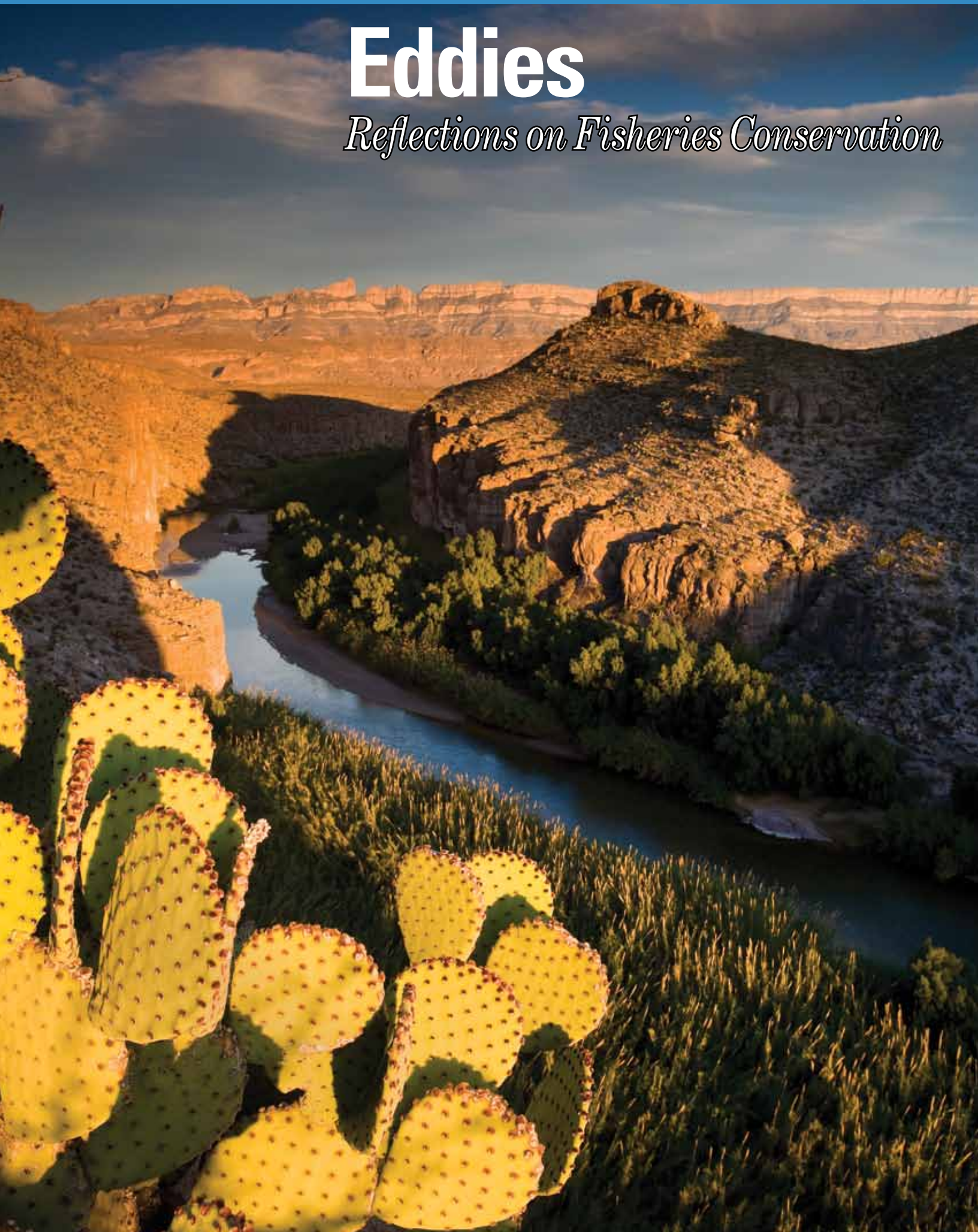
Eddies

Reflections on Fisheries Conservation



Eddies

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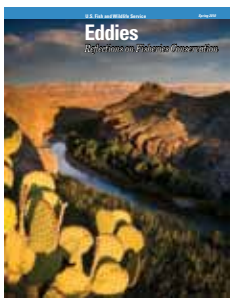
On the Cover:
Rio Grande silvery minnow swim these waters in Big Bend National Park, Texas. Read about it on page 20.
Ian Shive Photography



Departments

Features

M.C. Barnhart/Missouri State University

A rainbow darter rests below sacs of mussel larvae disguised as worms. Learn about rainbow darter life history on page 10, and mussel conservation on page 32.

The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people.

CONSERVING AMERICA'S Fisheries
U.S. Fish & Wildlife Service

Celebrating Sam D. Hamilton

By Bryan Arroyo

USFWS

This issue of *Eddies* is dedicated to the memory of Sam D. Hamilton. Sam was a career biologist with the U.S. Fish and Wildlife Service, starting at the bottom and rising to the top, when President Obama appointed him Director of the agency last year. Sadly, Sam died in February at age 54, leaving his friends and loved ones stunned by the terrible void.

Saying that Sam possessed a passion for conservation, is like saying that the universe has stars. He was my supervisor in Austin, Texas, during my first year with the U.S. Fish and Wildlife Service, 20 years ago. Sam did what great leaders do: he gave clarity of vision and purpose and approach. And I learned so much by observing how this man dealt with very tough and controversial conservation issues. In his laid back manner, he took those conservation challenges head on because he cared. Throughout the years, Sam's influence as a leader became more evident. In the last four years I witnessed his profound influence as a Regional Director. In the last few months as our Director, he had matured into a conservation giant.

Sam was one of those folks who you get to meet once in a lifetime and serves as a role model—well after they are no longer with us. His imprint on us remains. These words he spoke many times: "I am on borrowed time." When he spoke them, he always conveyed a sense of urgency, but also of hope for what still needed to be done. Sam's saying evokes the words of President John F. Kennedy. "Our most basic common link is that we all inhabit this planet. We all breathe the same air. We all cherish our children's future. And we are all mortal."

Those of us who attended Sam's memorial saw the full expression of who he was to the many different "communities" that he was a part of, and how all these circles of relationships made him the man he was—his family, his church, his neighbors, his conservation colleagues, and members of Congress. We were all privileged to participate in Sam's great life.

His family served as anchor and compass, helping him stay the course, to do the right things for the right reasons. Nothing made him light up more than talking about his wife Becky, and his boys Sam, Jr. and Clay, and in recent years his grandson Davis. He cherished his children, and the future of all children. But that's what you would expect of a conservationist, since conservation is an investment in the future.

Sam lived to the fullest, taking every day as if it was his last, and his unbound energy amazed me. Shortly before his untimely passing, he and I spoke over dinner, not about work, but vacations and fishing and friends and family, and how important it is to make time to be with them. His last minutes were spent doing just that, he was outdoors with friends.

I am certain Sam would have enjoyed immensely this issue of *Eddies*, as its contents exemplify the breadth and depth at which we work in conservation in the watery realm. Imperiled species conservation is the focus of this issue. We have stories about rare mussels in Wisconsin, toads in Wyoming, rice and minnows in Texas and sturgeon in the Atlantic Ocean—all in danger of being lost.

But I can tell you confidently, it won't happen. Our people work in the spirit that Sam led by: determined.

Bryan Arroyo is the Assistant Director for Fisheries and Habitat Conservation in Washington, DC.

Rare trout on a "sky island"

On November 4, 2009, about 500 threatened Gila trout were stocked in their native range in Frye Creek on the "sky island" of Mount Graham in southeastern Arizona. Mora National Fish Hatchery and Technology Center transported the fish to the Arizona Game and Fish Department's Cluff Ranch Wildlife Area near Pima, Arizona. After the fish were loaded into three 55-gallon drums, a helicopter transported them to biologists from multiple agencies that had hiked to drop zones along the rugged terrain on Mount Graham. Following a short acclimation period, the fish were stocked into pools within a five-mile reach of Frye Creek. "With a load of fish, this was physically taxing, but well worth the effort," said Jason Kline, an AGFD fisheries biologist. "It is a historic occasion, as it will not only provide five miles of recovery habitat for Gila trout, it may also be the first fishable population of Gila trout in Arizona when the population becomes established." The Gila trout recovery program is a joint effort among the Arizona and New Mexico departments of game and fish, U.S. Forest Service, U.S. Fish and Wildlife Service, Trout Unlimited, and other conservation organizations. ✦ Jeremy Voeltz

Craig Springer/USFWS

After a long absence, Gila trout now swim in Frye Creek.

Jennifer Johnson/USFWS

Stewart Jacks, Arizona Fish and Wildlife Conservation Office, receives Gila trout via helicopter.

Scientific study reveals utility of modern fish tagging technique

Tagging in some fashion is a long-practiced method used to manage fisheries. It works best when the marks made on fish are long-lasting and reliable. A study by biologists, Dr. Catherine Phillips and Joe Fries at the San Marcos National Fish Hatchery and Technology Center, of tags on two endangered species, the fountain darter and San Marco salamander, was recently published in the scientific journal, the *North American Journal of Fisheries Management*. They researched the utility of a visible elastomer tucked slightly under the animal's skin. Think of it as a small piece of colorful liquid plastic. Having marked and monitored many darters and salamanders, Phillips and Fries learned that the method was useful for management. Moreover, the method did not hamper survival or growth of either animal, something essential for endangered species conservation. ✦ Craig Springer

Gregg Eckhardt/Edwardsaquifer.net

A liquid plastic tag is useful for marking the endangered fountain darter, a scientific study shows.

LaCrosse Fish Health Center advances fight against VHS

VHS is a dirty word in fisheries management. It stands for Viral Hemorrhagic Septicemia. If a fish has it, it can bleed to death. Anyone interested in angling or fisheries management has probably heard of it, especially when rafts of fish turned up dead in 2005 in the Great Lakes.

New work done on walleye and northern pike by the LaCrosse Fish Health Center and Genoa National Fish Hatchery, both in Wisconsin, shows promise for a new tool in combating the virus. Working in conjunction with the U.S. Geological Survey's Upper Midwest Environmental Sciences Center, LaCrosse biologists documented the effectiveness of an iodine-based drug called iodophor against the Great Lakes-strain of viral hemorrhagic septicemia.

While fishery biologists have routinely disinfected salmon and trout eggs with iodophor during spawning operations for decades, little information regarding its effectiveness in warm and cool water fish eggs exposed to VHS was available, making this study unique. These findings are of importance, since fishery biologists throughout the Great Lakes, significantly reduced or completely stopped their fish stocking programs due to the deadly virus. The USGS published a fact sheet titled "Evaluation of the Efficacy of Iodophor Disinfection of Walleye and Northern Pike Eggs to Eliminate Viral Hemorrhagic Septicemia Virus" based on the work done at U.S. Fish and Wildlife Service Fisheries facilities. ✦ Ken Phillips

FEATURED FACILITY

Dexter National Fish Hatchery and Technology Center

Where: Dexter, New Mexico
When: Established 1932

Then:
Dexter National Fish Hatchery was established to culture catfish and largemouth bass for farm ponds.

Now:
In the "land of enchantment" lies a man-made haven for desert-dwelling fish. Dexter National Fish Hatchery and Technology Center near storied Roswell, New Mexico, is a New Deal-era facility. Shortly after the passing of the Endangered Species Act in 1973, priorities shifted from farm pond fish. Now the facility provides a safe harbor for 16 threatened or endangered fish species native to the American Southwest.

Roswell residents know about alien visitors. So do fish like the Big Bend gambusia and Comanche Springs pupfish, held at Dexter. Nonnative fishes caused their numbers to decline in the wild. Endangered fish conservation expanded at Dexter in the 1980s, when imperiled fishes from the Colorado River arrived on station: the razorback sucker, bonytail, and Colorado pikeminnow.

USFWS

Dexter's Molecular Ecology Lab manager, Sherri Baker, prepares a genetic test on the endangered Clear Creek gambusia, a rare fish found only in Texas.

Dexter became a Technology Center in 1991. Now, the 78-year-old facility is infused with leading-edge technology used by scientists to conserve imperiled fishes. Dexter is home to a molecular ecology and conservation genetics laboratory; the Regional Fish Health Center; and a physiology and pathobiology laboratory. ✦ Connie Keeler-Foster, Ph.D.

National Fisheries Friends Partnership on solid footing

The National Fisheries Friends Partnership (NFFP) held its 2nd Annual Meeting in April, in Arlington, Virginia. The board of directors elected Richard Hero from the Friends of Craig Brook National Fish Hatchery, Orland, Maine to a two-year term as chairman of the NFFP. The NFFP seeks to have Congress amend the National Fish Hatchery System Volunteer Act of 2006, which was signed into law without attending funds to implement the law. This law authorizes the U.S. Fish and Wildlife Service's Fisheries Program to carry out volunteer enhancement projects and use federal fisheries facilities for education purposes.

The NFFP was founded in 2009 to advocate for conservation of aquatic resources through stewardship, education, and partnerships with the Fisheries Program, businesses, educational institutions, and conservation organizations. The NFFP incorporated in March, and applied for charitable 501(c)(3) status with the IRS. It launched www.fisheriesfriends.org, ratified its bylaws, and sent a "needs assessment survey" to all member groups. Membership consists of representatives from Fisheries Friends Groups around the country. ✦ Richard Christian

Welaka National Fish Hatchery adapts when nature can't

Ken Blick/USFWS

Allan Brown, manager of the Welaka National Fish Hatchery in Florida, handles one of 400 sea turtles watched around the clock in an emergency.

Hundreds of cold-stunned sea turtles were transported to Welaka National Fish Hatchery in Florida during an extreme cold snap that lasted nearly two weeks this past January. The hatchery, which normally raises around five million freshwater fish each year, including Gulf Coast striped bass and Gulf sturgeon, became the ideal location to rehabilitate the turtles.

The federally endangered loggerhead and green sea turtles were unable to maintain vital body heat during the unusually cold weather. But what the sea turtles lack in adaptability, the folks at Welaka NFH have in spades.

The turtles arrived from all along the northeastern coast of Florida, most from the Indian River and Mosquito Lagoon near Merritt Island National Wildlife Refuge. The turtles were rounded up by hatchery biologists, and folks from the Florida Fish and Wildlife Conservation Commission, the National Marine Fisheries Service, sea turtle rescue groups, and many volunteers.

Round-the-clock care for the 400-plus turtles at Welaka NFH included constant monitoring, mixing of salt water, circulating tanks, cleaning and sanitizing, and moving the creatures—some weighing nearly 500 pounds. Welaka NFH biologists worked closely with experts to make sure the hatchery provided the appropriate refuge for the turtles. Biologists tagged each animal with a microchip and gathered data, such as weight and length.

Nearly every turtle was returned to warmer waters within ten days of arrival at Welaka. Hatchery manager, Allan Brown, said it was a thrill to work with the turtles, and added that "if it swims, we can handle it at Welaka."

Find out more about the interesting work being done at Welaka NFH by visiting www.fws.gov/welaka. ✦ Judy Toppins

Following bull trout movements and genetics

Wade Fredenberg/USFWS

Anglers and biologists seek bull trout.

Biologists with Montana Fish, Wildlife and Parks (MFWP) are conducting a population dynamics study of bull trout in the Lower Clark Fork River, in the Bitterroot Basin. Bull trout is designated a species of concern by the state of Montana, and listed as a threatened species by the U.S. Fish and Wildlife Service.

The study, funded by Sport Fish Restoration and the Endangered Species Grant Program, will locate bull trout spawning areas so that they might be monitored; it will examine population genetics and the extent of hybridization with the closely related brook trout.

Bull trout live in the Kootenai, St. Mary, and Clark Fork drainages. Their numbers declined from habitat loss, hybridization with brook trout, over-harvesting, and poaching. Adult bull trout spend most of their time in lakes or streams, but return to smaller tributaries to spawn, completing their special life cycle. Unlike salmon, bull trout do not die after they spawn, but spawn again in later years—and are highly mobile.

In 2008, MFWP biologists captured six bull trout in the East Fork of the Bitterroot River, and implanted them with radio telemetry devices to track spawning behaviors. Of the six bull trout tagged, one migrated through several different creeks; two were not located. Biologists also collected DNA to establish the genetic population structure of the species, and fortunately learned that there was no hybridization with brook trout.

Continuing studies on bull trout help biologists understand how to best manage this important sport fish, so that it will eventually be taken off the list of threatened species. ✦ Kevin Sloan

FROM THE ATTIC

Notes from D.C. Booth Historic National Fish Hatchery and Archives

Among the most beautiful objects used on fish hatcheries are the old glass hatching jars. Clear, thick glass, about 20 inches tall on a pedestal, and hand blown—they delight the eye. The first use of a glass jar for hatching fish in America occurred in a doctor's office on January 26, 1854. Nothing is known about this first jar, but many new designs crafted for hatching fish followed.

Randi Sue Smith/USFWS

A Clark jar (l), was used at Cape Vincent NFH, NY. The metal-spout jar incubated eggs at Garrison Dam NFH, ND.

Over a dozen different styles exist in the Archives at D.C. Booth. Among the most unique is a Clark jar, designed by Superintendent Frank N. Clark of the Northville, Michigan hatchery near 1907. It is possibly the only one of that style left. It is the most complicated, with a bulbous body, narrower neck, and spout. Although maker's marks are rare on the jars, this one is marked "Dorflinger Glass."

World War II put a halt to glass jar production, and it never resumed. Post-war jars were made of plastic. Many jars, glass or plastic, have been field-modified, with added spouts, screens, and measuring lines. These changes are expressions of the genius and individuality of the hatchery worker, modifying the tools to meet the needs. ✦ Randi Sue Smith

Pioneers

By Stuart Leon, Ph.D.

Erwin W. "Wally" Stuecke, Jr.

Courtesy Wally Stuecke

At the podium, Erwin "Wally" Stuecke, delivers a speech circa 1985, while Deputy Regional Director of the Pacific Region of the U.S. Fish and Wildlife Service.

What's that saying, about truth being stranger than fiction? You couldn't script this. Erwin W. Stuecke, known as "Wally" by his friends, has an "it's who you know story" that involved "the girl next door" that sent him on a stellar fisheries science career with the U.S. Fish and Wildlife Service, pioneering research in fish health.

But before we go there, let's back up to June 25, 1950. It's a significant date in international affairs that influenced Stuecke. Sixty years ago, the North Korean Army invaded South Korea, and war was on. By July 4, the first Americans were on the Korean Peninsula pushing back in what would eventually cost some 54,000 American lives in 37 months. Stuecke stepped up—at age 17—joining the military. The upstate New York native, raised the latter part of his youth near Washington, DC, did what he calls a "kiddie cruise" in the U.S. Navy. Though Stuecke didn't get the meat-grinder experience that Marines and Soldiers faced on the ground, he says that military experience was good for him, that it helped shape him to be a leader.

A historic 1986 news release from the U.S. Fish and Wildlife Service captures the culmination of his career: "Erwin W. (Wally) Stuecke, a fisheries biologist and manager with the U.S. Fish and Wildlife Service, has been appointed deputy regional director for the agency's [Pacific] Region, headquartered in Portland, Ore. . . ." It's in that position that he retired from public service in 1989. To get there, Stuecke wended his way working in nearly every sort of job imaginable in the Fisheries Program of the U.S. Fish and Wildlife Service, from cleaning raceways and fish traps, to conducting leading-edge scientific research related to fish blood. At the end of his career, he directed fisheries management in the Pacific Northwest that was confounded by immense biological problems, coupled with enormous competing interests. From the accounts of colleagues, Stuecke always worked for the good of the fish, always based on science.

Stuecke grew up near Rome State Fish Hatchery, born to a father who loved hunting and fishing. Father and son enjoyed angling for walleye on Oneida Lake, and Stuecke says as many conservationists do, that these early experiences had a profound influence on him. A move to Alexandria, Virginia, would also prove profound.

The Stuecke family resided next to the Topel family. Hubert C. Topel had a daughter named Joan. The senior Topel had a high-level management job with the U.S. Fish and Wildlife Service headquarters. He worked in the National Fish Hatchery System, the chief of its division of maintenance and construction. Joan Topel became Joan Stuecke. The triangulation—the relocation, Joan's father, and an abiding interest in conservation—located Stuecke in a fisheries career.

Following a 1954 discharge from the Navy, Stuecke attended the University of Montana, earning a degree in fisheries management. Summers and semesters off school, he worked at Yellowstone National Park when the U.S. Fish and Wildlife Service had a National Fish Hatchery and a significant research presence at the park. He worked with the Yellowstone cutthroat trout,

a fish found in nature only in the Yellowstone area.

Stuecke has committed to paper, musings on the people and places and events that unfolded while at Yellowstone—it's about bears and beer and boats badly in need of repair. It's amusing and insightful. The 60 pages of yet-to-be completed manuscript are at its heart about a man's love for his chosen profession.

Stuecke's autobiographical work will eventually tell us more about his meanderings, and his experience at a place where I also worked, but at a time when I was a mere preschooler, Ft. Apache Indian Reservation, in Arizona. Stuecke worked there for another pioneer in fisheries management, Jack Hemphill (see *Eddies* winter 2008), at what is presently called the Arizona Fish and Wildlife Conservation Office. He set up fishery management plans, and innovated the use of economic data and statistics, and even traffic counters to direct fish stocking.

From Arizona, Stuecke would head back north, and spend most of the rest of his career in the northern-tier states. He hired on at the former Lake Mills National Fish Hatchery in Wisconsin, and like many in his day, he attended a year-long course in fish culture and nutrition at the U.S. Fish and Wildlife Service's former training center in Cortland, New York, and another year of training at Leetown, West Virginia, finishing in 1963.

By 1966, Stuecke worked at the LaCrosse Fish Control Lab, in Wisconsin, staying on three years. It was there that Stuecke developed surgical techniques—techniques still used today to safely and humanely open fish. At LaCrosse, he researched elements of fish blood, studying largemouth bass, brook trout and brown trout, publishing numerous papers in the scientific literature. A survey of the literature reveals that scientists still cite his work as reference matter—44 years later. Stuecke's name lives not only in the scientific literature, but also in the U.S. Patent and Trademark Office, having patented techniques of using anesthesia on northern pike, muskellunge, and walleye. Stuecke secured the patent for the U.S. Fish and Wildlife Service.

Washington, DC, is a long way from Yellowstone, but Stuecke went there to work in headquarters. There, he dealt in dollars, heading up the budget office for the Fisheries Program. Knowing how fish work inside and out and the machinations of the bureaucracy inside the Beltway would serve Stuecke well at his next stops in Montana and Oregon, where he closed out his career.

Stuecke is like many other pioneers in fisheries conservation his age. He saw fish feed go from horse meat to scientifically formulated diets. Fish health rose in prominence in the profession, much to his doing. A life-history is hard to cover in a two-page magazine story, so we'll have to wait for the completed autobiography. It promises unvarnished looks at the past, a time that he lived where fisheries conservation moved from art toward science, a time when innovation was rampant, and Stuecke a participant. ✦

Stuart Leon, Ph.D., is the Executive Editor of *Eddies*, and Chief of Fisheries and Aquatic Resource Conservation in Arlington, Virginia.

Courtesy Wally Stuecke

Wally Stuecke holds daughter Karen during a break at work, circa 1963.

Courtesy Wally Stuecke

Some of Wally Stuecke's most notable work was done at the bench, seen here performing a surgical procedure on a largemouth bass. His research was published in scientific journals in the early 1960s.

Warblers in the Water

By Richard Christian

If you live near a clear-flowing creek anywhere from Colorado to New York, or Minnesota to Louisiana, chances are fair that you live near one of these colorful and exciting darters. Even the tiniest brook in your back yard might be a habitat for what are arguably the most colorful of fishes on the continent.

They look like a walleye—only dressed up for Mardi Gras. Warblers enliven the skies in the bird world. Underwater, the darters brighten the riffles. At first glance, they look worthy of a coral reef fishery. Truth is, you don't have to go that far to see the wonderful workings of nature, as these fish swim in your home streams.

Darters are aptly named for their swimming behavior. They cling close to the bottom of streams, and dart about from lair to lair, often in the fastest flowing water, the chutes and riffles where streams are steepest. Their form follows function, and it's their body shape that allows them to take up a niche where other fishes their size would literally be washed away. Darters have really big fan-shaped pectoral fins and a large head. It's the force of the water pressing down on these body parts that keep the fish in place. Most darters also lack an organ called a swim bladder that other fish species use for buoyancy. Bottom-dwelling darters don't need a swim bladder, and most don't have them.

Darters are native only to the North American continent. There are about 150 species swimming waters east of the Continental Divide (you won't find them native west of the Divide). Another 25 darters remain to be described and given a formal name by science. Eighteen darters are either federally threatened or endangered. Except for the minnow family, the darters are the most numerous group of freshwater fishes.

Here's a look at three of the most common, and certainly among the most colorful of American fishes, the greenside, orangethroat, and rainbow darters.

Rainbow darter

You couldn't pack more color into two inches of fish. Its scientific name speaks to color, *Etheostoma caeruleum*, meaning "shades of blue." It's so much more than that. Few of the darter species are as striking to look at as the rainbow darter.

You'll find this fish in little creeks to small rivers from Louisiana and Mississippi north to southern Ontario. They are common in clean creeks of the Ohio, Mississippi, and upper Potomac rivers.

Rainbow darters take up station over a rocky bottom with a moderate gradient and flow. It's there that they forage for caddisfly and mayfly larvae, lamprey eggs, tiny snails and very young crayfish. Rainbow darters spawn in spring, and females lay their eggs, up to 800 of them, where riffles tail out into pools.

Greenside darter

Constantine Rafinesque, the first professor of natural sciences west of the Alleghenies, laid eyes on a greenside darter from the Ohio River, during a float he made in 1817. Rafinesque had emigrated from Sicily, where he'd collected its local fish fauna. The professor thought this new species of fish looked much like the blennies of the Mediterranean Sea. He put the name blennoid, meaning "looks like a blenny," on the new darter. Today, science knows the fish as *Etheostoma blennioides*.

The greenside darter, growing up to six inches long, is among the largest of all darter species (the logperch grows to eight inches). This big darter lives in big creeks to medium-sized rivers from eastern New York to Michigan's thumb, south to Alabama and westward to northeast Oklahoma. While they have a decided fondness for flowing waters, they do live to a lesser degree on rocky lake shores, like that around the islands in western Lake Erie. But there, their numbers have greatly diminished in the face of the invasive round goby, also a bottom dweller.

The greenside darter spawns in the spring when the water warms to about 50 degrees. And like the warblers in the bird world, their colors intensify at breeding time. A male greenside is washed the color of a crabapple, strikingly banded with seven bars, flecked with orange-red dots on top, and often with a neon-orange dot at the base of the tail fin. It's the gravel and rubble-strewn riffles that these fish take to, and where there is filamentous algae around the rocks, that's where they will lay eggs. Females drop a few eggs at a time. The fertilized eggs stick to whatever they land on and hatch in 18 days, while the male stands guard. The young reach 60 percent of their maximum length by their first year, and live up to five years.

Darting among the riffles, the greenside darter dines on caddisfly and midge larvae.

Joe Tomelleri

Name any color, tone, tinge, or hue, and you can find it on a darter at breeding time. Top to bottom: orangethroat darter, greenside darter, rainbow darter.

Orangethroat darter

The Swiss-born American naturalist Louis Agassiz was first to scientifically propose that planet Earth had experienced an ice age. Seventeen years later in 1854, Agassiz proposed the orangethroat darter as a new species of fish, calling it *Etheostoma spectabile*, meaning "conspicuous." A colorful breeding male is just that. Moreover, the orangethroat darter is conspicuous in the scientific literature, too. It is well-studied owing to the fact it has been known for so long, and that it lives over a great swath of American landscape, from southeast Wyoming, to eastern Kentucky.

Life in a riffle may seem harsh, but that's not so. These little fish have a decided advantage living there. Plant material gathers or grows in the rocks, and so do the tiny bugs that eat the vegetable matter. Plants feed bugs, and those bugs become darter food. The water in the riffles is either too fast or too thin for big predatory fish, so all the more reason to hang out where the water flows fast. They may look a bit comical with their oversized pectoral fins, but they serve them well. Given their preference for swift waters and rocky bottoms, darters are particularly sensitive to siltation that smothers their rocky lairs, the spaces where they live, eat, and reproduce. ✦

Richard Christian grew up near greenthroat darters in west Texas, but now lives near rainbow darters in Maryland. He's the Deputy Executive Editor of *Eddies,* and Chief of Partnerships and Communications for the Fisheries Program at its headquarters in Arlington, Virginia.

By Rick Smaniotto

Backyard Ponds Grow Razorback Sucker

Private-public partnerships advance endangered fish conservation

Rick Smaniotto/USFWS

Razorback sucker grow here, the Beswick Gravel Pit Pond, near Grand Junction, Colorado.

It's an odd-looking fish, reclusive and rare. The razorback sucker is one of four fishes native to the Colorado River system that are currently listed as threatened or endangered by the Endangered Species Act. The others—the Colorado pikeminnow, humpback chub, and bonytail—share not only unusual names, but also a multitude of threats to their existence. The razorback sucker, however, benefits from partnerships with an unlikely set of allies and cooperators that are helping to nudge the species down the road to recovery.

The U.S. Fish and Wildlife Service's Colorado River Fish Project Office (CRFP) based in Grand Junction, Colorado, implements the Upper Colorado River Endangered Fish Recovery Program. Along with partners, the CRFP monitors populations of these endangered fishes, and strives not only to improve habitat, but also reduce threats to the species, such as removing and relocating non-native fish that prey on the imperiled native fish. Increasing the populations of the endangered fish in the Colorado and Gunnison rivers is a desired outcome. Achieving natural, self-sustaining populations of endangered fish so that they no longer require protection under the federal Endangered Species Act is the ultimate goal. Captive breeding of the razorback sucker is one such step toward reaching that ultimate goal.

The captive breeding operation includes the use of a dozen or more grow-out ponds scattered throughout the Grand Valley of western Colorado. Your conventional hatchery has most of its physical structure in

one place—its tanks, ponds, raceways and support buildings are all found in one locale. The "hatchery" conducted by the CRFP is different, raising razorback sucker in a variety of ponds in all shapes and sizes from one end of the valley to the other.

In 1991, the razorback sucker was listed as endangered after almost 30 years with little evidence of successful natural spawning. Over time, biologists found fewer and fewer young fish. At the same time, they noted the numbers of adult fish in the wild declining significantly. To prevent extinction, two new facilities were developed, one at the Ouray National Wildlife Refuge in Utah and the other, the Grand Valley Endangered Fish Facility in Grand Junction, Colorado, with accompanying broodstock ponds located within the Horsethief Canyon State Wildlife Area in nearby Fruita, Colorado. The latter facility was created from an old Bureau of Reclamation warehouse, while the accompanying broodstock ponds were built specifically for propagation purposes in the wildlife area.

But these facilities were not enough. A call went out in search of private landowners who would be willing to lease the use of their ponds to raise the endangered razorback sucker. The call was quickly answered, and the requests came pouring in—some people even volunteering the use of their backyard basins to help recover the razorback sucker. It was an eclectic mix—ranchers and real estate developers, environmentalists and construction companies—that offered up their waters.

These newly acquired ponds act as stepping-stones on a walk toward life in the river. They give the fish an opportunity to adjust to life on their own before ultimately being released into the muddy and malevolent Colorado, Green, and Gunnison rivers. The fish learn to naturally forage on invertebrates and other plant material lying on the pond bottoms. Their immune system strengthens, providing additional defense to external parasites and pathogens found in the wild. And finally, the fish are allowed ample opportunity to flourish, up to six months and sometimes longer, in a relatively competition- and predator-free environment. As a result, these private ponds frequently turn out fatter, more robust fish, better fit to survive life in the wild.

The ponds themselves are a rather motley assortment of old abandoned gravel pits, swimming holes, and farm ponds scattered from Palisade, Colorado, on the east end of the valley to Fruita on the west. They range in size from half an acre to over 15 acres. Irrigation runoff, groundwater, and direct draw from the valley's extensive canal network feed them. The ponds are as varied as the people who offered up their use. Some are deep and vegetation-free, others shallow and overgrown with aquatic flora. A handful require supplemental aeration to keep oxygen in the water for fish to breathe, while others depend upon carefully calculated applications of aquatic herbicide to control excessive algae and plant growth. And yet others need supplemental food and nutrients to stimulate increased growth and kick-

Michelle Shaughnessy/USFWS

Despite easy car access, harvesting fish is confounded by pond-side vegetation.

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The "razorback" behind the fish's head is thought to be an adaption to life in fast-flowing water.

The Upper Colorado River Endangered Fish Recovery Program is a voluntary, cooperative program whose purpose is to recover the endangered razorback sucker, humpback chub, bonytail, and Colorado pikeminnow while water development proceeds in accordance with federal and state laws and interstate compacts. For more information call Michelle Shaughnessy, 970-245-9319, ext. 19, or visit www.coloradoriverrecovery.org.

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Rick Smaniotto (l) and Michelle Shaughnessy put PIT tags in razorback sucker before releasing them into the Colorado River.

start the food chain. It's an incredibly dynamic and diverse system that requires constant attention and careful consideration by biologists.

Getting fish out of the water and into the river is another variable from pond to pond. In the larger, deeper, and un-drainable basins, nets with long mesh leads stretching to shore guide fish into a baited trap, and are checked throughout the week during harvest time. Fish that manage to elude the nets simply fatten up another year.

Ponds that can be drained are slowly lowered over a couple days each October, gradually congregating the unsuspecting fish into the remaining water at the deep end of the pool. At that point cautious biologists slip into neoprene chest waders and enter the frigid wallow, large seine in tow, and wrangle the reluctant razorback sucker towards their new home. Every fish is gathered, and the pond left to dry over the winter months, the entire process starting anew come spring.

Post-razorback-roundup, there's a quick stop back at the shop where each fish is weighed, measured and tagged with a tiny Passive Integrated Transponder, or PIT tag. These PIT tags hold a unique code that allows biologists to monitor individual fish throughout their development over time. Once tagged, the whole writhing mass is moved to the river's edge and sent swimming on their way downstream. It's yet one more new beginning for this ancient species edging toward recovery.

The work seems to be paying off. Last spring, biologist caught about 600 stocked razorback sucker in the Colorado and Gunnison rivers. Roughly one-sixth of those fish had survived in the river for more than a year, and half of those fish were in spawning condition. Larval fish have

been showing up too, a bellwether sign that fish are spawning and eggs are hatching. It's a success story that owes as much to the tenacious and resilient razorback sucker as it does to the eclectic mix of pond-owner conservationists who answered the call for help many years ago. ✦

Rick Smaniotto is a Fishery Biologist at the Grand Junction Colorado River Fish Project, Grand Junction, Colorado. He's an avid outdoorsman and adventurer, and recently traveled to Antarctica for two months to help study penguins around the Palmer Archipelago.

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Biologists pull a seine through Horsethief Broodstock Pond.

Rick Smaniotto/USFWS

Razorback sucker grow out in ponds of various sizes and shapes, such as this irregularly shaped Feurborne Gravel Pit Pond in Grand Junction, Colorado.

By John Bryan

Cruising for Atlantic Sturgeon

Multi-agency field work yields valuable data for an imperiled fish

On a winter night in 2002, a 60-year-dormant bomb is snatched from the floor of the Atlantic. Also in the research net—now hanging above a half-dozen smiling scientists on the deck of the Oregon II—is an Atlantic sturgeon. Dr. Wilson Laney's smile fades as he eyes the barnacled object. The crew stopped shaking the net.

Dr. R.A. Rulifson/ East Carolina Univ.

An otter trawl on the Oregon II snared this World War II-vintage aerial bomb off the North Carolina coast while trying to catch Atlantic sturgeon.

Just 400 years ago Atlantic sturgeon were so plentiful that Native Americans "rode" them. Just 115 years ago our economy included a seven-million-pound harvest. By the 1920s the harvest was 22,000 pounds. Now there is a coastwide moratorium on commercial and recreational harvest.

Thus, Wilson Laney is interested in tonight's sturgeon. But Laney's B.S. degree from Mars Hill, and M.A. and Ph.D. from North Carolina State University, and fisheries career—including now being the South Atlantic Fisheries Coordinator for the U.S. Fish and Wildlife Service—have included no expertise on bombs. "We don't do bombs," is the U.S. Coast Guard's telephone reply.

The Atlantic sturgeon, known to science as *Acipenser oxyrinchus*, is long-lived, slow-growing, and wide-ranging. Its lifespan is 60-plus years. Sexual maturity comes at 6 to 15 years of age, and growth can reach 14 feet and 800 pounds. A single fish's travel can range among the rivers and coastal waters of several states on the Atlantic Seaboard.

Tonight's adventure on the Oregon II is during one of the highly regarded "Cooperative Winter Tagging Cruises" that are populated by a variety of scientists from a variety of agencies studying a variety of fishes. Last year's Cruisers put newly developed acoustic tags—detectable a kilometer away—on 13 Atlantic sturgeon; 12 tags have since been detected. Acoustic tags are also now being used in Georgia's Altamaha River and the information is shared.

What caused the depletion of Atlantic sturgeon? "Historic overfishing, loss of access to spawning and nursery habitat, ship strikes, bycatch mortality, and poaching," responds Wilson Laney. Atlantic sturgeon have survived 80 million years, but the industrial age has introduced the most threatening challenges: dams that block important life cycle ranges, industry and population discards that damage water quality and blanket graveled riverbeds that are necessary for egg viability, and artificial channelization that eliminates vital bays and slackwaters.

Thus, you can see the importance of tonight's single captured sturgeon on the Oregon II.

The U.S. Navy is now on the telephone asking that the bomb's weight and photograph be transmitted. The weight indicates the bomb is likely live. The directive is to lash it to the Oregon II's stern deck, put a water hose on it, and deliver it to the Navy many hours distant. Wilson Laney takes his position on the Oregon II's bow—170 feet from the bomb.

The Cooperative Winter Tagging Cruises are a significant cooperative source of fisheries research. At the 2007 Sturgeon Symposium of the American Fisheries Society, the definitive paper about the Cruises' Atlantic sturgeon captures over the previous eight years was presented under the names of R. Wilson Laney as well as six other researchers: Joseph E. Hightower (North Carolina Cooperative Fish and Wildlife Research Unit), Beth R. Versak (Maryland Department of Natural Resources), Michael F. Mangold (Maryland Fisheries Resources Office, U.S. Fish and Wildlife Service), W.W. Cole, Jr. (South Atlantic Fisheries Coordination Office, U.S. Fish and Wildlife Service), and Sara E. Winslow (North Carolina Department of Environment and Natural Resources). The paper provides information based on 2,819 net-hauls by four research vessels the Oregon II; Chapman; Albatross IV; and Cape Hatteras, that produced 146 Atlantic sturgeon. The multitude of names and affiliations punctuates that fact that these fish are wide-ranging.

The Cruises are just one example of Atlantic sturgeon collaborations throughout the East Coast. One of the most beneficial is the Atlantic Coast Sturgeon Tagging Database—the nation's go-to repository for

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Jessie Thomas-Blate, Atlantic States Marine Fisheries Commission Habitat Coordinator, hangs on to a heavy Atlantic sturgeon captured during a Cooperative Winter Tagging Cruise in February 2009.

information on tagged Atlantic sturgeon—a database that is populated by information on nearly 12,000 Atlantic sturgeon by 31 different agencies from Maine to Georgia.

The PIT tag's history (passive integrated transponder that emits a unique signal like a bar code)—now standard in tagging research—is another example of widespread collaboration. When PIT tags first emerged, they were manufactured by several companies using several frequencies and several types of "readers" to detect the tags. A PIT tag could be detected only if the researcher happened to have a reader of the corresponding frequency by a certain maker. Tagged fish were missed. Collaboration has now resulted in widespread tag standardization. This included the successful recommendation of Steve Minkkinen, supervisor of the Maryland Fisheries Resource Office, that free standardized tags and readers be provided in exchange for data. Minkkinen was the on-site scientist for the highly successful 1996 release of 3,000 juvenile Atlantic sturgeon into the Nanticoke River. Hundreds have been recaptured, up to four times, Minkkinen reports.

Significant cooperative efforts also take place on regional levels. For example manager Kent Ware and his staff at Bears Bluff National Fish Hatchery in South Carolina are studying eight captive wild adult Atlantic sturgeon, collected via the collaboration with the University of Georgia's Doug Peterson. "Partnerships are the best way to go," confirms Ware. "The problem is always the funding, but by working together we can get things done." Dr. Mike Millard, manager of the U.S. Fish and Wildlife Service's Northeast Fishery Center Complex in Pennsylvania, is also working with captive adults. "We've learned how to propagate from egg stage up. We've also been keeping adults alive and are trying to get them to spawn in captivity."

Cooperative Winter Tagging Cruises take place along the coasts of North Carolina and Virginia, but Atlantic sturgeon range from Florida to Maine and have historically used 26 river systems within 5 coastal zones. Researchers are now able, via chemical analysis of tissue samples, to discern which of the 5 zones a sturgeon was born in, and will soon have enough data to determine the specific river. After sturgeon eggs hatch, the juveniles are imprinted in the rivers prior to venturing into the ocean. Genetic research will enable scientists to identify the spawning grounds of ocean-captured sturgeon and will be a catalyst for additional research done by individual geographic areas.

Hours have now passed with no explosion, and as the Oregon II finally approaches the Naval Station, they receive a radio directive to NOT anchor close to shore. A tiny Navy boat sporting a mound of sandbags arrives at the Oregon II and after the bomb is successfully offloaded, the Oregon II heads back to sea.

The metaphor is of course that the same sort of attention, care, collaboration, and time that were given to the bomb is being given to Atlantic sturgeon. Collaborative research—such as the Cooperative Winter Tagging Cruises—is increasing our knowledge.

Why care about the continued existence of Atlantic sturgeon? "We care about biodiversity not just for its own sake, but for the potential benefits it has for all of society," says Mike Millard. "It's just not a good thing to let a species go extinct."

"My long-term goal is to put them out there for people to enjoy and harvest," says Kent Ware. "That fits well with the U.S. Fish and Wildlife Service's goal of managing fish for the people."

The bomb, fortunately for the scientists and crew, turned out to be a memorable artifact of the past and a mightly good story to tell. ✦

By Patricia D. Grant

More Than Just a Plant

Texas wild rice teems with life

Patricia D. Grant/USFWS

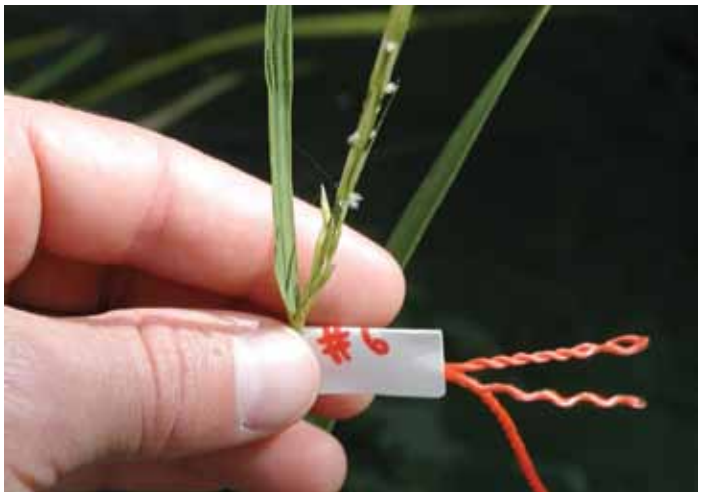
Tubers float by emergent Texas wild rice in the San Marcos River in central Texas.

Picture this. You're in a spring-fed river, underwater. It's a hot, sunny, Texas day and the water is clear and cool—and it's oh, so quiet. The gravelly river bottom is multicolored and smooth, and sparkles as the rays of the sun capture the various minerals, reflecting back their hues and shades. You see crayfish and dragonfly nymphs crawling about, and small fish dart all around you. As you swim, suddenly see long flowing strands of brilliant green fibers. In this peaceful active aqueous world, you could almost imagine the flowing locks of a mermaid passing by.

The mermaid's hair is a field of green underwater grasses that wave as the water flows. It is Texas wild rice. The green locks abound with wildlife: fountain darters hide there. Salamanders search for food around the wild rice roots. Insect larvae hide from the bigger fish looking for a snack, while young fish find protection among the strands. The plant teems with life not its own. The cycle of life swirls about the plant, from roots to stalks to leave and seeds.

Texas wild rice, *Zizania texana*, is an aquatic grass, one of about 20 similar species. But this one is found nowhere else in the world, except in the upper two miles of the San Marcos River, emerging from the highlands between Austin and San Antonio. This wild rice forms large masses of clones that firmly root in shallow, gravelly areas in the riverbed. It is adapted to fast-flowing clean water of a fairly constant temperature the year-round, about 68 to 72 degrees. For half of the year, the plant is completely submerged under water. It does emerge above the water surface to flower between May and November. During this time, the seeds—the rice—mature on the emergent stalks to drop into the river and root somewhere downstream.

Texas wild rice was once abundant throughout the San Marcos River and in Spring Lake. In 1978, it was the first Texas plant to be put on the federal endangered species list. The plant was considered to be a weed—and was treated like a weed. People pulled them from the river by the roots. Federal protection put an end to that. Now, a different threat looms—increased water pumping from the Edward's Aquifer. It lowers the river level, which in turn exposes the wild rice's roots, which already grows in the shallows. Dredging, damming, and riverside construction, they all change stream flows and alter the river in detrimental ways for Texas wild rice. Another factor in wild rice conservation comes from an unlikely source, recreation. The San Marcos River is a draw to swimmers,



Patricia D. Grant/USFWS

The endangered Texas wild rice is raised in captivity at the San Marcos National Fish Hatchery and Technology Center.

tubers, and canoeists. Many people are simply just unaware of the rarity of this plant and that uprooting it or tubing over emergent flowers greatly hampers its survival.

A great number of people are doing what they can to help protect this rare rice species. Here at the San Marcos National Fish Hatchery and Technology Center, we keep a large population of wild rice thriving in the raceways that once raised largemouth bass. We collect seeds to produce more plants, with an eye toward upping their numbers in the wild. We also conduct research to learn more about this plant and its importance in the river. Former U.S. Fish and Wildlife Service botanist, Paula Power, conducted extensive studies on the plant's life history requirements—information essential for future conservation work. Her research was published in several scientific journals.

Botanist Dr. Mara Alexander, continues research and restoration work at the technology center in collaboration with people like Jackie Poole, Texas Parks and Wildlife Department. She has monitored the population of wild rice for over 20 years.

Flo Oxley, Director of Plant Conservation and Education at the Lady Bird Johnson Wildflower Center, found that viable pollen of Texas wild rice can only travel a mere 30 inches. Some plant pollen travels miles and remains viable.

Dr. Robert Doyle of Baylor University has monitored rice populations, as well as numerous other native plants of the San Marcos River.

Valentin Cantu, a fish biologist from San Marcos National Fish Hatchery and Technology Center, and I dive the San Marcos River every three months to monitor and remove an invasive plant, water trumpet, known in botanical circles as *Cryptocoryne becketti*. It's native of Sri Lanka. It's a serious competitor of Texas wild rice. Water trumpet enjoys the same environmental conditions that the Texas wild rice needs, but grows much faster and out-competes Texas wild rice for space. When I first began diving with Val to eradicate "crypto" nearly four years ago, there were well over 1,000 plants, and I thought we would never be able to accomplish such an ambitious undertaking. On our most recent dive, in December 2009, we found only five plants.

Patricia D. Grant/USFWS

Below the surface, the long green strands wave in the water like wet hair. These emerging plant parts are about to seed, and grow new plants downstream.

Tubing or canoeing down a river is not very exciting when there is nothing to see but gravel and silt. Texas wild rice may not be glamorous or evoke strong emotion, but the long, flowing green fibers have their place, and that place is quite evident when you get underwater. The Texas wild rice teems with life. ✦

Patricia D. Grant is a Biological Science Technician at the San Marcos National Fish Hatchery and Technology Center, San Marcos, Texas. She's been an avid SCUBA diver for 23 years, and a lover of things aquatic since the age of 6.

By Aimee Roberson

A Little Fish in Big Bend

Rio Grande silvery minnow showing signs of reproduction in Texas

The Rio Grande silvery minnow flashes silver in sunlight, but it's no trophy fish. Too small in size to be of interest to anglers, the silvery minnow is a little fish with a big story. At one time, the silvery minnow swam in large schools and was one of the most common fishes in the Rio Grande from Española, New Mexico, to the Gulf of Mexico. But the Rio Grande was bigger then, *más grande*. Today, the silvery minnow is an endangered species, and until recently, existed in only seven percent of its historic range near Albuquerque, New Mexico.

The silvery minnow's absence from most of its historic range reflects the fact that the Rio Grande where the silvery minnow once thrived, suffers. The story of the Rio Grande and its silvery minnow is similar to stories all over the world, where people take water out and put pollutants in, dam or otherwise alter natural flows, and manage rivers in a way that is not sustainable. Healthy rivers support life; they provide clean water and abundant fisheries, and buffer people from flooding. However, people have taken their toll on the Rio Grande—it is fundamentally different than the wild, free-flowing river it once was. Many species, including the silvery minnow, have declined.

In the current chapter of the silvery minnow's story, the U.S. Fish and Wildlife Service returned it to its former home in the Big Bend reach of the Rio Grande, taking a critical step toward the fish's recovery. The Big Bend reach flows through the heart of the northern Chihuahuan Desert, surrounded by nearly three million acres of public and private conservation lands in Texas and Mexico. The river courses through Big Bend National Park and is the essence of the 196-mile-long Rio Grande Wild and Scenic River.

Given the silvery minnow has not been found in the Big Bend reach since 1960, biologists must look

Jason Remshardt/USFWS

Laden with ripe eggs, this Rio Grande silvery minnow likely contributed to the recent finding of fertilized eggs in Big Bend.

Aimee Roberson/USFWS

Dr. Gary Garrett, Texas Parks and Wildlife (l), and Dr. Robert Edwards, University of Texas-Pan American, try to catch Rio Grande silvery minnow in the fish's namesake river near the confluence of Terlingua Creek in Big Bend National Park.

at how the river has changed. To understand the changes, biologists work with experts on the river and the fish and also with people who manage the river's water for human uses. A path to recovery for the fish will meet the needs of people who also depend on the river. It's an enormous challenge.

By the time the Rio Grande flows from southern Colorado, through New Mexico and El Paso, Texas, there's not much water left due to diversions for agricultural and municipal use. Most of the water that flows through the Big Bend reach is from the Rio Conchos which enters the Rio Grande from Mexico near Presidio, Texas. As the river has diminished in size, it has become narrower and deeper and the diversity of aquatic habitat in the river has also diminished. In particular, there are less shallow areas with slow moving water. These areas produce plenty of algae and provide nursery habitat for the silvery minnow.

The Rio Grande silvery minnow releases its eggs directly into the water to incubate as the flow carries them along. One female can release thousands of tiny eggs in a 12-hour period. Fertilized eggs swell to about 3 millimeters and look like clear tapioca pearls. But few eggs are likely to produce minnows. Eggs that eddy out into high quality nursery habitat have a good chance of surviving to become larvae and then juveniles. Many eggs will be eaten by predators or perhaps hatch in areas where there is not enough food to support larval fish. Because there are usually plenty of eggs produced, the limiting factor for the silvery minnow seems to be high quality habitat that supports the growth of the fish. The U.S Fish and Wildlife Service continues to work with partners to improve the health of the river in New Mexico and in the Big Bend reach.

Raymond Skiles/NPS

Bill Williams (l) and William Knight, Dexter National Fish Hatchery and Technology Center net Rio Grande silvery minnow to be released in Big Bend National Park.

We know how to catch silvery minnow eggs in the Rio Grande in New Mexico, where there is still a wild population. We know how to take those eggs and raise healthy fish in captivity. And we have all the equipment we need to move fish from one place to another. But returning an endangered species to its former range is not that simple. Sometimes people are uneasy about reintroducing an endangered species because they are concerned that certain activities could be hampered

by regulations designed to protect these species. Returning the silvery minnow to Big Bend involved talking to people, listening to and addressing their concerns, assessing the potential effects of the reintroduction, and a lot of paperwork.

The Rio Grande Silvery Minnow Recovery Team identified the Big Bend reach as the first priority for reestablishing the silvery minnow. Beginning in 2004, guided by the Endangered Species Act and the National Environmental Policy Act, the U.S. Fish and Wildlife Service met with numerous representatives of state and federal agencies, non-governmental organizations, private landowners, and elected officials, all interested in the proposal to put silvery minnow back in the Rio Grande.

At long last, in December 2008, 425,000 silvery minnows travelled several hours in large trucks from the Dexter National Fish Hatchery and Technology Center, and Albuquerque's Rio Grande Silvery Minnow Breeding and Rearing Facility, both in New Mexico, to Big Bend. Work didn't stop there. So far, nearly one million silvery minnows have been released in the Big Bend reach on lands public and private—Big Bend Ranch State Park; Big Bend National Park; and the Adams Ranch del Carmen, a privately-owned conservation area. And just in time for Mother's Day, genetic tests performed at the University of New Mexico confirmed that eggs collected in the Big Bend reach in April 2010, are indeed silvery minnows.

The story of the silvery minnow and the Rio Grande is still being written. Recovering an endangered species in a river that is not as grand as it used to be is an enormous challenge. We hope that this story's concluding chapters will tell how the silvery minnow was successfully re-established in the Big Bend reach. For now, we are learning about the fish and what we can do to work toward its recovery. Research, monitoring, and habitat restoration continues, and we are developing recommendations for river flows to support the silvery minnow and life that depends on the Rio Grande.

If we can recover the silvery minnow, it will be because we made the Rio Grande healthier. And in the process, we will have learned a lot about ourselves and how to manage our rivers in a more sustainable way. Wouldn't that make a fine epilogue? ✦

Aimee Roberson is a Fish and Wildlife Biologist with the U.S. Fish and Wildlife Service in Alpine, Texas. She is also a yoga instructor and wellness coach and enjoys being of service to people who are creating holistic health, from personal to planetary.

The U.S. Fish and Wildlife Service does not work alone. The Middle Rio Grande Endangered Species Collaborative Program in New Mexico and the Bureau of Reclamation contribute funds to recover the silvery minnow in Big Bend. Partners in Texas and Mexico include Big Bend National Park, U.S. Geological Survey, the International Boundary and Water Commission, Texas Parks and Wildlife Department, the University of Texas – Pan Am, the World Wildlife Fund, Comisión Internacional de Límites y Aguas, Secretaría de Medio Ambiente y Recursos Naturales, Comisión Nacional de Areas Naturales Protegidas, and the Instituto Nacional Ecologia.

Aimee Roberson/USFWS

The Rio Grande upstream of Boquillas Canyon, inside Big Bend National Park. The villages of Boquillas del Carmen, Texas, and Sierra del Carmen (Mexico) are in the background.

By Jeremy Voeltz

El Coronado Ranch

Collaborative conservation on private lands

Jeremy Voeltz/USFWS

Jason Kline, Arizona Game and Fish Department (l), and Marty Underwood, U.S. Fish and Wildlife Service, beam over finding a Mexican stoneroller in West Turkey Creek.

It's a cool October morning in the Chiricahua Mountains of southeast Arizona mere miles from Mexico. The gentle repetitive beeps from a backpack electrofisher nearly mask the conversation of biologists as they wade through West Turkey Creek on El Coronado Ranch. The beeps warn fishery workers that DC current is pulsing in the water that flows over their waders. The electricity briefly stuns fish, so they may be caught. As they move toward a pool scoured by water pouring over a mass of tree roots, there is suddenly some excitement in their voices and in their actions.

"There they are!" says an excited Jason Kline, a fisheries biologist with the Arizona Game and Fish Department. Water splashes as he quickly moves to sweep the silvery fish into a long-handled net.

The "they" that's enlivened the morning are three kinds of fishes: the rare Yaqui-form of the longfin dace, Mexican stoneroller, and the federally endangered Yaqui chub. All three have a safe home in West Turkey Creek and in several ponds on the picturesque El Coronado Ranch. But, the ranch wasn't always a safe-haven for native fishes.

"What we wanted to do was show ranchers and landowners that endangered species did not have to be a liability."

Yaqui chub and longfin dace were first collected in 1895 from West Turkey Creek, known then as Morse Cañon, by 29-year-old Cloud Rutter. He was a young biologist employed in the U.S. Fish Commission, the predecessor of the U.S. Fish and Wildlife Service, an agency four years younger than he. Rutter and others like him in the Fish Commission cataloged what fishes lived in the West. Over time, what fishes Rutter had found in West Turkey Creek went missing.

Over the next several decades following Rutter's finds, overgrazing, excessive logging, water diversions, and competition from non-native fish species eliminated the Yaqui chub from West Turkey Creek and much of its natural range. The species was listed as endangered by the U.S. Fish and Wildlife Service in 1984.

Something else significant occurred about the same time, Josiah and Valer Austin purchased El Coronado Ranch. The ranchlands were badly degraded from some of the things that also ruined fish habitat. The streams were eroded and severely down-cut. The Austins envisioned running a cattle ranch that mended

Bill Radke/USFWS

The Yaqui chub is an endangered species.

the land—and its waters— something many at the time considered impossible. "It's harder in the short term, sure," Josiah says. "But if you let the land and the species tell you how to ranch, the better rancher you'll become, and the more likely the ranch is to survive in the long run. I want this to be a cattle ranch not just for my lifetime, but for multiple generations, whether it's in my family or not."

Over the last 25-plus years, the Austins have spent well over $1 million to restore ecological health to El Coronado. Over 20,000 stone gabion structures have been built in West Turkey Creek and its ephemeral tributaries to slow down the water and let it seep into the ground. That's repaired grasslands and riparian areas. The gabions trap silt and nutrients, providing a growing area for native vegetation, which in turn attracts wildlife.

In 1986, nearly 100 years after they were first collected, the endangered Yaqui chub was put back into the West Turkey Creek watershed. That could have created a dilemma for the Austin ranching enterprise. Because of the protections found in the Endangered Species Act, ranching at El Coronado could have been stopped if it were damaging the chub.

But the Austins *wanted* the imperiled fish on their ranch."Many people think you should just get rid of endangered species," Josiah said.

Bill Radke/USFWS

A Yaqui longfin dace were caught by U.S. Fish Commission biologist, Cloud Rutter, in the 1890s.

"That is the exact thing I did not want to happen. What we wanted to do was show ranchers and landowners that endangered species did not have to be a liability."

Their conservation resolve would be tested. By the mid 1990s, a suite of non-native fishes had established themselves throughout the ranch, and the Yaqui chub and longfin dace declined. "It would have been easy to let the non-native fish continue to take over," said Josiah, "but that would have meant the loss of the native fish. The late Arizona State University ichthyologist Dr. W.L. Minckley really encouraged us to work with the agencies to restore the native fish community in West Turkey Creek."

That encouragement led to Arizona's first Habitat Conservation Plan, or HCP. It's a voluntary agreement and permit between the U.S. Fish and Wildlife Service and landowners that allows them certain land use, in this case, ranching, that might otherwise affect listed species in a negative way. The 25-year HCP started in 1998, outlined what needs doing to restore the native fishes in the West Turkey Creek watershed while cattle ranching continued. The HCP was very much in synch with the desires of ranch owners.

Since then, a fish barrier built on the lower West Turkey Creek on El Coronado Ranch prevents non-native fishes from swimming upstream. The stream and the stock tanks

Bill Radke/USFWS

The Yaqui catfish looks similar to a channel catfish, but has a different bone structure, and lives in the Yaqui River basin in extreme southeast Arizona and northern Mexico.

Jeremy Voeltz/USFWS

This Mexican stoneroller is a handful, caught from a pond on El Coronado Ranch. The 'horns' on top of its head indicate that it is ripe for breeding.

were renovated with the piscicides rotenone and antimycin-A, non-native fish removed and Yaqui chub, longfin dace, and the threatened Yaqui catfish returned to waters of El Coronado. And finally, in 2007, Mexican stoneroller were transplanted from Rucker Creek in the Chiricahua Mountains to West Turkey Creek. That transplant was value-added, lending the rare nearby Rucker Creek fish population more security.

This native fish restoration project has truly been a partnership with too many individuals and institutions to name them all. The U.S. Fish and Wildlife Service's Arizona Fish and Wildlife Conservation Office monitors the West Turkey Creek fishery in cooperation with the San Bernardino National Wildlife Refuge and the Arizona Game and Fish Department. The Arizona Ecological

Chris Lohrengel/USFWS

A trio of U.S. Fish and Wildlife Service biologists use an electrofisher to catch fish on El Coronado Ranch.

Services Field Office prepared the HCP and has regulatory authority over the HCP. San Bernardino National Wildlife Refuge is one of the few refuges that exists mainly for fishes, and the Yaqui fishes have refuge there. Refuge biologists assist the Austins with their conservation work, which has included emergency fish salvage due to drought. The Coronado National Forest surrounds the deeded El Coronado, and the Austins lease and manage several grazing allotments from the U.S. Forest Service.

In addition to native fish work, the Austins are active in Gould's turkey and thick-billed parrot reintroductions, as well as being gracious hosts for a multitude of research and management projects on El Coronado Ranch, including a 20-plus year study on Sonoran mud turtles, and an annual hummingbird banding project.

The Austin's commitment to conservation has not gone unnoticed. In 2008, they received the "Conservationist of the Year" award from the AZ/NM Chapter of the American Fisheries Society, and the 2008 National Wetlands Award for landowner stewardship.

The beeps from the electrofisher, the splashing water, and Kline's excitement herald things to come. It's good to see those native fish splashing silver in the creek as Cloud Rutter may have seen them 115 years ago.✦

Jeremy Voeltz is a Fishery Biologist with the U.S. Fish and Wildlife Service. He says his work with the El Coronado Ranch has been a most rewarding experience.

Chris Lohrengel/ USFWS

Jeremy Voeltz, U.S. Fish and Wildlife Service, counts fin rays on a Yaqui catfish.

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Rancher Joe Austin receives the 2008 Conservationist of the Year award from the Arizona/New Mexico Chapter of the American Fisheries Society, presented by Marty Underwood, U.S. Fish and Wildlife Service.

By Leith Edgar

Toads on the Range

Fisheries biologists fight fierce fungus to reach breeding record

Fisheries biologist Dave Paddock arrived in 1997 for his first day of work at the U.S. Fish and Wildlife Service's Saratoga National Fish Hatchery in Wyoming ready to spawn trout. Soon after, Paddock found himself a biologist working on recovery of the Cowboy State's most imperiled amphibian: the Wyoming toad.

Although Paddock had no formal training in amphibian husbandry, he went straight to work caring for the first few dozen toads brought to Saratoga for breeding.

"This was pretty much trial by fire; I had no formula," said Paddock who has worked on recovery of the endangered species for more than a decade. "I relied on my fisheries background, which I applied to the amphibians. For me it was a chance to learn amphibian husbandry on the fly."

Paddock soon noticed the toads were prolific egg producers. In order to keep from breeding too many toads, he implemented controlled breeding techniques similar to those used when spawning fish. These basic fisheries principles served as a foundation for the record propagation of Wyoming toads in 2009 at Saratoga NFH, releasing 9,520 tadpoles and toadlets. The total accounted for about 40 percent of all toadlets released last year.

"Not only was 2009 the best year for Saratoga, but it was the best year for the program," Paddock said of the Wyoming toad Species Survival Plan, which guided the release of a record 20,138 tadpoles and toadlets. In the past, toads produced by Saratoga were released into Mortenson Lake National Wildlife Refuge in Laramie, Wyoming. To date, more than 20,000 were released into the refuge.

The Wyoming toad is a species out of place. Scientists believe the species is a glacial relict, isolated from its sister species, the Manitoba or Canadian toad, 10,000 years ago at the end of the Pleistocene epoch. Now, the Wyoming toad population is separated from its ancestors by more than 500 miles.

David Paddock/USFWS

Captive toads at Saratoga National Fish Hatchery.

Over time, the Wyoming species became distinct within its limited range. During the 1950s, surveys indicated the toads were doing well. But in the following decade something changed. The decline in population numbers proved precipitous in the 1960s and 1970s. By 1980, the species was thought by many to be extinct in the wild. The species was listed in 1984 as federally endangered.

The year 1987 brought new hope for the species when a wild population was discovered at Mortenson Lake. The following year the U.S. Fish and Wildlife Service and its partners raced to start a captive-breeding program and learn more about the toad before it went extinct.

Despite the best efforts of many concerned conservationists, the Wyoming toad still faces an uphill battle to a successful recovery.

"Population declines are thought to be a consequence of a number of factors adversely affecting the toads," said Jan McKee, a U.S. Fish and Wildlife Service biologist who has worked on Wyoming toad recovery for more than three years.

"We don't know exactly why the Wyoming toad was fine until the 1960s and then started dying off," she said. "Our unproven hypothesis is that a number of factors converged to create a perfect storm, which has really tested the species' resiliency and challenged every biologist's resolve." Although pesticides, herbicides, irrigation, grazing, drought, predation and climate change have all been attributed as causes of toad population declines, it's the chytrid fungus, first discovered in Queensland, Australia in 1993, that is most often charged as the culprit.

Moreover, chytrid fungus (*Batrachochytrium dendrobatidis*), also referred to as Bd, is the culprit responsible for a worldwide decline in amphibians across six continents (see *Eddies*, Fall 2008). The zoosporic fungus causes a disease of the skin in amphibians. Exposed frogs die from the fungus in 10 to 18 days. Since 1993, chytrid has been found to be ubiquitous and is found on all continents except Antarctica. The fungus is likely spread through many avenues, including invasive bull frogs, the global pet trade and salamanders used as fish bait, McKee said.

At Saratoga, Paddock is constantly on the lookout for the less-than-friendly fungus. Paddock said keeping a close eye on the toads can be the difference bbiletween life and death.

"One of the hardest things is that the toads don't exhibit many symptoms when they're sick," he said. "We monitor them constantly, looking for any signs they may need treatment."

Before treating any potentially infected toads, biologists verify there is a chytrid fungal infection by swabbing the specimen and sending the swab to Dr. Allen Pessier, a pathologist at the San Diego Zoo, for analysis. When the test comes back positive for the fungus, the infected toad is bathed in an anti-fungal solution. The solution includes an active-ingredient called Itraconazole, an anti-fungal drug also used to treat humans.

To ensure the toads remain on an upward trajectory, three annual surveys assess how the Wyoming toad is doing in the wild. Participants comb the riparian ecosystem searching for the diminutive toads to photograph, record weights and test for chytrid. Participants also do the same at two nearby sites on private lands enrolled in the Safe Harbor program. A Safe Harbor Agreement is a voluntary agreement involving private or other non-federal property owners whose actions contribute to the recovery of species listed as threatened or endangered under the Endangered Species Act.

Lee Bender/USFWS

Toad biologist, David Paddock, examines a Wyoming toad held at Saratoga National Fish Hatchery, Wyoming.

Prior to release at Mortenson Lake or one of the two safe harbor sites, Saratoga's toads reside in aquariums. Each aquarium is one-third water and two-thirds dry with a basking light for heat. Typically, eight toads share an aquarium and are fed crickets or worms.

Meeting the toads' needs is all in a day's work for Paddock, who continually refines his amphibian husbandry skills. His ever-improving skill set is, in large part, responsible for much of Saratoga's record setting toad propagation—not bad for a fisheries biologist who learned Wyoming toad recovery "on the fly." ✦

Leith Edgar is a Public Affairs Specialist at the U.S. Fish and Wildlife Service's Mountain-Prairie Regional Office in Lakewood, Colorado. Edgar served for five years in the active-duty Army with time spent overseas in Japan, Iraq and South Korea. When not communicating conservation, Edgar runs the streets, parks and natural spaces of metro Denver.

By Doug Aloisi

Rocks with Guts

Rebuilding endangered mussels in the upper Mississippi River

M.C. Barnhart/Missouri State University

These grub look-alike lures are full mussel larvae. Suspended in the current by a thread, they entice this orangethroat darter to bite down and rupture the packet, transferring the larvae to the fish's gills and skin.

North America once owned a rich diversity of freshwater mussels. At one time, over 300 species lived in our lakes and streams. More than just "rocks with guts," these valuable members of the freshwater community stabilize streambeds, and are living water-filters. Each adult mussel filters 8 to 10 gallons of water per day, effectively cleaning many suspended solids and pollutants from our waterways. But America's mussel populations are in big trouble. Through habitat destruction, poor water quality and aquatic invasive species, scientists estimate that 43 percent of those 300 species are in danger of extinction.

That makes locating in the wild the two federally endangered mussel species in the upper Mississippi River

as rare as finding a mint-condition $20 gold piece.

The winged mapleleaf mussel is confined to only fringes of its former range: select waters of Wisconsin, Minnesota, Missouri and Arkansas. It's endangered, and greatly reduced in number, but the trend is hoped to change.

The other rare animal is the Higgins eye pearlymussel. It's been listed as an endangered species since 1976. Its plight became even more critical with the invasion of non-native zebra mussels into the Mississippi River basin. At one point, the Higgins eye pearlymussel was one among 27 mussel species found in the rich mussel bed of the east channel of the Mississippi River at Prairie du Chien, Wisconsin. Surveys showed that from 1996 to 2000, the mussel bed became much less diverse. Only seven species had survived, and the Higgins eye pearlymussel was not among them. Zebra mussel shells had encrusted the rich native mussel bed in a layer nearly two feet thick in places.

A team of mussel biologists from the U.S. Fish and Wildlife Service, Army Corps of Engineers, U.S. Geological Survey, state conservation agencies of Minnesota, Wisconsin, and Iowa, and academic interests combined their expertise to save the Higgins eye pearlymussel. The team approached the Genoa National Fish Hatchery to raise the mussel in captivity—and our biologists have done just that.

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This Higgins eye pearlymussel mantle resembles a fish, enticing would-be fish-eating predators to come for a closer look—and get a mouthful of larval mussels.

USFWS

This winged mapleleaf mussel is open, filtering water.

More than just "rocks with guts," these valuable members of the freshwater community stabilize streambeds, and are living water-filters.

USFWS

In shop-talk, they call it "pollywogging." This U.S. Fish and Wildlife Service biologist snorkels Indiana's Fish Creek, counting mussels.

Every spring since 2000, gravid Higgins eye pearlymussel females have been collected in the wild, and about 9,000 walleye, largemouth bass, and smallmouth bass have been infested with mussel larvae, also called "glochidia." Glochidia parasitize fish until they are ready to survive and grow on their own.

Each year, up to 3,500 of the host fish infested with Higgins eye pearlymussel glochidia have been released to face the rigors of the wild in three rivers, the Wisconsin, Iowa, and Wapsipincon, all tributaries of the Mississippi. It's up to nature as to where the young mussels drop from their host fish. The remaining fish are placed in cages, not so much to retain the fish but to protect the mussels as they fall off and mature. As they get bigger, the mussels are marked and stocked in the wild with the intent of establishing five new populations. Since 2003, over 36,000 adult and sub-adult mussels have been stocked into the wild. About 9,000 sub-adult Higgins eye pearlymussels from the

USFWS

Biologists from Genoa National Fish Hatchery clean the crust of a zebra mussel infestation from native mussels in Wisconsin.

2008 year-class are set to be stocked out in fall of 2010 from the cages.

In the fall of 2003, researchers from the U.S. Fish and Wildlife Service's LaCrosse Fish and Wildlife Conservation Office, the U.S. Geological Survey, and Macalester College, Minnesota, made a breakthrough, discovering the host-fish species for the winged mapleleaf mussel. Genoa was called upon to breed this rare mussel as well.

Each year, divers collect gravid female winged mapleleaf mussels within a narrow window of time in September. The mussels are then taken to Genoa National Fish Hatchery where they are held until the glochidia are expelled. The species' natural host, channel catfish, plays host at the hatchery. In temperature-controlled tanks, the water is cooled in the winter and warmed in the spring to mimic what

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The endangered Higgins eye pearlymussels are among the tray of mussels, harvested from a cage that was pulled from the upper Mississippi River.

USFWS

A parasite needs a host. Mussels use many interesting adaptations to lure their fish hosts close by. This mussel has a modified mantle flap resembling a small fish.

M.C. Barnhart/Missouri State University

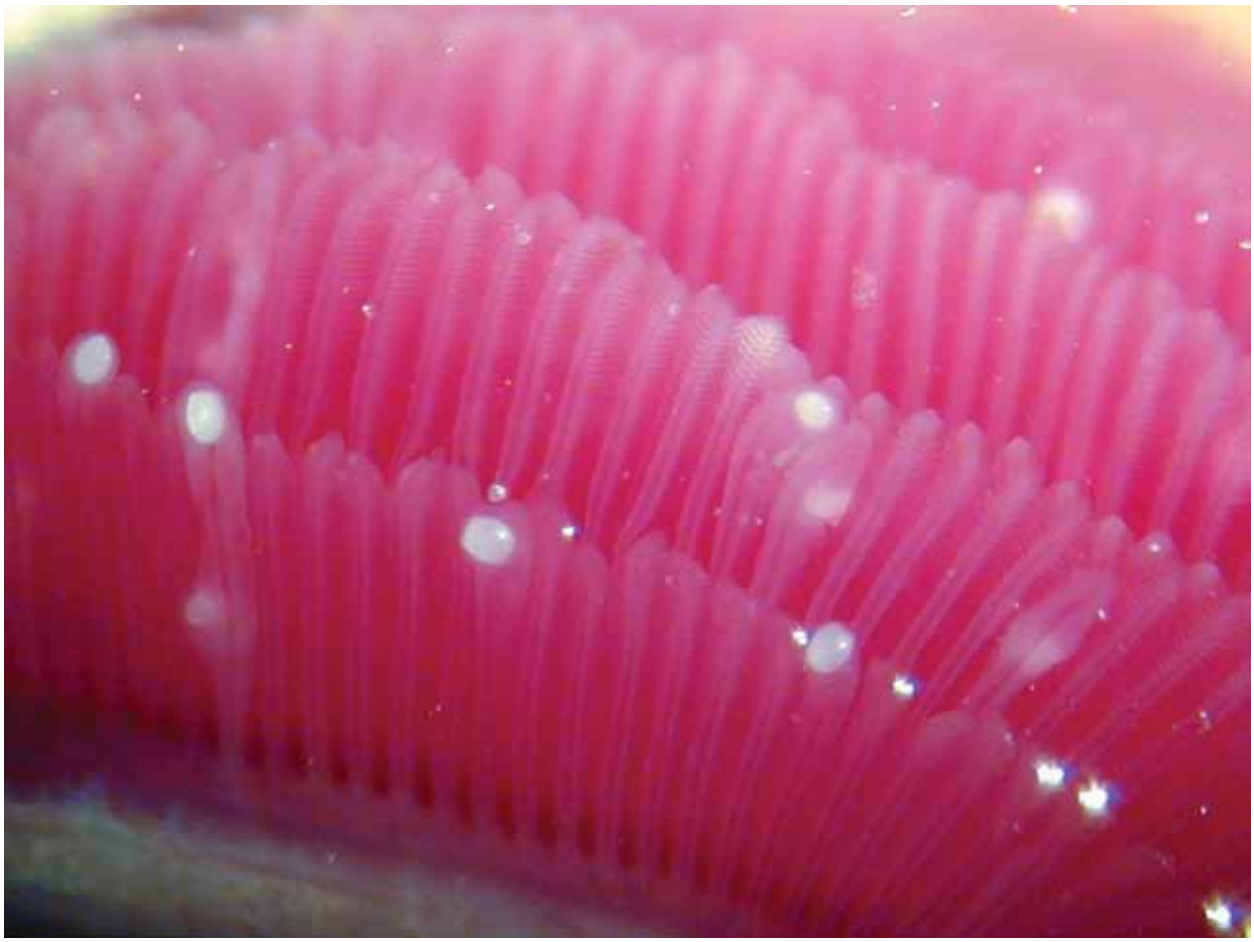
Mussels feed other animals. This pile of empty mussel shells, also called a "midden," was left by a mammal. Raccoon, muskrat, or otter find food between the clam shells.

the fish and growing mussels might face in nature.

By October of 2006, Genoa biologists turned out 25 winged mapleleaf mussels 0.4 to 0.8 inches long, marking the first captive breeding of this rare mussel species. Three year-classes of winged mapleleaf mussel have been bred at the National Fish Hatchery to date. These young mussels will stay the summer in captivity, and are slated for release in the fall of 2010. At present, more than 250 channel catfish are infested with about 125,000 glochidia, awaiting their time to be released in the wild.

Assessments of the free-releases of host fish holding Higgins eye pearlymussels in Iowa tributaries have turned up 10 young mussels. With a high natural mortality rate in the first year of life and a large potential habitat, locating them is difficult to say the least. So, finding one is akin to a gold piece, an exciting and welcome find, and priceless beyond face value. ✦

Doug Aloisi is the manager of Genoa National Fish Hatchery. When not turkey hunting or watching his kids' sporting events, he assists his amazing crew conserving aquatic species in one of the most fascinating and diverse ecosystems in the country.

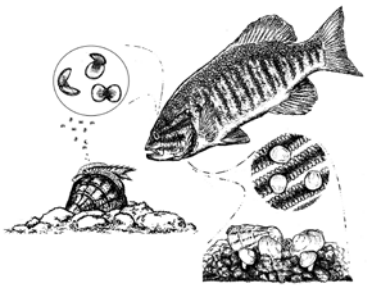


M.C. Barnhart/Missouri State University

Above: Mussel larvae, or glochidia, parasitize a fish's gill. Mussels need certain species to parasitize, not just any fish will do. It is not common for host-fish to perish because of the parasites.

Right-top: This illustration shows how mussels need fish to complete their life cycle. A smallmouth bass is drawn to a lure, the larvae are expelled and attach to the fish's gill where they feed on the fish's body fluids until developed enough to feed on their own. Young mussels fall off the host fish and live on the stream bottom. With the proper habitat, they will mature and continue the cycle, filtering water as they grow.

Right-bottom: Tiny glochidia are expelled from this look-alike grub.



M.C. Barnhart/Missouri State Univ.

M.C. Barnhart/Missouri State Univ.

Meanders

By Craig Springer

The Counsel of Waters

Signs of impending change come in subtle ways. Lengthening days, shorter shadows, and crisp birdsong bending through the air like hot sparks—they all come on subtly, and if you pay attention will tell you that something new approaches. The cold nights of winter yield to a new beginning, and like with each spring before, I'll lament the desire to get outdoors more than I did the year before.

As I grow into middle age, it's hard not to feel wistful about seasons long gone. I've fished across the country—rainbow trout in the North Cascades, Gila trout in the Southwest, brookies in Appalachia. Despite these many wonderful experiences, it's the counsel of waters pouring down a little southern Ohio creek that I still seek, if only behind my eyelids.

Every kid deserves a creek, and I'm sure glad I had mine. I grew up on the Ohio-Indiana line where the till plains flatter than a frying pan meet the glacial moraines. The gentle undulating hills are checker-boarded with cornfields and pastures and woodlots. My brother Gary and I fished Indian Creek, and got an early education catching anything that would bite. That usually meant kids' fish, like creek chub and redhorse sucker, whatever would take bits of worm on little golden hooks—even big pig-nosed logperch. Any fish was a fine catch, but landing a pugnacious smallmouth bass, well, that was like playing in the big leagues with Bench and Rose.

I am rapt by a recollection that carries me back more than 30 years to Indian Creek. Fishing was slow, winter had passed and spring was still coming on. Maybe the smallmouth bass hadn't moved upstream from bigger water where they rode the winter. I'd tired of fishing, not being able to draw a strike. My attention turned to fossils in the streambed. Gary charged on, ever determined to catch something. No matter what he was engaged in doing—fishing, algebra, or mowing the grass—he always did it with determination. He walked with a deliberate gait, and the way he ambled down the creek that late afternoon, pausing at every pool, showed his resolve.

He pushed his glasses up once or twice as he looked down, threading his line. He laid a jig in a pool of dark purple water under the filtered shade of bony boxelder branches. I happened to look up at the right time to see a real comedy. He felt a slow take. In his excitement, he set the hook as if he wanted to catch a marlin. His wet boots and a rocky creek bottom sent him staggering. He struggled to stay upright, but a little aluminum tackle box lying open sent him to the gravels, his one side soaked from shoulder to pant cuff. To save face, he blamed me for the spill. I'd left the tackle box where he could step on it, after all. We exchanged jabs, but it was all in fun. He took a pair of pliers to the tackle box and wrinkled it back into shape so it would close. We walked back to his old truck in the ambrosial light of dusk, down a farm lane taking shortcuts through pastures, pushing cud-chewing, slobbering Holsteins out of the way. In our idyll we recounted the day, and made guesses on fish biology for our poor showing. And ever the optimists, we talked about what we would do better next time.

Gary and I got to know Indian Creek. We got schooled in natural history by immersion, adolescence was our practicum. The different fish and bugs and birds that lived in the valley were ours. We got to know the moods of the place that changed season to season. Most importantly, we got to know ourselves and our place in the world as young men do where they come of age. Our time together purchased childhood souvenirs—the kind that only senility can steal. But time evinces new visions. What I could have done better was pay mind to the subtle signs that surfaced, as we grew into men.

That March, 25 years ago now, was exceedingly wet. I remember that sleep didn't come easy because of the rains. Flat raindrops pelted the tar-paper roof, splatting the portico right outside my second-story window. The old two-story house I rented while at Hocking Technical College was an artifact of the former coal-mining industries in Ohio's Appalachian Piedmont. What had housed an affluent family in the early 20th century during the mining heyday, now kept rain off poor college students.

Early one morning, a resonant rap on a cheap hollow bedroom door scared me from a half-sleep. Startled, I asked who it was.

"It's Zach," replied one of my roommates. "Campus police just dropped by to give you a message."

I told him to slide it under the door.

"I can't, Craig," he said plaintively. "Open the door!"

I was vexed and perplexed. It was about 4 o'clock in the morning. I opened the door and I could tell by Zach's face as he stood atop the stairwell in his underwear that something was seriously awry.

"Craig, I got some bad news," Zach said awkwardly. "A campus cop said there was a death in your family, and you should go home right away."

I went dizzy with dread. Questions ripped through my head. Zach stood there wide-eyed and pale. It wasn't easy for him.

Backlit by a distant street lamp, rain poured down my neighbor's kitchen window like thin drams of mercury. The dial on her dirty-yellow rotary wall phone spun torturously slow. The phone pulsed *teh-teh-teh-teh-teh* in my ear. The last number sent the call clear across southern Ohio. All of eternity seemed compressed in the moment. The phone rang once. Seconds later my dad, the man with a spine of steel, told me in a quivering voice that my brother was dead.

March is a wicked month. It's the year's fulcrum. It heaves winter into spring, and is never quite either one. The coming season will leaven the pallor of March. Summer in earnest will let go the colors of the sun. Those gentle undulating hills made by a Pleistocene winter will be spattered like the colors of bright church window glass.

I can see it all in the scraps of memory that flicker behind closed eyes. Sooty clouds lift on a bruised-orange horizon. Yellow-breasted chats embalm the sky with audible incense. The morning sun warms my face, and the close air is damp with dew. Gigantic gray-green sycamores sewn into the banks lean over the pools of purple water as if they have a yen to see who's coming upstream. I look down a hill to see my own teen-age self. There I am with Gary at the bottom of the valley, looking up at him. A smile is fixed on his face and there's wet sunshine in his hazel eyes.

Gary showed subtle signs of distress as a teenager, I can see clearly now. He ended his own life not yet in his prime, a time when there's still a lot of boy left in a man. Left with a poverty of understanding of how he could be so desperate, I tried to get inside his head. I never could. His cryptic note, the last words he scrawled before walking out the kitchen door offered no explanation. Somewhere beneath the blue ink was an answer, but some things, I am resigned to say, are simply unknowable. The riddle remains no more understood than it did in March of '85.

Here is what I do know. The past is not prelude—it's the very matter of tomorrow. Tomorrow will be an amalgam of all its yesterdays. Yesterday and tomorrow clarify one another—and so do these opposites. Without darkness there is no light, and without pain, no healing. Despite the slip of a quarter century downstream, the slog of suicide is still very palpable. But all wounds mend by degrees.

Just as there is no mind-body dichotomy, nature and humanity are not bifurcated. Nature *makes* me human. Science is a roadmap to the truth, but lore lays the path to irreducible truths where certainties are made cogent. These things are certain: I can't undo what's been done. But I have my childhood souvenirs. I have the counsel of waters. Without them, I may have turned to stone.

That old aluminum tackle box that Gary tripped over sits in a box in my garage. It's the only material link I have to my brother. Inside it has the faint, sweet smell of spilled anise oil we used to put on lures thinking it would attract big fish. The trays have a few dry-rotted sunfish poppers, rusty spinners, a scarred Jitterbug, and tangles of line. The keepsake is on the lip of the lid, the wrinkles and the pliers' bite marks from that sacred afternoon on a little creek those many years ago. ✦

Eddies

Reflections on Fisheries Conservation

U.S. Fish and Wildlife Service– Fisheries
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U.S. Fish and Wildlife Service
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Spring 2010

In Refugia

The Texas blind salamander lives only in water-filled caves of the Edwards Aquifer beneath the Texas Hill Country. This aquifer has the greatest species diversity of any known aquifer—over 40 species, most of them as endangered as the salamander. Because the Texas blind salamander is adapted for living in water underground, it has no eyes, and lacks skin pigment. Its red gills pull oxygen from the water. The Texas blind salamander depends on a constant supply of clean, cool water. Pollution and overuse of water caused by the growth of cities threaten its survival and has led to it being listed as endangered under the Endangered Species Act.

This species is one of the 10 threatened or endangered non-fish species held in refugia by the U.S. Fish and Wildlife Service's Fisheries Program. These 'refuges' are isolated facilities where rare organisms are protected, preferably for short periods, but possibly long-term. Biologists keep a population of this rare salamander in refugia at the San Marcos National Fish Hatchery and Technology Center in San Marcos, Texas. It is one of 16 facilities in the National Fish Hatchery System holding 37 species (27 are fishes) in refugia.

Lee Smith/TPWD

Eyeless and otherworldly, the Texas blind salamander is held in refugia by the U.S. Fish and Wildlife Service Fisheries Program.

Here are some other rare animals kept in refugia: Etowah darter, Chattahoochee Forest NFH, GA; greenback cutthroat trout, Leadville NFH, CO; James spinymussle and northern riffleshell, White Sulphur Springs NFH, WV; Delta smelt, Livingston Stone NFH, CA; pallid sturgeon, Gavins Point NFH, SD. ✦

Richard Christian