERS) in backwater areas of the Mississippi River.

Keywords: nitrate, water quality, backwaters, Lake Odessa, Pool 17

ADVANCES IN VEGETATION MAPPING USING 3D DESKTOP TECHNOLOGY AND FIELD COMPUTERS

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Recent advances in digital photography and 3D display technology associated with significant decreases in technology costs have made practical and cost-effective the transformation of vegetation mapping and monitoring from a film-based exercise to an entirely digital-based endeavor. The Resource Mapping and Spatial Analysis Team (RMSAT) at the U.S. Geological Survey, Upper Midwest Environmental Sciences Center (UMESC) has worked closely with the National Park Service (NPS), the U.S. Fish and Wildlife Service (FWS), and the U.S. Army Corps Of Engineers- Long Term Resource Monitoring Program (LTRMP), a component of the Upper Mississippi River Restoration-Environmental Management Program (EMP) to complete vegetation mapping products since 1989. We present how this technology has changed, advanced, and performs despite the demands of accuracy, reliability, and field durability, and how these advantages and disadvantages have changed the way in which vegetation is mapped.

Keywords: 3D, vegetation mapping, digital camera, image processing, field tablets

MEASURING THE SPATIAL DISTRIBUTION OF LEAD CONTAMINANTS IN THE LA CROSSE RIVER MARSH

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The La Crosse River Marsh is a 1,077 acre urban wetland located in the heart of La Crosse, WI. From 1932 to 1963 the La Crosse Gun Club resided on the shores of the La Crosse River Marsh; in this time, large quantities of lead shot were projected in and around the marsh making lead contamination a potential concern to the hundreds of animals which utilize this area. The purpose of this research is to quantify the spatial distribution of lead contaminants in the La Crosse River Marsh. Using differential Global Positioning System (GPS) and Geographic Information System (GIS) technology, a 20 x 20 meter grid covering the expected shot fallout zone was created within the marsh and 432 sample points were identified. Surface sediment was collected at each sample point and processed in the lab through drying and grinding methods. All samples were analyzed for lead and other heavy metals via X-ray fluorescence at the University of Wisconsin – La Crosse, with 10% of the samples also analyzed externally via inductively coupled plasma (ICP) analysis. Lead levels in the surface sediment range from 2 to > 10,000 ppm, with the greatest concentrations found in the shot fall zone 180-300 m from the former trap stations. The

Environmental Protection Agency's minimum standard for lead in bare soil in which children play in is 400 ppm while other non-play areas are 1,200 ppm. Results from this study will help to create a three-dimensional map of lead contamination within the La Crosse River Marsh and provide the framework for future studies looking at impacts on the vegetation, invertebrates, and water column.

Keywords: lead contamination, La Crosse River Marsh, sediment, environmental studies, GIS

IMPACT OF NITROGEN COMPOUNDS ON SALAMANDER HATCHING SUCCESS AND ONTOGENY

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Amphibian populations have been declining since the 1980s, especially in the Midwest. A variety of causes have been linked to these declines, including Chytridiomycosis, increasing ultra-violet radiation, and increasing anthropogenic contamination of the environment. Previous research has suggested that unnaturally high nitrogen levels in the environment, due to agricultural run-off, may be correlated with ontogenetic problems in frogs and toads. However, there has been no similar research examining the impact of elevated nitrogen levels on the ontogeny of salamanders. We predicted that salamander eggs exposed to artificially high nitrogen levels would experience greater mortality than eggs maintained in controls and that any resulting salamander larvae would similarly experience higher rates of ontogenetic problems. Furthermore, it was hypothesized that larvae raised in higher levels of nitrogen would experience a greater degree of problems during ontogeny. Salamander eggs were divided into a control and four experimental nitrogen-enhanced bins. The experimental nitrogen levels were 3ppm ammonium, 9ppm ammonium, nitrate 3ppm, and nitrate 9ppm. Hatched larvae were maintained in the same treatments. Enhanced nitrogen levels did have an impact on hatching success and post-hatching ontogeny. An increase in bent tails and missing digits was associated most with larvae exposed to the 9ppm nitrate concentration. These results suggest that unnaturally high nitrogen concentrations in the water during ontogeny detrimentally impacts salamanders. Clearly, more research is needed to further evaluate the relationship between excess nitrogen in the environment and salamander biology.

Keywords: ammonium, larval salamanders, nitrate, ontogeny

CURVE FIT: A PIXEL LEVEL RASTER REGRESSION TOOL

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Curve Fit is an extension to the GIS application ArcMap that allows the user to run regression analysis on a series of raster datasets. The user enters an array of values for an explanatory variable. A raster dataset representing the corresponding response variable is paired with each

explanatory variable value entered by the user. Curve Fit then uses either linear or nonlinear regression techniques to calculate a unique mathematical model at each pixel of the input raster datasets. Curve Fit outputs raster surfaces of parameter estimate, error, and multi-model inference. Curve Fit is both an explanatory and predictive tool that provides spatial modelers with the ability to perform key statistical functions at the finest scale.

Keywords: spatial, regression, curve, GIS, raster, parameter, estimate, model, fit

THE EFFECTS OF MACROPHYTES ON ORGANIC MATTER RETENTION IN STREAM ECOSYSTEMS

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Small streams provide several ecological services that support and maintain biological diversity and ecological integrity. Many stream properties, such as the importance of flow regime and discharge, have received considerable research attention. However, other stream properties such as the effect of macrophyte abundance on organic material retention remain a relatively understudied field. We hypothesized that macrophyte abundance increases hydraulic transient storage and decreases water velocity in streams thereby increasing the retention of three different forms of organic carbon: coarse particulate, fine particulate and dissolved organic carbon. During summer and fall 2011, we manipulated macrophyte abundance in two streams in the driftless region of western Wisconsin. In conjunction with these manipulations we also conducted experimental releases of different carbon sources before and after macrophyte removal. We found a positive effect of macrophyte abundance on retention of coarse particulate and dissolved organic carbon at both study sites. Our results suggest that macrophytes are important physical structures in stream ecosystems that significantly affect the hydrodynamic properties and also likely play an important role in organic carbon dynamics.

Keywords: organic matter, retention, macrophytes

CITIZENS PROVIDE QUALITY BIOLOGICAL DATA FOR ASSESSING STREAMS

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Iowa's volunteer water quality monitoring program, IOWATER, began as an idea in 1998 and has since grown into a network of volunteers across the state dedicated to monitoring Iowa's water resources. Between 2000 and 2011 there were 3,485 IOWATER volunteers trained and 5,313 monitoring sites registered. The IOWATER program provides training, equipment and technical support to volunteers, while the volunteers decide where, when, and what they will monitor.

At a series of staff led trainings, volunteers are instructed on how to complete different assessment types depending on their monitoring goals. These assessments can include chemical/physical, habitat, biological, bacteria and standing waters. The biological stream

assessment includes the monitoring of benthic macroinvertebrate populations. Benthic macroinvertebrates are identified and recorded based on presence or absence and are generally identified to the order level. They are divided into three categories: pollution intolerant, somewhat pollution tolerant, and pollution tolerant.

From 2000 through 2008, 3,675 biological assessments were completed at 1,185 different sites in Iowa and Minnesota. The most common habitat type sampled are runs and the most common microhabitat types sampled were silt & muck, sand, rock piles, root wads, fallen trees, cut banks, and overhanging vegetation. The benthic macroinvertebrate population statewide indicated a diverse population.

Keywords: volunteers, citizen science, macroinvertebrate, bioassessment, Iowa

ASSESSMENT OF GREAT BLUE HERON NEST SITES WITHIN THE MERTES SLOUGH HERONRY, UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE & FISH REFUGE – WINONA DISTRICT

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The Mertes Slough heronry in the Upper Mississippi River National Wildlife & Fish Refuge near Winona, MN, has been occupied by great blue herons (*Ardea herodias*) since 1977. Numbers of nesting herons have varied widely during that period, and the heronry location has shifted slightly. The objectives of this study were 1) to assess the current forest overstory used as nest trees and the forest midstory growing in as replacement nest trees; and 2) to document nest placement and clustering within nest trees. Nineteen variable radius plots were established evenly throughout the heronry. Overstory trees within each plot were counted, identified, and measured (height, diameter), and midstory tree species were recorded. Heron nests were counted and their heights were measured. Seven species of trees were represented in the heronry overstory, but silver maple (*Acer saccharinum*) dominated (85%) the community. Six species were recorded in the midstory, with silver maple (located in 79% of plots) and American elm (*Ulmus americana*, 37% of plots) being the most common. Heron nests were located in 40% of the overstory trees surveyed, with nest trees (95% silver maple) averaging nearly 5 m taller and 28 cm greater in diameter than non-nest trees. Most nest trees contained multiple nests (average 3.3 nests/tree, range 1-11 nests/tree), with nests averaging 16.1 m off the ground (range 8.2-23.2 m). Nest height was strongly correlated with tree height (linear regression $r^2 = 0.65$, $P < 0.001$), with nest heights averaging 78% of tree height. Preferred nest trees appear to be plentiful in the shorter overstory and mid-story forest within the heronry, suggesting adequate nesting habitat for future generations of great blue herons.

Keywords: great blue heron, nest tree, heronry, silver maple, Mississippi River

HYDRAULIC VARIABLES AS A PREDICTOR OF MUSSEL DENSITY IN THE SYLVAN SLOUGH OF THE UPPER MISSISSIPPI RIVER, POOL15

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Mussels play an important role in maintaining the aquatic ecosystem. Therefore, it is important to understand the various hydraulic factors that may be indicative of healthy/dense mussel beds in order to develop management plans to conserve the ecological integrity of the river system. As of now, there are few comprehensive studies about the preferred hydraulic conditions of freshwater mussels. Previous studies have found that shear stress and grain size were the best predictors of mussel density in Pool 8 of the Upper Mississippi River (UMR). The purpose of our study was to assess the degree of correlation between overall mussel density and measurable hydraulic and bathymetric variables in a known mussel bed in Pool 15.

As part of a research-intensive interdisciplinary hydroecology course, nineteen Augustana College students participated in a trimester-long mussel study of Sylvan Slough (an Illinois designated mussel sanctuary, RM 485.8). The study included two principle parts: 1) a field-based survey of mussels (with divers from US Fish and Wildlife Service and the IL DNR) and 2) a follow up study that aimed to assess the degree of correlations between the found densities with environmental factors (hydraulic and bathymetric variables). The work presented in this abstract pertains to the second part of the study.

This study collected data on four simple hydraulic variables (depth, sediment size distributions, velocity, and bed slope) to test for correlations against mussel density at the same sites that were used in the first part of the study. A total of eleven sites were included with seven of the points located along an island-to-shore transect. The remaining sites were near dive points from the mussel survey. A variety of methods were used to gather the data for the variables including (1) a Flow Mate velocimeter to collect the velocity readings (at 1/3 meter above the bed and 1/3 meter below surface), (2) an electronic fathometer and sounding rod, and (3) a PONAR dredge and a drag cylinder for bed sediment samples. A coupled differential GPS and single beam echosounder were used to collect data for bathymetric modeling. A standard sieve set was used to analyze the particle size distributions and a GIS was used to interpolate bathymetric measurements and to derive bed slope. A GIS was also used to combine and store the data at the 11 points.

After running diagnostics for multicollinearity, stepwise multiple linear regressions methods were employed to determine which of the explanatory variables were correlated with mussel density. A multiple regression model using all four variables was created with the following coefficients: D_{50} was 0.2149, Velocity was 0.1188, Depth was 0.0708, and Slope was 0.2553. However, stepwise multiple regression determined that slope was the most significant variable in predicting mussel density. A single-variable model was calibrated and bootstrapping determined an accuracy of ± 10.77 mussels/m². This model was extrapolated to the entire Sylvan Slough Study area and mapped at 5-meter raster cells. The ability to accurately predict mussel density is essential to conserving both time and resources when conducting mussel surveys, identifying conservation sites and potential riverfront developments. This single-variable model represents a small first step to understanding the mussel dynamics in Sylvan

Slough. Further research is necessary to see if these variables are actual predictors of mussel density. Some ways to do this could be by having a bigger sample size, a variety of sites and possibly having more complex variables such as sheer stress.

Keywords: Mussels, UMR, Slope, Hydraulic Variables, Pool 15

POPULATION ASSESSMENT OF SOUTHERN FLYING SQUIRRELS (*Glaucomys volans*) IN AN EASTERN IOWA FOREST

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Southern flying squirrels (*Glaucomys volans*) are considered a species of “Special Concern” in Iowa. Within Iowa, their abundance is officially “Uncommon” and their population trend is “Unknown.” Although their reported distribution in Iowa includes all but the extreme northwest corner, there are relatively few records for the species within the state. In 2010, we established two transects along park trails within the Mines of Spain Recreation Area (MoSRA; a state park) to initiate an assessment of the flying squirrel population. We used multiple-capture traps that are placed approximately 5-meters above ground level in large trees, baited with peanut butter, and checked each morning. In 2011, we expanded our effort with the addition of two transects in different regions of the park. This year, we successfully captured, tagged, and released 33 individuals (29 males and 4 females) and recaptured 16 individuals (13 males and 3 females), three of which were initially tagged during 2010. We will draw comparisons between the 2011 and 2010 capture results including the difference in average size of captured flying squirrels between the two years and the areas in which each individual was captured.

Keywords: *Glaucomys volans*, Iowa, mark-recapture, southern flying squirrel

SOUTHERN FLYING SQUIRREL (*Glaucomys volans*) HABITAT IN AN EASTERN IOWA FOREST ALONG THE UPPER MISSISSIPPI RIVER

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Southern flying squirrels (*Glaucomys volans*) are a “Species of Special Concern” in Iowa due to a lack of basic ecological knowledge. While southern flying squirrels are thought to prefer hardwood forests, especially those containing oaks and hickories, there has not been an assessment of the habitat characteristics associated with southern flying squirrel presence and abundance in Iowa. Southern flying squirrels at Mines of Spain Recreation Area (MoSRA; a state park) have been the focus of research for several years. This year, a thorough assessment of the habitat has been conducted in conjunction with a mark-recapture study of a southern flying squirrel population. At each trap site, on 4 different transects, we measured several habitat

variables, including tree species, size, and tree density as well as a ground cover assessment. These data were used to compare between trap sites that successfully captured southern flying squirrels and trap sites that did not. Preliminary results suggest that canopy cover is negatively related to southern flying squirrel abundance. Ultimately we hope to develop a predictive habitat model from features that are most related to the presence and abundance of southern flying squirrels.

Keywords: *Glaucomys volans*, habitat, Iowa, southern flying squirrel

DETERMINING CRITICAL HABITAT OF THE RIVER OTTERS (*LONTRA CANADENSIS*) AT THE UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE USING TRAIL CAMERA MONITORING TECHNIQUES

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The North American river otter (*Lontra Canadensis*) has historically experienced both decline and subsequent recovery in North America, particularly in regions bordering the Mississippi River. The recovery of river otter on the upper Mississippi River provides an opportunity to evaluate their current localized densities, as well as environmental factors that determine critical habitat of the species. Bushnell Trophy field cameras were placed near land trails with suspected otter activity on designated areas of the Upper Mississippi River National Wildlife and Fish Refuge to determine relative site visitation and seasonal variation. Areas chosen for analysis were located on Pool 13 of the Mississippi River and were selected due to their ease of access and unique topographical traits. Reported data is currently preliminary, however several patterns have been observed. Land trails always connected two or more water systems. Site visitation by otters was highly scheduled and site fidelity was often characterized by periods of common visitation followed by complete abandonment of the site. Site abandonment correlated strongly with freezing surface water. Site visitation concentrated on few trails with open water access during frozen periods, and spread back after periods of warm temperatures and ice thaw. Preliminary data also suggests that high use land trails are commonly concentrated on the smallest land division between two water systems; however this is not a strong correlation. Environmental factors that likely drive variation from this pattern are reported. This unique method of determining habitat use by trail camera images will provide insight into determining critical habitat of the river otter along the Mississippi River. Identifying critical habitat is crucial for the future management of this species.

Keywords: otter, Mississippi River, *Lontra canadensis*, trail camera, Pool 13, habitat

MANAGING HABITAT IN MOIST SOIL UNITS OF THE UPPER MISSISSIPPI RIVER FLOODPLAIN THROUGH FLOODED SOIL MANIPULATIONS IN THE FACE OF A CHANGING CLIMATE

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Moist soil management is an art that balances disturbances techniques and water level manipulations to produce optimal roosting, loafing, and foraging habitat for migrating waterbird species as well as a myriad of breeding species. Soil manipulations are important to maintain suitable habitat for a variety of species while managing moist soil units. These manipulations are traditionally done through disking after drawdown in the spring but before flood-up in the fall. Timing and amount of precipitation in the Upper Mississippi River drainages has shifted in recent years. Increased frequency of flood events has become common place and the duration of time before water levels recede has moved later in the spring. Traditional soil manipulations are not a viable management tool when water remains in the unit well into the growing season. Challenges of today with changes in climate and invasive species require new and innovative techniques to manipulate soils while water is standing in the unit. Rolling techniques have allowed management to proceed in a timely manner so that sufficient growing days are still available to provide suitable vegetation for the coming fall and the following spring migrations. This technique can also be used to manipulate for favorable responses against invasive species. Preliminary assessments depict a significant response in treated vs. untreated areas.

Keywords: Moist soil, rolling, wet soil manipulation, waterbird, disturbance

SPATIAL AND TEMPORAL PATTERNS OF PHYTOPLANKTON CHLOROPHYLL IN A LARGE RIVER ECOSYSTEM

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Changes in abiotic conditions create differences in the abundance of phytoplankton both seasonally and as a function of patch type. Abundance of phytoplankton can, in turn, influence the type and distribution of phytoplankton grazers within these habitats. The objective of this study was to measure the abundance of phytoplankton using chlorophyll concentrations in different large river environments. Spatial and temporal patterns of phytoplankton abundance were compared against abiotic measures, including nutrient concentrations, to identify causes for observed differences and see how abundance changes temporally. Habitats sampled included: main channel, secondary channel, island slackwaters, channel slackwaters, and backwater lakes. All samples were collected from RK 1162 - 1175 of the Upper Mississippi River, over the spring and summer of 2009 – 2011. Chlorophyll samples were analyzed using the spectrophotometric method and dissolved nutrients were analyzed by the Upper Midwest Environmental Sciences

Center. Other abiotic measures were made using standard field meters. Preliminary analysis shows that chlorophyll concentrations and dissolved nutrients are influenced most by short-term changes in discharge and the duration of stable hydroperiods. In general, stable periods of low discharge allow for nutrient depletion to occur, as slackwater habitats remain isolated from channel inputs. Further analysis of these flow patterns will be given during the presentation.

Keywords: chlorophyll, dissolved nutrients, hydrology, phytoplankton, Upper Mississippi River

TRENDS IN COMMERCIAL ROE HARVEST IN THE MISSOURI AND MISSISSIPPI RIVERS FROM 1945-2010

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Fish provide the main source of protein for the human population and has contributed to increased in commercial harvest. Due to the extreme harvest of these natural populations, overexploitation can occur and subsequently lead to depleted fisheries. This is especially true for commercially exploited roe-bearing species that exhibit late age at maturation and intermittent spawning. Historic foundational stock assessment models suggest strict regulations on harvest will prevent overexploitation. Overexploitation can create an imbalance in natural ecosystem function and jeopardize the livelihood of commercial fishers. Despite the problems created by overexploitation, trends of commercial harvest on large inland river roe-bearing populations have received minimal attention. As such, we evaluated trends in commercial fishing data from 1945-2010 for two roe-bearing species (paddlefish *Polyodon spathula* and shovelnose sturgeon *Scaphirhynchus platyrhynchus*) from two of the largest inland rivers in North America (Mississippi River and Missouri River) adjacent to Missouri. Commercial sturgeon and paddlefish catch has varied from ~300 to 29,000 kg over the course of the 55-year duration. Peak catches of both species occurred in 1980, 1990, and 2001. These abnormally high catches corresponded to initiation of worldwide caviar markets, onset of extensive regulations on the Missouri and Mississippi rivers, and the Caspian Sea fishery collapse; respectively. Furthermore, our results suggest that the harvest of paddlefish and sturgeon have increased substantially since 1945, in the face of decreased commercial fishers. Despite the increase in harvest of paddlefish and sturgeon and the possibility of overharvest, commercial fishing regulations have not been thoroughly evaluated for effectiveness. Evaluation of these regulations through collaborative efforts with commercial fisherman need to be examined to maintain a sustainable fishery. We suggest future efforts should be directed at direct observation of commercial catch to measure population demographics to aid in the development of population viability models.

Keywords: overexploitation, paddlefish, stock assessment

MUSSEL SURVEY OF UPPER SYLVAN SLOUGH, POOL 15

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In response to the proposed construction of a new I-74 bridge crossing the Mississippi river between Moline, IL and Davenport, IA, Augustana College and the US Fish and Wildlife Service (USFWS) collaborated to conduct a freshwater mussel survey. With many mussel species in the Upper Mississippi River on the endangered or threatened species list, it was important to determine what species are currently present in the area likely to be affected by construction of the new bridge.

We consulted with Jon Duveyjonck of the USFWS to plan a survey around the island on the Illinois side of the channel under the I-74 Bridge (River Mile 485.8). Survey sites were randomly selected within the wade-able area and, in a second random sample in deeper water. Finally, a transect line of samples was planned to cross from the Moline bank to the island.

The randomly selected and planned sites were surveyed on 9/7/11 and 9/8/11 by either polywoggers near the island shore or by divers in areas which were too deep for wading. All sites were assessed for depth, substrate type, mussel species, abundance, age, and length. We did this by doing a quadrat search in the ¼ meter by ¼ meter square of the quadrat, digging to about 10 cm in depth from the surface of the substrate. Timed searches were also done in a two meter radius by each quadrat. Unfortunately, due to communication errors, the length of the timed searched varied between the divers and the polywogging crews near shore.

A total of 553 live mussels were handled during the survey. We found that there are significantly more mussels living in deeper sections of the channel than in the shallow, wade-able areas. This may be due to mussels preferring to live on a more sloped surface, or their preferences in substrate.

We encountered twelve species of mussel in quadrat samples during the survey. *Quadrula pustulosa* (pimpleback) was by far the most common species of mussel found, and accounted for 48.9% of the live mussels encountered in the quadrats. The next most common were *Obliquaria reflexa* (Threehorn wartyback), which was 13.7% of all quadrat organisms, and *Amblema plicata* (Threeridge), which was 12.6% of all quadrat organisms. This comes as no surprise as all three species are very prevalent in the Midwest area. None of the other species in the quadrat samples individually accounted for over 10% of the organisms encountered.

Two state threatened species were encountered in the survey: *Ligumia recta* (Black Sandshell) was moderately abundant and comprised 4.6% of the quadrat catch. *Elipsaria linneolata* (Butterfly) was rare, with only two individuals encountered in quadrat samples and none in timed searches. In a pre-survey scouting run, a single, live, individual of a federally listed species, *Plethobasus cyphus* (Sheepnose) was encountered. All threatened or endangered mussel species were found east of the bridge. At the sites where a threatened species was found, there were a high number of other mussels found. This makes sense; the more mussels one finds, the greater chance a rare one will be found.

Age distributions were difficult to interpret, since sample sizes for many species were low, and the sampling method may be biased against juveniles. One positive indicator of the health of this mussel bed was the relative lack of live zebra mussels found in the area. Though there were a few, live zebra mussels were at very low frequency. Overall, we found that the mussel beds under the I-74 Bridge are relatively healthy.

Key Words: mussels, I-74 Bridge, survey, Mississippi River, endangered species

ASIAN CARP IN THE UPPER MISSISSIPPI – JUMP STARTING A RESPONSE PLAN

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Threats from several species of non-native, highly invasive fish, known collectively as Asian carp, have been building for over a decade in the Upper Mississippi Basin. Two of these carp species, bighead (*Hypophthalmichthys nobilis*) and silver (*Hypophthalmichthys molitrix*), have variously been collected from the system (e.g. Lower St. Croix River, Lake Pepin) since the mid-nineteen nineties. Currently, no reproducing population of either species has been detected in the Upper Mississippi. Though response to the threat these animals may pose has been slow, recent actions are beginning to address this oversight.

In January of 2011, the National Park Service (Mississippi National River and Recreation Area) convened an Asian Carp Task Force to begin to develop a strategy to meet the invasion. Participation has been diverse. The Task Force (now co-chaired by the Minnesota Department of Natural Resources) includes the cities of Minneapolis, St. Paul and Hastings, the St. Paul Port Authority, the shipping industry, the University of Minnesota, Wisconsin DNR, Minnesota DOT, St. Croix National Scenic Riverway, U.S. Fish and Wildlife Service, U.S. Geological Survey, the U.S. Army Corps of Engineers and other. The current focus is on determining presence at various locations on the St. Croix, Mississippi and Minnesota rivers, identifying ways to stop or slow the spread, and building a long term plan to support methods of control. These activities will be highlighted. Species ecology, history of the invasion and other agency objectives will also be explored.

Keywords: Asian carp, action plan, St. Croix River, Mississippi River, invasive species

IMPACT OF A LOW HEAD DAM ON FRESHWATER MUSSEL DISTRIBUTION AND RICHNESS IN THE LOWER ROCK RIVER

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Dams are known to cause major anthropogenic disturbances of freshwater mussel communities (Bivalvia: Unionidae). Dams have the capacity to convert lotic environments into lentic ones, which changes mussel habitat surrounding the dam. Given the abundance of low head dams in US river systems, it is important to understand their impact on Unionids. To evaluate the potential impact of Low Head dams on Mussel populations, we sampled upstream and downstream of the Milan Steel Dam in the Rock River (near Milan, IL) from the I-67 Bridge (approximately 2.5 km downstream of the dam) through the Milan Steel Dam and on to 27th St. Bridge (approximately 4 km upstream of the dam). Based on previous studies in the literature, we hypothesized that both abundance and richness of mussels would increase monotonically with distance from the dam until a plateau was reached. Our surveys were conducted between September 29th and October 9th, 2011. We distributed five downstream survey points between the

I-67 Bridge and Milan Steel Dam, and three upstream survey points between Milan Steel Dam and the 27th St. Bridge. Survey point locations were recorded using a portable GPS and later imported into Geographic Information Systems (GIS). Each survey consisted of a timed search by four individuals polywogging for thirty minutes each in a ten meter long and approximately seven meter wide wade-able area. The four polywoggers worked contiguous areas, so a total stretch of forty meters by seven meters was sampled at each survey point with two person-hours worth of sampling effort. Live mussels were identified to species and quickly returned to the same locations in the river. Substrate type was recorded for each site. Our results did not show a monotonic increase with distance from the dam. Abundance and richness first increased and then decreased in both the upstream and downstream reaches. One downstream point, at the confluence of Mill Creek and the Rock River, was a particular outlier as both abundance and richness were very low in spite of the fact that the immediately surrounding survey points were higher. Overall, our data had a distinctly two humped appearance, with peaks in abundance both upstream and downstream of the dam followed by declines further up and downstream. We hypothesize that this may be due to particular anthropogenic influences found on either side of the dam near these survey locations as they were near bridges and highways. We hypothesize that if these influences had not been encountered then the increase in abundance and richness would have continued to rise until stabilizing some distance from the dam. Our research showed that at the peak, we had a richness of six species upstream and five species downstream with a peak abundance of ten individuals upstream and nine individuals downstream per survey. These findings provide insight into the direct and indirect anthropogenic effects on mussels in the Rock River.

Keywords: Freshwater mussels, Low Head Dam, Rock River, Freshwater mussel abundance, Freshwater mussel distribution

NUTRITION AND CONDITION OF INVASIVE SILVER CARP ACROSS LARGE ILLINOIS RIVERS: CAN STRESS AND NUTRITION INFLUENCE ESTABLISHMENT?

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Invasive species are of worldwide concern as their establishment in non-native habitats may have negative influences on native biodiversity and ecosystems. Bighead (*Hypophthalmichthys nobilis*) and silver carp (*H. molitrix*) (collectively known as Asian carp) were intentionally introduced to the United States in the early 1970's and are currently distributed throughout the Mississippi River Basin (MRB). Because of the artificial connection between the MRB and Lake Michigan, Asian carp also have the potential to invade the Great Lakes. We tested for differences in physiological stress and nutritional parameters among silver carp populations within four large rivers of Illinois (Illinois, Mississippi, Ohio, and Wabash) that vary in ecosystem characteristics. The goal of our study was to test whether physiological stress and nutritional parameters could be used as indicators of habitat suitability for Asian carp establishment. To our knowledge, physiological characteristics of invasive species have not been used to make predictions about

habitat suitability in new environments or as a potential measure of ecosystem resiliency to invasion. Further, our research describing their physiology through metaphysiological studies will provide baseline information regarding the nutritional and stress parameters of these fishes in their natural environments. Silver carp were collected on all four rivers during June–October 2011 and individual fishes were measured for a suite of nutritional and stress parameters. Analyses of these parameters are ongoing and will be discussed. The results of our study may provide insights regarding aquatic ecosystem conditions that may support or fail to support the establishment of Asian carp.

Keywords: Asian carp, stress, nutrition, physiology, landscape

ZEBRA MUSSEL (*Dreissena polymorpha*) COLONIZATION AND DISTRIBUTION AMONG NATIVE FRESHWATER MUSSELS IN POOL 12 OF THE MISSISSIPPI RIVER

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Zebra mussels (*Dreissena polymorpha*) have been implicated in the decline in diversity and number of freshwater mussel species. *D. polymorpha* attach to nearly any solid object in aquatic systems, including native mussels where they hamper the reproduction and feeding effectiveness of the native mussels. As infestation levels of *D. polymorpha* approach 100 per freshwater mussel mortality can occur. Mussel population distribution at six sites around 9-Mile Island were monitored in the 2010 and 2011 field seasons near 9-Mile Island in Pool 12 of the Mississippi River. Mussels were collected by pollywogging along twenty five meter transects of randomly selected quadrants around the island and were checked for *D. polymorpha*. The infestation extent was measured on a scale of 0 to 4, 0 being no zebra mussels attached and 4 being one hundred percent of the native mussel covered. A total of 940 native mussels, representing fifteen species, were caught and cataloged, and of these captures 284 (30%) had zebra mussels associated with them. The two most captured species, *Amblema plicata* (three-ridge; n= 593) and *Fusconaia flava* (wabash pigtoe; n = 233), varied widely in *D. polymorpha* colonization as 60% of *A. plicata* had associated *D. polymorpha* while only 16% of the *F. flava* had associated *D. polymorpha*. Of the mussels with associated *D. polymorpha*, 81 % had less than 25 individual *D. polymorpha* attached to them. Implications of *D. polymorpha* colonization in pool 12 of the Mississippi River will be discussed.

Keywords: *Dreissena polymorpha*, mussels, invasive species Pool 12 Upper Mississippi River

MOVEMENT PATTERNS OF TROUT IN CATFISH CREEK

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In Iowa, rainbow trout (*Oncorhynchus mykiss*), brook trout (*Salvelinus fontinalis*), and brown trout (*Salmo trutta*), are stocked into several coldwater streams in the Mississippi River watershed, including Catfish Creek. Although brook trout is a native species, brown and rainbow trout are stocked to supplement introduced trout populations that support the demand by anglers for fishable trout. One of the sites where trout are stocked by the Iowa Department of Natural Resources is the Swiss Valley Nature Preserve, which is maintained by the Dubuque County Conservation Board. Movement patterns after stocking, including direction and distance, are not known in Iowa for any of the three trout species stocked there. To analyze the movement patterns of trout in Catfish Creek we performed a mark-recapture study at Swiss Valley Nature Preserve. There were a total of 26 trout captured including six specimens of *O. mykiss*, three of *S. fontinalis*, and 17 *S. trutta*. All fish were tagged and released at the site after capture. Movements of two recaptured trout were recorded including one which moved over 350m in a three-day period.

Keywords: Iowa, movement, *Oncorhynchus mykiss*, *Salmo trutta*, *Salvelinus fontinalis*

GEOMORPHOLOGICAL COMPLEXITY AS A DETERMINANT OF FISH COMMUNITY STRUCTURE IN A RIVER NETWORK

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A widely held view is that fish species richness increases as a function of an increase in river basin size. More recently geomorphic complexity, instead of location longitudinally within a river network, has been identified as a key factor in fish community structure at multiple spatial scales. Complexity is an attribute of local geology and climate independent of any continuum of physical connection. With greater complexity there is greater chance of more diverse habitat. This study examined fish community structure in longitudinally arranged patches to test longitudinal gradient and local geomorphology as determinants of community composition. We electrofished at six different sites, from low to high geomorphology complexity: Lake Pepin, Saint Croix River (2 sites), and Upper Mississippi River (3 sites). Analysis included density of each species, number of taxa, and species diversity. Geomorphological complexity was summarized by comparison of: island frequency, number of channels, wetted area width, river valley width, and sinuosity. Fish were identified and quantified as catch per unit effort. Species richness increased with greater geomorphological complexity, whereas the relationship of fish community structure to location along a longitudinal gradient was weaker. The findings, therefore, indicate that geomorphic complexity and not location on a longitudinal gradient is a critical determinant of community structure.

Keywords: geomorphic complexity, river, community structure, fish, basin area

COMPLIANCE OF BOATERS WITH THE BIG LAKE VOLUNTARY AVOIDANCE AREA, POOL 4, UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE & FISH REFUGE – WINONA DISTRICT

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Big Lake in Pool 4 of the Mississippi River is closed to waterfowl hunting during the Wisconsin waterfowl hunting season. This closed area (2,461 acres) also becomes a voluntary avoidance area for boaters beginning October 15, to reduce disturbance to feeding and resting waterfowl during fall migration. The objectives of this study were 1) to assess boater compliance with the voluntary avoidance regulation during the 2011 waterfowl hunting season, and 2) to determine the level of response of waterfowl to boat intrusions into the avoidance area. The area was monitored (20 different observers, 76 daytime observation periods) from an observation tower on the northeastern shore of the lake during 28 days between September 24 and December 3, 2011. Boat movements were recorded and levels of waterfowl disturbance (no disturbance, <1000 birds disturbed [minor disturbance], >1000 birds disturbed [major disturbance]) were noted. Numbers of waterfowl using the lake were recorded on each observation date. Fifty-nine boats were observed on the lake during the study period, with most (71%) observed prior to October 15. Boat counts exceeded 5/day prior to October 15 and <1/day after that date (significant decline, $t_{25}=2.98$, $P=0.02$). Waterfowl numbers increased dramatically (3-4 X) after October 15 and remained high through December 3 (significant increase after October 15, $t_{23}=6.24$, $P<0.001$). Prior to October 15, waterfowl were disturbed by 57% of boat intrusions, but disturbance rate increased to 94% after October 15. Major waterfowl disturbances were associated with 24% of boat intrusions before October 15, but with 53% of intrusions after October 15. On two dates (October 29, November 3) when >20,000 waterfowl were present on Big Lake, 12 boat intrusions all disturbed waterfowl, with six intrusions producing major disturbances. Boater compliance with the voluntary avoidance regulation on Big Lake during 2011 generally was good, with 58% of days without any boat intrusions and/or waterfowl disturbance (likely aided by cold weather and windy conditions). However, periodic warm weather led to increased boat traffic and multiple, major waterfowl disturbances per day.

Keywords: waterfowl, closed area, voluntary avoidance, disturbance, Mississippi River

ASSESSMENT OF THE RUSH-PINE CREEK WATERSHED, SOUTHEASTERN MINNESOTA, USING FISH AND BENTHIC INVERTEBRATE INDICES OF BIOTIC INTEGRITY

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The Rush-Pine Creek watershed has been impacted by poor agricultural land use in the past, and recently experienced a catastrophic, 1000-year flood event. The objectives of this study were to assess fish and benthic invertebrate assemblages at eight coldwater stream sites in the Rush-Pine Creek watershed, and compare them to three other stream sites outside the watershed to gain perspective on the health of aquatic communities within the watershed. Kick samples of invertebrates were collected and sorted, and communities (35 different taxa) were compared among sites using the Benthic Invertebrate Index of Biotic Integrity. Fish assemblages were sampled using a backpack electrofisher, and communities (18 species of fishes) were compared among sites using the Coldwater Index of Biotic Integrity. Invertebrate IBI scores generally were low (most sites rated poor or fair), with the highest scoring sites in the lower reaches of the Rush-Pine watershed. Low scores were attributed to deficiencies in number of stonefly species, long-lived species, intolerant species, and predator species. Fish scores were slightly higher (most sites rated fair or good), with the highest scoring sites in the upper reaches and tributaries of the Rush-Pine Watershed. Most sites had acceptable numbers of total species and coldwater species, and acceptable percentages of coldwater and intolerant species, but had an overabundance of white suckers and were deficient in percent salmonids as brook trout. These differences in scores suggest that the Rush-Pine has been impaired, and while stocking efforts may have improved fish assemblages, invertebrate assemblages have not yet recovered.

Keywords: coldwater stream, IBI, watershed, fish, macroinvertebrates

EFFECTS OF HABITAT IMPROVEMENT ON SIZE, CATCH RATE, AND CONDITION OF BROWN TROUT ANGLED IN A DRIFTLESS AREA STREAM

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The Driftless Area (southeastern MN, western WI, northeastern IA) is becoming a destination for trout anglers from around the United States. Visiting anglers often must decide which type of stream to fish: a stream that has received trout habitat improvement, or one that is in its natural state. The objective of this study was to determine which type of stream would produce (via angling) more and bigger brown trout and which stream type would produce fish in the best condition. Nearly 40 hours (three visits per site, 119-188 minutes per visit) were spent fishing (typical spinning tackle) five sections of Rush Creek, Winona and Fillmore counties, MN, during summer-fall 2011: two sections with habitat improvement and three without. Nearly 400 trout were angled during the study period, averaging 26 fish/site/visit. Fish ranged in length from 15.5-43.1 cm and in weight from 30-720 g. Stream sections did not differ in average fish length, weight, or condition (single-factor ANOVAs, all P values > 0.2), but maximum fish lengths and

weights were significantly greater (t tests, both $P = 0.04$) in natural stream sections than in improved habitat sections. Natural stream sections also tended to have marginally higher catch rates (site averages of 9.86-11.25 fish/hour) than sites with habitat improvement (7.45-9.54 fish/hour), but differences were not statistically significant (ANOVA, $P = 0.051$) among sites. Anglers have the potential to catch similar numbers and sizes of trout in natural and habitat-improved stream sections, but the chance of catching a large fish may be slightly greater in natural stream sections.

Keywords: brown trout, catch rates, angling, stream habitat improvement, Driftless Area

EFFECT OF HABITAT FRAGMENTATION ON GENETIC DIVERSITY OF NATIVE ORCHIDS IN THE UPPER MISSISSIPPI RIVER WATERSHED

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The wide range of environmental adaptation in orchids makes them one of the largest families of flowering plants with 20,000-30,000 different species. Majority are found in the tropical regions with quite a few adapted to survive in the temperate regions. Iowa is home to thirty-two different species of orchid; of the thirty-two species, two are endangered and six are threatened. The Tri-State region of Iowa, Wisconsin, and Illinois is very unique with prairie habitats, deciduous forests, and freshwater wetlands. This yields a great variation of orchid species. Our project is focused on the effect of habitat fragmentation on the species number, distribution and genetic diversity of the native orchids in the tri-state area.

Several areas of nature reserves, parks and private lands were surveyed from April to October of 2011 for native orchid distribution. We found 7 out of the 13 species documented from Dubuque and neighboring counties on Department of Fish and Wildlife website (www.fws.org). These seven includes *Goodyera pubescens* which is restricted to a single location and *Galearis spectabilis* which is found in most locations surveyed. Evaluation of environmental conditions suitable for orchids was carried out using soil samples, light level and surrounding vegetation. Also of interest is the extensive orchid-spider associations found in some locations. We are currently investigating whether there is a significant difference in pod development (pollination success) between the ones with the spider webs compared to the others.

Natural seed set was found among all of the native species observed so far. Each seed pod is being stored to investigate the germination rates in vitro with various hormones. Light levels and cold treatments. We have also collected leaf specimens from each habitat and currently evaluating the different primers for Rapid Amplified Polymorphic DNA (RAPD) analyses to assess the genetic diversity. We will discuss the results of RAPD analyses and whether the diversity is different within and between habitats. The locations of blooming plants were mapped onto the research sites using ESRI ArcGIS software to evaluate the distribution pattern of different species over time.

Keywords: genetic diversity, *Galearis spectabilis*, *Goodyera pubescens*, orchids, RAPD

ASIAN CARP TASTE TEST

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Asian carp have invaded and now inhabit several of the large river systems in the Midwestern United States. Of the many negative impacts Asian carp pose on aquatic systems, the most prominent influence relates to their remarkable filter feeding abilities and subsequent competition with native fishes. As such, recent studies have evaluated these interactions, and suggest said negative interactions are likely occurring. To circumvent or manage their negative impacts, creating commercial and recreational fisheries may provide the needed arena to promote the harvest of this fishery. However, limited information exists on the palatability of Asian carp as it relates to other food fishes. Because of this, a study was undertaken to determine Asian carp palatability in comparison to farm raised catfish and tilapia. To make above mentioned comparisons, participants were given an approximately one ounce serving of tilapia, catfish, and Asian carp prepared the same way (i.e., steamed or fried) in a blind taste-test trial (without knowledge of what species they were eating). The survey was designed to incorporate a broad based demographic of individuals with various preconceived notions of consuming fish. Over the course of evaluation, 307 (both male and female) participants (10 years old to greater than 60) from multiple ethnicities completed our taste-test. Our results suggested, that Asian carp were preferred nearly two to one over tilapia and catfish regardless of the method of preparation. Based on these results, Asian carp were favored over two of the most commonly consumed fish in the United States. Therefore, developing Asian carp recreational and commercial fisheries may assist fisheries managers in reducing population abundance through harvest and subsequently provide human consumers an additional palatable food fish.

Keywords: Asian carp, catfish, tilapia, commercial fishing

MONITORING DISTURBANCE TO WATERFOWL IN AN UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE CLOSED AREA

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The Upper Mississippi River National Wildlife and Fish Refuge (Refuge) serves as a migration corridor for millions of waterfowl and other waterbirds. During the fall migration, when duck hunting is also occurring, birds rely heavily on 23 designated closed areas along the 261-mile long Refuge to rest and feed. Closed areas on the Refuge prohibit migratory bird hunting year-round and all hunting, trapping, and camping during the duck hunting season. Closed areas have been in place on the Refuge since 1957, but adjustments to existing areas and additions of new ones were made during the Comprehensive Conservation Planning process that was completed in 2006. As part of a compromise during this process, most of these areas are also Voluntary Avoidance Areas requesting, but not requiring, other river users to avoid these areas to reduce further disturbance. As long as disturbance does not exceed established levels, further public use restrictions will not be implemented. The Big Lake Closed Area in Pool 4 near Nelson,

Wisconsin was established in 2009. This area is 2,271 acres and is also a Voluntary Avoidance Area. To ensure that it is providing optimal resting and feeding opportunities for migrating birds, Big Lake Closed Area was monitored for public use activity and waterfowl disturbance during the past three duck hunting seasons. The types of activity in the area, where they occurred, and what, if any, disturbance they caused were documented. The results will be used by Refuge managers to determine whether or not further actions are required to improve this resting and feeding area for migrating waterfowl.

Keywords: waterfowl, National Wildlife Refuge, human-caused disturbance, migration, public use

TERRESTRIAL LIDAR AND BATHYMETRIC DATA INTEGRATION AND POTENTIAL APPLICATION FOR THE UPPER MISSISSIPPI RIVER

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Elevation data for terrestrial portions of the floodplain and bathymetry data currently exist for much of the Upper Mississippi River System. The floodplain elevation data are attained using Light Detection and Ranging (LiDAR) technology. Bathymetry data are collected by boat surveys with a depth sounder, because turbidity and depth limit the ability of LiDAR to collect bed elevation under water. While some information needs can be met by using the individual datasets, an integrated spatial database for LiDAR and bathymetry is required in some cases. For example, hydrodynamic models used to predict flow have until now been limited to predictions in low water conditions. Other examples are information on near-shore habitat use by water birds, potential fish spawning habitat, and marshland vegetation use in these areas. Using specialized Geographical Information System (GIS) software and high-speed computer processors, it is now possible to merge LiDAR and bathymetric data into a seamless GIS layer to meet these needs. To accomplish this involves several steps including verifying LiDAR point classifications, development of a land/water boundary mask, rectifying discrepancies between shoreline boundaries as defined by the LiDAR and bathymetry data sets, and the process of interpolating elevation from the two data sets to create the seamless layer of elevation.

Keywords: LiDAR, Bathymetry, Elevation, GIS, Mississippi River

PRESENCE OF PADDLEFISH AND LAKE STURGEON ABOVE AND BELOW MISSISSIPPI RIVER LOCK AND DAM 5A

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The American Paddlefish (*Polyodon spathula*) and the Lake Sturgeon (*Acipenser fulvescens*) are primitive species of fish that require very specific spawning conditions to be successful. With the

construction of lock and dams along the Mississippi River, migration of the two species to up river spawning areas has been greatly restricted and become species of concern in Minnesota and Wisconsin. This was a preliminary study on the concentrations of paddlefish and lake sturgeon above and below the Mississippi River Lock and Dam 5A, near Winona, MN. Sampling was conducted in Polander Lake (above the dam), Blackbird Slough, and Straight Slough (below the dam). Fish were sampled using 100 m x 10 m monofilament gill nets (25 and 30 cm stretch mesh). A total of 7 paddlefish and 13 lake sturgeon were captured in 2011. The majority of these fish were captured in Polander Lake, while only two paddlefish were captured in Blackbird Slough, and no paddlefish or Lake Sturgeon were captured in Straight Slough. The successful capture of both species above and below the dam provides baseline information on populations status and habitat use. Future studies will concentrate on collecting further population information and additional sampling locations.

Keywords: Paddlefish, Lake Sturgeon, Lock and Dam 5A,

ZOOPLANKTON COMMUNITY DYNAMICS ACROSS A LARGE RIVER MOSAIC

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A wide range of biotic and abiotic factors have the potential to influence zooplankton community structure within the patch mosaic of a river. An especially important driver of zooplankton communities are hydrological patterns, which create spatial and temporal differences in zooplankton community composition. The objective of this study was to identify factors that regulate community structure of crustacean and rotifer zooplankton in different hydrogeomorphic patches of the Upper Mississippi River. Samples were taken of planktonic rotifers and crustaceans in May – September of 2009, 2010, and 2011. Rotifers were collected by passing 8-L of water through a 38- μ m sieve. Crustacean samples were collected with vertical tows using a 64- μ m mesh plankton net. Zooplankton community composition was similar across patch types when discharge increased or decreased markedly in the 7 – 14 d prior to sampling. In contrast, abundance of crustacean zooplankton, including predaceous species, increased whereas the number of rotifer species declined. Zooplankton densities were generally highest in areas with a low potential for water inputs from channels during flow pulses. The results of this study suggest that hydrologic factors and patch character influence abundance and types of zooplankton in a large river.

Keywords: zooplankton, community dynamics, Upper Mississippi River, patch, hydrology, temporal

EVALUATION OF SILVER CARP AGES DERIVED FROM SEVEN BONY STRUCTURES IN MIDWESTERN U.S. RIVERS

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To our knowledge, there has not been a consensus on which bony structure should be used for aging the invasive silver carp *Hypophthalmichthys molitrix*. Therefore, we analyzed the processing times and precision of seven different bony structures (commonly used for aging). A total of 120 silver carp were collected from six different locations throughout the Midwestern U.S. (Illinois, Missouri, Mississippi, and Ohio rivers) via electrofishing. Ages were evaluated for scales, vertebrae, opercles, pectoral fin rays, postcleithral bones, lapilli otoliths, and asterisci otoliths using methods provided by previous studies. Asteriscus otolith, opercle and scale annuli were difficult to discern and therefore not evaluated. We found that pectoral fins rays, postcleithral bones, and lapilli otoliths, had similar processing and handling times; whereas, vertebrae processing was much more time intensive. All structures with discernible annuli (pectoral fins rays, postcleithral bones, vertebrae, and lapilli otoliths) exhibited similar age assignments; however, lapilli otoliths provided more distinguishable annuli on older fish. From this, we recommend use of lapilli otoliths for aging silver carp, because processing time was similar to other structures and yielded consistently older ages. We recommend future efforts to validate the accuracy of lapilli otoliths.

Keywords: asian carp, electrofishing, otoliths

AN INVESTIGATION OF FISH COMMUNITY AND WATER QUALITY COMPOSITIONS IN AN ISOLATED SIDE CHANNEL OF THE UPPER MISSISSIPPI RIVER

Molly J. Sobotka, Quinton E. Phelps, Jason W. Crites, David P. Herzog, and Robert A. Hrabik Open Rivers and Wetlands Field Station, Missouri Department of Conservation, Jackson, Missouri, USA 63755

Varying degrees of connectivity between side channels and the main river channel are vital for sustainable ecological processes and functions for both aquatic and terrestrial communities. Within the Mississippi River, restoring side channel functional diversity is a top priority for many natural resource agencies. Buffalo Chute, located at river kilometer 41, is one of the several side channels, island complexes that becomes isolated from the main channel during low river stages leading to thermal and chemical stratifications and anoxic conditions. The purpose of this study was to better understand the impacts of side-channel isolation in the middle Mississippi River (MMR) by measuring fish community and water quality characteristics within an isolated waterbody. Therefore, we selected Buffalo Chute a representative side channel of the MMR to document water quality and fish community characteristics. Water quality measurements were summarized for the 2-year study. Thermal and chemical stratifications coupled with high water temperatures and anoxic conditions were observed in both years during summer. Oxygen reduction potential was lower in summer than winter, which could be attributed

to excessive growth of microorganisms and increased biological oxygen demand. Specific conductivity, total phosphorus, total nitrogen, and chlorophyll *a* were higher in summer compared to winter. Differences in water quality characteristics may have resulted in lower mean fish species richness, diversity, and evenness observed during the following winter. We surveyed 45 sites over 2 years using multiple gears to assess fish assemblage characteristics. The data collected in Buffalo Chute provide some insight into how isolated side channels function during low flow periods.

Keywords: Connectivity, oxygen, chlorophyll *a*, nitrogen

TRAWLING ON THE LA GRANGE REACH OF THE ILLINOIS RIVER: A BRIEF SUMMARY OF 18 YEARS OF LTRMP DATA AND INTRODUCTION OF THE MINI-MISSOURI TRAWL

Levi E. Solomon, Blake C. Ruebush, and Thad R. Cook; Illinois River Biological Station, Illinois Natural History Survey, 704 N Schrader Ave. Havana, IL. 62644

The Long Term Resource Monitoring Program (LTRMP) is part of the Upper Mississippi River Restoration Environmental Management Program (UMRR-EMP) and monitors fish and water quality on the La Grange Reach of the Illinois River. The Illinois River Biological Station (IRBS) has featured trawling as part of the multi-gear approach used by the LTRMP to sample fish since 1993. The standard LTRMP trawl has sampled 1690 individual fish with catches dominated by channel catfish and freshwater drum. Overall catches with the LTRMP trawl are stable with catch rates slightly increasing from 1993-2010. The Mini-Missouri Trawl (MT) was developed in the early 2000's by modifying the standard LTRMP trawl and reducing it to a smaller size. Past studies published have shown it to be effective in capturing small bodied fishes such as Cyprinids (e.g. *Macrhybopsis*). IRBS staff began deploying the MT in the summer of 2011 with catches being dominated by channel catfish, freshwater drum, and speckled chub. In addition to continued use of the LTRMP trawl in our standard fisheries sampling, we anticipate future use of the MT to yield important data on fishes in the La Grange Reach.

Keywords: trawling, LTRMP, Illinois River, mini-trawl

TWO-DIMENSIONAL HYDRODYNAMIC SIMULATION OF POOL SCALE EFFECTS OF ISLAND RESTORATION ACTIVITIES IN UPPER MISSISSIPPI RIVER POOL 8

***Brice E. Stafne**, Douglas J. Schnoebelen, and Larry J. Weber, IHR Hydroscience & Engineering, University of Iowa, Iowa City, IA 52242

The Upper Mississippi River system is a diverse aquatic ecosystem that has undergone substantial changes due to the increased demands of navigation on the river since the early 1900s. In general, the most significant changes were caused by the construction of the lock and dam system beginning in the 1930s and the building of levees. The resulting increased water levels caused many backwater areas to be flooded year round, with a loss of natural islands and a

decoupling of the river from the broader flood plain. In an effort to restore bathymetric diversity and original backwater habitat, island preservation and construction projects were started in the 1970s in Pool 8 by the Army Corps of Engineers. However, it is often difficult to fully understand pre-inundation or reference conditions. Typically, scientists, engineers and water managers are faced with the difficult decisions of what the reference conditions were like and how to best determine the effectiveness of river restoration projects. The goal of this study is the application of two dimensional hydrodynamic modeling to compare physical conditions around current and restored islands with original, pre-inundation conditions in the same location. Two dimensional models can provide decision makers with spatially and temporally resolved information about inundation, habitat suitability, and geomorphic patterns. With a better understanding of the effect of islands on both past and current pool scale hydrodynamics, river managers can make more informed decisions to help meet their habitat restoration goals.

Keywords: Upper Mississippi River, Numerical Modeling, River Restoration, Physical Habitat, River Ecology

VALIDATION OF THERMAL MODELS TO PREDICT THE MASS EMERGENCE OF MAYFLIES FROM THE UPPER MISSISSIPPI RIVER.

Mark Steingraeber, U.S. Fish and Wildlife Service, Fish and Wildlife Conservation Office, Onalaska, WI 54650.

Burrowing mayflies (*Hexagenia* sp.) are a key link in the trophic flow of energy through ecosystems supported by the Upper Mississippi River (UMR). As aquatic larvae, these insects consume nutrient-rich detritus in sloughs and backwaters for about one year. While synchronously emerging from the water and taking flight to mate, oviposit, and die (largely within a 2-day mid-summer period), these insects briefly represent an abundant source of proteins and lipids for a variety of aquatic, terrestrial, and avian insectivores. As poikilotherms, the rate of mayfly growth and development is strongly influenced by ambient water temperature. Based on results from an earlier laboratory investigation, the threshold temperature for development of *H. bilineata* mayflies was estimated at $10.1^{\circ}\text{C} \pm 3.1^{\circ}\text{C}$ and the cumulative degree-days from oviposition to first emergence was estimated at 2337 (95% confidence interval of 2045-2727). To validate these findings, I applied the reported developmental threshold temperature to daily water temperature observations made in UMR Pool 8, tallied the cumulative degree-days of development, and compared the predicted date of first emergence to the observed date of the first mass emergence here annually from 2007 to 2010. While this model proved highly accurate (± 1 day) in predicting the observed mass emergence date during most years, the precision of the reported confidence interval was quite low (± 2 -3 weeks). Meanwhile key values of a second thermal model ($9.2^{\circ}\text{C} \pm 1.6^{\circ}\text{C}$ threshold, 2530 degree-days to emergence, 95% confidence interval of 2201-2880), recently derived from an alternative analysis of the original laboratory data, proved to be just as accurate (± 1 day) but much more precise (± 1 day) than the original model during most years of comparison. Performance of the models is now being evaluated in several other UMR navigation pools. Because extreme weather events are anticipated to occur more frequently due to climate change, the Julian date of a localized mayfly mass emergence may exhibit greater annual variability in the future and alter the timely

availability of this nutritional resource, particularly to young endothermic insectivores (e.g., fledgling birds, bats).

Keywords: Bats, emergence, mayflies

AERIAL SURVEYS OF WATERFOWL ON THE UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE

Brian Stemper, USFWS, Upper Mississippi River National Wildlife and Fish Refuge, Winona, MN 55987

The Upper Mississippi River National Wildlife Refuge (Refuge) encompasses approximately 240,000 acres in four states in a more-or-less continuous stretch of 261 miles of Mississippi River floodplain from Wabasha, Minnesota downstream to approximately Clinton, Iowa. The Refuge has been designated as a globally important bird area. Up to 40 percent of the continent's waterfowl use the Mississippi Flyway during migration and over 50 percent of the world's Canvasback ducks and 20 percent of the eastern United States population of Tundra Swans stop along the Refuge during the fall migration. The Refuge has used standardized aerial transect surveys since 1978 to collect data on waterfowl abundance and distribution. Modifications to the number and location of transects have occurred in 1993, 2001, and 2007. Currently, aerial surveys are used to collect data on 20 waterfowl species as well as bald eagles, double-crested cormorants, American white pelicans, great blue herons, and great egrets. Information derived from the surveys is used by Refuge Managers and Biologists to monitor the status, trends and distributions of populations and to assess the effectiveness of management actions within an adaptive management framework.

Keywords: adaptive management, distribution, monitoring, status, trend

PLANTING A TREE: EXPOSING HIGH SCHOOL STUDENTS TO ECOLOGICAL RESEARCH WITH REPTILES

Jeramie Strickland¹, Lori Neuman-Lee², Shannon Thol³, Fredric Janzen³, ¹U.S. Fish and Wildlife Service, Thomson, IL 61285. ²Utah State University, Department of Biology, Logan, UT 84322. ³Iowa State University, Department of Ecology, Evolution, & Organismal Biology, Ames, IA 50010

There is a serious dearth of female and minority representation in the sciences. To help remedy this problem, we developed the Turtle Camp Research and Education in Ecology (TREE) program. The fundamental goal of TREE is to immerse traditionally-underrepresented high school and undergraduate students in an atmosphere of professional ecological research. Foreseeable outcomes of this immersion program are enhanced student interest in ecological careers, and improved appreciation and understanding of the importance of ecological research. An additional broad goal of TREE is to educate student participants in the importance of conservation, and to give them the tools and confidence to share this knowledge with their peers, families and educators. The specific objectives of TREE are to guide students in

performing ecological research, introduce students to key ecological concepts through reading and discussion, provide students an opportunity to deliver their new-found knowledge to the public, and expose the students to techniques and practices in mentoring. We seeded the program with high school students from Iowa and Illinois, along with undergraduate and graduate students, comprising an economically and racially diverse group. Participants converged at a field site (Turtle Camp) located in northwest Illinois on the Upper Mississippi River National Wildlife and Fish Refuge and the Army Corps of Engineers Thomson Causeway Recreation Area during the summers of 2007-2011. At Turtle Camp, students worked toward four main goals: research experience, education, local outreach, and mentoring. To date, more than 35 high school, 25 undergraduate, 10 graduate students, and 6 post-doctoral researchers have participated in the program which has provided meaningful experiences for all participants. Anonymous surveys from high school participants has shown that TREE has provided an excellent environment for advancing interest in, and knowledge of, science and for influencing career plans of the participants. Several high school alums have gone on to pursue science-related degrees at local universities.

Keywords: research, mentoring, outreach, education, reptiles

CONSERVATION AND MANAGEMENT OF THE IMPERILED ORNATE BOX TURTLES (*Terrapene ornata*) AT THE UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE

Jeramie Strickland¹, Ed Britton¹, Eric Tomasovic¹, Russell Engelke¹, Charles Tucker², David Delaney³, ¹U.S. Fish and Wildlife Service, Thomson, IL 61285. ²Missouri State University, Department of Biology, Springfield, MO 65897. ³U.S. Army Construction Engineering Research Laboratory, Champaign, IL 61820

In 2008, a long term comprehensive study of ornate box turtles (*Terrapene ornata*) was implemented within the sand prairies of the Upper Mississippi River National Wildlife and Fish Refuge (UMRNWFR) in northwest Illinois. In 2010, the study expanded to include two Illinois Nature Preserve sites and two private properties. The primary goals were to identify the population status of ornate box turtles within these areas and to implement best management practices to protect this imperiled species. A secondary goal was to reestablish a viable population of ornate box turtles in suitable sand prairie habitat at the Lost Mound Unit of the UMRMWFR. To date, field surveys have found fewer ornate box turtle populations and smaller numbers of individuals within most populations than expected. Of the nine prairies surveyed, three contained no ornate box turtles, three had only a few individuals, and three had viable populations. Radio transmitters are currently attached to 68 turtles located at four prairies to identify habitat use, home range size and hibernation characteristics. Through the use of automated telemetry, we are quantifying activity patterns and specific behaviors such as nesting events. We are also examining the efficacy of using radio transmitters with tilt sensors to quantify patterns of male courtship activity. Our nest predation study showed a mean predation rate of 30% with values as high as 56%. The first year of a head-start program was successful with the release of four turtles into the wild where the young turtles exhibited movement patterns similar to wild turtles and entered into hibernation when fall temperatures plunged. In 2011, we

experienced a setback with our headstart program in which many of our eggs did not hatch. The animal care protocol has been modified to resolve the problem experienced in 2011. Habitat management techniques were adopted to protect and conserve ornate box turtles. Environmental education programs were implemented to provide public awareness on the plight of the imperiled ornate box turtle. Project partners included local, state and federal agencies, conservation organizations, universities, zoos, youth groups, commercial developers and private land owners.

Keywords: Ornate box turtles, conservation, management, sand prairie, radio telemetry

TROPHIC PATTERNS OF FISH ACROSS PATCH TYPES OF A LARGE FLOODPLAIN RIVER

Travis J. Viker and Michael D. DeLong, Large Rivers Studies Center, Biology Department, Winona State University, Winona, MN, 55987

A floodplain river is a mosaic of patch types with discrete hydrogeomorphic conditions that shape their ecological character. Identifying trophic patterns of fish will help in understanding how food web organization is influenced by the type of patch. The objective of this study was to examine differences in food web attributes of different habitats using stable isotopes. Fish were collected from the Upper Mississippi River, between RK 1162 - 1175 in August and September 2011. Three different patch types (main channel, secondary channel, and backwater) were sampled to provide larger-scale representation of the river mosaic. Fish were collected via electrofishing. Fish were identified to species and a tissue sample was taken before the fish were returned to the water. Gut contents were also collected for representative piscivores. Stable isotopic analysis was completed at the Stable Isotope Mass Spectrometry Lab, Kansas State University. Bi-plot analysis indicated that isotopic ratios of most fish differed between the three habitats, suggesting that feeding was primarily local. This included both piscivorous and invertivorous species, which are often thought to use multiple feeding patches. A clear exception to this was *Esox lucius* from secondary channels, where variation in $\delta^{15}\text{N}$ was high, indicating a variable diet. Habitat-specific differences will be examined further by determining the trophic position of fish to examine food chain length and location of other fish on the food chain.

Keywords: Upper Mississippi River, fish, food chain length, stable isotopes, habitat

MONITORING OF COLONIAL NESTING WATERBIRDS ON THE UPPER MISSISSIPPI RIVER NATIONAL WILDLIFE AND FISH REFUGE

Stephen Winter¹ and Eric Nelson², ¹USFWS, Upper Mississippi River National Wildlife and Fish Refuge, Winona, MN 55987, ²USFWS, Upper Mississippi River National Wildlife and Fish Refuge - retired

The Upper Mississippi River National Wildlife Refuge (Refuge) encompasses terrestrial and aquatic habitats along 261 miles of the Mississippi River from Wabasha, Minnesota downstream

to approximately Clinton, Iowa. Currently, five species of colonial nesting waterbirds are known to have breeding populations on portions of the Mississippi River associated with the Refuge: double-crested cormorant, American white pelican, great blue heron, great egret and black tern. The Refuge has monitored breeding colonies since the 1960's but standardization of methodology and consistency of effort was not initiated until the 1990's. Monitoring efforts have been further enhanced through the use of digital aerial photography and Global Positioning System technologies. Future analyses of the Refuge's colonial nesting waterbird dataset with GIS may provide information that guides Refuge management actions and increases the Refuge's ability to protect these species.

Keywords: double crested cormorant, American white pelican, great blue heron, great egret, black tern, monitoring

SAUGER LIFE HISTORY IN THE LOWER PORTION OF THE UPPER MISSISSIPPI RIVER

***Kasey Yallaly**, Quinton E. Phelps, Sara J. Tripp, Justin R. Seibert, and David P. Herzog, Open Rivers and Wetlands Field Station, Missouri Department of Conservation, 3815 East Jackson Boulevard, Jackson, Missouri, USA 63755

Over the last century, sauger *Sander canadensis* populations have declined, which may be attributable to habitat alteration within rivers (e.g., loss of spawning habitat), hybridization and exploitation. However, a unique situation still occurs in the Upper Mississippi River in which a viable sauger fishery still exists. Therefore, in order to maintain a sustainable sauger population and subsequent sport fishery, it is important to thoroughly understand sauger life history. Because relatively little is known concerning sauger life history within the Upper Mississippi River, we sought to evaluate the dynamic rate functions (recruitment, growth, mortality) and reproductive ecology (sex ratio, age at maturity, fecundity and egg diameter) of saugers. In order to determine these life history parameters we collected sauger (N=151) via experimental gillnets during spring 2011. We found that sauger had similar growth to other reported studies while Recruitment patterns were erratic with the 2008 year class dominating the age structure. Total annual mortality of the population was 52.1% with the largest declines between ages 3 and 4. In terms of reproductive ecology, females were more abundant than males. Gravid females exhibited high fecundity of approximately 80,000 eggs with a mean egg diameter of 1.52mm. Based on these results, we have uncovered necessary sauger life history information to fully evaluate this population. Furthermore, this information provides unprecedented data that lays the framework for building detailed population level models that will assist in ensuring sustainability of the sauger in the Upper Mississippi River.

Keywords: exploitation, mortality, reproduction

**MINUTES OF THE 2011 BUSINESS MEETING
ANNUAL MEETING OF THE MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC.**

April 29, 2011

President Houser called the business meeting to order at 1:01 pm. Officers attending were Jeff Houser (President), Susan Romano (Vice President), and Secretary (Eric Strauss). In total, 35 Consortium members were present.

Presidents Report

Acknowledgements

President Houser welcomed members to the business meeting and acknowledged the contributions of the following individuals and groups for their efforts toward the 2011 MRRC meeting:

- Members of the executive committee, Vice President Susan Romano, Secretary Eric Strauss, and Treasurer Neal Mundahl for their help with planning and the proceedings
- Cammy Smith for her help with registration, logistics, and the website
- Terry Duckershein for coordinating the raffle
 - Mike Romano will do this next year
- Everyone who donated items for the raffle this year
- UW-L River Studies Center for providing the poster display boards
 - Roger Haro commented that UW-L's display stands are aging and the Consortium may want to start considering other options
 - Winona State University has some stands that might be used in the future
 - Pam Theil (USFWS) indicated they may have some stands we could use in the future.
- Judges for the student presentations: Dan Call, Greg Sass, Randy Hines, Mark Sandheinrich, Quinten Phelps, Roger Haro, Rebecca Kreiling, William Richardson, Susan Meiers, and Rip Sparks
- Moderators for the platform presentations: Doug Schnoebelen, Thad Cook, Rip Sparks, Bob Miller, Colin Belby, and Greg Sass.
- Thad Cook for taking photographs during the meeting
- Thanks to the National Great Rivers Research Center for hosting the website

Approval of Minutes

President Houser acknowledged a couple of errors in the 2010 MRRC business meeting minutes published in the 43rd Annual Proceedings. Specifically, in two locations the minutes referred to president Haro instead of president Sass. A motion to approve the minutes with those corrections was made by Rip Sparks and seconded by John Chick. Members approved the motion unanimously.

Meeting Attendance

President Houser announced the attendance at the 2011 meeting was 120 registrants; one of the highest attended meetings in consortium history. In addition, there were 38 poster presentations, another high statistic.

Awards

Appreciation Award

Terry Duckershein was presented an award for her years of dedicated service to the MRRC, especially for coordinating the raffle for many years.

Student Awards

Student Travel Awards were presented to Danielle J. Quist, University of South Dakota, Neil P. Rude, Southern Illinois University Carbondale, and Stefanie A. Fitzsimons, Western Illinois University.

The award for the Best Student Poster was presented to Christine Grannis for her poster titled “Characterizing southern flying squirrels in eastern Iowa”.

The award for Best Student Platform Presentation was presented to Emily Grossman for her presentation titled Relationships of river hydrology to annual tree growth in a population of pin oak (*Quercus palustris*) on the Mississippi River”.

Treasurer’s Report

President Houser presented the Treasurer’s Report prepared by Neal Mundahl, Treasurer. One value was amended from the report as published in the proceedings. The total expense value should read \$10,887.06 instead of \$6,847.78. A motion to accept the amended report was made by Roger Haro, seconded by Bob Miller. The vote to accept the motion was unanimous in the affirmative.

Old Business

Future meeting dates are as follows:

2012: April 26-27 at La Crosse Radisson Hotel

2013: April 25-26 at La Crosse Radisson Hotel

2014: April 24-25 at La Crosse Radisson Hotel

President Houser commented that his discussions with the Radisson Hotel indicated that groups need to schedule events with them approximately 3 years in advance to ensure the greatest flexibility in desired dates.

New Business

Election of Officers

Nathan De Jager and Charles Theiling were nominated for the position of Vice President.

Nathan De Jager was elected by Consortium members in a closed ballot election to serve as the next Vice President.

2011 Raffle Income

Ticket sales for this year’s raffle raised \$590. The silent auction raised an additional \$196.50.

Passing of the Presidency

In accordance with MRRC bylaws, President Houser turned the meeting over to the new President, Susan Romano. President Romano presented Dr. Houser with a plaque commemorating his year of service as President of MRRC.

Adjournment

President Romano entertained a motion to adjourn by Susan Meiers, seconded by Thad Cook. The motion passed and President Romano adjourned the 2011 Business Meeting of the Mississippi River Research Consortium at 1:21 pm.

**MISSISSIPPI RIVER RESEARCH CONSORTIUM
TREASURER'S REPORT – SUBMITTED BY NEAL D. MUNDAHL
14 MARCH 2012**

Accounts as of 30 June 2009	\$14,510.54
Accounts as of 30 June 2010	\$13,227.47

Transactions, 1 July 2010 to 30 June 2011

INCOME

2011 Registration and dues	7610.00
2011 Raffle/silent auction proceeds	786.50
Book sales	64.50
Interest	<u>10.14</u>
Total	8471.14

EXPENSES

2011 meeting (Radisson)	4918.85
2011 Proceedings	658.06
2011 Raffle prizes	70.93
2011 Awards	226.00
2011 Student Travel awards	540.00
2010 Corporation fee	<u>10.00</u>
Total	6423.84

Accounts as of 30 June 2011	\$15,274.77
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Transactions, 1 July 2011 to 1 March 2012

INCOME

Interest	<u>3.48</u>
Total	3.48

EXPENSES

2011 Keynote expenses	246.00
2011 Corporation fee	<u>10.00</u>
Total	256.00

Accounts as of 1 March 2012	\$15,022.25
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Accounts

Checking account	9007.23
Savings account	<u>6015.02</u>
Total	15022.25

MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC

BUSINESS MEETING AGENDA

*27 April 2012, 1:00 PM
Radisson Hotel, La Crosse, Wisconsin*

1. Call to Order

2. President's Report

- Acknowledgments
- Approval of the 2011 minutes and Proceedings
- 2012 attendance/participation growth information
- Awards

3. Treasurer's Report - Neal Mundahl

4. Old Business

- Future Meeting Dates
 - April 25-26, 2012, La Crosse, WI
 - April 24-25, 2014 La Crosse, WI
 - April 23-24, 2015 La Crosse, WI

5. New Business

- 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 thereafter in writing, signed at any time, whether before or after the time of the meeting, by the director entitled to such notice, shall be deemed equivalent to the giving of such notice. The attendance of a director at a meeting shall constitute a waiver of notice of such meeting, except where a director attends a meeting and objects to the transaction of any business because the meeting is not lawfully called or convened. Neither the business to be transacted at, nor the purpose, or any regular or special meeting of the Board of Directors need be specified in the notice or waiver.

3.06 Quorum.

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

3.07 Conduct of Meetings.

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

3.08 Vacancy.

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

3.09 Executive Director of the Corporation.

The Board may retain 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 RECIPEINTS OF THE MISSISSIPPI RIVER RESEARCH
CONSORTIUM FRIEND OF THE RIVER AWARD**

Friend of the River	Organization	Year	Meeting	Presenter
Calvin R. Fremling	Winona State University	1992	24 th	Neal Mundahl
Thomas O. Claflin	University of Wisconsin-La Crosse	1993	25 th	Ronald G. Rada
Pamela Thiel	U.S. Fish & Wildlife Service	1997	29 th	Terry Dukerschein
Richard V. Anderson	Western Illinois University	1998	30 th	Michael A. Romano
Ronald G. Rada	University of Wisconsin-La Crosse	1999	31 st	Terry Dukerschein
Marian E. Havlick	Malacological Consultants, La Crosse, Wisconsin	2008	40 th	Brian Ickes
Carl Korschgen	USGS, Columbia Environmental Research Center, Columbia, Missouri 65201 USA	2009	41 st	Roger Haro and Jim Wiener

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
15 th	1982	Radisson Hotel, La Crosse, WI	Dr. Richard Anderson Dr. Dave McConville Dr. Jim Wiener

-----	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
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
29 th	1997	Holiday Inn, La Crosse, WI	Ms. Therese Dukerschein Mr. Mark Steingraeber Dr. William Richardson Dr. Neal Mundahl
30 th	1998	Yacht Club Resorts, La Crosse, WI	Mr. Mark Steingraeber Dr. Melinda Knutson Dr. William Richardson Dr. Neal Mundahl
31 st	1999	Yacht Club Resorts, La Crosse, WI	Dr. Melinda Knutson Dr. Richard Anderson Mr. Brent Knights Dr. Neal Mundahl
32 nd	2000	Radisson Hotel, La Crosse, WI	Dr. Richard Anderson Dr. Yao Yin Mr. Brent Knights Dr. Neal Mundahl

33 rd	2001	Radisson Hotel, La Crosse, WI	Dr. Yao Yin Mr. Brent Knights Dr. Michael Romano Dr. Neal Mundahl
34 th	2002	Radisson Hotel, La Crosse, WI	Mr. Brent Knights Mr. Jeff Arnold Dr. Michael Romano Dr. Neal Mundahl
35 th	2003	Radisson Hotel, La Crosse, WI	Dr. Michael Romano Mr. Jim Fischer Dr. Neal Mundahl
36 th	2004	Radisson Hotel, La Crosse, WI	Dr. Michael Romano Dr. Mark Pegg Mr. Jim Fischer Dr. Neal Mundahl
37 th	2005	Radisson Hotel, La Crosse, WI	Dr. Mark Pegg Dr. Michael Delong Mr. Lynn Bartsch Dr. Neal Mundahl
38 th	2006	Radisson Hotel, La Crosse, WI	Dr. Michael Delong Dr. John Chick Mr. Lynn Bartsch Dr. Neal Mundahl
39 th	2007	Radisson Hotel, La Crosse, WI	Dr. John Chick Mr. Brian Ickes Dr. Robert Miller Dr. Neal Mundahl
40 th	2008	Grand River Center, Dubuque, IA	Mr. Brian Ickes Dr. Roger Haro Dr. Robert Miller Dr. Neal Mundahl
41 st	2009	Radisson Hotel, La Crosse, WI	Dr. Roger Haro Dr. Greg Sass Dr. Susan Romano Dr. Neal Mundahl

42 nd	2010	Radisson Hotel, La Crosse, WI	Dr. Greg Sass Dr. Jeff Houser Dr. Susan Romano Dr. Neal Mundahl
43 rd	2011	Radisson Hotel, La Crosse, WI	Dr. Jeff Houser Dr. Susan Romano Dr. Eric Strauss Dr. Neal Mundahl
44 th	2012	Radisson Hotel, La Crosse, WI	Dr. Susan Romano Dr. Nathan De Jager Dr. Eric Strauss Dr. Neal Mundahl

* The proceedings of the annual meeting 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 2012

The following persons or institutions have contributed substantially to the planning, execution, support, and ultimately, the success of the 44th Annual Meeting of the Mississippi River Research Consortium. The 2011-2012 Board of Directors and Consortium members gratefully acknowledge their efforts.

Local Meeting Arrangements, Meeting Announcements, and Mailings

Susan Romano, Western Illinois University, Macomb, Illinois

Nathan De Jager, US Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

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

Eric Strauss, University of Wisconsin, La Crosse, Wisconsin

Program and Proceedings

Susan Romano, Western Illinois University, Macomb, Illinois

Nathan De Jager, US Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin

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

Eric Strauss, University of Wisconsin, La Crosse, Wisconsin

Registration Table

Cammy Smith, The Nature Conservancy, Lewistown, Illinois

April Burgett, Illinois River Biological Station, Illinois Natural History Survey, Havana, Illinois

Poster Boards

University of Wisconsin – La Crosse River Studies Center, La Crosse, Wisconsin
McNair Scholars Program, University of Wisconsin-La Crosse, La Crosse, Wisconsin

Visual Aids, Poster Arrangements, and Awards

Eric Strauss, University of Wisconsin, La Crosse, Wisconsin

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

Sales and Arrangements (Raffle)

Mike Romano, Western Illinois University, Macomb, Illinois

Website

Cammy Smith, The Nature Conservancy, Lewistown, Illinois

April Burgett, Illinois River Biological Station, Illinois Natural History Survey, Havana, Illinois

Platform Session Moderators

Jeffrey Houser, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, LaCrosse, Wisconsin

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

Brian Gray, U.S. Geological Survey, Upper Midwest Environmental Sciences Center, LaCrosse, Wisconsin

Lisa Maas, US Fish and Wildlife Service, McGregor District, McGregor, IA 52157

Megan Moore, Minnesota Department of Natural Resources, Lake City Field Station, Lake City, Minnesota

Shawn Giblin, Wisconsin Department of Natural Resources, Onalaska Field Station, Onalaska, Wisconsin

Photography

Cammy Smith, The Nature Conservancy, Lewistown, Illinois

Raffle and Silent Auction Prizes

Dr. Tom Claflin, T.O.C. Fishing Rods, La Crosse, WI 54601

Alesa De Jager, <http://alesadejager.com/>

Tim Pearson, Riverblend Studio: <http://riverblendstudio.com/gallery/>

Roger Haro, Holmen, WI

Mike and Susan Romano, Macomb, Illinois