2015 UMSRS Oral Abstract Guide (arranged by session number)

Sunday Night Invited Talk: The Changing Face of River Restoration

Speaker: Marty Melchior (Inter-Fluve, Inc.)

The only thing constant is change. River restoration evolved from stabilization, rooted in the arrogant notion that we can control everything for our own production and reproduction. In the words of famous river dammer Floyd Dominy, "I believe we can improve upon nature." Awareness of physical and ecological processes increased in the last century, and eventually we realized that the two are inextricably linked. Well, at least some of us realized that. The burgeoning science of river restoration has progressed beyond the stumbling toddler stage and is now into awkward adolescence, clouded by an uncertain future. This talk looks at the current state of restoration, where the money is being spent, how techniques have evolved over time, and where things are heading. Standards of practice will be discussed, and we'll explore why we do restoration, if it's worth the cost, and the role of river restoration in a changing world.

Invited Talk: The Controversy Over Natural Channel Design (POSTPONED)

Speaker: Rebecca Lave (Indiana University)

Natural Channel Design is the most commonly used approach to stream restoration in the U.S. Despite sometimes intense criticism from academics and research agency staff, Natural Channel Design has been adopted by the majority of American resource agencies at both the state and federal levels, and more than 15,000 people have taken one or more of Dave Rosgen's short courses. Rosgen's knowledge claims, applied tools, and educational system are increasingly seen not just as scientifically legitimate, but as a more legitimate basis for stream restoration practice than academically-produced science and training.

How can we explain this startling reversal of the typical dynamics of scientific authority? Based on social and natural science data gathered over four years of research, I argue that the root causes of Rosgen's success lie not in the man or his method, but in political and economic forces internal and external to the stream restoration field. Simply put, Rosgen met the needs of restoration markets and the state by providing the lingua franca, standards of practice, and educational system for the field when universities failed to do so. Furthermore, broader ongoing changes in science and environmental management have strengthened Rosgen's authority by encouraging the privatization of knowledge production and its commercialization in the service of environmental markets.

Invited Talk: Photography and the Four-dimensional Measurement of Landscapes

Speaker: Mark Fonstad (University of Oregon)

In the first decade-and-a-half of the 21st century, geomorphic photography has undergone a dramatic revolution, made possible by inexpensive digital cameras, the rise of remote sensing training for river science, and the development of advanced and automated analytical techniques. This revolution has produced an explosion of tools and techniques to monitor many aspects of river environments at very low cost and at scales that correspond more directly to real-world stream processes. Such advances include (but are not limited to) spectral analysis of river materials, habitats, and bathymetry, textural and feature-based analysis of particle sizes and distributions, user-friendly photogrammetric mapping of topography, motion-based imaging of river processes in action, and a wealth of temporal change-detection methods. The possibility now exists to extend quantitative riverscape process measurement into the past using historical ground and airborne photography, and to use crowd-sourcing and other distributed approaches to map rivers at high resolution and over large extents. The revolution in riverscape photography suggests three specific needs. First, there is a need for the serious community cataloging, distribution, and analysis of riverscape-related photographs. Second, there is a need for a systematic dialog amongst river practitioners about when, how, and which techniques ought to be used for different projects. Third, the revolution warrants the consideration of photography as a primary tool in river studies, and demands inclusion at all levels of river-related education.

Session 1: Understanding Nutrient Dynamics in Streams

Moderator: Rosalyn Lehman (Iowa Rivers Revival)

Floodplain restoration as a stream management strategy in the agricultural Midwest

Sarah Roley, *Michigan State University***;** Jennifer L. Tank, Ursula H. Mahl, Robert T. Davis, *University of Notre Dame*

Streams across the agricultural Midwest have been channelized and straightened, in order to drain agricultural fields. These streams are typically deep and incised, lacking floodplains, and this geomorphology minimizes their capacity to process and remove excess nutrients. In addition, channelized streams are unstable during high flows, leading to bank collapse and resultant sediment loading. In the two-stage ditch design, floodplains are restored to channelized streams. During rain events, water flows onto the floodplains and slows down, increasing the time and space over which floodplain biota can process and remove excess nutrients. In addition, slower water velocities allow sediments to drop out of suspension and settle out on floodplains. To determine the effect of floodplain restoration on nutrient and sediment retention, we studied six streams in Indiana, Ohio, and Michigan. At all sites, we delineated a restored reach, with two-stage floodplain construction (in 1/2 mile segments), and an upstream control reach that remained channelized, and we quantified the effect of floodplain restoration by comparing measurements between the two reaches. Specifically, we measured nitrate-N removal via microbial denitrification, changes in water column turbidity, and concentrations of soluble reactive phosphorus (SRP), total phosphorus (TP), nitrate (NO_3^-), and ammonium (NH_4^+). We completed all measurements during both base flow conditions and during floodplain inundation events. We found that during high flows, stream reaches with floodplains had 3-24 times higher nitrate-N removal via denitrification than upstream control reaches. Floodplains with more organic matter had higher N removal rates, and soil organic matter generally increased with floodplain age, suggesting that N removal rates will be maintained, or even enhanced, through time. In addition, water column turbidity decreased relative to upstream control reaches, particularly during floodplain inundation events. The effects on water column chemistry were somewhat variable, however. At several sites, SRP and NO_3^- concentrations decreased, but we observed no effect on TP or NH_4^+. Overall, our results suggest that floodplain restoration can improve sediment and nutrient retention in agricultural streams, although ideally, this practice will be extended along more stream miles, or paired with other nutrient-reduction efforts, in order to maximize its effectiveness.

Analyzing and Optimizing Denitrification Hot Spots in Minnesota's Surface Waters

Abigail Tomasek, Jessica Kozarek, Miki Hondzo**,** *St. Anthony Falls Lab, University of Minnesota,* Michael Sadowsky, Jaques Finlay*, University of Minnesota*

Denitrification hot spots, or small areas of enhanced denitrification activity, frequently account for a high percentage of overall denitrification in streams. This research aims to identify and quantify parameters that enhance denitrification and those that can be used to predict denitrification hot spots, such as the influence of carbon type and concentration, flow characteristics, and flooding frequency and duration. This research is of significance in the upper Midwest due to the elevated nitrate concentrations in agricultural regions, which causes degradation of water quality and health concerns, as well as contributing to the large hypoxic “dead zone” in the Gulf of Mexico. Ultimately, this project aims to establish a set of management guidelines for sustainable surface water management to promote denitrification. We will present results from flume, field, and Outdoor StreamLab (OSL) experiments that investigate the effect of drivers including carbon, dissolved oxygen, and moisture content on microbial denitrification processes.

Addressing the Nutrient Driver Paradigm for Dissolved Oxygen in Small, Low Gradient Streams

Jeff Strom, *Wenck Associates*

The common understanding of dissolved oxygen (DO) in streams is that nutrients and resultant algal production drives DO dynamics. According to this paradigm, increased nutrients lead to increased algal growth and decay, resulting in large daily DO swings. This paradigm is further supported by the development of nutrient criteria for the State of Minnesota which include several eutrophication response variables such as DO swing. While this paradigm likely applies well to larger rivers, Wenck's experience in developing DO TMDLs for small, low gradient streams suggests that sediment oxygen demand (SOD), wetlands, and headwater DO are the primary drivers of low DO. Wenck hypothesizes that the residence time for nutrients in low-gradient streams is too low to cause excessive algae growth. While these conditions may not apply to all low gradient streams, they are common enough to suggest that the nutrient driver paradigm is not applicable in all systems. Wenck will present several case studies for low-gradient streams in the Crow River watershed where low DO concentrations were a result of SOD, flow-through wetlands, channel form, and headwater conditions rather than high nutrient concentrations.

Multi-Stage Open County Drain Design

Rob Myllyoja*, Stantec*

Conventional trapezoidal drains are inherently unstable, either due to excessive bank erosion or channel deposition. Effective open channel design can greatly reduce the risk of failure, maintenance needs, and long-term costs. Other benefits include reduced thermal, fine sediment, and nutrient impacts to receiving streams. There are over 50,000 miles of county drains in Michigan's Lower Peninsula. The wider adoption of improved county drainage rules could have tremendous beneficial impacts throughout the Great Lakes. Macomb County, MI requires a two-stage (or multi-stage) open drain as their minimum standard, but channel enhancement or restoration approaches are allowed. Technical guidance is being developed to implement a multi-staged channel approach. The tools include a plan review checklist and preliminary guidelines that will serve as a living document to improve channel sizing, sediment transport, and vegetation management. Sea Grant's integrated assessment approach is being used to facilitate the stakeholder involvement process. The presentation will discuss the preliminary guidance being proposed as well as case studies in open drain design.

Session 2: Building River Complexity

Moderator: Bob Gubernick (USDA Forest Service)

Engineering considerations for large wood in streams

Marty Melchior, *Inter-Fluve, Inc.*

This talk will examine the geomorphic and engineering issues to be considered when placing large wood in streams. This talk will primarily examine the use of large wood in urban and non-urban stream reclamation projects in Midwestern rivers. Concepts covered will include hydrologic and hydraulic engineering considerations such as installation timing and procedures, moment force calculations, species, design countermeasures, anchoring techniques and attendant bank stabilization techniques commonly employed. Project types demonstrated will include engineered log jams, individual wood, mobile wood, floodplain roughness, toe protection and trapping elements. Determination of risk and appropriate engineering and ecological protection due diligence procedures will be discussed.

Oxbow Restoration for Habitat and Water Quality Improvement

Chris Jones, *Iowa Soybean Association;* **Aleshia Kenney***, U.S. Fish and Wildlife Service*

Prior to European settlement and widespread landuse change, the prairie streams of Iowa naturally meandered, creating cut-offs of the outside loops of the main stream. These loops became U-shaped oxbow ponds that were reconnected to the stream during high-flow events. They remained hydraulically-connected to the alluvial aquifer and sustained adequate water even during dry summers. Warmer groundwater also prevented winter freeze-out. These oxbows provided habitat for many species of birds, amphibians, reptiles, and fishes, including the now endangered Topeka shiner (Notropis topeka). Anthropomorphic practices on the landscape have altered stream hydrology and hastened the disconnection of oxbows from the adjacent streams. Once abundant, these oxbows have slowly filled with sediment, disconnecting them from the alluvial aquifer. Fish still find these oxbows during high flow events, only to die in the summer when they dry up or in the winter when they freeze through. Overall, this type of habitat has been greatly degraded or eliminated.

Most of North-Central Iowa (Des Moines Lobe Landform) is artificially drained to enable crop production. Tile drainage contains elevated levels of nitrate-nitrogen and phosphorous, and is a large contributor to local water quality impairment and Gulf of Mexico Hypoxia. Restoration of degraded oxbows provides conservationists with a unique opportunity: habitat creation along with edge-of-field water treatment for field tile effluents. Restoring this component of flood plain hydrology also will enhance natural river function, creating a more resilient system in an era of climate change and increasing river flows.

Here we hypothesize that oxbow restoration will provide important habitat for many species, and improve stream function through flood plain reconnection and improved water quality via sequestration of tile water nutrients directed to the oxbow. Restoration consists of excavating post-settlement alluvial sediment from the oxbow to the surrounding flood plain. This allows the oxbow to reconnect with the alluvial aquifer and hold water year-round. The banks are re-seeded with native perennials. Fish species gain access to restored oxbows during 1-in-2 year high-flow events when flood water reconnects the stream to the flood plain. Field tile water intercepted by the oxbow provides nutrient sequestration. Tile water provides benefits to the habitat through temperature modulation and prevention of dry-out. Results of pre- and post-restoration fish survey (species and abundance) and water quality data will be presented that quantify benefits of these restorations. We will also present strategies for effective implementation and funding for this inexpensive conservation strategy.

The original ecological engineer: What North America's largest rodents can teach us about managing hydrology

Suzanne Hoehne, *Biohabitats, Inc.*

Prevalent across the pre-settled North American continent, beaver once played an important part within the hydrologic cycle, influencing stream ecosystems through physical, chemical and ecological processes. Beaver provide benefits that include alleviating droughts and floods, lessoning erosion, raising the water table and providing habitat for over half of endangered and threatened species in North America. Once the North American fur trade became well established in the late 1600's, the population was subsequently eradicated so that by the late 1800's, the beaver population was absent or severely diminished in much of the US. Along with changes in landuse practices, the loss of the beaver had a huge impact on the North American ecosystem. Beaver population is on the rise; however it still remains at only 5% of the pre-settled level. With a larger beaver population, there is concern about the impact their dams have on the built landscape, including stream restoration projects. Instead of looking at beaver as a problem or threat, the viewpoint should consider all of the ecological, chemical, and physical benefits they can provide to the ecosystem. This presentation will explore methods that beaver use that can be incorporated into stream restoration design within different settings, urban and rural to result in a more ecological viable project. It will also explore the effect an active beaver population has had on a project site during and post construction and what design modifications were made during construction to work with the beaver.

Session 3: Interdisciplinary Partnerships in Stream Restoration

Moderator: John Thomas (Hungry Canyons Alliance)

Fishers & Farmers Partnership: Using Social and Scientific Tools to Enhance Conservation Across the Upper Mississippi River Basin

Heidi Keuler, *U.S. Fish and Wildlife Service/Fishers & Farmers Partnership*

The Fishers & Farmers Partnership for the Upper Mississippi River Basin (FFP) is a self-directed group of interested, non-governmental agricultural and conservation organizations, tribal organizations and state and federal agencies working to achieve the Partnership's mission "to support locally-led projects that add value to farms while restoring aquatic habitat and native fish populations." Fishers & Farmers Partnership is organized and recognized under the National Fish Habitat Partnership (NFHP) and brings science and technical expertise to locally-directed projects throughout the Upper Mississippi River Basin including Illinois, Iowa, Minnesota, Missouri, and Wisconsin. Fishers & Farmers Partnership fosters collaborative conservation projects between farming landowners and natural resource managers that use innovative strategies for land use and stream restoration practices designed to benefit farms and aquatic habitats. Many of the early successes of the Partnership have been realized in the Meramec River Basin in Missouri, southwest of St. Louis. Landowner committees govern and guide watershed efforts. Local farmers and ranchers and agency staff work together to install best management practices to protect water quality, restore riparian forests, and enhance aquatic habitats. Conservation projects are succeeding beyond what has been experienced in the past, and landowner commentaries clearly express the value of efforts that bring them and agency personnel together as equal partners to reach a goal of healthy fish, healthy streams, and healthy farms.

Downstream Strategies, a GIS-based consulting firm, was contracted to conduct a habitat condition assessment for the Fishers & Farmers Partnership for the Upper Mississippi River Basin and for five other Midwestern National Fish Habitat Partnerships. The assessments will help Fishers & Farmers understand how natural landscape characteristics and anthropogenic stressors relate to fish species richness and presence in streams and rivers across the Upper Mississippi River Basin. Predictions for fish species presence were made at the HUC 8 or 1:100k stream catchment scale. Model assessments prioritized areas for protection where stress was low and natural habitat quality was high, and then prioritized areas for restoration where both stress and natural habitat quality were high. These assessments will be used by the Fishers & Farmers Partnership to help prioritize partnership projects to protect or restore aquatic habitat in agricultural areas across the Upper Mississippi River Basin.

EPA's NNPM Project finds a 24 percent nitrate reduction and more diverse fishery population in a restored prairie slough

Donald Rosebloom, *Illinois U.S. Geological Survey*

The prairie stream/slough restoration is located at the Grove housing development near Bloomington, Illinois. The City of Bloomington desired alteration of the agricultural ditches to a more natural state by incorporating green infrastructure - specifically floodplain reconnection, riparian wetlands, meanders, and rock riffles within a 90 acre floodwater detention basin. Restoration criteria require the mitigation of development runoff and the agricultural runoff from 9,000 acres of farmland.

A team of State and Federal agencies collected environmental data to determine the effectiveness of stream restoration to improve water quality and stream fisheries under the precipitation extremes of flood and drought over the last 7 years.

The placement of fixed nitrate probes at three U.S. Geological Survey (USGS) stream gaging stations and a portable nitrate probe allowed the determination of agricultural watershed processes that create the largest nitrate loading during major floods. Water quality improvements from nutrient reduction during normal stream flows are demonstrated by a 24 percent reduction in nitrate concentration and nitrate load in 2013. Stream fisheries also increased by ~30 percent per year through the extreme Midwest drought of 2012 and record flooding of 2013.

The Grove watershed lies in the Illinois River Basin which underwent record flooding in the last two weeks of April, 2013. This record flooding is typical of the agricultural floods which creates hypoxia in the Gulf of Mexico near New Orleans. The peak nitrate loading of that Illinois River flood occurred with the peak flood flow, which had a nitrate concentration of @6 mg/l.

Grove stream design criteria allowed large flood peak flows and sediment to overflow into wetlands during the rising limb but the smaller channel forming flood discharges passes much of the sediment load downstream. This approach maintains water detention capacity, nutrient uptake capacity in base flows, and increased stream fishery populations in the Grove Park.

Challenging the Way We Consider Iowa Rivers

Mimi Wagner, *Iowa State University*

River corridors in Iowa are understood as critical habitat linkages that also provide drainage, recreation and cultural functions. And sandwiched within and among these functions are geologic, historic and cultural signatures that shape each corridor's unique identity. Resource disciplines agree that interrelationships among resource types is important yet rarely do assessments of a rivers condition and function integrate data from multiple disciplines, particularly in a way that allows comparative study and discussion. This research begins to fill that gap by constructing an identity for twelve rivers in Iowa and utilizes results to prioritize future investments in restoration and conservation as they relate to public use.

This research examines public use, fisheries, mussels, terrestrial wildlife, geology, river and landcover change over time, flooding patterns, riparian buffers, channel condition, water quality, and archaeological data at the HUC 10 scale. These quantitative resource data are synthesized and overlain with NGO and state agency conservation priorities and stated public concerns and values for each river. Results are compared with several models predicting resource quality and potential, including economic impact.

This research include portions of the Big Sioux, Little Sioux, West Nishnabotna, South Skunk, Maquoketa, West Fork of the Des Moines, Lower Des Moines, Iowa, Upper Iowa and Cedar rivers and Black Hawk Creek. Agencies and organizations collaborating on this research include Iowa DNR, Iowa State University, Office of State Archaeologist, Iowa Natural Heritage Foundation and The Nature Conservancy.

Results will be used to predict appropriateness for conservation, restoration and public recreation in today's climate as well as identify the nature of local commitment for these goals. Expected outcomes include a model for directing resources and priorities to these rivers in ways that complement each rivers identity and potential. Lessons learned in this research include the challenges overcome in working across broad disciplinary boundaries and with unexpected public reactions.

<u>Invited Talk: River Restoration Writ Large - Science Underlying the Missouri River Recovery Program</u>

Speaker: Robb Jacobson (***USGS Columbia Environmental Research Center)***

More than $700 million has been spent over the last 10 years on recovery of the Missouri River, the nation's longest river, draining an area equivalent to 1/6 of the United States. Recovery activities have been driver by concerns for threatened and endangered species, so restoration objectives are highly focused on specific habitat needs. Because the Missouri River is highly valued and manged for multiple purposes (power generation, flood control, water supply, navigation, recreation), restoration objectives are more in line with the idea of a designed, optimized ecosystem rather than return to natural reference condition. This presentation will provide an overview of this extensive recovery effort with an emphasis on trasferability of scientific knowledge and restoration approaches.

Session 4: Restoring Ecological Function in Streams

Moderator: Amy Anderson (Barr Engineering)

Selection of plants for restoration along waterways in changing climate conditions

John Chapman, *Minnesota Erosion Control Association, University of Minnesota*

A better understanding of species competitive interactions under changing water regimes and potentially changing future climates is needed for restoration plant selection along fluvial environments. To represent aquatic plant communities we grew species used in restoration projects in Minnesota and Wisconsin in outdoor basins and manipulated water levels to determine the effect on above ground biomass. The proximity to water or inundation depth and frequency did affect biomass production of some species in the competing environment. Bolboschoenus fluviatilis, Schoenoplectus tabernaemontani, Carex comosa, Carex lacustris, Sparganium eurycarpum, Spartina pectinata, Carex vulpinoidea, and Juncus effuses were included in this study, but only the first five of the species listed showed statistical biomass differences related to inundation and placement. Sparganium eurycarpum and Bolboschoenus fluviatilis tended to dominate the total biomass in all water manipulations and have a potential risk of developing into monocultures but at the same time appear to provide good establishment under a variety of conditions. Carex vulpinoidea and Carex lacustris tended to have the least total biomass production in this study. This study and the data collected allows for better design of plant community composition and better vegetative erosion control under a variety of water conditions.

Response of Stream Ecosystem Structure and Function to Restorations in Urban Watersheds

Peter Levi, Peter B. McIntyre*, Center of Limonology*, *University of Wisconsin-Madison*

Stream ecosystems in urban landscapes are often severely degraded due to channelization, flashy discharge, and high inputs of nutrients from the surrounding watershed. Restorations seek to improve the integrity of these ecosystems, often via channel re-naturalization. For example, floods in urban areas may be mitigated or prevented by replacing concrete-lined channels with more natural channel geomorphology (e.g., sediment, meander bends). We evaluated several metrics of ecosystem structure and function of restored stream reaches relative to concrete-lined channels located immediately up or downstream of the restoration in six watersheds in Milwaukee, WI. Functional metrics, such as whole-stream metabolism and nutrient cycling dynamics, may be especially useful indicators to assess the ecological health of restored stream reaches because these metrics integrate both in-stream and watershed characteristics. Furthermore, we studied streams that spanned a range in size, from small headwater streams to mainstem rivers (baseflow discharge = 20–150 L/s), in order to evaluate whether stream size was related to changes in ecosystem structure or function from channel re-naturalization. Nutrient concentrations were generally high among our study streams (e.g., average nitrate = 552 µg/L, average ammonium = 51 µg/L) and did not differ between the restored and concrete reaches. In contrast, chlorophyll-a and organic matter content were generally higher in the concrete reaches, while transient storage metrics were generally higher in the restored reaches. Whole-stream metabolism, an estimate of the gross primary production (GPP) and ecosystem respiration (ER) within the stream reach, demonstrated that the streams were primarily autotrophic (i.e., GPP > ER), suggesting that both the restored reaches and concrete channels are impaired biologically. Our research suggests that channel restorations do improve some ecosystem characteristics relative to up or downstream concrete channels, but ecosystem structure and function cannot be fully restored in urban streams by re-naturalizing short reaches alone.

Sediment transport, geomorphic and hydrologic analyses for urban channel improvement

Ben Lee, *Inter-Fluve, Inc.;* Stephen McCracken*, DuPage River Salt Creek Workgroup*

Restoration of urban channels to pre-settlement conditions is often unfeasible or unsustainable. Many factors driving channel form and process differ drastically from pre-disturbance conditions including sediment supply, hydrologic regime, and infrastructure that confines floodplains and limits channel dynamics. In many systems, human manipulations in channels and riparian areas further alter form and process.

Improvement of urban channels should focus on speeding up channel evolution to a new sustainable, ecologically functional condition rather than returning to a pre-settlement condition. To demonstrate the design process for an urban channel, we will highlight the analyses completed for Salt Creek at the Oak Meadows Golf Course in Addison, IL. Most of the Salt Creek watershed has been developed and the stream has a long history of human alterations. Enhancement of the channel was desired to improve biological integrity because the stream is listed as impaired as part of a federal Clean Water Act regulatory program.

Design for the low gradient, sand-bed Salt Creek was based on a combination of geomorphic-based reconnaissance information, sediment transport modeling, hydrologic metrics, and habitat needs associated with target fish species. The integration of this information constrained the potential channel geometry that would remain sustainable under current watershed conditions.

Stream Restoration and the use of Nationwide Permit 27 (NWP 27)

Al Frohlich, *US Army Corps of Engineers*

NWP 27 authorizes projects in Waters of the U.S. that are associated with restoration, enhancement and the establishment of wetlands and streams provided those activities result in a net increase in aquatic functions and services. Applicants often have a diffucult time showing the difference between restoration of these functions and services and stabilizing a degrading stream (bank stabilization), thus causing delay and questions about the project purpose. This presentation will focus on what should and could be authorized under NWP 27 and what can’t. I will draw upon past projects and discuss how they were permitted and whether the permit was used appropriately.

Session 5: Stream Pollutant Management

Moderator: Michelle Larson (US Army Corps of Engineers)

Watershed Pollutant Load Monitoring Network: Data for Tracking and Determining Pollutant Sources, and Source Contributions

Pat Baskfield, *Minnesota Pollution Control Agency*

The Clean Water Land and Legacy Amendment is providing an unprecedented opportunity for enhancing monitoring of Minnesota waters and our understanding of the relative contributions of pollutants from various sources and waters. One example is the Minnesota Pollution Control Agency's (MPCA) Watershed Pollutant Load Monitoring Network (WPLMN), a long-term statewide river monitoring network designed to obtain pollutant load information from more than 200 river monitoring sites. The program utilizes state and federal agencies, universities, local partners, and MPCA staff to collect water quality and flow data to calculate nitrogen, phosphorus, and sediment pollutant loads. Monitoring sites span three ranges of scale: basin, major watershed, and subwatershed with intensive water quality sampling occurring at all sites. In this presentation, several years of total suspended solids loading data are used from WPLMN sites within the Upper Mississippi River Basin above Lock and Dam #3 are used to highlight the benefits and strengths of this multi-scaled monitoring approach in sediment source tracking, determining source contributions, and understanding annual, seasonal, and runoff event specific pollutant delivery dynamics.

Concentrations in Sedimentation: Effects of Mining within Streams of the Dubuque Area

Kyle Leytem, Dale Easley, *University of Dubuque*

During the 18th century the human development of mineral mining operations along the Mississippi River and the aftereffects of abandoned lead mines allowed for dangerous metals to leach into aquatic systems. A statistical analysis of data collected by the United States Geological Survey was conducted to compare heavy metal concentrations in pools 11 and 12, upstream and downstream of dam 11 in Dubuque, Iowa. After analyzing the results, we found a significant difference in lead concentrations between the two pools. Catfish Creek is a major tributary into pool 12 of the Mississippi River and drain areas with many known mine locations. Our hypothesis states that there will be increased amounts of lead throughout and at the mouth of Catfish Creek, and there will be little to no trace of lead in Catfish Creek sediments upstream where it crosses the Silurian-age rocks. A measured amount of the dried sediment sample was prepared with the acid digestion procedure recommended by the United States Geological Survey's Method 3050B. Concentrations were then determined through an ICP analysis preformed at the University of Wisconsin Madison's limnology laboratory. Data analysis indicates that there are significant concentrations of lead throughout the entire sampled area. We have also found high concentrations of lead near the known lead mines throughout the middle and south fork the Catfish Creek. Lower concentrations were found upstream near Silurian outcrops, near the Dubuque Regional Airport.

Riparian Corridor Protection as a Watershed Restoration Tool in the Missouri Ozarks

Joe Pitts *James River Basin Partnership*

Riparian land easements are an important component of long-term watershed restoration in the James River Basin (3,780 km2) of southwest Missouri. It is a mixed-use watershed in the Ozark Highlands with Springfield, the third largest city in the state located in the middle of the basin. The purpose of this presentation is to report on the successes and problems encountered with initiating a riparian easement program for the James River to reduce long-term nonpoint sources loads of nutrients and sediment. With four years of experience into the project, we will describe the planning, implementation, and non-point load reduction assessment involved.

In 2009 the James River Basin Partnership (JRBP) was awarded a Section 319 Clean Water Act grant through the Missouri Department of Natural Resources (MDNR) to implement a program of riparian restoration and protection using perpetual conservation easements along riparian corridors that leave a minimum of 100 feet of undisturbed forest and grassland to provide maximum sediment and nutrient removal at minimum cost. The grant was the first of its kind for the state. A partnership was created between the JRBP and Ozark Greenways Land Trust (OG) to handle private and public landowner involvement and to hold deeds.

The Ozarks Environmental and Water Resources Institute at Missouri State University completed nonpoint load reduction analysis to evaluate the effectiveness of riparian management sites on the reduction of nutrients form runoff and sediment inputs from bank erosion. Initially, a field-based geomorphic assessments and nonpoint source inventories were used to obtain channel and bank stability data and identify nonpoint problem areas. Runoff contributions to nonpoint loads were evaluated using STEP-L modeling under different land use scenarios. Bank erosion sediment inputs were quantified using long-term rates from historical aerial photographs and short-term rates using erosion pins. Significant reductions in nutrient supply to the James River were attributed to restricted development, low impact agriculture, and vegetative bank stabilization.

The value of the donated easements provided the 40% match requirement for the 319 nonpoint source funding and enabled JRBP and OG to undertake remediation activities. After more than four years of implementation we have established easements on nearly 20 miles of the James River and its tributaries, planted thousands of trees, and constructed over two miles of cattle exclusion fencing. In addition, willow stake plantings have been installed on two sites to prevent future erosion of the stream bank.

Session 6: Fish in Midwest Rivers

Moderator: Dale Higgins (USDA Forest Service)

A Scientific Basis for Restoring Fish Spawning Habitat in the St. Clair and Detroit Rivers of the Laurentian Great Lakes

David Bennion, Bruce A. Manny, Edward F. Roseman, Gregory Kennedy, *U.S. Geological Survey, Great Lakes Science Center*

Loss of functional habitat in riverine systems is a global fisheries issue. Few studies, however, describe the decision-making approach taken to abate loss of fish spawning habitat. Numerous habitat restoration efforts are underway and documentation of successful restoration techniques for spawning habitat of desirable fish species in large rivers connecting the Laurentian Great Lakes are reported here. In 2003, to compensate for loss of fish spawning habitat in the St. Clair and Detroit Rivers that connect the Great Lakes Huron and Erie, an international partnership of state, federal, and academic scientists began restoring fish spawning habitat in both of these rivers. Using an adaptive management approach, we have completed five reef construction projects in the system, with another underway, and potentially two more projects to be completed in the near future. Here, we describe the adaptive-feedback management approach that we used to guide our decision making during all phases of spawning habitat restoration, including problem identification, team building, hypothesis development, strategy development, prioritization of physical and biological imperatives, project implementation, habitat construction, monitoring of fish use of the constructed spawning habitats, and communication of research results. Numerous scientific and economic lessons learned from 10 years of planning, building, and assessing fish use of these fish spawning habitat restoration projects are summarized.

Effects of the Vernon Springs Dam modification on fishes in the Turkey River, Iowa

Gregory Gelwicks, *Iowa Department of Natural Resources*

Fish movement studies in Iowa have identified critical habitats for some fish species and revealed the importance of seasonal movements of fishes between critical habitats. Results of these studies suggest that the removal or modification of barriers to fish movement in Iowa rivers and streams has the potential to improve fish populations. The recent modification of a low-head dam on the Turkey River near Cresco, Iowa provided the opportunity to quantify the effects of dam modification on the river's fish community. The project involved conversion of the Vernon Springs dam to a series of rock arch rapids to improve safety and allow fish passage. The goals of our study were to document fish movement over the structure and quantify changes in the river's fish community upstream of the dam. Pre-construction fish community samples were conducted at two sites downstream of the dam and three sites upstream of the dam during 2008-2010. Over 4,400 fishes were marked below the dam to monitor fish movement over the new structure. Construction of the rock arch rapids was completed in August 2010. Post-construction fish community sampling was conducted at all sites during 2011-2014. Fish community sampling was also conducted during 2010-2014 at three sites on the Volga River, a tributary of the Turkey River, that serve as control sites for the three upstream sites on the Turkey River. There were no barriers to fish movement between control sites and the Mississippi River, and control sites had drainage areas similar to sites above Vernon Springs Dam. Marked fish collected during post-construction sampling above the dam included 15 Black Redhorse, 11 Golden Redhorse, three Walleye, and one Northern Hog Sucker that moved upstream over the structure. Preliminary results suggest improvements in Black Redhorse and Smallmouth Bass populations, particularly at the two most upstream sites on the Turkey River. Both species were sampled post-construction at these sites where they were not detected pre-construction.

Experiments on Culvert Design for Fish and Aquatic Organism Passage in Minnesota

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Culverts can act as barriers to fish passage for a number of reasons including insufficient water depth, excess velocity, excess turbulence or insufficient roughness. In addition, fish and other aquatic organisms may encounter a behavioral barrier due to different conditions within the culvert. This presentation will cover a series of experiments conducted in the field and at St. Anthony Falls Laboratory (SAFL) to examine the physical performance of fish passage culvert design as well as the behavior of warm water species when approaching a dark culvert. While significant research efforts have been made to understand individual fish swimming abilities, our projects examine other aspects of fish and aquatic organism passage through culverts: a) culvert performance in terms of sediment transport into and through embedded culverts (a key component to predict habitat conditions within the culvert), b) potential behavioral barriers (light), and c) novel methods to add roughness along the boundaries of concrete box culverts. These experiments provide guidance to culvert designers on a) the need for sediment placement within embedded culverts to maintain natural stream bed roughness, b) the need for light mitigation strategies in long, dark culverts, and c) the ability to utilize inexpensive methods to retrofit culverts with additional boundary roughness. These experiments focus on Minnesota culvert design for aquatic organism passage, but lessons learned are applicable to other locations with similar geomorphic characteristics and fish communities.