Aquatic Organism Passage and Habitat Connectivity

Symposium Proceedings

68th Annual Midwest
Fish & Wildlife Conference
Madison, Wisconsin
December 9th-12th, 2007

Contents

Letter from the Coordinators

Thanks to everyone who participated in the Aquatic Organism Passage and Habitat Connectivity Symposium at the 68th Midwest Fish and Wildlife Conference December 9th-12th, 2007 in Madison, Wisconsin. Aquatic habitats in the Midwest are fragmented by thousands of dams, culverts, dikes, water diversions, and other barriers. Many of these barriers have a negative impact on fish and other aquatic organisms, such as crayfish, freshwater mussels, and insects. As highlighted within these proceedings, many exciting barrier removal and aquatic organism passage activities are occuring across the Midwest.

This symposium offered an opportunity to share ideas about aquatic organism passage in the Midwest and to explore needs in addressing the impacts of barriers. We have included the abstracts, presentations, highlights of our roundtable discussion, and participant contact information for your reference within this proceedings document. This document is intended to reflect the accomplishments, creative ideas, lessons learned, and challenges shared in Madison. Our presentations and discussions touched on the use of new techniques to assess the impacts of stream barriers and their removal, design guidelines and standards for various system types, the influence of lessons learned on policy, opportunities to work together more effectively, and future needs. It was an insightful and informative symposium.

Each day, within our own circles, we have an opportunity to influence fish and wildlife management and to “be the change” as suggested in the conference theme. We encourage you to use and share the ideas from this symposium and we hope that they will feed an ongoing discussion of how we can work together to improve aquatic organism passage in the Midwest. The work that we do to restore habitat connectivity in our own corners of the region will have an important impact on aquatic organism passage at the regional level. We invite you to contact us or any of the symposium participants if you have questions or comments.

Sincerely,

Tim Patronski and Mark Fedora
Symposium Coordinators

Date: Tuesday, 11 December, 1:20 - 5:00 PM
Room: Monona Terrace, Lecture Hall
Moderators: Tim Patronski and Mark Fedora

1:20 PM	**<u>U.S. Fish and Wildlife Service's Midwest Fish Passage Program- Current Projects and Future Directions</u> -Tim Patronski** There are approximately 15,300 dams over 6 feet high and hundreds of thousands of other smaller barriers to fish passage, such as culverts and road crossings in the U.S. Fish and Wildlife Service's eight state Midwest Region. Many of these barriers have a negative impact on fish and other aquatic organisms, such as crayfish, freshwater mussels, and insects. Removing these barriers will enhance biodiversity and help restore healthy populations of aquatic species. Since 1999, the Service's Midwest Fish Passage Program has removed 87 barriers and has reconnected 660 stream miles, while projects currently in progress will remove 23 barriers and reconnect an additional 394 stream miles. Partnerships with states, tribes, local municipalities, NGOs, other federal agencies, and watershed groups have been a key ingredient to the program's success. As the program grows and our partnerships strengthen, we will further focus our efforts in priority watersheds and work with our partners to evaluate the biological outcomes of our barrier removal activities. Tim Patronski U.S. Fish and Wildlife Service Bishop Henry Whipple Federal Building 1 Federal Drive Fort Snelling, Minnesota 55111 tim_patronski@fws.gov 612-713-5168
1:40 PM	**<u>The Growing Crisis of Aging Dams: Policy Considerations and Recommendations for Michigan Policy Makers</u> - Mark A. Coscarelli** In Michigan, a majority (93 percent) of the approximately 2,500 dams in the state were constructed more than 25 years ago. Since the average life expectancy of dams is 50 years, this suggests that over the next 25 years many of these dams will need to be removed or repaired due to their age. Some of these dams have already been abandoned by their owners, and others and may be abandoned if the costs for repair or removal are prohibitive. The lack of dedicated funds for dam removal and repair portends an increasing problem as dams across Michigan age and the need to make reinvestment decisions becomes more acute. In Michigan, there are nearly 120 identified dams in need of an estimated $50 million to address repair and/or removal issues. Resource managers estimate that the numbers are likely much higher, but that they lack the detailed information necessary to develop a total cost estimate. Without dedicated state funds to assist municipalities and other dam owners whose dams are approaching the end of their lifespan, little progress will be made to avert this growing problem. Some states (including Maine, Massachusetts, New Jersey, Ohio, Utah, and Wisconsin) provide dedicated funding in the form of a grant or loan to repair or remove unsafe dams or dams otherwise in need of rehabilitation. A number of states (California, Connecticut, Maine, New Hampshire, North Carolina, Ohio, Pennsylvania, and Wisconsin) have applied dedicated state funds or coordinate the use of federal funds to dam removal projects as part of watershed plans, habitat improvement, river restoration, and fishery enhancement. These funds often originate through special legislation for a dedicated funding source for natural resource protection and restoration and to address the public health, safety and welfare issues. Mark Coscarelli Public Sector Consultants Inc. 600 W. St. Joseph Street, Suite 10 Lansing, Michigan 48933-2265 mcoscarelli@pscinc.com 517-484-4954

2:00 PM	**<u>Evaluation of Recently Installed Road/Stream Crossings, Forest and Florence Counties, Wisconsin</u> - Mark Fedora** We measured physical characteristics of recently installed road/stream crossings to examine the effects of the structures on the stream channels. To quantify the extent that the structure impacted the waterway, the characteristics of the natural stream channel were compared to the dimensions of the structure, as well as the waterway immediately upstream and downstream of the crossing. For sites that had more obvious problems (large scour pools at the outlet, vertical drop at the outlet, very fast or shallow water depth through the structure) we surveyed the structure gradient and channel profile to model the site using FishXing software. FishXing was used to estimate what sites might be barriers to aquatic organism movements. All installations had been permitted by the Wisconsin Department of Natural Resources between 2000 and 2006. Although the DNR is responsible for protecting public rights to water quality and quantity, recreational activities, and scenic beauty in the navigable waters of Wisconsin, there has currently not been any evaluation to determine the extent that road crossings fragment aquatic habitat. This project helps to quantify the extent of the problem and will provide the science to develop specific guidance and recommendations for the installation of road/stream crossings. Mark Fedora USDA Forest Service Ottawa National Forest E6249 US Highway 2 Ironwood, Michigan 49938 mfedora@fs.fed.us 906-932-1330
2:20 PM	**<u>Evaluation of brook trout genetic markers as tools for prioritizing stream crossing improvement projects</u> - Anne L. Timm** Self-sustaining brook trout (*Salvelinus fontinalis*) populations exist in only 5% of subwatersheds within their range in the eastern United States (Hudy *et al*. 2006). Brook trout populations that are isolated by barriers to movement are especially at risk genetically due to a loss of gene flow with other native populations if barriers remain or hybridization with non-native hatchery stocked trout if barriers are removed. The objectives of my research are to identify influences of stream crossings that are barriers to movement on brook trout population genetic diversity and to apply genetic marker techniques to identify at risk populations. I will also investigate genetic diversity patterns of brook trout associated with natural barriers. I will establish study sites within subwatersheds of the Blue Ridge and Northern Lakes and Forests Level III Ecoregions (USEPA 2000; Bailey 2003). Within each of nine subwatersheds, I will select one stream site each of no stream crossing barrier present, stream crossing barrier present, and no stream crossing structure present, for a total of three sites per subwatershed. I will also sample natural barrier sites that are available throughout each ecoregion. I will collect fin clip samples from 15 to 50 juvenile and adult brook trout above and below each stream crossing site and natural barrier (Kriegler *et al*. 1995; Rogers and Curry 2004; Yamamoto *et al*. 2004) and preserve them in 95% ethanol. In the laboratory, I will extract DNA and amplify microsatellite fragments using polymerase chain reaction (PCR) technology. Statistical analysis will compare the difference in genetic differentiation (FST), heterozygosity (HS), and number of allele (A) values above and below each barrier and non-barrier site. Genetic diversity comparison values above and below barriers can potentially be used to validate the presence of a barrier to fish movement and to prioritize stream crossing barrier improvement projects. Anne Timm USDA Forest Service, Northern Research Station Virginia Tech, Department of Fisheries and Wildlife Sciences Cheatham Hall Blacksburg, Virginia 24061-0321 altimm@vt.edu 540-808-8252

2:40 PM	**<u>Fragmentation in Menominee River Lake Sturgeon</u> - Ryan P. Franckowiak*, Brian L. Sloss, and Todd Kittel** **Presenter* Two remnant lake sturgeon (*Acipenser fulvescens*) populations occur in the Menominee River below the White Rapids Dam and the Grand Rapids Dam. These are naturally reproducing populations with a small estimated spawning population size (~200 spawning fish/year). The two populations are separated by dams with no lock systems, allowing downstream movement of fish (over the dam) but no upstream fish passage. Concerns exist over the fragmentation and small size of these populations. Our objectives were to assess potential genetic impacts of fragmentation on the Menominee River lake sturgeon populations, to determine potential impacts of small population size and fragmentation on the population's viability and sustainability, and to estimate the contemporary population size and compare the size structure of the White Rapids and Grand Rapids lake sturgeon populations. A total of 1,225 age 1+ and 235 larval sturgeon were sampled during the 2005-06 spawning seasons. Fish were individually pit-tagged, measured for length and weight, and a fin-clip taken for genetic analysis. Samples were genotyped at 10 standardized microsatellite loci. Tests of genic differentiation between the adult population samples showed no significant heterogeneity. Estimates and simulations of pairwise relatedness among the larval fish and estimates of the inbreeding coefficient for each population segment showed no sign of inbreeding. Estimates of the effective number of breeders ranged from 57.9-61.4. Size structure comparisons between the two populations showed similar bimodal patterns with no differences between the two segments. We conclude that the current status of lake sturgeon in the Menominee River does not require fish passage based on immediate concerns. Nevertheless, a plan to increase connectivity of the two populations would alleviate the potential long-term impacts of fragmentation on the sustainability of Menominee River lake sturgeon. Ryan Franckowiak Wisconsin Cooperative Fishery Research Unit College of Natural Resources University of Wisconsin-Stevens Point 800 Reserve Street Stevens Point, Wisconsin 54481 rfrancko@uwsp.edu 715-346-3873
3:00 PM	Break
3:20 PM	**<u>History of Fish Passage Issues and Solutions in Western Iowa Tributary Streams</u> - Chris J. Larson** Nearly 500 riprap grade control structures (GCS) have been placed in streams of western Iowa, USA to reduce erosion and protect bridge infrastructure and farmland. The majority of these structures consists of a 1.2 m high metal dam, a downstream apron of rock riprap (4:1 slope) and is located directly downstream from bridges, forming large backwater pools that promote sediment deposition and bank stability around bridge infrastructure. Fish population sampling efforts in southwest Iowa tributary streams following 12 years of GCS construction in streams to control erosion indicate a lack of species diversity and reduced gamefish populations. In 2000, Iowa Department of Natural Resources fisheries personnel, in conjunction with Iowa State University Department of Natural Resource Ecology and Management, Fish & Wildlife Service, and Hungry Canyons Alliance implemented studies on the effects of modified and unmodified GCS on fish population dynamics and movement in two streams located in southwest Iowa. Unmodified GCS slopes of 4:1 and modified slopes of 15:1 in Turkey Creek and 20:1 in Walnut Creek were monitored for fish passage over a six year period. Hoop nets and electrofishing gear were utilized to conduct mark and recapture studies of targeted fish species within the study area. Results indicated some bi-directional movement of selected species over modified GCS with very limited movement over unmodified GCS in both streams. Following modification of three GCS in Turkey Creek, fish IBI scores increased at seven of nine sites sampled during pre- and post-modification electrofishing surveys (mean increase = 4.6 points; $P = 0.031$). As a result of these studies, design and construction of new and reconstructed GCS require no less than a 15:1 downstream slope as well as other components that improve fish passage and GCS stability. Chris Larson Iowa Department of Natural Resources 57744 Lewis Road Lewis, Iowa 51544 chris.larson@dnr.state.ia.us 712-769-2587

3:40 PM	**<u>Evaluation of full dam ramp and bypass channel fish passage structures on a high quality tributary stream in Northeastern Illinois</u> - Stephen M. Pescitelli* and Robert C. Rung** **Presenter* Big Rock Creek is a relatively large, high quality tributary to the Fox River, located in Northeastern Illinois. In 2005, fish passage structures were installed at two mainstem dams using funds from USFWS National Fish Passage Program. Two different structures were installed, a full width ramp, and a bypass channel located 3.4 and 4.9 miles, respectively, upstream from the Fox River. Both structures were constructed using a 20:1 slope. In the spring of 2006, a total of 537 fish were captured downstream of the structures and marked using site-specific fins markings. Most of the marked fish were Catastomids migrating upstream on spring spawning runs. Only two recaptures of marked fish were made during subsequent sampling throughout the target area, possibly indicating the presence of a large spawning population. However, un-marked spawning groups of shorthead redhorse and other river species were found upstream of the full width ramp. Fish have also been routinely collected throughout the entire length of this structure which sustained ice and high water damage during the winter of 2007. In 2006 and 2007, a trap net was set at the upstream end of the bypass channel to capture upstream migrants during spring and early summer. A total of 16 species were found in the bypass channel capture net, including sunfish, darters, catfish, suckers, and minnows. Overall usage of the bypass channel was relatively low, with a total of 96 fish captured over 2 years. Channel catfish, a primary target species were captured in 2007 following a large rain event. Generally, upstream movement appeared to be affected primarily by water level and seasonal factors. Results indicate that a large range of species were able to pass both structures, despite damage to the full dam ramp. Stephen Pescitelli Illinois Department of Natural Resources 5931 Fox River Drive Plano, Illinois 60548 steve.pescitelli@illinois.gov 815-786-5688
4:00 PM	**<u>Design of a Fish Passage Structure on the Upper Mississippi River</u> - Mark A. Cornish** The Corps of Engineers is planning construction of fish passage structures at two dams on the Upper Mississippi River. Three years of preconstruction monitoring studies have been used to identify fish distribution in tailwaters for siting locations for fish passage structures. Computer simulation and physical hydraulic models have been used to aid in design, evaluate alternatives, and also to assess the effects of the fishways to commercial navigation. The study team designed a rock ramp fishway to restore longitudinal connectivity at one of these dams. The Adaptive Hydraulics 2-D Model (ADH) predicts that a rock ramp fishway will be effective at providing the diversity of flows necessary to pass the 34 species of migratory fish in the project area; hydroacoustic monitoring studies indicate that these species will be able to find the downstream entrance of the fishway. Improved fish passage will benefit the migratory fish, and mussel species that require them for reproduction, in both the mainstem and the tributaries with little risk at expanding the range of bighead and silver carps. Mark Cornish U.S. Army Corps of Engineers Rock Island District Clock Tower Building P.O. Box 2004 Rock Island, Illinois 61204-2004 Mark.A.Cornish@usace.army.mil 309-794-5385

4:20 PM	**<u>Free Span Low-water Crossings improve passage for threatened Niangua darter</u> -** **Joanne M. Grady*, Craig Fuller, John Fantz, Ange Corson, and Doug Novinger** **Presenter* The threatened Niangua darter occurs in 11 counties in the Osage River Basin in Missouri, and nowhere else in the world. Decline of the species is attributed to habitat loss from reservoir construction and stream channelization. Current threats include isolation of the remaining populations by low water road crossings causing fish passage issues. Improving road crossings to facilitate intra-population movements and seasonal migrations has been identified as a management and recovery goal to protect existing populations of the Niangua darter. An interagency team is surveying the fifty-four crossings within the Niangua darter's range to prioritize crossing replacement. Many of the stream crossings in the eight Niangua darter watersheds are low water fords with inadequately sized, perched culverts which block fish movements. Replacing these fords with free span structures constructed of pre-cast concrete beams provides fish passage and improved sediment transport. The new design also improves vehicle safety, decreases road closures due to flooding and minimizes maintenance costs for the county road commissions maintaining the finished structures. Post-construction physical and biological monitoring indicates the streams' re-stabilize well and Niangua darters move through the crossings. Joanne Grady U.S. Fish and Wildlife Service 101 Park DeVille Drive, Suite A Columbia, Missouri 65203 Joanne_Grady@fws.gov 573-445-5001 x 21
4:40 PM	**<u>Assessment of Sculpin Movement in a 1st order Tributary Using PIT Telemetry, and Habitat and Prey Evaluation</u> - Jason A. DeBoer** Loss and alteration of habitat are principal factors in declining native fish abundance and overall loss of biodiversity. We evaluated Sickle Creek, a spring-fed 1st order tributary to the Big Manistee River. Following perched culvert replacement (Summer '05), a pronounced shift in Mottled Sculpin (*Cottus bairdi*) distribution (upstream versus downstream) was observed. Pre-restoration, 31% of sculpin were captured upstream of the culvert. Post-restoration, 58% were captured upstream of the new bridge. To better quantify sculpin movement, a total of 95 Sculpin (64 - 131mm TL) were captured from eight 100m reaches (10 each from 5 downstream reaches, and ~15 each from 3 upstream reaches). Fish were measured and weighed, implanted with a PIT tag (Biomark, Boise, ID), and released back into the reach where they were captured. Sculpin were relocated every 2-4 weeks. Once relocated, coordinates were taken with a GPS, the fish was located visually, and the location described. 46 of 88 (7 dropped tags) individuals (52.3%) were recaptured at least once. Preliminary results indicate many sculpin stayed in the reaches in which they were initially captured, though individual fish (2) moved as much as 400m. Post-restoration, several habitat variables were examined and compared between downstream and upstream reaches, including surficial sediment composition, LWD, SWD, and water depth and velocity. No significant difference (Kruskal-Wallis: 0.406) was detected between upstream and downstream sections. Surber samples were taken in the spring (3 at each of 3 up- and 3 downstream transects), 2 years pre- and 2 years post-restoration. Pre-restoration, average macroinvertebrate abundance per m^2 was 149 upstream, and 286 downstream (434 total). Post restoration, the values were 254 upstream, and 189 downstream (443 total). Several individual taxa exhibited dramatic changes, likely in response to restoration For example, downstream chironomid density decreased significantly; upstream Baetid density increased significantly. From a management perspective, our results indicate removing undersized, perched culverts can have multiple positive impacts on macroinvertebrate communities, perhaps driving responses in fish communities. Jason DeBoer Grand Valley State University Biology Department 1 Campus Drive Allendale, Michigan 49401 fish_hedd@yahoo.com
5:00 PM	End

Date: Wednesday, 12 December, 8:10 - 11:59 AM
Room: Monona Terrace, Hall of Ideas H
Moderators: Tim Patronski and Mark Fedora

8:10 AM	**Fish Passage Restoration on 18 Mile Creek, Bayfield County, Wisconsin - Ted J. Koehler* and Glenn Miller** **Presenter* Multiple partners in northern Wisconsin worked together to restore fish passage at the junction of Eighteen Mile Creek and North Sweden Road in Bayfield County, Wisconsin. The culvert located within the Bad River Watershed was both perched and a velocity barrier to brook trout and other fish passage. The Bad River watershed is a high priority for restoration and evaluation by the area's private organizations, government agencies and the Bad River Band of Lake Superior Chippewa. The Ashland Fishery Resources Office and the Bad River Watershed Association are evaluating the status of nearly 1,100 road crossings in the watershed. The Town of Grandview, Bayfield County Land Conservation Department, Wisconsin Department of Natural Resources and the U.S. Fish and Wildlife Service partnered to install and embed a 12 foot diameter culvert at the road crossing and restore fish passage to 16.5 miles of cold water habitat above the former barrier. Many challenges and obstacles were overcome in the planning and installation of the project. A mark/recapture assessment of the project is being conducted with the assistance of Northland College. Ted Koehler U.S. Fish and Wildlife Service 2800 Lake Shore Drive East Ashland, Wisconsin 54806 ted_koehler@fws.gov 715-682-6185
8:30 AM	**Risk Assessments are Needed in Decisions to Execute Aquatic Organism Passage Projects: Invasive Species Examples - Michael H. Hoff** Before an aquatic organism passage project (project) begins, social, economic, historical, and/or environmental concerns either should or must, by policy or law, be considered. All projects intended to eliminate barriers to aquatic species movements and migration should be expected to result in environmental impacts. Net environmental impacts may be either positive or negative. Environmental impacts that should be considered, when deciding whether to proceed with a project, include: temperature, contaminants, sediments and turbidity, diseases, genetics, community structure, listed species, nonnative species, and cumulative impacts. Compliance with state and federal laws is required under certain circumstances to ensure that a decision to proceed with a project will most probably result in net benefits. My experience is that risk assessment is a tool that has greater potential than has been realized to assist decisions on whether to proceed with a project. A simple decision tree is presented for use in considering project risks of negative impacts resulting from aquatic invasive species. That decision tree can be adapted to evaluate risk of potential project impacts on other components of aquatic ecosystems. Risks of all impacts can be considered together when deciding whether a project will be funded and executed. Michael Hoff U.S. Fish and Wildlife Service Bishop Henry Whipple Federal Building 1 Federal Drive Fort Snelling, Minnesota 55111 Michael_Hoff@fws.gov 612-713-5114

8:50 AM	**Emulating Nature in Aquatic Passage - Luther P. Aadland** Fragmentation of rivers through dam construction has caused major and wide ranging damages to rivers worldwide. While blockage of migratory organisms is among these damages, inundation of high gradient habitat by reservoirs may limit benefits of restored passage. Riffle spawning fishes such as lake sturgeon as well as many species of mussels depend on these high gradient habitats. Traditional technical fishways do not provide a habitat component and often target only game species. Dam removal is the most complete restoration solution to river fragmentation as it exposes historic rapids. Where this is not possible, a secondary solution is the use of nature-like fishways that provide riffle habitat. We have converted lowhead dams to rapids and built by-pass fishways in addition to dam removal to reconnect river systems. Trap-nets, SCUBA, and Snorkeling have been used to monitor passage and use. Over 40 species of fishes have been observed passing these fishways including young of the year and juveniles as well as species previously thought to be non-migratory. Mussels, and other benthic invertebrates have colonized them and several species of fish have been observed spawning in the constructed riffles. A strategy in dam removal and fish passage in the Red River of the North has been to reconnect historic rapids in the tributaries to the mainstem. This has been concurrent with reintroduction of the extirpated lake sturgeon. Luther Aadland Minnesota Department of Natural Resources 26907 230th Avenue Fergus Falls, Minnesota 56537 luther.aadland@dnr.state.mn.us (218)739-7576
9:10 AM	**Managing for Aquatic Organism Passage on the Superior National Forest, Minnesota - Jason T. Butcher*, Ken J. Gebhardt, and Marty E. Rye** **Presenter* Stream crossings present one of the biggest challenges to managing aquatic ecosystems. The design, installation, or maintenance of a crossing or changes in a stream profile can lead to physical and velocity barriers to aquatic organism passage or undesirable changes to the stream morphology. The three million acre Superior National Forest (SNF), located in northeastern Minnesota, has approximately 3,400 miles of streams that are crossed over 1,600 times by roads. The SNF uses an interdisciplinary program to assess, prioritize, implement, and evaluate restoration activities associated with stream crossings. Crossing improvement projects on the forest range in scale from small culverts to bridges and occur in a variety of aquatic systems from low gradient wetland streams to high gradient rivers. We present a review of the various aspects of the program, from assessment to project activities, as well as some design standards and lessons learned along the way. Jason Butcher USDA Forest Service Superior National Forest 318 Forestry Road Aurora, Minnesota 55705 jtbutcher@fs.fed.us 218-229-8830
9:30 AM	**Innovative and Unique Techniques to Providing Fish Passage in the Midwest - Susan E. Wells** The Alpena National Fish and Wildlife Conservation Office (ANFWCO) is actively involved in restoring fish passage in the Lake Huron and Lake Erie Watersheds. The ANFWCO has implemented over 25 projects and has been able to utilize innovative techniques to complete projects with monetary and physical constraints. This includes using recycled materials at road crossings, designing rock ramps at low head dams, and experimenting with mechanical fishways on Lake Erie coastal wetlands. Completions of such projects were possible by broadening the concepts of fish passage and the devotion of partners and constituents to improving habitat for fish and other aquatic species. Susan Wells U.S. Fish and Wildlife Service Fisheries and Habitat Conservation Branch of Fish and Wildlife Management 4401 N. Fairfax Drive, Room 760F Arlington, VA 22201 susan_wells@fws.gov 703-358-2523

9:50 AM	Break
10:20 AM	**<u>Culvert Design for Aquatic Organism Passage, Stream Morphology and Water Quality</u> - Dale A. Higgins** Over the past decade, the Chequamegon-Nicolet National Forest has designed and installed over 125 culverts for the multiple objectives of improving aquatic organism passage, protecting water quality, restoring channel morphology, reducing road maintenance and providing a safe, efficient transportation system. This work provides numerous examples of survey, design and construction practices for environmentally friendly culverts. Stream profile surveys are necessary to determine culvert invert elevations that will pass aquatic organisms and restore channel morphology. Proper culvert sizing is also important and is accomplished with traditional hydrology and hydraulics analysis that can be supplemented with bankfull width measurements. In low gradient streams (<0.35%), passage will normally be provided by setting a properly sized culvert flat, at an elevation where the tailwater will provide water depths and velocities that will pass all species present. For higher gradient streams, the culvert may need to be set at a slope to prevent channel head-cutting and maintain channel morphology. In these cases, baffles, stabilized rock or a simulated stream channel can be constructed in the culvert to provide velocity breaks that will allow organisms to pass upstream. If such streams have a mobile gravel bed, bedload transport must be maintained, the culvert width must be at least as wide as the bankfull channel and stream simulation is the preferred design method. Culvert failures and maintenance problems are minimized by utilizing beveled culverts; favoring one, large culvert over multiple culverts; and using good construction techniques such as proper bedding, compaction, temporarily by-passing flows around the construction site, stable side slopes of 2:1 or flatter, riprap and road surface drainage. Dale Higgins USDA Forest Service Chequamegon-Nicolet National Forest 1170 South 4th Avenue Park Falls, Wisconsin 54552 dhiggins@fs.fed.us 715-762-5181
10:40 AM	**<u>Round Table Discussion</u>**
12:00 PM	End

U.S. Fish and Wildlife Service's Midwest Fish Passage Program

Aquatic Organism Passage Symposium
Midwest Fish and Wildlife Conference
Madison, WI

Tim Patronski
December 11, 2007

National Fish Passage Program Goal

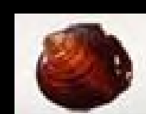
To restore native fish and other aquatic species to self-sustaining levels by reconnecting habitats that have been fragmented by artificial barriers, where such reconnection will result in a positive ecological effect.

- **Over 15,300 dams over 6 feet high in FWS Region 3**
- **~100's of thousands of other smaller barriers**

Many fish have been disconnected from important habitats

Sharp declines in some migratory fish species and other species which depend on them

Skipjack Herring
Wisconsin DNR



Ebonyshell
Wisconsin DNR

Midwest Fisheries Program Conservation Status Summary

60% of Fish

67% of Crayfish

75% of Freshwater Mussels

Imperiled Locally, Imperiled Range-wide or Possibly Extinct in FWS Region 3

Midwest Fish Passage Program Accomplishments 1999-2007

Completed Projects:

98 Barriers Removed; 773 Stream Miles Reconnected

Projects In-Progress:

12 Barriers; 319 Stream Miles

Project Sites

Key Ingredient = Partnerships

- States
- Tribes
- Local Municipalities
- Other Federal Agencies
- NGOs
- Local Watershed Groups

Iowa:	7
Illinois:	32
Michigan:	47
Minnesota:	17
Missouri:	14
Ohio:	8
Wisconsin:	30

= 155 Total Partners

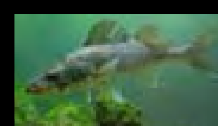
Total Investment 1999-2007

Fish Passage Program Funding:	$2,493,700
Partner Support:	$8,058,510
Total:	$10,552,210

= $ 3.23 in Partner funds and in-kind support for every $1 in Fish Passage Funding

Current Challenge

Better understand the impact we are actually having on the ground in terms of biological outcomes.



A Watershed Approach

Focus funding on projects that are part of larger watershed restoration efforts and which are in-line with both Service priorities and our Partners' priorities

A Vision For the Future

- Strengthen coordination
  Fish Passage Decision Support System
  http://fpdss.fws.gov
- Focus on key geographic areas
- Quantify biological outcomes
- Take an "adaptive" approach

Midwest AOP Symposium

- Sharing lessons learned
- Identify opportunities – science, policy, management
- Enhanced collaboration

↓

Reconnect Habitat and Restore Populations

Midwest Fisheries and Aquatic Resources Conservation Program

Office	Area of Responsibility	Project Leader	Phone Number
Ashland NFWCO	Lake Superior Watershed	Mark Brouder	715-682-6185 x11
Green Bay NFWCO	Lake Michigan Watershed	Mark Holey	920-866-1760
Alpena NFWCO	Lake Huron and Western Lake Erie Watershed	Jerry McClain	989-356-3052 x18
Carterville NFWCO	Mississippi River Watershed in Illinois, Indiana, and Ohio	Rob Simmonds	618-997-6869
LaCrosse NFWCO	Mississippi River Watershed in Minnesota, Wisconsin, and Iowa and the Red River of the North Watershed	Pam Thiel	608-783-8431
Columbia NFWCO	Missouri River Watershed and Mississippi River Watershed in Missouri	Tracy Hill	573-234-2132 x102

The Michigan River Partnership

The Growing Crisis of Aging Dams: Policy Considerations and Recommendations for Michigan Policy Makers

In Cooperation with the Michigan Municipal League

Mark Coscarelli
Public Sector Consultants Inc.
December 11, 2007

Funding provided by:
C.S. Mott Foundation
National Fish and Wildlife Foundation

1

Outline

- Purpose of MRP
- Project Overview
- By the Numbers
- Conclusions and Recommendations

2

Purpose

The *Michigan River Partnership* (MRP) is a broad based coalition of government and nongovernment partners formed in 2005 to:

- Assess opportunities to facilitate dam removal on Michigan rivers
- Highlight the need to repair dams that are not candidates for removal
- Provide dam owners, opinion leaders, and other stakeholders with the information necessary to optimize decision-making processes at the local level
- Underscore the need for dedicated funding to address emerging challenges posed by aging dams

3

MRP Membership

- American Fisheries Society, Michigan Chapter
- Michigan Association of County Drain Commissioners
- Association of State Dam Safety Officials
- Izaak Walton League, Michigan Chapter
- Michigan Environmental Council
- Michigan Lakes and Streams Association
- Michigan Municipal League Foundation
- Michigan Sea Grant College Program
- Michigan State University—Extension/Dept. Fisheries & Wildlife
- Michigan Townships Association
- Michigan United Conservation Clubs
- Sierra Club
- The University of Michigan—School of Natural Resources and Environment
- Tip of the Mitt Watershed Council
- Michigan Council of Trout Unlimited

4

Technical Advisors

- Michigan Department of Natural Resources
- Michigan Department of Environmental Quality
- Michigan Department of Transportation
- U.S. Department of Agriculture - Natural Resources Conservation Service
- U.S. Army Corps of Engineers
- U.S. Fish and Wildlife Service

5

Project Overview

This project included

- Stakeholder participation
- Research and analysis
- Strategy development
- Final report and recommendations

6

Final Report

- Dams in Michigan
  - Number, type, function, ownership, hazard potential, age
- Economic and social dimensions
- Environmental and ecological
- Legal and regulatory
- Trade-offs of removal vs. retention
- Conclusions and recommendations

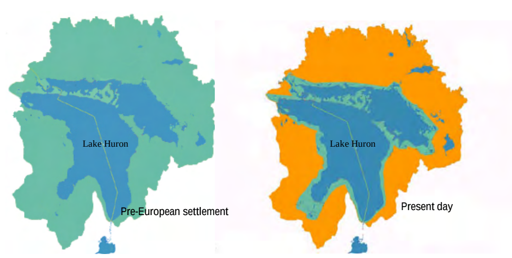
7

Importance of Dams

- Electrical generation
- Water supply
- Flood storage
- Impoundments (i.e., recreation, irrigation)

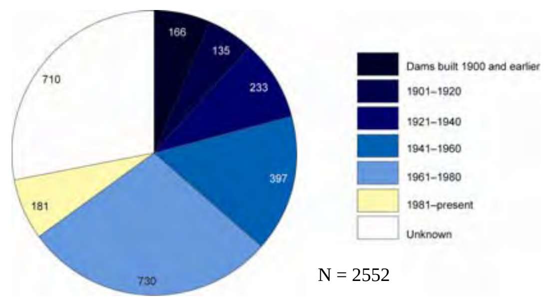
8

Inland tributary habitat available to fishes in Lake Huron watershed



Source: Michigan Department of Natural Resources

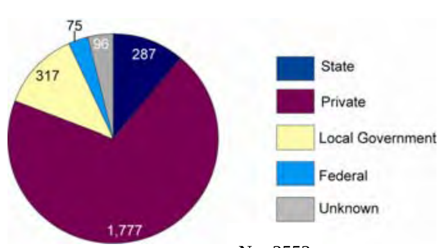
Dams by Year of Construction



N = 2552

Source: Prein&Newhof

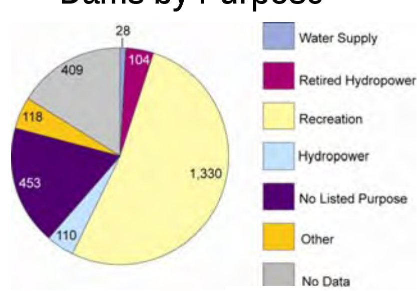
Dams by Ownership



N = 2552

Source: Prein&Newhof

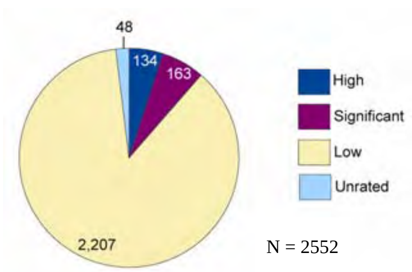
Dams by Purpose



Source: Prein&Newhof

N = 2552

Dams by Hazard Ranking



Source: Prein&Newhof

Recommendations

- Create a dedicated state funding program.
- Examine and streamline the current dam removal.
- Enhance Michigan's geographic information system and dam database to be used as a prioritization tool for dam removal.
- Require that any dams repaired using public funds include measures to mitigate resource damages that occur as a result of the dam's continued operation.

14

Recommendations (continued)

- Develop and disseminate an information brochure as part of routine dam safety and permit correspondence by the MDEQ.
- Develop a river restoration team comprised of representatives from MDEQ and MDNR.
- Encourage MDEQ to emphasize dam removal as part of comprehensive watershed management planning.
- Explore new and expanded partnerships with nonprofit organizations (e.g., Michigan River Network).

15

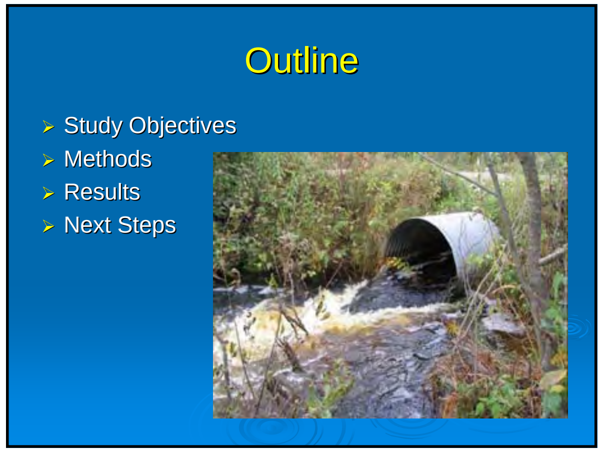
Questions?

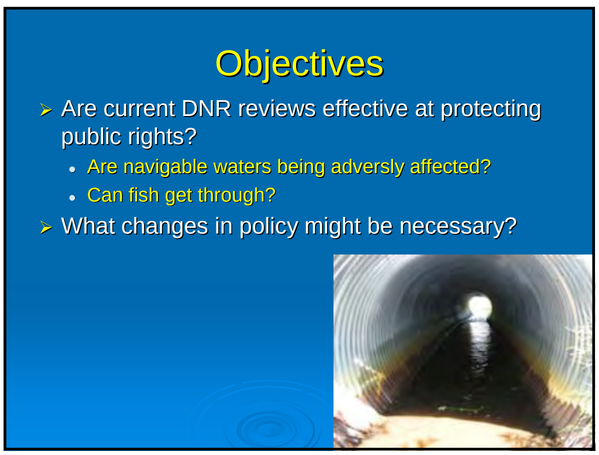
Final Report may be accessed at:
www.pscinc.com/publications.html

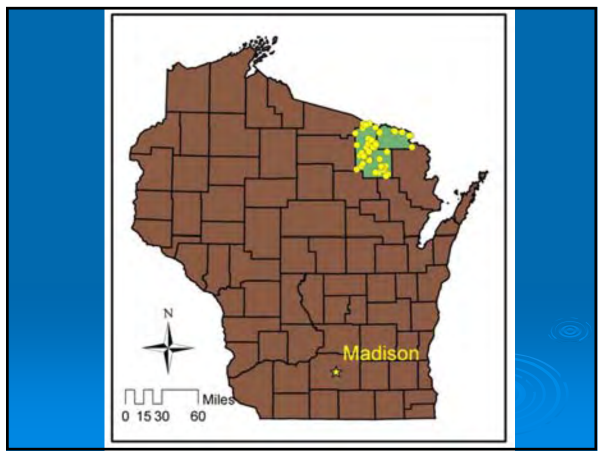
Mark Coscarelli, 517-484-4954
Email: mcoscarelli@pscinc.com

16


Can a fish cross the road?
Mark Fedora
mfedora@fs.fed.us
The Nature Conservancy


Outline
Study Objectives
Methods
Results
Next Steps


Objectives
Are current DNR reviews effective at protecting public rights?
Are navigable waters being adversly affected?
Can fish get through?
What changes in policy might be necessary?


N
Madison
Miles
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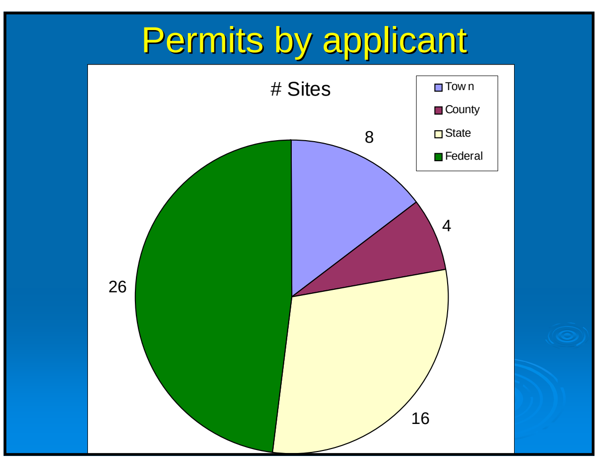
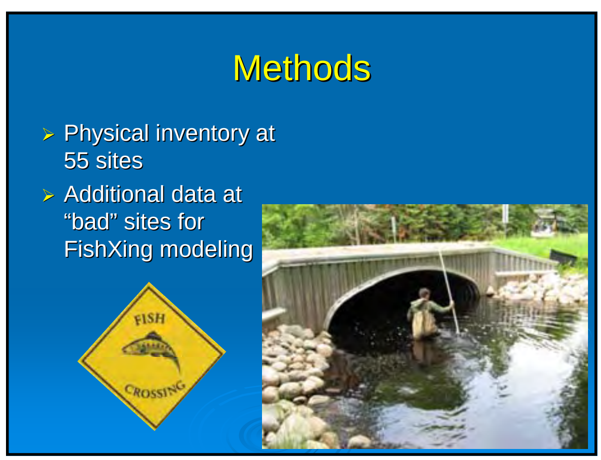

Permits by applicant
Sites
Tow n
County
State
Federal
8
4
16
26

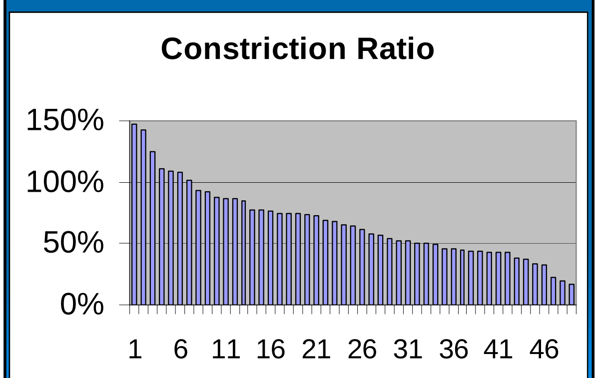

Methods
Physical inventory at 55 sites
Additional data at "bad" sites for FishXing modeling
FISH
CROSSING

Inventory

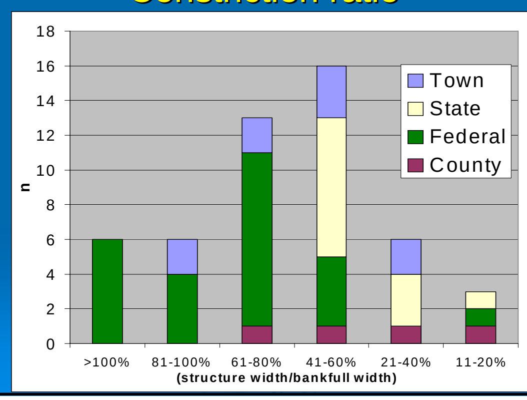
- Stream measurements
- Culvert / bridge measurements
- Erosion

Quick evaluation parameters

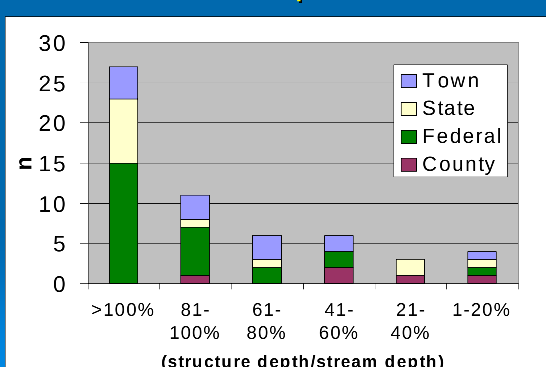
- Constriction ratio
- Water depth ratio
- Outlet scour pool to stream width ratio
- Outlet drop



Constriction ratio



Water depth ratio



Other problems

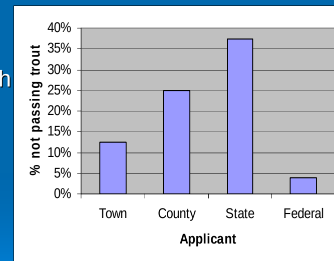
- Outlet scour pool (56%)
- Alignment (22%)
- Erosion (15%)
- Outlet drop (10%)

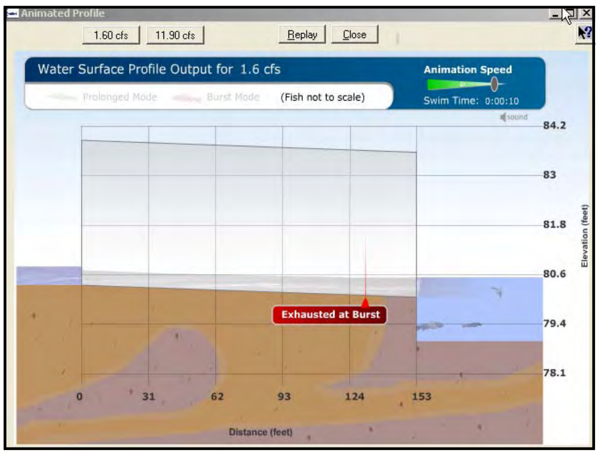
FishXing additional info

- Culvert slope
- Cross-section at tailwater control
- Stream slope

FishXing

- 9 sites evaluated
- 8 sites modeled would not pass fish (7” brook trout)
- 1 partial barrier
- Suspect 3 more problem sites





Conclusions

- DNR review process fails to catch potential problems
- Lack of design objectives and standards leads to variable interpretation and application of authority

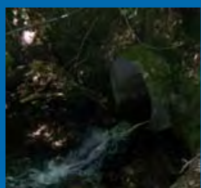
Next steps

- Formed AOP working group
  - Reviewing design standards used in other states
  - Continue internal/external education & outreach
  - Combine these data with similar data state-wide
- Affect internal DNR policy change

Questions?

Acknowledgements:
Thanks to Laurie LaBumbard, Hiawatha National Forest; Jon Simonsen, Wisconsin DNR; and Dale Higgins, Chequamegon-Nicolet National Forest

Evaluation of brook trout (*Salvelinus fontinalis*) genetic markers as tools for prioritizing stream-crossing improvement projects



Anne Timm, Dr. Andy Dolloff, Dr. Randy Kolka, USDA Forest Service
Midwest Fish & Wildlife Conference
Aquatic Organism Passage Symposium
December 11, 2007

Acknowledgements:

Committee Members:

- Dr. Andy Dolloff (committee chair), USDA Forest Service, Southern Research Station
- Dr. Randy Kolka, USDA Forest Service, Northern Research Station
- Mark Hudy, USDA Forest Service, National Aquatic Ecologist
- Virginia Tech, Department of Fisheries and Wildlife Sciences: Dr. Eric Hallerman, Dr. Paul Angermeier

Field Crew, 2007:
- Cody Fox and Anthony Palmeri

Overview:

- Background, goals, objectives of doctoral research
- Study design and methods
- Preliminary natural barrier results for Great Lakes National Forests
- Potential applications
- Questions for discussion

Background:

- Biological monitoring tools for stream restoration
- Fragmentation and brook trout genetics
- Genetic markers and assignment tests for brook trout

Effects of Culverts

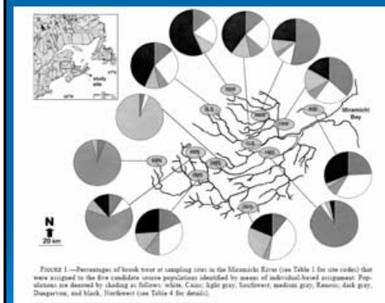
Fragment:
- **habitat**
- **populations**

Disrupt:
- **gene flow**

Why brook trout genetics?

- Brook trout are good indicators of high water quality
- High jumpers (2-3 feet; Coffman 2005; Kondratieff and Myrick 2006) and widely dispersing up to 6.6 km (Flick and Webster 1975); indicate worst case scenario barriers
- Native trout species of the Eastern United States; highly-valued sport species, population declines (intact in only 5% of range, Hudy 2006)
- Genetic marker methods and information highly available; genetic markers incorporate various spatial and long-term intergeneration effects

RESULTS:



White = Cains
Light Gray = Southwest
Medium gray = Renous
Dark gray = Dungarvon
Black = Northwest

•Probability distributions to estimate number of source populations, most likely K=5

•Significant levels of genetic differentiation among 5 source populations observed

(Rogers and Curry 2004)

Proposed research goals:

GOAL 1: To evaluate whether stream-crossings that are barriers to fish movement influence genetic diversity of brook trout populations

GOAL 2: To investigate risks to brook trout populations posed by identified threats

GOAL 3: To develop prioritization tools for stream-crossing improvement projects

Objectives:

OBJECTIVE 1: To establish indicators of reduced genetic diversity for brook trout populations that can be associated with stream-crossing improvement projects

OBJECTIVE 2: To apply a risk model for brook trout populations that includes genetic diversity

OBJECTIVE 3: To develop a tool for prioritization of stream-crossing improvement projects that includes risk factors to brook trout populations

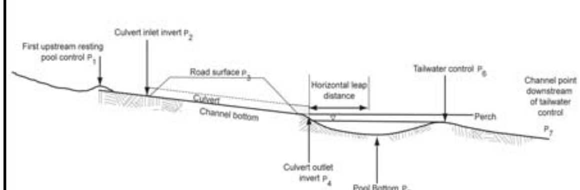
Study design:

- Nine subwatersheds (6th level HUC) in Blue Ridge Level III Ecoregion; 65-70% forested (Thieling 2006)
- In each subwatershed: one no barrier present, one barrier present, no stream-crossing structure present
- Comparison of natural barriers between Northern Lakes and Forests and Blue Ridge Level III Ecoregion

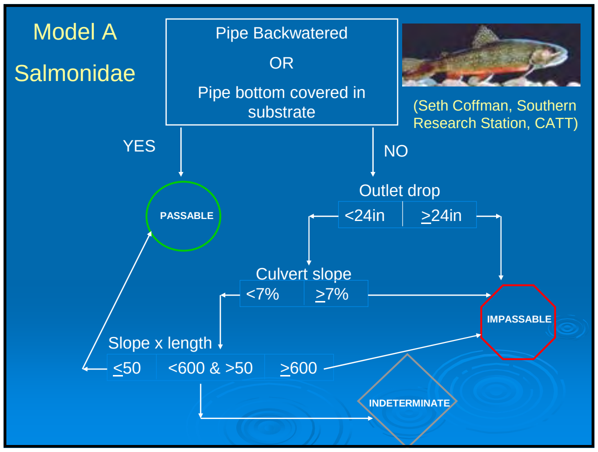
Methods:

- Backpack electro-shock surveys to collect 30 to 50 fin clips of brook trout above and below barriers; store in 95% ethanol
- Length, weight, CPUE as estimate of density
- San Dimas protocol and Coffman (2005) coarse filters to characterize barriers

Methods: San Dimas Protocol



US Forest Service- San Dimas Technology and Development Center



Genetic analysis:

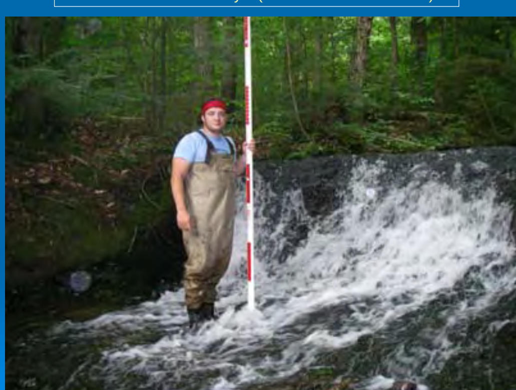
- Extract DNA from fin clips, and amplify microsatellite fragments using polymerase chain reaction (PCR) technology
- Brook trout population percent polymorphic loci (*P*), genetic differentiation (F_{ST}) values, heterozygosity (*Hs*) values, and number of allele (*A*) values above and below stream-crossings that are barriers and stream-crossings that are not barriers
- Individual-based assignment methods for identifying migrants from a given source population in streams with or without barriers to movement (Ranala and Mountain 1997; Pritchard et al. 2000; Corander et al. 2003)

Natural barrier preliminary results (2007):

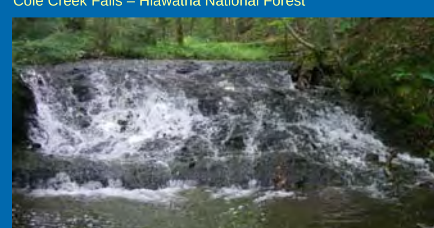
- National Forests of Great Lakes: Chequamegon-Nicolet (WI), Hiawatha (MI), Ottawa (MI), Superior (MN)
- Coffman (2005) criteria: barrier if outlet drop ≥ 24 inches, slope ≥ 7%, slope*length ≥ 600 feet
- N = 8 cascades, waterfalls; 3-70 feet drops (see slides) (720 fin clips)

Cole Creek waterfall survey – (Hiawatha National Forest)

Cole Creek waterfall survey – (Hiawatha National Forest)



Cole Creek Falls – Hiawatha National Forest

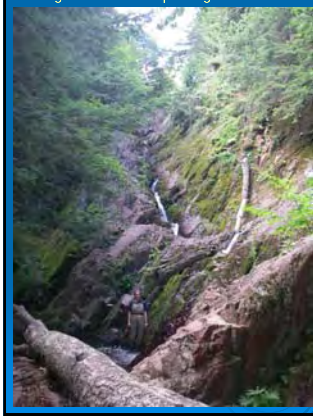


Drop: 171 in. Slope: 74% Slope*Length: 675 ft.

Brook trout density: Downstream – 50 total; 0.40 per m., 1937 CPUE
Upstream – 56 total; 0.36 per m., 2351 CPUE

Rainbow trout density: Downstream - 1 adult; 0.008 per m.
Upstream - 0 per m.

Morgan Falls – Chequamegon-Nicolet National Forest



Drop: 70 feet

Brook trout density:

Downstream – 52 total; 0.39 per m., 1554 CPUE

Upstream – 51 total; 0.33 per m., 1148 CPUE

Rainbow trout density: 0 per m.

Junco Creek – Superior National Forest

Drop: 30 in. (smallest); 64 in. (largest)

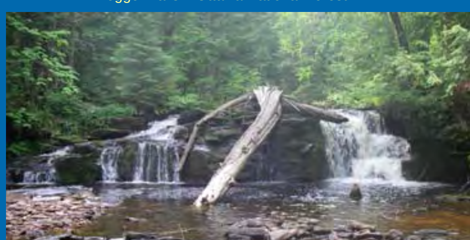
Slope: 5% (smallest); 16% (largest) Slope*Length: 36 ft. (smallest); 97 ft. (largest)

Brook trout density: Downstream - 24 total; 0.10 per m.; 3373 CPUE

Upstream - 51 total; 0.20 per m.; 2855 CPUE

Rainbow trout density: 0 per m. downstream and upstream

Hogger Falls – Ottawa National Forest



Drop: 87 in. (smallest); 240 in. (largest)

Slope: 8% (smallest); 81% (largest) Slope*Length: 78 ft. (smallest); 872 ft. (largest)

Brook trout density: Downstream - 17 total; 0.01 per m., 6999 CPUE

Upstream - 50 total; 0.04 per m., 7186 CPUE

Rainbow trout density: Downstream - 103 total; 0.08 per m.

Applications:

1. Use fish population genetics as a biological tool to validate the presence of a barrier; compare and combine use of biological tools and physical characterization of barriers

2. Use brook trout genetic diversity tools to define populations spatially using assignment tests; use to monitor increased desirable gene flow and genetic diversity due to improved dispersal

3. Prioritize locations for stream-crossing improvement at the subwatershed scale using genetic diversity and assignment test information, considering risk

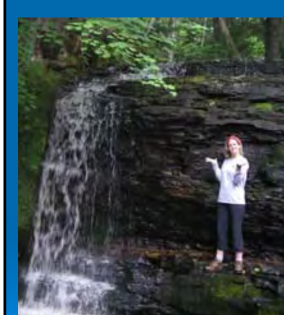
Questions to consider:

1. Human barriers in Northern Great Lakes and Forest Ecoregion different from Blue Ridge; need specific assessment tools according to Ecoregion

2. How much "connectivity" is enough and how do we measure it? How can we measure progress 5-10, 15, 20, 50,75, 100 years (temporal)? And at various spatial scales?
   - Monitor population genetic diversity data over time and use of simulations

3. Will you participate in a questionare???

What criteria do you use to determine if it's a barrier?



Fragmentation in Menominee River Lake Sturgeon

Ryan P. Franckowiak, Todd Kittel, and Brian L. Sloss

Wisconsin Cooperative Fishery Research Unit
U.S. Geological Survey
College of Natural Resources
University of Wisconsin-Stevens Point
Stevens Point, WI 54481

Lake Sturgeon
(*Acipenser fulvescens*)

Population Declines

Fragmentation

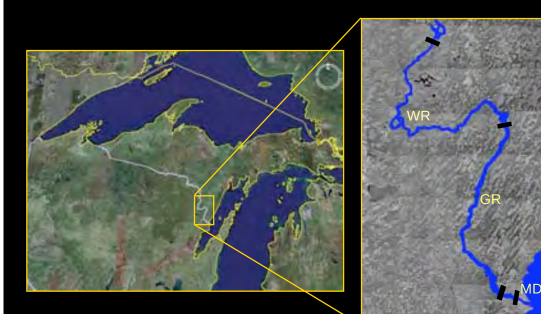
- Major source: Dams
- Reduce or eliminate gene flow (migration)
- Small populations subject to greater demographic and genetic stochasticity
- Long-term threat to population viability and sustainability

Great Lakes Lake Sturgeon Management Goal

“to maintain, enhance, and rehabilitate self-sustaining populations where the species historically occurred basin-wide”

-Great Lakes Lake Sturgeon Rehabilitation Plan

Menominee River



1

Problem Statement

- Knowledge gaps are major obstacle for management and rehabilitation
- Problem or gap:
  - Demographic stability
  - Reproductive life-history characteristics
  - Factors controlling recruitment
  - Levels and distribution of genetic diversity

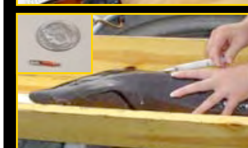
Objectives

1. Estimate contemporary population size and compare to previous population estimates
2. Examine key demographic characteristics for differences between years and population segments
3. Compare genetic characteristics within and among population segments

Adult Sampling Strategy

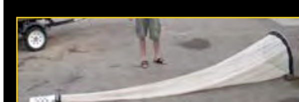
- Spring spawning period
- 2005 Opportunistic
  - Electrofishing/gill nets
- 2006 Standardized
  - Electrofishing only
- Fall recapture run to estimate abundance

Field Methods



- Length (TL and FL)
- Weight
- Sex determination (when possible)
- Fin clip (genetic analysis)
- PIT tag

Larval Sampling Strategy



- D-frame drift nets
- Two transects (0.8 and 1.2 km)
- Three nets/transect
- Max depth 2 m
- Fished 4-7 hrs

Demographic Analysis

- Population estimates
  - Schnabel estimator (1938; Ricker 1978)
- Size Structure
  - Plotted in 10 cm length bins
  - Two sample t-test to compare mean size
  - Test for equal variance among years

Summary Data

	White Rapids		Grand Rapids	
Date	2005	2006	2005	2006
Sampling Period	4/20 – 6/1	4/21 – 6/11	4/21 – 5/30	4/17 – 6/12
# Fish Handled	306	360	374	290
# Field Data	276	316	370	287
# Genetic Sampled	231	300	342	256
# Newly Tagged	229	227	291	226
# Previously tagged	64	105	82	62

Population Estimates

	White Rapids			Grand Rapids	
	2005 Opportunistic	2006 Opportunistic	2006 Standardized	2005 Opportunistic	2006 Standardized
Population Estimate	1337	727	2233	922	2791
95% CI	969 -1897	445 -1260	1158 - 4683	765 -1160	1242 - 6678
Marked	295	136	193	346	171
Recaptured	35	14	7	91	4
% Recap	11.86	10.29	3.63	26.3	2.34

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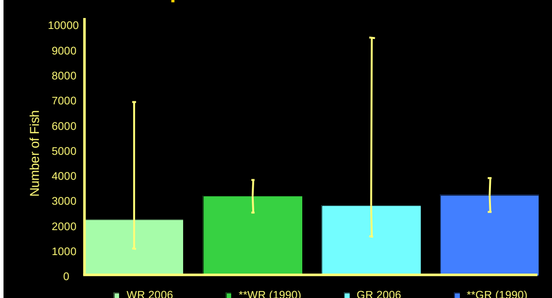
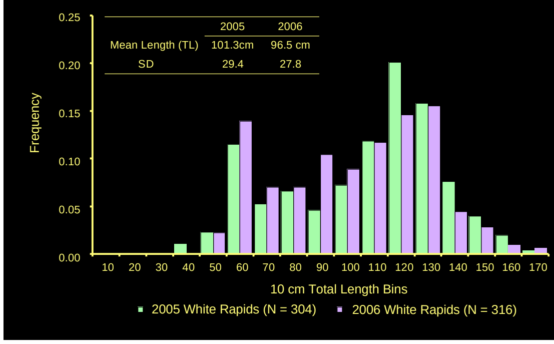
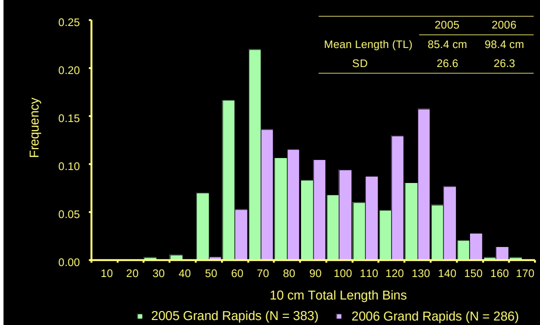


**1990 population estimates (Thuemler 1997)

White Rapids Size Structure



Grand Rapids Size Structure



Total Length Comparisons

Comparison	t-value	df	p-value
White Rapids 05 vs 06	-2.05	569	0.041
Grand Rapids 05 vs 06	6.24	617	<0.001
White Rapids 05 vs Grand Rapids 05	7.06	557	<0.001
White Rapids 06 vs Grand Rapids 06	-0.88	599	0.381

USGS
science for a changing world

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Laboratory Methods

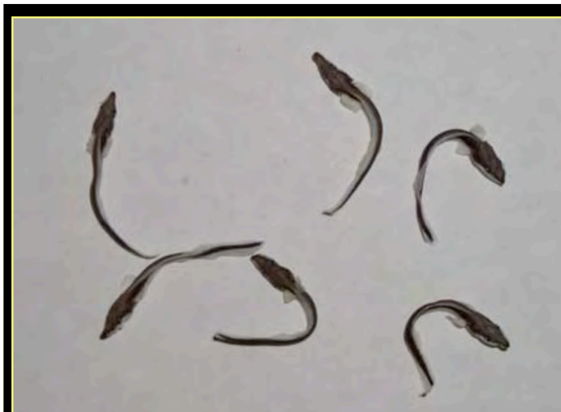
- DNA isolation and purification
  - *Qiagen DNeasy® DNA purification kit*
- DNA quantification and normalization
  - *NanoDrop® ND-1000 Spectrophotometer*
- Assayed ten microsatellite loci
  - *AfuG9,AfuG56, AfuG63, AfuG74, AfuG112, AfuG160, AfuG195, AfuG204, Afu68b, Spl120*
- ABI Prism 377xl Automated DNA Sequencer
  - *Multi-locus genotype data*

Genetic Analysis

- Hardy-Weinberg and Linkage equilibrium
  - Exact probability tests (Genepop v3.3)
- Genetic diversity measures
  - Allelic richness (HP-rare)
  - Heterozygosity (GenAlEx)
  - Wilcoxon signed-rank test
- Genetic differentiation
  - Allele frequency homogeneity (Genepop v3.3)
  - Weir and Cockerham's Theta (Arlequin v3.11)
- Larval Lake Sturgeon Only
  - Effective number of breeders (N_b)
  - Relatedness (Kinship)

Adult Genetic Characteristics

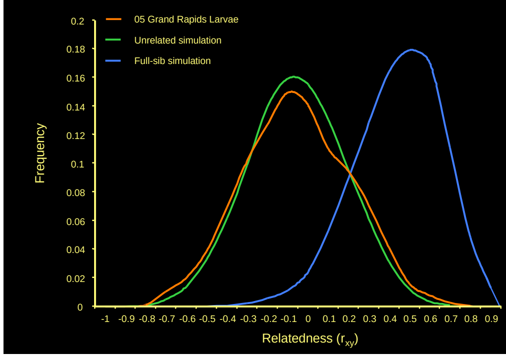
- Diversity levels comparable to other Great Lakes Lake Sturgeon populations
- Genetic diversity measures not significantly different between GR and WR segments (All signed-rank tests > 0.05)
- Estimates of F_{IS} not significantly different from zero (no evidence of inbreeding)
- Significant allele frequency heterogeneity between larvae and adults



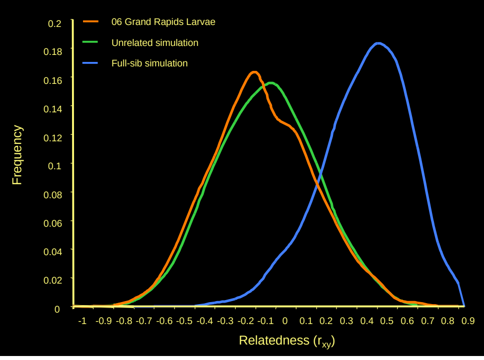
Effective Number of Breeders

Cohort	N_b Estimate	95% CI	N_c Estimate	N_b/N_c
2005 Grand Rapids	57.9	(44.9 – 77.6)	921	0.06
2006 Grand Rapids	61.4	(47.5 – 82.4)	2791	0.02

2005 Grand Rapids Larvae



2006 Grand Rapids Larvae



Larval Genetic Characteristics

- Level of genetic diversity similar to adult samples
- Estimates of F_{IS} not significantly different from zero (no evidence of inbreeding)
- Mean relatedness estimates ~ zero
- Suggests random mating of adults within each population segment

Summary

- Population size stable over 15+ years
- Trend toward larger presumably older fish
- Bimodal size distribution and presence of smaller fish indicates successful recruitment
- No apparent reduction in genetic diversity or genetic heterogeneity between WR and GR

Fish Passage

- Increased fish passage long-term goal of Wisconsin and Michigan DNR
- Fish passage not an immediate concern
- Differences will accumulate with time
- Continue monitoring population segments


Acknowledgements
Funding provided by:
We Energies – Wilderness Shores Settlement Agreement
USGS
science for a changing world
College of Natural Resources
Assistance:
Technicians
Craig Williamson
Allen Lane
Melvin Kittel
WDNR-Peshtigo Fisheries Professionals
Mike Donofrio
Greg Kornely
UWSP Graduate Students
Mike Hughes
Joshua Raabe
Nick Scribner
Justin VanDeHey

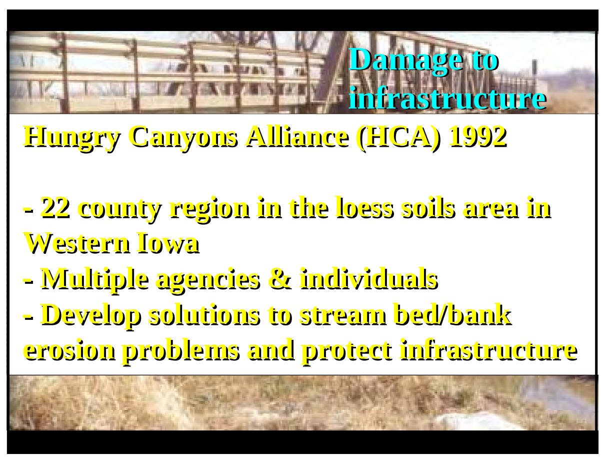

History of Fish Passage Issues & Solutions in Western Iowa Tributary Streams
Presenter: Chris J. Larson
Iowa Dept. of Natural Resources
DNR
Iowa State University
Natural Resource Ecology and Management
Hungry Canyons Alliance

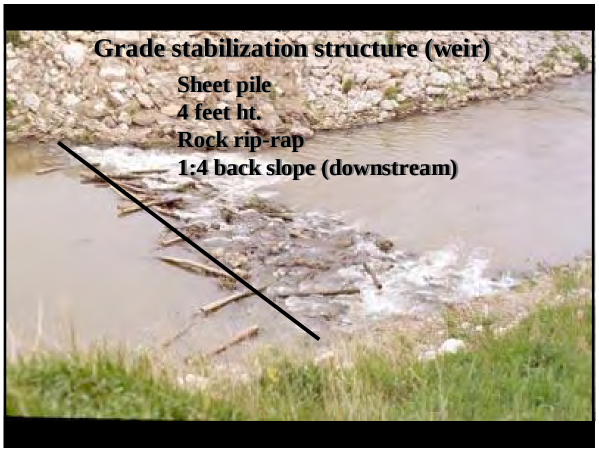

Loess Soils


90% of stream channels in western Iowa have been straightened or modified.

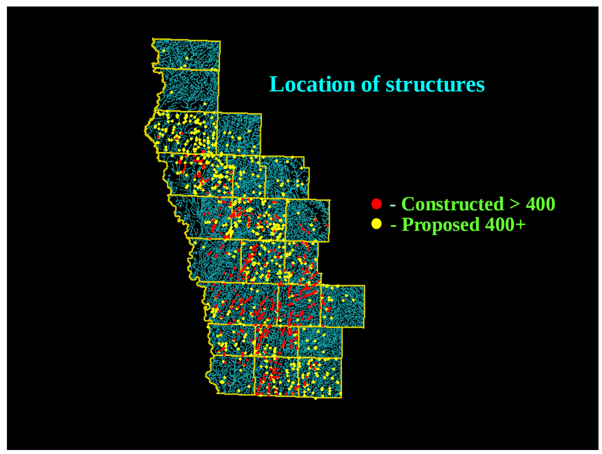

Flooding


• Streambed degradation
• Bank erosion


Damage to infrastructure
Hungry Canyons Alliance (HCA) 1992
- 22 county region in the loess soils area in Western Iowa
- Multiple agencies & individuals
- Develop solutions to stream bed/bank erosion problems and protect infrastructure


Grade stabilization structure (weir)
Sheet pile
4 feet ht.
Rock rip-rap
1:4 back slope (downstream)


$1 spent = $4.50 of property protected
~ $90 million in property protected

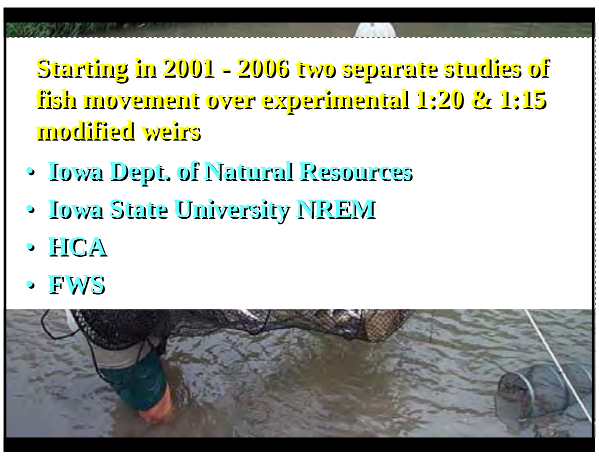

Location of structures
- Constructed > 400
- Proposed 400+


Sampling efforts indicated a decline in sportfish numbers & reduced species diversity in sites located upstream of weirs

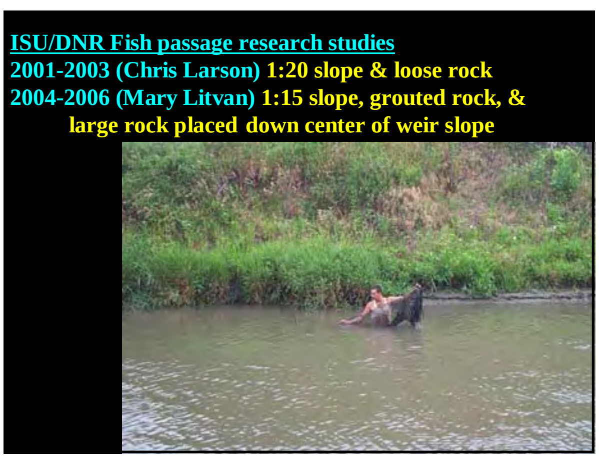

Prior to weir construction these channelized streams still provided important habitat!
1984 study estimated 500 channel catfish/mile in Walnut Creek


1999
3. 1. 2000


Solutions?


Starting in 2001 - 2006 two separate studies of fish movement over experimental 1:20 & 1:15 modified weirs
• Iowa Dept. of Natural Resources
• Iowa State University NREM
• HCA
• FWS

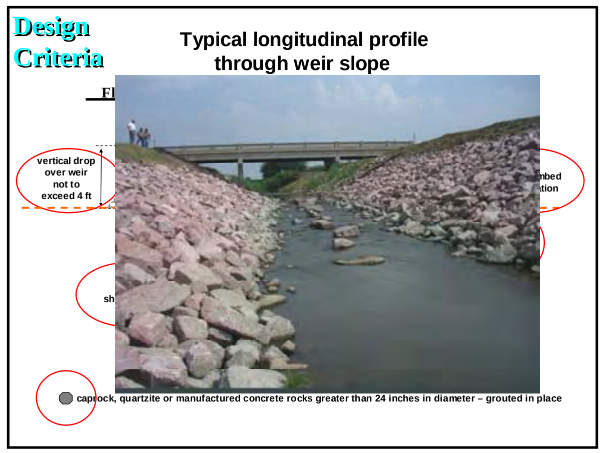

Goals
• infrastructure protection
• long-tem stability
• cost benefit
• fish passage!

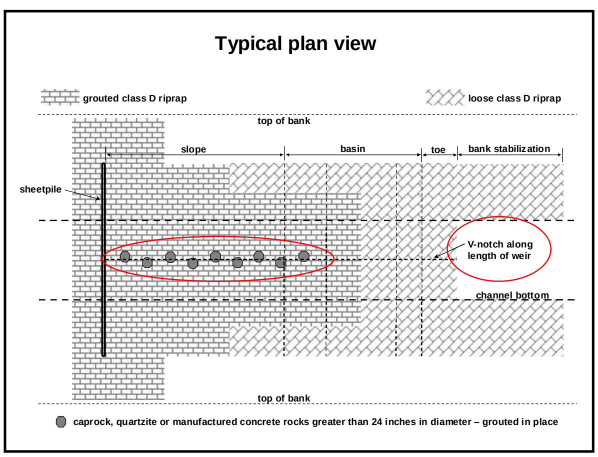

ISU/DNR Fish passage research studies
2001-2003 (Chris Larson) 1:20 slope & loose rock
2004-2006 (Mary Litvan) 1:15 slope, grouted rock, &
large rock placed down center of weir slope

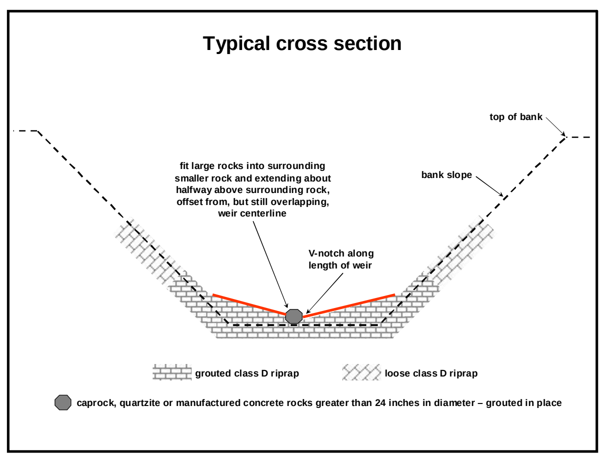

Target Species
Channel catfish
Bullhead sps.
Creek chub
Flathead chub


Results
• Significantly more fish passage over 1:15 or 1:20 weir slope design than a typical 1:4


2006 HCA & Iowa DNR agreement; all future constructed and modified weirs must meet specified new design criteria.
Additional funding to modify existing weirs; HCA $200,000 + IDNR $50,000 annually
(2 years - modified 11 of 105 priority structures)

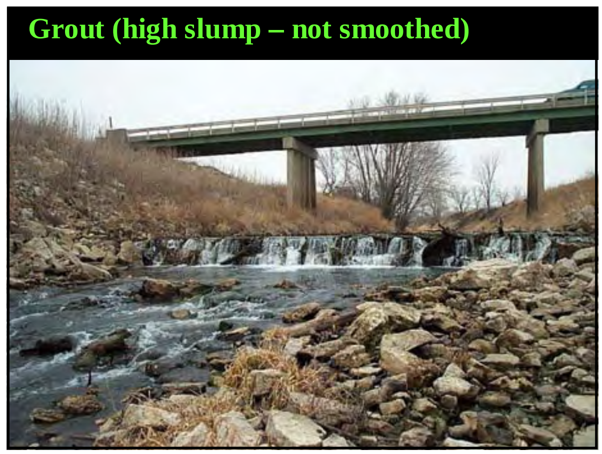

Design Criteria
Typical longitudinal profile through weir slope
vertical drop over weir not to exceed 4 ft
caprock, quartzite or manufactured concrete rocks greater than 24 inches in diameter – grouted in place


Typical plan view
grouted class D riprap
loose class D riprap
top of bank
slope
basin
toe
bank stabilization
sheetpile
V-notch along length of weir
channel bottom
top of bank
caprock, quartzite or manufactured concrete rocks greater than 24 inches in diameter – grouted in place


Typical cross section
top of bank
fit large rocks into surrounding smaller rock and extending about halfway above surrounding rock, offset from, but still overlapping, weir centerline
bank slope
V-notch along length of weir
grouted class D riprap
loose class D riprap
caprock, quartzite or manufactured concrete rocks greater than 24 inches in diameter – grouted in place


V-notch


Low flow


Grout (high slump – not smoothed)


Grout


Resistant caprock, quartzite, or manufactured concrete
rocks greater than 24 inches in diameter


24. 3. 2006


Cost to modify $ 30k - 60k
Cost for new construction
$120 - 150k


Solution? Questions

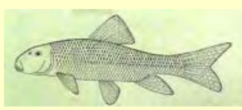
Evaluation of full dam rock ramp and bypass channel fish passage structures on Big Rock Creek

Stephen M. Pescitelli and Robert C. Rung
Illinois Department of Natural Resources
5931 Fox River Drive
Plano, IL
Steve.pescitelli@illinois.gov

Big Rock Creek Fish Passage Evaluation

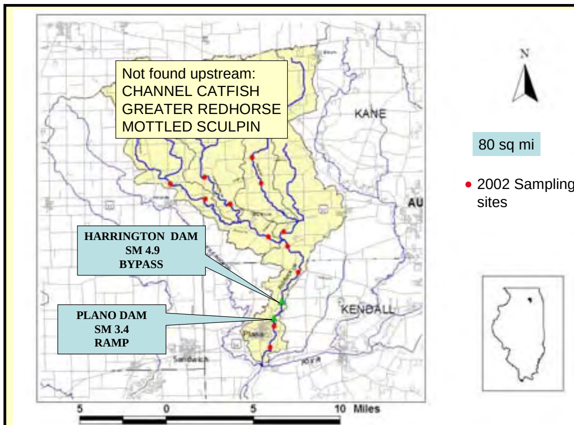
- Brief overview of the projects
  - Location, setting
  - Full width ramp design
  - Bypass channel design
- Methods used to evaluate passage
  - Observation / sampling
  - Fish marking study
  - Bypass capture net
- Results
- Life history/behavioral observations in relation to evaluation/expectations
- Structure stability

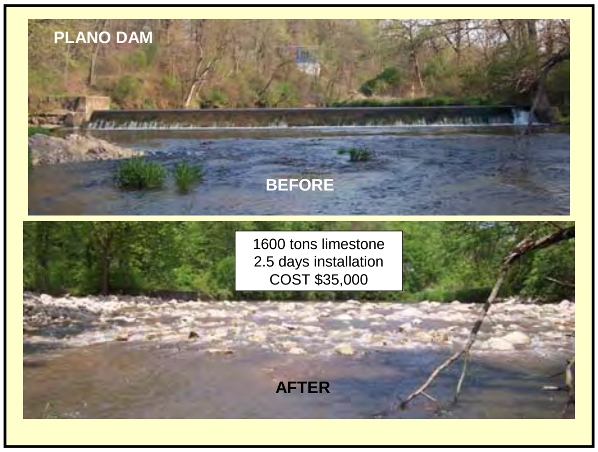
BIG ROCK CREEK FISH PASSAGE PROJECT



National Fish Passage Program

BIG ROCK CREEK WATERSHED

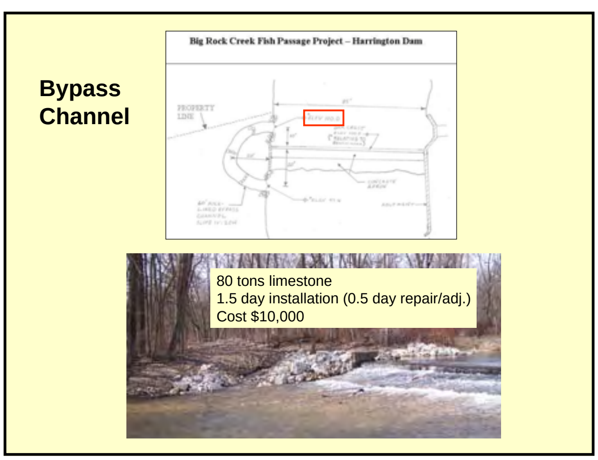


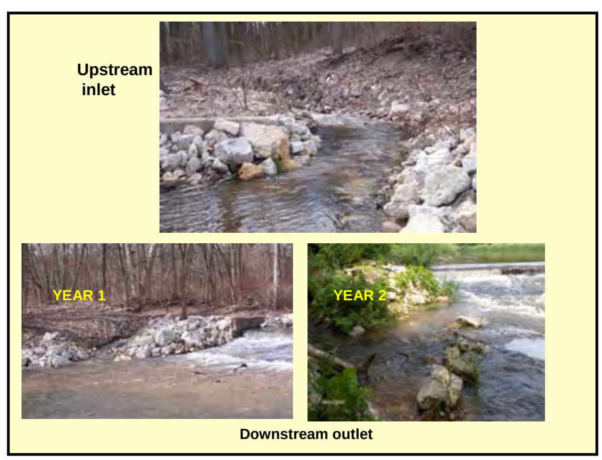

PLANO DAM
BEFORE
1600 tons limestone
2.5 days installation
COST $35,000
AFTER

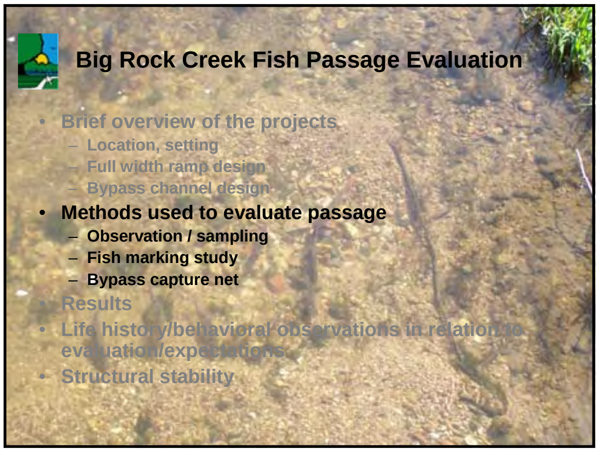

RESTING
POOLS
Plano Dam Ramp


YEAR 1
YEAR 2

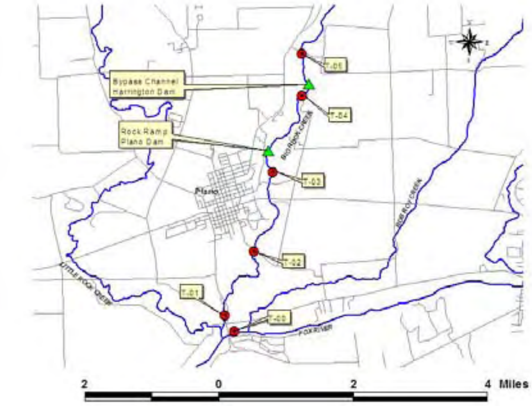

HARRINGTON DAM:
85 ft. W X 2.6 ft. H


Bypass
Channel
Big Rock Creek Fish Passage Project – Harrington Dam
80 tons limestone
1.5 day installation (0.5 day repair/adj.)
Cost $10,000


Upstream
inlet
YEAR 1
YEAR 2
Downstream outlet

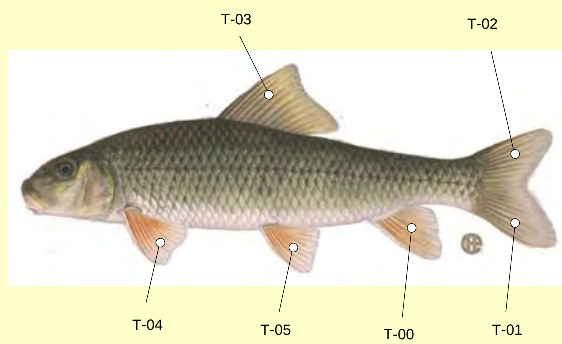


MARKING /OBSERVATION SITES



Fin marking

FIN MARKING – Big Rock Creek Fish Passage Evaluation



BYPASS NET STUDY:

BYPASS CAPTURE NETS

1/8 in. mesh
(2006; April, 2007)

½ in. mesh
(May-July, 2007)

Big Rock Creek Fish Passage Evaluation

- Brief overview of the projects
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  - Observation / sampling
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  - Bypass capture net
- **Results**
- Life history/behavioral observations in relation to evaluation/expectations
- Structural stability

Marking study results:

No. fish marked in Big Rock Creek: 4 Apr – 4 May 2006

Species	No.
Shorthead redhorse	347
Quillback carpsucker	232
Golden redhorse	27
White sucker	11
Smallmouth bass	13
Black redhorse	18
Other species	5
TOTAL	653

Number or Recaptures

Species	No.
Shorthead redhorse	2
Quillback carpsucker	0
Golden redhorse	0
White sucker	0
Smallmouth bass	0
Black redhorse	0
Other species	0
TOTAL	2

Big Rock Creek marking study

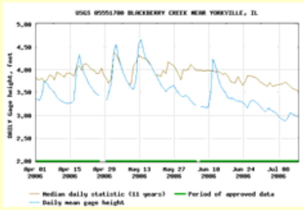
Potential marking problems
- Very large population
- Collection (EF) & marking may retreat from creek

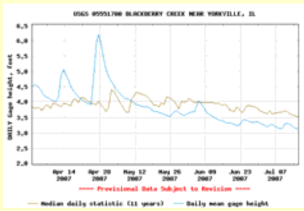
Potential solutions
- Increase number marked
- More permanent marking technique (multiple years)
- More targeted approach

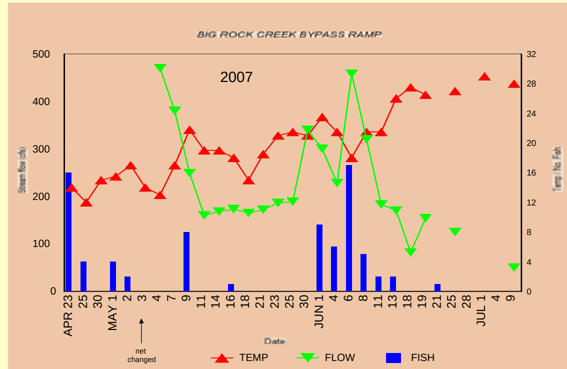
Shorthead redhorse spawning nests

Capture Net Results

Species	2 MAY - 30 JUNE 2006	20 APR- 9 JUL 2007	total
Bluntnose minnow	2	5	7
Sand shiner	1	2	3
Central stoneroller	4	3	7
Hornyhead chub	0	1	1
Creek chub	0	2	2
Common shiner	3	2	5
Blacknose dace	1	0	1
Redfin shiner	1	1	2
Common carp	→ 3	32	35
White sucker	1	1	2
Quillback	0	1	1
Channel catfish	0	10	10
Yellow bullhead	1	0	1
Bluegill	3	10	13
Green sunfish	3	4	7
Rock bass	1	1	2
Orangethroat darter	2	0	2
TOTAL NO.	26	75	101
NO. SPP	13	14	17

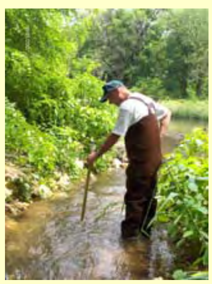


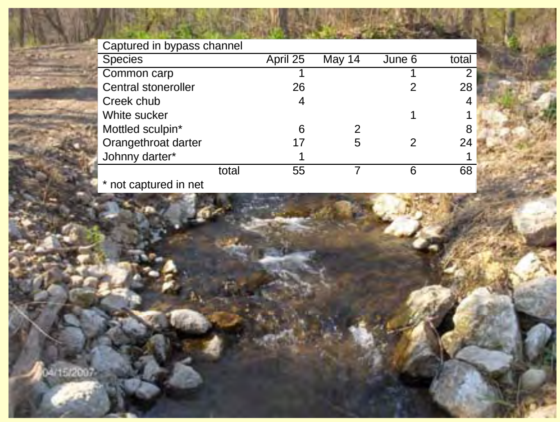




	Vel. ft/sec	
site	0.25 WC	0.5 WC
1	7	11
2	5	8
3	0	6.5
4	5.5	7.5
5	5.5	11
6	4.5	7
7	8	10.5
8	7.5	9
9	3	6.5
10	3	7.5

6 JUN 2007

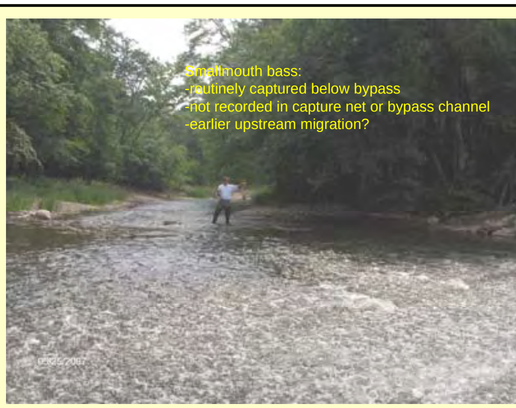


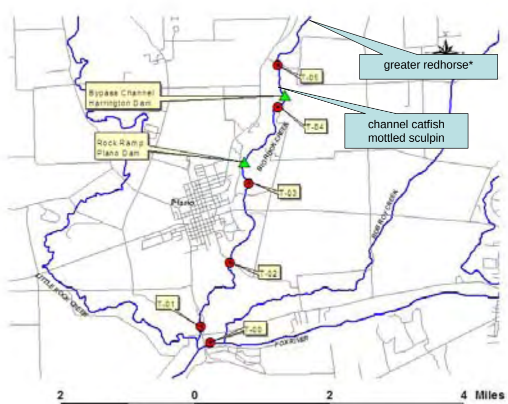


Captured in bypass channel

Species	April 25	May 14	June 6	total
Common carp	1		1	2
Central stoneroller	26		2	28
Creek chub	4			4
White sucker			1	1
Mottled sculpin*	6	2		8
Orangethroat darter	17	5	2	24
Johnny darter*	1			1
total	55	7	6	68

* not captured in net





Big Rock Creek Fish Passage Evaluation

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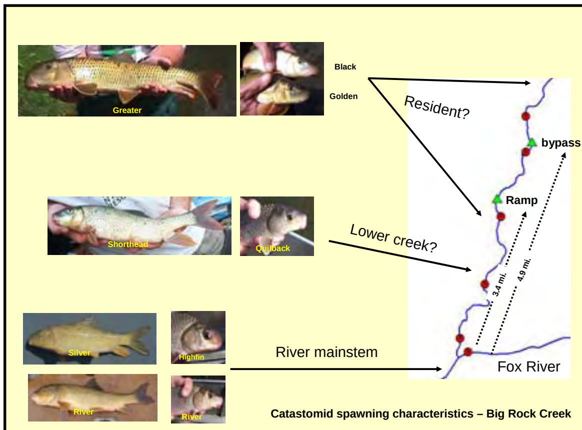
- Results
- **Life history/behavioral observations in relation to evaluation/expectations**
- Structural stability



Catastomid spawning characteristics – Big Rock Creek

Big Rock Creek Fish Passage Evaluation

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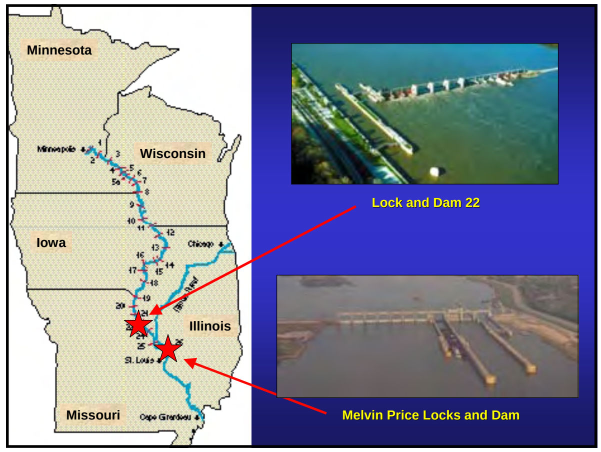
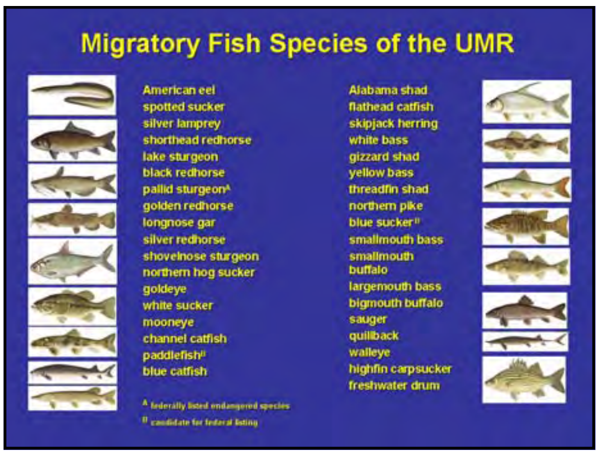
  - Bypass capture net
- Results
- Life history/behavioral observations in relation to evaluation/expectations

- **Structural stability**

Summary

- Full dam ramp: passage for redhorse, channel catfish and many other species based on collections and instream observations
- Bypass channel: passage for 17 species including ‘weak swimmers’ but usage low – position of outlet critical. ‘High flow’ design reduces effectiveness. Located farther upstream from river.
- Fin marking requires large numbers of individuals – may be disruptive to spawning populations
- Visual observation and sampling can determine extent of spawning migration and success of fish passage
- Bypass net very effective method – upstream location provided information on ramp passage
- Movements related to flow levels, temperature
- Knowledge of life history characteristics and spawning habits important in fish passage studies and for setting expectations of effectiveness
- Structural stability - plan for cost increases, use larger stone.

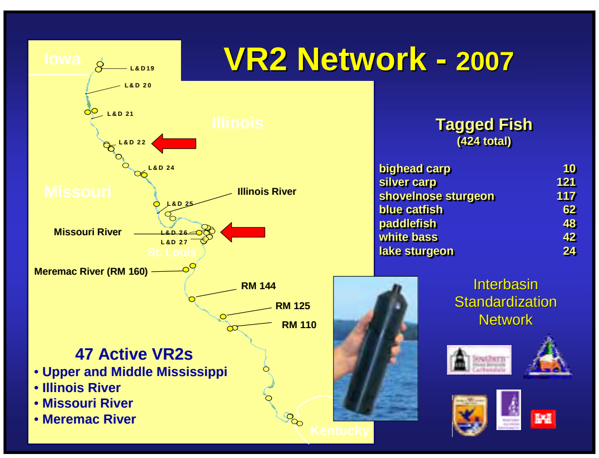


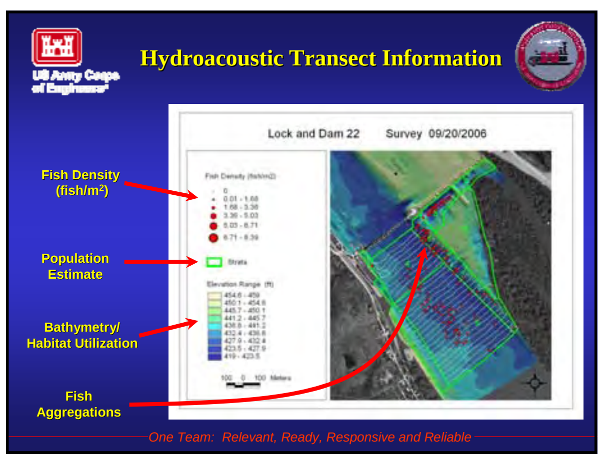


Monitoring plan for fish passage projects

Monitoring Activity	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Objective 1										
Study 1.1 – Geotech Recon	x									
Study 1.2 - Fish aggregations in tailwater	x	x	x	x	x	x	x	x		
Study 1.3 – Hydraulic conditions at aggregation area		x								
Objective 2										
Study 2.1 – Fish movement thru gate openings & lock		x	x	x	x	x	x			
Study 2.1 – Carp capture (if needed)						x	x	x	x	x
Objective 3										
Study 3.1 – Telemetry		x	x	x	x	x	x	x	x	x
Objective 4										
Study 4.1 - Configuration of the downstream opening				x	x					
Objective 5										
Study 5.1 - 2-D hydraulic model	x	x				x				
Study 5.2 - Physical Model (if needed)			x							
Study 5.3 - Water quality monitoring				x	x					
Study 5.4 - as-built survey - bathymetry					x	x		x		x
Study 5.5 - ADCP surveys of fishway					x	x		x		x
Study 5.6 – Structural survey of fishway toe					x	x		x		x
Construction represented by green										

Pre-Construction (Years 1–3) · Construction (Years 4–5) · Post-Construction (Years 6–10)





Fish Location

One Team: Relevant, Ready, Responsive and Reliable

Habitat Utilization

One Team: Relevant, Ready, Responsive and Reliable

Ecohydraulic Indicators

One Team: Relevant, Ready, Responsive and Reliable

One Team: Relevant, Ready, Responsive and Reliable

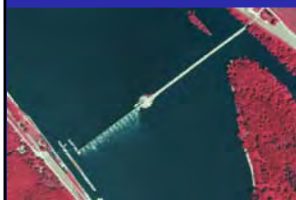
One Team: Relevant, Ready, Responsive and Reliable

Alternatives Considered

Non-Structural
- No project
- Increase open river conditions
- Assisted fish lockage

Structural
- Rock ramps
- Nature like by pass channel on Illinois side
- Technical fishways
- Modified gate bay
- Notches through overflow spillway with and without rock ramp
- Dam removal

Fish Passage: Design Parameters



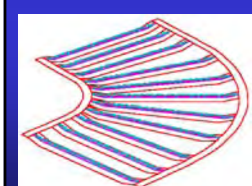
- Head
- Velocity and Depth
- Flow
- Location
- Constraints
  - Operational
  - Maintenance
  - Flood Impact
  - Financial
- Adaptive Management
  - Learning

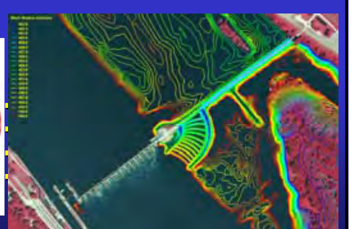
Example Nature-Like Fishway

Location: St. Laurent des Eaux, France
River: Loire
Type: step-pool rock ramp fishway
Slope: 1:50
Headloss: 16in max. per step, 6ft dam height
Width: 52.8ft
Length: 264ft
Flow: 63-835cfs (design), 12,670cfs (mean annual)
Designer: Travade
Picture Source: Travade

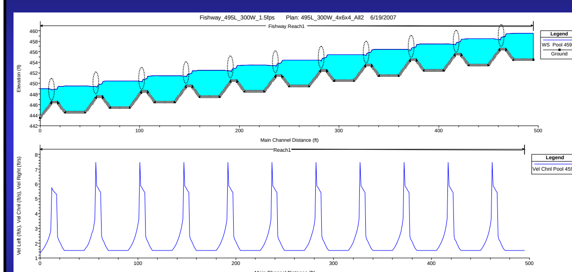
Fit Fishway to the Site
Computer simulation and physical hydraulic models

How much flow will be needed?
How wide should it be?
Will a fishway affect navigation?
How can the design be optimized for fish?
What size does the stone need to be?



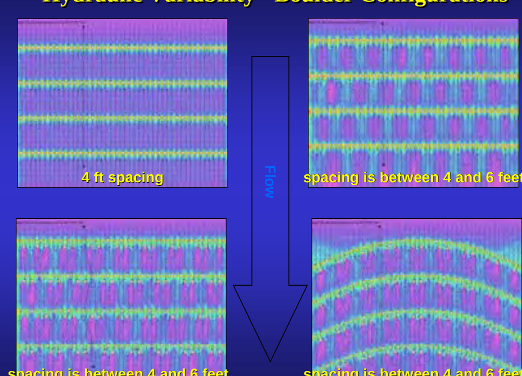


Velocity and Depth
Pool / Boulder Riffle



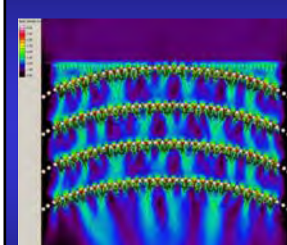
- 5-ft deep pools with 1.5 fps velocity
- Higher velocity through boulder riffles
- Length of pools? and riffles? (2% slope shown)

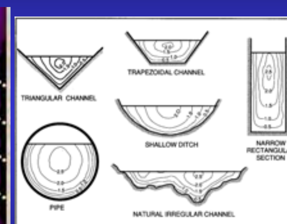
Hydraulic Variability - Boulder Configurations



Velocity & Depth
Adding Hydrodynamic Diversity

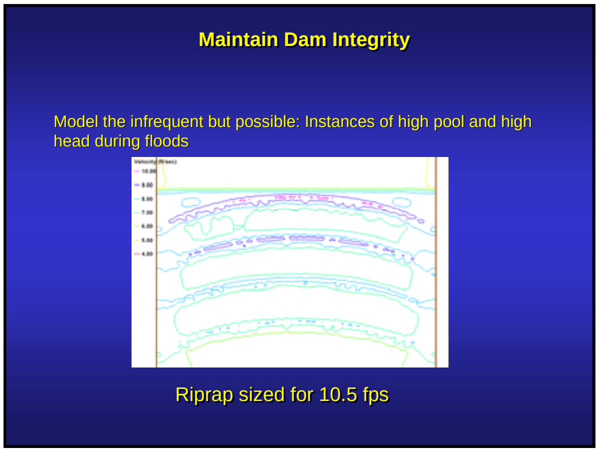
US Army Corps of Engineers

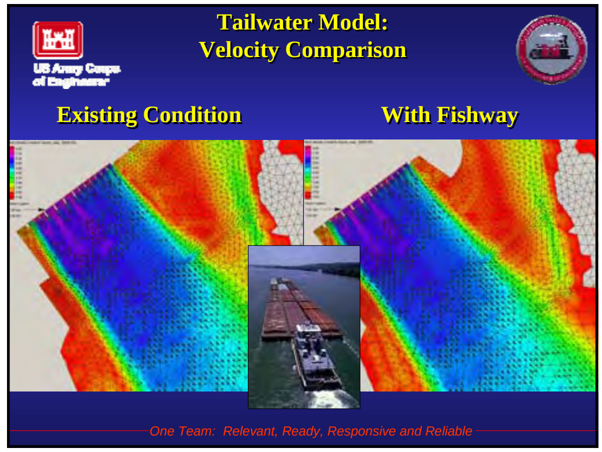


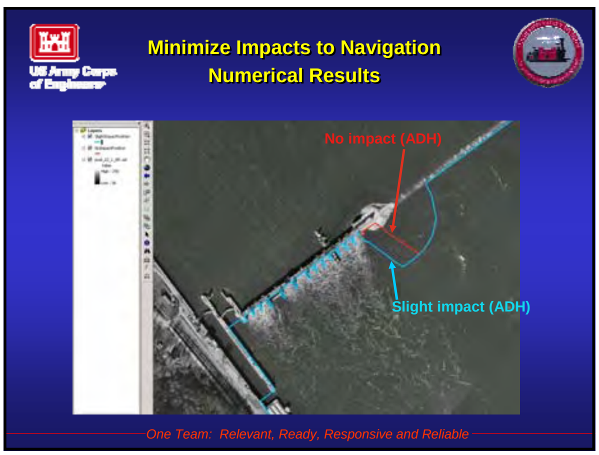


- Vary boulder spacing and have 2nd row of boulders
- Parabolic shape

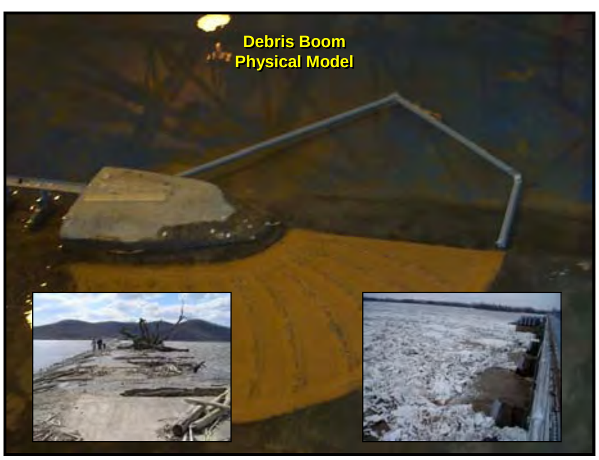
One Team: Relevant, Ready, Responsive and Reliable

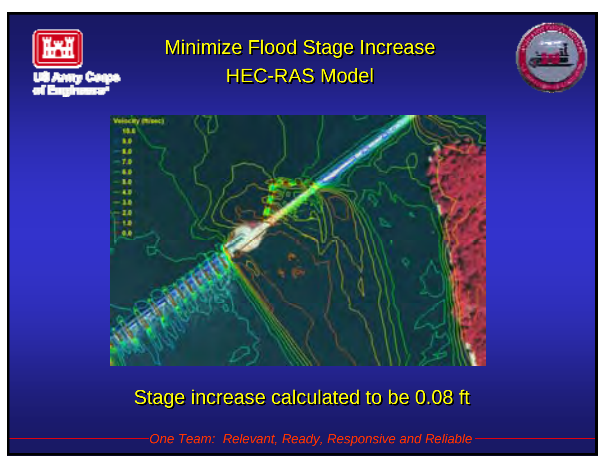

Maintain Dam Integrity
Model the infrequent but possible: Instances of high pool and high head during floods
Riprap sized for 10.5 fps

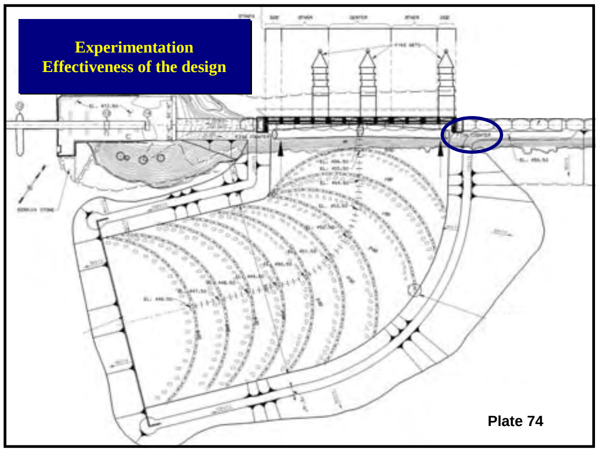

Tailwater Model:
Velocity Comparison
US Army Corps of Engineers
Existing Condition
With Fishway
One Team: Relevant, Ready, Responsive and Reliable

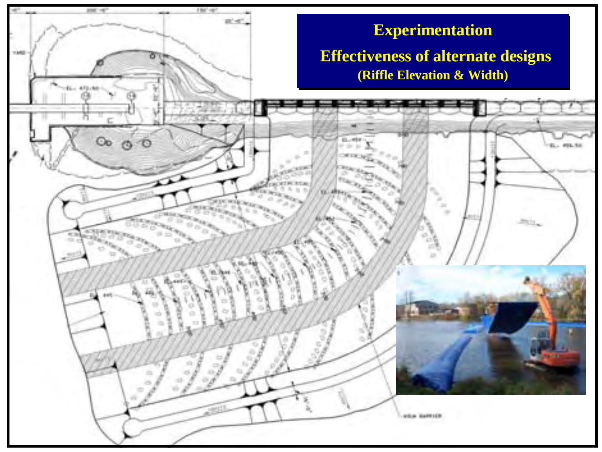

Minimize Impacts to Navigation
Numerical Results
US Army Corps of Engineers
No impact (ADH)
Slight impact (ADH)
One Team: Relevant, Ready, Responsive and Reliable

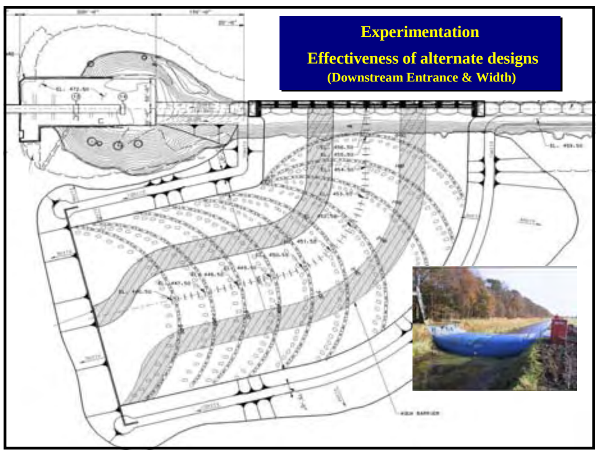

Lock & Dam 22
Physical Model
ERDC
Vicksburg,
Mississippi
(1:120 scale)

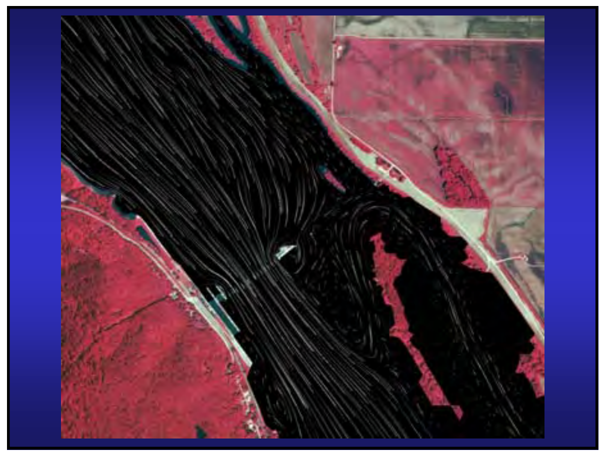

Debris Boom
Physical Model


Minimize Flood Stage Increase
HEC-RAS Model
US Army Corps of Engineers
Stage increase calculated to be 0.08 ft
One Team: Relevant, Ready, Responsive and Reliable

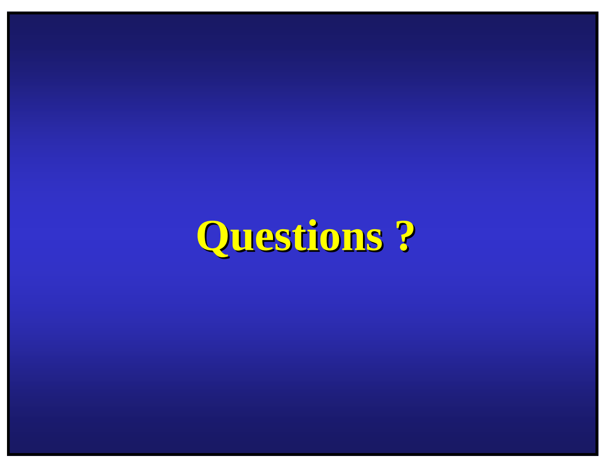

Experimentation
Effectiveness of the design
Plate 74


Experimentation
Effectiveness of alternate designs
(Riffle Elevation & Width)


Experimentation
Effectiveness of alternate designs
(Downstream Entrance & Width)




Schedule
Complete Planning - 2008
Complete Design - 2009
Initiate Construction - 2010

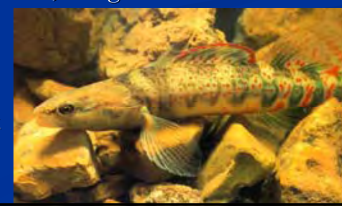

Questions ?

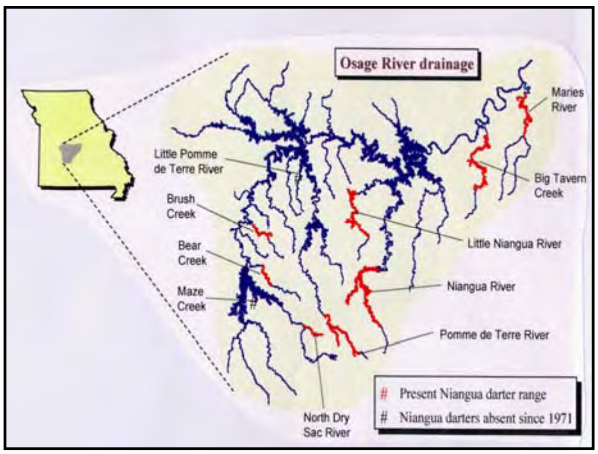
Free span low-water crossings improve passage for threatened Niangua darter

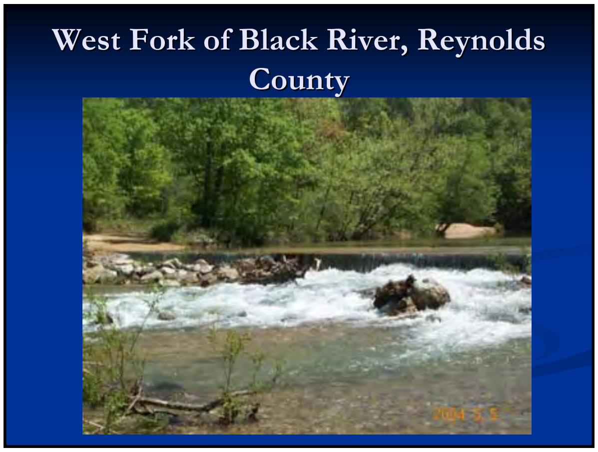
Joanne Grady - U.S. Fish & Wildlife Service
Craig Fuller, John Fantz, Angie Corson, and Doug Novinger – Missouri Department of Conservation

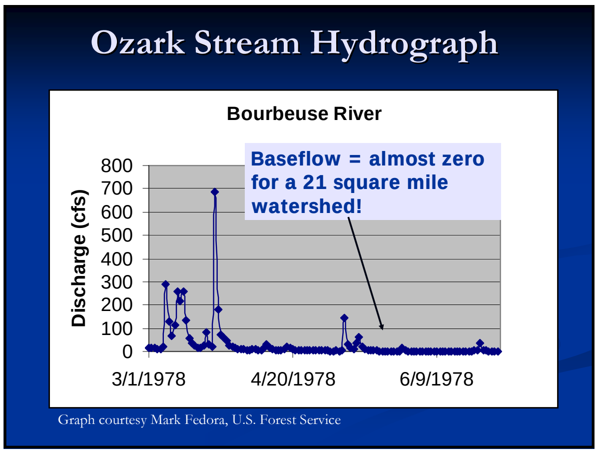
Niangua Darter

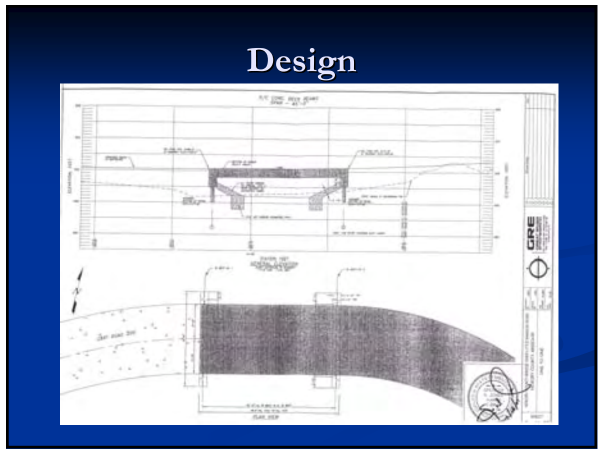
- Prefers clear shallow pools and slow runs in medium sized streams with gravel bottoms. Moves to riffles to spawn.
- Threatened by dam and bridge construction, stream channelization, and gravel removal.
- Also declined following 1940 introduction of spotted and rock basses.

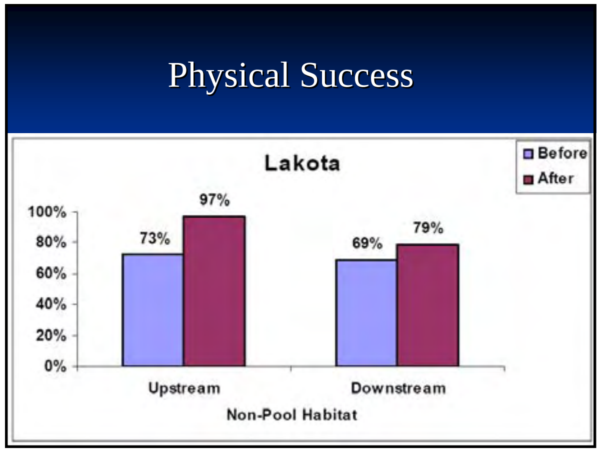


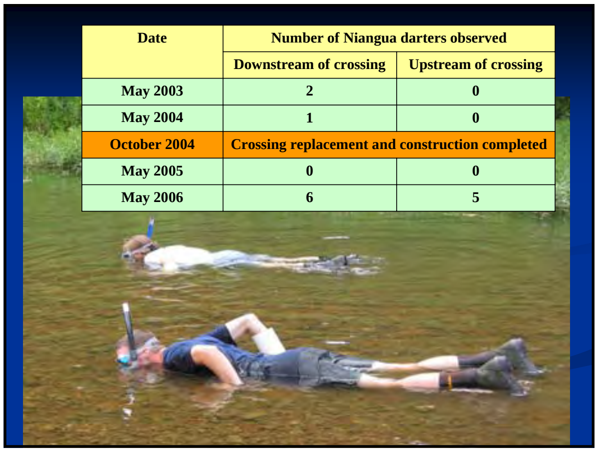



West Fork of Black River, Reynolds County


Ozark Stream Hydrograph
Bourbeuse River
Baseflow = almost zero for a 21 square mile watershed!
Discharge (cfs)
800
700
600
500
400
300
200
100
0
3/1/1978
4/20/1978
6/9/1978
Graph courtesy Mark Fedora, U.S. Forest Service


Design





Date	Number of Niangua darters observed	
	Downstream of crossing	Upstream of crossing
May 2003	2	0
May 2004	1	0
October 2004	Crossing replacement and construction completed	
May 2005	0	0
May 2006	6	5

Biological Success

Niangua Darter abundance increased in 2 of 3 locations following crossing replacement.

Number of Niangua Darters

		Upstream		Downstream	
		Before	After	Before	After
Lakota	(Thomas Creek)	0	5	0	6
Massman	(Little Tavern Creek)	0	0	2	1
Mule Shoe	(Little Niangua River)	1	12	19	22

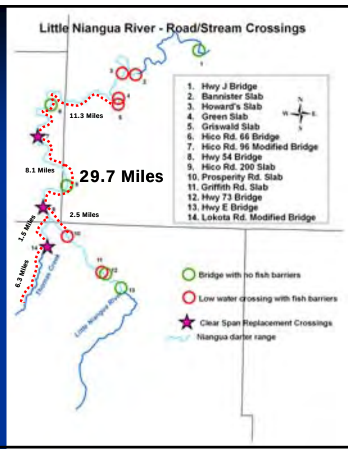
Species richness increased upstream of bridges following crossing replacement.

Species Richness

		Upstream		Downstream	
		Before	After	Before	After
Lakota	(Thomas Creek)	16	20	18	22
Massman	(Little Tavern Creek)	14	20	21	20
Mule Shoe	(Little Niangua River)	13	17	20	20

Hickory County Road 200/ Little Niangua River

Before - - - - August 10, 2007 **After** - - - - November 7, 2007



Prioritizing Crossing Replacements

Total No. of Crossings..........1,791

Within ND Range....................129

Non-State and US Roads..........91

Other known non-LWC.............76

INVENTORY

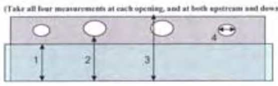
At Each UPSTREAM Opening Measure:
(Fill out chart measurements from **LDB to RDB**; English units to the nearest 1/10 inch)
(See numbered graphic for reference) (Note: if there are no openings only measure #'s 1 and 3 at lowest point on deck up and down)

1.Water Depth (channel bottom to water surface)						
2.Opening Perch (channel bottom to bottom of opening)						
3.Height of Bridge (channel bottom to top of deck)						
4.Size of Opening (round-diameter, other-L and W)						
Opening blockage (% plugged by sediment: 0-25, 25-50, 50-75, 75-100)						

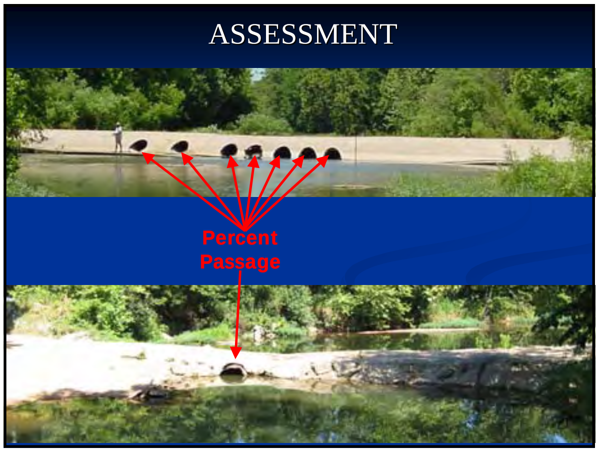
At Each DOWNSTREAM Opening Measure:
(Fill out chart measurements from **LDB to RDB**; English units to the nearest 1/10 inch)

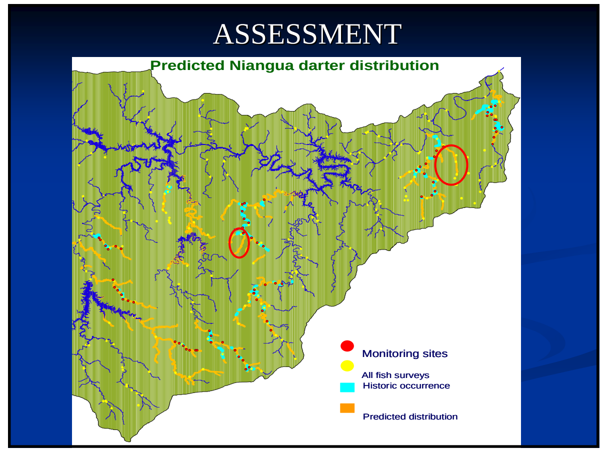
1.Water Depth (channel bottom to water surface)						
2.Opening Perch (channel bottom to bottom of opening)						
3.Height of Bridge (channel bottom to top of deck)						
4.Size of Opening (round-diameter, other-L and W)						
Opening blockage (% plugged by sediment: 0-25, 25-50, 50-75, 75-100)						

(Take all four measurements at each opening, and at both upstream and downstream side of crossing)



ASSESSMENT





Success through Partnerships!

- Great River Engineering
- Dallas County Commission
- Hickory County Commission
- Missouri Conservation Heritage Foundation – Stream Stewardship Trust Fund
- Missouri Department of Conservation
- U.S. Fish & Wildlife Service
- FEMA

Assessment of Mottled Sculpin (*Cottus bairdi*) Movement in a 1st order Tributary

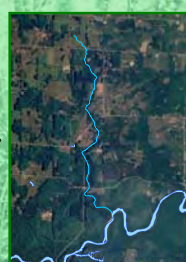
Using PIT Telemetry, and Habitat and Prey Evaluation

Jason DeBoer
and Dr. Eric Snyder
Grand Valley State University, Allendale, MI
and
Marty Holtgren, Stephanie Ogren
Little River Band of Ottawa Indians, Manistee, MI

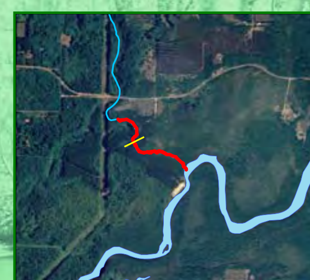
Intro

- Why are sculpin cool?
  - Important link
    - Numerically dominant in many small streams
    - Forage for larger salmonids
  - Understudied
    - More "charismatic" species

Study Site



Study Site, con't

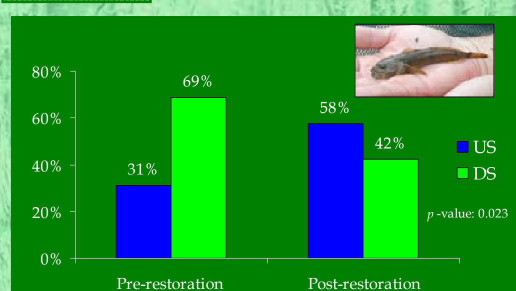


Study Site, con't

- Small culverts, 1 perched at low flow

- Fall 2005 – open bottom bridge installed

Impetus



Why?

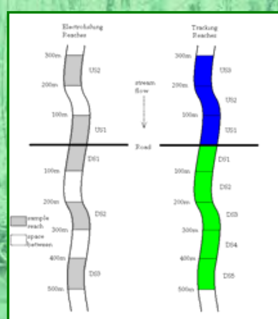
- Habitat?
- Forage?
- Other?

Purpose

- Determine how much and how far sculpin move in this system.
- Determine if they move to a certain location.
- Determine why they move there.

Study Design

- ~100m reaches
  - 3 up, 5 down
- 95 sculpin
  - 10 each DS
  - ~15 each US

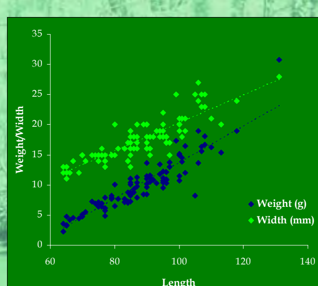


Study Design, con't

- Measured
  - length
  - weight
  - head width
- Implanted with PIT tag (Ruetz III *et al*, 2006)
  - Biomark, TX1411SST
  - 12.5mm X 2.07mm
  - 0.102g

Study Design, con't

- Mean TL: 88.0±1.4mm
- Mean weight: 10.1±0.4g
- Mean head width: 17.5±0.4mm



Study Design, con't

- Tracking
  - triangle wand
    - 4-6" detection
  - Hand-held GPS (differentially corrected post-collection, <1m acc.)
  - 1-2x monthly (summer/early fall 2007; 7 times)

Results

- 88 tags (7 drops)
  - 44 fish recap'd
  - 82 recap events

  - 40 recaps US, (~350m) = 0.114 recaps/m
  - 18 fish US = 0.051 fish/m
  - 42 recaps DS, (~600m) = 0.07 recaps/m
  - 26 fish DS = 0.043 fish/m

Purpose

- Determine how much and how far sculpin move in this system.
- Determine if they move to a certain location.
- Determine why they move there.

Results

of 41 US fish

18 recaps (44%)

12 stayed home (67%)

3: 0 mov't (25%)

9 moved w/in (75%)

6 moved out (33%)

3 moved down (50%)

2 moved downstream (67%)

1 stayed upstream (33%)

3 moved up (50%)

Results

of 47 DS fish

26 recaps (55%)

16 stayed home (62%)

3: 0 mov't (16%)

13 moved w/in (84%)

10 moved out (38%)

8 moved up (80%)

3 moved upstream (38%)

5 stayed downstream (62%)

2 moved down (20%)

Results

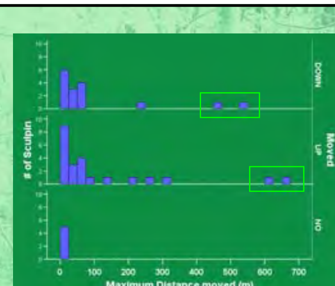
- US
  - 67% reach fidelity
  - 89% section fidelity (stayed upstream)
- DS
  - 62% reach fidelity
  - 88% section fidelity (stayed downstream)

InCapRch	N	Mean	Std. Error
US1	5	170.6	101.0
US2	8	82.5	54.8
US3	5	34.2	13.4
DS1	4	113.5	49.7
DS2	4	26.0	15.2
DS3	4	179.0	147.5
DS4	7	28.4	9.5
DS5	7	180.7	91.6
Total	**44**	**100.5**	**25.2**

- US: 95.8 ± 56.4m
- DS: 105.5 ± 62.7m

Results

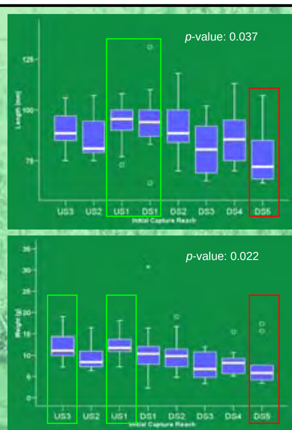
- <10m: 20 (45.4%)
- 10-100m: 15 (34.1%)
- >100m: 9 (20.5%)
  - >400m: 4 (9.1%)



- Up: n=23; 125.7 ± 39.7m; median = 49.5m
- Down: n= 16; 102.9 ± 40.9m; median = 34.5m

Results

- Movement variables ***not*** dependant on any size variable.
- Significant differences in length/ weight for ICR.



Other Literature

- Movement not based on size (Breen *et al;* Keeler).
- Petty and Grossman found it was:
  - juveniles more mobile than small or large adults
  - most of our sculpin likely adults
- Distance/directional bias corroborated by Breen *et al.*
  - 16% >100m (20.5%)
  - Both small (2-5m) streams in MI
- ↑ than Petty and Grossman
  - Rocky stream in Appalachians

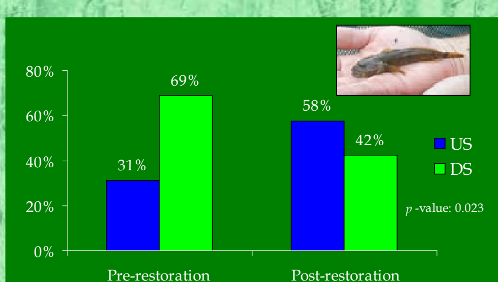
Results

- Possible interaction with the Big Manistee (or upstream reaches of Sickle Creek)?
- Summer '07 electrofishing:
  - 5 of 8 reaches electrofished (3-pass, blocker nets)
  - 54 of 82 recap events (65.9%) in those 5 reaches
  - 850 sculpin captured
  - Only 5 had tags

Purpose

- Determine how much and how far sculpin move in this system.
- Determine if they move to a certain location.
- Determine why they move there.

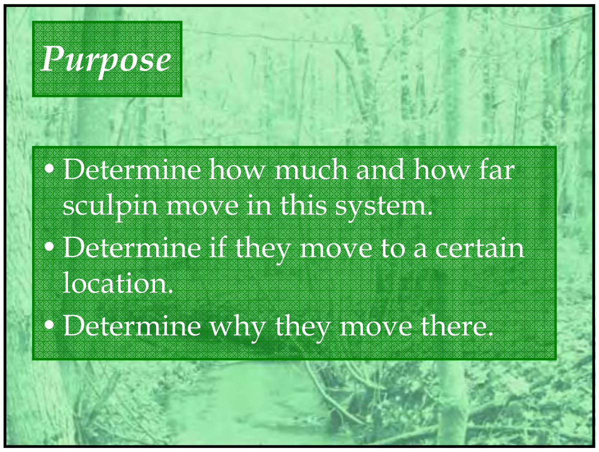
Results

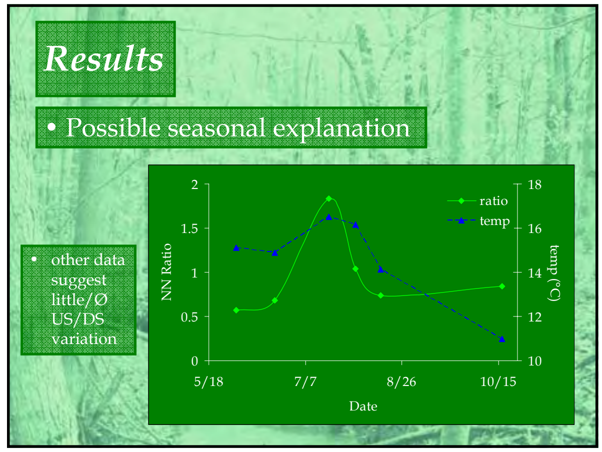


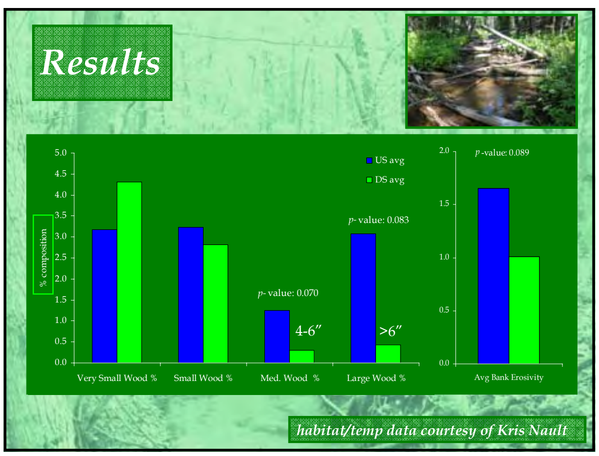
Results

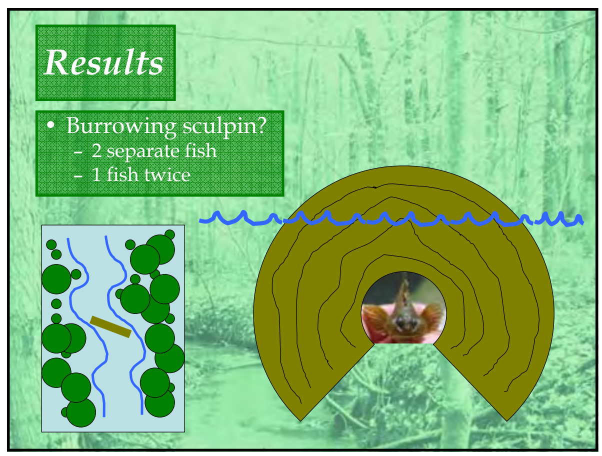
- ArcMap
  - Nearest Neighbor Ratio

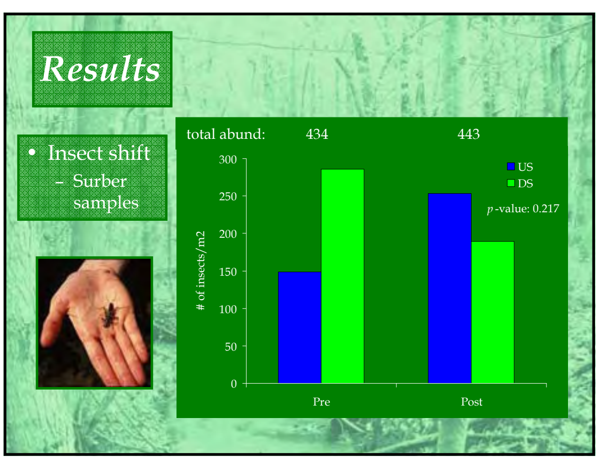
recap3	1.834	most clustered
recap4	1.043	↑
recap6	0.844	
recap5	0.736	
recap2	0.685	↓
recap1	0.572	least clustered

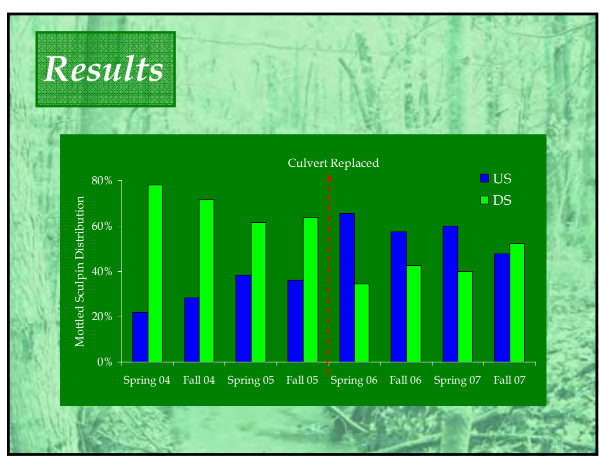

Purpose
• Determine how much and how far sculpin move in this system.
• Determine if they move to a certain location.
• Determine why they move there.

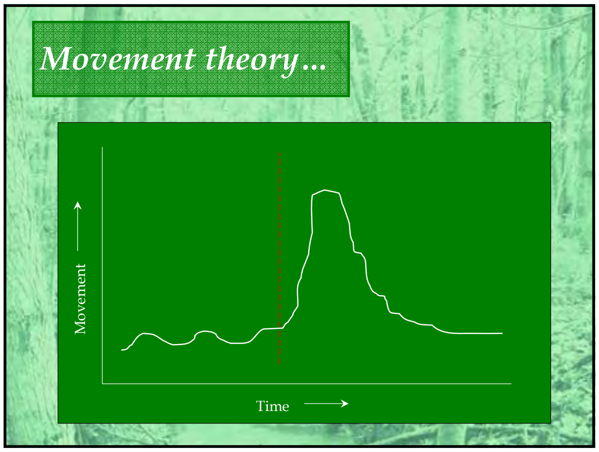

Results
• Possible seasonal explanation
• other data suggest little/Ø US/DS variation
ratio
temp
NN Ratio
temp (°C)
Date
5/18
7/7
8/26
10/15

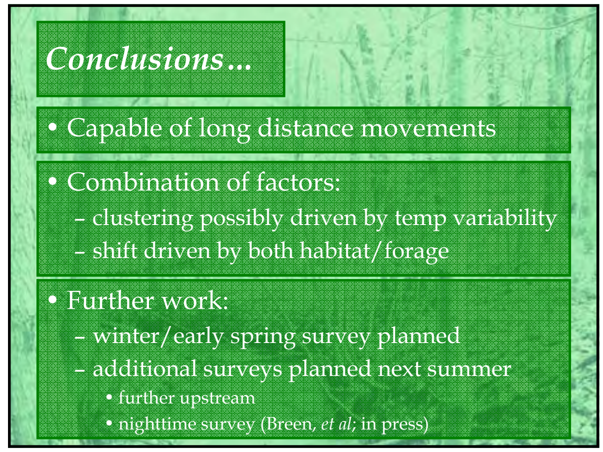

Results
US avg
DS avg
% composition
p- value: 0.070
p- value: 0.083
p -value: 0.089
4-6″
>6″
Very Small Wood %
Small Wood %
Med. Wood %
Large Wood %
Avg Bank Erosivity
habitat/temp data courtesy of Kris Nault


Results
• Burrowing sculpin?
– 2 separate fish
– 1 fish twice


Results
• Insect shift
– Surber samples
total abund:
434
443
US
DS
p -value: 0.217
# of insects/m2
Pre
Post


Results
Culvert Replaced
US
DS
Mottled Sculpin Distribution
Spring 04
Fall 04
Spring 05
Fall 05
Spring 06
Fall 06
Spring 07
Fall 07


Movement theory…
Movement
Time


Conclusions…
• Capable of long distance movements
• Combination of factors:
– clustering possibly driven by temp variability
– shift driven by both habitat/forage
• Further work:
– winter/early spring survey planned
– additional surveys planned next summer
• further upstream
• nighttime survey (Breen, *et al*; in press)


Acknowledgements
• Funding provided by:
– Little River Band of Ottawa Indians
– U.S. EPA Targeted Watershed Grant
– U.S. Forest Service Centennial Funding
– U.S Fish and Wildlife Service Tribal Wildlife Grant


Questions?
Suggestions?

18 Mile Creek Fish Passage Restoration

Ashland National Fish and Wildlife Conservation Office

Ted Koehler and Glenn Miller

18 Mile Creek Location

Top Secret!

18 Mile Creek Location

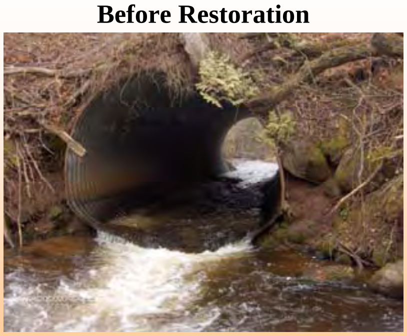
Bad River / Lake Superior Watershed

Bad River Watershed

- **1,054 Square Miles**
- **1,500 Stream Miles**
- **1,122 Crossings**
- **Many Partners**

18 Mile Culvert

Before Restoration

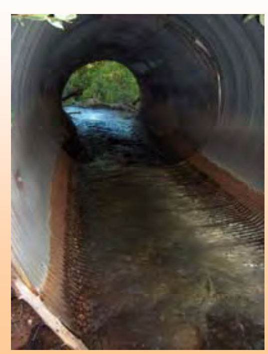


Perched

18 Mile Culvert

Before Restoration

- **Velocity Barrier**
- **Deterioration of Pipe – Center Collapsing**



Planning and Design

- Coordination with Town of Grandview and other Partners
- Stream Profile Survey
- Design Assistance from ABDI-LCD and NRCS

Construction

12 Foot Diameter Pipe

Construction

Removal of Old Pipe and Creation of Bypass Channel

Construction

Removal of the Old Pipe

Construction

Excavation to a Fish Friendly Elevation

Construction

Excavation to a Fish Friendly Elevation

Construction

Massive Pieces of Concrete Buried at Site

Construction

Turning Big Rocks into Little Rocks

Construction

Stream Bypass Channel

Construction

Dropping in the First 40 Foot Section

Construction

Banding Together the 2 Sections

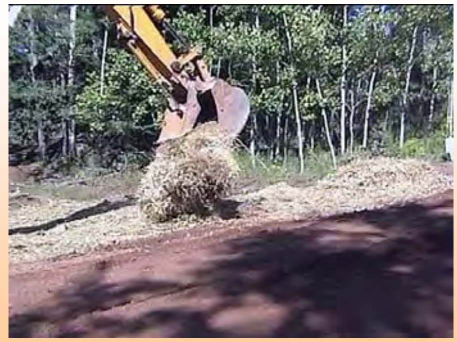
Construction

Compaction of Clean Fill Around Pipe

Construction

Upstream Current Break

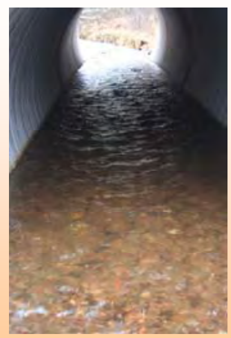
Construction



Mega Mulcher

18 Mile Culvert – Restored

18 Mile Culvert – Restored



Center of Pipe – Gravel Bottom Throughout

18 Mile Culvert – Restored

Outlet of Pipe

Project Assessment

Pre-construction Marking Run – 30 Aug. 2007

- 172 Trout Captured

- 4 Brook Trout
- 168 Brown Trout

- All Given an Upper Caudal Fin Clip

Project Assessment

Pre-construction Marking Run – 30 Aug. 2007

- All Trout > 6 Inches (150 mm) Moved Below the Barrier
- 1 Brook Trout
- 57 Brown Trout

Project Assessment

Post-construction Recapture Run – 11 Oct. 2007

- 113 Total Trout, 8 Brook and 105 Brown Trout
- 26 Total Recaptures
- All Recaptures - Brown Trout
- 20 Recaptures Over 6 Inches (150 mm) Found Above Culvert

Project Assessment

Post-construction Recapture Run – 11 Oct. 2007

Our results indicate that at least 35% of the fish which were moved below the barrier, successfully negotiated the new culvert.

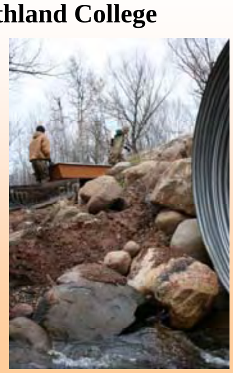
Project Assessment

Assistance From Northland College

Fisheries Science and Management – Fall 2007

Project Assessment

Assistance From Northland College



- Most Important Reason for Enthusiastic Students

18 Mile Fish Passage Restoration Partners

- Town of Grandview
- USFWS – Ashland NFWCO
- USFWS – R3 Fish Passage Program
- USFWS – Partners for Fish & Wildlife Program
- ABDI – Land Conservation Department
- Northland College
- USDA – NRCS
- Wisconsin Department of Natural Resources
- K & D Excavating

A Decision Tree for Rapidly Assessing (Some) Risks of Aquatic Invasive Species Impacts in Aquatic Organism Passage Projects

Mike Hoff
U.S. Fish and Wildlife Service
Fisheries and Aquatic Resources Program
Midwest Regional Office
Fort Snelling, MN

Planning and Compliance of Proposed Passage Projects

- Before an aquatic organism passage (AOP) project begins with FWS (or other Federal) support, historical and environmental concerns must, by policy and law, be considered.

Planning and Compliance of Proposed Passage Projects

- All projects intended to pass aquatic species below or above barriers should be expected to result in environmental impacts.
- Net environmental impacts may be either positive or negative.

Planning and Compliance of Proposed Passage Projects

- Environmental impacts that should be considered, when deciding whether to proceed with a project, include:
  - Temperature
  - Contaminants
  - Sediments and turbidity
  - Diseases
  - Genetics
  - Community structure
  - T&E species
  - Nonnative species
  - And cumulative impacts of those listed above (and barrier passage projects planned above or below the proposed project site).

All Dams are not "Damns"

- Not all barriers to aquatic organism passage have net negative impacts
- Some barriers protect stream sections from negative impacts of AIS (and other factors that degrade native species populations and their habitats)
  - Particularly true where AIS have been introduced since barrier construction
    - e.g., Great Lakes and Mississippi River Basins

All Dams are not "Damns"

- For example,
  - Electrical barriers in the Chicago Sanitary and Ship Canal were constructed to minimize risks of exchange of AIS between the Great Lakes and Mississippi River Basins
  - Many barriers in the Great Lakes block sea lamprey from potential spawning grounds

All Dams are not "Damns"

- For Example:
  - The State of MN has worked effectively with their Congressional delegation to authorize, via WRDA, an Asian Carp barrier in the Mississippi River mainstem

Planning and Compliance of Proposed Passage Projects

- Compliance with Federal and some state laws is required under certain circumstances to ensure that a decision to proceed with a project will most probably result in net environmental benefits.

Risk Assessments: Integrating with Planning and Compliance of Proposed Passage Projects

- My experience is that risk assessment is a tool that has greater potential than has been realized to assist decisions on whether to proceed with a project.
- I have seen planning for a single basin by
  - one group to install a barrier
  - and another group to remove all barriers

Risk Assessments: Integrating with Planning and Compliance of Proposed Passage Projects

- A simple DECISION TREE is presented for use in considering project risks of negative impacts resulting from AIS.

Risk Assessments: Integrating with Planning and Compliance of Proposed Passage Projects

- That decision tree can be adapted to evaluate risk of potential project impacts on other components of aquatic ecosystems.
- Risks of all impacts need to be considered together when deciding whether a project will be funded and executed.

Risk Assessments: Integrating with Planning and Compliance of Proposed Passage Projects

- The decision tree presented is a guide
  - Is meant to provide structure to consideration of AIS issues in relation to fish passage projects
    - Specifically, it is intended to help planners recognize, early in the planning process, where AIS risk is high
      - And thus, minimize time and effort spent planning a project that poses a high and possibly unacceptable risk of AIS impacts

Overview of the Approach

- Collect and organize, analyze, and synthesize data and information
- Enlist an expert in AIS issues
  - Categorize risk for each element in the Risk Assessment
  - Categorize uncertainty

Expert Opinions Needed

- Not all people involved in Organism Passage Projects have expertise to conduct a rapid risk assessment of AIS impacts
- Seek input from experts

Basis of Approach and Definitions

- Reference:
  - Risk Assessment and Management Committee. 1996. Generic nonindigenous aquatic organisms risk analysis review process: Submitted to the Aquatic Nuisance Species Task Force. U.S. Government Printing Office, Washington, DC.

Definitions

- Risk
  - Low = acceptable risk; organism of little concern; preventing spread is not a priority
  - Medium = unacceptable risk; organism of moderate concern; preventing spread and impact is a priority
  - High = unacceptable risk; organism of major concern; could cause catastrophic effects; preventing spread and impact is a very priority

Definitions

- Introduction = act of transporting/allowing an organism into a habitat
- Establishment = the state when natural recruitment maintains a population of an organism
- Negative Impact = unacceptable damage to native species populations and/or their habitats

Types of Uncertainty

- Process (methodology)
- Assessor (human error)
- About organism (biological and environmental)

Statistical Error Types

- Type I
  - False positive
    - Stating that a difference occurs when there is none
- Type II
  - False negative
    - Stating that no difference occurs when there is one

AIS Error Types

- In relation to AIS impacts in AOP projects,
  - Must most guard against a form of Type II error in risk assessment, which is a
    - Finding low risk of significant AIS impact, when significant impact truly will occur

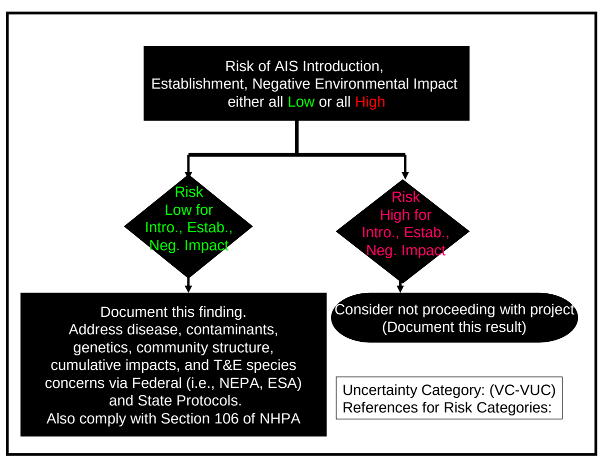
Uncertainty Categories

- Very Certain
- Reasonably Certain
- Moderately Certain
- Reasonably Uncertain
- Very Uncertain

References for Risk Categories

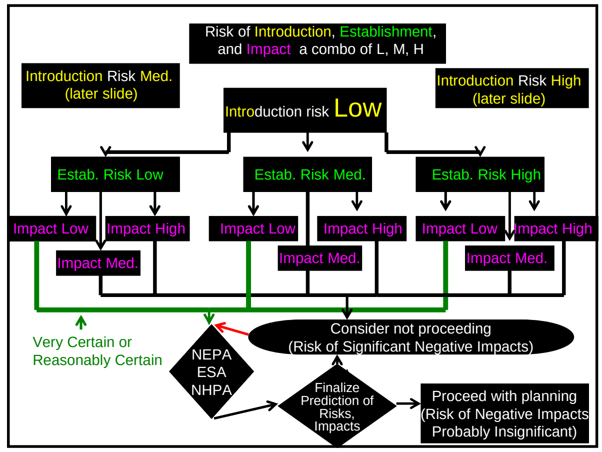
- Document References for Risk Categories. Types of References include:
  - General Knowledge, no specific source
  - Judgmental evaluation
  - Extrapolation – information specific to pest not available; however, information available on similar organisms applied
  - Literature Cited

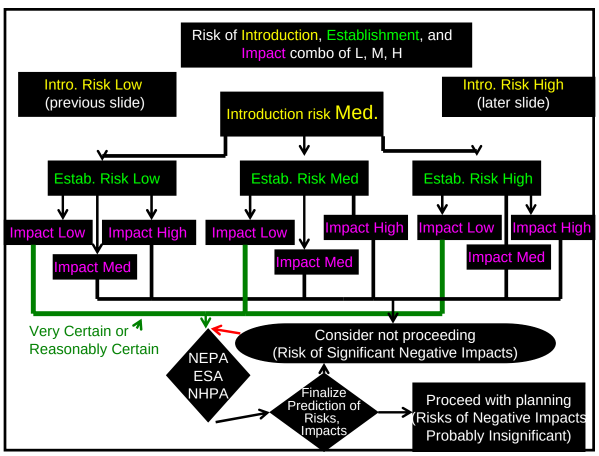
The most important slide…

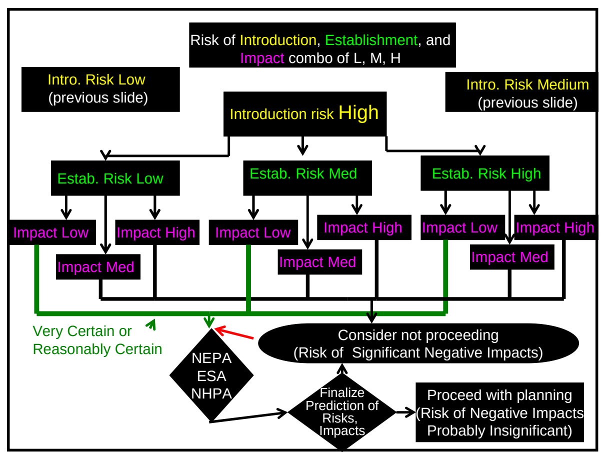


If your quick Risk Assessment results in a finding of either mixed risk levels for Introduction, Establishment, and Spread, or Uncertainty is High

- Then you probably need more:
  - Detailed risk assessment analyses, and
  - Detailed environmental compliance analysis and documentation
  - but here are three additional decision tree slides, anyway







The Decision Tree was based on

- My Risk Tolerance
  - A risk level for impact of Medium or High, irrespective of the risks of Introduction and Establishment
    - Resulted in my conclusion to “Consider not proceeding - (Unacceptable risks of significant negative impacts)”
    - That is because I used my version of the Precautionary Principle

Hoff’s Definitions: Precautionary Principle

- Precautionary Principle (or approach):
  - Definition:
    - The most conservative approach may need to be taken, when either
      - Prediction of negative impact is either Medium or High, irrespective of risks of introduction and establishment, or
      - Uncertainty is medium or high

Decision Tree is Intended as a Guide

- The decision tree presented is a guide
  - Can be modified to different (i.e., even lower, or higher, if you dare) risk tolerance than mine
  - Is meant to provide structure, early in the planning process, to consideration of AIS issues in relation to fish passage projects

Decision Tree is Intended for Use by

- Biologists with adequate understanding of AIS issues in the subject aquatic ecosystem

Decision Tree Strengths, Weaknesses

- Strengths
  - Quick, and probably reasonably precise conclusions
    - For Expert assignment of High and Low Risk Categorization
- Weaknesses
  - More difficult to conduct a Risk Assessment for Medium or mixed risks (of introduction and establishment)
  - More detailed and formal risk assessment is (probably) needed to sort through the details in Medium and mixed risk situations
    - E.g., NEPA analysis

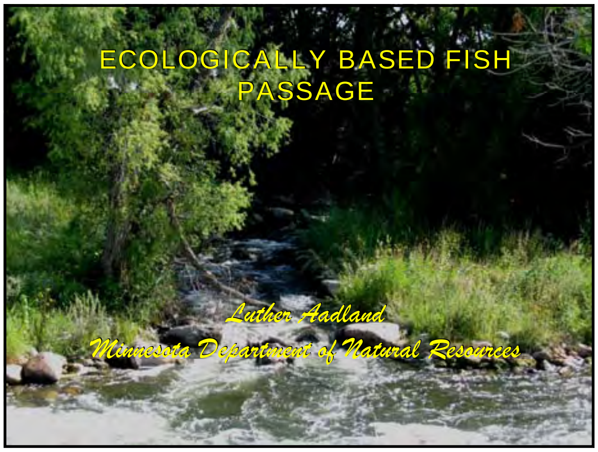
A Final Word

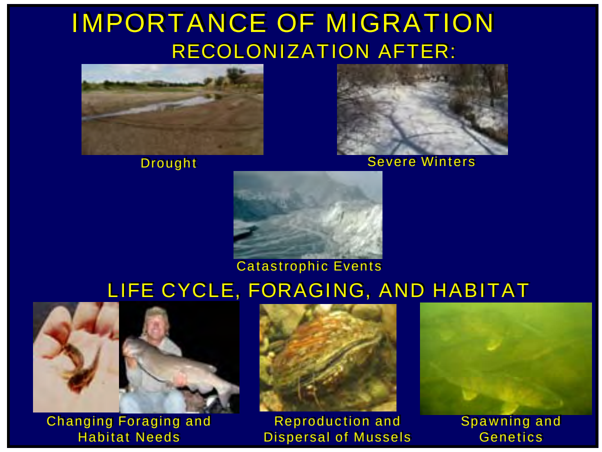
- Risk assessments cannot determine the acceptable level of risk.
- What risk, or how much risk, is acceptable depends on how a person, or agency perceives those risks.
- Risk levels deemed acceptable are value judgments that are characterized by variables and approaches beyond the analysis and synthesis of the systemic information.

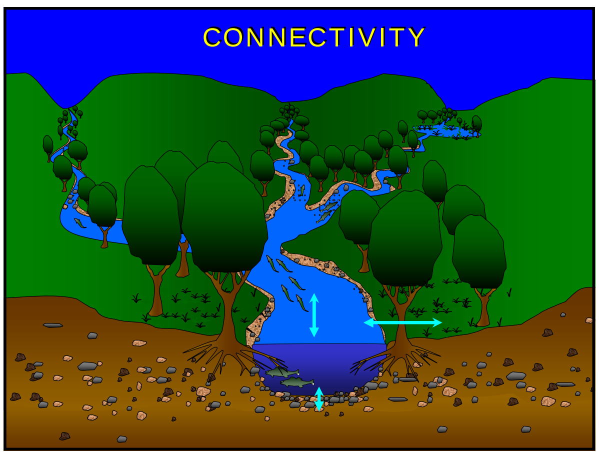
Contact information
Michael_Hoff@fws.gov
612-713-5114

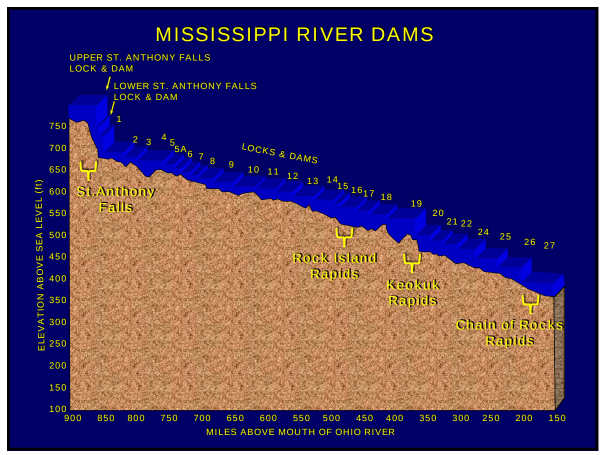
NEPA – the Umbrella

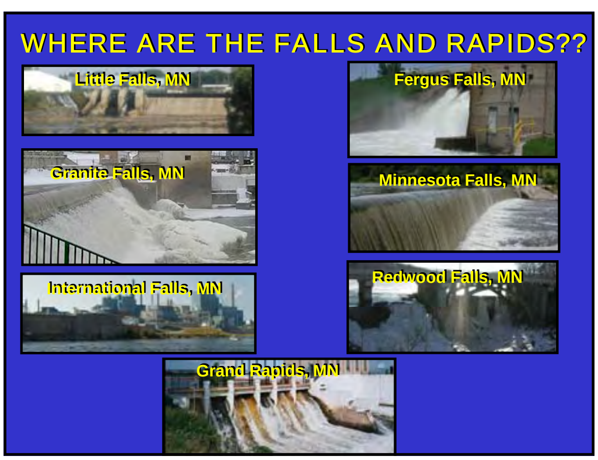
- Must look at all impacts of action
- Requires that all other compliance issues be addressed including:
  - – Endangered Species Act
  - – National Historic Preservation Act
  - – Executive order 11990 - Wetlands
  - – Executive order 11988 - Floodplains
  - – Executive order 12898 - Environmental Justice
  - – Section 504 - Accessibility


ECOLOGICALLY BASED FISH PASSAGE
Luther Aadland
Minnesota Department of Natural Resources

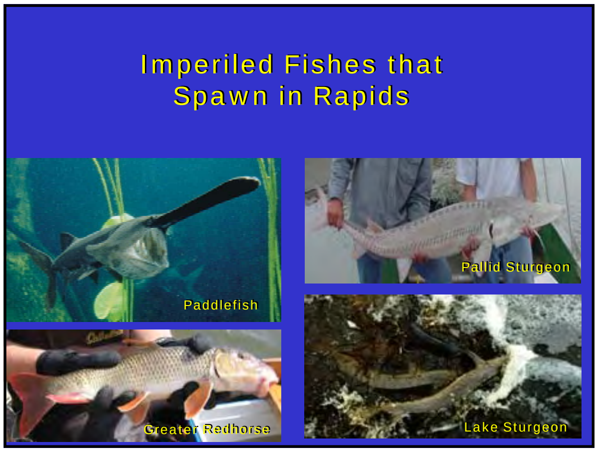

IMPORTANCE OF MIGRATION
RECOLONIZATION AFTER:
Drought
Severe Winters
Catastrophic Events
LIFE CYCLE, FORAGING, AND HABITAT
Changing Foraging and Habitat Needs
Reproduction and Dispersal of Mussels
Spawning and Genetics


CONNECTIVITY


MISSISSIPPI RIVER DAMS
UPPER ST. ANTHONY FALLS LOCK & DAM
LOWER ST. ANTHONY FALLS LOCK & DAM
LOCKS & DAMS
St. Anthony Falls
Rock Island Rapids
Keokuk Rapids
Chain of Rocks Rapids
ELEVATION ABOVE SEA LEVEL (ft)
MILES ABOVE MOUTH OF OHIO RIVER

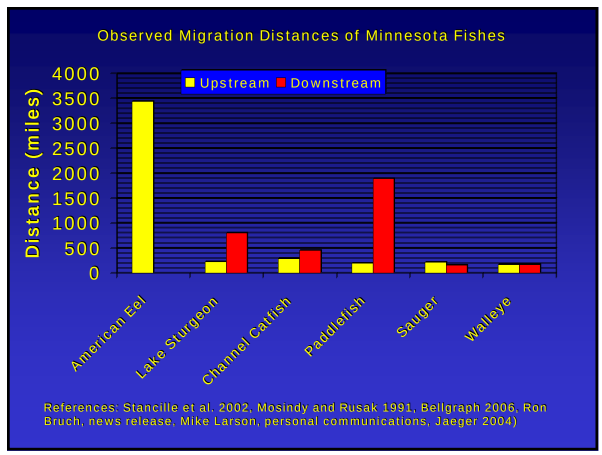

WHERE ARE THE FALLS AND RAPIDS??
Little Falls, MN
Fergus Falls, MN
Granite Falls, MN
Minnesota Falls, MN
International Falls, MN
Redwood Falls, MN
Grand Rapids, MN


St. Anthony Falls, Mississippi River
International Falls, Rainy River

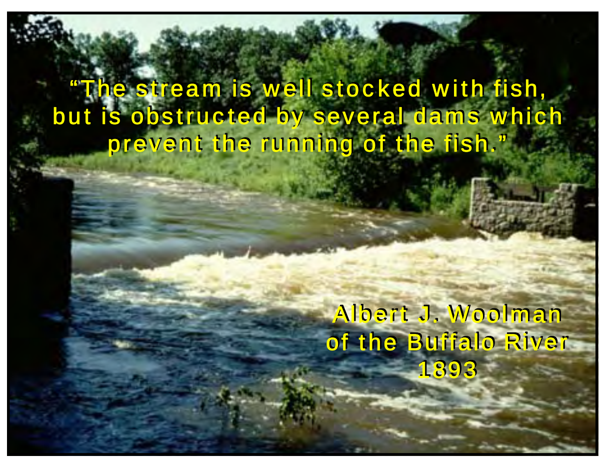

Imperiled Fishes that
Spawn in Rapids
Paddlefish
Pallid Sturgeon
Greater Redhorse
Lake Sturgeon


176 pound lake sturgeon from White
Earth Lake, May, 1926
406 pound lake sturgeon from the
Roseau River, October, 1903
The last lake sturgeon recorded from
the Red River of the North Basin was
caught in 1947

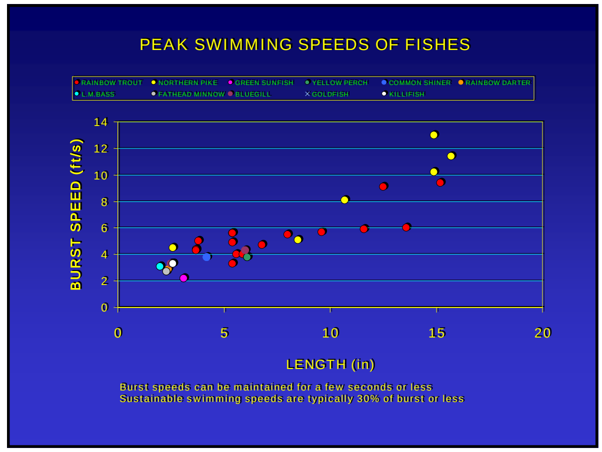

DAMS
RED LAKE RIVER
RED RIVER OF THE NORTH
EAST GRAND FORKS
WILD RICE
RIVER
RED RIVER
MOORHEAD
RED RIVER
BRECKENRIDGE
BUFFALO
RIVER
OTTER TAIL
RIVER
HABITAT IN THE RED RIVER BASIN

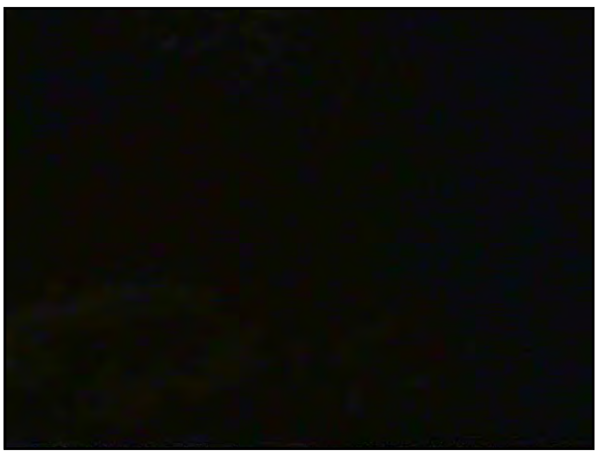

Observed Migration Distances of Minnesota Fishes
Upstream
Downstream
Distance (miles)
4000
3500
3000
2500
2000
1500
1000
500
0
American Eel
Lake Sturgeon
Channel Catfish
Paddlefish
Sauger
Walleye
References: Stancille et al. 2002, Mosindy and Rusak 1991, Bellgraph 2006, Ron
Bruch, news release, Mike Larson, personal communications, Jaeger 2004)

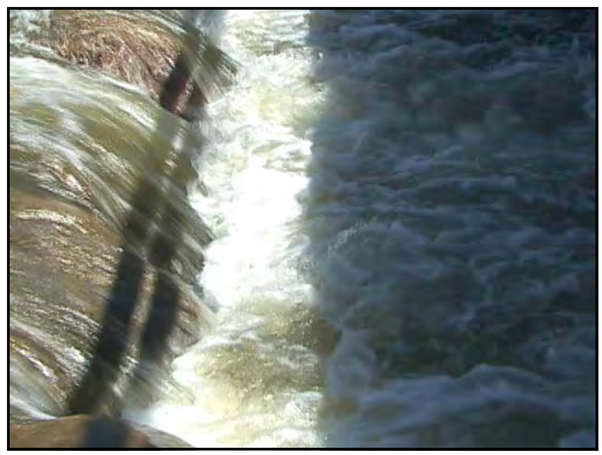

Appleton Mill Dam and River Restoration
Before Removal
After Removal
After Removal and River Restoration

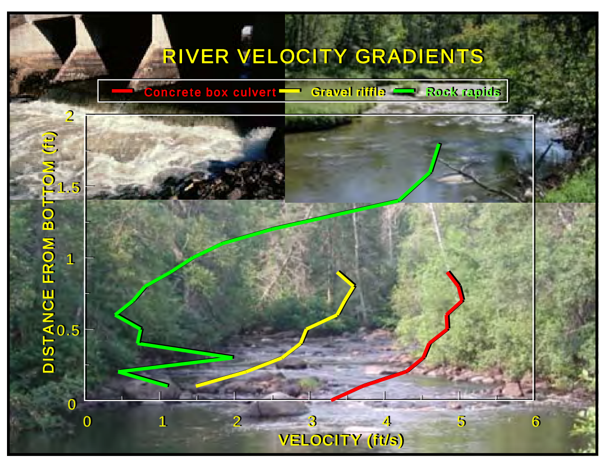

"The stream is well stocked with fish,
but is obstructed by several dams which
prevent the running of the fish."
Albert J. Woolman
of the Buffalo River
1893


ELIZABETH DAM AND FISH LADDER
PELICAN RIVER
(Built 1929)

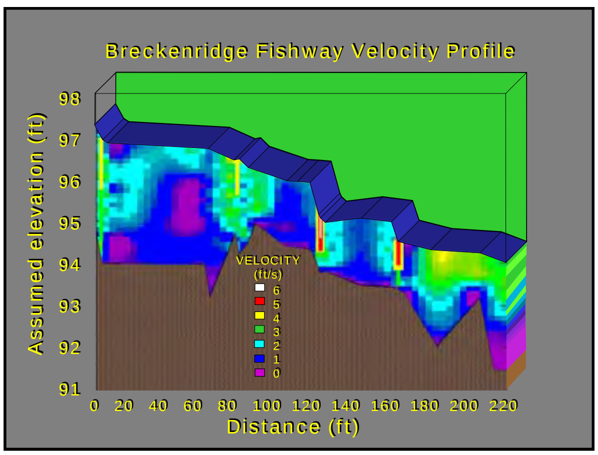

PEAK SWIMMING SPEEDS OF FISHES
RAINBOW TROUT
NORTHERN PIKE
GREEN SUNFISH
YELLOW PERCH
COMMON SHINER
RAINBOW DARTER
L.M.BASS
FATHEAD MINNOW
BLUEGILL
GOLDFISH
KILLIFISH
BURST SPEED (ft/s)
14
12
10
8
6
4
2
0
0
5
10
15
20
LENGTH (in)
Burst speeds can be maintained for a few seconds or less
Sustainable swimming speeds are typically 30% of burst or less



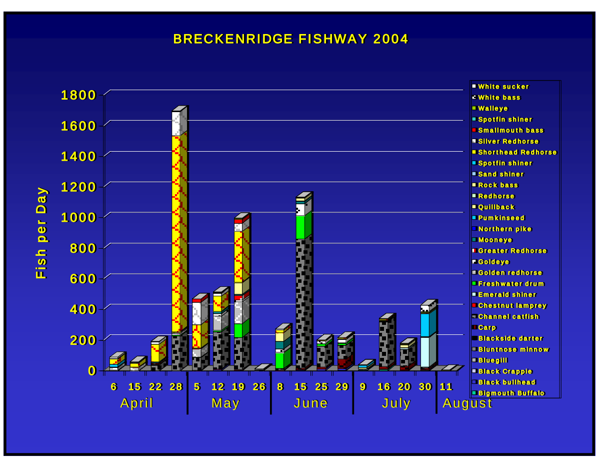



RIVER VELOCITY GRADIENTS
Concrete box culvert
Gravel riffle
Rock rapids
DISTANCE FROM BOTTOM (ft)
2
1.5
1
0.5
0
0
1
2
3
4
5
6
VELOCITY (ft/s)

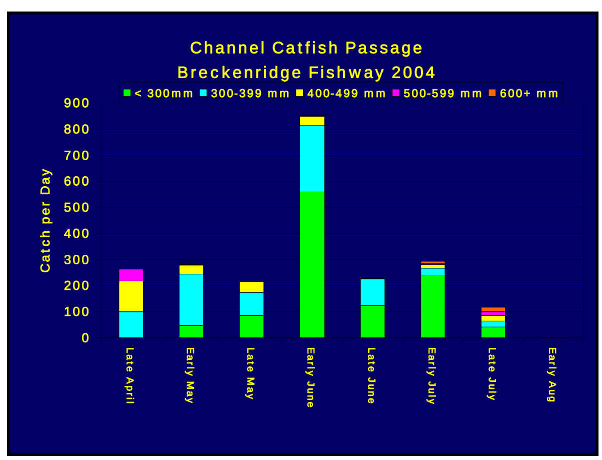
Breckenridge Fishway
Year: 1996
Dam maximum head loss = 7 feet
350 tons fieldstone, 300 yards clay
$20,000
Tom Rickles, Wilkin County, Project Engineer



Breckenridge Fishway Velocity Profile
Assumed elevation (ft)
98
97
96
95
94
93
92
91
VELOCITY (ft/s)
6
5
4
3
2
1
0
0 20 40 60 80 100 120 140 160 180 200 220
Distance (ft)

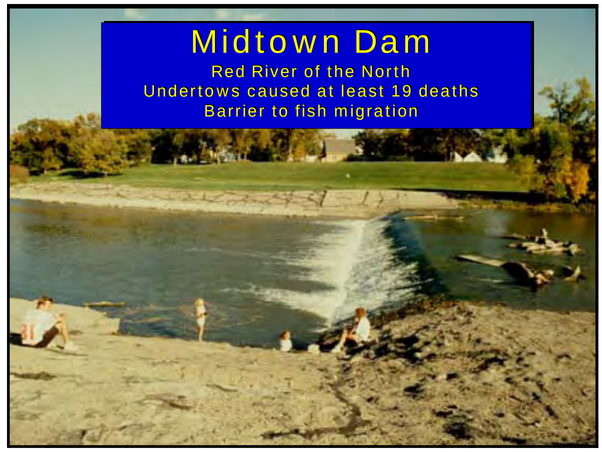


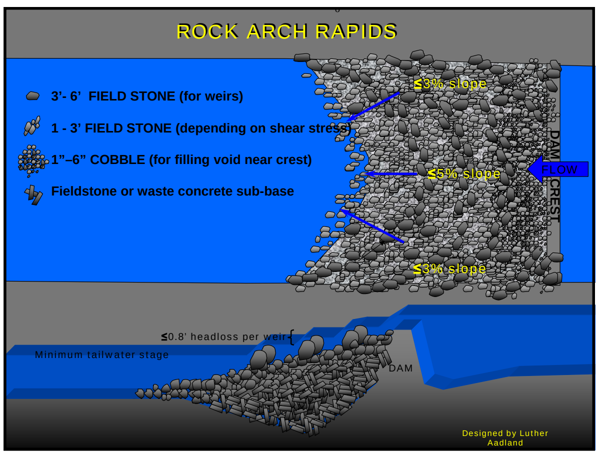
BRECKENRIDGE FISHWAY 2004
Fish per Day
1800
1600
1400
1200
1000
800
600
400
200
0
6 15 22 28 5 12 19 26 8 15 25 29 9 16 20 30 11
April
May
June
July
August
White sucker
White bass
Walleye
Spotfin shiner
Smallmouth bass
Silver Redhorse
Shorthead Redhorse
Spotfin shiner
Sand shiner
Rock bass
Redhorse
Quillback
Pumkinseed
Northern pike
Mooneye
Greater Redhorse
Goldeye
Golden redhorse
Freshwater drum
Emerald shiner
Chestnut lamprey
Channel catfish
Carp
Blackside darter
Bluntnose minnow
Bluegill
Black Crappie
Black bullhead
Bigmouth Buffalo

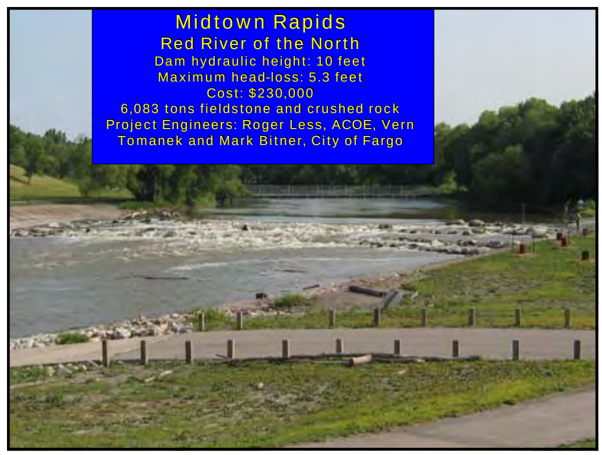


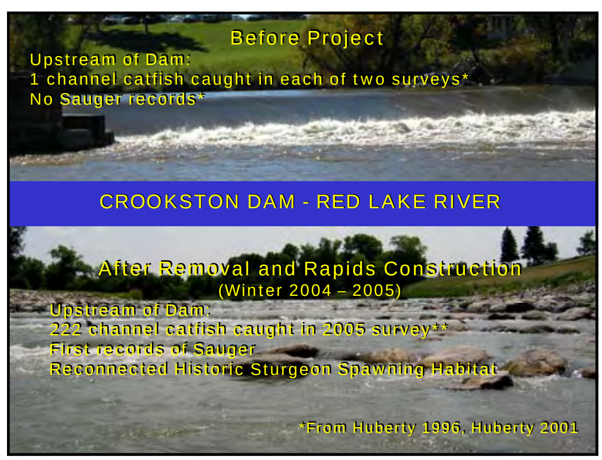
Channel Catfish Passage
Breckenridge Fishway 2004
< 300mm
300-399 mm
400-499 mm
500-599 mm
600+ mm
Catch per Day
900
800
700
600
500
400
300
200
100
0
Late April
Early May
Late May
Early June
Late June
Early July
Late July
Early Aug


PASSAGE OBSERVATIONS
Large numbers of Y-O-Y fish
Large numbers of juvenile fish
Large numbers of "non-migratory" fish
Catches of small fish underestimate numbers passed due to predation in net


Midtown Dam
Red River of the North
Undertows caused at least 19 deaths
Barrier to fish migration

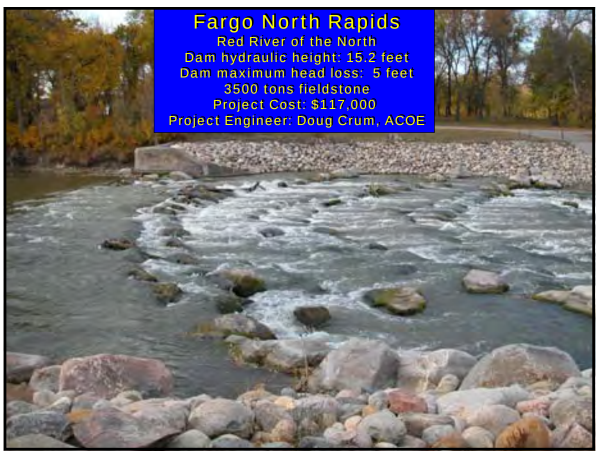

ROCK ARCH RAPIDS
3'- 6' FIELD STONE (for weirs)
1 - 3' FIELD STONE (depending on shear stress)
1"–6" COBBLE (for filling void near crest)
Fieldstone or waste concrete sub-base
≤3% slope
≤5% slope
≤3% slope
FLOW
DAM CREST
≤0.8' headloss per weir
Minimum tailwater stage
DAM
Designed by Luther Aadland

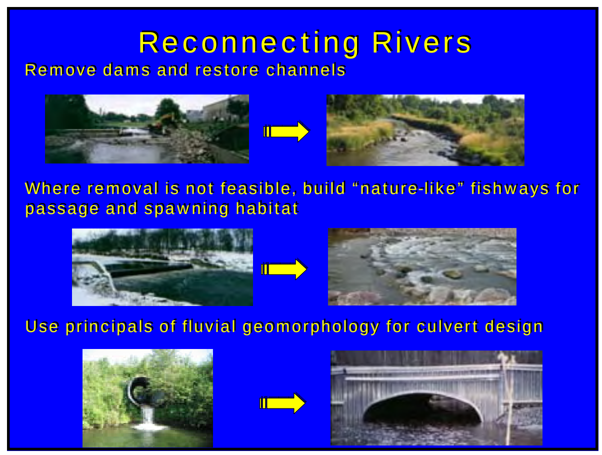

Midtown Rapids
Red River of the North
Dam hydraulic height: 10 feet
Maximum head-loss: 5.3 feet
Cost: $230,000
6,083 tons fieldstone and crushed rock
Project Engineers: Roger Less, ACOE, Vern Tomanek and Mark Bitner, City of Fargo

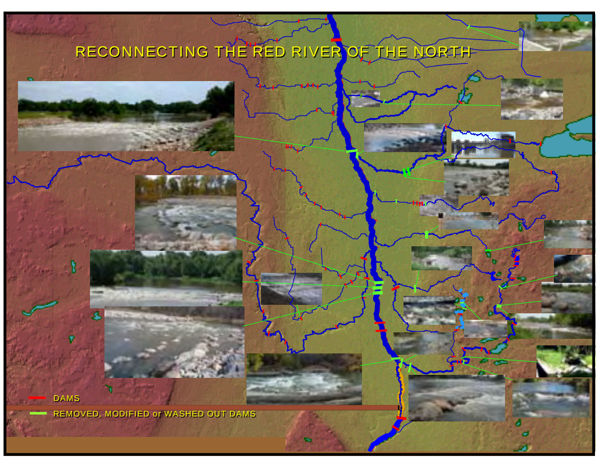

Before Project
Upstream of Dam:
1 channel catfish caught in each of two surveys*
No Sauger records*
CROOKSTON DAM - RED LAKE RIVER
After Removal and Rapids Construction
(Winter 2004 – 2005)
Upstream of Dam:
222 channel catfish caught in 2005 survey**
First records of Sauger
Reconnected Historic Sturgeon Spawning Habitat
*From Huberty 1996, Huberty 2001


Species Observed Passing
Our Nature-like Fishways
QUILLBACK
SAND SHINER
CHESTNUT LAMPREY
EMERALD SHINER
SPOTFIN SHINER
GREATER REDHORSE
STONECAT
YELLOW BULLHEAD
CARP
ROCKBASS
FATHEAD MINNOW
SPOTTAIL SHINER
BLACKSIDE DARTER
MUSKELUNGE
FRESHWATER DRUM
SHORTHEAD REDHORSE
HORNYHEAD CHUB
BLUNTNOSE MINNOW
WALLEYE
SILVER REDHORSE
SILVER LAMPREY
SAUGER
BIGMOUTH BUFFALO
NORTHERN HOG SUCKER
BLACK BULLHEAD
CHANNEL CATFISH
MOONEYE
COMMON SHINER
NORTHERN PIKE
WHITE BASS
BLACK CRAPPIE
PUMPKINSEED
LAKE STURGEON
CENTRAL STONEROLLER
GOLDEN REDHORSE
SMALLMOUTH BASS
GOLDEYE
WHITE SUCKER


LAKE STURGEON SPAWNING HABITAT
STURGEON RIVER, ONTARIO
GLIDE
LITTLE FORK RIVER
BOULDER EDDY
LITTLE FORK RIVER
BELOW CASCADE
RAPID RIVER
BELOW CASCADE IN BOULDER EDDIE


Fargo North Rapids
Red River of the North
Dam hydraulic height: 15.2 feet
Dam maximum head loss: 5 feet
3500 tons fieldstone
Project Cost: $117,000
Project Engineer: Doug Crum, ACOE

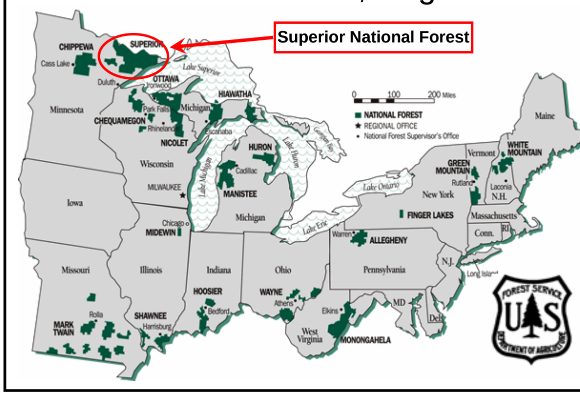

Reconnecting Rivers
Remove dams and restore channels
Where removal is not feasible, build “nature-like” fishways for passage and spawning habitat
Use principals of fluvial geomorphology for culvert design


RECONNECTING THE RED RIVER OF THE NORTH
DAMS
REMOVED, MODIFIED or WASHED OUT DAMS

Managing for Aquatic Organism Passage on the Superior National Forest

Jason Butcher, Ken Gebhardt, Marty Rye
USDA Forest Service
Superior National Forest

US Forest Service, Region 9



- Over 3400 miles of stream (22% of R9)
- Over 1600 stream crossings
- 10% to 13% of stream crossings on the Superior NF have passage issues
- Approximately 30% have other habitat degradation associated with crossings
- Stream crossings are one of our largest impacts to aquatic habitat on the Superior NF

SUPERIOR National Forest

Overview

1. Aquatic Passage Program Summary
2. Project Examples
3. Lessons Learned

Aquatic Passage Program Summary

- Coarse level surveys
- Prioritize
- Focused surveys / Design data collection
- Design
- Implementation
- Monitoring

Coarse level field surveys

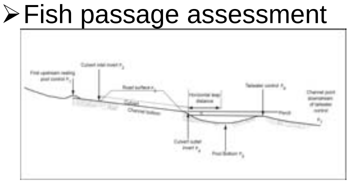
- Consists of site visit and mostly qualitative survey for:
  - Site information
  - Geomorphology
  - Culvert stats & conditions
  - Road conditions
  - Photos
- 750 crossings surveyed (of 1600) since 2002

Prioritization

- Rank and/or scale the course level factors to identify "problem" crossings
- TES/NNIS habitat or connection
- Number of culvert crossings/barriers above or below
- Consideration of other priorities:
  - Available Funding
  - Location
  - Engineer needs and scheduling
  - Other resource area needs
  - Agency/District/Forest Priorities

Focused Field Surveys

- Done on a subset of coarse survey sites
- Survey data
  - Riffle cross-sections
  - Longitudinal profile
- Substrate analysis
- Fish passage assessment



Design

"Stream Simulation" is the goal:

- **Match bankfull width**
- **Maintain stream gradient**
- **Maintain flood flow capacity**

Sizing & Placement of Stream Culverts

The Stream Will Tell You!

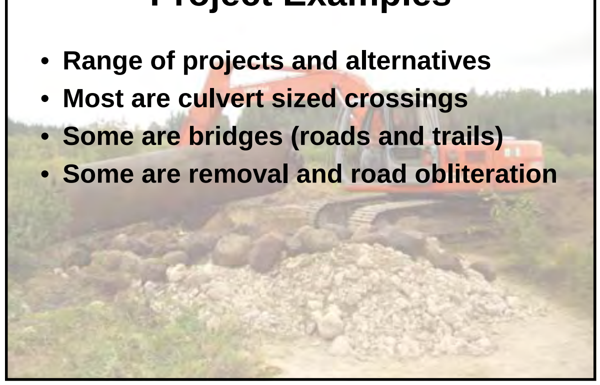
- **M**atch Culvert Width to Bankfull Stream Width
- **E**xtend Culvert Length through side slope toe
- **S**et Culvert Slope same as Stream Slope
- **B**ury Culvert 6" to 1' (2'-6' Culverts. Dig 1'-1.5' below bottom)
- **O**ffset Multiple Culverts (floodplain ~ splits lower buried one) (higher one ~ 1 ft. higher)
- **A**lign Culvert with Stream (or dig with stream sinuosity)
- **C**onsider Cut-offs and head cuts

(modified from Verry, 2002)

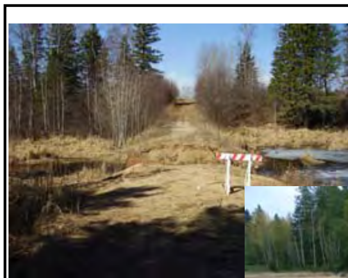
Monitoring

- **Photo points**
- **Pre- and Post-project (yr 2 and 5):**
  - **Cross-sections above and below structure**
  - **Longitudinal profiles**
  - **Substrate analysis**
- **Future goals in Biological Monitoring:**
  - **Validating pre and post fish movement**

Project Examples



- **Range of projects and alternatives**
- **Most are culvert sized crossings**
- **Some are bridges (roads and trails)**
- **Some are removal and road obliteration**




Road Removal

Tait River, 1935

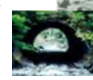
Bridge (19'span)

Tait River, 1955

Bridge (19'span)

Culvert (12' span)

Tait River, 2001

Bridge (19'span)

Culvert (12' span)

Bridge (24'span)

Blind Temperance History

1930's: Bridge
1950's: Culvert

1977 project file: ".. Existing culvert (6') was broken into two sections, washed downstream 200 to 500 feet, and is not salvagable. Survey and design, replace with larger capacity culvert, remove old bridge timbers and existing culvert…

1988 project file: ".. Immediate repair of the damage to the crossing (8') is important to minimize sediment problems resulting from the existing washouts" replaced w/ 8' culvert"…

Blind Temperance 2001

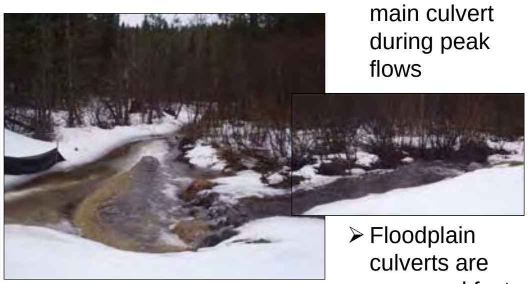

Photos – John Olson

Timber Bridges

Other benefits to floodplain culverts:

Upstream during snowmelt

Downstream during snowmelt



- Ice reduces capacity in main culvert during peak flows
- Floodplain culverts are accessed faster with more flow

Offset Culverts

Kadunce River

Lessons Learned

- Working with other disciplines
  - Engineering:
    - Give them what they need to design and develop contracts (over a winter)
    - Engineers can do amazing work with little information
    - Training for engineers and other non-aquatic folks helps them understand our needs and bring new ideas to the table
    - Package multiple projects for logistics (and watersheds)
  - Terrestrial biologists, Soils, Forestry
  - Helps to multi-fund/cost share larger projects
- Have a “system”
  - With multiple levels of survey and assessment intensities
  - To identify passage priorities
  - Be willing to adjust and adapt your priorities
- Multiple benefits help ‘sell’ the project
  - Debris passage
  - Reduced maintenance (life-cycle costs)
  - Increased protection to roadway

Thank You

Alpena National Fish and Wildlife Conservation Office

Utilizing Innovative Techniques to Provide Fish Passage

Susan E. Wells
US Fish and Wildlife Service
Fisheries and Habitat Conservation
Division of Fish and Wildlife Management and Habitat Restoration
Arlington, VA

Alpena Fish Passage Program

- Initiated in 1999
- Addresses issues on barriers that prevent fish movement
- Emphasizes strong partnerships
- Provides assistance with funding and technical support

Alpena Fish Passage Program

- Has secured over $420,000 since 1999
- Initiated 33 projects
- Over 46 partners involved
- Partners have provided 64% of the budgets for completed projects

Goals of the Fish Passage Program

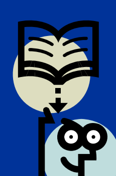
- Reconnect fragmented habitat
- Restore native fish populations
- Promote partnerships for the resource
- Provide funds for use as a contribution

How do you Implement???

- The days of limited resources are here
  - Limited money
  - Limited personnel
  - Limited time

When to Think Out of the Box

But the project is good!!!!
The resource needs it!!!!



A New Set of Tools

- When thinking out of the box you will need a new set of tools most biologists are not used to
  - Outreach and education (the human dimensions component)
  - Reaching out to non traditional partners, including those that may be perceived as the enemy
  - Speaking and writing skills (not the scientific kind)
  - Herding
    - Politics
    - Coordinating
    - Listening

Silver Creek Road RSX

- Problem
  - Perched double culvert
  - Undersized – velocity barrier during high flows
  - Large sediment contribution into the cold water trout stream

Silver Creek Road RSX

- Railroad tanker car
- Saved approximately $4500
- Recycled
- Two for the price of one

Potagannasing Dam Retrofit

- Reduced northern pike population caused by loss of habitat
- Old fish ladder non-effective

Potagannasing Dam Retrofit

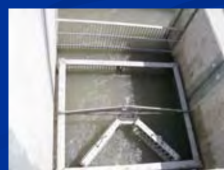
- Needed to maintain water levels in marshes (over 1000 acres)
- Gradient difference

Metzger Marsh

- 906 coastal wetland on Lake Erie
- Barrier beach eroded away in 1980's during high water levels
- 1990's a dike was constructed to protect wetland habitat but fish passage was needed

Metzger Marsh

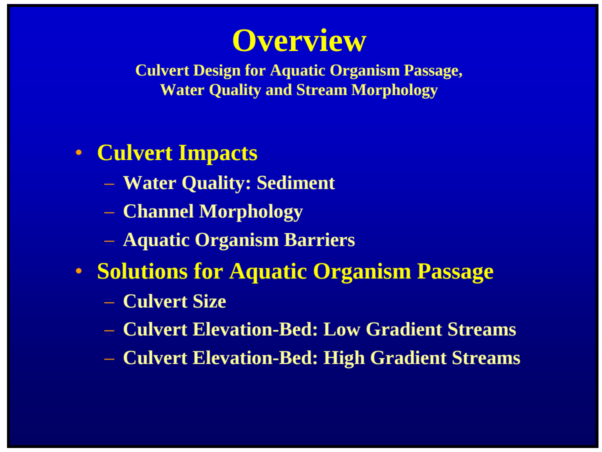
- Mechanical fish passage structure was added after dike construction, majority of Lake Erie fish species depend upon coastal wetlands
- Over 85% of Lake Erie coastal wetlands are diked and inaccessible to the lake fish community
- Physically pass fish from lake to wetland and back again



Remember

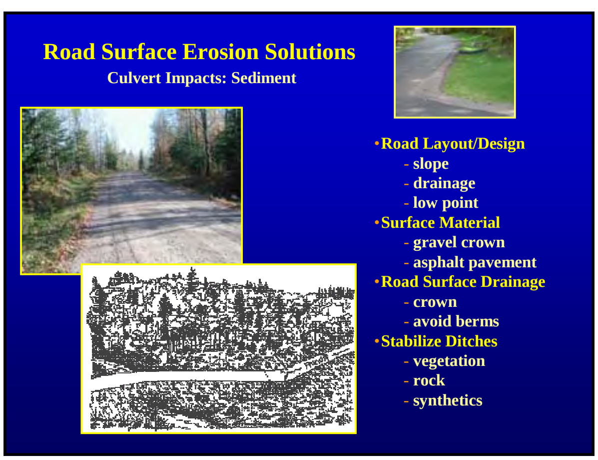
- Keep your options open
- No idea is a bad idea
- Don’t be afraid to try the unusual, you may find a new technique that works!!


Culvert Design for Aquatic Organism Passage,
Stream Morphology and Water Quality
Dale Higgins, USDA Forest Service, Chequamegon-Nicolet National Forest


Overview
Culvert Design for Aquatic Organism Passage,
Water Quality and Stream Morphology
• Culvert Impacts
– Water Quality: Sediment
– Channel Morphology
– Aquatic Organism Barriers
• Solutions for Aquatic Organism Passage
– Culvert Size
– Culvert Elevation-Bed: Low Gradient Streams
– Culvert Elevation-Bed: High Gradient Streams


Frequent Washouts
Culvert Impacts: Sediment
• Major Source
-Sediment Volume
-Sediment Delivery
• Solution
- Adequate Size
- Good Installation

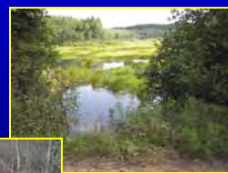

Road Surface and Ditch Erosion
Culvert Impacts: Sediment
Key Factors:
• Surface Material
• Drainage
• Slope Length
• Slope Steepness
• Low Point

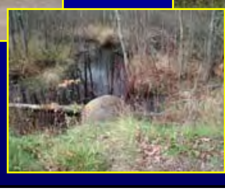

Road Surface Erosion Solutions
Culvert Impacts: Sediment
•Road Layout/Design
- slope
- drainage
- low point
•Surface Material
- gravel crown
- asphalt pavement
•Road Surface Drainage
- crown
- avoid berms
•Stabilize Ditches
- vegetation
- rock
- synthetics


Embankment Erosion
Culvert Impacts: Sediment
Problems:
• Culvert Short
• Steep Side Slopes
• No Riprap
• Bare ground
Solutions:
• Culvert Length
• 2:1 Side-Slopes or
• headwall
• Riprap
• Vegetation
Note: beveled ends minimize plugging, allow easier maintenance; one large culvert is less likely to plug than multiple culverts; headwalls can help shorten culvert length.

Upstream Ponding
Culvert Too High on Flat Streams
Culvert Impacts: Channel Morphology

Stagnant water in riverine ecosystem.

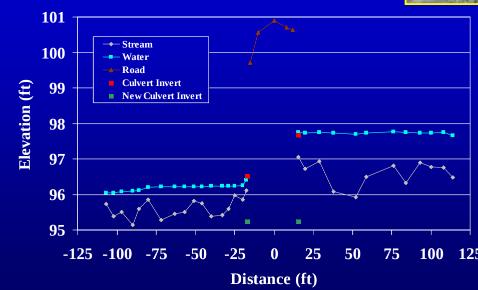




Sand, silt and muck deposit in the upstream channel.

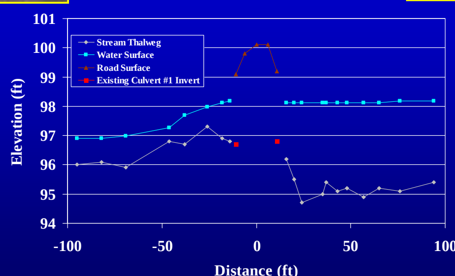
Water temperatures may increase.

Upstream Ponding – Culvert Set High
Marengo Trib at Forest Road 194
Culvert Impacts: Channel Morphology



Note: A stream profile survey is necessary to identify channel impacts and determine the proper elevation for a new culvert.

Upstream Ponding
Frequent Washouts on Flat Streams
Culvert Impacts: Channel Morphology



Note: A stream profile survey is necessary to identify channel impacts and determine the proper elevation for a new culvert.

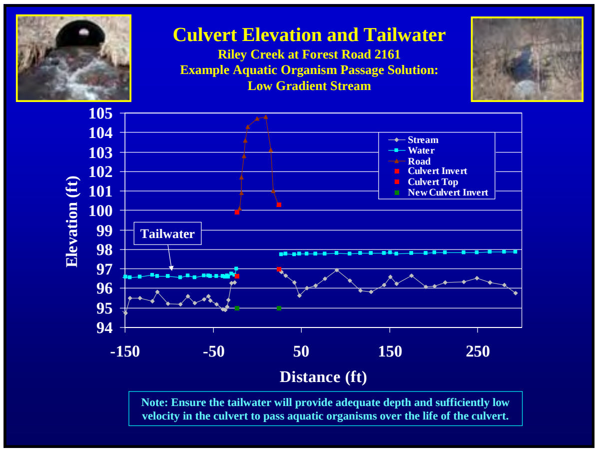
High Velocity and Shallow Depth
Aquatic Organism Passage

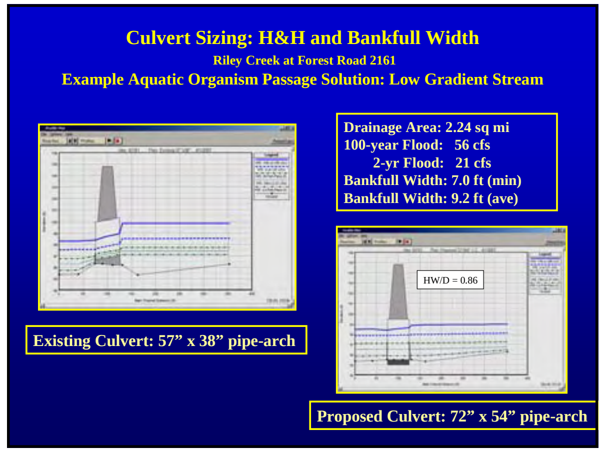
Depth, Velocity and Exhaustion Barriers

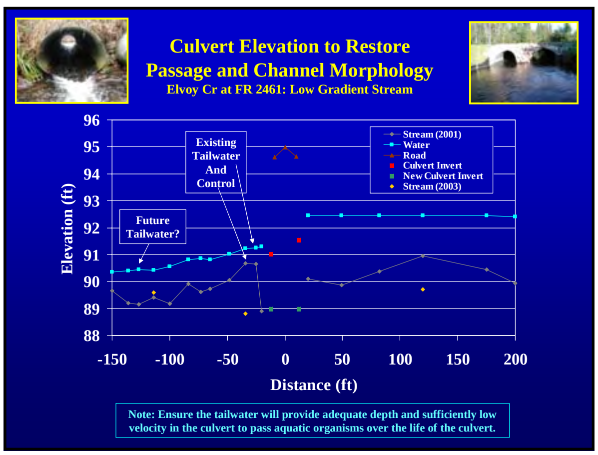
Drop at Outlet – Jump Barriers
Aquatic Organism Passage

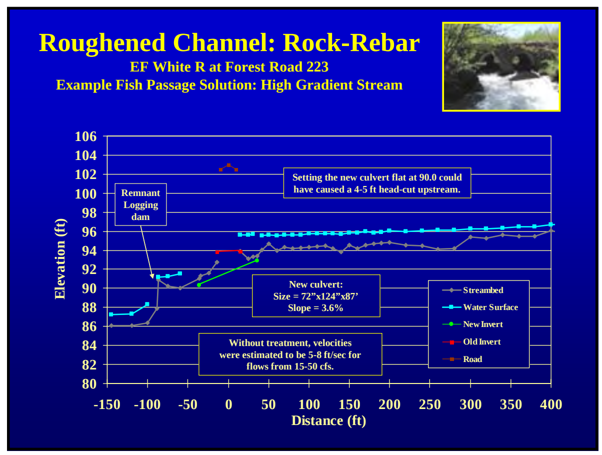
Chequamegon-Nicolet NF Examples
Aquatic Organism Passage Solutions at Culverts

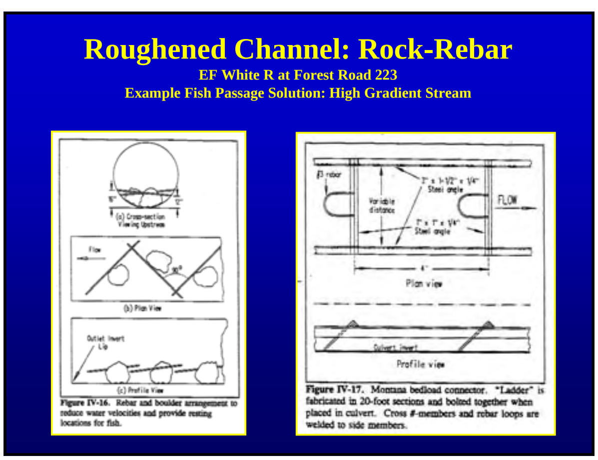
- Culvert Size
  - Hydrology-Hydraulics (H&H): 100-yr Q, HW/D≤1
  - Bankfull Width: straight, narrow, stable
  - Combination
- Culvert Elevation and Bed Material
  - Low Gradient (no slope, tailwater control)
  - High Gradient (stream slope, bed material)
    - Roughened Channel
    - Baffles
    - Stream Simulation

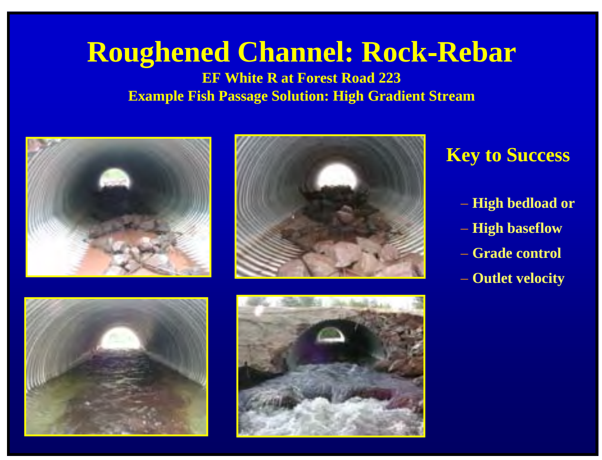

Culvert Elevation and Tailwater
Riley Creek at Forest Road 2161
Example Aquatic Organism Passage Solution:
Low Gradient Stream
Elevation (ft)
Distance (ft)
Stream
Water
Road
Culvert Invert
Culvert Top
New Culvert Invert
Tailwater
Note: Ensure the tailwater will provide adequate depth and sufficiently low velocity in the culvert to pass aquatic organisms over the life of the culvert.


Culvert Sizing: H&H and Bankfull Width
Riley Creek at Forest Road 2161
Example Aquatic Organism Passage Solution: Low Gradient Stream
Drainage Area: 2.24 sq mi
100-year Flood: 56 cfs
2-yr Flood: 21 cfs
Bankfull Width: 7.0 ft (min)
Bankfull Width: 9.2 ft (ave)
Existing Culvert: 57” x 38” pipe-arch
HW/D = 0.86
Proposed Culvert: 72” x 54” pipe-arch


Culvert Elevation to Restore
Passage and Channel Morphology
Elvoy Cr at FR 2461: Low Gradient Stream
Elevation (ft)
Distance (ft)
Existing Tailwater And Control
Future Tailwater?
Stream (2001)
Water
Road
Culvert Invert
New Culvert Invert
Stream (2003)
Note: Ensure the tailwater will provide adequate depth and sufficiently low velocity in the culvert to pass aquatic organisms over the life of the culvert.

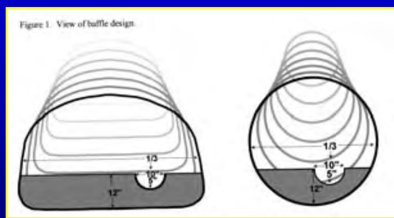

Roughened Channel: Rock-Rebar
EF White R at Forest Road 223
Example Fish Passage Solution: High Gradient Stream
Elevation (ft)
Distance (ft)
Remnant Logging dam
Setting the new culvert flat at 90.0 could have caused a 4-5 ft head-cut upstream.
New culvert:
Size = 72”x124”x87’
Slope = 3.6%
Without treatment, velocities were estimated to be 5-8 ft/sec for flows from 15-50 cfs.
Streambed
Water Surface
New Invert
Old Invert
Road


Roughened Channel: Rock-Rebar
EF White R at Forest Road 223
Example Fish Passage Solution: High Gradient Stream
Plan view
Profile view
Figure IV-16. Rebar and boulder arrangement to reduce water velocities and provide resting locations for fish.
Figure IV-17. Montana bedload connector. “Ladder” is fabricated in 20-foot sections and bolted together when placed in culvert. Cross #-members and rebar loops are welded to side members.


Roughened Channel: Rock-Rebar
EF White R at Forest Road 223
Example Fish Passage Solution: High Gradient Stream
Key to Success
– High bedload or
– High baseflow
– Grade control
– Outlet velocity

General Baffle Design

Example Fish Passage Solution: High Gradient Stream



Jump cutouts alternate 1/3 of top width.

Baffles 12" high, jump cutouts 10" wide, 5" deep.

Bedload is trapped in sediment rich systems.
Works well for low baseflows.

What is a Stream Simulation?

A streambed constructed through the culvert or crossing where:

- Channel continuity is maintained through the crossing
- Streambed material and complexity are similar to the natural channel
- Water velocities, water depths, cover and resting areas are similar to the natural channel
- The crossing is transparent to aquatic species

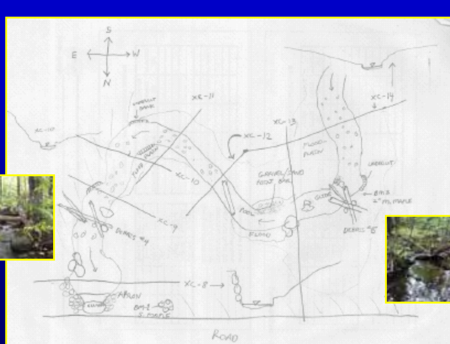
Stream Simulation Steps

Example Fish Passage Solution: High Gradient Stream

- Initial Assessment of WS Characteristics
- Site Assessment
  - Alignment and channel conditions
  - Longitudinal profile
  - Reference reach: slope, bfw, bed material, bed forms
  - Site suitability
- Stream Simulation Design
  - Alignment and profile
  - Bed material and channel shape
  - Structure width, elevation
- Construction Design
  - Structure type and shape
  - Bed material mix and volume
  - Bank materials, rock bands
  - Site plans including dewatering and erosion control
- Construction

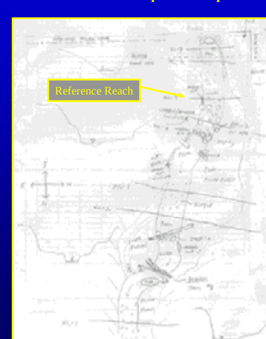
Upstream Schematic

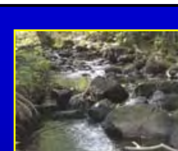
Stream Simulation Example: Pre-emption at FR 377



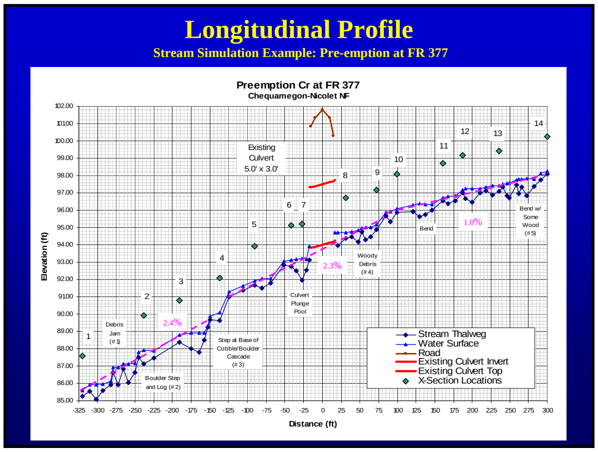
Downstream Schematic

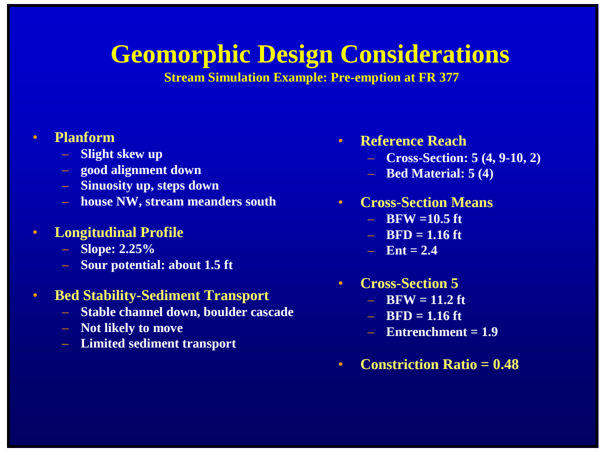
Stream Simulation Example: Pre-emption at FR 377

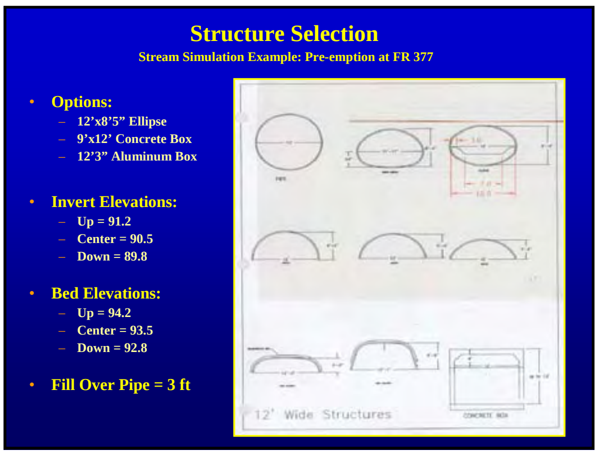


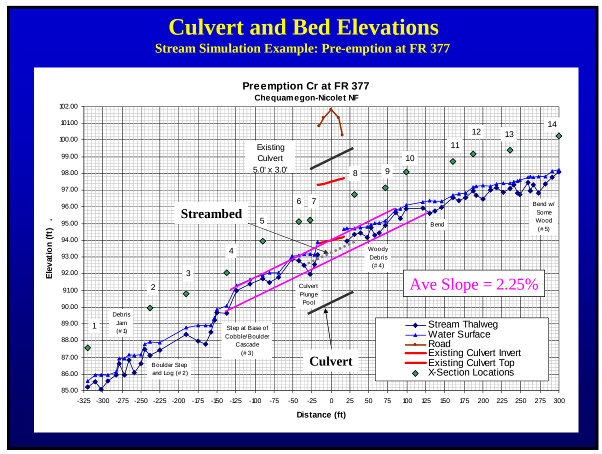


Particle Size	X-Sec 5 (%)
Boulders	4.3
Cobble	28.7
Gravel	47.8
Sand, silt, clay	19.1


Longitudinal Profile
Stream Simulation Example: Pre-emption at FR 377
Preemption Cr at FR 377
Chequamegon-Nicolet NF
Elevation (ft)
Distance (ft)
Existing Culvert 5.0' x 3.0'
2.4%
2.3%
1.0%
Debris Jam (# 1)
Boulder Step and Log (# 2)
Step at Base of Cobble/Boulder Cascade (# 3)
Woody Debris (# 4)
Bend w/ Some Wood (# 5)
Culvert Plunge Pool
Bend
Stream Thalweg
Water Surface
Road
Existing Culvert Invert
Existing Culvert Top
X-Section Locations


Geomorphic Design Considerations
Stream Simulation Example: Pre-emption at FR 377
Planform
– Slight skew up
– good alignment down
– Sinuosity up, steps down
– house NW, stream meanders south
Longitudinal Profile
– Slope: 2.25%
– Sour potential: about 1.5 ft
Bed Stability-Sediment Transport
– Stable channel down, boulder cascade
– Not likely to move
– Limited sediment transport
Reference Reach
– Cross-Section: 5 (4, 9-10, 2)
– Bed Material: 5 (4)
Cross-Section Means
– BFW =10.5 ft
– BFD = 1.16 ft
– Ent = 2.4
Cross-Section 5
– BFW = 11.2 ft
– BFD = 1.16 ft
– Entrenchment = 1.9
Constriction Ratio = 0.48


Structure Selection
Stream Simulation Example: Pre-emption at FR 377
Options:
– 12'x8'5" Ellipse
– 9'x12' Concrete Box
– 12'3" Aluminum Box
Invert Elevations:
– Up = 91.2
– Center = 90.5
– Down = 89.8
Bed Elevations:
– Up = 94.2
– Center = 93.5
– Down = 92.8
Fill Over Pipe = 3 ft
12' Wide Structures


Culvert and Bed Elevations
Stream Simulation Example: Pre-emption at FR 377
Preemption Cr at FR 377
Chequamegon-Nicolet NF
Elevation (ft)
Distance (ft)
Existing Culvert 5.0' x 3.0'
Streambed
Culvert
Ave Slope = 2.25%
Stream Thalweg
Water Surface
Road
Existing Culvert Invert
Existing Culvert Top
X-Section Locations


Construction
Stream Simulation: Pre-emption at FR 377
Diversion
Invert at Elevation
Compacting Backfill
De-watering
Streambed Construction
Streambed Construction


Before and After
Stream Simulation: Pre-emption at FR 377

Summary
Aquatic Organism Passage Solutions at Culverts

- **Culvert Impacts**
  - Aquatic Organism Passage: jump, depth, velocity, exhaustion barriers
  - Sediment: failures, road surface/ditches, embankments
  - Channel Morphology: culverts undersized and/or set too high
- **Aquatic Organism Passage**
  - Culvert Sizing: 100-yr flood, bankfull width or both
  - Culvert Elevation and Bed Material
    - Low Gradient (~<0.3%): no culvert slope, tailwater control, bed optional
    - High Gradient (~>1.0%) Options:
      - Roughened Channel: high baseflow or bedload
      - Baffles: tailwater critical, culvert slope installation critical
      - Stream Simulation: best solution, mimics natural channel, ref reach, bf width, slope, bed & bank materials

Aquatic Organism Passage Symposium Roundtable Discussion Highlights - December 12, 2007

Facilitator: Nick Schmal, USDA Forest Service

Questions posed at beginning for discussion (we only had enough time to discuss some of them):

1) What is the best way to monitor and measure our progress as we reconnect aquatic habitats in the Midwest?

> How will we know that we are making progress on the ground- 5, 10, 15, 20, 50, 75, 100 years from now? (temporal)
>
> How can we measure progress at various scales? (spatial)

2) How can we work together more effectively to make a difference?

3) What are our greatest research needs regarding AOP issues?

4) Are there any key lessons from this symposium?

5) How does existing policy address AOP across the Midwest?

6) When do you need to do stream simulation, and when can you get away with a hydraulic design?

7) When do you need to account for other organisms besides fish?

Question 1: What is the best way to monitor and measure our progress as we reconnect aquatic habitats in the Midwest?

- Need to know what we have on ground (comprehensive baseline inventories), collaborate across boundaries on a watershed basis;
- Need to query the states, develop GIS layers, track how many structures have been removed e.g. an inventory within the Great Lakes Watershed
- Need to identify what the essential information is and how can we standardize or coordinate across a regional scale
- Need to identify what parameters, what metrics for a comprehensive database. The Fish Passage Decision Support System (http://fpdss.fws.gov/) is a GIS based tool with barriers to fish passage, dams, some culverts, based on NHD; can do modeling of what would be restored if remove X barrier; can do scenarios where remove one barrier or two, etc.; links to some other databases at state level; serves

as a central framework for uploading barrier data; working on improving the ease of uploading barrier coordinates and inventories

Question 1a: How will we know that we are making progress on the ground- 5, 10, 15, 20, 50, 75, 100 years from now? (temporal)

- Need to monitor species by species; currently monitoring is not integrated as part of each project; we track miles restored; however, not every project monitored

- We record success project by project; in thinking long-term, consider influencing management agency guidelines through organizations such as AFS

- Need long term monitoring of fish genetics; If you remove a barrier, when is the habitat viable, after 50 years?; How do you meld all agencies everywhere working on AOP?; Do we need a center for all info on AOP?; have to have grassroots in place and people working on the ground together; top down and bottom up at the same time; bottom up so that can feed to the top; currently there is little consistency at different levels of government; AFS and Bioengineering section, use to pull people or panel together to feed up to federal group and look at state level basis; recommend policy changes to legislators; standardize inventory values, etc.

- Depends on scope spatially or temporally; can use genetic tools over 10 years, for example to document dispersal and colonization; expensive but effective; need baseline information at the right time for researchers to address research questions on the ground; need partnerships between researchers and agency people on ground

Question 2) How can we work together more effectively to make a difference?

- Establish standards for road builders; when putting roads in, prioritize: biodiversity, genetics, and monitoring of reconnectivity that results in benefits to geomorphology and genetics down the road as benchmarks; inventories should be necessary, check points at 5, 10, 15 years; reconcile agency approaches; if there is a national committee on AOP, regional subcommittees would be valuable; break down by context – forestry, hydro dams, etc; develop a strategic document and plug in partnerships; we are reinventing the wheel a lot

- Need strategies for reconnecting watershed scale habitats and assuring connectivity at larger scales

- Need a group to begin small steps toward this; e.g. if each state had an AOP group; is AFS too fish centered for AOP?

- Different issues in Midwest than out West; Association of Fish and Wildlife Agencies could be venue for committee on AOP, has link to federal level; create group within the Association so every state would have a contact; Association has clout to effect change in policy

- Midwest could get lost if lumped into a big group; need specific assessment tools and approaches for Midwest, AFS North Central Division Rivers and Streams Technical Committee in Great Lakes and Midwest for example is active and meets at least once a year; each chapter is active

- Focusing on the Midwest is good – knowing where we are at and where we need to go. We have unique species and issues in this area; Possibly form a group of interested individuals to develop a framework down the line; this could be a good example for the rest of the country; need to take small steps to move forward;

- AFS and Association of Fish and Wildlife Agencies could coordinate, not mutually exclusive; filter up from states; federal up to regional level; compile state level database for federal level

- There is a new federal group with representatives of all the federal agencies that meets on quarterly basis to discuss coordination of AOP issues (Federal Fish Passage Action Plan and Federal Fish Passage Steering Committee)

Question 3) What are our greatest research needs regarding AOP issues?

- Knowing how much is enough; how connected do streams need to be?; how many stream miles need to be reconnected to maintain population viability?; viability for species to exist?;

- Viability and connectivity are key issues; the State of WI and other states, need to standardize and coordinate on AOP issues, also at the local level

- Need to better understand where in the system barriers are located; how barrier position in the watershed should influence our prioritization

- We don’t know a lot about the effective population size for most species; mussels, fish, etc.

- Need selective indicators that pick up on functions; fish passage can be sold by species and spawning success; 50% or 80% connected?; how many barriers are actually barriers and how many are okay; look at population goals

- Need community response measures; use multi-metric indexes for invertebrates and fish; calibrate for issue at hand; know effectiveness of community and functional measures and how they can key toward AOP; track IBI above and below culvert over time; some metrics useful toward passage and some won’t be useful; identify good community measure(s) of success and their effectiveness at monitoring at the regional or ecoregional level

Aquatic Organism Passage Symposium Roundtable Discussion Participants and Contact Information - December 12, 2007

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