swimming upstream

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

Field Report 2017

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Black Rocks, critical habitat to the endangered humpback chub. This unique section of Ruby Horsethief Canyon offers some of the deepest water in the Colorado River.

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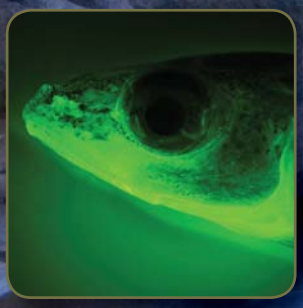

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COVER PHOTO BY KARIE HIAM, USFWS

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.

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Program Director's Message

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

Thirty years ago our Recovery Program founders were just wrapping up what must have been a series of interesting (and grueling) sessions that led to what we now call the Upper Colorado River Endangered Fish Recovery Program. Some of these folks had worked with each other before these negotiations, but most were establishing new relationships. A few years later, many of the same players (this time including representatives from Native American tribes) decided to do it all over; hence the San Juan River Basin Recovery Implementation Program. The Programs were implemented via cooperative agreements which have been extended a couple of times since those early days, but are currently scheduled to sunset in 2023. The premise for that date was that the endangered fish would be recovered and our collective goal achieved by 2023.

As time went by, researchers gained a better understanding of the needs and response time of these long-lived river fish. Along the way we redefined proper flow and habitat management. And also during the past 30 years, several predatory nonnative fish species gained traction in the Green and Colorado rivers. As those predators expanded their distribution and abundance, the Recovery Programs worked to understand the scope of the problem and to develop a strategy to combat it. We always knew the path to recovery was going to be a long haul. We couldn't foresee all the twists and turns.

The endangered fish will not be recovered by 2023 despite 35 years of recovery efforts. Resetting the recovery clock is not easy for any of us working within the Recovery Programs day to day; and it's even tougher for those outside it looking in. Many believe that continuing the Programs beyond 2023 will require a redefinition of the Programs themselves. Our plan is to describe the post-2023 Programs in a Report to Congress by 2021 — a daunting task. However, this time around, the stakeholders come to the table with long-standing working relationships and three decades of shared experience. We're gonna figure this out.

Tom Chart

P.S. This long view of the Programs corresponds to the careers of many compadres — the list of recent and pending retirees is growing — all the best to all of you! A special commendation goes out to Ms. Angela Kantola, our Upper Colorado River Deputy Director, for her career of boundless optimism and energy!

Swimming Upstream Publication Date is Changing to Late Spring
This is the last fall delivery date. The next printed copy will be available May/June, 2019.

Humpback Chub in Species Status Assessment

By **Tom Czapla**, *Upper Colorado River Endangered Fish Recovery Program*

Whenever the U.S. Fish and Wildlife Service (Service) adds or removes a species from the endangered species list, changes a species' listing status, issues a recovery plan, etc., it includes a review of all information available for that species. Recently, the Service has developed the Species Status Assessment (SSA) as a way to separate the scientific review from the policy decision to prevent duplicating effort.

An SSA allows the Service to provide a consistent, conservation-focused, and scientifically-based evaluation of the biological status of a species. An SSA begins by describing the species' life history including its place in the food chain, reproductive strategies, biological interactions, and habitat requirements. The SSA documents how individuals at each life stage respond to natural and man-made influences.

A discussion of resiliency, redundancy and representation (the "3 Rs") form the foundation for each stage of the SSA. Resiliency is the ability of a species' populations to withstand annual environmental variation. Resilient species often have long life spans, high reproductive potential, and high variability in their native environment. Redundancy is the species' ability to withstand catastrophic events. Redundant populations exist in many locations, so if one is affected by disaster, others would likely survive. Representation is the species' ability to adapt to changing environmental conditions. Populations with high genetic diversity have high representation. The next stage of an SSA describes the current condition of the species' habitat and demographics. In the last stage, an SSA forecasts the species' response to future scenarios of environmental conditions and conservation efforts over a biologically meaningful timeframe. Thus, the SSA is a description of a species' anticipated future status, based on the best available scientific understanding of future abundance, distribution, and diversity (geographic or genetic). The SSA is used to inform decisions based on Service policies, regulations, and the Endangered Species Act.

Turbulent Waters of Westwater Canyon, Home to Humpback Chub

By **Brian Hines,** *Utah Division of Wildlife Resources*

As the first light of the day begins to show on the horizon line of the canyon walls, we start the boat motor to head out for our first trammel net check. A mist rises above the turbulent waters of Westwater Canyon as we motor upstream. Westwater Canyon is a short, narrow canyon in the Colorado River, with large rapids, swift water, and abundant eddies. It supports the largest of five upper Colorado River basin populations of endangered humpback chub.

Other populations of humpback chub in the upper Colorado River basin (above Glen Canyon Dam) occur in Yampa Canyon on the Yampa River, Desolation and Gray canyons on the Green River, Cataract Canyon, and Black Rocks Canyon (both on the Colorado River). In the lower Colorado River basin (below Glen Canyon Dam), the single and largest population of humpback chub occurs in the Little Colorado River and the adjacent mainstem Colorado River in the Grand Canyon.

We begin to pull in the first net: one chub, then two chubs. Overall, there are 12 chubs in the first net and we still have six nets to go. The live well on the boat quickly fills with chubs and we have to run back to camp several times during the check to deliver them to be processed. After checking all seven nets we have caught 64 chubs total (17 humpback chub and 47 roundtail chub) — this could be a busy trip! We work nonstop on the first day at our first camp picking fish from nets and processing fish, which entails measuring length, taking weights, and determining if the fish has a PIT tag (a small microchip used to follow an individual fish over time). We finally finish around midnight.

Over the next eight days, we move camp several times and our nets are still producing many humpback chubs and very few nonnative fish that would compete or prey on them. This is a very good sign. By the time we make it to our last camp, things have slowed down a bit. At the final site, there is little habitat (large eddies) to sample, and fewer chubs are captured. On the last day, we pull the nets a final time and everyone gets mentally and physically ready to run the rapids. Each person checks frantically for that last cam strap to tighten down gear in the rafts. After we shove off, all that can be heard over the roar of the water are the yips and cheers of the crew as we run the rapids. When the last boat makes it through the final rapid, it is nothing but smiles and cheers from the crew. Then we attach all of the boats together and motor our "barge" to the takeout.

PHOTOS BY BRIAN HINES, UDWR

Inset: Wild humpback chub being PIT-tagged in Westwater Canyon.

All Fish Illustrations © Joseph R. Tomelleri

As we motor out, I think about the canyon we floated through and native fish that inhabit those waters. I realize humpback chub in Westwater Canyon have a great survival strategy by calling places like this home and I am hopeful our work will help them overcome their endangered status and become self-sustaining once again.

PHOTO BY BRIAN HINES, UDWR

Grand Canyon has Robust Population of Humpback Chub

By **Melissa Trammell** and **Brian Healey,** *National Park Service*

In the tumultuous waters of Grand Canyon National Park lives the only population of humpback chub in the lower Colorado River basin. This population is larger and more widely distributed than any of the humpback chub populations in the upper Colorado River basin. After reaching a worrisome low point of about 5,000 adult fish in 2001, abundance has been increasing for the last several years. The most recent estimates increased to about 12,000 adults in 2012, larger than all the other populations combined. The reason for the increase is not completely clear, but both non-native fish removal and warmer river temperatures may have contributed. A monitoring program to capture and document spawning of razorback sucker in the lower, western portion of the Grand Canyon began in 2014, and discovered that humpback chub were also increasing in this area. Once rare in the lower gorge, and limited to a few aggregation areas, humpback chub are now reproducing and increasing in abundance down the Colorado River at least as far as Pearce Ferry, in Lake Mead National Recreation Area. Larval and juvenile humpback chub have been captured in all years of the study, throughout the lower 100 miles of river from the mouth of Havasu Creek down to Pearce Ferry (*Figure 1*).

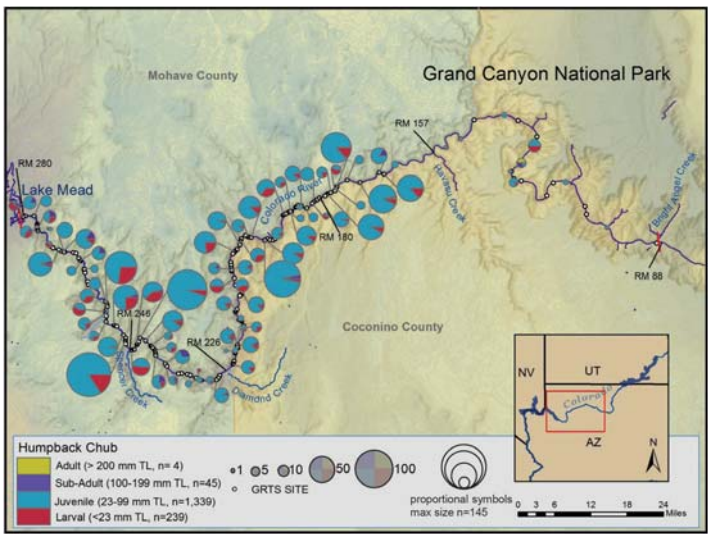


Figure 1. Humpback chub captured in the lower Grand Canyon by seining from 2014 to 2017. (Data and graph provided by Adam Barkalow, American Southwest Ichthyological Researchers [ASIR].)

In addition, humpback chub have been translocated into Shinumo and Havasu Creeks over the last 8 years. The Shinumo Creek effort was interrupted by a fire, followed by flood, which wiped out the translocated humpback chub. The stream is still recovering from the fire and flood damage. However, in Havasu Creek the translocated chub are reproducing and recruiting into the new population. In 2016, the non-translocated population (spawned in Havasu Creek) was estimated at around 89 fish (95% confidence interval 87 – 97) out of 294 total (95% confidence interval 285 – 329). About a quarter of these fish were in spawning condition, including 4 females. The majority of these fish are probably 2–3 years old and we have documented reproduction since 2012 (translocations began in 2011) (*Figure 2*). We have successfully established a second reproducing population of humpback chub in the Grand Canyon! This has long been a goal to provide a refuge population in case of catastrophic loss in the mainstem Colorado River and the Little Colorado River upstream. Close coordination and consultation with the Bureau of Reclamation, U.S. Fish and Wildlife Service, U.S. Geological Survey, Arizona Game and Fish Department, and the Hualapai Tribe have made this not only possible but successful.

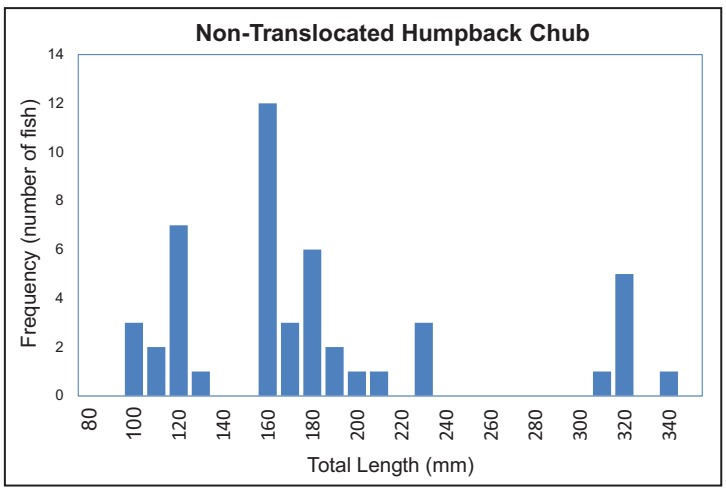


Figure 2. The distribution of sizes indicates at least three year-classes of wild-spawned humpback chub in Havasu Creek, a sign of repeated successful reproduction in this newly established population. (Data and graph provided by Brian Healy, NPS.)

Other recent improvements in habitat and protection for the humpback chub have been made. A new bridge over the Little Colorado River at Cameron was built, which reduced the likelihood of toxic spills upstream of the spawning area for humpback chub. In 2016, the Long Term Experimental and Management Program EIS (DOI 2016) was completed; which provides for flows designed to improve sediment retention and management that maintains habitats, as well as nonnative fish management and monitoring.

While these improvements are great news for the humpback chub, threats still remain to the conservation and recovery of this species. Nonnative fish, toxic spills, and water quality (including temperature) all must be managed into the future to protect the species and their habitat.

Wild humpback chub in spawning coloration in Havasu Creek, Grand Canyon NP in May 2017.

Amy Martin, Martin Frye, Ralph Stewart record data on humpback chub captured in Havasu Creek, Grand Canyon NP in May 2017.

PHOTOS BY MELISSA TRAMMELL, NPS

Black Rocks, Deep Water Home of Humpback Chub

By **T.A. Francis,** *U.S. Fish and Wildlife Service*

Of the five discrete canyon-bound populations of humpback chub, the one in Black Rocks is found in the smallest geographical reach. Black Rocks is an almost one-mile stretch of deep water habitat about 4 miles upstream from the Colorado-Utah state line. It formed from erosion-resistant metamorphic rock (gneiss and schist) intruded by veins of igneous, molten rock in the river channel. The channel is narrow with turbulent eddies, pools and runs throughout. Black Rocks is substantially deeper than other parts of the Colorado River, with an average depth of about 16 feet and maximum depth of nearly 60 feet. Deep areas along the rock faces provide important habitat for humpback chub.

We began mark-recapture population estimates for humpback chub in Black Rocks in 1998. From 1998 to 2012, our primary sampling techniques included setting 75-foot long trammel nets during dawn and dusk and conducting jet boat-based electrofishing during the day. In 2012, experimental use of baited modified turtle hoop nets and submersible PIT tag antennas yielded more recaptures and improved the precision of our population estimates. Thus, in 2016, we began using all four sampling techniques. Estimated humpback chub abundance in Black Rocks was highest in 1999 at 994 fish, but that declined significantly to the lowest estimate of 283 fish in 2007. From 2008 to 2012, estimated abundance of humpback chub in Black Rocks remained stable. Estimated mean apparent survival has remained stable during the same period, suggesting young humpback chub recruiting into the adult population was insufficient to maintain high adult densities observed in the late 1990s. Drought, human influences, and fish community level interactions all likely contributed to the decline through 2012.

More recently, however, recruitment from large cohorts of young fish produced in 2010, 2012, 2014, 2016, and 2017 may help the population return to historic adult abundance levels. It is my theory that a large number of senescent (old, unable to reproduce) humpback chub were collected in 1998 and 1999 and those fish disappeared by the early 2000s. Many species that live in harsh, variable environments are long-lived. With time on their side, they may not invest energy in reproducing young in harsh years. The upper Colorado River basin experienced a prolonged drought beginning in October 1999. Researchers suggest moderate flows are most beneficial for humpback chub reproduction and recruitment. I theorize that in recent years,

Humpback chub encountered in Black Rocks during 2017 population estimates.

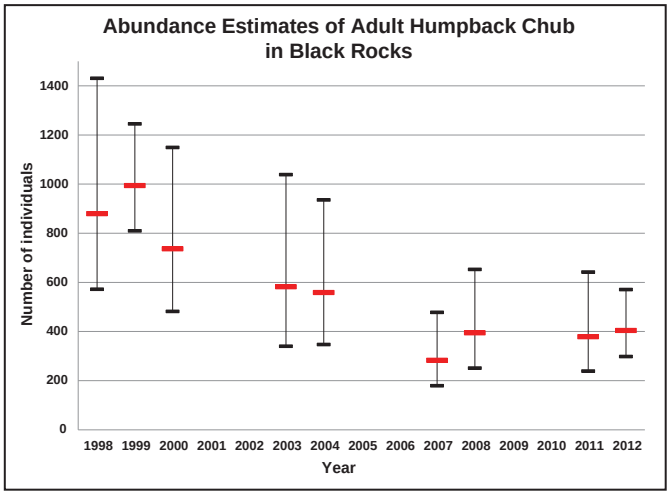
Colorado pikeminnow captured in Black Rocks in 2017.

Field crew records data and inserts PIT tag into wild-spawned humpback chub. From left to right: Tyler Sexton, Jen Herdman, Travis Francis and Britney McKelvey, USFWS.

PHOTOS BY MELANIE FISCHER, USFWS

moderate peak spring runoffs coupled with early large fall rain events may have created improved conditions for humpback chub reproduction and recruitment.

Theories aside, the proof is in the Colorado river-colored pudding. In 2016 and 2017, we captured (or detected by PIT tag antenna) adult humpback chub in numbers comparable to 1998 and 1999. Of 220 adult humpback chub captured or detected in 2017, we'd previously encountered 40% from 1998–2016. A small percentage of those fish were originally been encountered downstream in Westwater Canyon., indicating continued movement of fish between these two humpback chub populations. Go Team Chub!



Adult, juvenile, and young of year chubs sampled in hoop nets in Black Rocks Canyon, September, 2017.

Electrofishing is one method used to estimate humpback chub populations in critical habitat. Pictured: Britney McKelvey, and Jen Herdman, USFWS.

Submersible PIT tag antennas are placed in the Colorado River to count tagged fish. Pictured: Britney McKelvey, USFWS.

PHOTOS BY MELANIE FISCHER, USFWS

M. Tildon Jones Named 2017 Researcher of the Year

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

2016 award winner Matt Breen presented M. Tildon Jones with the Recovery Programs' 2017 Researcher of the Year award at the 38th Annual Researcher's Meeting in Grand Junction, Colorado. Tildon, Supervisory Fish Biologist for the U. S. Fish and Wildlife Service's Green River Basin Fish and Wildlife Conservation Office, demonstrates exemplary professionalism, strong leadership, and first-rate skills as a researcher working with the endangered Colorado River fishes. Tildon was recognized for:

- Contributions to invasive species control – Tildon leads smallmouth bass control efforts in Yampa Canyon, co-leads similar work in Whirlpool Canyon and Island Parks, and has coordinated northern pike control in portions of the upper Yampa River.
- Floodplain research – Tildon has been an integral and innovative contributor to the Program's larval razorback sucker monitoring efforts that directly influence Flaming Gorge Dam operations. He also provided technical expertise for two Cooperative Research Initiative projects to reconfigure the Johnson Bottom and Sheppard Bottom floodplains on the Ouray National Wildlife Refuge.

Tildon draws from his field expertise to understand and solve the big-picture challenges of endangered fish recovery. He has contributed critical insight to the Program's basin-wide nonnative predator control, Colorado pikeminnow population estimation, electrofishing standardization, fish monitoring by stationary PIT antenna, native fish entrainment and salvage in irrigation canals, fish community monitoring in Lodore and Yampa Canyons, and big river ecosystem conservation in general.

Tildon understands that the ultimate success of the Recovery Program hinges on an informed public. Whether working with Uintah basin school children, whitewater river guides, recreational boaters, Dinosaur National Monument managers, or local politicians and irrigation companies, he always takes the time to communicate the importance of a healthy river ecosystem.

PHOTO BY MELANIE FISCHER, USFW

From left to right: Tom Chart, M. Tildon Jones, Angela Kantola and Matt Breen.

Information & Education Update

By **Melanie Fischer,** *Upper Colorado River Endangered Fish Recovery Program*

Want to see the endangered fishes of the upper Colorado River basin? There are several places you can view them in Utah and Colorado. These rare fish live nowhere else except the Colorado River basin. Take the time to visit one of these locations soon and experience these unique native fish.

FACILITY	ADDRESS	CONTACT INFORMATION
Ouray National Fish Hatchery Randlett Unit **Appointment Required**	Ouray National Fish Hatchery 21000 East Wildlife Refuge Road Randlett, Utah 84063	Karl "Dave" Schnoor Project Leader / Hatchery Mgr. (435) 789-0351 X 17 or (435)828-7134 VernalFishandWildlife@fws.gov
Ouray National Fish Hatchery Grand Valley Unit **Appointment Required**	1149 24 Rd. Grand Junction, CO 81505	(970)245-9236
Children's Nature Center **Entry Fee Required**	Mesa Mall / Sear's Wing 2424 Hwy 6 & 50 Grand Junction, Colorado 81505	(970) 241-1000 thechildrensnaturecenter.org
Denver Aquarium **Entry Fee Required**	700 Water St Denver, CO 80211	(303) 561-4450 downtownaquarium.com
Living Planet **Entry Fee Required**	12033 Lone Peak Pkway Draper UT 84020	(801) 355-FISH (3474) info@thelivingplanet.com thelivingplanet.com
Utah Field House of Natural History **Entry Fee Required**	496 E. Main St Vernal, UT 84078	(435) 789-3799 stateparks.utah.gov/parks/utah-field-house

PHOTO © TERRY BATEY

Anderson Batey at the Denver Aquarium

PHOTO BY MELANIE FISCHER, USFWS

Ouray National Fish Hatchery

PHOTO BY MELANIE FISCHER, USFWS

Utah Field House of Natural History

Rehabilitation of Grand Valley Power Plant to Begin Soon

By **Don Anderson,** *U.S. Fish and Wildlife Service*

These days, we hear a lot about America's aging infrastructure and the need to rehabilitate aging facilities. In the Grand Valley of Colorado, along a reach of the Colorado River crucial to the recovery of endangered fish, the Orchard Mesa Irrigation District (OMID), Grand Valley Water Users Association (GVWUA), and U.S. Bureau of Reclamation are doing just that.

Where the mainstem Colorado River emerges from the mountains and mesas of western Colorado and flows into the Grand Valley, a portion of the river is temporarily diverted through the Grand Valley Power Plant near Palisade, Colorado, where it generates three megawatts of clean and renewable hydroelectric power.

The power plant, which is owned by the U.S. Bureau of Reclamation and operated by OMID and GVWUA, is now more than 80 years old. Its hydroelectric turbines are nearing the end of their useful lives. Recovery Program partners secured more than $5 million in funds and financing to proceed with a much-needed replacement of the power plant's generators. The year-long rehabilitation project is expected to begin this winter.

Continued smooth functioning of the Grand Valley Power Plant is of keen interest to the Recovery Program. Water delivered to the turbines returns to the top of the "15-Mile Reach" of the Colorado River to enhance flows and benefit endangered fishes including the Colorado pikeminnow.

PHOTOS BY MELANIE FISCHER, USFWS

Keeping this power plant in operation is "just a smart public investment," says Max Schmidt, general manager of OMID. Max and his peers at GVWUA did much of the legwork to ensure the upgrades will happen, including securing a $965,000 grant from the Bureau of Reclamation's WaterSmart program, lining-up a $1.7 million loan from the Colorado Water Conservation Board, and arranging other financing agreements. The rehab project will generate around 1.35 megawatts more power than in the past, thanks to more efficient turbines.

Additional renewable energy, more long-term reliability in power production, and continued delivery of water to benefit endangered fish: this is exactly the kind of win-win-win scenario that Recovery Program partners love to see.

San Juan River Waterfall Study

By **Casey Pennock, Skyler Hedden, & Keith Gido,** *Kansas State University,* **Mark McKinstry,** *U.S. Bureau of Reclamation*

In February 2017, biologists began investigating population size, mobility, and early life history of razorback suckers in the San Juan River below the waterfall and in the inflow area of Lake Powell. Since 2015, more than 900 razorback have been detected and more than 300 captured below the nearly 20-foot tall waterfall that initially formed in the late 1980s and again in the late 1990s.

Sixty-one fish were PIT-tagged and radio/acoustic tagged here. About half were translocated and released two miles upstream of the waterfall and the other half were released downstream. In addition, 120 razorback suckers, 6 Colorado pikeminnow, and 34 flannelmouth suckers were implanted with PIT tags and translocated upstream of the waterfall. Biologists also captured adult razorback in the San Juan arm of Lake Powell, implanted 30 with transmitters, and released them back in the lake.

Initial results suggest fish move back and forth between the reservoir and the river and can travel great distances. Fish tagged by the waterfall were detected as far upstream as Mexican Hat, UT (~90 miles from the waterfall). By late summer, most radio and sonic-tagged fish moved back downstream, over the waterfall, and into to the lake. Several fish captured and tagged at the waterfall had been stocked >200 miles upstream in the Green, Colorado, and Gunnison rivers.

Researchers sampled downstream of the waterfall and collected more than 200 juvenile Colorado pikeminnow from a single backwater in March. In March and April when reservoir levels were low, researchers found juvenile Colorado pikeminnow to be the second-most abundant species collected (~14%), with nonnative red shiner comprising 83%. After the reservoir filled in June, the fish community was dominated by young-of-year common carp, gizzard shad, and threadfin shad. However, 15 young-of-year razorback were collected at three sites 4-6 miles downstream of the waterfall.

PHOTO BY MARK MCKINSTRY, USBR

Calcein Marking Experiment on Age-1 Colorado Pikeminnow

By **Melissa Mata,** *U.S. Fish and Wildlife Service*

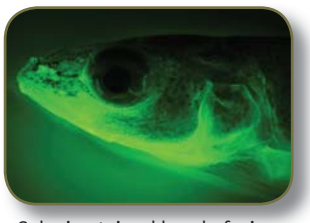
The San Juan River Basin Recovery Implementation Program (San Juan Program) has been stocking age-0 Colorado pikeminnow into the San Juan River to supplement populations. Stocking age-0 fish allows many more fish to be released than if larger fish were stocked, but because they are too young to mark at this age, it makes it more difficult for biologists to figure out if reproduction is occurring from wild fish.

The San Juan Program is working to solve that problem with calcein, a fluid which can be used to mark fish that are too small to PIT tag. Fish are given a salt bath and then immersed in calcein, which produces a mark that is detectable in live fish under fluorescent light. Biologists marked a group of age-1 Colorado pikeminnow with calcein on January 19, 2017, leaving another random selection of individuals unmarked to serve as a control. Eighty fish were sampled by five "blind" readers on three occasions: 14, 42, and 196 days post marking. The fish grew from an average of 65 mm to 140 mm over the course of the experiment.

Researchers correctly identified marked and unmarked fish over 90% of the time (98.25%, 99.75%, and 91% in chronological order). False positives were more common than false negatives (i.e., readers would more often call unmarked fish "marked" rather than incorrectly call marked fish "unmarked").

During the experiment, differences were found based on who was "reading" the fish, differences in light/shade treatment, and which tool was used to read the calcein. Given these complications, San Juan Program biologists are developing a prototype reader to ensure consistency.

Overall, it appears the mark is still detectable more than 90% of the time after 196 days, but the detectability decreases over time as the fish grow. The last sampling effort will occur in December 2017 (~320 days post marking) to see if detectability continues to drop.



Calcein stained head of a juvenile Colorado pikeminnow illuminated by fluorescent light.

Unstained head of a juvenile Colorado pikeminnow illuminated by fluorescent light.

Biologist using a florescent light, to determine if a calcein mark is present or absent.

PHOTOS BY NICK BERTRAND, SOUTHWESTERN NATIVE AQUATICE RESOURCES AND RECOVERY CENTER

An Unwanted Invader Found in Lake Powell

By **Kevin McAbee,** *Upper Colorado River Endangered Fish Recovery Program*

Researchers conducting razorback sucker monitoring in Lake Powell made a distressing discovery in 2015, when they confirmed that grass carp were reproducing in the upper basin. Reproducing grass carp are a concern because grass carp are part of the group of Asian carp (along with bighead and silver carp) that are considered highly invasive in the Mississippi River. Asian carp are voracious filter feeders, have no natural predators in North America, and females lay approximately half a million eggs each time they spawn. The invasive potential of Asian carp in the Great Lakes is a natural resource issue of national importance.

PHOTO BY JOHN CALDWELL, UDWR MOAB

This adult grass carp was collected in the Green River in 2017 and was confirmed as a fertile fish.

Grass carp are widely used in the United States to control vegetation in ponds and lakes, but stocking these fish is strictly regulated to ensure fish cannot reproduce. The process is so strict that every fish purchased for stocking is tested to ensure it cannot reproduce. All four upper basin states (Colorado, New Mexico, Utah, and Wyoming) prohibit stocking fertile grass carp upstream of Lake Powell, making the discovery of larval grass carp both surprising and concerning.

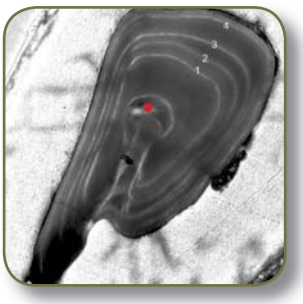
For many years crews have documented a few large adult grass carp while sampling, but assumed that those fish were sterile and had escaped a stocked pond – not born in the river, nor reproducing there. Based on the confirmation of larval fish, crews began collecting adult grass carp and sending tissue samples to the U.S. Fish and Wildlife Service's La Crosse Fish Health Center to determine if they were fertile or sterile. Unfortunately, through July 2017 all five of the adult grass carp collected and analyzed were fertile fish, including three from the Green River and two from the Colorado River.

We do not know when or where fertile grass carp were initially introduced into the upper Colorado River basin, especially since stocking is so strictly regulated. We also do not know exactly where they are spawning. The greatest mystery is what ecological effects grass carp could have in the upper Colorado River basin. Both Recovery Programs will continue to monitor this issue with increased vigilance and interest.

Determining Origin of San Juan River Basin Razorback Suckers

By **Stephani Clark Barkalow,** *American Southwest Ichthyological Researchers*

To achieve recovery, we must document wild-spawned razorback sucker reaching adulthood. We've stocked hatchery-reared adults and sub-adults into the San Juan River since 1997. Fish are PIT-tagged prior to release. We regularly collect untagged adult razorback via electrofishing and need to differentiate wild-spawned from hatchery-reared fish.



Fin ray cross section from an age–4+ razorback and core or location of natal signature (red dot).

Microchemical analysis can examine some of the smallest building blocks of the world around us: elements and isotopes. The technique has been used to track human migrations using teeth from archaeological sites, analyze asteroidal crusts to better understand formation of planetary bodies, and reconstruct historic water temperatures in the Great Barrier Reef. Microchemical analysis also is used to reconstruct fish migration patterns, determine fish natal origin, and determine the source reservoirs of escaping invasive fish. Elements and isotopes in otoliths (ear bones) and fin rays are analyzed and compared with the microchemical signature of surrounding geology.

Otoliths are the "gold standard" of microchemical analysis, but removing them requires killing a fish. Fin rays can be sampled non-lethally. Like otoliths, fin rays produce discrete annual growth rings, similar to trees. Microchemical signatures of elements and isotopes accumulate in the fin ray calcium matrix, providing a record of where a fish has been. The fin ray core contains information about where a fish came from.

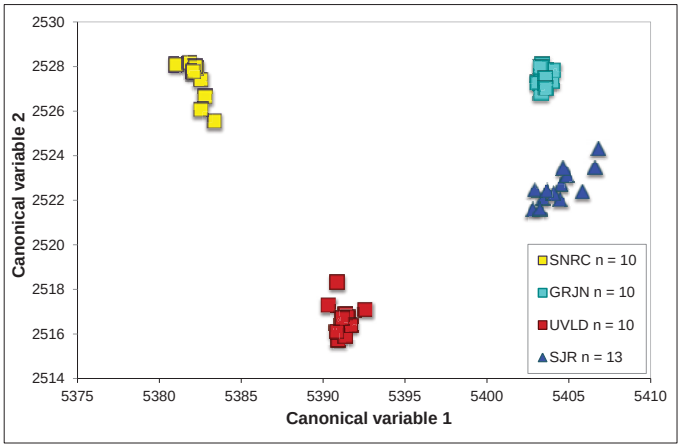
PHOTOS BY ASIR

Mark McKinstry (USBR) and Stephani Clark Barkalow (ASIR) analyze fin ray samples.

Pectoral fin ray segment removed.

San Juan field crews collected fin rays from some untagged razorbacks in the river. Analyzed at Woods Hole Oceanographic Institution, microchemical signatures of hatchery-reared razorback were easily distinguished from wild spawned fish and documented a wild-spawned age-1+ razorback sucker.

The study was expanded in 2016 to include razorback from the San Juan River arm of Lake Powell. Hundreds of



Differences in microchemical signatures from four hatcheries.

PHOTO BY MARK MCKINSTRY, USBR

The waterfall in the San Juan arm of Lake Powell.

razorback suckers have been found just downstream of the waterfall there, many without PIT tags. The waterfall may have prevented them from re-entering the San Juan River or fish may have migrated from the upper Colorado River basin. We'll soon learn the extent of recruitment of wild-spawned razorbacks in the San Juan River and the San Juan arm of Lake Powell and the extent of migration from other rivers in the Upper Basin.

Anglers Angle to Help Endangered Species

By **Mike Porras**, *Colorado Parks and Wildlife*

The summer of 2017 marked the third year of successful fishing tournaments hosted by Colorado Parks and Wildlife (CPW) across Colorado's western slope.

At Elkhead Reservoir in the Yampa basin, 332 anglers caught and removed 963 smallmouth bass and 396 northern pike. Smallmouth bass have escaped and are adversely affecting populations of native fish in several rivers, including the Yampa in northwestern Colorado. To aid in reducing their numbers, CPW and Recovery Program partners encourage anglers to "catch and keep" northern pike and smallmouth bass in the many western Colorado waters with established populations of the predatory fish. $4,500.00 in cash and prize incentives were funded by Colorado Water Conservation Board (CWCB) and given out at the Elkhead Reservoir Fishing Classic. With the public's help and support, CPW officials say detrimental warmwater fish populations across the region can ultimately be controlled, helping bring native fish recovery efforts to a successful conclusion.

PHOTOS BY MELANIE FISCHER, USFWS

At a similar tournament at Ridgway Reservoir, 126 anglers caught and removed 2,339 smallmouth bass in three weeks. Smallmouth bass were introduced illegally at Ridgway Reservoir about 10 years ago. The species is a predator that can survive in Western Slope rivers. There is significant risk of smallmouth bass escaping from the reservoir into adjacent rivers where they would reproduce and consume native fish species that are found nowhere else in the world.

CPW is already preparing for the 2018 tournaments and encourages the public to participate next summer!

Changing the Fish but Keeping the Fun

By **Kevin McAbee,** *Upper Colorado River Endangered Fish Recovery Program*

It's an exciting time to be an angler in the upper Colorado River basin! Depending upon where they go, anglers can hook more fish, reel in a new type of fish, take more fish home, or even win a cash prize. Thanks to state wildlife agencies' commitment to listening to anglers, the agencies are making changes that improve both sport-fish (fish desired to catch or eat) and native fish (fish that only live in the Colorado River basin). The changes benefit anglers, local communities, the economy, and the ecosystem. You could say it's a win-win-win-win.

Changes to upper basin angling focus on removing and replacing three fish that cause lots of problems – smallmouth bass, northern pike, and walleye – with other fish that don't cause the same problems – such as trout, largemouth bass, or sterile walleye, just to name a few (see table below). You may be asking, "Why would anyone want to replace smallmouth bass, northern pike, and walleye? People love to fish for them!"

Smallmouth bass, northern pike, and walleye disrupt the ecosystem balance by eating other fish, using the habitat and food, and reproducing in large numbers. For example, northern pike can quickly degrade a prized trout fishery like they did in Stagecoach Reservoir, Lake Catamount, and the downstream Yampa River. In these locations, northern pike reduced trout and harmed the local economy. However, if northern pike are removed, other fish can grow in size and number; which is what happened to trout and other fish when Colorado Parks and Wildlife (CPW) removed northern pike at Lake Catamount and the downstream Yampa River.

CPW is making replacements like these in many locations. Just downstream from Lake Catamount, CPW is stocking largemouth bass (both lunkers and fry) in Elkhead Reservoir to replace smallmouth bass. And to support removal of smallmouth bass (and northern pike), CPW and partners hold a fishing tournament each summer (see previous story).

Anglers don't have to be part of a tournament to help agencies and enjoy fishing. Wildlife agencies are using a number of tools to engage the community and to provide anglers with continued fishing access and an opportunity to be part of the solution. One of the clearest messages of engagement comes from new fishing regulations that allow anglers to take home as many smallmouth bass, northern pike, and walleye as they want in most locations in the upper Colorado River basin! In fact, in Utah, anglers are prohibited from returning these fish back to the river.

Another way to involve anglers is to simply ask them what they want. For example, when Utah Division of Wildlife Resources (UDWR) used rotenone to reset Red Fleet Reservoir because of illicitly introduced walleye that were escaping downstream, they asked local anglers to help select the new fish that would be put back in the reservoir. This collaboration resulted in a new stocking plan for the lake that was acceptable to both the agency and the community. UDWR also developed a new program to grow sterile walleye and stock them back into the same reservoir, because sterile fish offer the same fishing experience but don't cause the same problems.

Replacing smallmouth bass, northern pike, and walleye with other species is vital to the recovery of the endangered fish downstream of reservoirs because these three fish prey on all life stages of the endangered fish. State agencies have found a way to solve this issue while minimizing impact to their angling constituents. Fishing for trout instead of pike, largemouth bass instead of smallmouth bass, and sterile walleye instead of fertile walleye are small changes that make a huge difference in both the quality of sport fishing and native fish recovery. So next time you are fishing in the upper Colorado River basin, keep those northern pike, smallmouth bass, and walleye – following all state regulations, of course!

YES - Compatible sportfish can be stocked in reservoirs

BLACK CRAPPIE

YELLOW PERCH

BLUEGILL

RAINBOW TROUT

KOKANEE

BROWN TROUT

LARGEMOUTH BASS

WALLEYE (STERILE FISH)

HYBRID STRIPED BASS (STERILE FISH)

...and many others!

NO - Incompatible sportfish cannot be stocked in reservoirs

SMALLMOUTH BASS

WALLEYE (FERTILE FISH)

NORTHERN PIKE

BURBOT

New PIT Tag Antennas in the San Juan River

By **Mark McKinstry**, *U.S. Bureau of Reclamation* and **Peter MacKinnon,** *Biomark Inc.*

New PIT tag antenna arrays have recently been placed in the San Juan River basin. One antenna is in a channel near the Hogback Canal, ~20 miles downstream of Farmington, NM. This antenna is part of the large antenna system installed in the Hogback Canal and Fish Weir. The channel with the new antenna is a bypass for the irrigation canal and usually has large amounts of water (with the entire river often contained in this channel when the canal is not operating). We've already recorded several thousand detections from hundreds of individual fish at the strategic location in the San Juan River.

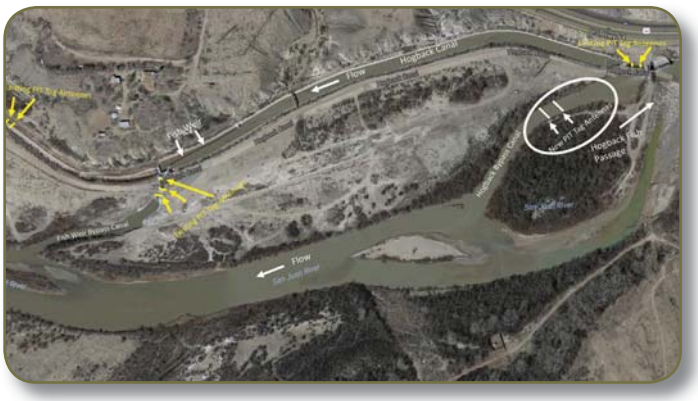


PHOTO BY DANIEL LAMARRA, ERI

New PIT tag antennas (white lines) at Hogback Canal. Existing antennas in the canal are shown in yellow.

McElmo Creek has long been a refuge for spawning flannelmouth suckers and is also used by razorback suckers and Colorado pikeminnow. The Utah Department of Transportation recently needed to replace rip rap at the Highway 160 Bridge over McElmo Creek. The USFWS required antennas to detect fish as they moved out of the San Juan River and upstream in McElmo Creek as part of the mitigation for the bridge reinforcement and to test whether the re-routed stream created a barrier to upstream fish passage.

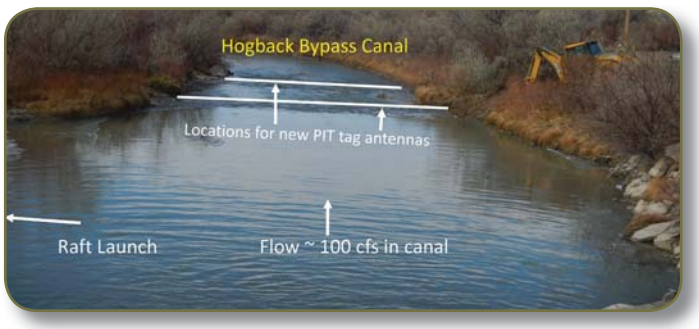


PHOTO BY MARK MCKINSTRY, USBR

New PIT Tag antennas at Hogback Canal.

Antenna arrays were installed upstream and downstream of the bridge in January 2017 and information gathered from these antennas to date shows the reworked channel is not a barrier to fish movement and it has provided hundreds of detections of fish in the few short months it has been operational.

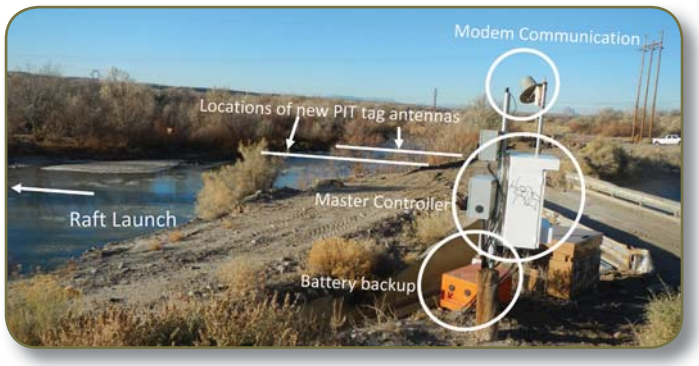


PHOTO BY MARK MCKINSTRY, USBR

A final PIT tag antenna was installed downstream of the San Juan River waterfall, ~15 miles upstream of Lake Powell.The waterfall has been in place since the late 1990's and is a barrier to upstream fish movement. Since 2015, portable PIT tag antennas and electrofishing identified hundreds of endangered fish using this area every year. A permanent antenna with remote data acquisition was needed to continue detecting fish that congregate at the base of the waterfall throughout the year. We constructed an antenna using concrete and a small kiddie pool; with associated electronics, solar array for power, and a satellite uplink completing the system. More than 350 individual PIT-tagged fish have been detected using this area since August 2017.

PHOTO BY MARK MCKINSTRY, USBR

Peter MacKinnon, with Biomark Inc. prepares a PIT Tag antenna for installation on the upstream side of McElmo Bridge Crossing. One antenna is already in place at lower left.

Staff from the San Juan Program office including Scott Durst, Nathan Franssen, Eliza Gilbert, and Scott Clark supported the project and assisted with installations. The Navajo Nation, through funding provided by the Bureau of Indian Affairs, supported antenna installation at the San Juan River waterfall. Biologists and staff from The Navajo Nation, Kansas State University, Utah State University, USFWS, Biowest Inc., Keller-Bliesner Engineering, and the State of Utah also provided assistance with permitting, installation of these systems, and interpreting the data.

Navajo Reservoir Operations: Lessons and Adaptations in the San Juan River Basin

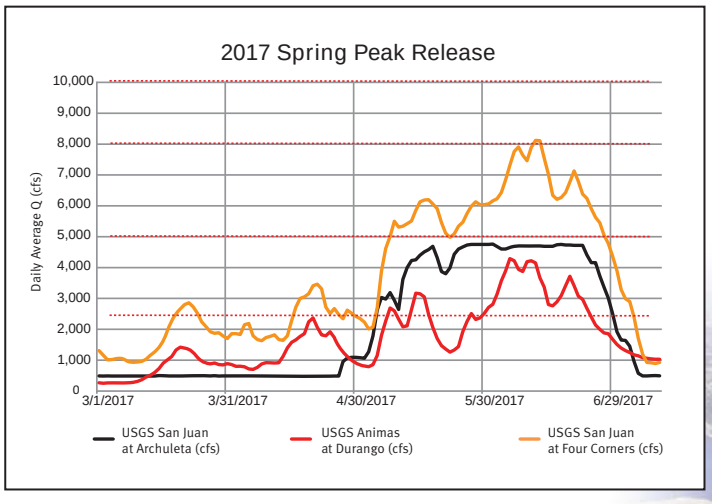
By **Susan N. Behery**, *U.S. Bureau of Reclamation*

Since 1999, the San Juan Program and the U.S. Bureau of Reclamation (Reclamation) have been working together to release water from Navajo Reservoir in a way that mimics a natural hydrograph for the benefit of endangered Colorado pikeminnow and razorback sucker. Continued drought in the basin has changed the timing and pattern of releases in the last few years and made it harder to achieve flow targets in the San Juan River.

PHOTO BY STACEY SMITH, USBR

Peak releases from Navajo Dam flow into the San Juan River in Northwest New Mexico.

Reclamation calculates how much water will be available to the San Juan Program for a spring peak release based on reservoir inflow forecasts, expected project operations and basin water usage, reservoir storage and carryover needs. A new process to implement flow recommendation was developed in 2015 and 2016 for releasing flows while reducing risk of future water shortages.



A spring peak release is made only if it can be maintained for 21 days. Reclamation times the release to coordinate with peak Animas River flows to achieve the largest possible peak downstream. Timing of the ramp-down is determined by remaining available water and projected declines in Animas runoff.

Last year (2016), Reclamation staff recognized they had enough water to meet the 21-day minimum for the first time in four years. However, in the interim, vegetation, sediment, and man-made encroachment decreased the safe capacity of the channel. While the U.S. Army Corps of Engineers identifies 5,000 cubic feet per second (cfs) as the safe channel capacity to the Animas River confluence, flooding currently occurs at lower flows.

In late 2016 and early 2017, Reclamation worked with partners to determine why channel capacity decreased so substantially and what could be done to restore it to 5,000 cfs. Experts from the Sedimentation and River Hydraulics Group at Reclamation's Technical Service Center studied affected locations and documented probable natural and anthropomorphic causes. Reclamation hosted a public meeting in August 2016 to share their results, the U.S. Army Corps of Engineers perspective, and discuss a path forward with Navajo releases.

In April of this year, Reclamation calculated an available water volume of 500,000 acre-feet for the spring peak release, enough to proceed for a second year in a row. Because of downstream safety and property concerns during last year's release, Reclamation planned a longer ramp-up period of 16 days. The ramp-up was timed to match an expected May 3rd peak in the Animas River.

The extended ramp-up period, coupled with channel scouring from the previous year's releases, resulted in a much safer and more predictable increase in peak flows. Property issues downstream of the dam were less dramatic and were handled by the San Juan County Office of Emergency Management.

Long-term studies are underway to determine optimal management, including ramping-up and down rates, new gaging locations, and possible increased channel capacity. Reclamation is working with federal, state, and local agencies, stakeholders, landowners, and the general public, to determine what can be done to regain the full 5,000 cfs capacity of the channel.

Coordinated Reservoir Releases Boost Peak Flows for Fish

By **Don Anderson,** *U.S. Fish and Wildlife Service*

For the third year in a row, Program partners in the upper Colorado River basin coordinated reservoir releases to substantially boost peak flows in the "15-Mile Reach" of the Colorado River, a segment crucial to endangered fish recovery. The 15-Mile Reach lies immediately above the river's confluence with the Gunnison River near Grand Junction, Colorado.

Healthy rivers are dynamic. Periodic high flows (most commonly from melting snow) rework and rejuvenate riverine fish habitat. In the 15-Mile Reach, they mobilize coarse riverbed sediments and provide fish with important spawning cues. The high flows create new cobble bars suitable for spawning and wash them free of fine sediments. Backwaters and side channels are scoured and reconnected to the river. This restores vital habitat complexity and helps native fishes thrive, including the Colorado pikeminnow and razorback sucker.

Naturally occurring peak flows have diminished in the 15-Mile Reach over the last few decades as water projects upriver diverted, captured, and stored a larger share of spring runoff. To help compensate for the decline in natural channel-reworking flows, the Recovery Program implements voluntary "Coordinated Reservoir Operations" (CROS) to augment and extend the natural peaks.

Through CROS, upstream reservoir operators look for opportunities to release and bypass water to augment high flows in the 15-Mile Reach. This year, beginning on June 3, the Bureau of Reclamation, Colorado River District, Denver Water, and Northern Water Conservancy District voluntarily joined forces to maintain elevated reservoir releases for 3-7 days before winding them down. The result was a boost in mean daily flow in Palisade, Colorado, from about 12,435 cubic feet per second (cfs) without the CROS releases to a peak of 14,900 cfs with those releases.

This was the Program's third consecutive year of making coordinated releases. Not every year is ideal for CROS. When conditions are too wet, concerns about potential flooding constrain releases. When conditions are too dry, participating reservoirs need to store more water, and low river flows provide a poor base upon which to build a useful peak.

However, 2017 fell into the sweet spot of being neither too wet nor too dry. Green Mountain, Williams Fork, Willow Creek, Wolford Mountain, and Ruedi Reservoirs each contributed flow timed to maximize benefits to the 15-Mile Reach. The total water contributed by each cooperator is shown in the table below. The Recovery Program is grateful to the participating entities for their commendable role in voluntarily implementing a well-timed and very welcome boost to 15-Mile Reach peak flows this year!

Cooperator	Reservoir	Acre-Feet of CROS Water Contributed, June 3 — June 13*
Bureau of Reclamation	Green Mountain	14,410
Bureau of Reclamation & Northern Colorado Water Conservancy District	Willow Creek	7,206
Bureau of Reclamation	Ruedi	4,502
Colorado River District	Wolford Mountain	4,245
Denver Water	Williams Fork & Moffat Collection System	5,372
TOTAL		**35,735**

*One acre-foot equals 325,821 gallons. These numbers are preliminary estimates.

PHOTO BY VICTOR LEE, P.E., USBR

Endangered Species Updates

PHOTO BY USFWS

An adult Colorado pikeminnow.

Colorado pikeminnow

In 2016, UDWR collected 150 age-0 pikeminnow in the lower Colorado River (5th highest catch in 30 years), and 426 in the lower Green River (6th highest in 30 years). In the middle Green, only 6 age-0 fish were collected (7th lowest since sampling began in 1986), possibly due to less abundant backwater habitat and clearer water (less cover from predators). Maintaining a specific range of base flows likely contributed to 2015 success and continued 2016 success in the lower Green. These results reinforce the value of manipulating Flaming Gorge Dam releases.

PHOTO BY UDWR

Brian Hines with humpback chub encountered in Westwater on the Colorado River.

Humpback chub

UDWR began a new cycle of humpback chub population estimates in Westwater Canyon in 2016. Biologists conduct mark-recapture population estimates for 2 years, followed by 2 years without estimates. Mark-recapture is a technique where a pass is made to collect fish, then they are marked and released, and then on subsequent passes, the number of marked fish is compared to number of unmarked fish to derive a population estimate. 2016 humpback chub catch rates were the highest calculated since population estimates began in 1998. Biologists estimated the population size in Westwater Canyon to be 2,002 adult humpback chubs.

PHOTO BY USFWS

Tildon Jones holds a bonytail captured at Johnson Bottom, Ouray NWR, Vernal, UT.

Bonytail

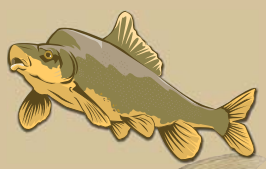
Recently improved habitat at the Johnson Bottom wetland on the Ouray National Wildlife Refuge is a boon for bonytails. The U.S. Fish and Wildlife Service stocked over 2500 bonytail into the wetland and surrounding waters this spring at an average size of just under 10 inches. So far this year, 106 of them have been detected returning to the river from the site, and those fish grew an average of 3-1/2 inches over the summer.

PHOTO BY USFWS

Tristan Francis and Melissa Trammell, NPS hold a razorback sucker from Lake Powell, UT.

Razorback sucker

Razorback sucker continue to grow and thrive in restored wetland habitats on the Green River, including the recently improved Sheppard Bottom and Johnson Bottom wetlands on the Ouray National Wildlife Refuge as well as Stewart Lake. This year, biologists conducted experiments at Johnson Bottom to determine the distance from which razorback sucker larvae are attracted to light traps. We use light traps to attract larval fish and to estimate the number of razorback sucker entering wetland sites each spring.



You Might Catch a Pikeminnow if ...

By **Brett Walker,** *Colorado Parks and Wildlife*

You might catch a pikeminnow if you fish every day for the next 25 years. That's what I told my 7-year old son the previous Saturday. My son and I love fish and fishing. As we looked through historical accounts of endangered, native fish in the Colorado River, he saw a black-and-white photo of a kid holding a 6-foot long Colorado pikeminnow. "Wow! Dad, can we catch one of those?" he asked. I explained the Grand Valley held lots of Colorado pikeminnow in the early 1900's, but now they were endangered, so probably not. The following Saturday, we canoed the river from Fruita to Loma with friends. We were fishing for catfish from an island when we got a hard tug. My son grabbed the rod and reeled it in. At first we thought it was a big roundtail chub. Then I saw the huge lips, and I almost couldn't believe my eyes, it was a 23" Colorado pikeminnow! Everyone ran over to see the fish. We kept it in the water, gently unhooked it, and took photos. As we released it, my son had an ear-to-ear grin. It was an amazing catch we'll never forget. And I was only off by 24 years and 358 days!

PHOTO BY COLORADO PARKS AND WILDLIFE

Wesley and Brett Walker release a Colorado pikeminnow encountered while fishing in Grand Junction, CO.

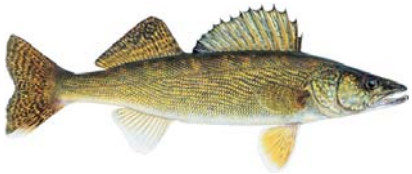
UCREFRP
PO BOX 25486
DENVER, CO 80225

HELP PREVENT THE SPREAD OF NONNATIVE SPECIES

CATCH & keep

SMALLMOUTH BASS

NORTHERN PIKE



WALLEYE

UTAH AND WYOMING HAVE
CATCH & KEEP
REGULATIONS. IT IS ILLEGAL TO RETURN THESE FISH TO THE RIVER.

One hundred years ago only 13 native species swam in the Upper Colorado River and its tributaries–today they have been joined by more than 50 nonnative species. Introduction and establishment of problematic nonnative predators affect native fishes, the Recovery Program, anglers, and local communities with high environmental and economic costs.

Removing illegally-introduced species is expensive and time-consuming. We must all join forces to prevent the spread of these problematic nonnative predators in order to preserve native fish in the river and desirable sport fisheries in the reservoirs.

Fish Illustrations © Joseph R. Tomelleri

Review your state fishing regulations. State regulations may vary based on river mile and are the LAW. Regulations on the river may be **very different** than in reservoirs. **Know the law.**

http://cpw.state.co.us/Documents/RulesRegs/Brochure/fishing.pdf
https://wildlife.utah.gov/utah-fishing-guidebook.html
https://wgfd.wyo.gov/Regulations/Regulation-PDFs/WYFISHINGREGS_BROCHURE
http://www.wildlife.state.nm.us/fishing/game-fish/