PROCEEDINGS OF THE MISSISSIPP RIVER RESEARCH CONSORTIUM

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April 22-23, 2021

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PROCEEDINGS OF THE

MISSISSIPPI RIVER RESEARCH CONSORTIUM

Volume 52
April 22-23, 2021
Virtual Conference

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MISSISSIPPI RIVER RESEARCH CONSORTIUM

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ACKNOWLEDGMENTS

The 2020-2021 Board of Directors and Consortium members acknowledge the following persons or institutions for their contributions to the success of the 52nd meeting of the Mississippi River Research Consortium.

Meeting Arrangements & Announcements
Levi Solomon, Illinois Natural History Survey, Illinois River Biological Station
Michelle Marquart, University of Illinois Conference and Event Services
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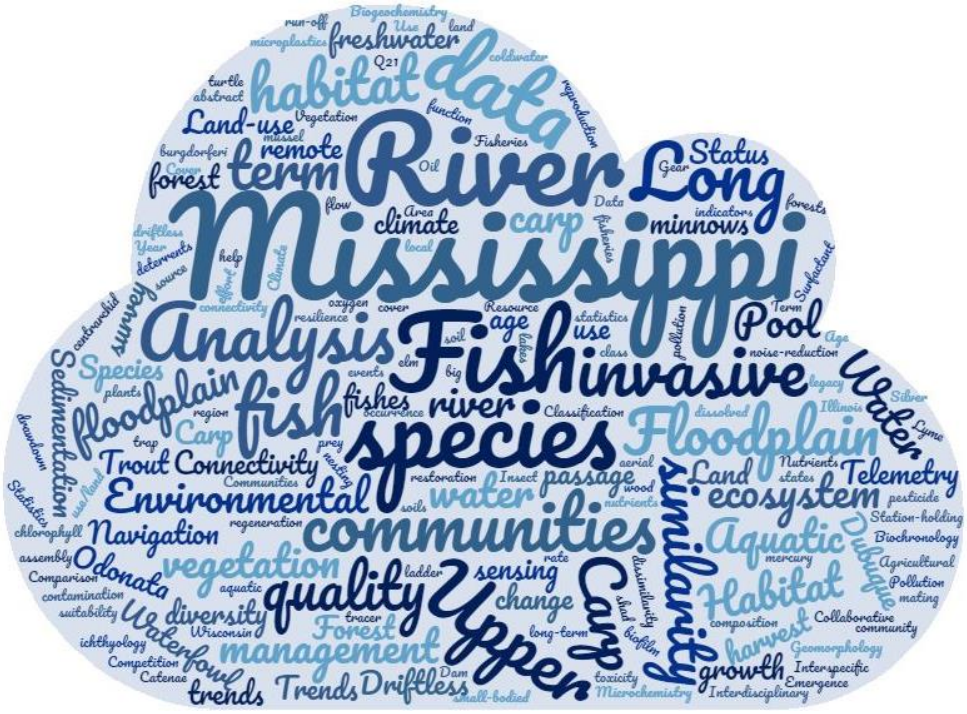
Levi Solomon, Illinois Natural History Survey, Illinois River Biological Station
Andrya Whitten, Illinois Natural History Survey, Illinois River Biological Station
Stephen Winter, Winona, MN

MRRC 2021 KEYNOTE SPEAKER

Dr. Carl R. Ruetz III

Dr. Carl R. Ruetz III is a Professor at Grand Valley State University's at the Annis Water Resources Institute in Muskegon, Michigan. He has a B.S. degree from Lake Superior State University, M.S. degree from University of Georgia, and Ph.D. degree from University of Minnesota. His postdoctoral work was at Florida International University, where he studied population and community ecology of Everglades fishes. His research broadly focuses on freshwater fish ecology. His main area of research is in drowned river mouth ecosystems of eastern Lake Michigan, with an emphasis on connectivity of fish populations and spatiotemporal patterns of fish assemblages. He is active in the current effort to reintroduce Arctic grayling to Michigan and the EPA's Great Lake Coastal Wetland Monitoring Program.



Keywords submitted with 2021 presentation abstracts, depicted in proportion to their frequency of occurrence.

MRRC MEETING AGENDA

Thursday, April 22, 2021

8:00–9:10 AM	**WELCOMING ADDRESS & KEYNOTE PRESENTATION**
9:10–9:30 AM	BREAK
9:30–10:50 AM	**SESSION I**
10:50–11:10 AM	BREAK
11:10– 12:10 PM	**SESSION II**
12:10–1:20 PM	LUNCH
1:20–3:20 PM	**SESSION III: Ecological Status and Trends of the Upper Mississippi River System from 1993 to 2019**
3:20–3:40 PM	BREAK
3:40–5:00 PM	**SESSION IV**

Friday, April 23, 2021

8:00–9:30 AM	**WELCOME BACK & SESSION V**
9:30–9:50 AM	BREAK
9:50–10:50 AM	**SESSION VI**
10:50–11:10 AM	BREAK
11:10– 12:10 PM	**SESSION VII**
12:10–1:00 PM	LUNCH
1:00–2:20 PM	**SESSION VIII**
2:20–2:40 PM	BREAK
2:40–3:40 PM	**BUSINESS MEETING**

MEETING AGENDA THURSDAY, APRIL 22, 2021

Oral Presentations
(*Student Presenters)

8:00–8:10 AM: Welcome
Levi Solomon, MRRC President

PLENARY

8:10–9:10 **Dr. Carl R. Ruetz III**
ruetzc@gvsu.edu

9:10–9:30 AM: BREAK

SESSION I (Moderator: Levi Solomon)

9:30–9:50 CONUNDRUMS OF FISH GROWTH IN AN ANTHROPOCENE RIVER
Jason A. DeBoer[1], Martin C. Thoms[2], James T. Lamer[1], Andrew F. Casper[1], Michael D. Delong[3].
[1]Illinois River Biological Station, Illinois Natural History Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign. [2]Riverine Landscapes Research Laboratory, University of New England. [3]Large River Studies Center, Biology Department, Winona State University.
jadeboer@illinois.edu

9:50–10:10 ENVIRONMENTALLY DRIVEN SHIFTS IN FISH COMMUNITY STRUCTURE WITHIN A LARGE REGULATED RIVER
John V. Gatto and John H. Chick.
Great Rivers Field Station, Illinois Natural History Survey.
jvgatto@illinois.edu

10:10–10:30 NATAL ORIGINS OF BLUEGILL, FRESHWATER DRUM, AND CHANNEL CATFISH ACROSS SEVERAL REACHES OF THE MISSISSIPPI AND ILLINOIS RIVERS
***Shaley A. Valentine** and Greg W. Whitledge.
Center for Fisheries, Aquaculture, and Aquatic Sciences, Southern Illinois University-Carbondale.
shaley.valentine@siu.edu

10:30–10:50 EFFECTS OF HABITAT CONNECTIVITY ON DIVERSITY AND ABUNDANCE OF FISHES IN THE MAIN CHANNEL OF THE MISSISSIPPI AND ILLINOIS RIVERS

Eric C. Hine, John V. Gatto, and John H. Chick.
Illinois Natural History survey, Great Rivers Field Station.
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10:50–11:10 AM: BREAK

SESSION II (Moderator: Alicia Carhart)

11:10–11:30 AQUATIC VEGETATION DYNAMICS IN THE UPPER MISSISSIPPI RIVER OVER TWO DECADES SPANNING VEGETATION RECOVERY

Kristen L. Bouska[1], Danelle M. Larson[1], Deanne C. Drake[3], Eric M. Lund[2], Alicia M. Carhart[3], and Kyle R. Bales[4].
[1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, Wisconsin, USA. [2]Wisconsin Department of Natural Resources, La Crosse Field Station, 2630 Fanta Reed Road, La Crosse, Wisconsin, USA. [3]Minnesota Department of Natural Resources, Lake City Field Station, 1801 South Oak Street, Lake City, Minnesota, USA. [4]Iowa Department of Natural Resources, Bellevue Field Station, 206 Rose Street, Bellevue, Iowa, USA.
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11:30–11:50 WHAT IS A STAND? REDEFINING THE SCALE OF FOREST MANAGEMENT UNITS IN THE UPPER MISSISSIPPI RIVER FLOODPLAIN

Laura Reuling[1], Molly Van Appledorn[2], Andrew Meier[3], Daniel Nielsen[1], and Marcella Windmuller-Campione[1].
[1]University of Minnesota, Department of Forest Resources. [2]U.S. Geological Survey, Upper Midwest Environmental Sciences Center. [3]U.S. Army Corps of Engineers– St. Paul District, Environmental Section.
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11:50–12:10 SOIL PHYSICAL, CHEMICAL, AND BIOTIC CHARACTERISTICS IN NATURAL REFERENCE CONDITIONS AND ECOSYSTEM RESTORATION PROJECTS IN THE UPPER MISSISSIPPI RIVER

Aaron M. McFarlane[1], Nia R. Hurst[2], Carina M. Jung[2], and Charles Theiling[2].
[1]U.S. Army Corps of Engineers, St. Paul District. [2]U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, Mississippi, USA
aaron.m.mcfarlane@usace.army.mil

12:10 - 1:20 PM: LUNCH

SESSION III: Ecological Status and Trends of the Upper Mississippi River System from 1993 to 2019 (Moderator: Jeff Houser)

1:20–1:30 THE UPPER MISSISSIPPI RIVER SYSTEM FROM 1993 TO 2019: INTRODUCTION TO AN ASSESSMENT OF THE STATUS AND LONG-TERM ECOLOGICAL TRENDS OF THE RIVER AND ITS FLOODPLAIN
Jeffrey Houser, Kristen Bouska, Nathan De Jager, Brian Ickes, Kathi Jo Jankowski, Danelle Larson, Molly Van Appledorn, and Jason Rogala.
USGS Upper Midwest Environmental Sciences Center.
jhouser@usgs.gov

1:30–1:50 RECENT HYDROLOGIC AND GEOMORPHIC CHANGE IN THE UPPER MISSISSIPPI RIVER SYSTEM
Molly Van Appledorn and James T. Rogala.
U.S. Geological Survey, Upper Midwest Environmental Sciences Center.
mvanappledorn@usgs.gov

1:50–2:10 CHANGES IN LEVEES AND FLOODPLAIN FOREST COVER IN THE UMRS 1989-2010
Nathan R. De Jager and Jason J. Rohweder.
USGS Upper Midwest Environmental Sciences Center, La Crosse WI 54630.
ndejager@usgs.gov

2:10–2:30 WATER QUALITY OF THE UPPER MISSISSIPPI RIVER SYSTEM FROM 1993-2019
Kathi Jo Jankowski.
U.S. Geological Survey Upper Midwest Environmental Sciences Center.
kjankowski@usgs.gov

2:30–2:50 THE STATUS AND TRENDS OF AQUATIC VEGETATION IN THE UPPER MISSISSIPPI RIVER FROM 1998 TO 2019 REVEAL SUBSTANTIAL VEGETATION COMMUNITY CHANGES
Danelle M. Larson.
U.S. Geological Survey.
dmlarson@usgs.gov

2:50–3:10 THE STATUS AND TRENDS OF FISHERIES IN THE UPPER MISSISSIPPI RIVER SYSTEM
Brian S. Ickes[1], Kris Maxson[2], Levi Solomon[2], Andy Bartels[3], and Mel Bowler[4].
[1]United States Geologic Survey UMESC. [2]Illinois Natural History Survey, Illinois River Biological Station. [3]Wisconsin Department of Natural Resources, La Crosse Field Station. [4]Iowa Department of Natural Resources, Iowa DNR Mississippi River Monitoring Station.
bickes@usgs.gov

3:10–3:20 **Session Discussion**

3:20 - 3:40 PM: BREAK

SESSION IV (Moderator: Andrya Whitten)

3:40–4:00 DETERMINING THE PRESENCE AND COINFECTION RATES OF TICK-BORNE DISEASE PATHOGENS, BORRELIA MIYAMOTOI AND BORRELIA BURGDORFERI
***Reegan L. Sturgeon** and Kelly A. Grussendorf.
University of Dubuque.
rsturgeon@dbq.edu

4:00–4:20 HOW THE ADDITION OF OIL AND A SURFACTANT TO THE LA CROSSE RIVER MARSH INFLUENCES BACTERIAL COMMUNITY FUNCTION
***Andrew R. Wells** and Bonnie J. Bratina.
University of Wisconsin-La Crosse.
wells2562@uwlax.edu

4:20–4:40 DISSOLVED ORGANIC CARBON: A LINK TO VITAL PROCESSES IN STREAMS AND LAKES
***Vanessa Czeszynski** and Eric Strauss.
River Studies Center and Department of Biology, University of Wisconsin – La Crosse, WI 54601.
czeszyns.vanessa@uwlax.edu

4:40–5:00 MONITORING THE IMPACT OF THE LAND USE CHARACTERISTICS ON THE SURFACE WATER QUALITY OF MISSISSIPPI RIVER TRIBUTARIES
***Isaiah Williams** and Adam Hoffman.
Department of Natural and Applied Sciences, University of Dubuque.
iwilliams@dbq.edu

MEETING AGENDA FRIDAY, APRIL 23, 2021

Oral Presentations

(*Student Presenters)

8:00–8:10 AM: Welcome Back
Levi Solomon, MRRC President

SESSION V (Moderator: Levi Solomon)

8:10–8:30 INTERSPECIFIC COMPETITION BETWEEN BROOK TROUT AND NON-NATIVE BROWN TROUT IN SOUTHWEST WISCONSIN DRIFTLESS REGION
***Kristina Pechacek**[1], Eric Strauss[1], Kirk Olson[2], and Jordan Weeks[2].
[1]University of Wisconsin-La Cross. [2]Wisconsin Department of Natural Resources-La Crosse.
pechacek0059@uwlax.edu

8:30–8:50 CATCH COMPARISON OF FISHES AND TURTLES IN HOOP NETS USING THREE BAIT TYPES
Samuel J. Schaick, Jesse A. Williams, Kristopher A. Maxson, Levi E. Solomon, and James T. Lamer.
Illinois Natural History Survey, Illinois River Biological Station.
sschaick@illinois.edu

8:50–9:10 LOCAL FISH SPECIES EXPOSED TO THE PESTICIDE, THIAMETHOXAM, EXHIBITS CHANGES TO SURVIVAL, EMBRYONIC MOTOR ACTIVITY, AND PREDATOR ESCAPE IN EARLY LIFE STAGES
***Shayla Michel**[1], Megan Hein[1], Allie Helgeson[1], Elisabeth Harrahy[2], and Tisha King-Heiden[1]. [1]University of Wisconsin-La Crosse. [2]University of Wisconsin-Whitewater.
michel.shayla@uwlax.edu

9:10–9:30 SAMPLING OF SMALL-BODIED FISHES IN EMERGENT VEGETATION USING A 1.0M^2 THROW TRAP IN POOL 26 OF THE MISSISSIPPI RIVER
***Courtney R. Weldon**[1], John H. Chick[1], and James T. Lamer[2].
[1]Department of Natural Resources and Environmental Sciences, University of Illinois Champaign-Urbana. [2]Illionis Natural History Survey, Illinois River Biological Station.
crweldon@illinois.edu

9:30 – 9:50 AM: BREAK

SESSION VI (Moderator: Quinton Phelps)

9:50–10:10 WILD CELERY WINTER BUD DYNAMICS IN POOLS 4, 8, AND 13 OF THE UPPER MISSISSIPPI RIVER
***Kirsten I. Schmidt**[1], Jacob N. Straub[2], Benjamin S. Sedinger[1], and Stephen L. Winter[3].
[1]University of Wisconsin-Stevens Point. [2]State University of New York-Brockport. [3]U.S. Fish and Wildlife Service.
misskirstens12@gmail.com

10:10–10:30 THE EFFECTS OF WATER DRAWDOWNS ON MARSH BIRD NEST SURVIVAL AT EMIQUON PRESERVE, IL
***Stephanie M. Schmidt**[1,2], Thomas J. Benson[1,2], Auriel M. V. Fournier[1,2], and Joshua M. Osborn[1].
[1]Illinois Natural History Survey, University of Illinois at Urbana-Champaign. [2]Dept. of Natural Resources and Environmental Sciences at UIUC.
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10:30–10:50 WATERFOWL DISTRIBUTIONS AND HABITAT USE ON POOL 8 OF THE MISSISSIPPI RIVER DURING AUTUMN MIGRATION
***Casey Kroening**[1], Benjamin Sedinger[1], Kirsten Schmidt[1], and Stephen Winter[2].
[1]University of Wisconsin Stevens Point College of Natural Resources. [2]U.S. Fish and Wildlife Service, Upper Mississippi River National Wildlife and Fish Refuge.
casey_kr@yahoo.com

10:50 – 11:10 AM: BREAK

SESSION VII (Moderator: Andrya Whitten)

11:10–11:30 POPULATION STRUCTURE AND HABITAT USE OF GIZZARD SHAD IN THE UPPER MISSISSIPPI RIVER
***Elaine A. Ewigman**[1], Colby G. Gainer[2], Ethan A. Rutledge[3], Hae H. Kim[1] and Quinton E. Phelps[1].
[1]Department of Biology, Missouri State University, [2]Oklahoma Department of Wildlife Conservation, [3]Department of Environmental Conservation, University of Massachusetts, Amherst.
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11:30–11:50 ASIAN CARP EARLY LIFE HISTORY AND REPRODUCTION IN THE UPPER MISSISSIPPI RIVER

James T. Lamer[1], Brent Knights[2], Michael Weber[3], and Kevin Irons[4].
[1]Illinois River Biological Station, Illinois Natural History Survey. [2]Upper Midwest Environmental Sciences Center, USGS. [3]Department of Natural Resource Ecology & Management, Iowa State University. [4]Division of Fisheries, Illinois Department of Natural Resources.
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11:50–12:10 USE OF DEPTH-SENSITIVE TRANSMITTERS AND FISH TRANSLOCATION TO STUDY ASIAN CARP BEHAVIOR AT A MISSISSIPPI RIVER HIGH-HEAD DAM

Andrea Fritts[1], Brent Knights[1], Amanda Milde[1], Jessica Stanton[1], Marybeth Brey[1], Doug Appel[1], Sara Tripp[2], Mark Fritts[3], and James Lamer[4].
[1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603. [2]Missouri Department of Conservation, Cape Girardeau, MO 63701. [3]U.S. Fish and Wildlife Service, Onalaska, WI 54650. [4]INHS-Illinois River Biological Station, Havana, IL 62644.
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12:10 - 1:00 PM: LUNCH

SESSION VIII (Moderator: Steve Winter)

1:00–1:20 THE POTENTIAL OF SATELLITE REMOTE SENSING FOR DELINIATING COLDWATER STREMES IN THE DRIFTLESS REGION OF NE IOWA

Niti Mishra[1], Michael Siepker[2], Greg Simmons[2], and Eric Strauss[1].
[1]University of Wisconsin-La Crosse. [2]Iowa DNR.
nmishra@uwlax.edu

1:20–1:40 WINGED MAPLELEAF (*QUADRULA FRAGOSA)* PROPAGATION EFFORTS: WHAT ARE THE WEAK LINKS?

Michelle Bartsch[1], Diane Waller[1], Steve Houdek[1], Doug Aloisi[2], Megan Bradley[2], Elizabeth Glidewell[2], Mike Davis[3], Bernard Sietman[3], Madeline Pletta[3], Lindsay Ohlman[3], Zeb Secrist[3], Dan Hornbach[4], Mark Hove[5], Dan Kelner[6], Tamara Smith[7], Lisie Kitchel[8], Jesse Weinzinger[8], Nathan Eckert[9], and Marian Shaffer[10].
[1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI. [2]U.S. Fish and Wildlife Service (USFWS), Genoa National Fish Hatchery, Genoa, WI. [3]Minnesota Department of Natural Resources, Center for Aquatic Mollusk Programs, Lake City, MN. [4]Macalester College, Department of Environmental Studies, St. Paul, MN. [5]University of Minnesota Department of Fisheries, Wildlife and Conservation Biology, St. Paul, MN. [6]U.S. Army Corps of Engineers, St. Paul District, St. Paul, MN. [7]USFWS, Minnesota-Wisconsin Ecological Services Field Office, Bloomington, MN. [8]Wisconsin Department of

Natural Resources, Madison, WI. [9]USFWS, Neosho National Fish Hatchery, Neosho, MO. [10]St. Croix National Scenic Riverway, National Park Service, St. Croix Falls, WI.
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1:40–2:00 IS THAT MINNOW IN YOUR BAIT BUCKET AN INVASIVE SPECIES? AN INQUIRY-BASED ACTIVITY FOR TEACHING TAXONOMY IN COLLEGE-LEVEL COURSES
Robert J. Mooney, Benjamin E. Martin, and M. Jake Vander Zanden.
University of Wisconsin – Madison, Center for Limnology.
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2:00–2:20 THE FRESHWATER COLLABORATIVE OF WISCONSIN – AN INITIATIVE TO TRAIN THE NEXT GENERATION OF WATER PROFESSIONALS
Marissa Jablonski[1] and Roger Haro[2].
[1]Freshwater Collaborative of Wisconsin, School of Freshwater Science, University of Wisconsin – Milwaukee, Milwaukee, WI. 53204. [2]River Studies Center, University of Wisconsin-La Crosse, La Crosse, WI 54601.
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2:20 – 2:40 PM: BREAK

2:40–3:40 BUSINESS MEETING

PLATFORM PRESENTATIONS ABSTRACTS

ALPHABETICAL LISTING BY PRESENTING AUTHOR

(*Student Presenter)

WINGED MAPLELEAF (*QUADRULA FRAGOSA)* PROPAGATION EFFORTS: WHAT ARE THE WEAK LINKS?

Michelle Bartsch[1], Diane Waller[1], Steve Houdek[1], Doug Aloisi[2], Megan Bradley[2], Elizabeth Glidewell[2], Mike Davis[3], Bernard Sietman[3], Madeline Pletta[3], Lindsay Ohlman[3], Zeb Secrist[3], Dan Hornbach[4], Mark Hove[5], Dan Kelner[6], Tamara Smith[7], Lisie Kitchel[8], Jesse Weinzinger[8], Nathan Eckert[9], and Marian Shaffer[10].
[1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI. [2]U.S. Fish and Wildlife Service (USFWS), Genoa National Fish Hatchery, Genoa, WI. [3]Minnesota Department of Natural Resources, Center for Aquatic Mollusk Programs, Lake City, MN. [4]Macalester College, Department of Environmental Studies, St. Paul, MN. [5]University of Minnesota Department of Fisheries, Wildlife and Conservation Biology, St. Paul, MN. [6]U.S. Army Corps of Engineers, St. Paul District, St. Paul, MN. [7]USFWS, Minnesota-Wisconsin Ecological Services Field Office, Bloomington, MN. [8]Wisconsin Department of Natural Resources, Madison, WI. [9]USFWS, Neosho National Fish Hatchery, Neosho, MO. [10]St. Croix National Scenic Riverway, National Park Service, St. Croix Falls, WI.

The St. Croix National Scenic Riverway (SACN) in Minnesota and Wisconsin supports the only known self-sustaining population of the federally endangered Winged Mapleleaf mussel (*Quadrula fragosa)* in the upper Mississippi River basin. Since the species was federally listed in 1991, our knowledge of the breeding behavior and life history characteristics of *Q. fragosa* has increased substantially. *Quadrula fragosa* is one of the few species that are fall, short-term (~6 weeks) brooders, and in the SACN, Channel Catfish (*Ictalurus punctatus*) are the only known host. *Quadrula fragosa* glochidia are assumed to overwinter on their host fish and transform into free-living juveniles the following spring. Propagation efforts for this species began in 2003, when an interagency Mussel Coordination Team (MCT), made up of personnel from federal and state resource agencies and universities, was tasked by the US Army Corps of Engineers (USACE) to implement a plan to propagate, augment, and reintroduce the species within its historic range. Thousands of juvenile *Q. fragosa* have been successfully produced through hatchery efforts; however relatively few subadults have been released into the wild, suggesting that alternative propagation methods may be required. Our research is novel in that we will compile historic data from >14 years of *Q. fragosa* propagation efforts into a searchable database to identify potential knowledge gaps that may be limiting its success. We will use this information to direct in situ and ex situ propagation techniques to optimize production of *Q. fragosa* juveniles. Lastly, we will characterize the movement pattern of wild-caught Channel Catfish that are artificially inoculated with the SACN strain of *Q. fragosa* to identify potential juvenile release survey locations in future years. Our progress thus far and future direction will be discussed.

Keywords: freshwater mussel, endangered species, Winged Mapleleaf, propagation, Channel Catfish

AQUATIC VEGETATION DYNAMICS IN THE UPPER MISSISSIPPI RIVER OVER TWO DECADES SPANNING VEGETATION RECOVERY

Kristen L. Bouska[1], Danelle M. Larson[1], Deanne C. Drake[3], Eric M. Lund[2], Alicia M. Carhart[3], and Kyle R. Bales[4].
[1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, Wisconsin, USA. [2]Wisconsin Department of Natural Resources, La Crosse Field Station, 2630 Fanta Reed Road, La Crosse, Wisconsin, USA. [3]Minnesota Department of Natural Resources, Lake City Field Station, 1801 South Oak Street, Lake City, Minnesota, USA. [4]Iowa Department of Natural Resources, Bellevue Field Station, 206 Rose Street, Bellevue, Iowa, USA.

Macrophytes have recovered in rivers across the world, but long-term data and studies are lacking regarding community assembly and diversity changes during macrophyte community recovery. We investigated patterns of aquatic vegetation species composition and diversity in thousands of sites in the upper Mississippi River, U.S.A. spanning twenty years of monitoring and a period of vegetation recovery. Our results demonstrated site-level differences in aquatic vegetation assemblage structure were associated with water depth and substrate, and a clear gradient of species abundance and diversity was apparent. A common trend in community dissimilarity over time and across sites indicated that community composition changed and diversity increased within the past 20 years with surprising synchrony. Shared trends across the 400 km study reach are symptomatic of widespread, common driver(s); however, hydrologic extremes or turbidity did not explain vegetation community patterns. Following several years of strong changes in community composition and increases in diversity, the vegetation community displayed signs of increasing stability in some pools but not others. Our results have spurred further research aimed at identifying drivers and mechanisms of aquatic vegetation community expansion, assembly, and resiliency, all of which will be applicable to the recovery of aquatic vegetation in floodplain systems worldwide.

Keywords: Macrophytes, community assembly, floodplain lakes, dissimilarity, diversity

DISSOLVED ORGANIC CARBON: A LINK TO VITAL PROCESSES IN STREAMS AND LAKES

***Vanessa Czeszynski** and Eric Strauss.
River Studies Center and Department of Biology, University of Wisconsin – La Crosse, WI 54601.

Dissolved organic carbon (DOC) is a key component of the carbon cycle in aquatic systems and understanding the dynamics of DOC is essential for understanding aquatic ecosystem metabolism and functioning. However, higher levels of recent atmospheric deposition of DOC is causing increased staining, or browning, to occur in freshwater systems. This impacts the gross primary production (GPP), as browning interferes with light dependent biological processes. Chromophoric or colored dissolved organic material (CDOM) can be used to explain the optical properties of

organic carbon. It is known for having a strong relationship with total DOC in many systems and has been used as a proxy for DOC in other studies. The objectives of this study were to determine the range in DOC and CDOM quantity in streams and lakes, and to assess any differences in trends between the two system types. Sampling a variety of stained and unstained systems, we predicted a wide range in DOC and CDOM with a positive relationship between the two parameters. We expected that this relationship would be stronger in lakes because less-open systems allow for longer retention of nutrients and greater decomposition of less-colored DOC with low molecular weight. Surface water grab samples were taken from 54 streams and lakes across the Northern Highlands region of Wisconsin and the upper peninsula of Michigan. In addition to DOC and CDOM, spectrophotometric properties of water samples were analyzed for color at 456nm, specific ultraviolet absorption at 254nm (SUVA), and spectral slope at 275-295nm (S275-295). Overall, DOC ranged from 3.01-25.01 mg/L and CDOM ranged from 4.25-32.29 mg/L. In both streams and lakes, the relationship between DOC and CDOM was highly linear, and spectrophotometric properties exhibit a strong relationship with DOC and CDOM. As expected, these relationships were tighter for lake samples than stream samples. Additionally, various samples possessed high values for color relative to DOC and CDOM quantity, which can be caused by the presence of other dissolved materials (e.g., iron) present in the system.

Keywords: Biogeochemistry, Carbon, Nutrients, Lakes, Streams

CONUNDRUMS OF FISH GROWTH IN AN ANTHROPOCENE RIVER

Jason A. DeBoer[1], Martin C. Thoms[2], James T. Lamer[1], Andrew F. Casper[1], Michael D. Delong[3]. [1]Illinois River Biological Station, Illinois Natural History Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign. [2]Riverine Landscapes Research Laboratory, University of New England. [3]Large River Studies Center, Biology Department, Winona State University.

The Illinois River has undergone a regime shift – it is an Anthropocene river. Ecosystem structure and function in the Illinois River have undergone rapid, pronounced, and persistent change resulting from a legacy of anthropogenic stressors. The Illinois River was historically one of the most-productive and diverse inland fisheries in the USA, but collapsed because of degraded water quality conditions and land-use change. Although recovery in the biodiversity of the fish community has occurred, recovery trajectories were unexpected and 'novel'. Fish growth is an indicator of ecosystem function, although the characteristics of fish growth in Anthropocene rivers remain largely unknown, especially at the river-network scale. We examined fish growth metrics using four species that represented different functional feeding guilds to reveal patterns along the Anthropocene Illinois River.

Keywords: river, fish, growth, resilience, ecosystem function

CHANGES IN LEVEES AND FLOODPLAIN FOREST COVER IN THE UMRS 1989-2010

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At broad scales, such as the navigation pool or reach scale, the abundance and distribution of physical features, such as leveed areas and floodplain forests provides information about how river-floodplain ecosystems are structured and how they function. We investigated status and trends in leveed areas and floodplain forests of the Upper Mississippi River System for the years 1989, 2000 and 2010. The percentage of total river and floodplain area (total reach area) behind levees generally increased from upriver to down river in the UMRS. The Upper Impounded Reach (pools 1-13) had approximately 4% of total reach area behind levees, compared to approximately 46% in the Lower Impounded reach, and approximately 59% in the Unimpounded reach. The Illinois River had approximately 38% of total reach area behind levees. These estimates of levee distribution changed little over time. Total forest area, as a percentage of total navigation reach area ranged from a high of approximately 20.6% in the Upper Impounded Reach to a low of approximately 16.8% in the Unimpounded Reach in 2010. Total forest cover declined continuously from 1989 to 2010 in the Upper and Lower Impounded Reaches of the UMR and in the Illinois River. Forest loss estimates ranged from 2,508 ha in the Upper Impounded Reach (6.4% decrease) to 1,311 ha (3.6% decrease) in the Illinois River. In contrast to the other reaches, forest cover in the Unimpounded Reach increased by 3,823 ha (17.3% increase). Our results suggest that the distribution of levees has changed little over time in much of the UMRS and thereby continue to influence the degree to which the river is connected to the floodplain. In contrast, floodplain forest cover continues to decline in the impounded portions of the river system, likely owing to ongoing impacts of changes in hydrology.

Keywords: Floodplain Forest, Land Cover, Levees

POPULATION STRUCTURE AND HABITAT USE OF GIZZARD SHAD IN THE UPPER MISSISSIPPI RIVER

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Gizzard Shad are amongst the most important prey species throughout the Mississippi River. Fish populations are driven by the dynamic rate functions (i.e., recruitment, growth, and mortality). Knowledge of these vital rates can provide critical information to determine spatiotemporal population-level changes in the system. Therefore, understanding these vital rates is important in the proper management of any fishery. Anthropogenic modifications to the environment have had damaging effects on the organisms within these ecosystems. Specific to Upper Mississippi River fishes, channelization, dams, and loss of floodplain connectivity have all been purported as deleterious. In the face of these modifications, understanding vital rates and habitat use of individual species is needed to help guide management and restoration efforts. As such, the objective of this study is to determine the population demographics and habitat use of Gizzard Shad in the Upper Mississippi River system. Knowledge of vital rates and habitat needs will provide a baseline for managers as a reference to future changes in the river. Gizzard Shad were collected via

electrofishing conducted by the United States Army Corps of Engineers' Long-Term Resource Monitoring (LTRM) element. The information garnered in this study can be used to help direct management efforts that not only favor Gizzard Shad, but also other fishes in the Upper Mississippi River.

Keywords: prey, population, habitat, management, age

USE OF DEPTH-SENSITIVE TRANSMITTERS AND FISH TRANSLOCATION TO STUDY ASIAN CARP BEHAVIOR AT A MISSISSIPPI RIVER HIGH-HEAD DAM

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Asian carp populations continue to expand their range in North America, necessitating efforts to limit the spread and establishment of reproducing populations. Potential control measures include the installation of deterrents (e.g., electric, acoustic) and targeted harvest to limit propagule pressure. Mississippi River Lock and Dam 19 (LD19) is a high-head dam that serves as a population 'pinch-point' because the main channel spillway gates are impassable and passage through the lock chamber is the only means by which fish can complete upstream migrations. As such, LD19 represents a location that could be a pivotal control point for minimizing the spread of invasive carps in the Upper Mississippi River. Our objectives were to use acoustic telemetry arrays to study Asian carp behavior at LD19 and to identify factors or conditions that facilitate upstream passage through the lock chamber. We deployed depth-sensor transmitters in Asian carps to obtain information about the behavior and occupancy within different depths in the downstream lock approach, lock chamber, and upstream lock approach. We also translocated Asian carps that we captured upstream of LD19, tagged, and released downstream into Pool 20. These translocated fish have demonstrated a higher rate of upstream passage relative to Asian carps collected and tagged in Pool 20 and are providing insight on how fish passages relate to lock operation and river traffic. These data are being used to guide the design and installation of an experimental underwater Acoustic Deterrent System at LD19.

Keywords: Telemetry, Asian carp, Mississippi, fish passage, deterrents

ENVIRONMENTALLY DRIVEN SHIFTS IN FISH COMMUNITY STRUCTURE WITHIN A LARGE REGULATED RIVER

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Hydrologic modification and global climate change have resulted in rapid and dramatic changes in community structure across a wide range of ecosystems. Large rivers are susceptible to

anthropogenic modification and exhibit multiple regime shifts and alternative stable states. We evaluated changes in fish community structure and the environmental and hydrological factors influencing fish communities across six study reaches within the Upper Mississippi River System (UMRS). Catch-per-unit effort was estimated for every species and standardized across multiple gear types using the multigear mean standardization method to form a community composition matrix. Water quality variables from the Long-Term Resource Monitoring Program were compiled along with hydrological variables from local water gages. SIMPER analysis detected an average 38.56% +/- 2.11 change for Pool 4, 48.62% +/- 2.41 for Pool 8, 47.94% +/- 1.54 for Pool 13. The southern three reaches indicated an average 45.10% +/- 1.27 change for Pool 26, 34.60% +/- 1.31 for the Open River, and 34.81% +/- 1.18 for the La Grange reach from 1994 to 2018. The most common species to contribute to community shifts among the six study reaches were Bluegill (*Lepomis macrochirus*) and Common Carp (*Cyprinus carpio*). Results indicated that these species contributed between 6.68-13.23% and 6.83-32.98% of the differences respectively for five of the six study reaches. The recently introduced Silver Carp (*Hypophthalmichthys nobilis)* contributed to > 5% of the dissimilarity for two of the three southern reaches. Principal Components Analysis revealed temporal trends in both water quality and hydrology that were driven by changes primary productivity, suspended solids, and the duration of floods. These changes were driven primarily by water quality at all study reaches except Pool 13. Hydrology did not significantly impact fish community structure except for the Open River reach ($r = 0.27$, $p < 0.01$). Results suggest that the fish communities are responding to changes in water quality driven primarily by increased sedimentation. Furthermore, invasive Silver Carp described a small percentage of the dissimilarity among years within invaded reaches and may contribute to future changes within fish communities. Habitat restoration should focus on improving water quality, monitoring changes in flood dynamics, and removing invasive species to maintain fish community composition within large rivers.

Keywords: water quality, invasive species, fish communities, hydrology

THE FRESHWATER COLLABORATIVE OF WISCONSIN – AN INITIATIVE TO TRAIN THE NEXT GENERATION OF WATER PROFESSIONALS

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The Freshwater Collaborative of Wisconsin (FCW) is a partnership of Wisconsin's 13 public universities, connecting with industry partners, local communities, policymakers and advocacy groups. The mission is to train the next generation of water professionals, and to establish Wisconsin as a global leader in water-related science, technology and economic growth. Water is the fastest growing sector of the world’s economy. By 2035, it will be worth approximately $800 billion. According to UNESCO, 78% of all jobs globally are water dependent. Climate change, increasing urbanization, intensive agricultural and other trends will require an ever-greater number of skilled water professionals to innovate and to tackle challenging problems. Wisconsin's unique natural setting makes it the perfect home for the Freshwater Collaborative. Wisconsin is bordered

by one of the world's great river systems and two inland seas, in the heart of the Great Lakes Region it holds 44,000 miles of rivers and streams, over 15,000 lakes, rich and diverse wetlands and significant groundwater assets. The goal of the FCW is to build a statewide, interdependent educational programming network that will include: (1) customizable undergraduate degree programs that allow students to enroll in courses at University of Wisconsin campuses statewide; (2) certificate programs for deep dives into specific topics, with field opportunities at multiple campuses; (3) transformative hands-on experiences where students spend a time in the field at campuses around the state as part of their degree; and (4) internships and job opportunities through industry, government and community partners. UW-La Crosse and the Driftless Region are uniquely poised to be strong collaborators in the FCW. UW-La Crosse is the only UW-System campus next to the Mississippi River. The university can provide educational and research expertise in large river ecology through its River Studies Center, which was established in 1972.

Keywords: Freshwater Collaborative, Water Economy, Wisconsin

EFFECTS OF HABITAT CONNECTIVITY ON DIVERSITY AND ABUNDANCE OF FISHES IN THE MAIN CHANNEL OF THE MISSISSIPPI AND ILLINOIS RIVERS

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Large rivers have been altered extensively through anthropogenic activity resulting in a loss of backwater and side channel habitats due to sedimentation. The loss of access to these habitats has negatively impacted fish species which rely on them for refuge and spawning. Decreased connectivity can reduce species diversity as access to these desirable habitats is reduced and individuals become restricted to the main channel. We hypothesized that catch rates, species composition, and species diversity will differ among pools with relatively high habitat accessibility compared to pools with low habitat accessibility. We used annual Long-Term Survey and Assessment of Large River Fishes in Illinois project (LTEF) data collected in four pools (Alton, Pool 25, Chain of Rocks, and Kaskaskia) from 2011 to 2019 using random 15-minute DC electrofishing transects along the main channel. Fish communities were compared among pools with ANOSIM using a species composition matrix of catch-per-unit effort (CPUE). Additionally, we calculated three diversity indices (species richness (S), Margalef Richness Index (d), Pielou's Evenness (J')) and compared these metrics among pools using ANOVA. An indicator species analysis was then performed to identify the species most associated with each pool. Analyses indicated that CPUE did not differ significantly among pools ($F=2.41$; $p=0.085$); however, species composition were significantly different among pools ($R= 0.60$; $p<0.05$). Diversity was highest at the Alton Pool ($S=45.67 \pm 2.66$; $d=7.45 \pm 0.27$; $J'=0.45 \pm 0.0$) and lowest at Pool 25 ($S=36.44 \pm 1.76$; $d=6.35 \pm 0.29$; $J'=0.62 \pm 0.04$). Indicator species analysis determined that five species were most associated with the Illinois River (Yellow Bass, Golden Shiner, Spottail Shiner, Western Mosquitofish, Golden Redhorse), three species associated with Pool 25 (Sand Shiner, Mimic Shiner, Mississippi Silvery Minnow), and six species for both the Chain of Rocks and Kaskaskia pools (Blue Sucker, Goldeye, Blue Catfish, Spotted Bass, Chestnut Lamprey, Freckled Madtom). These results suggest that habitat connectivity and access to both side channels and backwaters reduced overall diversity. Both the Chain of Rocks and Alton pool showed a similar degree of

species diversity which may be explained by the prevalence of revetted shoreline within these pools. Both Blue Suckers and Blue Catfish were identified as indicators of the Chain of Rocks pool which may reflect these species associations with revetment. Species diversity and abundance within the four pools may be more affected by the type of habitat available than the degree of connectivity with backwaters and side channels.

Keywords: Species diversity, Habitat connectivity, Species composition, Large-river fisheries

THE UPPER MISSISSIPPI RIVER SYSTEM FROM 1993 TO 2019: INTRODUCTION TO AN ASSESSMENT OF THE STATUS AND LONG-TERM ECOLOGICAL TRENDS OF THE RIVER AND ITS FLOODPLAIN

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The Upper Mississippi River System (UMRS) is a globally significant ecosystem that is recognized by the U.S. Congress as a nationally significant transportation system and a nationally significant river ecosystem. Most of the challenges currently facing the river reflect the combined impacts of historic and ongoing changes to the river and its watershed. These challenges include a changing hydrologic regime, increased frequency and magnitude of floods, altered geomorphic processes and rates, floodplain forest loss, altered river-floodplain connectivity, high rates of nutrient and sediment input, scarce aquatic vegetation in some reaches, and invasive species. We have recently completed the third assessment of the ecological status and trends of the Upper Mississippi River System which describes what has changed and where over the last 27 years. The assessment is based on data collected by the Long Term Resources Monitoring element (LTRM) of the Upper Mississippi River Restoration Program supplemented with data from other sources. The LTRM monitors six study reaches that span much of UMRS and the various gradients contained therein. The LTRM study reaches within the UMRS include Navigation Pools 4, 8, 13, and 26, the portion of the Unimpounded Reach of the UMR between Grand Tower IL, and Cairo, IL; and the La Grange Pool on the Illinois River. Within these study reaches the LTRM sampling design accounts for geomorphic and biological variation using a stratified random sampling design to allocate sampling effort among different aquatic area types (e.g., channels, backwaters, etc.) The specific metrics monitored through time by LTRM reflect its objective of assessing the general habitat conditions in the river across space and time. The indicators in the report represent a subset of the larger suite of metrics monitored by LTRM and were selected to represent a broad range of ecological components of the system and to collectively indicate how and where the system is changing. The selected indicators describe the status and trends for the hydrology, geomorphology, floodplain vegetation, water quality, vegetation, and fishes of the UMRS. The quantitative assessments of these indicators describe how the conditions of the river differ across hydrogeomorphic and climate gradients and through time and are intended to support the restoration and management of the UMRS.

Keywords: Long-term trends, ecosystem monitoring, ecological indicators

THE STATUS AND TRENDS OF FISHERIES IN THE UPPER MISSISSIPPI RIVER SYSTEM

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Nearly one in every four freshwater fish species in North America is native to the mainstem reaches of the Upper Mississippi River System (UMRS). As such, the UMRS represents a nexus of freshwater fish diversity in North America and a key natural heritage resource for the United States of America. The UMRS fish community is comprised of species of ancient evolutionary origins, economically and socially important recreational and commercial species, species of special conservation concern, and invasive and naturalized nonnative species. Given the importance of the UMRS as a natural resource, about every 10 years the Upper Mississippi River Restoration (UMRR) program produces a Status and Trends report focusing on the ecological health of the UMRS. To inform these periodic assessments, the UMRR Long Term Resource Monitoring (LTRM) element's Fisheries Component collects quantitative information on the distribution and abundance of fish species and communities in the UMRS and conducts research related to fishes for understanding resource status and trends, ecological dynamics, and fish community response to disturbances and UMRR restoration activities.

In this third UMRR Status and Trends report, the fisheries indicators were reconceived to express and represent functional attributes and dynamics of the UMRS fish community. These new indicators represent functionally or socially relevant assemblages within the UMRS fish community, rather than simple faunistic ones, and were crafted to gain insights into changes in key functional interactions and attributes among assemblages, across LTRM study reaches, and over time. By recasting the indictors in this way, we sought to more directly connect observed fisheries responses and drivers such as habitat, exploitation, and invasive species impacts on the UMRS fish community. Key in crafting these functional expressions is the ability to group species into socially and functionally relevant assemblages and express these composite indicators in units of functional response. This was achieved using a life history database developed for the Central Basin of the United States, permitting the design-based estimation of composite functional guild classes in functional units of mass, rather than counts as expressed in earlier reports. Our presentation focuses upon empirically observed status and trends in the functional attributes of the UMRS fish community over 1960 km of river and 27 years, including discussion of the ecological and social importance of these observations and patterns.

Keywords: Status, Trends, Fisheries, Upper Mississippi River, Illinois River

WATER QUALITY OF THE UPPER MISSISSIPPI RIVER SYSTEM FROM 1993-2019

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Water quality plays a central role in supporting a healthy community of aquatic organisms in the riverine environment, is important for recreation, and is key to providing healthy drinking water for communities along the Upper Mississippi River System (UMRS). Although water quality in many areas of the UMRS is sufficient to support diverse assemblages of aquatic species and migratory birds, sediment and nutrient-rich runoff from agricultural land uses and groundwater continue to affect water quality conditions in many reaches of the UMRS, and, ultimately, the Gulf of Mexico. Using long-term data as part of the Upper Mississippi River Restoration Long-term Resource Monitoring program, we assessed the status and trends of water quality from 1993-2019 across six reaches and ten tributaries of the UMRS. We selected several indicators of water quality that reflect habitat conditions for aquatic organisms, including suspended solids (SS), total nitrogen (TN) and total phosphorus (TP), chlorophyll a (CHL), and the frequency of low dissolved oxygen (DO) in backwaters. In addition, to evaluate whether long-term trends in SS, TN, and TP reflected changes in delivery from the watershed over time, we used a load modeling approach that accounted for the effect of inter-annual variation in river flow that can sometimes obscure long-term trends. We show that there have been long-term declines in both SS and TP in several reaches and tributaries of the UMRS, but that TN has generally remained stable or increased. Although there were long-term fluctuations in CHL concentrations and backwater DO in response to shifts in discharge and aquatic vegetation, there were no linear trends throughout the record. Our results indicate that the UMRS remains eutrophic in many reaches, but there is evidence of improvements in water clarity (SS), TP concentrations, and CHL in several areas. We have opportunities to build on these improvements both in the UMRS and its basin, through restoration efforts that maintain and enhance floodplain and backwater connectivity; maintaining gains in SAV, and continuing to dedicate effort toward implementing best management practices on fields and in the riparian zones of the UMRS Basin.

Keywords: water quality, trends, nutrients, chlorophyll, dissolved oxygen

WATERFOWL DISTRIBUTIONS AND HABITAT USE ON POOL 8 OF THE MISSISSIPPI RIVER DURING AUTUMN MIGRATION

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Migrating waterfowl can meet their nutritional demands by foraging at stopover locations during migration. Nutritional demands are species specific so the distribution of waterfowl species is dependent on the occurrence of their preferred forage types. Distributions of waterfowl species can also be influenced by predation risk and other behaviors not related to foraging. The Mississippi River corridor is an important migratory pathway for many waterfowl species traveling to and from their breeding grounds. We used 2017-2019 vegetation data from the Long Term Resource Monitoring Program (USGS) and waterfowl aerial survey data (USFWS) from pool 8 on the Mississippi River to examine how two species, Canvasbacks (*Aythya valisineria*) and Mallards (*Anas platyrhynchos*), distribute themselves relative to the common waterfowl foods, wild rice *Zizania aquatica* and wild celery *vallisneria americana*. We also examined how hunting disturbance and proximity to terrestrial environments affected the distribution of these species on

pool 8 throughout the hunting season. Canvasbacks appear to be selecting areas in close proximity to wild celery, a preferred food, while mallards were generally located in closer proximity to wild rice beds and land cover. Canvasbacks and mallards used waterfowl sanctuary areas that were closed to hunting which suggests that both disturbance and food availability influence how waterfowl use the river corridor during migration. Conclusions from this research aim to help prioritize resources selected for by various species of waterfowl during migration along the Mississippi River Corridor.

Keywords: Waterfowl, Resource Use, Mississippi River

ASIAN CARP EARLY LIFE HISTORY AND REPRODUCTION IN THE UPPER MISSISSIPPI RIVER

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Bighead Carp and Silver Carp reproduction in the Mississippi River system has been evident since the 1990's and despite the wealth of research devoted to their life history, dynamics contributing to their early life history and spawning behavior are still not well understood. The complementary design and synthesis of independent agency research and monitoring provides a comprehensive insight into Asian carp production and early life history. The multi-agency collaborative assessment provides location of spawning activity (egg trawls, YOY otolith microchemistry, telemetry), frequency of spawns (egg trawls, larval light trapping, otolith microstructure, histological evidence, spawning patches and year class strength observed through contracted removal), and magnitude of individual spawns (larval light trapping, YOY sampling, year class strength). These collective efforts identified tributary contributions to production, identified up to 7-11 unique spawning events in 2016, contributed to identification of hydrological triggers correlated with spawning behavior, and identified factors contributing to YOY success. This research and collaboration demonstrates the value of multi-agency partnerships to address complex issues in invasion biology.

Keywords: Asian carp UMR invasive species reproduction

THE STATUS AND TRENDS OF AQUATIC VEGETATION IN THE UPPER MISSISSIPPI RIVER FROM 1998 TO 2019 REVEAL SUBSTANTIAL VEGETATION COMMUNITY CHANGES

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The Upper Mississippi River Restoration Program has monitored the aquatic vegetation community of the Upper Mississippi River System over the past 22 years because of its critical role in the

ecosystem and ongoing interest in maintaining or restoring vegetation abundance and diversity. I analyzed the long-term dataset to determine the status and trends of several ecological indicators, including vegetation diversity, submersed aquatic vegetation, emergent vegetation, and dominance of free-floating plants (like duckweeds and algae). Vegetation data included annual field-based monitoring in Navigation Pools 4, 8, and 13 of the Upper Mississippi River and decadal aerial photography derived data for the entire system. Over the last 22 years, all life forms of aquatic vegetation (submersed, emergent, rooted-floating leaved plants and free-floating plants) substantially increased within the Upper Impounded Reach. Aquatic vegetation remains scarce or nonexistent in the Lower Impounded, Unimpounded, and Illinois River Reaches. Changes to the vegetation community in the Upper Impounded Reach have been partially attributed to increases in water clarity, decreases in invasive common carp, and the collective effects of constructed islands. The submersed plants in Pool 13 increased in prevalence in the early LTRM record but had steadily declined since 2012 for reasons unclear. Aquatic vegetation diversity has been dynamic through time but increased in Pool 8 and decreased in Pool 13 over the 22-year record. Submersed vegetation rapidly increased between the years 1998–2010 in the Upper Impounded Reach, and then remained between 50–75% prevalence in Pools 4 and 8 but declined to 50% prevalence in Pool 13. Arrowheads (an important emergent species) declined since 2008 throughout the Upper Impounded Reach study pools. In contrast, wild rice (another key emergent species) continued to increase since 2010 in Pools 4 and 8. Free-floating plants were the dominant life form in sampling sites in the Lower Impounded Reach and Illinois River, but rarely dominated sampling sites within the Upper Impounded Reach. Future pressures likely include an emerging invasive species (flowering rush) and high discharge, and future opportunities include manipulating drivers of vegetation for restoration and maintenance. Future monitoring and community data analyses will inform management to improve resiliency of aquatic vegetation and possibly restore vegetation in sections of the Lower Impounded Reach and Illinois River.

Keywords: aquatic vegetation, macrophytes, plants, long-term data, big data

SOIL PHYSICAL, CHEMICAL, AND BIOTIC CHARACTERISTICS IN NATURAL REFERENCE CONDITIONS AND ECOSYSTEM RESTORATION PROJECTS IN THE UPPER MISSISSIPPI RIVER

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The U.S. Army Corps of Engineers and partners have designed and constructed thousands of acres of ecosystem restoration features within the Upper Mississippi River System (UMRS). Many restoration projects on the UMRS include construction of islands to restore geomorphic diversity and floodplain habitat. Recently, UMRS resource managers have begun to incorporate restoration goals for floodplain forests. Soils are the basis of the ecological function and successful establishment of these terrestrial communities. Soil physical and chemical characteristics serve as the conduit through which plants obtain water, nutrients, and minerals necessary for growth. Soil systems also support a great diversity of bacteria and fungi that decompose organic matter and interact with the physical and biotic communities by regulating plant nutrient and water uptake,

providing protection against stress, and regulating plant pathogens. These services tend to be more developed and highly influential in maintaining forest ecosystems. If we are to create successful and resilient floodplain forest restorations, it is critical to understand how to create favorable soils tailored to the desired outcome. To date, created islands within the UMRS have been built using a mix of river sediments. We conducted a pilot study at three natural and four manmade sites to compare physical, chemical, and biological differences between soils in floodplain forest reference sites and soils that were created for ecosystem restoration purposes.
Sites were characterized and compared based on elevation and hydrologic data. Field data collection consisted of vegetation surveys, soil descriptions, and collection of soil samples for physical, chemical, and microbial testing. Lab tests included a wide range of typical physical and chemical evaluations on each soil sample. Soil enzyme activities analyzed were Beta-glucosidase, Phosphatase, Xylosidase, Cellobiosidase, and N-acetyl-glucosaminidase. Microbial sampling included bacterial community analysis using 16s rDNA sequencing and fungal community analysis using Internal Transcribed Spacer (ITS) rDNA sequencing.
Overall, results suggest restoration sites are progressing on a trajectory towards biogeochemical functioning similar to those displayed in natural sites. Natural and manmade sites displayed textural and profile differences. Natural sites had higher soil organic matter and dissolved organic carbon. Natural sites had substantially lower bulk density, pH, and soluble reactive phosphorus than manmade sites. Beyond the results, the study provides a framework for future sampling, and detailed data to compare future additional results to. Analysis of the microbial results for the study are pending and may provide further insight.

Keywords: ecosystem restoration, soil, floodplain forest, microbiome

LOCAL FISH SPECIES EXPOSED TO THE PESTICIDE, THIAMETHOXAM, EXHIBITS CHANGES TO SURVIVAL, EMBRYONIC MOTOR ACTIVITY, AND PREDATOR ESCAPE IN EARLY LIFE STAGES

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Thiamethoxam (TM) is a neonicotinoid pesticide that is an agonist of the nicotinic acetylcholine receptor (nAChR), which causes paralysis and death in target invertebrates. TM was designed to target invertebrate nAChRs; however, recent research has revealed that vertebrates may suffer sublethal effects as a result of exposure to TM. Thiamethoxam is a commonly used pesticide in agriculture and has been found in Wisconsin surface waters, at concentrations above ecological threshold levels. Therefore, the effects of chronic exposure to environmentally relevant concentrations of TM on a local fish species at two different early life stages were assessed. Fathead minnow (*Pimephales promelas)* embryos and larvae were exposed to 0, 0.02, 0.2, 2, 20, or 200 µg TM/L for 7 days and then raised in TM-free water until fish reached 21 days old. Embryos exposed to TM displayed no changes in hatching rates, predator escape response or feeding efficiency, but showed reductions in survival of up to 17, 20, and 21% following exposure to 0.02, 20, and 200 µg TM/L, respectively. Increases in embryonic motor activity also occurred following exposure to 0.02 and 200 µg TM/L. While chronic exposure to TM beginning at the larval stage resulted in decreased latency of the predator escape response, no other significant impacts on

overall health or neurotoxicity were observed. Together, our work suggests that TM is capable of activating fathead minnow nAChR, and age at exposure needs to be considered when assessing its safety. These findings indicate the need for further investigation of the effects of TM on local fish species for the purpose of determining the impacts of this prevalent pesticide on the overall health of aquatic ecosystems.

Keywords: pesticide, toxicity, fish, freshwater, fathead minnows

THE POTENTIAL OF SATELLITE REMOTE SENSING FOR DELINIATING COLDWATER STREMES IN THE DRIFTLESS REGION OF NE IOWA

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Coldwater streams are crucial habitats for many types of biota. Climate change is projected to alter the prevalent thermal characteristics of coldwater streams in the Driftless region. To protect coldwater stream habitats, we must first know where they exist on the landscape. A preliminary assessment of streams in the Driftless region of NE Iowa showed that in many cases coldwater stream sections were erroneously misclassified as warmwater streams. This ongoing study aims to develop a methodology to accurately map and reclassify coldwater streams for the entire Driftless area in Iowa by integrating in situ observations with the analysis of high-resolution satellite imagery. Canoe Creek watershed was selected as a pilot site for developing this remote sensing-based methodology. Coldwater streams were field sampled at strategically selected locations to record stream conditions and geomorphic properties. For these selected locations, satellite imagery archive was extensively searched to select cloud free high spatial resolution multi-spectral and panchromatic imagery from winter and summer conditions. Images were pre-processed (pan sharpened) followed by applying a buffer to select areas within a selected distance of stream banks. Both winter and summer imagery for the stream buffered area were analyzed using manual interpretation and automated classification techniques to determine the suitability of these methods. Results show that various site properties (channel width, canopy cover/density) as well as data characteristics (pixel size, sun angle at time of image acquisition) influence the detection of coldwater streams. The findings from this pilot study provide critical understanding about the potential and challenges of using high resolution satellite remote sensing for identifying coldwater streams over the entire Driftless region of Iowa.

Keywords: coldwater streams, driftless region, remote sensing

IS THAT MINNOW IN YOUR BAIT BUCKET AN INVASIVE SPECIES? AN INQUIRY-BASED ACTIVITY FOR TEACHING TAXONOMY IN COLLEGE-LEVEL COURSES

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Despite the importance that taxonomy and species identification have in our current understanding of ecology, evolution, and conservation of organisms, it is a challenging topic to teach at the university level. One of the primary reasons for this challenge is the lack of student motivation to learn organism classification and identification, which is often reinforced by curricula that do not show the practical value of taxonomic knowledge. Here we present an inquiry-based learning activity designed to show students the real-world value of organism identification. In the activity, students relate the misidentification of baitfish to the spread of invasive species via the baitfish industry. Students role play as fish ecologists and help a bait shop owner identify the specimens in their baitfish supply and develop a strategy to ensure that the business is not contributing to the spread of invasive species. By relating the importance of proper organism identification to species invasions, one of the greatest ecosystem threats in the Anthropocene, instructors can show students that they are learning information and gaining skills that have utility outside of the classroom We found this activity to be an appealing alternative to other species identification activities, which typically focus on low-level learning such as memorization and ability to recall information. In turn, we believe this activity promoted student motivation and has the capability to improve student learning in biology courses that have at least a small portion devoted to taxonomy and species identification.

Keywords: taxonomy, ichthyology, invasive species, pedagogy, teaching

INTERSPECIFIC COMPETITION BETWEEN BROOK TROUT AND NON-NATIVE BROWN TROUT IN SOUTHWEST WISCONSIN DRIFTLESS REGION

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Brook Trout (*Salvelinus fontinalis*) and Brown Trout (*Salmo trutta*) are the two dominant salmonid species within the Driftless Region of Wisconsin. Brook and Brown Trout require cold, highly oxygenated waters. Brook Trout are native to Wisconsin and can usually be found in stream headwaters. Brown Trout, a species introduced to the region in 1887, compete with Brook Trout due to similar resource requirements. Brown Trout generally are the dominant competitor, but questions remain about how the two species interact in different habitats within the Driftless Region. The objective is to determine how interspecific competition affects Brook and Brown Trout thermal distribution, habitat use, and diets in two Wisconsin Driftless streams. This study examined Maple Dale Creek (treatment stream) where Brown Trout were removed and Cook Creek (control stream) where no fish were removed. Data was collected during the summer of 2019 and 2020 using the Before and After Control Impact Design (BACI). Brown Trout removal reduced competitive pressure on Brook Trout, creating possible shifts in habitat use, diets and thermal distribution. Changes within the food web were determined using stable isotope analysis before and after the removal of more than 15,000 Brown Trout from the treatment stream. After the removal of Brown Trout there has been significant changes with the Brook Trout population. This research will provide possible management plans for future Brown Trout removal and Brook Trout preservation projects. Bringing light to adverse impacts of interspecific competition from Brown Trout on streams with similar characteristics in the Driftless Region of southwest Wisconsin.

Keywords: Driftless Region, Interspecific Competition, Trout

WHAT IS A STAND? REDEFINING THE SCALE OF FOREST MANAGEMENT UNITS IN THE UPPER MISSISSIPPI RIVER FLOODPLAIN

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Floodplain habitats of the Upper Mississippi River are part of a complex and highly altered riparian system. Forests are the primary terrestrial habitat in this system and provide a range of ecosystem services such as supporting a diverse biota, reducing sediment load, removing pollutants, and offering recreational opportunities. Individuals and organizations tasked with managing these forests, including the U.S. Army Corps of Engineers, must balance the interests of multiple stakeholders while considering the many forces shaping these systems including altered hydrology and invasive plants and pests.

In traditional forestry, the forest stand typically represents relatively homogenous forest conditions and is generally the unit at which forest attributes are assessed and at which management occurs. However, high levels of variability at scales smaller than the stand in river floodplains make it challenging to prescribe and implement management actions at the stand level. The question we look to answer is "what is the appropriate scale of management in the UMR floodplain forests?"

This work aims to a) quantify stand structure, composition and species diversity at the stand level or management unit in floodplain forests of the Upper Mississippi River, and b) test at what spatial scale environmental variables may be related to these forest characteristics. We found that patterns of forest composition and structure were more similar for plots comprising similar environmental conditions than plots within a stand, suggesting that current methods of stand delineation do not capture the full extent of within-stand environmental variation. Inundation attributes may be important predictors of structure and composition in these forests.

Our approach will allow managers to identify "microstands" or "microconditions" within their unit of management to develop strategies for forest regeneration, climate resilience, and invasive species management.

Keywords: Floodplain forests, management, inundation

CATCH COMPARISON OF FISHES AND TURTLES IN HOOP NETS USING THREE BAIT TYPES

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Hoop nets are one of the most common passive gear types used in commercial fishing and are frequently used to sample and monitor riverine fish communities throughout the Mississippi River basin. Further, hoop nets can be baited with various attractants to target species of interest and increase catch rates. Since 1993, the Illinois Natural History Survey (INHS) has used small and large hoop nets baited with soybean cake as part of the Upper Mississippi River Restoration Program's Long-Term Resource Monitoring element (LTRM). These LTRM hoop nets are intended to sample the breadth of the benthic fish community. Starting in 2019, LTRM style hoop netting efforts were implemented with two specialized baits (clam and cottonseed) to specifically monitor for invasive Black Carp (*Mylopharyngodon piceus*). The use of hoop nets baited with soybean, clam, and cottonseed baits in the La Grange Reach of the Illinois River also allows for catch comparisons among the three baits. Using LTRM and Black Carp monitoring data, we compared catch per unit effort (CPUE) from 2019-2020 of fish species of interest to both fisheries managers and commercial and recreational anglers, including Channel Catfish (*Ictalurus punctatus*), Freshwater Drum (*Aplodinotus grunniens*), Smallmouth Buffalo (*Ictiobus bubalus*), Black Crappie (*Pomoxis nigromaculatus*), White Crappie (*Pomoxis annularis*), and White Bass (*Morone chrysops*). We also examined turtle by-catch in our hoop nets with the three aforementioned baits. Based on our results, we believe fisheries managers can use different bait types in hoop nets if they wish to gain additional insight regarding specific species, while also potentially minimizing turtle by-catch.

Keywords: Fish, Turtles, Gear Comparison

WILD CELERY WINTER BUD DYNAMICS IN POOLS 4, 8, AND 13 OF THE UPPER MISSISSIPPI RIVER

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Submerged aquatic vegetation (SAV) serves a vital role in maintaining healthy aquatic ecosystems and serves as an important food source. Wild celery (Vallisneria americana) is a species of SAV that produces energy rich winter buds below the substrate that canvasbacks (*Aythya valisineria*) select for during their migration through the Upper Mississippi River. Since 1998 the Upper Mississippi River Restoration Program, Long Term Resource Monitoring (LTRM) element has monitored aquatic vegetation by conducting rake samples. During rake sampling aboveground biomass of aquatic vegetation species are given a value from 1-5 based on species relative abundance on a rake. Since the rake does not sample underground structures, there remain questions on how data collected by the LTRM translates to waterfowl habitat quality and bioenergetics. This study aims to discover if a relationship exists between LTRM rake scores and belowground wild celery winter bud count estimates from substrate core samples in open and closed areas to waterfowl hunting within pools 4, 8, and 13 of the Upper Mississippi River, USA. Rake samples were collected by LTRM in summer 2018 and 2019 in pools 4, 8 and 13. Substrate cores were collected at the same locations as LTRM rake sample sites before the annual waterfowl migration in autumn 2018 and 2019, and spring 2019 and 2020. Rake score was the only predictor

in the top model estimating the probability of at least one wild celery bud at a site. At a rake score of a one there is about a 90% chance the site has a wild celery bud and when the average rake score is higher than two, the probability of a wild celery bud present is 100%. Rake score with a quadratic term, an open or closed to hunting area designation, pool, and season were in the top model predicting wild celery winter bud counts ($P < 0.05$, $R2 = 0.32$). At an average LTRM rake score of about a 1.7 the relationship between rake score and wild celery winter bud count becomes negative. Results indicate LTRM data can be used to predict the presence and count of wild celery winter buds. This study proposes an alternative, cost effective and time saving method to quantify underground plant structures compared to traditional quadrat or core sampling.

Keywords: Waterfowl, Submerged Aquatic Vegetation

THE EFFECTS OF WATER DRAWDOWNS ON MARSH BIRD NEST SURVIVAL AT EMIQUON PRESERVE, IL

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Wetland obligate marsh birds are a group of birds that are habituated to changing hydric conditions and are declining worldwide due to habitat loss and degradation. These birds are often associated with complex vegetated habitat interspersed with open water that provides protection from predators and a space for waterbirds to forage. Emiquon Preserve, a restored cattail marsh along the Illinois River, is managed as a semi-permanent emergent marsh through moist soil management, an aspect of which is water-level manipulations. Emiquon Preserve uses a complex pump-system within a levee separating the restored marsh from the Illinois River to control a drawdown of water from June to August after marsh birds have initiated nesting. Drawdowns follow annual cycles of intensity (minimal, moderate, intense), and in 2020 Emiquon Preserve underwent an intense 4.5-foot drawdown intended to expose moist soil for plants (i.e., millet, smartweed) that feed fall migrating waterfowl. Knowledge on the effects of water-level manipulation for nesting marsh birds is limited, and we are particularly interested in learning more about the effects water drawdowns have on nest success and predator access to nests. In 2020, we searched suitable habitats (hemi-marsh, dense emergent) and located marsh bird nests (Least Bittern, Common Gallinule, Black-crowned Night-Heron, American Coot) at varying water depths and distances from the shore. We set up continuously recording cameras at a subset of nests to record predators at the nests and we revisited the nests throughout the season to document their fate. We found that nests in shallow water and closer to the water's edge face an increased risk of predation by mammals, and intense dewatering as prescribed by moist soil management may be exacerbating predation risk at marsh bird nests.

Keywords: wetlands, management, ornithology, wildlife, predators

DETERMINING THE PRESENCE AND COINFECTION RATES OF TICK-BORNE DISEASE PATHOGENS, BORRELIA MIYAMOTOI AND BORRELIA BURGDORFERI

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Tick-borne diseases are increasing at startling rates throughout the United States, with Lyme disease being the highest reported tick-borne and vector-borne disease. The Lyme disease causing bacteria, *Borrelia burgdorferi* is transmitted to humans through the bite of the tick, *Ixodes scapularis* (deer tick), throughout most areas of the United States. *I. scapularis* can carry many other pathogens as well, and it is thought that many of the individuals that suffer long term effects of Lyme disease is due to coinfections. Our lab has worked over the past five years to gain an understanding of the prevalence of the Lyme disease causing bacteria throughout Eastern Iowa, particularly along the Mississippi River. This work is an expansion of this long-term study to look at the rates of other tick-borne pathogens, and possible coinfections, focusing on the bacterium *Borrelia miyamotoi*, which causes tick-borne relapsing fever (TBRF*). Borrelia miyamotoi* infections are prevalent in the same areas that Lyme disease is found in. In addition, TBRF has some of the same symptoms as Lyme disease including the following fever, headache, fatigue, joint and muscle pain, loss of appetite, disorientation or memory loss, and lack of coordination. Though we know that *B. miyamotoi* can be found in the same tick species as *B. burgdorferi* there is less known of its presence and prevalence in the US, particularly in Iowa. To gain a better understanding of *B. miyamotoi* and its location and possible rates of coinfection with *B. burgdorferi* we have been testing previously collected blood samples from rodents as well as ticks for the presence of a *B. miyamotoi* specific gene. Currently, samples are being tested from the pilot study that was carried out during summer 2016 when blood samples from 25 rodents were collected as well as 91 samples collected during summer 2017. Preliminary results suggest the presence of coinfections of *B. miyamoti* with *B. burgdorferi* as well as a possible variation in presence due to habitat type.

Keywords: Tick-Borne, *Borrelia burgdorferi*, Lyme disease

NATAL ORIGINS OF BLUEGILL, FRESHWATER DRUM, AND CHANNEL CATFISH ACROSS SEVERAL REACHES OF THE MISSISSIPPI AND ILLINOIS RIVERS

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Effective management and conservation of fishes requires understanding habitat use across multiple life stages while ensuring necessary habitats are available. In the Midwest U.S., habitats such as tributaries may play important roles in recruitment and dispersal of fishes in anthropogenically modified rivers like the Mississippi and Illinois rivers. Identifying habitats that contribute to the recruitment of fish populations can determine the importance of connectivity within river networks and pinpoint habitats for potential restoration efforts. In the Mississippi and Illinois rivers, identification of the habitats used in early life stages (i.e. fish natal origin) is possible through otolith microchemistry. Otolith microchemistry relies on the incorporation of elements such as strontium (Sr), barium (Ba), and calcium (Ca) into otoliths, the long-term stability of water chemistry (Sr:Ca and Ba:Ca), and chemical distinctness in these elements among water bodies. To

determine what habitats are important to the recruitment of native fishes in the Mississippi and Illinois rivers, an otolith microchemistry study is being conducted on twelve different fishes that vary in life history characteristics. Here, we discuss and compare among river reaches the natal origins of Bluegill (*Lepomis macrochirus*), Freshwater Drum (*Aplodinotus grunniens*) and Channel Catfish (*Ictalurus punctatus*). Fishes were collected through Long Term Resource Monitoring (LTRM) across multiple reaches that vary in habitat characteristics. Otoliths from 50 individuals of each species from each LTRM sampling reach (Pools 4, 8, 13, and 26 of the Upper Mississippi River, Open River of the Middle Mississippi River, and La Grange of the Illinois River) were analyzed for Sr, Ba, and Ca using laser ablation inductively coupled plasma mass spectrometry. Using the resulting Sr:Ca and Ba:Ca chemical signatures of the otolith cores, natal origins as tributaries or mainstem river were determined based on relationships between otolith and water chemistries. Using the natal origin information we can manage the habitats most pertinent to the recruitment of these fishes and ensure viable connectivity among mainstem rivers and recruitment habitats. Furthermore, this project is part of a larger study concerned with estimating vital rates and genetic structure of the same fishes. Combining natal origin with these other elements can yield insights into factors affecting year class strength and the boundaries of fish populations.

Keywords: Microchemistry, Connectivity, Habitat use, Native fishes

RECENT HYDROLOGIC AND GEOMORPHIC CHANGE IN THE UPPER MISSISSIPPI RIVER SYSTEM

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The hydrology and geomorphology of the Upper Mississippi River System (UMRS) form the physical template for ecological and biophysical patterns and processes in the river. Here, we use three hydrologic indicators to describe 80 years of flow dynamics across the river system and two indicators of geomorphic change for the Upper Mississippi River (UMR). Significantly increasing trends in indicators of annual flow conditions, high-water events, and monthly flow patterns show hydrologic change has occurred over time for the UMR and Illinois River. No significant decreasing trends were found in any hydrologic indicator. Patterns suggest an increase in the river system's total annual discharge that is driven by relatively higher flows during more of the year rather than increases in only the spring flood pulse. It is unclear the extent to which climate, watershed land-use, river engineering, or other factors may contribute to these findings, but all have the potential to affect the future hydrologic regime of the UMRS. We also found evidence of continued geomorphic change in the UMR: gains in new landform surface area have occurred consistently across two time periods of analysis in the impounded reaches, and positive pool-wide mean rates of bed elevation change indicate a gradual loss of water depth in backwaters from Pools 4 and 8 over the past 20 years. Such changes have both physical and ecological implications. For example, net gains in landform surface area can affect hydrologic connectivity while representing new habitat conditions, and bed elevation changes are often of concern to resource managers because filling can deplete deeper lentic habitat. Together, the hydrologic and geomorphic changes in the UMRS are important to consider when understanding dynamics of the broader ecosystem through time.

Keywords: Status and Trends, Hydrologic Regime, Sedimentation Rates, Planform Change

SAMPLING OF SMALL-BODIED FISHES IN EMERGENT VEGETATION USING A 1.0M^2 THROW TRAP IN POOL 26 OF THE MISSISSIPPI RIVER

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As a nationally important navigation system and ecosystem, the Upper Mississippi River System (UMRS) supports US commerce by providing an economically important transportation corridor for millions of tons of agricultural and industrial products, and by supporting recreational and commercial fisheries and recreational hunting. However, managing the river to maintain a 9 ft navigation channel has had some negative impacts on the ecosystem. Seasonal low-water periods that used to occur during the late summer supported the growth of emergent and submergent vegetation that provided important habitats and food used by fishes, waterfowl, and other wildlife. In order to combat these effects, the United States Army of Civic Engineers (USACE) created Environmental Pool Management (EPM), a strategy for drawing down pool levels seasonally while maintaining levels needed for commercial navigation. The goal of EPM is to create baseflow conditions that promote the growth of vegetation and allow sediment compaction along the margins of contiguous backwater lakes and side channels. Although the effects of the EPM drawdown has been studied for vegetation, waterfowl, and adult fishes, there is currently a distinct lack in knowledge of the effects of the drawdown on juvenile and small-bodied fishes. We proposed the use of a 1.0 m2 throw trap to enable standardized monitoring of small-bodied and juvenile fish responses to the annual EPM drawdown and their use of the resultant emergent vegetation.

Keywords: Upper Mississippi River System, Environmental Pool Management, small-bodied fishes, throw trap, drawdown

HOW THE ADDITION OF OIL AND A SURFACTANT TO THE LA CROSSE RIVER MARSH INFLUENCES BACTERIAL COMMUNITY FUNCTION

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Crude oil is a serious pollutant that can wreak havoc in an ecosystem. Oil spills not only alter the composition and function of an ecosystem on a macro level, they can dramatically change the composition and function of the microbial community within an ecosystem as well. Should an oil spill occur, cleanup efforts often include the use of surfactants designed to enhance bioremediation via oil degrading bacteria. However, surfactants themselves may prove toxic to a portion of the microbial community. Because of this, it is important to understand how the microbial community of a vulnerable aquatic ecosystem might react to both an oil spill and the addition of a common surfactant. One such vulnerable ecosystem is the La Crosse River marsh. Microcosms were used as

a proxy to test the effects an oil spill and the addition of a surfactant would have on the La Crosse River marsh microbial community. Four replicates of 4 different treatments were run in 250 mL glass flasks. One of these treatments contained marsh water only, another marsh water and 2% v/v oil, the third contained marsh water and surfactant, and the last treatment group contained marsh water, 2% v/v oil, and surfactant. A total of 3 trials each lasting 2 weeks using these treatment groups were run, with a different concentration of surfactant used for each trial. Trial 1 had the highest concentration of surfactant and trial 3 had the lowest concentration. Community function has been characterized through measuring bacterial secondary production and enumeration via acridine orange direct counts. The results from the first 2 trials indicated that secondary production was highest in the non-surfactant treatments during the first 2 days of incubation. However, secondary production in trial 3 was noticeably higher in the surfactant only treatment. Acridine orange staining revealed that bacterial counts do not appear to be significantly different between treatments, indicating that neither oil nor surfactant had a toxic effect on the microbial community.

Keywords: Oil, Pollution, Surfactant, Bacteria

MONITORING THE IMPACT OF THE LAND USE CHARACTERISTICS ON THE SURFACE WATER QUALITY OF MISSISSIPPI RIVER TRIBUTARIES

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Water quality is an extremely important driver for the ecological processes that support life and influence biodiversity. Land use has a significant influence on water quality. Iowa is a major contributor of nitrogen and phosphorus to the Mississippi River and plays an oversized role in the Gulf of Mexico dead zone. To examine spatial and temporal variation in nutrient transport to the Mississippi River, we sampled all 29 HUC-12 watersheds in Dubuque County. Sampling sites included both agricultural and urban areas. Samples were collected in the fall, winter, spring, and summer during baseflow and runoff events. Parameters analyzed were water temperature, pH, dissolved oxygen, ammonia, nitrite/nitrate, total phosphorus, dissolved reactive phosphorus, chlorides, E. coli, total coliform bacteria, and total suspended solids. To further explore land-use impacts, vegetative buffers were examined in six sites throughout our sampling area. We gathered water and soil samples in six sites in agricultural areas before and after fall harvest in and around Catfish creek, Whitewater Creek, and the Little Maquoketa River. Soil samples were gathered in the middle of vegetative buffers.
Rain events were major drivers of phosphorus transport, and winter runoff events were the major transport events for phosphorus. Nitrogen and phosphorus concentrations were found above EPA recommendations at nearly all sites during at least one sampling period. However, variation was noted between the sites and during seasons. Chloride was detected at concentrations that could lead to chronic impacts on organisms in a small subset of our sampling locations. Coliform bacteria, good indicators of potential pathogens, were problematic in some areas. Our results indicate that the land use characteristics are impacting multiple tributaries of the Mississippi River. However, there is much variation in the spatial and temporal transport of sediments and nutrients.

Keywords: Environmental, Water Quality, Mississippi River, Land-use, Run-off

POSTER PRESENTATION ABSTRACTS

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(*Student Presenter)

MICROPLASTIC ABUNDANCE AND PATTERNS IN THREE FISH SPECIES OF THE UPPER MISSISSIPPI RIVER SYSTEM

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In 2019, microplastics were listed as one of the top 12 emerging threats to freshwater biodiversity. Microplastics are in the size range of 0.3-5.0 mm, allowing them to integrate into tissues once ingested. The consumption of microplastics by native fishes has been documented in several tributaries of Lake Michigan, raising the question of whether the same threat exists in the Upper Mississippi River System (UMRS). There is a need to establish a baseline dataset of microplastic abundance and patterns in the UMRS in order to determine the effect microplastics have on this unique ecosystem. To create this baseline, the gut contents of three fish species will be analyzed for the presence of microplastics. Fish sampling was done across three habitat strata: main channel, side channel, and backwater. The digestive tract will be removed from the fish and undergo KOH digestion. The remaining sample will be filtered and visually analyzed for microplastics under a dissecting microscope. Once completed, a regression analysis will be done including water quality data that was collected during each sampling event. Relationships between fish body length and body mass and the number of microplastics present in the gut will be established. This information will be used to determine if different species of fish have varying levels of microplastics in their gut. This amount of previously unavailable data will be used to suggest different maintenance protocols and influence the development of new projects that are implemented along the UMR.

Keywords: microplastics, Upper Mississippi River, Silver Carp, habitat strata, water quality

DRIVERS OF FISH GROWTH AND RECRUITMENT IN LARGEMOUTH BASS, BLUEGILL, AND BLACK CRAPPIE IN THE EMIQUON PRESERVE

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The Emiquon Preserve is a restored backwater lake that is managed by a water manipulation at a gated pumping structure with variable connectivity to the Illinois River. Trends in composition and structure of the Emiquon fish community has been evaluated through standardized monitoring since initial stocking in 2007. However, evaluation of fish vital rates and their response to specific management actions have not been investigated. Our objectives of our study will determine the

influence of biotic and abiotic predictors (water elevation, water temperature, vegetation abundance, plankton abundance) on 1.) year class strength using catch curve residuals, 2.) yearly growth using otolith increment width and biochronology, and 3.) growth (individual yearly and cohort specific using length at age and size structure). From largemouth bass, bluegill, and black crappie, we will leverage previously collected sagittae otoliths from 2015 (n=269) and 2016 (n=120) and collected additional structures in 2020 to achieve an otolith record dating back to Emiquon's initial stocking. Fishes were collected in Spring 2020 using LTRM standardized electrofishing (60hz PDC), 10 fish per 10 mm size class for each species (min= 100 per species), and water elevation, water quality, zooplankton biomass, and vegetation abundance will be collected as covariates. Sagittae otoliths will be sectioned, annuli identified and enumerated, and will use catch curves derived from age-length keys generated from standardized monitoring, to calculate catch curve residuals and evaluate year class strength. Additionally, incremental growth (response variable) will be measured and estimated using a linear mixed effects model accounting for variation in individual fish and age at capture to determine annual growth. Annual growth and year class strength will then be tested for correlation with biotic and abiotic predictors such as water elevation, water temperature, vegetation abundance, plankton abundance. Determination of these relationships will help guide management actions to determine the effects of water level management of Emiquon sportfish communities.

Keywords: Emiquon, Sportfish, Year class, Otoliths, Biochronology

LEGACY MERCURY CONTAMINATION IN SOILS AS A TRACER OF HISTORIC FUR-TRADE ACTIVITY IN THE GREAT LAKES REGION

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Mercury (Hg) is an environmental pollutant and potent neurotoxin. Recent studies have indicated toxic levels of Hg contamination in soils at Grand Portage National Monument, MN (GRPO). The contamination is believed to be linked to vermilion, a mercury-bearing cinnabar-ore, which was a trading item used by French Voyageurs in the Great Lakes and Mississippi River watersheds in the 1600-1800s. To assess the spatial contamination of trading sites at GRPO, 42 soil cores were collected from the Fort Charlotte depot in September 2019. Samples were analyzed at UW-L via thermal decomposition/atomic absorption spectroscopy for total mercury concentration. Results produced a more thorough concentration map of the sites, with the highest samples over 100-fold greater in concentration than regional background soils. Stable isotopes will be employed to confirm whether these high levels of contamination are connected to the vermilion-ore residue. Combustion studies were conducted on the September 2019 samples to determine how controlled burns would affect the liberation of Hg from such contaminated soils. Samples were placed in the muffle furnace at 250°C and 500°C for periods of 1, 3, and 5 hours. Initial results indicated significant loss in Hg concentration in soils at these temperatures and that "natural" Hg was somewhat more labile than "contaminated" Hg. All results will be made available to GRPO staff to help determine how best to protect native populations and visitors from contamination. Further sampling is needed to determine if Hg in GRPO soils has leached into nearby waterways, ultimately contaminating the local food web. Such extensive Hg contamination may not be a

unique occurrence and has important implications for historical fur trading sites along the Great Lakes, the Mississippi River, and beyond.

Keywords: Mercury, contamination, soils, tracer, legacy

LAND USE DRIVERS OF NITRATE LEVELS IN CROW CREEK WATERSHED TRIBUTARY OF THE MISSISSIPPI RIVER

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Crow Creek in Scott County Iowa is a tributary of the Mississippi river and its watershed occurs in a gradient of agricultural, mixed, and urban land use. In 2018 and 2019, two hotspots for nitrate were identified in the watershed at established sampling sites, (hotspot one: mean of 4.21 mg/L and mean 4.76 mg/L, hotspot two: mean 5.89 mg/L and mean 5.39 mg/L). The goal of this project was to look upstream of these two high flux zones and in between them to piece together the origin of the nitrate in order to provide a report to the city on the worst water quality sites in this watershed, as well as to provide guidance about the process of water quality improvement. In the fall of 2020, on October 17th and November 7th, eleven urban sites, twelve agricultural sites, and six sites that were approximately an equal combination of both urban and agricultural were sampled. These sites were chosen to capture nitrate levels at streams that are not part of our usual sample network for this watershed. Samples from the watershed were taken in acid washed sample containers, stored on ice, and loaded into a Discrete Autoanalyzer for colorimetric analysis via the Cadmium Reduction method. We observed that approximately 50% of the agricultural sites showed a higher nitrate concentration than all the urban sites while 91% of the agricultural sites showed a greater concentration than 90% of the urban sites. We found a statistically significant difference between nitrate concentration in agricultural streams than urban, (ANOVA, 2df, $F= 6.628$, $p<0.005$). It was not the case that low order streams were all elevated in Nitrate. First order agricultural streams were elevated in nitrate compared to urban ones. The results suggest that factors of land use, specifically agricultural land use upstream, explains the flux of nitrate concentrations in the previously identified hot spots.

Keywords: Nitrate, Land use

THE EFFECTS OF AGRICULTURE ON FISH COMMUNITIES IN THE UPPER MISSISSIPPI RIVER SYSTEM THROUGH ARCHAEOLOGICAL AND MODERN TIME PERIODS

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Throughout time, humans have impacted the environment. Scientists now recognize a new geologic epoch, the Anthropocene, defined as the period where human actions are the primary driver of climatic and environmental processes. One factor affecting the environment is agricultural production. Agriculture causes nonpoint source pollution, increasing phosphorus and nitrogen inputs, and sedimentation. More intensive agricultural practices developed during the Mississippian (900 and 1500 A.D.), and as such, Mississippian agricultural production may have affected the river and riverine fish communities in the past. We hypothesized that the development of intensive agriculture in the Mississippian period would cause fish communities to be more similar to fish communities in the modern era relative to fish communities in other archaeological time periods. To test our hypothesis, we compared fish communities represented among archaeological collections and modern fish monitoring programs. We specifically focused on those fish taxa sensitive to water quality. We found no significant differences between fish communities in archaeological collections from the Mississippian period and archaeological collection from other periods, but fish communities from all modern reaches differed significantly from fish communities in all archaeological time periods, which does not support our hypothesis.

Keywords: Agricultural production, Nonpoint source pollution, Fish communities, Long term data, Analysis of similarity

AIR AND WATER TEMPERATURE RELATIONSHIPS IN TROUT STREAMS OF NORTHEASTERN IOWA

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Water temperature is an important habitat component of aquatic ecosystems, especially for streams that harbor species like trout that require a narrow range of temperatures. The Driftless Area is known for its trout habitat as many of the streams are classified as coldwater streams and fed by groundwater. The Driftless Area is characterized by its steep bluffs and bedrock geology littered with karst features. These karst features lead to many streams having significant groundwater inputs into streams across the region. Trout prefer stable water temperatures less than 20°C and identifying stream reaches that contain suitable temperature habitat has been difficult. In this study we used stream water temperature monitoring data from the Iowa Department of Natural resources collected from over 50 known trout streams across the Driftless Area of northeastern Iowa. These stream water temperatures were compared to patterns of air temperatures collected from regional weather stations. Weekly mean temperatures were compared using linear regression and the linear slopes and y-intercepts were used as metrics of identifying groundwater-fed systems and subsequently coldwater habitat. We found an average slope of 0.42, intercept of 6.0, and an R2 of 0.85. Our findings confirm those of other regional temperature comparison studies of coldwater streams. This modeling is important as climate change is expected to increase air temperature so knowing how air temperature will affect the water temperature in these critical trout habitats is of the utmost importance.

Keywords: Trout, groundwater, temperature, Driftless Area

YELLOW PERCH POPULATION DYNAMICS AND SIMULATION MODELING IN THE UPPER MISSISSIPPI RIVER

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The Upper Mississippi River (UMR) supports diverse recreational fisheries. Yellow Perch are found across the UMR and represents an economically and recreationally important fishery. Throughout the UMR, Yellow Perch are exploited by recreational anglers year-round. Exploited fisheries need proper management to conserve and protect stocks. Traditionally, fisheries are managed by quantifying population dynamics (i.e., recruitment, growth, mortality). However, few studies have evaluated Yellow Perch population dynamics throughout the UMR. As such, we sought to quantify Yellow Perch population dynamics across three pools in the UMR (i.e., Pool 13, Pool 8, Pool 4). Using the U.S. Army Corps of Engineers Long Term Resources Monitoring Element's fish component collections. Electrofished Yellow Perch were collected across the upper three field stations (i.e., Pool 13, Pool 8, Pool 4). Age estimations were generated using Yellow Perch otoliths. From age data, we quantified Yellow Perch recruitment, growth, and mortality. Age and growth data was used to develop Beverton-Holt yield per recruitment models. These models simulated various exploitation rates across the UMR. Further, simulation models can provide insight into length-based regulations throughout the UMR. Using this approach, we can evaluate the status of the UMR Yellow Perch fishery.

Keywords: Yellow Perch Age Growth Model

2020 AERIAL SURVEY OF UPPER-MISSISSIPPI RIVER SYSTEM FOR DECADAL LCU MAPPING

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The U.S. Army Corps of Engineers-Upper Mississippi River Restoration program, through its Long Term Resource Monitoring element, collected systemic imagery of the entire Upper Mississippi River System during the summer of 2020. Development of the 2020 Land Cover/Land Use database will provide a fourth systemic dataset to compare to the 1989, 2000, and 2010/11 systemic coverages. Using a crosswalk to update the 1989 survey, originally interpreted using a different classification system, the 2000, 2010/11, and 2020 LCU datasets will share the same vegetation classification system and image interpreters, making them directly comparable. Once completed, the 2020 dataset will be invaluable in assessing the current state of floodplain vegetation, as well as evaluating long-term vegetation trends and habitat changes over the past 30 years.

Keywords: remote sensing, aerial survey, land use/land cover, vegetation mapping

FEASIBILITY OF AGEING AND APPLICATION TO CYPRINID PREY SPECIES IN THE UPPER MISSISSIPPI RIVER

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Family Cyprinidae (i.e., minnows and carps) are one of the most widely globally distributed fish taxa. In North America, minnow species are important links to higher trophic levels in riverine ecosystems. Specifically, in the Mississippi River basin, minnow species represent an important forage species for various recreationally and commercially important species (e.g., Blue Catfish, Largemouth Bass). Minnow population dynamics (i.e., recruitment, growth, mortality) have the potential to influence higher trophic level fishes. However, few studies have evaluated minnow age and growth. Further, even fewer studies have evaluated minnow age and growth using otoliths. Studies have suggested otoliths are the superior ageing structure. Minnows (i.e., Bullhead Minnows and Emerald Shiner) were collected via mini-fyke nets and daytime electrofishing respectively. Sampling was carried out by the United States Army Corps of Engineers' Long-Term Resource Monitoring element across six field stations in the Mississippi and Illinois rivers. Otoliths were used to assign ages and subsequently used to quantify vital rates. Understanding demographic trends and changes can elucidate changes to the environment. Given their life-history traits, minnows have the potential to rapidly reflect the environmental perturbations.

Keywords: minnows age growth river otoliths

DO FISH COMMUNITIES VARY WITH FLOODING ACROSS THE MILLENNIA IN THE UPPER MISSISSIPPI RIVER SYSTEM?

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Flooding is an important factor structuring the biota, including fish communities, of river-floodplain systems. There are archaeological time periods known to have been "wet" or "dry". We examined how fish communities varied with flooding across the last two millennium using modern monitoring data and fish remains recovered from archaeological deposits. We expected to see differences between the frequency of occurrence of specific fish taxa within wet and dry periods of the archaeological data, as well as between the years with and without flooding in the modern data. Further, we expected fish communities from archaeological wet periods to be more similar to modern years with flooding than to archaeological dry periods and modern years without flooding.

We found no significant differences in fish communities among different flood categories in the modern data. We did, however, find significant differences in the frequency of occurrence of fish taxa between wet and dry archaeological periods.

Keywords: Floodplain Connectivity, Fish Communities, Long Term Data, Analysis of Similarity, Interdisciplinary Research

ANALYZING LOCAL SYSTEMATIC CHANGES IN EXTREME WEATHER EVENTS DUE TO CLIMATE CHANGE

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In recent years, climate change has become the environmental issue of this generation. Human-produced emissions have caused our global temperature to increase, sea levels to rise, and extreme weather events to increase. Systematic changes in magnitude and frequency of extreme events are happening in the Midwest. Many farmers are experiencing the impacts of increases in maximum temperatures, precipitation, and weather variation. The purpose of our research was to determine if large scale climate changes are being exhibited through local climate patterns. We obtained data from the Dubuque Lock & Dam through the National Oceanic and Atmospheric Administration (NOAA). The data were analyzed through pivot tables to find the maximum and minimum temperatures along with maximum and sum amounts of precipitation, both monthly and seasonally. The data were then graphed for visual representation and tested for statistical significance using regression analysis. Our results determined an increase in autumn and winter minimum temperatures and an upward trend in spring and summer average temperatures. There are also significant increases in precipitation in October, April, May, and June. Lastly, winter snow increased, but we saw a decrease in spring seasonal snow.
These climate changes can have a specific impact for the Midwest. Iowa uses 85% of its land for agriculture, and increased variability in weather patterns can hinder crop yields in several ways. A large amount of rain, or multi-day rain events in October can have a negative effect on crops before harvest, and an increase in rain creates a smaller window for harvesting crops. Growing season in the summer months could also be affected by an increase in the average temperature, coupled with May and June seeing an increase in precipitation. Another emerging problem is minimum temperatures in the winter increasing, possibly leading to insects not dying in these months – leading to an increase in the spring. Citizens of Dubuque will also be affected by these local climate changes. A large increase in precipitation for April, May, and June is leading to large flooding events that adds stress to people and infrastructure in Dubuque. Overall, there's an increase in variability for temperatures and precipitation events that if left unchecked may harm the people, agriculture, and ecosystems in Iowa.

Keywords: climate change, local weather, extreme events, Dubuque County

IMPACTS OF HYDROLOGIC CHANGE AND FLOODING OF THE MISSISSIPPI RIVER ON RIVERINE TURTLE NESTING AND POPULATION

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Expected changes being observed on the Upper Mississippi River due to climate changes include hydrologic changes due to increased flow magnitude, duration, and frequency. Among other ramifications, these changes could impact the ability of riverine turtles to nest. The purpose of this study was to model potential impacts of climate change on turtle nesting sites. Field surveys were conducted along the 9-Mile Island in Pool 12 of the Upper Mississippi River Wildlife and Fish Refuge. Sample sites were categorized based on turtle nesting quality, using several criteria. We used GIS to model the impacts of hydrology changes on the potential nesting sites. Our results found that the primary nesting sites are becoming increasingly vulnerable to increased water flow and hydrologic changes. These changes could lead to detrimental effects for the riverine turtle population on the Upper Mississippi.

Keywords: river, turtle, nesting, flooding, climate change

DOES PRESENCE OF AQUATIC VEGETATION HELP US UNDERSTAND VARIATIONS IN FISH COMMUNITIES BETWEEN THE ARCHAEOLOGICAL RECORD AND MODERN SAMPLES?

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Through the use of archaeological and modern ecological datasets, we explored the relationship between fish communities and the presence of vegetation within the Upper Mississippi River System (UMRS). Researchers suggest that aquatic vegetation was present during archeological times throughout the UMRS. Today, submersed aquatic vegetation (SAV) is prevalent in the upper reaches of the UMRS, but nearly absent in the lower reaches (i.e. below Lock and Dam 19). We hypothesized that fish communities represented in archaeological collections would be more similar to the modern day upper UMRS than the lower UMRS. We compared the frequency of occurrence of fish communities represented in archaeological collections and modern samples. The modern samples were significantly different from all archaeological collections. Nevertheless, there was overlap between some archeological collections and the upper reaches of the UMRS which provides partial support for our hypothesis. We predicted that 12 taxa that use aquatic vegetation for spawning would have a greater frequency of occurrence in the upper reaches relative to the lower reaches; however, only six taxa aligned with our expectations.

Keywords: Aquatic vegetation, Fish communities, Long term data, Analysis of similarity

GIZZARD SHAD HABITAT USE IN THE UPPER MISSISSIPPI RIVER

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Throughout the Mississippi River human alterations to the river have occurred for numerous reasons including flood control, navigation or hydropower. These manmade changes in the river have altered flow, depth, temperature, sedimentation, vegetation and substrate. River alterations may potentially impact filter-feeding fishes (e.g., Gizzard Shad *Dorosoma cepedianum*, Bigmouth Buffalo *Ictiobus cyprinellus*). Gizzard Shad are important links to higher trophic levels in riverine ecosystems. Prey density alterations can have profound effects on the entire community. Given the potential impacts Gizzard Shad can have on the fish community, they can be used as an indicator species. As an indicator species, quantifying habitat use can inform management decisions on river restoration. We evaluated Gizzard Shad habitat use via electrofishing conducted by the United States Army Corps of Engineers' Long-Term Resource Monitoring (LTRM) element. Large-scale macrohabitat features (e.g., side channels) did not drive Gizzard Shad use. Rather, fine-scale river features (e.g., depth) influenced Gizzard Shad habitat use. Our study suggest that Gizzard Shad are utilizing similar habitats to other off-channel habitat specialists. Habitat restoration efforts should focus on replicating shallower and slower velocity habitats.

Keywords: habitat shad Upper Mississippi River

OCCURRENCE AND RELATIVE ABUNDANCE OF ODONATA SPECIES IN THE UPPER MISSISSIPPI RIVER VALLEY, 2013-2018

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Annual surveys of dragonflies and damselflies (Odonata) were conducted in Navigation Pools 6-10 of the Upper Mississippi River Valley, in cooperation with the United States Fish and Wildlife Service (USFWS) from April-November, 2013-2018. This survey consisted of point inventories, with locations based on convenience or opportunistic sampling by foot, vehicle, and boat throughout the Pools. Observations were recorded only if a free-ranging or netted individual was positively identified. It was deemed important to conduct a new survey to investigate current trends on the UMR. Our objectives were to provide inference on species occurrence, relative abundance, and sampling effort. Sixty-four species of odonates were observed, the tule bluet was the most frequently observed. Jackson recorded 31,159 observations of odonates during the 6-year survey and recorded more than 435 hours. Data on all odonate observations were submitted annually to a biologist in the Winona Office of the Upper Mississippi River National Wildlife and Fish Refuge (UMRNWFR) for compilation and summarization. The combined annual surveys enabled the

construction of a functional database that can be used to analyze trends and collect future records by refuge staff and volunteers. Navigation Pool,

Keywords: occurrence, Odonata, relative abundance, survey effort

CLASSIFICATION OF ECOLOGICAL STATES USING TOPOLOGICAL DATA ANALYSIS

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'Ecological states' are sets of unique biological and physiochemical conditions that are useful for characterizing an ecosystem and informing ecosystem restoration. The Upper Mississippi River Restoration Program has gathered river data for decades that can be used to explore ecological states. We hypothesized the river will have at least two ecological states: a "clear-water state" defined by low turbidity, nutrients and chlorophyll a, and another "turbid-state" defined by high turbidity, nutrients and chlorophyll a. We also anticipated additional ecosystem states are possible. The abundance of highly dimensional data posed challenges when applying common statistical methods to analyze ecological states; therefore, we used 'topological data analysis' tools that effectively sorted the complexities of big data to define states. These tools include 'persistence homology' to capture topological features of the data that persists through time as well as 'TDAMapper', an algorithm whose output is a graph that represents the shape of the data at a given time. These tools provided a framework for dimension and noise reduction while maintaining meaningful topological information. Currently, we have applied principal component analysis, GIS data interpolation, and TDAMapper to Pool 13 in the Upper Mississippi River and found discrete shapes in the data that can imply multiple ecological states. The variables Turbidity, Total Phosphorous, and Chlorophyll a capture the most variability within the dataset when compared alongside many other hypothesized variables (e.g., suspended solids, water temperature, dissolved oxygen, total nitrogen, etc), which suggests that these are likely indicator variables for defining the ecological states. These variables also support our hypotheses of the "clear-water" and "turbid-states." Our future work will use topological data analysis tools to quantify the discrete number of ecological states, map the states throughout the Upper Mississippi River, as well as test for changes in the indicator variables and states over the past few decades. These results will inform river practitioners on where undesirable states exist and which indicator variables should be managed in order to switch ecological states. Likewise, identifying where desirable states occur and their indicators will help preserve and manage those states.

Keywords: topology, states, data, statistics, noise-reduction

ECOLOGICAL TRENDS OF THE ULMUS AMERICANA IN THE UPPER MISSISSIPPI FLOODPLAIN FOREST

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The Upper Mississippi Floodplain Forest (UMFF) is located in the heart of the driftless region, an ecological system unique to the Midwest defined as an area unaffected by glacial drift from the last North American continental glacier. This diverse region is home to a number of rare and heritage species including the endangered American elm (*Ulmus americana*). Studies have determined significant ecological shifts as the UMFF's historically dominant tree species and understory species have changed, creating intermittent habitats and raising concerns for tree regeneration of the American elm. In analyzing a UMFF inventory dataset and considering a variety of parameters (pool number and American elm canopy class, health class and diameter at breast height), differences in parameter characteristics were determined that reflected changes between pool locations, revealing shifting ecological trends. There are multiple factors, including understory invasive species and deer herbivory, that may influence native tree regeneration, but we require additional data to understand the impacts on the American elm and the historically prominent tree species of the UMFF.

Keywords: American elm, regeneration, floodplain forest, heritage species, invasive species

STATION HOLDING ENDURANCE OF SLIMY SCULPIN (COTTUS COGNATUS) ON DIFFERENT SUBSTRATES

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Coldwater streams in the Driftless region of Southwestern Wisconsin are sensitive to increased inputs of fine sediments that limit the interstitial space between larger substrates that are crucial to benthic fishes. Detrimental land-use practices and climate change threaten to increase the fine sediment load of these streams through overland flow. Freshwater sculpin (*Cottus spp*.) are adapted to minimize energetic demands maintaining position in flowing water by anchoring into large substrates that can be completely embedded with increased fine sediment inputs. We describe the influence of embedded fine sediments in coldwater streams on the swimming and station-holding abilities of Slimy Sculpin (*Cottus cognatus*). Slimy Sculpin swimming performance was measured in a 10-L Brett-type flume using an endurance protocol that measures time-to-failure. An experimental pool of sculpin (n = 70) were tested on unembedded gravel (Mean Gravel Diameter=8.3±2.4 mm, n = 100) and gravel fully embedded by fine-sand using an endurance protocol at seven velocity increments (i.e., 5, 10, 15, 20, 25, 30, 40 cm s-1). Failure time was recorded when the sculpin became impinged on the downflow grate for >10 s with a maximum time of 200 min and no response to a physical stimulus. It is assumed that once the 200 min maximum is reached that the fish can sustain its position at this velocity indefinitely. The endurance curve for this species for the unembedded gravel trials (y = -0.0258x + 2.3121) suggests that increasing velocity has little impact station holding ability. From the equation of the trendline, endurance at 35 cm s-1 is projected to be 25.7 min for the gravel test group. Endurance for Pallid Sturgeon > 115 mm without in a substrate has been found to be 9.7 min (y=-0.059+3.052) (Hoover et al. 2005). This comparison highlights the higher endurance at this velocity, possibly showing the

effects of substrate on benthic swimming endurance and station holding that is used by both species. Embedded substrate trials are still ongoing and will be completed and analyzed in March 2021. Slimy Sculpin in the region are already under stressors as result of a climate change and are preyed on by non-native Brown Trout (*Salmo trutta*) that are well researched. However, research focused on the risk of sedimentation on sculpin energetics are rare despite the potential negative population level effects. The distribution of Slimy Sculpin could be influenced by the landscape changes that alter sedimentation rates.

Keywords: Sculpin, Swimming Endurance, Sedimentation, Station-holding

ASSESSING THE HISTORICAL IMPORTANCE OF LIGHT-SEEDED TREE SPECIES IN UPPER MISSISSIPPI RIVER NAVIGATION POOLS 3-10

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The species composition of floodplain forests in the Upper Mississippi River (UMR) Valley has changed significantly since European settlement, and particularly since the establishment of the 9-foot navigation channel project in the 1930s. It has been widely thought that a primary result of this change has been an increase in the prevalence and dominance of more flood tolerant light-seeded tree species, especially silver maple (Acer saccharinum), at the expense of less flood tolerant hard mast producing species, especially oaks (Quercus spp.). However, many of these assumptions are built on datasets from the lower pools of the Upper Mississippi River or datasets that overlap with adjacent blufflands in the upper pools. Though a wider assessment of historic vegetation data from the 1800s in Mississippi River Pools 3-10 does indicate about a 15% decline in hard mast species with concurrent increases in silver maple in the UMR, the same datasets indicate that hard mast species were historically a minor component of the system, comprising only about 20% of total trees. Utilizing UMR landcover datasets for the area, many of the areas with the highest dominance of hard mast species in the early 1800s, particularly species in the marginally flood tolerant red oak group (Quercus section Lobatae), were areas that were converted to agriculture or development well before establishment of the locks and dams, with remaining forest areas in more flood-prone zones. Silver maple has substantially increased in dominance in the UMR, but this is primarily at the expense of other light seeded species. Both ash and birch have decreased by more than 10%, while elm and willow have also declined. Further, within the study area, natural regeneration of light-seeded species is far below the threshold required to maintain those species at their current levels, while hard mast species make up a higher proportion of regeneration plots than they do in the forest canopy, indicating a potentially expanding distribution for those species. These data indicate that forest restoration in the upper pools of the UMR should not discount the importance of light seeded species in maintaining forest diversity, both from the perspective of historical vegetation and future forest resilience, and management actions should be undertaken that encourage the establishment of light-seeded species as well as hard mast.

Keywords: Forest, Floodplain, Light-seeded, Regeneration, Historic

SPATIOTEMPORAL DRIVERS OF SUITABLE OVERWINTERING HABITAT FOR CENTRARCHID SPECIES IN THE UPPER MISSISSIPPI RIVER

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In rivers that experience winter ice cover, overwintering conditions play a central role in the survival and distribution of fishes. Fishes that rely heavily on backwater areas, such as centrarchids, are particularly sensitive to winter conditions and their populations can be bottlenecked by the availability of suitable habitat. In management settings, suitable habitat is often defined by the ranges of depth (≥ 1m), flow (≤ 0.01 m/s), temperature (≥ 1 °C) and dissolved oxygen (≥ 5 mg/L). However, despite the importance of maintaining and enhancing overwintering habitat, there remains uncertainty in the spatial and temporal drivers of midwinter conditions. We paired aquatic habitat connectivity metrics with long-term midwinter data from 6 field stations along the Upper Mississippi River System (UMRS) to evaluate the spatiotemporal drivers of backwater habitat conditions. We found that presence of suitable habitat not only varied among sites throughout the UMRS, but also within individual sites over the last 25 years. Increased ice and snow depth, which are typically indicative of winter severity, were associated with reduced habitat suitability throughout the UMRS. Further, increased connectivity between backwaters and adjacent lotic habitats consistently led to elevated flow rates and thus reduced suitable habitat. Understanding how connectivity and winter climate variability combine to influence backwater environments is critical to maintaining sustainable fish communities throughout the UMRS, especially as we expect winter length and severity to change through time and mediate the spatial drivers of winter conditions.

Keywords: Winter, habitat, centrarchid, suitability

SPATIAL AND TEMPORAL VARIABILITY OF AQUATIC INSECT EMERGENCE IN POOL 8 OF THE UPPER MISSISSIPPI RIVER

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Large rivers transport nutrients and energy from aquatic to the terrestrial ecosystems via insect emergence. In addition, these rivers provide diverse habitats, ranging from main channel to floodplain, and dynamic environmental conditions. However, little is known about how spatial and temporal variability influences insect emergence. In the study, we quantified spatial and temporal variability in insect emergence diversity and abundance across Pool 8 of the Upper Mississippi River near La Crosse, WI, USA. Physicochemical data and insect emergence were collected at nine different sites, that varied in distance from main channel (far, mid, close). Dissolved oxygen levels were elevated in the far distance sites compared to the close and mid distance sites, however, there were no differences in temperature, pH, and conductivity. Preliminary results of emergence (n=14) suggest community diversity and evenness are affected by distance from main channel. Future processing of samples will aim to quantify peaks in emergence timing. Identifying hotspots and hot

moments in insect emergence will help managers better promote and protect this important aquatic-terrestrial transfer of energy.

Keywords: Aquatic Insect, Emergence, and Mississippi River

COMPARATIVE ANALYSIS OF FISH HARVEST OVER TIME IN THE UPPER MISSISSIPPI RIVER SYSTEM

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Available data evidencing fish harvest and community trends in the Upper Mississippi River System (UMRS) may provide insights on the presence and effect of the Anthropocene in great river systems and their floodplains. By investigating fish community variation between commercial fish harvest and archaeological collections in the UMRS along with modern monitoring data we gain insight into changes in fish communities through time. We conducted multivariate analyses including analysis of similarity (ANOSIM) non-metric multidimensional analysis (nMDS) and SIMPER of these collections using Primer-7. We hypothesized that commercial fish harvest data would be more similar to archaeological collections than modern monitoring samples. Although the commercial data and archaeological time periods differed significantly (ANOSIM $P \leq 0.005$), several archaeological collections grouped with the commercial data at 85% similarity, providing partial support for our hypothesis. Commercial fish harvest in the UMRS still allows sustainable fish yields. Based on previous research and our findings, we suggest that any negative changes in fish communities in the modern-day UMRS are likely the result of other anthropogenic factors besides commercial harvest.

Keywords: Fish harvest, Fish communities, Long term data, Analysis of similarity

BEHAVIORS OF ODONATA SPECIES IN THE UPPER MISSISSIPPI RIVER VALLEY, 2013-2018

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Surveys of adult Odonata were conducted by Daniel E. Jackson, a citizen scientist, in Navigation Pools 6-10 of the Upper Mississippi River Valley in cooperation with the United States Fish and Wildlife Service during April-November, 2013-2018. Surveys were conducted opportunistically

from foot, vehicle, and boat. Observations were only recorded if identification was possible. Jackson recorded 31,159 individuals of 64 different species of adult dragonflies and damselflies. Of the 9 developed behavioral categories, the following were observed in order of descending abundance: perching (26.9%), flying (15.1%), patrolling (8.2%), on the ground (8.1%), ovipositing (4.1%), feeding (3.7%), mating (2.9%), roosting (0.6%), and foraging (0.1%). About 30.2% of the observed individuals were listed in an "unknown" behavioral category because there was not enough information given to infer a specified behavior. Mating behavior was observed most frequently in the month of August (34.1%). Ovipositing was observed primarily in the month of July (57.1%), and patrolling was most commonly seen during the month of July (38.6%). The most commonly observed species were the tule bluet (Enallagma carunculatum) (n=6,487), the Eastern forktail (Ischnura verticalis) (n=5,408), and the orange bluet (Enallagma signatum) (n=4,455). The majority of individuals were observed within the month of July.

Keywords: Behavior, dragonfly, damselfly, mating, Odonata

EVALUATION OF ASIAN CARP USE OF A STEEPPASS FISH LADDER.

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Asian carp continue to be a persistent threat to our Illinois waterways. Additional methods that aid in management, control, and removal are being explored. Asian carp are often attracted by water flow for upstream movements and spawning, a behavior we looked to evaluate to see it if it can be exploited for their removal. We assessed both nonnative and native fish passage using Whoosh Innovations steeppass fish ladder installed at The Nature Conservancy Emiquon Preserve's water control structure. The objectives of this study were to evaluate (1) if native and nonnative fish will use a steeppass fish ladder, and (2) if they are using the ladder, what factors contribute to its use. During a five-day trial in September 2020, water was pumped from Emiquon to operate the steeppass and attract fish. We measured a suite of biotic and abiotic variables before, during, and after steeppass operation, including dissolved oxygen, temperature, conductivity, chlorophyll-a, turbidity, and daily zooplankton samples. We used wifi-controlled outdoor security cameras to record fish movement over the steeppass and into a holding pool. At the end of the trial, we collected a total of 76 individual fish from seven species out of the holding pool. Gizzard shad were the dominant catch (n=61), and no bighead or silver carp were collected. Most of the fish collected were between 150mm and 450mm. Complications due to low water level during the trial likely had a large influence on size distribution and species composition. We are planning to run additional trials in Spring 2021 with lessons learned from 2020, including adjusting the elevation of the steeppass off the river bottom and using an AI scanner to better capture fish passage. With successful fish passage, this research could have important implications for Asian carp management and native fish passage.

Keywords: Asian carp, steeppass fish ladder

VARIATION IN FISH COMMUNITIES AMONG ARCHAEOLOGICAL COLLECTIONS, MODERN MONITORING SAMPLES, AND COMMERCIAL HARVET RECORDS FROM THE MISSISSIPPI RIVER SYSTEM

***Roland P. Sanchez[1], *Genevieve E. M. Zilmer[2]**, Carol E. Colaninno[3], and John H. Chick[4].
[1]Department of Anthropology, Fort Lewis College, 100 Rim Drive, Durango, CO 81301. [2]School of Integrative Biology, University of Illinois Urbana-Champaign, 286 Morrill Hall, MC-120, 505 S. Goodwin Ave., Urbana, IL 61801. [3]Center for STEM Research, Education, & Outreach, Southern Illinois University Edwardsville, Campus Box 2224, Edwardsville, IL, 62026. [4]Great Rivers Field Station, Illinois Natural History Survey, University of Illinois Urbana–Champaign, Alton, IL, 62002.

The Anthropocene is defined as a period where human actions are the primary driver of environmental processes. Studies that compare archaeological collections prior to the onset of the Anthropocene to modern ones can provide insights into the degree to which humans have impacted the environment. We compared long-term changes in fish communities using three sources of data: zooarchaeological collections, Long Term Resource Monitoring (LTRM) samples, and commercial harvest records. LTRM sampling is designed to represent the entire fish community as accurately as possible, whereas archaeological collections and commercial fishing records represent fishes people consume for food. We hypothesize that archaeological collections will be more similar to modern commercial records than to modern LTRM sampling in the Upper Mississippi River System (UMRS). With the exception of two archaeological time periods, we found significant differences among all groups (ANOSIM $P \leq 0.048$), which is not consistent with our hypothesis. At 75% similarity 14 archaeological collections group with all the commercial harvest records, partially supporting our hypothesis that archaeological collections are more similar to commercial harvest records.

Keywords: Fish harvest, Fish communities, Long term data, Analysis of similarity

LARGEMOUTH BASS POPULATION DYNAMICS IN THE UPPER MISSISSIPPI RIVER

***Grant W. Schmitz**, Kylie B. Sterling, Elaine A. Ewigman, Hae H. Kim, Aaron P. Muehler, and Quinton E. Phelps.
Department of Biology, College of Natural and Applied Sciences, Missouri State University

Largemouth Bass are an important recreational species throughout the United States. In the Mississippi River, Largemouth Bass are found from the delta to the headwaters. Recreationally sought-after fish have been traditionally managed through quantifying dynamic rate functions. Dynamic rate functions (i.e., recruitment, growth, and mortality) are the drivers used to quantify fish populations. Population dynamics are important for guiding management decisions. As such, we sought to quantify Largemouth Bass population dynamics in the Upper Mississippi River. Largemouth Bass were collected by daytime electrofishing according to the United States Army Corps of Engineers Upper Mississippi River Restoration Program's Long Term Resource Monitoring (LTRM) element sampling protocol. Quantifying Largemouth Bass population

dynamics in the Upper Mississippi River will provide further information to sport fishery managers along the Mississippi River.

Keywords: Largemouth bass, population dynamics, age

DAM PASSAGE AND HABITAT OCCUPIED BY BIGMOUTH BUFFALO AND ASIAN CARP

***Bryan D. Sea[1,3]**, Dominique D. Turney[3], Andrea K. Fritts[2], James T. Lamer[3].
[1]University of Illinois Urbana-Champaign. [2]U.S. Geological Survey, Upper Midwest Environmental Sciences Center. [3]Illinois Natural History Survey, Illinois River Biological Station

In the Upper Mississippi River (UMR), native fish passages are believed to have decreased because of dams. Although passage is feasible at most UMR dams, pinch-point dams rarely experience open river conditions may be more of a barrier to native fish passage. The disruption of habitat connectivity blocks native fish access to different habitat types needed in different life-history stages. We acoustically tagged 180 Bigmouth Buffalo and 150 Asian carps in pools 15-19 in the UMR to determine the passage frequency and the habitat occupied by Bigmouth Buffalo and Asian carps. Two Bigmouth Buffalo made a total of three passages in 2020. One fish made a downstream passage at LD 15 and LD16. The second fish made a downstream passage at LD15, then attempted to pass upstream at LD 15 twice through the lock chamber but was unsuccessful. Bigmouth Buffalo mainly used habitats of side channels (40%), backwater habitat (36%), and channel boarder (23%). Asian Carp mainly used habitats of channel boarders (44%) and side channels (35%). We observed a low number of passages which is likely due to the low water levels in 2020. This could be evidence that open-river conditions are vital to Bigmouth Buffalo passage at dams. Bigmouth Buffalo and Asian carps did have habitat overlap as they both occupied side channels and may result in competition where these species inhabit the same areas.

Keywords: Bigmouth Buffalo, Dam passage, invasive species, Asian Carp, Telemetry

CONNECTING DUBUQUE: DEVELOPING SOFTWARE AND ANALYZING LOCAL CLIMATE DATA.

***Samuel K. Z. Taylor** and Dale H. Easley.
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Internationally, the last six years have been the hottest in recorded human history, and according to NASA 2020 was tied for the hottest year on record. Across the United States, climate change has morphed the landscapes that our grandparents lived upon -- winters are no longer common in some areas, the beginning of inland migrations are being seen and fires rage at unprecedented sizes. In the Midwest and Iowa specifically, there has been a large increase in precipitation across the board, which increases the likelihood of large floods. Agriculture is becoming increasingly tougher to practice, potentially leading to a future food shortage within the United States.

Locally, in Dubuque, we are not aware of the circumstances that climate change has created. However, there is a large amount of unused data from the Lock and Dam and Regional Airport that could paint a clear picture of the changing local climate. For this research project, we obtained the available data. We then developed a program that will generate relevant information about Dubuque's climate -- especially change through time. We also processed data for other nearby cities. Finally, we created a website to disseminate the results of the study to the public. Statistically significant findings include the following:

1. October and July are wetter and less predictable.
2. The snowfall in March has decreased over time.
3. The last freeze in the spring is occurring earlier.
4. The first freeze of fall is occurring later.

Not only was this project worth doing for its statistical results, but the conclusions drawn from the data could help Dubuque's citizens. Benefits could be seen from city planning to farming, minimizing losses due to climate disruption. Furthermore, this project creates a bridge between scientists and the public to understand the changing world around them on a personal level, which could inspire many to do something about it.

Keywords: Local, Climate, Software, Statistics, Dubuque

MAPPING HYDROGEOMORPHIC SETTINGS AND CHANGE IN THE UPPER MISSISSIPPI RIVER SYSTEM

Angus A. Vaughan[1], Faith A. Fitzpatrick[2], Jayme Strange[1].
[1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center. [2]U.S. Geological Survey, Upper Midwest Water Science Center

There is a substantial body of scientific research and monitoring in the Upper Mississippi River Basin (UMRB) concerning long and short-term changes in hydrogeomorphic patterns, processes, and rates of change. Hydrogeomorphic conditions within the UMRB reflect watershed and channel-floodplain settings and processes acting across a range of spatial and temporal scales. In 2018-20 a preliminary hydrogeomorphic conceptual model and related classification framework was developed by a team of multi-disciplinary scientists in the Upper Mississippi River Restoration Program. In 2020, a new study was started to further describe and map the linkages between landforms and their sensitivity to change. The base component of the classification is the hydrogeomorphic unit, which is an integration of existing maps of aquatic habitat types and floodplain vegetation. Hydrogeomorphic units were grouped into a continuum of units (called catenae) based on connectivity of hydraulic and sediment dynamics. Also contributing to the mapping of the hydrogeomorphic catenae are information on tributary sediment loads, as estimated by the SPARROW model, and reach-scale gradient, determined by water surface elevations measured at stream gages along the channel. The catenae are part of larger geomorphic "interdam process zones" that reflect a longitudinal gradient in sediment supply and transport capacity. Process zones range from sediment starved and erosion/transport dominated conditions below dams to depositional conditions at deltas within impoundments. The remaining levels in the classification

comprise previously defined geomorphic segments determined by broad-scale valley and floodplain morphology and major slope breaks in the longitudinal profile; "floodplain reaches" defined by anthropogenic factors such as degree of levying and impoundment; and physiographic provinces reflecting large-scale natural landscape features and geologic history, which determine the ultimate topographic and climatological conditions of the basin. The goal of this project is to map areas of the river that are most prone to hydrogeomorphic change along a continuum of erosion to depositional settings and to give context to questions of why, how, and where geomorphic change is happening in the river. This basin-wide framework will provide a context for targeting research and monitoring efforts as well as for informing the design of restoration projects.

Keywords: Geomorphology, Classification, Mapping, Catenae

EXTRACTION OF DNA FROM BIOFILM FOUND ON SUBMERGED WOOD IN DIFFERENT FLOW REGIONS

***Seth Wisowaty** and Bonnie J. Bratina.
University of Wisconsin-La Crosse

Large wood is often added to aquatic systems to improve the habitat for macrofauna, but it can also serve as a surface for colonizing bacteria. Studying how bacterial biofilm communities form on wood surfaces in river ecosystems may be crucial in understanding their role in structural integrity of wooden structures in river systems. This project began by submerging a string of wood slices into the Mississippi River at different locations with differing flow rates. The flow rates were classified for each location as: high (1.1-1.9 m/s), medium (0.6-0.8 m/s), or low (0.0-0.1 m/s). Slices were removed from the river at five different timepoints. Layers of biofilm had formed on the surface of all the log slices. The biofilm layer was removed by scraping the surface with a razor blade in three 2 cm x 2 cm squares, for a total of 12 cm2 for each slice. The amount of biofilm found on the wood slices generally increased over time. On average, 9.0 mg of biofilm/cm2 was recovered from wood slices in low flow regions. Wood slices in the medium and high flow regions had an average of 9.5 and 7.9 mg/cm2, respectively. DNA was then extracted from the biofilm samples and 7.4, 4.6, and 9.3 ng DNA/mg biofilm was found for low, medium, and high flow regions respectively. The DNA was sent off to be sequenced and will be analyzed to look at the development of the biofilm community over time, and to compare the community composition on submerged wood in the different flow regions of the Mississippi River.

Keywords: submerged wood, biofilm, flow rate

LAND COVER USE OF ODONATES IN THE UPPER MISSISSIPPI RIVER VALLEY (UMRV), 2013-2018

***Jar Xiong[1]**, Jaden Kerkhoff[1], Ellen Peterson[1], Scott Hygnstrom[1], Daniel E. Jackson[2], Meta Griffin[3], and Stephen Winter[3].
[1]University of Wisconsin-Stevens Point, [2]Citizen Scientist, [3]United States Fish and Wildlife Service, Upper Mississippi River National Wildlife and Fish Refuge.

The relationship between odonates and their associated land cover use are not well studied, while most research focused on routine movements instead. Annual field surveys encompassing Navigation Pools 6-10 in the Upper Mississippi River Valley (UMRV), 2013-2018, was conducted using convenience sampling by Daniel E. Jackson to explore this relationship. The field surveys were a cooperate work between a citizen scientist and the United States Fish and Wildlife Service (USFWS). A comprehensive database was created to store the data and can be accessed on ServCat at https://ecos.fws.gov/ServCat/Reference/Profile/116720. To observe the relationship, a functional geodatabase was constructed using ArcGIS Pro and the data fields in the comprehensive database. Relationships was determined by mapping out survey locations with 50-meter buffers onto a 2010-2011 land cover base map. This land cover has 3 classes (Class 7, 15, 31) with a maximum of 31 covertypes that each defines a land cover. We observed 19 covertypes with the top three consisting of developed areas (19.38%), open water (17.87%), and floodplain forest (12.56%). Compared to the habitat description field Jackson noted in the comprehensive database, there was a difference in gathering data, thus the difference in land cover classification. Jackson had 145 habitat descriptions with the top three are as followed: grass, low plants, and brush (21.95%), upland sand prairie near Lake Onalaska and backwater (15.26%), and sand prairie near backwaters and main channel (11.86%). Jackson described land cover based on his ocular vision with no classification guide while the covertypes for the geodatabase was completed using Long Term Resource Monitoring (LTRM), derived from the United States Geological Survey (USGS). The deciding factor was largely due to convenience sampling. Odonates and their relationship to their associated land cover use are still under-studied and a more thorough research is needed to determine trends in their relationship.

Keywords: Covertype, Habitat, Navigation Pool, Odonates, Upper Mississippi River Valley

MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC

2021 BUSINESS MEETING AGENDA

April 23, 2021

1. Call to Order

2. President's Report

- Acknowledgments
- 2020 recap
- Approval of the 2019 business meeting minutes
- 2021 missing items:
    - Student poster and oral presentation awards
    - Board of Directors Awards
    - Raffle

3. Treasurer's Report (Quinton Phelps)

4. Old Business

- Bylaw revisions ad hoc committee
- Tax exempt status ad hoc committee
- Expanded student scholarship

5. New Business

- Welcome our new Student Representative: Stephanie Schmidt
- Future meeting dates and change of venue
    - April 20-22, 2022 (Radisson Center, La Crosse, WI)
        - Not a true change of venue, but 2022 will be the first MRRC in the Radisson Center due to cancellation of 2020 and virtual 2021 meeting
- Introduction of executive board nominees for Vice President and Treasurer
- Election of Vice President and Treasurer to the Board of Directors
- Passing of the Presidency
- Other new business

6. Adjournment

MRRC 2021 TREASURER'S REPORT

Submitted by Treasurer Quinton Phelps April 2021

Checking account balance as of 30 June 2016		18078.16
Checking account balance as of 30 June 2017		19051.38
Checking account balance as of 30 June 2018		19539.12
Checking account balance as of 30 June 2019		22425.17
Checking account balance as of 30 June 2020		22173.42
Transactions 1 July 2020 to 21 March 2021		
Income		
	Interest	0.00
Total Income		0.00
Expenses		
	Registration refunds	515.00
	Monthly Maintenance Charges	24.00
Total Expenses		539.00
Checking account balance as of 21 March 2021		21634.42

MISSISSIPPI RIVER RESEARCH CONSORTIUM, INC

2019 BUSINESS MEETING MINUTES

The 2020 MRRC meeting was cancelled due to the COVID-19 global pandemic, which is when these business meeting minutes would normally have been reviewed.

Radisson Hotel, La Crosse, Wisconsin
April 26, 2019

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1. Call to Order at 11:20 on April 26, 2019

2. President's Report by Colin Belby

- Acknowledgments
    - President thanks everyone for attending and the Radisson Hotel for hosting the 2019 conference with a special thanks to the board members, Eric Strauss (website) and Kim Dunnigan (welcome desk and photography) for their assistance. The board also thanks the oral presentation moderators, fundraiser committee, raffle donator for both 2018 and 2019 meeting, student presentation judges, and workshop leader Jim Lamer and student volunteers.
- Approval of the 2018 business meeting minutes
    - Rodger Haro moved to approve and many seconded
- 2019 attendance/participation information
    - 25 oral and 54 poster presentations
    - 18 people attended the workshop
    - 75 professionals, 60 students, and 2 retirees pre-registered with a total of 160 people attending

3. Treasurer's Report by Neal Mundahl

- MRRC balance as of March 1, 2019 was $18,483.12
- John Chick moved to approve and many seconded

4. Old Business

- Website updates with bylaws, articles of incorporation, keynote speakers and Friend of River Award
- Discussion Google group- all emails will be added to the list. This will help increase communication between members, which was a goal highlighted in the 2018 business meeting. Updates for 2020 conference will be sent through this email group.
    - Updates or suggestions for the website can be sent to the board email address, which can be found on the website.
    - Meredith Thomsen would like the Murphy library added to the website Mississippi River Links page
- Two student representatives are now serving on the Board of Directors to assist with passing of the duties

5. New Business

- Future Conference dates and change of venue
    - April 22-24, 2020 at the Radisson Center, La Crosse, WI (not the hotel). The Radisson Center will be used for the 2020 conference instead of the current rooms connected to the Radisson Hotel to avoid being charged the new room use fee. that meeting room to avoid being charged a room fee.
    - April 21-23, 2021 (La Crosse, WI)
- Bylaw revisions ad hoc committee
    - Anyone interested in being on the Bylaw revision ad hoc committee to make examine current bylaws and make revisions from membership comments please contact Steve Winter
- Tax-exempt status ad hoc committee
    - The board is still working to gain tax exempt status for the group again. Anyone interested in being on the tax-exempt ad hoc committee to assist with this effort please contact Colin Belby
- Introduction of executive board nominees for vice president and treasurer
    - Vice President: Nominee Levi Solomon from Illinois, 13 years with LTRM, currently at the Illinois River Biological Station.
        - Steve Winter moved for approval of the nomination and April Burgett seconded
    - Treasurer: No new nominees. Current treasurer, Neal Mundahl, was approved to serve as treasure for another two years
        - Quinten Phelps would like to assist with the treasurer duties for one year and then possibly take over. Since this is not a co-chaired position, Steve Winter suggested creating a finance committee, which Quinten Phelps would serve on. John Chick moved to approve a finance ad hoc committee and Kristen Bouska seconded
- 2019 Conference sold $1500 in raffle tickets and $732 in MRRC shirts (61 shirts)
- Student awards:
    - Hudman Evans, Southern Illinois University, won second place oral presentation
    - Claire Snyder Southern Illinois University, won first place oral presentation
    - Courtney Camp, University of Georgia, won second place poster presentation. Second author, Olivia Mullenax, University of Minnesota, accepted award.
    - Alicia Skolte, Winona State, won first place poster presentation
- Passing of the Presidency to Steve Winter from Colin Belby
- Steve Winter presented outgoing president Colin Belby with a Certificate of appreciation

6. Other new business

- Creation of a new MRRC Scholarship of ~$1500 to support research was suggested by Nate De Jager. President Steve Winter suggested further discussion on this proposal be conducted by the board. April Burgett suggested a new committee could organize this effort and serve as the reviewers of proposals if a research scholarship is supported by the board and members. President Steve Winter would like to create a line-item budget to help manage MRRC's finances, as well as, have more ad hoc committees to help the

organization grow and assist with future changes. The board is obligated to listen to the membership but does not require the membership to vote on all matters, that is the boards duty.

7. Adjournment by consensus at 12:11pm on April 26, 2019

MRRC FRIEND OF THE RIVER AWARD

Friend of the River	Organization	Year	Meeting	Presenter
Calvin R. Fremling	Winona State University	1992	24th	Neal Mundahl
Thomas O. Claflin	University of Wisconsin-La Crosse	1993	25th	Ronald G. Rada
Pamela Thiel	U.S. Fish & Wildlife Service	1997	29th	Terry Dukerschein
Richard V. Anderson	Western Illinois University	1998	30th	Michael A. Romano
Ronald G. Rada	University of Wisconsin-La Crosse	1999	31st	Terry Dukerschein
Marian E. Havlick	Malacological Consultants, La Crosse, Wisconsin	2008	40th	Brian Ickes
Carl Korschgen	USGS, Columbia Environmental Research Center, Columbia, Missouri	2009	41st	Roger Haro and Jim Wiener
Ken Lubinski	USGS, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin	2012	44th	Susan Romano
Neal Mundahl	Winona State University	2016	48th	Susan Romano
Michael Vanderfort	U.S. Fish & Wildlife Service	2018	50th	Pamela Thiel

MRRC PAST MEETINGS AND OFFICERS

Meeting	Year	Location	President
1st	1968*	St. Mary's College, Winona, MN	Brother George Pahl
2nd	1969	Wisconsin State Univ., La Crosse, WI	Dr. Thomas Claflin
3rd	1970	Winona State College, Winona, MN	Dr. Calvin Fremling
4th	1971	St. Cloud State College, St. Cloud, MN	Dr. Joseph Hopwood
5th	1972	Loras College, Dubuque, IA	Dr. Joesph Kapler
6th	1973	Quincy College, Quincy, IL	Rev. John Ostdiek
7th	1974	No Meeting	----------
8th	1975	Monmouth College, Monmouth, IL	Dr. Jacob Verduin
9th	1976	St. Mary's College, Winona, MN	Mr. Rory Vose
10th	1977	Winona State University, Winona, MN	Dr. Dennis Nielsen
11th	1978	Univ. Wisconsin-La Crosse, La Crosse, WI	Dr. Ronald Rada
12th	1979	Cancelled	Dr. Edward Cawley
13th	1980	Loras College, Dubuque, IA	Dr. Edward Cawley
14th	1981	Ramada Inn, La Crosse, WI	Mr. Michael Vanderford
			Board of Directors
15th	1982	Radisson Hotel, La Crosse, WI	Dr. Richard Anderson Dr. Dave McConville Dr. Jim Wiener
-----	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
29th	1997	Holiday Inn, La Crosse, WI	Ms. Therese Dukerschein Mr. Mark Steingraeber Dr. William Richardson Dr. Neal Mundahl
30th	1998	Yacht Club Resorts, La Crosse, WI	Mr. Mark Steingraeber Dr. Melinda Knutson Dr. William Richardson Dr. Neal Mundahl
31st	1999	Yacht Club Resorts, La Crosse, WI	Dr. Melinda Knutson Dr. Richard Anderson Mr. Brent Knights Dr. Neal Mundahl
32nd	2000	Radisson Hotel, La Crosse, WI	Dr. Richard Anderson Dr. Yao Yin Mr. Brent Knights Dr. Neal Mundahl
33rd	2001	Radisson Hotel, La Crosse, WI	Dr. Yao Yin Mr. Brent Knights Dr. Michael Romano Dr. Neal Mundahl
34th	2002	Radisson Hotel, La Crosse, WI	Mr. Brent Knights Mr. Jeff Arnold Dr. Michael Romano Dr. Neal Mundahl

35th	2003	Radisson Hotel, La Crosse, WI	Mr. Jeff Arnold Dr. Michael Romano Mr. Jim Fischer Dr. Neal Mundahl
36th	2004	Radisson Hotel, La Crosse, WI	Dr. Michael Romano Dr. Mark Pegg Mr. Jim Fischer Dr. Neal Mundahl
37th	2005	Radisson Hotel, La Crosse, WI	Dr. Mark Pegg Dr. Michael Delong Mr. Lynn Bartsch Dr. Neal Mundahl
38th	2006	Radisson Hotel, La Crosse, WI	Dr. Michael Delong Dr. John Chick Mr. Lynn Bartsch Dr. Neal Mundahl
39th	2007	Radisson Hotel, La Crosse, WI	Dr. John Chick Mr. Brian Ickes Dr. Robert Miller Dr. Neal Mundahl
40th	2008	Grand River Center, Dubuque, IA	Mr. Brian Ickes Dr. Roger Haro Dr. Robert Miller Dr. Neal Mundahl
41st	2009	Radisson Hotel, La Crosse, WI	Dr. Roger Haro Dr. Greg Sass Dr. Susan Romano Dr. Neal Mundahl
42nd	2010	Radisson Hotel, La Crosse, WI	Dr. Greg Sass Dr. Jeff Houser Dr. Susan Romano Dr. Neal Mundahl
43rd	2011	Radisson Hotel, La Crosse, WI	Dr. Jeff Houser Dr. Susan Romano Dr. Eric Strauss Dr. Neal Mundahl

44th	2012	Radisson Hotel, La Crosse, WI	Dr. Susan Romano Dr. Nathan De Jager Dr. Eric Strauss Dr. Neal Mundahl
45th	2013	Radisson Hotel, La Crosse, WI	Dr. Nathan De Jager Dr. Eric Strauss Ms. Nerissa Michaels Dr. Neal Mundahl
46th	2014	Radisson Hotel, La Crosse, WI	Dr. Eric Strauss Dr. Andrew Casper Ms. April Burgett Dr. Neal Mundahl
47th	2015	Radisson Hotel, La Crosse, WI	Dr. Andrew Casper Ms. Michelle Bartsch Ms. April Burgett Dr. Neal Mundahl
48th	2016	Radisson Hotel, La Crosse, WI	Ms. Michelle Bartsch Dr. Gretchen Gerrish Ms. April Burgett Dr. Neal Mundahl
49th	2017	Radisson Hotel, La Crosse, WI	Dr. Gretchen Gerrish Ms. Patty Ries Ms. April Burgett Dr. Neal Mundahl Mr. Mark Fritts
50th	2018	Radisson Hotel, La Crosse, WI	Ms. Patty Ries Dr. Colin Belby Ms. April Burgett Dr. Neal Mundahl Mr. Mark Fritts Mr. Doug Appel

51st	2019	Radisson Hotel, La Crosse, WI	Dr. Colin Belby Dr. Stephen Winter Ms. April Burgett Ms. Andrya Whitten Dr. Neal Mudahl Mr. Doug Appel Ms. Dominique Turney
-----	2020	Meeting Cancelled due to the COVID-19 Global Pandemic	Dr. Stephen Winter Mr. Levi Solomon Ms. Andrya Whitten Ms. April Burget Dr. Neal Mudahl Ms. Dominique Turney
52nd	2021	Virtual Meeting	Mr. Levi Solomon Ms. Andrya Whitten Ms. April Burgett Ms. Alicia Carhart Dr. Quinton Phelps Ms. Stephanie Schmidt

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. Past Proceedings are available on the MRRC website: <http://m-r-r-c.org/History.html>