

swimming upstream

San Juan River Basin Recovery Implementation Program
Upper Colorado River Endangered Fish Recovery Program

Razorback suckers are making a comeback in the upper Colorado River basin

Biologists are thrilled that the recovery programs' stocking efforts are bearing fruit and razorback suckers are becoming more numerous throughout the upper Colorado River basin. "We catch so many razorbacks these days; it takes us longer to complete our Colorado pikeminnow sampling trips," says U. S. Fish and Wildlife Service (USFWS) researcher Travis Francis.

Historically, the razorback sucker occurred throughout warm-water reaches of the Colorado River Basin from Mexico to Wyoming. When this species was listed in 1991, its numbers were much reduced and biologists were worried it might become extinct. Thanks to the efforts of the San Juan River Basin Recovery Implementation Program and the Upper Colorado River Endangered Fish Recovery Program, these fish are making a real comeback today. Hatchery-produced fish are being stocked to re-establish the species in the wild and preferred habitat is being restored and provided through flow management, floodplain protection, and nonnative fish management.

Upper Colorado River Basin

Numbers of stocked razorback sucker are increasing in the wild. Not only are stocked fish surviving, but researchers find them in spawning groups in several locations in the upper basin, including the Yampa River just above the confluence of the Green



PHOTOGRAPH COURTESY UDWR-NOAB

JUVENILE RAZORBACK SUCKER, MAY, 2013

River, "Razorback Bar" in the middle Green River, Desolation Canyon in the lower Green River, and in the Colorado River near Loma, Colorado. Captures of larval razorback sucker in the Yampa, Green, Gunnison, and Colorado rivers confirm that the fish are reproducing in each of these areas. Most exciting, this spring, researchers captured juvenile fish that were spawned in the wild in 2011 and 2012 and successfully overwintered in both the Colorado and lower Green rivers.

Hatchery programs have been very successful. In the upper basin, razorback suckers are being raised by the Ouray National Fish Hatchery, Rantlett and Grand Valley units near Vernal, Utah and Grand Junction, Colorado. Following analysis of razorback sucker stocking and survival by Colorado State University's Larval Fish Lab, the Recovery Program increased the size of razorback sucker for stocking from an average of about 11 inches to about 14 inches and is stocking the fish in the fall when fish survive better. To increase growth, the Program raises the fish in a combination of outdoor ponds during warmer months and indoor tanks in the winter.

This past summer, many wild-spawned razorback larvae drifted from a middle Green River spawning bar into the Stewart Lake wetland about 11 miles downstream. Utah Division of Wildlife Resources (UDWR) personnel used a "picket weir" (like a picket fence in the water) with quarter-inch openings to allow larval razorback sucker and other small-bodied fishes to move into the wetland, but prevent large nonnative fish from entering. "The weir did a great job of keeping out large-bodied adults to allow for a higher success in razorback survival and to sample the fish community upon draining," said UDWR's Joe Skorupski. When Stewart Lake was drained in August, researchers counted more than 600 1.5" - 3.5" razorbacks exiting the wetland to the Green River.

In this issue



Flash floods and the forces of nature

Biologists awaken to the crashing sound of their rafts being upended by a flash flood.



Electrofishing standards in place

Electrofishing standards improve ability to catch target fish



The Fisheye

SJRIP Director, Dave Campbell shares his passion for falconry in the third installment of this Swimming Upstream series.



San Juan River Recovery Program wins AGO award

Cooperative effort creates and restores fish habitat on the San Juan River.



Larval Fish Laboratory celebrates 35 years

Larval Fish Lab honored for their scientific contributions.

Connecting floodplain nursery habitats like Stewart Lake is one of the goals of Green River flow recommendations. The Bureau of Reclamation is experimenting with spring flow releases from Flaming Gorge Dam timed to coincide with the presence of wild-produced larval razorback sucker. In 2013, larvae were first detected on May 26 and on May 28, larvae were swept into Stewart Lake and other locations.

Researchers are faced with a very good problem: they're catching or detecting so many razorback suckers that it takes more time to process the fish and the data collected. Remote passive integrated transponder (PIT) tag antennas detect so many razorback suckers that a master database has to be built to provide easy access to the data. (A PIT tag is a small microchip in a glass capsule similar to those placed in a dog or cat for individual identification.)

During Colorado pikeminnow population estimates in the middle Green River, the USFWS captured 55 razorback suckers in 2008, 983 in 2011, and 765 in 2012. This is a lot of fish to handle, but biologist Tildon Jones says: "It's exciting to see our hatchery fish taking hold in the river and recolonizing new areas."

While electrofishing to remove smallmouth bass from Yampa Canyon this year, biologists passed over an old spawning bar just above the Yampa/Green confluence at Echo Park. They captured three razorback suckers, two of which were tuberculated and appeared to have spawned. (Tubercles are tiny, keratinized bumps that grow on a fish's fins, head, and body scales during the breeding season. They are found primarily in males on parts of the body that are likely to come in contact with females.) This is the first time razorback suckers have been captured on this spawning bar in many years.

In 2012, two PIT tag-reading antennas were placed on the spawning bar in the middle Green River near Dinosaur National Monument in northeast Utah. These antennas cover just over two square feet each, but detected fifty-two unique razorback sucker stocked between 2004 and 2010, 88 percent of which had not been seen since they were stocked. In 2013, the antennas detected 517 razorbacks from April to mid-June.

Due to the success of razorback stocking efforts, the Recovery Program is now raising fewer (but larger) razorback sucker which has allowed the Recovery Program to put more effort into raising and stocking more (and larger) bonytail to improve their stocking success.

San Juan River

The San Juan Program began stocking razorback sucker in 1994. Collections of larval fish show that razorback sucker have reproduced in the San Juan River for 15 years (1998-2012). The number of larval razorback sucker ("age-0," meaning they were hatched that year) captured has been increasing over time and they are widely distributed throughout the river.

In 2012, 1,778 age-0 razorback sucker were collected, the largest number since monitoring began in 1998 (Figure 1). For each of three consecutive years, more than 1,000 age-0 razorback sucker have been collected from the San Juan River. This 2010 - 2012 period has produced two-thirds (63.7%) of all razorback sucker collected from the San Juan River in the last 15 years. This fact, along

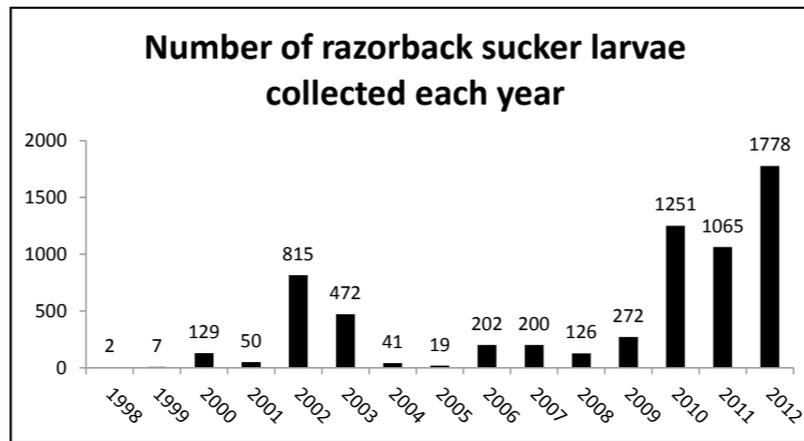


FIGURE 1. SAN JUAN RIVER LARVAL RAZORBACK SUCKER COLLECTIONS (N=6,408)

with a continued increase in the upstream distribution of larvae (19+ river miles since 2000), a nearly 10-week spawning period, and 15 consecutive years of documented reproduction all suggest that adult razorback sucker are well established in the San Juan River.

Recaptures of adult razorback suckers also show a steady increase over time with a good mix of age classes and upstream expansion.

Many razorback suckers remain close to their original stocking location; however, long distance movement has been documented. Four razorback suckers stocked in the San Juan River were detected in 2011 and 2012 during monitoring efforts in Lake Powell, the mainstem reservoir at the downstream end of the San Juan River in Utah. These fish had moved downstream into the lake as much as 188 miles from their stocking location. In total, biologists captured 75 adult razorback suckers in Lake Powell in 2011 and 72 in 2012. Considering how large the lake is and the small area that was sampled, these numbers indicate that large numbers of razorback suckers are probably living in the reservoir.

Razorback sucker reproduction in the reservoir also has been documented. Male and female razorback sucker in spawning condition were collected during the two-year study and one larval razorback sucker was collected in 2011. Razorbacks appeared to be spawning at Spencer's Camp, an upstream site, and then at Neskahi Canyon, a downstream site, about a month later.

Of the 147 razorback suckers collected in Lake Powell in 2011 and 2012, 55 (37%) did not have a PIT tag which could mean they were not previously tagged by the SJR Recovery Program. Considering the vast majority of razorbacks stocked in the San Juan River are tagged before being stocked and only ~14% of razorbacks recaptured in the San Juan River do not have a PIT tag; could any of these un-tagged fish be wild-born? The San Juan Recovery Program will be doing further investigations to try to answer this important recovery question.

Researchers have also discovered that razorback suckers can move between Lake Powell and Upper Colorado River tributaries when lake levels are higher. Typically, fish cannot move upstream into the San Juan River because lake levels are lower than the river. In July 2011, above-average snow pack raised Lake Powell up to the river's level for a brief time (allowing fish passage) and five

Lake Powell razorbacks were subsequently captured in the San Juan River. By examining PIT tag records, researchers discovered that three razorback sucker stocked in the San Juan River had been recaptured in the Colorado River in 2004 and 2006. Those fish had moved down the San Juan River, through Lake Powell, and up the Colorado River, one fish moving almost 300 miles (Figure 2).

Considering razorback sucker were virtually gone from the San Juan River when the San Juan Recovery Program began, the increasing numbers of adult and larval fishes in this system are promising. The challenge now is to get wild-born larval fish to survive to adulthood in the river. Numerous reports have been submitted by 2013 survey crews that wild-born juvenile razorback sucker -- that very important recruitment class -- are being captured!



FIGURE 2: LONG-DISTANCE MOVEMENT OF STOCKED RAZORBACK SUCKER DOWN THE SAN JUAN RIVER AND UP THE COLORADO RIVER. POINTS SHOW LOCATION, YEAR AND LENGTH IN MILLIMETERS AT TIME OF RECAPTURE. IN PARENTHESIS, LENGTH IN MILLIMETERS AT TIME OF ORIGINAL RELEASE.



CLICK ABOVE TO SEE RAZORBACK SUCKERS RELEASED INTO THE SAN JUAN RIVER, NM.

Program director's message

By Tom Chart, Program Director
Upper Colorado River Endangered Fish Recovery Program

It is hard to believe that the Upper Colorado River Program is celebrating its 25th anniversary. It is harder to believe that 1988 doesn't seem that long ago. My family and I had just moved from Fort Collins, Colorado to Helper, Utah to accept a two-year contract position with Utah Division of Wildlife Resources. My responsibility as a recent graduate of Colorado State University was to lead a radio-telemetry study of bonytail in the Green River. At the time, I did not fully grasp that my little project was part of this bigger effort that would have as much staying power as the Recovery Program has.

The Recovery Programs, (the San Juan Program came along just a few years later), have gathered considerable recognition through the years. Other resource managers have picked up on our collaborative, programmatic approach, leading to the development of similar programs in other ecosystems. To this day, our Recovery Programs are recognized as the preferred way to implement the Endangered Species Act. I am continually amazed at the complexity and magnitude of our recovery efforts, which to our partners credit, only seems to increase from year to year.

Our Recovery Programs' accomplishments over the past quarter century are astounding – from reconnecting habitats, to Bureau of Reclamation and water user reservoir reoperations, to the development of sound hatchery programs including state of the art hatchery facilities, to endangered fish monitoring programs that have steadily improved through time, and to one of the largest, most coordinated nonnative fish control efforts anywhere.

Our work is far from done. I don't want to dwell on the increasing threat of nonnative predators, but it must be mentioned. I, along with all our partners, lament the fact that the nonnative problem has gotten so far out in front of us. However, I am finally comfortable with the conversations the Upper Basin Recovery Program is having on this issue, which focus on treatment of sources and a zero-tolerance policy toward the 'worst of the worse' species. Yes, we have a long way to go, but I feel we are now poised to give this our best shot.

Speaking of a long way to go - In 1988, the fledgling Upper Basin Recovery Program was deliberating over whether we should pursue razorback sucker recovery through habitat management or start bringing old adult fish into captivity to develop a hatchery broodstock. Twenty five years later we have developed genetically diverse broodstocks, built hatcheries, refined hatchery techniques, achieved stocking targets, documented that hatchery fish have the capacity to spawn in the wild, and in 2013, captured our first wild-produced age-1 razorback sucker. Recovery of long-lived fish in a place like the Colorado River takes a long time, but I don't think there is a better chance for success than with this recovery program approach and with the dedicated folks that make these Programs happen.

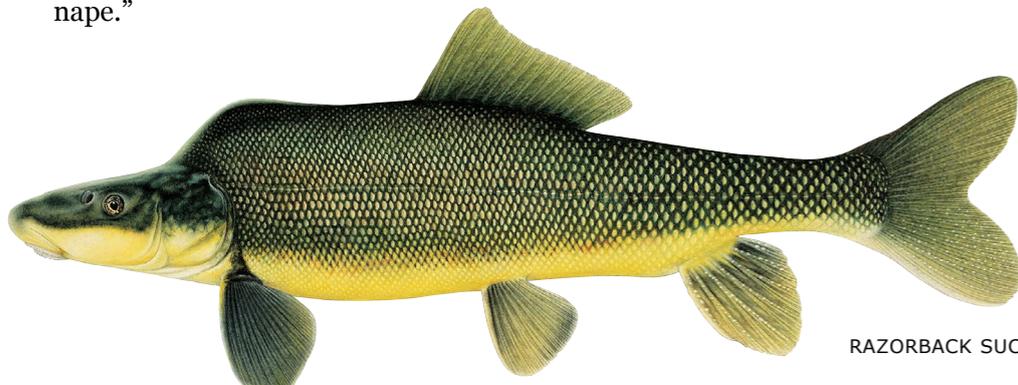


TOM CHART

Tom Chart

Did you know that Texas also has a Colorado River?

In 1860, archeologist and naturalist Charles Conrad Abbott described the razorback sucker from a stuffed specimen that he mistakenly thought came from the Colorado River in Texas! That's how the razorback got the scientific name *Xyrauchen texanus*. The genus name *Xyrauchen* is more fitting – it literally means "razor-nape."



RAZORBACK SUCKER ILLUSTRATION © JOSEPH R. TOMELLERI



Platania named researcher of the year

The San Juan River Recovery Implementation Program (San Juan River Program) hosted the Annual Researcher's Meeting in Moab, Utah, in January 2013. During the meeting, the San Juan River Program had the honor of presenting one of its own and long-time Colorado River researcher, Steven Platania, with the Researcher of the Year award.

Steven got his Bachelors of Science from Towson University in 1977 and, as a college undergraduate, worked with fish and amphibians throughout Maryland and Delaware.

In 1982, Steven made the move to attend graduate school at Colorado State University (CSU). At CSU, he trained on larval fish identification, taxonomy, and ecology at the Larval Fish Laboratory and studied fishes of the Colorado River and its tributaries.

In 1986, Steven and fellow biologist, Kevin Bestgen, moved from Fort Collins to Albuquerque to work with David Propst at the University of New Mexico (UNM) to determine the status of Rio Grand bluntnose shiner and other Middle Rio Grande endemic cyprinids. In 1987, they sampled the San Juan River in New Mexico to determine if Colorado pikeminnow and razorback sucker were still present in the system. They collected two adult Colorado pikeminnow in May 1987 and young-of-year specimens in October 1987 – documenting the presence of a reproducing population. The discovery of this endangered species in the San Juan River provided the seed that ultimately grew into the San Juan River Program.

During the summer of 1994, Steven and a colleague, Rob Dudley, struck out on their own as independent contractors. Their new research organization, American Southwest Ichthyological Researchers (ASIR), was dedicated to providing high quality research on issues affecting the fishes of the American Southwest.

As Steven and his colleagues approach 30 years of studies in the American Southwest, they are seeing the positive results of razorback sucker reintroduction in the San Juan River. Their larval fish sampling is tracking reproduction of the endangered species and they are working with new techniques to document recruitment of wild spawned razorback suckers.

Steven's years of experience on the San Juan River makes him one of the most knowledgeable and respected biologists that I have had the pleasure to work with," said Dave Campbell, director of the San Juan River Program, who co-presented the award. "He brings a wealth of knowledge and experience that can only be gained from spending decades working on the river."



BILL MILLER, SAN JUAN RIVER PROGRAM BIOLOGY COMMITTEE CHAIR, CO-PRESENTED THE AWARD TO PLATANIA



PLATANIA, ON THE RIVER

ANGELA MANTOLA, USFWS

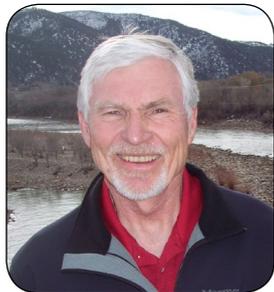
The Endangered Fish Recovery Program and the Colorado River Water Conservation District

In a time of increased tensions over access to the waters of the Colorado River, mediation and collaboration can often take a back seat to costly lawsuits. Fortunately, leaders in the water community, such as Colorado River Water Conservation District (River District) General Manager Eric Kuhn, have helped cultivate lasting partnerships to further water development, satisfy environmental concerns and avoid litigation.

Early this year, H.R. 6060, the Endangered Fish Recovery Programs Extension Act of 2012, became law (P.L. 112-270). The act extends the use of hydropower revenues collected via the Colorado River Storage Project Act to fund existing endangered fish recovery implementation programs. The programs ensure compliance with the Endangered Species Act (ESA) for historical water use and future water development from the Colorado River and help restore the four endangered native fish species.

Kris Polly, editor-in-chief of *Irrigation Leader* magazine, talked with Eric about the River District and its instrumental role in the development and implementation of the Upper Colorado River Endangered Fish Recovery Program.

Kris Polly: Can you tell us about your issues with endangered species?



ERIC KUHN

Eric Kuhn: In the Upper Colorado River system there are 14 native fish species. In the early 1980s half of those species were in trouble and 3 had been listed as endangered (Razorback sucker did not get listed until 1991.) Looking to avoid litigation, Colorado, Utah, and Wyoming water entities negotiated a programmatic approach to recovering the three ESA-listed native fishes. This led to signing of the Upper Colorado River Basin Endangered Fish Recovery Program Cooperative Agreement in 1988. From the beginning we [the water organizations] decided to establish the pillars of the Recovery Program - developing additional water and recovering the endangered fish. Many thought we were crazy and that the program would not work. Through many people's efforts the program has been operating successfully since 1988.

Kris Polly: Who has benefitted from the program?

Eric Kuhn: It has directly benefitted agricultural, industrial, municipal and recreational interests and it also has had secondary benefits for irrigators. For example, improving stream flows in the 15-mile river reach that extends upstream of the confluence of the Colorado and Gunnison Rivers also adds high-quality water to the system and ensures irrigators are not "chasing" each other's water when supplies are low.



FISH STOCKING

Kris Polly: Has the program worked so well that it has become invisible to its beneficiaries?

Eric Kuhn: Yes. Many applicants don't even realize that the program is the reason they successfully obtained necessary permits. The program has not put an obvious burden on our water users. The program has also installed fish ladders, acquired floodplain habitats and helped build fish hatcheries. It even helped fund the enlargement of one of our reservoirs from which it has a portion of the project yield. The sources of funding include federal and state appropriations, a depletion fee and power revenues.

Kris Polly: Why did the recent legislation pass?

Eric Kuhn: The River District and many others work hard to maintain broad Congressional support for the program and its goals. The program is not too demanding and not too accommodating. It is just right to accomplish the twin goals of developing water resources and recovering endangered fish.



FISH SCREEN INSTALLED ON THE REDLANDS CANAL NEAR GRAND JUNCTION RETURNS FISH TO THE GUNNISON RIVER.

Duchesne River water management aids fish

The Central Utah Water Conservancy District completed a report summarizing water management by the Duchesne River Work Group (DRWG). This group has been working cooperatively to provide instream flows in the lower Duchesne River as called for in the USFWS's May 4, 2005, "Update to the Reasonable and Prudent Alternative in the July 1998 Biological Opinion for the Duchesne River Basin." Scientific research indicated that a 50 cfs base flow was needed to preserve biological productivity in the river. In the past, flows often fell below this base flow target, but since the DRWG began cooperative flow protection in 2005, the number of days below 50 cfs has dropped dramatically (Figure 4). Tom Bruton, Uintah Operations & Maintenance Manager for the Central Utah Water Conservation District (CUWCD) says "CUWCD appreciates the collaborative and understanding efforts of all the entities and individuals involved in managing the fishery flows for the lower Duchesne River."

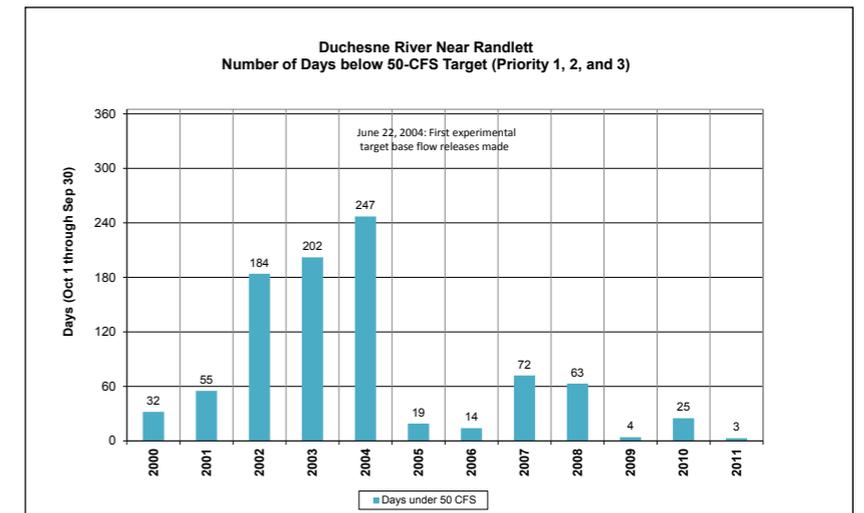


FIGURE 4



LOWER DUCHESNE RIVER NEAR RANDLETT, UTAH. A GROUP OF RECOVERY PROGRAM RESEARCHERS DISCUSS STRATEGIES TO IMPROVE CONTROL OF NON-NATIVE SMALLMOUTH BASS.

TOM CHART, USFWS

Colorado native fish projects updates

By Mike Porras, CPW

Colorado Parks and Wildlife (CPW) has been busy with several projects benefiting native and endangered fishes.

Rifle Gap Reservoir

Northwest CPW staff recently completed the construction of a screen that prevents nonnative fish that have escaped from Rifle Gap Reservoir from reaching the Colorado River.



RIFLE GAP FISH SCREEN

According to CPW biologist Lori Martin, this is a "win-win" because it protects native fish populations downstream and provides the opportunity to improve a combination, cool-warmwater fishery within Rifle Gap Reservoir.

Partners involved in the project included CPW, the Silt Water Conservancy District and the Bureau of Reclamation. The project cost almost \$400,000, most which came from the sale of fishing and hunting licenses.

CPW staff is drafting a lake management plan for Rifle Gap Reservoir that will be submitted to the USFWS and the States for final approval.

Paonia Reservoir

Paonia Reservoir, an irrigation impoundment in the North Fork of the Gunnison River drainage, was stocked with northern pike in 1969 as a management tool to control white suckers. The pike became established, creating a threat to endangered fish downstream.

In October 2012, the reservoir was drawn down by an irrigation company to just 10 surface acres. CPW biologists moved quickly to obtain approval from the Bureau of Reclamation to chemically remove northern pike. The steep-sided reservoir was difficult to access, but in follow-up monitoring, biologists found that no fish survived in the reservoir or tributary streams.

Most of the funding for the \$37,000 project came from the sale of fishing and hunting licenses. Partners included: CPW,

Bureau of Reclamation, Fire Mountain Canal, Reservoir Company and the Upper Colorado River Recovery Program.

In spring 2013, the Hotchkiss National Fish Hatchery stocked 6,200 catchable rainbow trout in the reservoir, a species that is not a threat to the endangered fish. Removal of the northern pike and stocking of trout were greeted favorably by area recreationists.

Miramonte Reservoir

On September 10, 2013, CPW aquatic staff conducted a chemical-treatment operation to eliminate smallmouth bass from this 400-acre reservoir that were stocked illegally sometime before 2011. The bass represented a significant threat to the resident trout fishery, native roundtail chub, bluehead sucker and flannel-mouth sucker populations in the San Miguel and Dolores rivers.

The bass reproduced prolifically and grew quickly. They overwhelmed the Miramonte Reservoir fishery that is famous for growing big trout. Surveys found that in one year the bass expanded from 5 percent to more than 40 percent of the fish in the reservoir.

CPW restocked the reservoir with rainbow trout in October.

The cost of the operation could reach \$100,000. Most funding came from revenues from the sale of hunting and fishing licenses. Partners in the project included CPW, the Recovery Program and Colorado Division of Water Resources.

CPW appreciates the Recovery Program's contributions of \$28,000 towards the Miramonte and Paonia projects.

Larval Fish Lab celebrates 35 years

In 1978, the Larval Fish Laboratory, located in the Department of Fish, Wildlife, and Conservation Biology at Colorado State University opened its doors and it is still going strong 35 years later! The Lab has played a vital role in work on the endangered fishes throughout the years, monitoring early life stages of the fish, working on nonnative fish control, leading Green



TOM CHART, DR. KEVIN BESTGEN AND ANGELA KANTOLA

River Colorado pikeminnow population estimates, and much more. Friends and colleagues of the Lab gathered to celebrate the occasion on September 6. Upper Colorado River Endangered Fish Recovery Program's Director, Tom Chart, and Deputy Program Director, Angela Kantola attended and presented Lab Director, Dr. Kevin Bestgen with a razorback sucker print by Joseph Tomelleri. The Recovery Program congratulates the Lab on their 35 years of strong scientific contribution to the recovery of the endangered Colorado River fishes.

Horsethief Update

The grow-out ponds at the new Horsethief Canyon Native Fish Facility (HCNFF) near Fruita, Colorado are up and running. So far, all indications are that the facility's first crop of razorback sucker had excellent growth and a near-100% survival rate of fish stocked into the ponds in 2013. The HCNFF ponds have many advantages over previously used ponds scattered throughout the Grand Valley:

- The HCNFF ponds are in a fenced area with a reliable, high-quality water source;
- Water quality is monitored daily, providing a better growing environment for fish;
- The ponds are all located together, saving travel time;
- Fish can be fed daily for faster growth rates; and
- The ponds can be easily and quickly drained to a central "kettle" structure, allowing biologists to capture and account all fish (this maximizes harvest and helps reduce harvest stress).



BRIAN SCHEER AT HORSETHIEF PONDS

In addition to raising razorback sucker for the Upper Colorado and San Juan recovery programs, the facility is also raising bonytail for the Upper Colorado program and recently brought a few wild chubs in from Black Rocks area of the Colorado River to try to start a humpback chub refugia.



HUMPBAC CHUB ILLUSTRATION © JOSEPH R. TOMELLERI

San Juan River Recovery Program wins America's Great Outdoors award

By Sharon Whitmore, USFWS

In May 2013, the San Juan River Basin Recovery Implementation Program was presented an award under America's Great Outdoors program (AGO). Mark McKinstry of the Bureau of Reclamation nominated the project for the habitat improvements made using a unique partnership with tribal, state, federal, and non-profit cooperators.

AGO takes as its premise that lasting conservation solutions should come from the American people—that the protection of our natural heritage is a non-partisan objective that is shared by all Americans.

The San Juan Habitat Restoration Project was nominated under the Rivers initiative and was one of 50 projects selected nation-wide to receive the award.

The award states in part: *"The San Juan River Habitat Restoration Project in New Mexico is designated a keystone conservation and outdoor recreation project under President Obama's America's Great Outdoors program. Here, we celebrate the partnerships and collaboration that resulted in significant wildlife habitat restoration and species protection in the watershed."*

The San Juan Habitat Restoration Project was a cooperative effort between the San Juan Recovery Implementation Program, the Navajo Nation, the State of New Mexico, The Nature Conservancy, and Keller-Bliesner Engineering. These entities worked together to restore and create fish habitat on the San Juan River in New Mexico to assist in the recovery of the razorback sucker and Colorado pikeminnow, and provide habitat for other native aquatic species. Six individual sites on the San Juan River were restored, creating 3.5

AGO consists of five conservation and outdoor initiatives. These initiatives include:

- **Landscapes**, the protection of America's large, rural landscapes.
- **Recreation**, the support of outdoor recreation access and opportunities to connect Americans to the outdoors.
- **Rivers**, the restoration of our country's rich legacy of rivers and waterways.
- **Urban**, the connection of city-dwelling American to urban parks and green spaces.
- **Youth**, the development of the next generation of environmental stewards.

miles of secondary channel, several acres of backwater habitat, and removing 6.5 acres of nonnative riparian vegetation. Monitoring in 2012 showed that endangered and other native fish were using the new habitats only three months after creation.

All construction costs for the project were funded by New Mexico's Surface Water Quality Bureau, with the other partners contributing significant in-kind contributions. The project was managed by Karen Menetrey with the New Mexico Environment Department and Patrick McCarthy with The Nature Conservancy. Due to the project's success, work is underway to restore additional river habitat along the San Juan. More information about the San Juan Habitat Restoration project can be obtained from Patrick McCarthy, pmccarthy@tnc.org; (505) 946-2037.



KEY PARTNERS OF THE SAN JUAN RIVER HABITAT RESTORATION PROJECT: JIM BROOKS, ELIZA GILBERT, CHRIS CHEEK, MARK MCKINSTRY, BRIAN WESTFALL, PATRICK MCCARTHY, DAVE CAMPBELL, SHARON WHITMORE, AND STANLEY POLLOCK, (NOT PICTURED KAREN MENETREY.)



PATRICK MCCARTHY, TNC, AND SCOTT DURST, USFWS, INSPECT ONE OF THE RESTORED HABITAT SITES ON THE SAN JUAN RIVER AFTER A HIGH FLOW EVENT ON JUNE 5, 2012.

Barrier proposed for Tusher Wash Diversion Dam

The Upper Colorado River Recovery Program is considering constructing an e-barrier at the Tusher Wash Diversion Dam upstream of Green River, Utah. An e-barrier is an alternative to fish screens that sends out an electronic direct current pulse causing the fish to change the direction they are swimming in the river and diverting them from entering irrigation and power canals. The e-barrier is a new technology to the Recovery Program and will be less intrusive than a fish screen to the operation of hydropower and irrigation diversions.

The Natural Resources Conservation Service, hydropower plant operators, and local irrigation companies are proposing to rehabilitate the Tusher Wash Diversion Dam.

The Recovery Program is incorporating design and construction of the e-barrier into this rehabilitation work. Construction of the e-barrier will be coordinated between the Natural Resources Conservation Service and Bureau of Reclamation in 2014.



TUSHER WASH DIVERSION DAM

H.R. 6060 passed

H.R. 6060, the Endangered Fish Recovery Programs Extension Act of 2012, (P.L. 112-270) was passed in the early morning hours of January 1, 2013 and became law with the President's signature on January 14. The act extends the use of hydropower revenues collected via the Colorado River Storage Project Act to fund existing endangered fish recovery implementation programs for the Upper Colorado and San Juan River Basins. Kudos to the recovery programs' non-Federal partners for their hard work on this legislation!

Cha..cha...changes!

The Upper Basin Program was delighted to have Melanie Fischer join the staff of the Program Director's office this March. Melanie is the graphic artist who designed the Upper Basin Program's website, the San Juan Program's logo, tradeshow booth, banner stands, and Program Highlights briefing book. In addition to her administrative role in the Program Director's office, Melanie is providing graphic design and layout for Program Highlights, the Swimming Upstream newsletter, administering the Upper Basin Program's website, and is leading social media outreach.



MELANIE FISCHER

Pat Martinez joined the Program Director's office staff in 2010 as the Nonnative Fish Coordinator. Pat helped the Program make significant strides in addressing the threat of nonnative fishes. Pat's "magnum opus," the Upper Colorado River Basin Nonnative and Invasive Aquatic Species Prevention and Control Strategy is in final review and is expected to be complete by the end of 2013. In early July, Pat left the Program Director's office to join his wife, Anita, in "real" retirement. He's staying in touch, though, and recently helped us write the electrofishing article on page 2. Anita Martinez leapt into retirement in late March. The Recovery Program thanks Anita for her contributions she made to endangered fish recovery over the years, particularly in the area of nonnative fish control. We wish Anita and Pat all the very best in their retirement!

Dale Ryden, CRFP project leader in Grand Junction, CO has passed the responsibilities of participating on the San Juan Biology Committee meetings to Ben Schleicher. Dale has worked with the San Juan River Program since 1991, when it was a multi-agency, ad hoc work group. In early 2013, Dale assumed responsibility as the USFWS Region 6 representative on the San Juan's Coordination Committee, replacing Patty Gelatt.

Ben Schleicher has worked extensively with the endangered and other fish species of the Colorado and San Juan River basins since 2008, with both the UDWR Moab field station (2008-2009)



KEVIN MCABEE AND SON, OWEN

The Program Director's office has hired a number of staff from the USFWS Utah Ecological Services office over the years. Building on this tradition, Kevin McAbee joined the Program Director's office as Instream Flow Coordinator this August. With Pat Martinez' retirement, Kevin's primary duties have quickly shifted to coordinating nonnative fish activities. Recovery Program folks already know and admire Kevin for his work on Tusher Wash fish screen, White River remote antenna, and more. Welcome aboard, Kevin!

Doug Osmundson probably knows more than anyone about Colorado pikeminnow in the Colorado River. After a productive 30-year career with the USFWS, Doug retired in April. Congratulations to Doug for his significant contributions to recovery of the endangered fishes! Doug now volunteers at the CRFP office and also is serving on the Colorado Pikeminnow Recovery Team.

Information and Education Coordinator Debbie Felker retired in May. She and her husband, Bob, are enjoying spending more time with friends and family and traveling with their dog, Cody, in their motorhome, "Cody's Roadhouse." Debbie was the creative force behind the Program's outreach efforts for 14 years and her bubbly personality is greatly missed. Congratulations, Debbie – enjoy your travels!



DEBBIE FELKER



USFWS BIOLOGIST JAKE MAZZONE HOLDS AN ENDANGERED COLORADO PIKEMINNOW.

Jacob "Jake" Mazzone is the Fisheries Biologist for the Jicarilla Apache Nation Department of Game & Fish (JDGF) and is the Nation's new representative on the San Juan River Basin Recovery Implementation Program's Biology Committee. Jacob is responsible for native aquatic species health, managing the Nation's sport fishing opportunities, and representing the Nation in multi-jurisdictional recovery teams and work groups. Jacob has a bachelor's degree in fisheries biology from Colorado State University and numerous field-research-related certificates and skills. He can be reached at 575-759-3255, Jacob.a.mazzone@gmail.com.

He's back! The Recovery Program welcomes Paul Badame back to the fold. Paul formerly supervised, UDWR Moab field office and now is back with UDWR in Salt Lake assisting Krissy Wilson, Native Aquatic Species Program Coordinator. Paul's first assignment is to draft a strategy to prevent escapement of nonnative fishes, primarily walleye and smallmouth bass, from Starvation Reservoir.



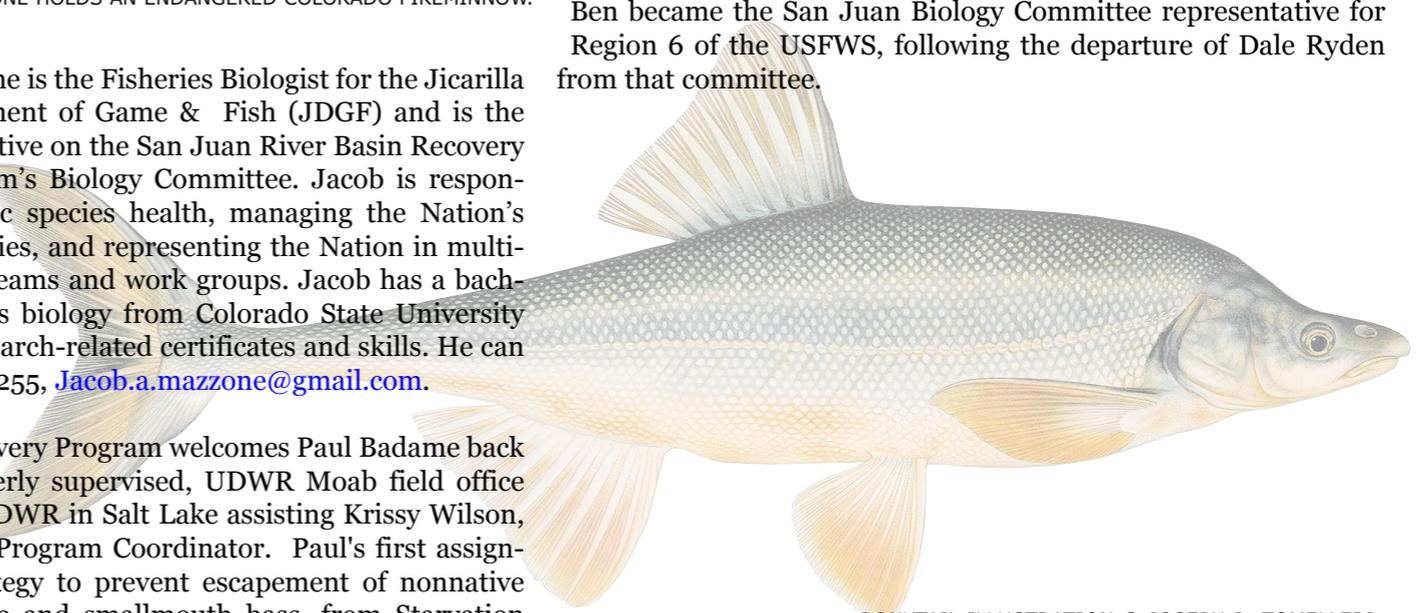
USFWS BIOLOGIST BEN SCHLEICHER AND ENDANGERED COLORADO PIKEMINNOW

and the Grand Junction CRFP office (2010-present). In May 2013, Ben became the San Juan Biology Committee representative for Region 6 of the USFWS, following the departure of Dale Ryden from that committee.



LEITH EDGAR

Although Debbie's shoes are tough to fill, USFWS Public Affairs Specialist Leith Edgar now provides half-time outreach support for the Recovery Program in addition to his duties in the region's Office of External Affairs. Program participants got to know and appreciate Leith as a member of the Information and Education Committee and are glad to welcome him back.



BONYTAIL ILLUSTRATION © JOSEPH R. TOMELLERI

the fisheye:

Dave Campbell, San Juan Recovery Program Director and budding falconer

Many biologists hunt and fish in their spare time, but few pursue hunting via the ancient and demanding art of falconry. Dave Campbell, Program Director for the San Juan River Basin Recovery Implementation Program, tells The Fisheye about his entry into the fascinating world of hunting with a trained raptor.

How did you get interested in falconry? *A good friend of mine, Brian Millsap, is the USFWS National Eagle Coordinator. I've had the opportunity to work with Brian collecting and tagging Cooper's Hawks. Brian is a Master Falconer, and about a year and a half ago, I asked him if he would sponsor me as an apprentice falconer.*

How many falcons do you have and where did you get them? *As an Apprentice Falconer, I am only allowed one bird—either a Red-tailed Hawk or an American Kestrel. I chose a Red-tailed Hawk. An Apprentice Falconer is required to trap their hawk from the wild. I trapped mine east of Albuquerque last winter using a Bal-Chatrri trap, which has small monofilament nooses to snare the legs of the hawk as it attempts to take live bait inside the trap. The falconer sets and continuously monitors this trap in order to capture their bird. My hawk, who I named Ruby, was a juvenile bird, probably 8-9 months old, when I captured her. She was migrating down from somewhere up northeast of New Mexico.*

How do you learn falconry? *A two-year apprenticeship is required before you can become a General Falconer and you have to be sponsored. Your sponsor is responsible for training you throughout your apprenticeship. The training consists of gen-*



DAVE AND RUBY

eral husbandry of a wild raptor, identifying and treating health issues, handling, and hunting. Before you can get your apprentice license, you have to pass an extensive test on all of these elements.

Where do you keep Ruby? *Falcons and hawks are kept in a special enclosure called a "mew." I built mine in my barn by turning a 12'x12' horse stall into a mew.*

Where do you practice your falconry? *I am fortunate because I can practice right outside my back door. I live in the East Mountains bordering the high eastern plain outside Albuquerque. Ruby primarily hunts rabbit here. I am trying to train her to go after jackrabbits, but she is still young. She just turned a year old last spring and has now completed her first molt.*

Do you feed Ruby or does she capture her own prey? *I keep the prey that Ruby catches to feed to her later. I feed her quail, rabbits, squirrels, and mice. The quail I buy; the rest she can capture. She gets all the food she catches and she catches more food working with me than she would on her own.*

How far do falcons typically fly from you? Do they always return?

Ruby is primarily a perch hunter. You've seen Red-tailed hawks sitting on power poles along roads, where they sit to watch for prey. When they see prey they dive down on it. When we go for walks, Ruby follows along going from tree to tree until I flush a rabbit for her to go after. She will get up to a half mile away from me at times. Birds don't always return, for many reasons, but Ruby has always returned when called. She does wear a radio-tracking device, so if she did take off, I could track and recover her.

What do you like best about falconry? *Falconry isn't a sport as much as it is an art form. It is very much a partnership or bond that you establish with a wild bird. You do your part right and more than likely, they will respond accordingly.*

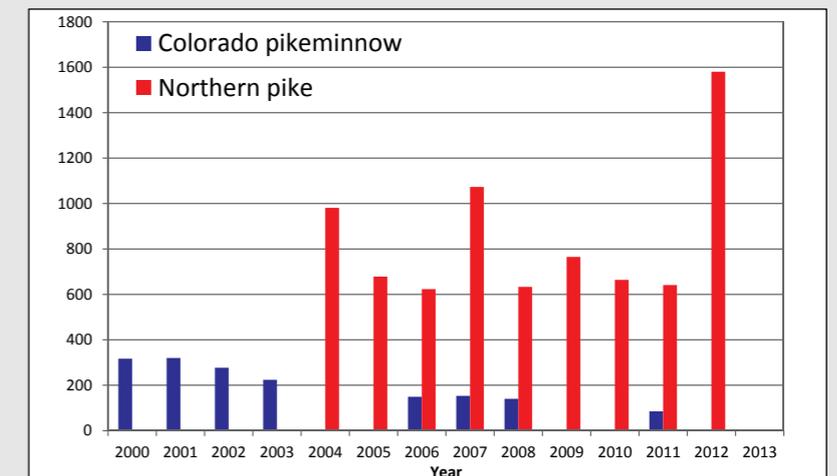
Do you have suggestions for folks who think they might be interested in falconry? *I would suggest that anyone who is interested contact the North American Falconers Association (<http://www.n-a-f-a.com/>). Every state has a chapter. NAFA would be able to guide anyone serious about falconry through the process.*

Revising Recovery Plans

The U.S. Fish and Wildlife Service is revising recovery plans for the endangered Colorado River fishes, starting with the Colorado pikeminnow. A recovery team of species experts began meeting in November 2012. The team reviewed data showing a persistent downward trend in Colorado pikeminnow population estimates from 2000 – 2012 in the Yampa River, which has been linked to high densities of nonnative predator fish (Figure 3). Based on this information, the team recommended against considering any change in the species' status. Due to the elevated concerns over the high densities of nonnative predators (e.g. northern pike) USFWS expanded the Recovery Team to include representatives from the Upper Basin State wildlife agencies. USFWS will issue a

draft revised recovery plan for public review in 2014. At that time, USFWS also will convene a recovery team to begin revising the humpback chub recovery plan. Revisions to the razorback sucker and bonytail recovery plans will follow.

FIGURE 3. COMPARISON OF COLORADO PIKEMINNOW POPULATION ABUNDANCE ESTIMATES (CPM) AND TREND IN THE YAMPA RIVER WITH POPULATION ABUNDANCE ESTIMATES AND TREND OF NORTHERN PIKE (98A NP) IN THE MIDDLE YAMPA RIVER (PROJECT 98A 2012 ANNUAL REPORT). THE 2011 DATA POINT FOR COLORADO PIKEMINNOW IS PRELIMINARY. IN 2012, ONLY 6 COLORADO PIKEMINNOW WERE COLLECTED, WITH SUCH LOW NUMBERS, AN ESTIMATE COULD NOT BE MADE.



Orchard Mesa canal system improvements to benefit 15-mile reach

By Justyn Hock, Bureau of Reclamation
and Jana Mohrman, USFWS

The first phase of construction on Orchard Mesa Canal System Improvements began in November 2013.

Major features of the project include:

- Upgraded check structures in canals;
- Construction of a 10-acre regulating reservoir;
- Installation of remote monitoring systems;
- Replacement of some open earth laterals with pressurized pipeline; and
- Improved operational procedures.

These improvements will provide a more reliable water supply throughout the canal system and estimated water savings of approximately 17,000 acre-feet per year. This water will benefit endangered fishes, wildlife, and river recreation in the important "15-Mile reach" of the Colorado River downstream of Palisade, Colorado.

When asked about the project benefits to Orchard Mesa Irrigation District (OMID), Manager Max Schmidt said, "OMID's canals were designed to carry a full water right to each property. In the early spring water use is very sporadic. When water levels get too high in the canal, ditch riders spill water into open drains. OMID then attempts to match the water supply to demand by reducing the amount of water pumped to our service area (it can take up to 24 hours to match irrigation demand in the lower end of the distribution system)." Schmidt continued, "The check structures being installed this winter in both of OMID's irrigation canals will make it easier to manage water levels by maintaining a constant deliverable water level on the entire length of both irrigation canals. This will reduce pumping and spills. The OMID Canal



ORCHARD MESA IRRIGATION DISTRICT CANAL AUTOMATION PROJECT AREA

System Improvement Project will benefit OMID's residential and agricultural customers by creating a more dependable water supply."

The initial construction contract for the installation of new check structures was awarded to DLM Contracting Enterprises, Inc. from Albuquerque, NM and will cost \$1.1 million. Some portions of the project will be subcontracted to local contractors. All project features and components are expected to be completed within three to five years and are estimated to cost approximately \$16.5 million. Additional construction contracts will be released in the future.

The OMID Project is a part of the overall strategy to improve instream flows in the 15-Mile reach of the Colorado River. An earlier component of this strategy is the Grand Valley Water Management (GVWM) Project. This project focused on the Grand Valley Water User's Association canal system and included canal check structures, remote monitoring and control systems, and a pumping plant at Highline Lake. This system, in place since 2002, has conserved an average of 45,000 acre-feet of water each year,

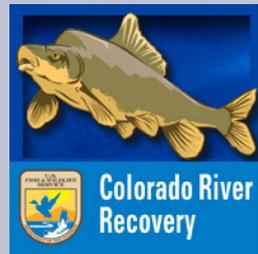
providing a more dependable irrigation water supply and improving river flows to assist in recovery of the endangered fish.

OMID and GVWM help protect late summer base flows in the river. OMID will help augment base flows, but not under hydrological conditions classified as "very dry." Other tools for protecting base flows are strong lines of communication on weekly phone calls held to maximize coordinated reservoir releases. Recovery Program partners also work together to protect spring peak flows in the 15-Mile reach. The Coordinated Reservoir Operations project, or "CROS," occurs when reservoir operators are confident their reservoirs will fill and spill, and then all the spills are coordinated in an effort to create a natural peak flow. (If floods are predicted, however, reservoirs follow safe operating protocol and do not operate CROS.)

As illustrated in the table below, flow protection in the 15-Mile reach has been significant. However, flow targets for the endangered fish are not always met and the Recovery Program monitors endangered fish populations in the Colorado River to determine the adequacy of the 15-Mile reach flows.

Reservoirs	Acre-Feet
Granby	39,914
Green Mountain	532,200
Palisade Bypass	101,208
Ruedi	291,338
Williams Fork	94,423
Willow Creek	9,853
Windy Gap	3,718
Wolford Mountain	142,750
Total (1997 – 2012)	1,215,404

Like us on social media



The Colorado River Endangered Fish Recovery Program and the San Juan River Basin Recovery Implementation Program are now part of the Facebook and Twitter communities! We encourage you to "like" our Facebook page and "follow" our Twitter feed to have the latest videos, pictures, and links about the programs delivered to your news feed daily. The pages include the most up-to-date information on the

efforts of the programs to conserve native fishes from New Mexico to Wyoming and all the western states in between. Please join us on Facebook at: <https://www.facebook.com/ColoradoRiverRecovery> and find us on Twitter at <https://twitter.com/CORiverRecovery>.

For more information contact, Melanie Fischer, 303-236-9881, melanie_fischer@fws.gov.

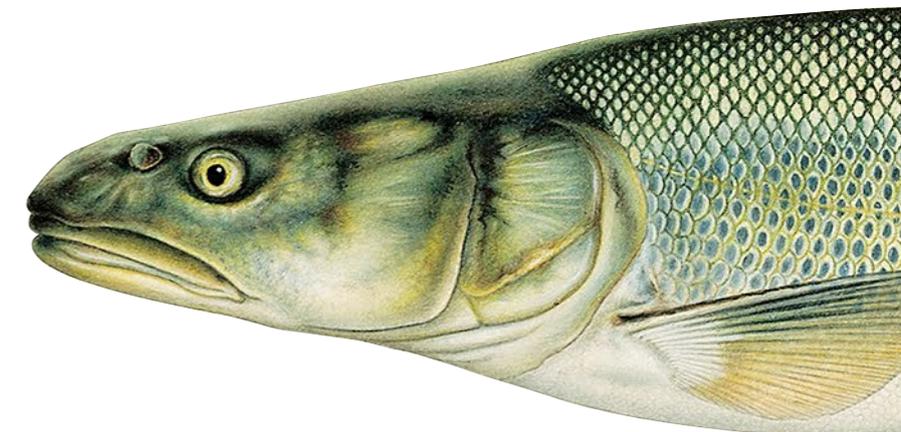
Dexter National Fish Hatchery & Technology Center has a new name



PHOTO COURTESY OF USFWS

Dexter National Fish Hatchery changed its name in 2012 to the Southwestern Native Aquatic Resources and Recovery Center.

This new name more accurately reflects the purpose and mission of the facility as a production and refugium center for threatened and endangered fish species of the southwestern region of the U.S.



COLORADO PIKEMINNOW ILLUSTRATION © JOSEPH R. TOMELLERI

Developing a Management Plan for the White River



The White River is an important component for the conservation of native fishes in the Upper Colorado River Basin and for the recovery of endangered Colorado pikeminnow and razorback sucker. The hydrology of the White River is relatively unchanged by large storage projects or depletions.

This past summer the Upper Colorado Program's Management Committee approved a scope of work to develop a White River management plan.

The plan's goals are to:

- Identify existing, and some level of future, water depletions;
- Characterize current hydrology and projected depletions to identify the effects of past and future water development on endangered fish habitat;
- Identify the role of the White River in recovery of the endangered fish;
- Identify flow recommendations for endangered fish habitat in the White River; and

Identify a broad range of recovery actions to be carried out by the Recovery Program to support a recovered endangered fish population in the White River.

A federal-state cooperative or other agreement to implement the resultant management plan will constitute the federal action (likely via USFWS participation) that will serve as the basis for a Section 7 consultation under the Endangered Species Act and development of a White River Programmatic Biological Opinion (PBO). PBOs also have been developed for the Colorado, Gunnison, and Yampa rivers. This is the last PBO planned for the upper Colorado River basin.

Funding for a consultant to work on the White River management plan is being provided from the Species Conservation Fund, as requested by the Colorado Water Conservation Board. This fall the Recovery Program held public meetings in Craig and Rangely Colorado, and Vernal, Utah to solicit initial input to the plan.

For more information contact, Jana Mohrman, 303-296-9883, jana_mohrman@fws.gov.

Flash floods and the forces of nature

By Leith Edgar
USFWS

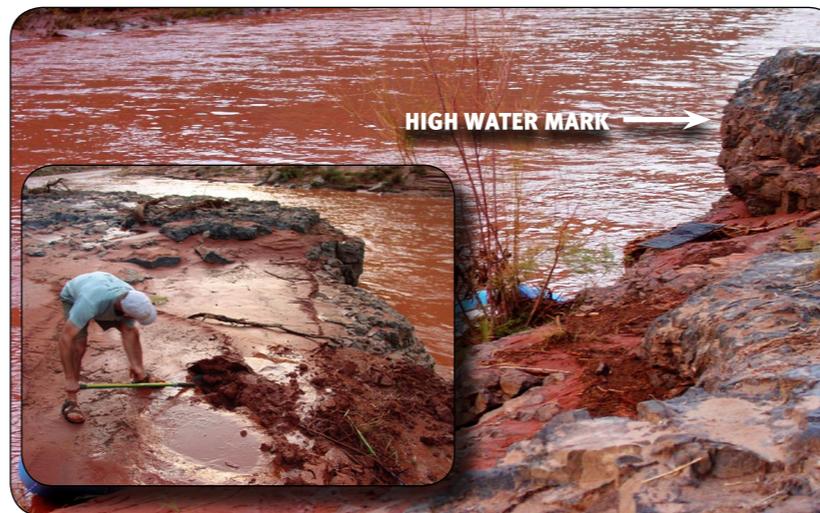
Sometimes the forces of nature aid conservation work... and sometimes not so much.

A crew of San Juan River biologists had a rude awakening while at work on the river. At 2:30 a.m. on July 15, a crew member awoke to a crashing sound, and found their two rafts on top of one another thanks to the rapid ascent and decent of the water level.

In a flash, the flash flood essentially wiped out one of the two crews' larval fish sampling effort for the lower San Juan River. The samples collected prior to the flood were washed away and the crew lost seines and sample containers, which would have been used to collect more samples following the flood's passing. The flash flood hit biologists as they camped on BLM land, about seven miles downstream of Mexican Hat, Utah.

The crews were conducting larval fish monitoring as part of the San Juan River Basin Recovery Implementation Program's comprehensive monitoring program. Two crews had simultaneously launched from Shiprock, New Mexico, and Sand Island, Utah. While the upstream crew was sampling up to Sand Island, the downstream crew worked down to the take-out at Clay Hills, Utah. Combined, the crews had covered more than 70-river miles in approximately four days when the samples, tools and supplies of the downstream crew were unexpectedly washed away in the middle of the night.

What washed away was half of the San Juan 2013 larval fish monitoring effort, which is designed to specifically monitor the



THE MONITORING CREW'S CAMP SITE ON THE SAN JUAN RIVER THE NIGHT OF THE JULY 15, 2013, FLASH FLOOD

reproductive output of Colorado pikeminnow and razorback sucker, (see cover story) and also provides information on the entire larval fish community.

After the flash flood, biologists recovered what was salvageable. "As we rowed out after the flood, we salvaged two oars and one sampling bucket," said Michael Farrington. The various land management agencies in the San Juan River area and collaborators working on the river were notified of the lost equipment, so perhaps more will be found, but as time passes, hope of recovering any equipment and samples diminishes said Farrington.

The flash flood that claimed the larval fish sampling effort for the lower San Juan River in 2013 was not unusual. During the

monsoon season flash floods can hit without warning. Every year there are probably a small number of floods that substantially raise the level of the San Juan River. Additionally, flash floods happen periodically in the lateral washes and canyons in the canyon-bound section of the San Juan River downstream of Chinle Wash. These can be especially dangerous since many campsites are located at the mouths of these washes.

The biologists were not the only rafters affected by the flash flood. They encountered a family and four other groups, all of whom lost some gear and supplies. A family of seven with three small children lost all of their food. "We were able to give them all the food we could spare and they gave us a spare oar. We had two rafts and lost four of the six oars. We strapped the two rafts together nose-to-nose and rowed them together as one big raft. Shortly after we borrowed their oar we found one of those we lost and we were able to separate and row the two rafts normally," said Scott Durst, USFWS biologist with the San Juan Program.

Not every effort to assist those affected by the flood was successful though. "A large group with canoes and inflatable kayaks had one of their canoes pinned in Government Rapid. We attempted to help them unpin the canoe, but unfortunately, the canoe ended up bending in half and sinking to the bottom of the rapid," said Durst.

In the end, both of the San Juan sampling crews made it safely home after the floods, albeit sans some samples and equipment.

"Some of the skills from our Swiftwater Rescue training certainly came into play, but good luck and clear thinking certainly played a role too" said Durst.

Electrofishing equipment standards in place

By Angela Kantola
Deputy Director
UCREFRP

Electrofishing is a common non-lethal method biologists use to collect fish. Researchers in the Upper Colorado and San Juan recovery programs use electrofishing to monitor fish populations and to remove detrimental nonnative fishes from the rivers.

Typically, a boat-mounted generator creates electrical currents that pass through partially submerged positive (anodes) and negative electrodes (cathodes), producing a field of electricity in front of the boat. Appropriate settings on the electrofishing box elicit “taxis” (pronounced tak-sis), an involuntary muscular response that causes fish to swim toward the anodes.

Electrofishing involves a complex and dynamic mix of electrical theory, water quality, mathematics, and fish physiology and behavior. In light of these complexities and the need to minimize harm during sampling, biologists working on the endangered Colorado River fishes have monitored the effects of electrofishing on the fishes and electrofishing efficiency for many years.

Pat Martinez and Larry Kolz (USFWS, retired) recently collaborated with field biologists to standardize the Recovery

Standardizing the Recovery Program’s electrofishing fleet allows better comparison of catch data and may improve the catch of target fishes, while reducing potential injury to fish.

Program’s entire electrofishing fleet of aluminum-hulled jon-boats and whitewater rafts. This work provides scientific measurements to support intensive electrofishing as a safe, effective, and efficient method to sample endangered, native, and nonnative fishes. Standardization requires a comprehensive understanding of electrical principles, especially of power transfer theory (how electrical power is transferred to fish). Electrofishing studies recognize a relationship between fish injury and the power (watts) of exposure per pulse of electricity. This can be compared to safety standards for livestock fence chargers that limit the magnitude of the electrical current and the time duration of the pulsed waveform.

Together, Larry and Pat refined and simplified the application of the power transfer theory specifically for Recovery Program electrofishing boats and rafts. Their model compensates for the need to deliver constant electric power to fish in waters with differing conductivities. (Conductivity is a measure of water’s ability to pass electrical current.) This is important because the recovery programs’ researchers electrofish in many river reaches with different water conductivities, and those conductivities also vary by season.



USFWS BIOLOGISTS ELECTROFISHING

Working with field crews over the past few years, Larry and Pat measured electrode resistance and power output characteristics of boat electrofishing equipment. They then graphed the relationship between the variations in resistance for the electrode configurations used by the Recovery Program. The graphs also identify the approximate required electrofishing power, the voltage and current required to successfully capture fish at any water conductivity. This information has been made available in tables that allow field crews to quickly analyze conditions and appropriately adjust their equipment without making manual calculations.

Standardizing the Recovery Program’s electrofishing fleet allows better comparison of catch data and may improve the catch of target fishes, while reducing potential injury to fish.

As project leader for the USFWS Colorado River Fish Project (CRFP) in Grand Junction, Colorado, Dale Ryden supervises crews on both the Colorado and San Juan rivers. Dale says: “Standardizing our electrofishing equipment and procedures simplified field crew training due to the similar set-up of electrofishing boats and rafts. It also improves our ability to interchange crew members.”

Colorado State University Larval Fish Laboratory researcher Cameron Walford says: “A huge pat on the back to Pat and Larry for the easy-to-use guidelines for setting our new electrofishing units.”



ELECTROFISHING CONTROLS & METERS

swimming upstream

Swimming Upstream is a publication of the Upper Colorado River Endangered Fish Recovery Program and the San Juan River Basin Recovery Implementation Program. These programs are national models of cost-effective, public and private partnerships. The programs are working to recover endangered fishes while water development continues in accordance with federal and state laws and interstate compacts, including fulfillment of federal trust responsibilities to American Indian tribes.

Angela Kantola • Sharon Whitmore
Melanie Fischer
Co-editors

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