37th Annual Researchers Meeting of the Upper Colorado River Endangered Fish Recovery Program and the San Juan River Basin Recovery Implementation Program

Fort Lewis College, Student Union Ballroom (1000 Rim Drive) and
Best Western - Rio Grande Inn (400 E 2nd Avenue)
Durango, Colorado 81301

12-13 January 2016

Program and abstracts of presented papers and posters

Sponsored by:

Upper Colorado River Endangered Fish Recovery Program

San Juan River Basin Recovery Implementation Program

Registration will occur outside the Student Union Ballroom (top floor) starting at 7:15 am on Tuesday 12 January 2016. A registration fee of $25 (cash or check only please) will offset the costs of the meeting room and refreshments. Note that daily parking permits at Fort Lewis College are available for $5. Daily permit machines are located at the information boards located on Fort Lewis Drive, between East 8th Avenue and Goeglein Gulch Road, and on East 8th Avenue, the "front hill" leading to Fort Lewis College.

If you are giving an oral paper please be sure your presentation is copied to the laptop running the projector before your session begins. Oral presentations should be limited to 15 minutes to allow time for questions. Push pins will be available to hang posters before Tuesday's evening social.

Tuesday 12 January 2016

8:00 am WELCOME, LOGISTICS, AND INTRODUCTION TO THE JOINT ANNUAL RESEARCHERS MEETING – Sharon Whitmore and Tom Chart.

8:20 IN REMEMBRANCE: DR. RONALD RYEL – Rich Valdez.

Session 1: Hydrology, temperature, and habitat

Moderator: Sharon Whitmore

8:30 SUMMARY OF HYDROLOGIC CONDITIONS IN THE 2015 WATER YEAR – **Jana Mohrman**.

8:50 WATER TEMPERATURE DEPRESSION IN THE SAN JUAN RIVER AND IMPLICATIONS TO ENDANGERED SPECIES RECOVERY – **William J. Miller**.

9:10 BIOLOGICAL IMPLICATIONS AND RESULTS FROM CONTINUOUS SEDIMENT-TRANSPORT MONITORING IN DINOSAUR NATIONAL MONUMENT AND CANYONLANDS NATIONAL PARK – **David J. Topping**, Ronald E. Griffiths, David J. Dean, and Erich R. Mueller.

9:30 THE ROLE OF THE COLORADO RIVER WILDLIFE MANAGEMENT AREA IN RECOVERY OF THE FOUR COLORADO RIVER FISH SPECIES – **Sonja Jahrsdoerfer**.

Session 2: Augmentation, reproduction, and natural recruitment of Colorado River fishes

Moderator: Nathan Franssen

9:50 OURAY NATIONAL FISH HATCHERY 2015 – **Matthew Fry**.

10:10 AUGMENTATION OF A BLUEHEAD SUCKER (*CATOSTOMUS DISCOBOLUS*) POPULATION UTILIZING CAPTIVE REARED FISH – **Jenn Logan** and Tom Fresques.

10:30 **BREAK**

10:45 POTENTIAL APPROACHES FOR RE-ESTABLISHING BONYTAIL *GILA ELEGANS* POPULATIONS WITHIN THE COLORADO RIVER BASIN – **Ron Kegerries**, Brandon Albrecht, Dave Speas, and Mark McKinstry.

11:05 ENDANGERED RAZORBACK SUCKER REPRODUCTION IN THE LOWER GREEN AND COLORADO RIVERS – **Julie Howard**.

11:25 REFINING STRATEGIES FOR NONNATIVE FISH EXCLUSION FROM STEWART LAKE, A WETLAND MANAGED AS NURSERY HABITAT FOR RAZORBACK SUCKER, *XYRAUCHEN TEXANUS*, ON THE MIDDLE GREEN RIVER, UTAH – **Robert C. Schelly** and Matthew J. Breen.

11:45 USING MICROCHEMISTRY TO DETERMINE NATAL ORIGIN OF RAZORBACK SUCKER IN THE SAN JUAN RIVER – **Stephani L. Clark Barkalow**, Steven P. Platania and Jennifer L. Kennedy

12:05 pm **LUNCH**

Session 3: Managing and monitoring fish entrainment, use of remote and portable PIT tag antennas, and data management

Moderator: Krissy Wilson

1:30 EVALUATION OF THE HOGBACK FISH WEIR: A STRUCTURE DESIGNED TO REDUCE ENTRAINMENT OF ENDANGERED FISH IN CANALS – **Mark McKinstry**, Chris Cheek, Peter MacKinnon, Howard Brandenburg, Robert Dudley, Stephen Platania, Robert Norman, Scott Durst, and Kevin Bestgen.

1:50 EVALUATION OF THE HOGBACK FISH WEIR: TRANSPORT AND ENTRAINMENT OF LARVAL FISH AND NEUTRALLY BUOYANT PARTICLES (NBP) – **W. Howard Brandenburg**, MarkC. McKinstry, Stephani Clark Barkalow, Kevin Bestgen, Manual Ulibarri, and William Knight.

2:10 SMALL ANTENNAS YIELD BIG RESULTS AT SAN JUAN RIVER WATERFALL – **Mark McKinstry**, C. Nathan Cathcart, Chris Cheek, and Peter MacKinnon.

2:30 ENDANGERED FISH MONITORING WITH PASSIVE INTEGRATED TRANSPONDER (PIT) TECHNOLOGY AT SPAWNING BARS – **M. Tildon Jones**, Chris Smith, Aaron Webber, and David Beers.

2:50 HOW DO WE USE DATA FROM PORTABLE PIT TAG ANTENNA SYSTEMS? – **Ben Stout**.

3:10 STREAMSYSTEM.ORG AN INTRODUCTION TO THE ONLINE PIT TAG DATABASE – **Amy Greenwell**.

3:30 **BREAK**

Session 4: Role of Lake Powell and Lake Mead in Razorback Sucker recovery

Moderator: Dale Ryden

3:45 ENDANGERED RAZORBACK SUCKER (*XYRAUCHEN TEXANUS*) IN LAKE POWELL: A STUDY TO DETERMINE HOW THESE FISH USE THIS IMPOUNDMENT AND HOW THESE FISH MAY CONTRIBUTE TOWARDS THE RECOVERY OF THIS ENDEMIC LARGE BODIED COLORADO RIVER FISH – **Brian A. Hines**, Travis A. Francis, Benjamin J. Schleicher, Derek S. Elverud, and Dale W. Ryden.

4:05 RAZORBACK SUCKER (*XYRAUCHEN TEXANUS*) RESEARCH AND MONITORING IN THE COLORADO RIVER INFLOW AREA OF LAKE MEAD AND THE LOWER GRAND CANYON, ARIZONA AND NEVADA – **Brandon Albrecht**, Ron Kegerries, Ron Rogers, Eliza Gilbert, W. Howard Brandenburg, Adam L. Barkalow, Steven P. Platania, Mark McKinstry, Brian Healy, James Stolberg, Emily Omana Smith, Clay Nelson, and Harrison Mohn.

4:25 COMPARISONS OF RAZORBACK SUCKER *XYRAUCHEN TEXANUS* REPRODUCTION IN THE COLORADO RIVER WITHIN THE LOWER GRAND CANYON AND THE SAN JUAN RIVER – **Eliza I. Gilbert**, W. Howard Brandenburg, Adam L. Barkalow, Mike A. Farrington, Ron B. Kegerries, Brandon C. Albrecht, Ron J. Rogers, Mark C. McKinstry, Brian D. Healy, Emily C. Omana Smith, Clay B. Nelson, James R. Stolberg, and Harrison E. Mohn.

Session 5: Genetics and pathogen assessment

Moderator: Scott Durst

4:45 EXAMINATION OF MICROBIOTA ASSOCIATED WITH EXTERNAL LESIONS ON NATIVE AND ENDANGERED FISHES OF THE SAN JUAN RIVER, NM AND UT – **Tracy A. Diver**, Wade D. Wilson, and Benjamin J. Schleicher.

5:05 GENETIC CONTRIBUTION OF NATIVE AND INTRODUCED CATOSTOMIDS TO LARVAL DRIFT IN EXPERIMENTAL AND CONTROL STREAMS OF THE GUNNISON RIVER BASIN IN COLORADO – **Evan W. Carson**, Michael R. Schwemm, Kevin Thompson, and Thomas F. Turner.

5:25 GENETIC MONITORING AND BIOLOGICAL CONTROL OF RECRUITMENT IN BONYTAIL REARING PONDS – **Wade Wilson**, Tracy Diver, Catherine Sykes, William Knight, and Manuel Ulibarri.

5:45 **ADJOURN**

Evening Social at Best Western – Rio Grande Inn lobby

6:30 – 8:30 FOOD AND BEVERAGES
POSTER SESSION
SPECIAL AWARDS

Wednesday 13 January 2016

Session 6: Non-native fish management and native fish response

Moderator: Ed Kluender

9:00 am THE INVASION OF NONNATIVE SMALLMOUTH BASS IN THE UPPER COLORADO RIVER BASIN AND THE RESEARCH-DRIVEN MANAGEMENT RESPONSE FROM 2003 TO 2015 – **John Hawkins**, Kevin Bestgen, Matthew Breen, Katie Creighton, Julie Howard, Tildon Jones, Ed Kluender, Jenn Logan, Chris Michaud, Lori Martin, Cory Noble, Robert Schelly, Chris Smith, Richard Staffeldt, Cameron Walford, Koreen Zelasko.

9:20 NORTHERN PIKE MANAGEMENT IN THE UPPER BASIN 2015 UPDATE – **Chris Smith**, Travis Francis, Lori Martin, Jenn Logan, Cory Noble, Kyle Battige, John Hawkins, Don Tuttle III, Cameron Walford, Ed Kluender, Kevin Bestgen, Koreen Zelasko, Tate Wilcox, Richard Staffeldt, Robert Schelly, Matthew Breen.

9:40 MANAGING WALLEYE EXPANSION IN THE UPPER COLORADO RIVER BASIN WITH EDUCATION, ERADICATION AND ESCAPEMENT PREVENTION: ONE EXPENSIVE FILLET – **Travis Francis**, Lori Martin, Tildon Jones, Robert Schelly, Matt Breen, Chris Michaud.

10:00 RESPONSE OF THE NATIVE FISH COMMUNITIES OF THE YAMPA AND GREEN RIVERS TO NONNATIVE FISHES AND FLOWS – **Kevin R. Bestgen**, Cameron Walford, Angela Hill, Tate Wilcox, and John Hawkins.

10:20 **BREAK**

10:35 COLORADO PIKEMINNOW RECRUITMENT IN THE UPPER COLORADO RIVER BASIN: A NEW PERSPECTIVE FOR THE GREEN RIVER, UTAH – **Matthew J. Breen**, Kevin R. Bestgen, Christopher M. Michaud.

10:55 RIVER REGULATION AFFECTS REPRODUCTION, EARLY GROWTH, AND SUPPRESSION STRATEGIES FOR INVASIVE SMALLMOUTH BASS IN THE UPPER COLORADO RIVER BASIN – **Kevin R. Bestgen** and Angela A. Hill.

11:15 RAINBOW TROUT ABUNDANCE, DISTRIBUTION, AND MOVEMENT IN GLEN AND GRAND CANYONS, AZ – **Scott P. VanderKooi**, Josh Korman, Michael D. Yard, and Charles B. Yackulic.

11:35 RAPID RESPONSE TO NEW GREEN SUNFISH INVASION IN THE COLORADO RIVER IN GLEN CANYON NATIONAL RECREATION AREA – **Melissa Trammell**, Brian Healy, Mark Anderson, Mike Anderson, David Ward.

11:55 **LUNCH**

Contributed Session 7: Recovery planning, assessment, information, and education

Moderator: Tom Czapla

1: 20 pm PROGRESS ON COLORADO PIKEMINNOW RECOVERY DEVELOPMENT OF POPULATION VIABILITY ANALYSIS – **Richard A. Valdez**, Thomas E. Czapla, and Thomas E. Chart.

1:40 HUMPBACK CHUB RECOVERY PLANNING PROCESS – **Richard A. Valdez** and Thomas E. Czapla.

2:00 COPYRIGHT FACTS AND REGULATIONS AND INFORMATION AND EDUCATION UPDATE – **Melanie Fischer**.

2:20 STATUS OF LCR MSCP FISH AUGMENTATION AND HABITAT CREATION GOALS AFTER 10 YEARS OF IMPLEMENTATION – **Gregg Garnett**.

2:40 **ADJOURN**

Abstracts of presented papers and posters **(in the order presented in the meeting program)**

SUMMARY OF HYDROLOGIC CONDITIONS IN THE 2015 WATER YEAR

Jana Mohrman
Hydrologist for the Upper Colorado River Recovery Program

Summary of hydrologic conditions and issues that occurred in the 2015 Water Year sets a backdrop for conditions for the endangered fish last year.

WATER TEMPERATURE DEPRESSION IN THE SAN JUAN RIVER AND IMPLICATIONS TO ENDANGERED SPECIES RECOVERY

William J. Miller
Miller Ecological Consultants, Inc, 333 Haggerty Ln, Ste 2, Bozeman, Montana 59715

Water temperature regimes in the San Juan River have changed from the natural conditions since the construction and operation of Navajo Reservoir in the 1960s. Additional water temperature changes have occurred since the implementation of the flow recommendations for recovery of the endangered fishes in the late 1990s. The high flow releases of cold water from the reservoir depress water temperature to conditions lower than the natural water temperature regime. The water temperature warmed during the spring into early summer as flow increased under the natural water temperature regime prior to construction and operation of the reservoir. The current water temperature regime begins to warm and then decreases rapidly during the time peak releases are made from Navajo Reservoir. Peak flows are a key component of the San Juan

River flow recommendations and needed for obtaining desired habitat responses. Methods to obtain a more natural water temperature regime may have other unintended impacts such as introduction of and providing habitat for non-native species. It is currently unknown if the magnitude and duration of the temperature depressions has a negative impact on endangered species recovery in the San Juan, however, returning to a more natural water temperature regime should be considered as a component for recovery during the flow recommendation revision process.

BIOLOGICAL IMPLICATIONS AND RESULTS FROM CONTINUOUS SEDIMENT-TRANSPORT MONITORING IN DINOSAUR NATIONAL MONUMENT AND CANYONLANDS NATIONAL PARK

David J. Topping, Ronald E. Griffiths, David J. Dean, and Erich R. Mueller
U.S. Geological Survey, Southwest Biological Science Center, Grand Canyon Monitoring and Research Center, Flagstaff, AZ

Sediment is a master variable that controls the physical habitat of rivers, and regulates biological processes and the interactions of river organisms. Sediment provides habitat for fish in that it defines the wetted perimeter of the river; thus, sediment on the bed and banks forms the physical template for riverine ecosystems. Suspended-sediment concentration regulates the size and distribution of fine-grained bars and regulates channel-margin and floodplain deposition, physical processes that are important to many biological processes. Suspended-sediment concentration also controls turbidity, which affects important biological processes and interactions, such as algae production and piscivory. The endangered and threatened native fishes of the Colorado River basin evolved in highly turbid rivers. In addition to providing habitat, turbidity influences the capture probability of both passive (i.e., hoop nets) and active fish sampling gears (electro-fishing) that are used to monitor Colorado River basin fish populations. Thus, characterizing sediment conditions helps inform both monitoring and management of native fishes in the Colorado River basin.

Beginning in 2012, the National Park Service funded the USGS-Grand Canyon Monitoring and Research Center to install sediment-transport monitoring networks in and around Dinosaur National Monument and Canyonlands National Park. These networks monitor the status of sediment on the bed and in suspension (and thereby also monitor turbidity). Each station in these networks employs multi-frequency acoustical methods and conventional sampling methods to measure suspended-silt-and-clay concentration, suspended-sand concentration, and suspended-sand median grain size at 15-minute intervals. 15-minute turbidity is calculated on the basis of these suspended-sediment measurements and verified using turbidity-probe measurements. There are 5 stations in the Dinosaur network, co-located at the USGS gaging stations on the Yampa River near Maybell, CO (09251000), Little Snake River near Lily, CO (09260000), Yampa River at Deerlodge Park, CO (09260050), Green River above Gates of Lodore, CO (404417108524900), and Green River near Jensen, UT (09261000). Differencing the sediment loads calculated using the 15-minute acoustical suspended-sediment measurements allows the construction of continuous mass-balance sediment budgets for the reaches of the Yampa River in Deerlodge Park and the Green River in the parks below the confluence with the Yampa River. These sediment budgets allow tracking of the amounts of silt and clay and the amounts of sand

that have been either eroded from or deposited in these reaches, thus resulting in changes in channel complexity and habitat commensurate with these changes in sediment mass. The 2 stations in the Canyonlands network are co-located with the USGS gaging stations on the Colorado River at Potash, UT (09185600), and Green River at Mineral Bottom near Canyonlands National Park, UT (09328920).

The data from the stations, user-interactive plots of the data, and user-interactive sediment budgets are available at either http://www.gcmrc.gov/discharge_qw_sediment/ or http://cida.usgs.gov/gcmrc/discharge_qw_sediment/. In addition to demonstrating these websites, turbidity duration curves will be presented to illustrate the percentage of time various levels of turbidity are equaled or exceeded at the 7 suspended-sediment monitoring stations in the Dinosaur and Canyonlands networks.

THE ROLE OF THE COLORADO RIVER WILDLIFE MANAGEMENT AREA IN RECOVERY OF THE FOUR COLORADO RIVER FISH SPECIES

Sonja Jahrsdoerfer
U.S. Fish and Wildlife Service

The Colorado River Wildlife Management Area (WMA) is a unit of the National Wildlife Refuge System of the U.S. Fish and Wildlife Service (Service). The WMA was established in the late 1990's with the intent of acquiring easements on floodplains within the upper Colorado River system that would function as important habitat for the four Colorado River endangered fish species. The purpose of the easements is to restore, enhance, and/or protect floodplain habitats to benefit endangered fishes by allowing floodplains to flood and function as naturally as possible. Of the 17 parcels that make up the Colorado River WMA, 16 of them are privately owned, with conservation easements held by the Service. The Service owns one parcel near Grand Junction.

Easement conditions prevent alterations in floodplain topography or hydrology resulting from earth-moving, excavation, and/or construction or operation of flood-control features. Easements are monitored annually by staff of the Lower Green River NWR Complex (Complex) to ensure compliance. Other WMA work conducted by Complex staff includes review of site restoration projects associated with oil well plug & abandon work, and design and installation of interpretive panels at the Service-owned parcel. Future efforts will include invasive plant control and working with landowners on habitat restoration efforts.

OURAY NATIONAL FISH HATCHERY 2015

Matthew Fry
Ouray National Fish Hatchery

Ouray National Fish Hatchery (ONFH) was established in 1996 as a fish refugia and technology development facility to assist in the recovery of razorback sucker (RZ). Historically, ONFH has produced an excess of 15,000 > 300mm genetically diverse razorback suckers (*Xyrauchen texanus*) to meet the Recovery Program stocking goals for the Green River, and additional fish

for flood-plain stocking, and other research purposes. The Recovery Program eliminated the request for excess research fish and reduced the requested number for larger Razorbacks but increased stocking size to 350mm average length. This modification to the stocking schedule has freed up rearing space at ONFH and allowed us to take on a new species the bony tail ((*Gila Elegans*) BT). Utilizing a similar rearing strategy that was used on the RZB, ONFH now produces 6,000 razorback suckers >350mm and 10,000 bony-tail chub >250mm. Along with the changes to the fish rearing programs, other changes and upgrades have occurred at ONFH. Some of these changes include new replacement wells, new replacement VFD's, changes to bird depredation control, and dealing with tiger salamanders (*Ambystoma tigrinum*) in RZ fry ponds. This presentation is to bring researchers and others up to speed on the current status and procedures at ONFH.

AUGMENTATION OF A BLUEHEAD SUCKER (*CATOSTOMUS DISCOBOLUS)* POPULATION UTILIZING CAPTIVE REARED FISH.

Jenn Logan[1] and Tom Fresques[2]
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[2]Bureau of Land Management, Silt, CO, T1fresqu@blm.gov

Once common in the Yampa River of northwestern Colorado, bluehead suckers (*Catostomus discobolus)* are now encountered infrequently in the mainstem river and many of its tributaries upstream of Lily Park, approximately 55 miles west of Craig, CO. Drought conditions, predation by non-native fish species, hydrologic changes and competition and hybridization with non-native suckers have contributed to bluehead sucker population declines. The Three Species Range-Wide Conservation Agreement and Strategy (2006) established conservation actions to expand populations through transplant activities or reintroductions in historic habitats. In 2010, Colorado Parks and Wildlife (CPW) acquired bluehead sucker brood stock from the Yampa River near Lily Park, CO. These fish were transported to CPW's Native Aquatic Species Restoration Facility and spawned successfully for the first time in 2012. In 2015, 2,800 bluehead suckers from the 2012 and 2013 year classes were released into Milk Creek, a tributary of the Yampa River located on BLM lands. Fish were reared to a minimum 7" total length, implanted with passive integrated transponder tags, and flow trained prior to release. By utilizing submersible passive interrogation arrays in addition to survey work, CPW increased detections of captive reared bluehead suckers while concurrently monitoring movement and survival post stocking. This presentation will focus on the release of these fish and the first year monitoring efforts.

POTENTIAL APPROACHES FOR RE-ESTABLISHING BONYTAIL *GILA ELEGANS* POPULATIONS WITHIN THE COLORADO RIVER BASIN

Ron Kegerries[1], Brandon Albrecht[1], Dave Speas[2], and Mark McKinstry[2]
([1] Bio-West, Inc.; [2] U.S. Bureau of Reclamation)

Bonytail *Gila elegans* is one of four endangered fish species in both the upper and lower Colorado River basins. To date, there has been no measurable success in recovering, or developing stable populations of this fish species anywhere in the Colorado River basin outside

of hatchery or predator-free, pond-type settings. Since 1996, nearly 250,000 Bonytail have been stocked into the upper Colorado River basin, mostly within the Green and Colorado rivers (approximately 90%). Despite these stocking efforts less than 10,000 (<4%) individuals have been captured or detected via various sampling methods. According to capture history data, only 34 individual Bonytail were at large for more than a year before being recaptured. The longest period between captures was 7 years: a single fish stocked into the Colorado River in 2007. Due to the lack of survival and recruitment under the current stocking plan, the U.S. Bureau of Reclamation supported the development of different approaches for conserving and recovering Bonytail with emphasis on all life stages to promote recruitment. To do so, biologists from the upper and lower Colorado River basins discussed research-based approaches that may be beneficial to increase survival and recruitment of the species. Based on historical efforts with the species, literature review, as well as the workgroup's collective insights, two potential approaches include: 1) releasing Bonytail into complex off-channel wetlands within the Green River, and 2) releasing Bonytail into coves within Lake Powell that provide turbidity and cover near the Colorado inflow. The goal for each would be to establish populations that reproduce in areas that contain habitat necessary for rearing, growth, and potentially recruitment. Under each of these approaches stocked fish would be tracked, reproduction assessed, and recruitment measured through continued monitoring. In the end, these approaches are intended to generate discussion among cooperators, while aiming at improved Bonytail recovery potential.

ENDANGERED RAZORBACK SUCKER REPRODUCTION IN THE LOWER GREEN AND COLORADO RIVERS

Julie Howard
Utah Division of Wildlife Resources

Determining the location, timing, extent, and success of razorback sucker spawning is essential for evaluating the effectiveness of the stocking program, identifying recruitment, and guiding future management. Increased razorback sucker encounters, the presence of multiple age classes and congregations of ripe individuals prompted sampling for larval razorback presence and distribution via light traps and seining. The study was implemented in 2009 in the lower Green River from Green River State Park in Green River, Utah to the confluence with the Colorado River; however, in 2014 the study expanded to include the Colorado River from Moab, Utah to the confluence with the Green River after an increase in encounters of ripe adult razorback sucker and age 1 fish in 2012 and 2013. Larval razorback sucker were collected in large numbers in both the lower Green and Colorado reaches. The number of larvae collected in the Green River has increased significantly from the first three years of the study. The documentation of razorback sucker larvae in the Colorado River is the first evidence that successful spawning may be occurring in this reach. The timing of larval captures was used to back calculate hatching and spawning dates (Muth et al 1998, Bestgen et al 2002) and spawning estimates for both reaches show a preference for razorback sucker to spawn on the ascending limb of the hydrograph. Spawning in the Green River began earlier and spanned more days than spawning in the Colorado River where the increase in discharge and water temperature occurred later and was more abrupt. Stocking of razorback sucker has facilitated reproduction in the wild and the future management of this species will depend on a continuation of successful spawning events and the recruitment of wild spawned individuals into adulthood.

REFINING STRATEGIES FOR NONNATIVE FISH EXCLUSION FROM STEWART LAKE, A WETLAND MANAGED AS NURSERY HABITAT FOR RAZORBACK SUCKER, XYRAUCHEN TEXANUS, ON THE MIDDLE GREEN RIVER, UTAH

Robert C. Schelly and Matthew J. Breen
Utah Division of Wildlife Resources, Northeastern Regional Office, 318 North Vernal Avenue, Vernal, UT 84078.

Since 2013, Stewart Lake, a gated wetland on the middle Green River near Jensen, Utah, has served as a promising model for the re-coupling of larval Razorback Suckers with productive off-channel wetland nursery habitat. In a cooperative multi-year effort by Federal and State agencies called the Larval Trigger Study Plan, light trapping is being used to detect the presence of larval razorback suckers in the river, triggering increased releases from Flaming Gorge Reservoir, temporally matching peak flows to the period of larval drift. By filling the wetland during this period and maintaining entrainment until early autumn, three year-classes of wild-spawned Razorback Suckers have been returned to the Green River. Here we consider the ongoing challenge of proliferation of nonnative fishes in managed wetlands, and our attempts to refine a picket-weir system to allow larval Razorbacks and large-bodied native fishes access to the wetland while excluding nonnatives. As different nonnative species predominate from year to year, fine-tuning of our management strategy is necessary to maximize Razorback Sucker survival and further disadvantage nonnative fishes.

USING MICROCHEMISTRY TO DETERMINE NATAL ORIGIN OF RAZORBACK SUCKER IN THE SAN JUAN RIVER

Stephani L. Clark Barkalow*, Steven P. Platania and Jennifer L. Kennedy
American Southwest Ichthyological Researchers, Albuquerque, NM;
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Although the federally endangered Razorback Sucker *Xyrauchen texanus* naturally reproduces in the San Juan River, there is no evidence that wild-spawned fish recruit into the adult population. While untagged individuals are detected annually, it is unknown whether they originated in the river or are hatchery-produced fish that lack PIT tags. A nonlethal method for determining natal origin was developed to assess recruitment dynamics of Razorback Sucker in the San Juan River. Elemental (Sr/Ca and Ba/Ca) and isotopic ($^{87}Sr/^{86}Sr$) microchemical analyses of Razorback Sucker fin rays and otoliths were used to determine recruitment success and to ascertain natal origin of untagged fish. Isotopic and elemental analyses revealed notable differences between hatcheries and the river, allowing determination of natal origin for untagged individuals. An important finding of this study was the documentation of a naturally produced Razorback Sucker (224 mm TL), which represents recruitment to a much larger size than had been previously documented. Comparison of isotopic signatures of fin rays, otoliths, and water from the same source revealed that fin rays were better correlated with water than were otoliths. Otoliths and fin rays were highly correlated, indicating that fin rays are an appropriate surrogate for otoliths in microchemistry work. Analysis of fin ray microchemistry is a useful and nonlethal tool for assessing natural recruitment of Razorback Sucker in the San Juan River.

EVALUATION OF THE HOGBACK FISH WEIR—A STRUCTURE DESIGNED TO REDUCE ENTRAINMENT OF ENDANGERED FISH IN CANALS

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Kevin Bestgen, Larval Fish Lab, Colorado State University, Fort Collins, CO 80523; kbestgen@cnr.colostate.edu; (970) 491-1848

The Hogback Diversion Canal near Shiprock, NM diverts approximately 250 cfs of the San Juan River from May through October; this diversion can take > 50% of the river's flow at low-flow periods and can entrain a significant number of native fish. An 8-foot tall, 300-foot long weir wall was constructed in the canal in 2013 with the goal of diverting fish and debris back to the river via a bypass channel before going over the weir into the irrigation canal. We used PIT tag antennas and larval drift nets to determine the effectiveness of the weir wall by evaluating movements of fish > 100mm and entrainment of larval fish and beads. A total of 422 Colorado Pikeminnow (*Ptychocheilus lucius)*, 381 Razorback Sucker (*Xyrauchen texanus*), 194 Flannelmouth Sucker (*Catostomus latipinnis*), and 58 Bluehead Sucker (*Catostomus discobolus*) fish > 100mm were implanted with PIT tags to determine entrainment rates. PIT-tagged fish were stocked directly into the intake canal so that they had to exit the intake in one of three directions: (1) upstream through the intake to the river, (2) through the bypass to the river, or (3) over the weir and into the irrigation canal. We detected 18 fish that were entrained in the irrigation canal, for an overall entrainment rate of 1.7%. 152 (17.8%) fish were diverted back to the river and 651 (61.7%) fish exited the canal upstream back to the river. After the test was completed and the intake canal was drained 234 (29%) fish remained in the upper canal (i.e., were not bypassed or entrained)—we did not anticipate the high rate of fishing moving upstream or remaining in the intake canal. Additional tests for adult fish were planned in 2015 but were cancelled due to canal shutdown from the Gold King Mine release. The results from the large-bodied fish experiment suggest that the weir is very effective at preventing entrainment of fish larger than 100mm.

EVALUATION OF THE HOGBACK FISH WEIR— TRANSPORT AND ENTRAINMENT OF LARVAL FISH AND NEUTRALLY BOUYANT PARTICLES (NBP)

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In 2015, tests were conducted in the Hogback Diversion Canal, NM, to assess the affects of the weir wall (constructed completed 2013) on entrainment of drifting larval fishes. Tests were conducted using two densities of neutrally buoyant particles (NBP) and either larval Razorback Sucker, *Xyrauchen texanus*, or Colorado Pikeminnow, *Ptychocheilus lucius*. Larval fishes were obtained from Southwestern Native Aquatic Resource and Recovery Center. Recently hatched fish larvae were marked using oxytetracycline so they could be separated from wild produced larvae in larval fish monitoring surveys conducted in the San Juan River. Larval fish and NBPs were released near the Hogback Diversion inlet. The first test utilized protolarval Razorback Sucker (n=100,000) and two densities NBP (660,000 semi-buoyant [red] and 410,000 buoyant [purple]). The second test employed protolarval Colorado Pikminnnow NBP (n=45,000 red; n=690,000 purple). Larval fish of both species were entrained in the irrigation canal at rates greater than predicted. The more buoyant NBP (purple) were entrained at rates similar to those of the larval fishes while the less neutrally buoyant red NBP were diverted back to the river in significantly greater numbers. These results suggest that stocked larval fish were concentrated near the top of the water column, thereby increasing their risk of entrainment. Unfavorable sampling conditions precluded in-depth analysis of the portion of the study conducted using Colorado Pikeminnow.

SMALL ANTENNAS YIELD BIG RESULTS AT SAN JUAN RIVER WATERFALL

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In March of 2015 we installed two small submersible PIT tag antennas below the 10m waterfall on the San Juan River near Lake Powell. We detected 499 razorback suckers, 15 Colorado pikeminnow, and one bonytail in a 0.5 ha area below the waterfall through early July. The majority of detections occurred in early March and suggests that the fish are congregating at the waterfall in an attempt to migrate upstream to spawn. Subsequent trapping and netting by personnel from USFWS, Reclamation, BioMark, Navajo Nation, Kansas State University, Utah State University, and Bio-West Inc. captured 10 Colorado pikeminnow and 16 razorback suckers. Only five of the 16 captured razorback suckers were PIT tagged, suggesting that more than 1,500 razorbacks could be using this area at certain times of the year. Detailed records for the bonytail were hard to uncover, but the fish may have been stocked as early as 2005, which would make it the oldest stocked bonytail documented in the Upper Colorado River Basin. The waterfall was created within the last 20 years when the water level of Lake Powell dropped and the San Juan River carved another channel over a 30-foot cliff. Except for a couple of weeks in summer of 2011 when the water level in Lake Powell rose enough to briefly inundate the waterfall, the waterfall has served as a barrier to upstream fish movement. Although the waterfall serves as a barrier that helps exclude nonnative fish from the river, it also prevents the return of razorback suckers and Colorado pikeminnow that have travelled over the waterfall. In March 2016 a project will be implemented by USFWS, UDWR, University of New Mexico, and Reclamation to trap and move a portion of the fish that are captured at the waterfall. Up to 40 of the fish that are trapped at the waterfall will be implanted with both acoustic and radio tags and transported around the waterfall upstream to a stocking area near Shiprock, NM. Sonic and radio receivers will be used on the river to track the fish and determine if they stay in the river or return to the lake, and may identify spawning areas in the river.

ENDANGERED FISH MONITORING WITH PASSIVE INTEGRATED TRANSPONDER (PIT) TECHNOLOGY AT SPAWNING BARS

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We have been using PIT antenna systems to detect endangered razorback sucker (*Xyrauchen texanus*) at a known spawning location for the last four years. This method has documented the presence and survival of several hundred stocked fish each year at a single site, most of which had not been previously contacted through other techniques. For 2015 we expanded the use of this technology to two new sites where fish have been observed spawning in the past, including a spawning site for Colorado pikeminnow (*Ptychocheilus lucius*). These sites yielded additional fish detections representing species that are not a large proportion of the fish found at Razorback Bar. For all three sites, were able to detect and identify 743 unique tags, representing 593 razorback sucker, 95 Colorado pikeminnow, 5 bonytail, 1 humpback chub, 30 roundtail chub, 16 flannelmouth sucker, 1 bluehead sucker, and 2 flannelmouth x razorback sucker hybrids.

HOW DO WE USE DATA FROM PORTABLE PIT TAG ANTENNA SYSTEMS?

Ben Stout
Utah State University

The razorback sucker and the Colorado pikeminnow are federally endangered fish that were historically found in the San Juan River. Through stocking, populations of both endangered fish have improved. Endangered fish in the San Juan River are tagged prior to stocking or are captured using electrofishing or traps and tagged with Passive Integrated Transponder (PIT) tags to allow researchers to track their movements and estimate survival, which are essential knowledge to facilitate recovery of these species. The recent development of mobile PIT tag antenna systems could help to mitigate the negative impacts of traditional methods (e.g., electroshocking) to recapture these fish because it does not require physical capture of individuals. However, this system has a potential important drawback in that it detects tags and not fish and, consequently, is more susceptible to reading tags that are embedded in the substrate than other methods. This means a tag that has been shed or is left from a dead fish cannot be differentiated from a live encounter, which can result in biased estimates of vital rates. The specific objectives for this phase of the project are to develop and test methods to determine whether PIT detections collected by a floating antenna system are from tags in live fish or from tags embedded in the substrate. Data, which will be collected through time during multiple passes, includes tag number, location, time, and date. From these we can calculate the distance and direction moved between sightings, as well as the direction of river flow and movement direction relative to the flow. We will use the locations of PIT tags collected during multiple passes to develop a decision set and assign probabilities that a tag is alive or dead. There are three probabilistic states that a tag can be classified; likely alive, likely dead, unknown. Here, we present tentative rules to classify a tag as likely alive or dead/shed, and seek feedback and additional ideas for classification rules.

STREAMSYSTEM.ORG – AN INTRODUCTION TO THE ONLINE PIT TAG DATABASE

Amy Greenwell

The first release of the STReaMS online PIT tag database is now available! This site provides a centralized location for the data from both the Upper Colorado and the San Juan River Endangered Fish Recovery Programs. The database is custom built to facilitate the sharing, retrieval, management, and entry of your data. We will walk through the features on the website, discussing:

- The data currently available in the system.
- How to browse data by a variety of criteria, including: date range, species, encounter location, watershed, and many more.
- How to create text file downloads of encounters from filtered lists.
- Cross-basin and cross-study downloads for examining fish movement.
- Forms for editing existing data, and adding new data one record at a time.
- How to get help or report a bug/suggestion

After exploring the website, we'll briefly discuss the development process going forward. I'll lay out the year 2 priorities and touch briefly on year 3 goals. After the presentation, I welcome both questions and suggestions for future features.

ENDANGERED RAZORBACK SUCKER (*XYRAUCHEN TEXANUS*) IN LAKE POWELL: A STUDY TO DETERMINE HOW THESE FISH USE THIS IMPOUNDMENT AND HOW THESE FISH MAY CONTRIBUTE TOWARDS THE RECOVERY OF THIS ENDEMIC LARGE BODIED COLORADO RIVER FISH

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Razorback sucker is one of four Colorado River endangered fishes that have become greatly reduced in numbers and range since the mid 1900's. Although typically thought of as a riverine species, they are thriving in lentic environments. In 2011, the San Juan River Basin Recovery Implementation Program funded a project to investigate the status of all life stages of razorback sucker occupying the San Juan arm of Lake Powell. The work in 2011-2012 found a relatively large population of adult fish that were not only occupying the reservoir, but were also actively spawning there. In addition, a large proportion of these fish were without a passive integrated transponder tag suggesting potential wild recruitment. These findings highlighted the need to survey other areas of the reservoir. In 2014 and 2015 additional research was completed in the Colorado River Arm of Lake Powell using sampling techniques similar to those used in the San Juan arm (sonic tagging and tracking, trammel netting and electrofishing) with the addition of larval light traps and submersible PIT tag antennas (2015 only). Captures in the inflow resulted in 241 individual razorback captures in 2014 and 277 in 2015. The PIT tag antennas resulted in the re-sight of 101 additional razorback sucker in just two areas (Trachyte Canyon and Castle Butte). Three spawning areas were identified, two near Trachyte Canyon (LM 134) and one near Castle Butte (LM 126). Light traps, in 2014, produced 811 larval razorback sucker, which were the second most abundant larval species. Samples from 2015 are awaiting identification. In order to determine age structure of the population, fin clips (n=46) were taken from a subset of adult razorback suckers that did not have a PIT tag prior to sampling; samples showed ages ranging from 2-13 years. Sonic tagging revealed movement of razorback sucker among all spawning sites with migrations of up to 62 miles. Data from this study suggest that a large number of razorback sucker inhabit both the Colorado and San Juan Arms of Lake Powell and are reproducing in the wild. The acquisition of additional information to describe these populations (i.e. abundance, recruitment, etc.) is recommended to increase the understanding of razorback sucker in Lake Powell and to determine if and how these populations could contribute to the recovery of the species.

RAZORBACK SUCKER (*XYRAUCHEN TEXANUS*) RESEARCH AND MONITORING IN THE COLORADO RIVER INFLOW AREA OF LAKE MEAD AND THE LOWER GRAND CANYON, ARIZONA AND NEVADA

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For more than 20 years, Razorback Suckers were thought to be extirpated within the Grand Canyon. However, based on past studies and recent movements of sonic-tagged Razorback Suckers from Lake Mead into the lower Grand Canyon (LGC) section of the Colorado River, there are renewed questions regarding the presence of wild individuals and their relationship between the river and reservoir. This collaborative study includes efforts to continue research of Razorback Sucker (all life stages) within the Colorado River inflow of Lake Mead (CRI) combined with the inclusion of sonic telemetry, small-bodied fish community, and larval fish community sampling from Lava Falls downstream to Pearce Ferry, in the LGC (RM 180-280). The specific objectives outlined for these efforts included; (1) conducting larval and small-bodied fish community studies to quantitatively assess annual fish reproduction, spawning, and nursery areas in the LGC, (2) determining if Razorback Suckers are present in the study area and if they associate with specific habitats found within the LGC through the use of telemetry, and (3) identifying habitat associations, relative spawning and reproductive effort, and population trends of Razorback Sucker in the CRI. Specifically, this paper presents findings from the CRI portion of this multi-faceted study, particularly regarding natural recruitment observed within this population, with additional results from the LGC, as informed from small-bodied fish community sampling. Comparisons to historical data will be made, as appropriate. Finally, this research has also provided a means for fairly extensive documentation of young Humpback Chub (*Gila cypha*) throughout the riverine portions of the study area, as well as adult Razorback Sucker movement and habitat use within both a lentic and lotic environment.

COMPARISONS OF RAZORBACK SUCKER *XYRAUCHEN TEXANUS* REPRODUCTION IN THE COLORADO RIVER WITHIN THE LOWER GRAND CANYON AND THE SAN JUAN RIVER

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Prior to 2012, Razorback Suckers were believed to be extirpated from the Colorado River in the lower Grand Canyon. In 2014, efforts to document the presence of this species with larval sampling as a means to document reproduction were undertaken. Surveys in both 2014 and 2015

resulted in capture of larval Razorback Sucker. Data from these captures indicate an earlier initiation of spawning in the lower Grand Canyon than is observed in the Upper Colorado River Basin. Within the San Juan River, Razorback Sucker larvae have been captured annually since 1999 where it appears Razorback Sucker initiate spawning later and have a shorter duration. Larval surveys in the San Juan River documented recently transformed juvenile Razorback Sucker, a life stage absent in collections from the lower Grand Canyon. Potential factors (discharge and water temperature) influencing differences in Razorback Sucker spawning periodicity among drainages are being investigated to provide more insight into the spawning ecology of Razorback Sucker.

EXAMINATION OF MICROBIOTA ASSOCIATED WITH EXTERNAL LESIONS ON NATIVE AND ENDANGERED FISHES OF THE SAN JUAN RIVER, NM AND UT

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Relatively little is known about how the severity and duration of pathogenic outbreaks affect fish populations; yet, health can often be directly linked to and dependent on the integrity of ecosystems. Recent field surveys have identified the occurrence of lesions on non-native, native, and endangered fishes in the San Juan River, NM and UT. Severity of lesions range from minor, irritant-like abrasions to gaping infected wounds. Infections appear to be pathogenic in origin; however, it is difficult to determine without further examination. We conducted a pilot study to examine the microbiota associated with fish exhibiting lesions. Bacterial swabs were collected in the field and then cultured in vitro. Isolated colonies were extracted and then sequenced using universal bacterial primers. Sequence data was compared to files accessioned to the National Center for Biotechnology Information to examine potential candidates causing pathogenicity.

GENETIC CONTRIBUTION OF NATIVE AND INTRODUCED CATOSTOMIDS TO LARVAL DRIFT IN EXPERIMENTAL AND CONTROL STREAMS OF THE GUNNISON RIVER BASIN IN COLORADO

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Biology and Museum of Southwestern Biology, University of New Mexico (EWC and TFT); Southwestern Aquatic Resources and Recovery Center (MRS); and Colorado Department of Natural Resources (KT)

Diagnostic microsatellite markers were used to characterize interspecific hybridization among native and nonnative catostomids in two streams of the Gunnison River system. As part of an experimental study to evaluate the influence of nonnative removal on hybridization, we conducted a baseline genetic assessment of catostomid larvae at two geographically proximate streams, Potter and Cottonwood creeks, one of which (Cottonwood) will be subject to removal of nonnative suckers (via fish trap) and their hybrids prior to spring spawning in 2016. Baseline admixture analyses revealed that streams differed in species composition and levels of interspecific hybridization. Genetic haracterization showed that the prospective treatment stream (Cottonwood) was composed primarily of nonnative white sucker (*Catostomus commersonii*),

native flannelmouth sucker (*Catostomus latipinnis*), and advanced backcrosses to flannelmouth between these species. In contrast, larval drift in the proposed control stream contained primarily native flannelmouth or native bluehead suckers (*Catostomus discobolus*), with relatively few hybrids (advanced backcrosses) between these species. These results provide a baseline of the level of hybridization among species prior to nonnative removal, and additionally offer insight into the incidence of natural hybridization between flannelmouth and bluehead suckers.

GENETIC MONITORING AND BIOLOGICAL CONTROL OF RECRUITMENT IN BONYTAIL REARING PONDS

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To address the management implications of natural recruitment in grow out ponds, this study had three objectives, the first two being: 1) explore the use of *Ptychocheilus lucius* (Colorado Pikeminnow), a piscivorous fish, as a means of biological control to reduce natural recruitment in production grow-out ponds at Southwestern ARRC; and 2) optimized the species, growth and stocking rates specifically for pond culture of Bonytail (*Gila elegans*). Results from objective 1 and 2 of this study showed a strong negative effect of *P. lucius* on the abundance of *G. elegans* recruitment and total pond biomass. However, there was not a difference in the final number of recruits or differences in total biomass between the two treatment levels of *P. lucius*, suggesting densities as low as 50 *P. lucius* /0.4ha can effectively control unwanted recruitment of *G. elegans*. The third object was to use microsatellite markers to assess the genetic diversity of recruitment spawned naturally in grow-out ponds and conduct parentage assignments to determine how many parents contribute. Results of objective 3 combined with the portion of objective 1 and 2, suggest that although recruitment can be genetically diverse and similar to the parental population in terms of total number of alleles and allelic richness, as seen in the experimental control samples, the demographics and genetic diversity of the parental population is key.

GUIDE TO CYPRINID FISH LARVAE AND EARLY JUVENILES OF THE UPPER COLORADO RIVER BASIN WITH COMPUTER-INTERACTIVE KEY

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Use of collections of fish larvae and young-of-the-year juveniles to help document fish spawning sites and seasons or assess larval production, transport, distribution, nursery habitat, survival, and other aspects of early life history, requires diagnostic criteria to accurately distinguish target species from all similar appearing taxa in the waters sampled. To facilitate identification of larvae and early juveniles of the five native (three endangered) and ten (most) of the non-native Cyprinidae in the Upper Colorado River Basin (UCRB), developmental series of reared and collected specimens were studied for differences in size relative to developmental state, morphology, meristics, and pigmentation. The results, including detailed descriptive species accounts, comparative summary tables, and instructions for downloading and using the

associated computer-interactive key, are documented in an Upper Colorado River Endangered Fish Recovery Program Final (Draft) Report, available at http://warnercnr.colostate.edu/lfl-downloadable-keys-guides-and-bibliography. The guide manuscript portion of the report is planned for formal publication through Colorado Parks and Wildlife to complement a previously published guide to larvae and early juveniles of UCRB catostomids (Snyder and Muth 2004, CDOW Technical Publication 42). Together, these two guides complete a long series of descriptive investigations begun over 35 years ago with publication of *Contributions to a Guide to the Cypriniform Fish Larvae of the Upper Colorado River System in Colorado* (Snyder 1981, Bureau of Land Management Biological Sciences Series No. 3, Denver).

THE INVASION OF NONNATIVE SMALLMOUTH BASS IN THE UPPER COLORADO RIVER BASIN AND THE RESEARCH-DRIVEN MANAGEMENT RESPONSE FROM 2003 TO 2015

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A major component of the Upper Colorado River Endangered Fish Recovery Program is the reduction of threats posed by nonnative fishes to endangered, native fish species. As smallmouth bass (*Micropterus dolomieu*) expanded their range in the basin and their abundance increased, the Recovery Program responded with a fish removal program for this species that increased in intensity over time. In 2015, the Recovery Program, through its cooperating partners, conducted smallmouth bass removal projects in nearly 400 miles of the Colorado, Green, White, and Yampa Rivers. This presentation provides a history of smallmouth bass expansion and the research-driven management actions that ensued. Environmental conditions, especially related to flow and temperature were important drivers in smallmouth bass production. We discuss how low-flow years of 2007 and 2012 which had early, short duration runoff events produced two strong year classes compared to the high-flow year of 2011 which had a sustained, late runoff and produced a weak, practically missing year class. Even though strong year classes emerged in some years, we present evidence of a removal effect on abundance and population size-structure in some reaches. Crews from multiple agencies used similar strategies for targeting and removing bass at the highest rates possible, primarily using boat electrofishing; but, removal during smallmouth bass nesting and spawning was the most effective technique and resulted in the highest removal rates and spawning disruption. Future management actions will focus on redirecting effort to increase removal during the spawning period in some reaches and implementing new techniques that increase catch rates or target specific life stages. Additional strategies being implemented include targeted information and education programs, changes in fishing regulations, reservoir screening, and evaluating the potential for flow disruption of spawning where appropriate.

NORTHERN PIKE MANAGEMENT IN THE UPPER BASIN 2015 UPDATE

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As the largest non-native piscivore in the Upper Colorado River Basin, northern pike present a predatory threat to all life stages of native fish and compete for resources with Colorado pikeminnow. Northern pike removal efforts are conducted throughout the Upper Basin, employing techniques such as boat electrofishing, fyke netting, and more recently gill netting. In 2015, abundance and catch rates for adult northern pike were among the lowest observed in most reaches for the past 13 years. However, age-0 northern pike catch rates and abundance were the highest on record in the Middle Yampa River, which raises concerns of a strong 2015 year class. Despite observed low densities of northern pike in the Upper Colorado Basin in 2015, recent findings suggest that removal efficiency and effort must be increased to control northern pike in the Yampa River. Therefore, we recommend continuing the current level of electrofishing removal, expanding and refining netting efforts, and increasing our knowledge of northern pike spawning behavior and timing in the Upper Colorado River Basin.

MANAGING WALLEYE EXPANSION IN THE UPPER COLORADO RIVER BASIN WITH EDUCATION, ERADICATION AND ESCAPEMENT PREVENTION: ONE EXPENSIVE FILLET

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Introductions (by government agencies) of highly desired non-native fishes for angling opportunities and watershed management have been a tenet of fishery management; in fact the culture of government agencies that manage fisheries has shifted through time. The U.S. National Fish Hatchery System was developed in 1872 leading to the beginnings of Interstate

transport of desirable sport fish. However, fisheries management began to shift directions with the onset of an Environmental Era that began in 1960. Unfortunately, before the societal shift towards environmental stewardship and native species conservation, non-native and invasive fishes had contributed to deleterious effects on native fishes. The Colorado River Basin, home to a unique assemblage of endemic fishes, has an ever growing number (> 50) of non-native fish species competing with and predating upon the 13 native species. Walleye (*Sander vitreus*) have been present in the system since 1959, thought to have come from a reservoir spilling them into the Duschene River. Walleye collections were fairly rare, in the main-stem river until the early 2000's. Two major mechanisms are most likely the culprits to the walleye population expansion in the Colorado River Basin. One mechanism is the illegal introductions of these fishes to Colorado River Basin reservoirs, and the second mechanism could be the accidental stocking of gizzard shad (*Dorosoma cepedianum*; Morgan Lake, San Juan River Drainage, 1998) which is a pivotal management tool (prey item) used by fishery managers to bolster walleye condition and populations where they are desired. Chemical fingerprinting (strontium isotopes laser ablated from otoliths), conducted by CSU (Johnson et al, 2014), identified three reservoir sources of walleye (Redfleet and Starvation (Green River), and Rifle Gap (Colorado River)) as well as in river reproduction from samples collected through 2008. Both the states of Utah and Colorado have been proactive in containing these sources. Reservoir outlet screens have been installed, piscicide treatments have been deployed, and public education messaging has been disseminated. Beginning in 2010, researcher's documented a substantial increase of walleye in their catch in the lower portions of the Green and Colorado Rivers, the primary nursery areas for endangered Colorado pikeminnow (*Ptychocheilus lucius*) and razorback sucker (*Xyrauchen texanus*). Beginning in 2013, a focused mechanical removal effort began and 1,043 walleye have been removed (2013-2015) from the entire Green River (> 350 river miles) and 666 have been removed (2013-2015) from the lower Colorado River (112 river miles).

RESPONSE OF THE NATIVE FISH COMMUNITIES OF THE YAMPA AND GREEN RIVERS TO NONNATIVE FISHES AND FLOWS

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Mechanical removal of several non-native fish predators has been implemented in several rivers of the Upper Colorado River Basin in an effort to restore once-abundant native fishes. From 2003-2015, we sampled small-bodied fishes in low-velocity habitat in treatment (piscivorous fish removal) and control (no removal) reaches with a variety of gears to assess whether predator removal benefited the native fish community in the Yampa River, Colorado. Through 2007, main channel fish communities were dominated by non-natives, particularly young-of-year (YOY) smallmouth bass. Native fishes were rare in main channel habitat, and were usually present only in isolated pools where smallmouth bass were uncommon. Although still relatively uncommon, higher frequencies of native fishes in main stem samples since 2008 were coincident with increased removal of YOY smallmouth bass, particularly in the treatment reach. Native fish abundance in main channel samples in the control and treatment reaches increased in 2008-2012 and was particularly high in 2011. Higher flows and relatively cool water prevailed in that

period, especially in 2011, compared to earlier years. In the warmer and low flow year 2012-2015 native fish abundance declined from 2011 levels likely as a result of higher bass abundance and larger bass body size. Positive native fish response since 2008 was likely due to synergistic effects of smallmouth bass removal and return to a higher, more normal hydrologic regime, which delayed bass spawning, growth, and perhaps abundance of smallmouth bass in the Yampa River, Colorado. As part of the native fish response story, we also examined trends for Colorado pikeminnow in the Green River subbasin. Adult Colorado pikeminnow have declined throughout the Green River subbasin. We examine reasons for those trends including abundance of drifting Colorado pikeminnow larvae, young of year pikeminnow abundance in backwater habitat, and relationships of those data to flow patterns and nonnative fish abundance. Increased summer baseflow levels in nursery habitat reaches, to moderate levels, was associated with higher abundance of ago-0 pikeminnow in backwaters in autumn in the Green River. Immediate action is needed to arrest declines of adults and increase abundance of young and recruit-sized fish in both the middle and lower Green River.

COLORADO PIKEMINNOW RECRUITMENT IN THE UPPER COLORADO RIVER BASIN: A NEW PERSPECTIVE FOR THE GREEN RIVER, UTAH

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Long-term monitoring data is valuable to assess distribution and abundance of endangered fish populations and their response to environmental management and invasive species. Young-of-year (YOY) Colorado pikeminnow (*Ptychocheilus lucius*) sampling is ongoing since 1986 in the upper Colorado River basin as part of the Interagency Standardized Monitoring Protocol (ISMP) to monitor recruitment success of this federally endangered species. Survival of YOY pikeminnow varies greatly between years independent of spawning success as a result of numerous interacting biotic and abiotic factors including flow variation, water temperature, rearing habitat condition and availability, and competition and predation by nonnative fishes. Autumn ISMP sampling is intended to provide a large-scale (224 miles of the Green River, 111 miles of the Colorado River) snapshot of annual recruitment following spawning and summer growth periods. To accomplish this, a sub-sample of backwater habitats that meet specific criteria are seined, focusing on two nursery habitat reaches in the Green River (104 and 120 miles) downstream of known Colorado pikeminnow spawning locations. In the Green River, Utah, we observed a marked decline in autumn recruitment beginning in 1994, with the exception of high production years 2009 and 2010, and adult Colorado pikeminnow populations are declining throughout the Green River basin, the largest remaining population. In light of poor recruitment for more than two decades, preliminary data from our 2015 efforts indicate successful reproduction and late summer survival, widespread occupation of backwater habitats throughout sampling reaches, and capture of several hundred YOY pikeminnow. One potential explanation for this success may derive from summer flow regimes (i.e., base flow timing and

magnitude) given that experimental water releases from the Flaming Gorge Dam have benefitted other endangered fishes (e.g., razorback sucker). Following a significant effort to analyze available data from 1979 – present, we recommend maintaining summer base flows within a specific range through manipulation of flow releases from Flaming Gorge Dam. This action is needed immediately as it offers the best opportunity to boost survival of young fish that only add to the adult population 5-8 years later. Flow management, along with invasive species control, may provide additional tools to aid recovery of Colorado pikeminnow in the upper Colorado River basin.

RIVER REGULATION AFFECTS REPRODUCTION, EARLY GROWTH, AND SUPPRESSION STRATEGIES FOR INVASIVE SMALLMOUTH BASS IN THE UPPER COLORADO RIVER BASIN

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Understanding the reproductive ecology of organisms enables predicting effects of environmental factors to control population growth. Otolith microstructure was used to estimate hatching dates and growth of invasive smallmouth bass *Micropterus dolomieu* collected in regulated or partially regulated reaches of the Green River, and the free-flowing Yampa River, Colorado and Utah, 2003-2011. Smallmouth bass hatching in the unregulated Yampa River was initiated in June through mid-July consistent with a 16°C water temperature threshold over a range of flow levels. In dam-regulated and partially regulated Green River reaches, spawning occurred only after habitat was available and was several to many days after the 16°C threshold, so bass reproduction was controlled by water temperatures and flow level. In all reaches, bass hatched later in cooler and higher flow years and earlier in warmer and lower flow years. Total length of Age-0 smallmouth bass in mid-September was positively influenced by length of growing season as well as water temperature and indicated flow reductions from water storage or climate change would increase bass growth and negative effects on native fishes. Management actions such as abrupt flow increases (managed floods), reduced water temperatures, or physical disturbances directed at disrupting spawning smallmouth bass may reduce reproductive success but need to consider effects on other native and nonnative fishes as well as water availability tradeoffs. Increased use of flow and water temperature regimes from dams to reduce negative effects of nonnative fishes, and to increase growth and survival of native kinds, is discussed as a viable use of reservoir water storage and may offer management agencies another tool to achieve a more naturally functioning river ecosystem and enhance recovery of native biota.

RAINBOW TROUT ABUNDANCE, DISTRIBUTION, AND MOVEMENT IN GLEN AND GRAND CANYONS, AZ

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As with many tailwaters in the western U.S., nonnative Rainbow Trout (*Oncorhynchus mykiss*) were introduced to the Colorado River downstream from Glen Canyon Dam in 1964 shortly after the dam was completed. The objective of this and other nonnative fish introductions was to create recreational sport fisheries. Negative effects on native fish populations may have been unintentional, but now present real and serious threats to the continued persistence of some native fishes. In Grand Canyon, Rainbow Trout can compete with the endangered Humpback Chub (*Gila cypha*) for food and habitat and also predate on juveniles. We initiated a large-scale mark-recapture study to better understand the threat presented by a large Rainbow Trout population approximately 100 km upstream from the greatest concentration of Humpback Chub in Grand Canyon near the Little Colorado River confluence with the Colorado River. Objectives for this study included quantifying the abundance, distribution, and movement of Rainbow Trout between Glen Canyon Dam and a segment of the Colorado River just downstream of the Little Colorado River confluence. Since 2012, approximately 70,000 Rainbow Trout have been marked with passive integrated transponder (PIT) tags and released. About 8,000 marked fish have subsequently been recaptured. The distribution of Rainbow Trout from Glen Canyon Dam to the Little Colorado River is highly skewed with the greatest densities closest to the dam (> 10,000 fish per km) and lowest at the Little Colorado River confluence (< 1,000 fish per km). Abundance was highest in upstream reaches at the beginning of the study and has generally declined since. In contrast, abundance increased in downstream reaches over the first two years of study then dropped sharply coincident with similar declines observed in upstream reaches. The proportion of Rainbow Trout moving distances of 20 km or more downstream was very small, < 1%. Despite low rates of emigration, increases in Rainbow Trout abundance observed downstream early in the study can be explained by dispersal from Glen Canyon due to the high densities of fish in this 25-km long tailwater segment.

RAPID RESPONSE TO NEW GREEN SUNFISH INVASION IN THE COLORADO RIVER IN GLEN CANYON NATIONAL RECREATION AREA

Melissa Trammell NPS, Brian Healy NPS, Mark Anderson NPS, Mike Anderson AGFD, David Ward GCMRC

In July 2015 an unusually large number of Green Sunfish (43) were collected from a large backwater in the Colorado River, approximately 3 miles below Glen Canyon Dam, by the Arizona Game and Fish Department (AGFD). This collection immediately caused concern among biologists as potentially signifying a new invasion of this nonnative fish in a sensitive area, and management agencies agreed there was an urgent need to control this population. Fish biologists from the AGFD, National Park Service (NPS), U.S. Geological Survey Grand Canyon Monitoring and Research Center (GCMRC), and US Bureau of Reclamation (BOR) conferred and agreed to conduct mechanical removal in the backwater where the fish were found and

several downstream habitats that were thought to be suitable for Green Sunfish. Removal trips occurred from 12 -14 August and from 27-28 August, 2015. Methods consisted of boat and backpack electrofishing, seining, and minnow traps. Biologists captured and removed 954 and 2,574 Green Sunfish on the first and second trips, respectively, but did not find Green Sunfish in any of the downriver habitats. Repeated electrofishing passes during each removal trip did not result in depletion of the population, and Green Sunfish numbers also increased between removal trips because of active reproduction. Given the lack of success in depleting Green Sunfish with these efforts, alternative management options for control were needed. While additional methods of removal and control were considered, a block net was constructed and installed to limit escapement from the backwater to the main river. A rotenone treatment to eliminate the Green Sunfish from this backwater and prevent downstream colonization was planned and successfully implemented in November, 2015. Long-term solutions to prevent another invasion of Green Sunfish or other invasive species in this backwater habitat are being discussed. The speed of this rapid response to an early detection of an invasive species is a model of shared vision and collaboration among many agencies, but points to a need for additional pre-planning and compliance for future emergency actions.

PROGRESS ON COLORADO PIKEMINNOW RECOVERY DEVELOPMENT OF POPULATION VIABILITY ANALYSIS

Richard A. Valdez, Thomas E. Czapla, and Thomas E. Chart

A Draft Colorado Pikeminnow Recovery Plan was completed on November 25, 2014. During review and evaluation webinars in April and May, 2015, stakeholders and U.S. Fish and Wildlife Service agreed that a Population Viability Analysis (PVA) would be a useful tool for assessing status and viability of the Colorado Pikeminnow. A Scope of Work (SOW) was developed and the Conservation Breeding Specialist Group of Minnesota was retained to develop a PVA. The objectives of the SOW are to conduct a PVA to determine near-term and long-term risk of extinction for downlist and delist criteria, and to evaluate species viability at different threat levels. Four tasks include: (1) clarify desired PVA analyses and outputs, (2) assimilate and reach consensus on best available scientific data, (3) conduct and develop a PVA, and (4) review and finalize a PVA Report. The lead agencies are the Upper Colorado River Endangered Fish Recovery Program and the San Juan River Basin Recovery Implementation Program. Four species experts and five advisors have been designated to assist with and evaluate the ongoing PVA process. The project started in September 2015, and a Final PVA Report is expected in October 2016.

HUMPBACK CHUB RECOVERY PLANNING PROCESS

Richard A. Valdez and Thomas C. Czapla

A Humpback Chub Recovery Team was appointed in 2015 by the U.S. Fish and Wildlife Service (USFWS), Region 6 Director, Noreen Walsh, for the purpose of preparing a Revised Humpback Chub Recovery Plan. The Recovery Team is coordinated by a USFWS Agency Lead and an appointed Recovery Team Leader, and consists of three subgroups: Scientific Advisory Subgroup, Implementation Subgroup, and Writing Subgroup. A recovery planning process will

be implemented that is consistent with the Recovery Enhancement Vision (REV) of the USFWS, and will result in three documents: (1) Species Status Assessment, (2) Recovery Plan, and (3) Implementation Plan. A Species Status Assessment Report is expected about April 2016, and a Final Recovery Plan (includes Recovery Plan and Implementation Plan) is expected to be delivered for approval by the Regional Director in June 2017.

COPYRIGHT FACTS AND REGULATIONS AND INFORMATION AND EDUCATION UPDATE

Melanie Fischer, Information and Education Coordinator, UCREFRP and SJRIP

Copyright Facts and Regulations: An overview of what's involved in creating the fish illustrations of Joseph R. Tomelleri. Why we need to pay a usage fee and general copyright information.

Information and Education Update: What we are doing to promote both the Upper Colorado River Endangered Fish Recovery Program and the San Juan River Basin Recovery Implementation Program. Review of new educational products and discussion of what would help your efforts in the field.

STATUS OF LCR MSCP FISH AUGMENTATION AND HABITAT CREATION GOALS AFTER 10 YEARS OF IMPLEMENTATION

Gregg Garnett

The Lower Colorado River Multi-Species Conservation Program (LCR MSCP), now in its 11th year of implementation, was created to balance the use of Colorado River water resources with the conservation of native species and their habitats. The program works toward the recovery of species currently listed under the Endangered Species Act (ESA). It also reduces the likelihood of additional species listings. Implemented over a 50-year period, the program accommodates current water diversions and power production, and will optimize opportunities for future water and power development by providing ESA compliance through the implementation of a Habitat Conservation Plan (HCP). Among the many conservation measures detailed in the HCP, 17 support conservation of native fishes. There are eight for razorback sucker, five for bonytail, three for flannelmouth sucker, and one for humpback chub. In this presentation we provide the status and accomplishments of the fisheries conservation measures over the past ten years specific to habitat creation and fish augmentation goals for razorback sucker and bonytail. A total of 360 acres of backwater habitats are to be created for razorback sucker and bonytail and approximately 660,000 subadult razorback sucker and 620,000 bonytail are to be stocked into the lower Colorado River over the life of the program. We discuss where we are in terms of meeting these goals after a decade of implementation and some of the strategies that will allow us to continue to effectively conserve these species and meet the goals of the LCR MSCP.