

Eddies

Reflections on Fisheries Conservation



Eddies

Vol. 4, No. 3

Publisher

Bryan Arroyo, Assistant Director
U.S. Fish and Wildlife Service
Fisheries and Habitat Conservation

Executive Editor

Stuart Leon, Ph.D.

Deputy Editor

Richard Christian

Editor

Craig Springer

Contributing writers

Dale Bast	Carlos R. Martinez
Steve Brimm	Mike Oetker
Kari Duncan	Nicole Osborn
Valerie Fellows	Jan Rowan
Brett Galyean	Randi Sue Smith
Catherine Gatenby, Ph.D.	Judy Toppins
Buddy Jensen	

Editorial Advisors

Mark Brouder, U.S. Fish and Wildlife Service
Ryck Lydecker, Boat Owners Association of the United States
Mark Maskill, U.S. Fish and Wildlife Service
Hal Schramm, Ph.D., U.S. Geological Survey
Michael Smith, U.S. Fish and Wildlife Service (retired)
Denise Wagner, U.S. Fish and Wildlife Service

Assistant Regional Directors – Fisheries

Michael Carrier, Pacific Region
Dan Castleberry, Pacific Southwest Region
Jaime Geiger, Ph.D., Northeast Region
Tim Jennings, Alaska Region
Linda Kelsey, Southeast Region
Mike Oetker, Southwest Region
Sharon Rose, Mountain–Prairie Region
Todd Turner, Acting, Midwest Region

Contact

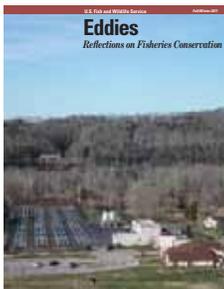
For subscriptions, visit
www.fws.gov/eddies, email craig_springer@fws.gov
call 505 248-6867, or write to:
Craig Springer
USFWS Fisheries RM 9100D
500 Gold Ave. SW
Albuquerque, NM 87103

Design

Blue Heron
Communications

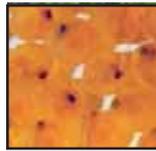
On the Cover:

Every trout stocked in
Kentucky comes from
Wolf Creek National
Fish Hatchery,
located below Lake
Cumberland. James
Gray/USFWS.



<i>Departments</i>	Headwaters	3	American Fishes	8
	Watermarks	4	Meanders	42
	Pioneers	6		

Features



**An American
Heritage—10**
Steve Brimm



**Reading Between
the Lines—26**
Craig Springer



**Net Worth: The
Economic Value
of Fisheries
Conservation—13**



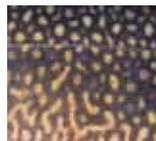
**Peering Under the
Hood—30**
Kari Duncan



**Living with Drought
and Fire—21**
*Mike Oetker and Nicole
Osborn*



**Hatchery in the
Heartland—34**
Stuart Leon, Ph.D.



**Thirty Years Young:
Iron River National Fish
Hatchery—24**
Dale Bast



**History in the
Making—38**
*Jan Rowan and Valerie
Fellows*



Davy Wotton

Teresa VanWinkle, past-president of the Friends of Neosho National Fish Hatchery, earns a living by guiding anglers in Arkansas's White River, a fishery maintained by Norfolk and Greers Ferry National Fish Hatcheries. Turn to page 13 to learn more about the economics of fisheries conservation.

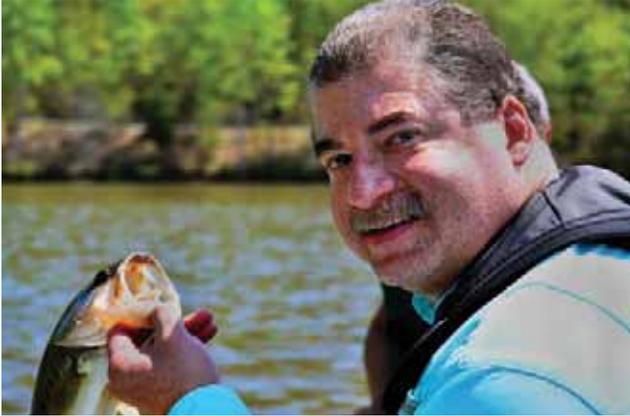
***The mission of the U.S. Fish and Wildlife Service
is working with others to conserve, protect and enhance fish,
wildlife, plants and their habitats for the continuing benefit
of the American people.***



Headwaters

Richness in Fisheries Conservation

By Bryan Arroyo



Hazel Arroyo

This issue of *Eddies* is focused on the original foundation of our present-day Fisheries Program, America's National Fish Hatchery System.

The National Fish Hatchery System has been an integral part of the aquatic resource conservation story of this country for the last 141 years. From its very beginnings the focus has been on being of value to communities, and that focus continues.

Growing up in Puerto Rico I will never forget the richness in my first trip to the fish hatchery in the mountain town of Maricao. There, I observed with fascination some of the game species that were raised and then stocked for the benefit of all. The hatchery also raised native species that formed part of the overall aquatic species management approach by the Puerto Rico Department of Natural Resources and Environment. To this day I enjoy visiting hatcheries and learning about the fascinating work and the great conservation success story that is forged at every one of our 71 hatcheries.

The word "hatchery" may conjure images of trout and salmon. In the beginning of the System those were the main species we raised. As our country became more concerned with aquatic biodiversity, our work trended toward threatened and endangered species like darters and even freshwater mussels. As President John F. Kennedy once said "Change is the law of life. And those who look only to the past or present are certain to miss the future." The National Fish Hatchery System exemplifies how to move smartly into the future.

From its early days the hatcheries operated on present need, but with an eye to the future, as reflected by great scientific and management advancements.

Our hatchery folks have figured out how to raise rare freshwater mussels, for example—species hardly known to science. I am certain that a number of these rare and precious animals are still present because of the great scientific prowess in the Fisheries Program.

As we face the future we need to be prepared to live up to the challenges faced by our aquatic resources. Some of the historical stressors on fisheries—water quality and quantity, pollution, habitat loss and degradation—are present still, but new ones like climate change and invasive species exacerbate those historical stressors. We must challenge ourselves and continue innovation that has marked our hatchery operations.

Just as the myriad cultural, economic, environmental, political, and global influences have continually shaped and re-shaped the direction of this country over the past 141 years, the National Fish Hatchery System has been required to remake itself, time and time again, to best respond to the Nation's greatest conservation needs. Simply stated, the System has always strived to benefit the American people.

Today, the National Fish Hatchery System is not only a prominent leader in restoration and recovery of depleted aquatic populations, and the application and dissemination of science and technology, but also stands as an important economic engine throughout America.

Each year, the System propagates and stocks more than 120 million genetically appropriate and disease-free fish in watersheds across the country. Angling resulting from National Fish Hatchery stocking programs generates 13.5 million angler-days, more than \$550 million in retail sales, \$903 million in industrial output, and 8,000 jobs. The best part is the System is foundational to our larger Fisheries Program that generates \$28 of economic benefit for every taxpayer dollar spent on our conservation activities.

Our facilities are centers of excellence; they are magnets for our youth conservation education efforts, providing meaningful experiences and opportunities for underserved minority youth. Our hatcheries also have been front and center in the commitment to tribal conservation efforts which have also opened the door for collaboration of shared fish and wildlife resources.

Our hatcheries continue to have a very special relationship with our State counterparts as we leverage our resources to support recreational opportunities for the public. All told, we work to conserve the richness that is America's fisheries.

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

Hatchery reveals Civil War secrets



Camp Lawton as it existed in 1864, drawn by Robert Knox Sneden, a Union private who was a prolific sketcher during the Civil War.

Bo Ginn National Fish Hatchery in Millen, Georgia, will play a critical role in imperiled fish conservation, but extraordinary archaeological discoveries have brought new revelations about the importance of this site. The crystal clear springs that make the site ideal for a fish hatchery was once valued for an entirely different reason.

During the last days of the Civil War the Confederates built Camp Lawton—a prison camp—to relieve the squalor of infamous Andersonville. The post was hastily abandoned only weeks later when threatened by Sherman’s march on Savannah. For most of the last 100-plus years the site rested undisturbed, the exact location of the stockade having been lost to time. Prominent archaeologists long ago dismissed the possibility of significant findings, especially of personal artifacts.

In the spring of 2010, student archaeologists from Georgia Southern University, working in partnership with the U.S. Fish and Wildlife Service and the Georgia Department of Natural Resources, pinpointed the former site of prisoner occupation in a rarely trod pine forest near the hatchery’s ponds. Upon excavation, they discovered an enormous density and variety of artifacts, including many unique personal relics.

According to archaeologists, Bo Ginn National Fish Hatchery may hold one of the most pristine Civil War archaeological sites in existence. To learn more, visit www.fws.gov/camplawtonsite. ♦ Judy Toppins

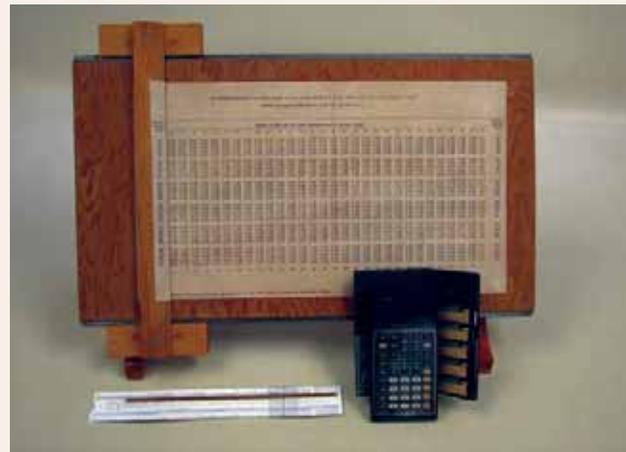
Courtesy Virginia Historical Society

FROM THE ATTIC

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

Back in the dark ages, biologists did mathematical calculations by hand. Fisheries science was in the early days and complex calculations were not required. As the complexity of research advanced, difficulty of calculations grew. Slide rules, used into the 1970s, speeded things up, and were quite accurate in skilled hands. Several have made it to our collection at D.C. Booth Historic National Fish Hatchery and Archives, some with leather cases.

Recently discovered in the archives is a very special slide rule. Tucked away in an accordion file labeled “DR. ALEXANDER M. DOLLAR,” along with memos and letters, was a modified slide rule. The files came from Harvey Willoughby, Chief of the Division of National Fish Hatcheries in the 1960s. Taped along the length of the rule are badly yellowed labels with a new scale for “HATCHERY CONSTANT” and directions to set the constant and put fish length on another scale, so as to calculate percentage of body weight to feed.



Pre-PC, these tools, a 1950s fish growth chart, slide rule, and ancient programmable calculator were essential tools on National Fish Hatcheries.

Hand-held calculators were an advancement. The first programmable calculator used for fisheries work that we are aware of was not greeted with enthusiasm by the supervisor when the young employee presented the idea. Computers were met with similar distrust when they came on the scene. ♦ Randi Sue Smith

Randi Sue Smith/USFWS

Manager of Wolf Creek National Fish Hatchery 2011 Federal Land Manager of the Year



Amanda Patrick/USFWS

James Gray stands with his daughter Haley during the annual fishing derby at Wolf Creek National Fish Hatchery in Jamestown, Kentucky.

James H. Gray, manager of Wolf Creek National Fish Hatchery (NFH) in Jamestown, Kentucky, is the 2011 Federal Land Manager of the Year for the U.S. Fish and Wildlife Service.

The Federal Land Manager of the Year award is given annually as part of the U.S. Department of the Interior's Take Pride in America program, a nationwide partnership authorized by Congress to promote the appreciation and stewardship of our nation's public lands. Gray was honored for his contribution to our public lands and for his effort in using volunteers in creative and innovative ways.

"Wolf Creek National Fish Hatchery is a major hub for the Service's efforts to connect people with America's Great Outdoors—through innovative conservation education programs, and by

creating opportunities for citizens to share their talents through rewarding volunteer experiences," said Cindy Dohner, the Service's Southeast Regional Director. "We are proud of James and the positive impact he has made in fisheries conservation. We are also proud of the people who have played a role in the good work he made possible through his vision and leadership."

Gray and his staff are the driving force behind one of the largest and most successful volunteer programs in the National Fish Hatchery System. Besides maintaining a demanding fish production program producing one million trout yearly, Gray leads a robust conservation education program with innovative projects. In 2006, Wolf Creek NFH became home to the first Visitor/ Education Center of its kind located on a working fish hatchery. ♦ Judy Toppins

FEATURED FACILITY Coleman National Fish Hatchery

Where: Anderson, California

When: Established 1942

Then: In 1942, Shasta Dam blocked the uppermost drainage of the Sacramento River, preventing access to about 187 miles of Chinook salmon and steelhead spawning habitats. Coleman National Fish Hatchery was built along the north bank of Battle Creek to mitigate for this habitat loss.

Now: The hatchery is one of the largest salmonid hatcheries in the U.S., producing 13 million Chinook salmon and 600,000 steelhead each year. Fish produced at the Coleman NFH contribute substantially to the multi-million dollar commercial and recreational fishing industry in California and benefit the region's social, cultural, and economic well-being.

Since 1991, on the third Saturday in October, the hatchery hosts a one-day "Return of



USFWS

Coleman National Fish Hatchery in California, is among the largest salmonid hatcheries in the country.

Salmon Festival," attended by about 6,000 visitors. Overall more than 50,000 visitors tour the hatchery each year. Volunteers provide tours for hundreds of school groups during the fall months. Friends of Coleman NFH participate in numerous public outreach events and have created a two-mile Battle Creek Salmon Trail. ♦ Brett Galyean

By Carlos R. Martinez

Dewitt Clinton Booth



Dewitt Clinton Booth started in a business career; to become a true pioneer in fisheries conservation.

USFWS

A native of the New York's Mohawk Valley, Dewitt Clinton Booth was born in 1867. After attending the state's public schools he pursued an education at the Colgate Academy, later to become Colgate University. Booth went on to obtain a wealth of business experience in the Chicago headquarters

of one of the nation's prominent railway systems, which led him to an appointment in the United States Treasury Department. At the time, positions within that department were viewed to be among the most desirable within the federal government. During the World's Columbian Exposition in Chicago, he was assigned to a detail with the Treasury Department's Customs Division which oversaw some of the most interesting exhibits of the Expo. It is believed that his experiences at the event made him realize an outdoor-related career was more appealing than the office work he had grown accustomed to in the Treasury Department. Booth actively sought, and successfully obtained, a position in the U.S. Fish Commission.

Booth, who insisted on being called "D.C.," started his fisheries conservation career with the distinction of being the first federal Civil Service employee in the Fish Commission. His first job took him back to his home state of New

York. While at Cape Vincent, New York, he obtained experience in the commercial fisheries of the Great Lakes. With a move to the coast, he gained knowledge about the marine varieties of fishes of the Atlantic Coast at Woods Hole, Massachusetts. Later yet, at Leadville, Colorado, Booth learned about and cultured fishes in the Rocky Mountains.

In 1899, D.C. Booth became the youngest superintendent in the U.S. Fish Commission when he was promoted to head of the new fish cultural station being built in Spearfish, South Dakota. It is here that he established himself, a former businessman and Treasury Department worker, and then flourished into a well-respected authority and true pioneer in the field of fisheries conservation.

The Spearfish Fish Cultural Station was originally founded to establish fisheries in the Black Hills of South Dakota and Wyoming, a territory largely void of fish. The few populations that existed were considered undesirable native fishes, principally suckers and minnow species. Booth's leadership and oversight of the station would eventually encompass a land base that was arguably the largest of any other National Fish Hatchery. Under challenging and primitive conditions, Booth engaged in the propagation of a variety of species to include brook trout, brown trout, rainbow trout, cutthroat trout, steelhead, lake trout, and land-locked Atlantic salmon. During his tenure, millions of eyed eggs and fish were distributed to numerous destinations including distant lands such as Alaska and the British Isles.

Perhaps the most notable of the programs that he developed is the Yellowstone National Park fishery, located 400 miles west of Spearfish, South Dakota. In 1901, with the assistance of four U.S. Army soldiers, Booth investigated the fish cultural possibilities at West Thumb, in Yellowstone. As a result, the Spearfish hatchery began to operate a substation inside Yellowstone National Park. The station's original purpose was to collect "black-spotted trout" eggs and ship them to Spearfish. After their subsequent incubation and hatching, the product was strategically distributed.

In a day with few roads and minimal mechanized equipment, overland expeditions to gather fish eggs in the wild were complex and arduous. The journey began in Spearfish via rail. By the time fishery workers arrived at Yellowstone, the railroad train had morphed into a wagon train, overflowing with specialty equipment to include boats, nets, egg crates, and troughs. To support the endeavor, a hatching building was eventually built on Little Thumb Creek, the first in the history of Yellowstone National Park. In the development of this fishery, Booth made 13 annual trips to Yellowstone National Park, spending 10 summers there. During that time he harvested, shipped, and stocked millions of eggs from the Yellowstone stocks. Ultimately Booth's efforts resulted in the world's largest trout egg collecting station creating new fisheries throughout Yellowstone, the U.S. and foreign countries, many of which are still enjoyed today.

Booth turned the Spearfish operation, in what originated as a subsidiary to the Leadville National Fish Hatchery, into a prominent center for federal fisheries conservation.

He was the first to experience and solve many problems in early trout cultivation related to disease and nutrition. Although considered stern, tough, and stubborn, Booth was still a well respected leader.

In 1933, after forty years of public service, D.C. Booth retired in Spearfish where he lived out the rest of his life. After a temporary closure in the early 1980s, the Spearfish National Fish Hatchery was reopened with a new mission and a new name. Today the D.C. Booth Historic National Fish Hatchery and Archives preserve our nation's fisheries history and heritage. In 1986, the Fish Culture Section of the American Fisheries Society enshrined Dewitt Clinton Booth into the National Fish Culture Hall of Fame. Booth's foresight and contributions from a century ago remain a legacy. ♦

Carlos R. Martinez is the Director of the D.C. Booth Historic National Fish Hatchery and Archives in Spearfish, SD. He contributed a story about another "Pioneer," Dr. Livingston Stone, in the Spring 2011 issue of *Eddies*.



Shadowed by daughter Katharine, Booth pushes a wheelbarrow at the Spearfish facility, ca 1908.



The Spearfish Fish Cultural Station Superintendent's house was built in 1905. The Neo-Colonial Revival style home served as the Booth family's living quarters for almost 30 years. It has since been restored and renamed the Booth House. Decorated with period furnishings, the home serves as a popular tourist attraction.

Family Photos DC Booth Archives/USFWS

USFWS

Northern Riffleshell

By Catherine Gatenby, Ph.D.

They sit nearly as still as a stone, river water percolating around them—and through them. The northern riffleshell is so named for its hard rippled exterior as much as it is for the habitats it uses. This American mussel was brought to the fore of science by an American businessman with diverse interests.

Based on the prodigious writing Isaac Lea did on the subject of freshwater mussels, you would think that is what he did for a living—conduct scientific inquiries into freshwater shellfish. But it was not. Lea was a Philadelphia book publisher with an ardent interest in animals with shells, and that's not all. He published his first scientific paper at age 36, and would keep it up for another 52 years. In the end, Lea inquired into natural history, geology, and paleontology, but it was mussels where he mostly made his mark. He described hundreds of new species of snails and mussels from the heartland of the North American continent. The northern riffleshell was among them, described for science in 1838, in some of his earliest writings.

Historically, the northern riffleshell occurred in rivers and streams of the Great Lakes and the Ohio River drainages. It could be found in western Ontario to Alabama, from Kentucky to West Virginia. Today the northern riffleshell occurs in only a few short reaches of the Green River in Kentucky; the Detroit and Black rivers in Michigan; Big Darby Creek in Ohio; and French Creek, LeBoeuf Creek and the Allegheny River in Pennsylvania. It's the latter site where the largest remaining population of the rare mussel lives at present.

The northern riffleshell (*Epioblasma torulosa rangiana*) was federally listed as an endangered species in 1994. A major cause for the decline of the northern riffleshell is loss of suitable habitat for both the mussel and its host fish.

Mussel conservation involves many aspects of biology and habitat, but a host fish is essential to a mussel. Simply put, a mussel cannot reproduce without its host fish. Indeed, in order to complete metamorphosis—to transform from the larvae to adult—larval freshwater mussels must attach to a host fish where they derive nutrition and possibly some immune resistance. For a complete explanation of this fascinating life-history process with copious photos, see “Rocks with Guts” in *Eddies* Spring 2010.

Scientists haven't yet deciphered all that a mussel gains from the host fish. Nonetheless, a mussel needs a fish in order to complete full development to adulthood. Damming of rivers, channelization, and pollution have all led to the decline in host-fishes, which in turn has led to the decline of freshwater mussels. The northern riffleshell uses a host-fish, such as a sculpin or darter to complete its life cycle. She accomplishes this by attracting her unsuspecting host-fish through the use of a lure. She lies in wait on the bottom of the river, set on her dorsal side, her valves gaping open displaying her pearlescent blue mantle tissue, and a small worm-like structure that spins around. Those little darters and sculpins are such curious fellows, they think they see food. They sneak up to investigate, hoping to eat something, and the female rapidly clamps her

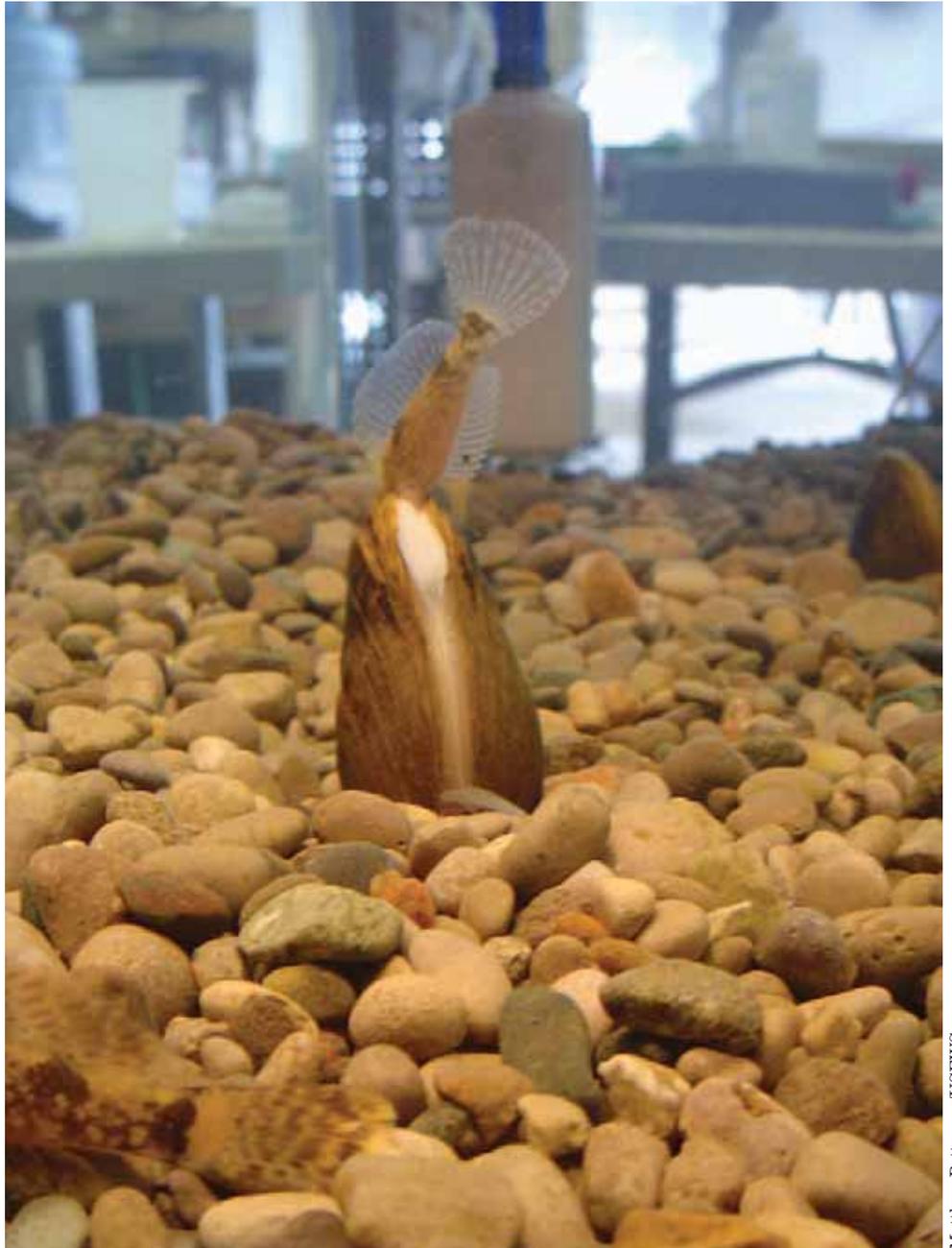
valves shut, trapping the sculpin or darter between her valves. Only the fish's head is trapped, its body and tail wave as it tries to escape. But to escape is in vain. After a few moments it stops trying and in about 15 minutes, the female mussel releases the fish. Though the fish might appear a bit stunned as it swims away, its head and gills are covered with attached mussel larvae that anchor into fish flesh.

Scientists believe that only the larvae attached to the gills metamorphose because the gill tissue is full of good proteins, fats, and sterols. Lest you be concerned about the health and welfare of these unsuspecting host fish, let me provide you with a little assurance. Russian scientists have evidence to suggest that fish that have been inoculated by mussel larvae are more resistant to stress. Thus, both fish and mussels may benefit from this host-parasite relationship.

Recovering this endangered species requires establishing viable populations in 10 river drainages. Because of their complex life cycle and because the northern riffleshell's range has been severely reduced, it could be decades if at all before the northern riffleshell recolonizes and reestablishes itself into new and improved habitat. The recovery of northern riffleshell will, therefore, require that additional self-sustaining populations be established in other rivers in stream-to-stream transfers, or stocking new waters with hatchery-reared mussels. The White Sulphur Springs National Fish Hatchery in the West Virginian town of the same name has an aquaculture program underway for rearing endangered northern riffleshell.

This will allow the U.S. Fish and Wildlife Service and its partners to recover this species through stock enhancement of dwindling populations, and by reintroducing the rare mussel into new drainages where the habitat has been restored.

White Sulphur Springs National Fish Hatchery, the U.S. Fish and Wildlife Service's Pennsylvania Ecological Services, and Ohio River Islands National Wildlife Refuge recently teamed up to release over 400 young northern riffleshell into the Allegheny River. The one-year-old mussels produced at the hatchery were large enough to tag, making it possible to come back at a later date and monitor their growth and survival in the wild. Starting in 2004, divers from the U.S. Fish and Wildlife Service, the Environmental Protection Agency, and the West Virginia Division of Natural Resources worked with the Pennsylvania Department of Transportation to remove approximately 250 adult northern riffleshell from under a new bridge project at East Brady, Pennsylvania. The mussels were relocated to the hatchery, a temporary refuge. While held at the hatchery, female northern riffleshell became gravid, providing hatchery biologists with an opportunity they were hoping for—to propagate northern riffleshell in captivity and develop an aquaculture program aimed at recovering this endangered species. ♦



Matthew Patterson/USFWS

Catherine Gatenby, Ph.D. is the manager of White Sulphur Springs National Fish Hatchery in WV. When not at work, she is tap-dancing with the “Footnotes” out of Blacksburg, VA, listening to South American folk music, or playing piano with her son.

It only looks painful. This fish lightly grasped by a northern riffleshell mussel is being inoculated with larval mussels, called glochidia. The young mussels ride the host to their next stage toward maturity. They eventually fall off and live a life on a stream bed. The host fish rarely perish as a direct result of mussel infestation.

By Steve Brimm

An American Heritage

The National Fish Hatchery System



Fish biologist Molly Bowman moves an adult smallmouth bass to a new tank as part of a sedation study at the Aquatic Animal Drug Approval Partnership, co-located with the Bozeman Fish Technology Center in Montana.

Predawn on a summer morning a young college student crawls into the passenger side of a fish hatchery truck destined to journey across western Ohio, stopping at numerous Soil Conservation Service offices throughout the day to meet local farmers who needed fish for their farm ponds. That was my initiation into the work of the National Fish Hatchery System over 40 years ago. As a new trainee right out of college, I moved from one hatchery

to another, each with different species of fish and a different role in fisheries conservation. I remember an early afternoon that we left the New London National Fish Hatchery in Minnesota and drove to Valley City National Fish Hatchery in North Dakota, to pick up a load of walleye. From Valley City we drove throughout the night back across Minnesota, almost hitting a bear at four in the morning. We arrived at the Lac Du Flambeau Indian Reservation

at sunrise to meet tribal biologists to stock one of their lakes.

I just couldn't wait for my next trainee experience and loved learning the culture methods of various fish. While stationed at the Jordan River National Fish Hatchery in Michigan, I was so impressed with the caravan of trucks that would load up lake trout at mid afternoon and travel to Ludington, Michigan to board a car ferry and head into the night across

Lake Michigan. Around midnight the captain of the ferry would signal that we had reached our stocking zone over one of the historic lake trout spawning reefs. The back end of the ferry would rise and our four trucks were in position to release our finny cargo. Off into the dark waters went the lake trout that we had spent over a year rearing.

That's a glance at my first few years with the National Fish Hatchery System in the 1970s. Hatcheries have various roles in conservation as defined by legislation and by location. But all are connected by the desire to provide the best possible product to fisheries managers to meet conservation goals. America needs a system of hatcheries to address federal fisheries conservation responsibilities.

The National Fish Hatchery System has a rich and proud heritage. Over 140 years ago the New England states wanted federal leadership in fisheries because they realized that many species of fish crossed state boundaries and would require federal coordination. The first National Fish Hatchery was established by Livingston Stone in California to address salmon issues (see *Eddies*, Spring 2011). Following those historic moments in the early 1870s an infrastructure of facilities expanded across the country to address a whole host of fisheries conservation issues. I remember just how important that infrastructure was back in the 1980s when many of our warmwater hatcheries were re-tooled by a great need to restore striped bass along the Atlantic Coast. Without that existing infrastructure one can only imagine when—or even if—this important fishery would have been restored.

Other times during my career I witnessed our hatchery system gear up to help other hatcheries, both federal and state facilities, when natural disasters or disease outbreaks required them to temporarily close. For several years I coordinated our National Broodstock Program that provides eggs to federal, state, university, and research programs. Almost 50 million fish eggs of many species were distributed each year. I'm extremely proud of the leadership of our broodstock managers who would work closely with fisheries managers at many levels to ensure that they received the exact product at the precise time. The National Fish Hatchery System has provided our nation's fisheries managers with fish culture tools, technologies, and fish health policies and procedures since 1872. And speaking of health, fish are an excellent indicator of the environment and require healthy waters. Our National Fish Hatcheries were built where high quality water could be found. By default today, such critical waters are protected from over exploitation.

The value of using our National Fish Hatcheries for conservation education and connecting with our youth is critical to the future of conservation. Over my career, funding was naturally dedicated primarily to fish work, but we always found a way to support youth programs, curricula to schools, and host special events like National Fishing

Week. From my very first duty station in Fairport, Iowa, followed by assignments at eight other National Fish Hatcheries, I'm sure I guided several thousand kids on tours and shared educational programs on fisheries conservation, always hoping that I might have made a difference. While I served as Director of the D.C. Booth Historic National Fish Hatchery and Archives, I had the opportunity to share my career experience with college classes at our local Black Hills State University. Recently, three years after one of those opportunities, a young man approached me at a National Wild Turkey Federation banquet and told me that my presentation led him to change his career path and pursue a master's degree in fish and wildlife management. He hugged me and thanked me and I barely held back a tear. Hundreds of National Fish Hatchery System employees share their work with youth throughout the year. They may never know if they are making a difference—but they do. And with an infrastructure of hatcheries throughout the nation



Garrison Dam National Fish Hatchery manager, Rob Holm, expresses eggs from a wild pallid sturgeon brought to the hatchery.



USFWS

Eyed-egg stage is only one phase along the way in development. Depending on the conservation goal, some fish are raised to large sizes before being stocked. Some are never stocked at all, used either for future broodstock or in scientific research.

we influence the vast diversity of America's youth. Tomorrow's conservation leaders will be culturally diverse.

Fisheries conservation has been the primary mission of the National Fish Hatchery System since its inception. Our former conservation leaders understood the values of restoring fish populations and providing recreational fishing for Americans. What we didn't realize until recent years were the measurable economic values of our work. I was involved with economists who evaluated the

economic impact of our 11 rainbow trout hatcheries. We were pleased if not shocked to learn that for each single federal tax dollar invested in our rainbow trout hatcheries, it created \$32.20 in retail sales and \$36.88 in net economic value. We've since learned more, and you can read about it yourself in the pages that follow. While we strive to save endangered fish, restore habitats and depleted stocks, and provide recreational activities, we cannot overlook the tremendous economic value derived from fisheries conservation.

Throughout my early days in the hatchery system I never met a person who didn't appreciate the value of our hatcheries. The wakeup call for me came as I moved higher in the management of hatcheries. Following a year of training at our Fisheries Academy in Leetown, West Virginia, my family had just moved to Wytheville National Fish Hatchery in Virginia. As a broodstock station and provider of fish for National Forests in West Virginia and Virginia, we were assured that the hatchery was safe as Congress prepared to close several hatcheries. With that assurance, my wife and I bought our first home and moved in around Thanksgiving time. Two weeks before Christmas we learned that Wytheville would close. Things would eventually work out for us, but I learned a valuable lesson in understanding how Congress worked and how important it was to make sure your local community and congressional legislators understand the value of each hatchery program. When I moved to the Washington office in the late 1980s, I also found colleagues in academia and co-workers who didn't share my values. Understanding their perspective helped me strive to clearly articulate the entire values of the hatchery system, to make sure we were using the best science available to conduct our work in a most efficient manner, and to make outreach a priority of our work.

As I finished my career working in the collection of historic artifacts and archives at the D.C. Booth facility, I connected like never before with the rich American heritage of fisheries conservation. I realized that the National Fish Hatchery System is not museum artifact, but an infrastructure of facilities uniquely poised to meet future needs of our nation. ♦

Steve Brimm is a retired fish biologist living in South Dakota. He wrote "Fish Came First" in *Eddies*, Spring 2008.

U.S. Fish & Wildlife Service

Net Worth

*The Economic Value of
Fisheries Conservation*

Fall 2011



This report is based on “Conserving America’s Fisheries, An Assessment of Economic Contributions from Fisheries and Aquatic Resource Conservation,” a 41-page peer-reviewed report prepared by Joseph Charbonneau, Ph.D., and James Caudill, Ph.D. and published by the U.S. Fish and Wildlife Service’s Division of Economics.

To receive additional copies of this report or more information, contact:

Mr. Michael DeRosa
U.S. Fish and Wildlife Service - Fisheries
4401 North Fairfax Drive
Arlington, VA 22203
(703) 358-1792
michael_derosa@fws.gov
www.fws.gov/fisheries/



Melanie Dabovich/USFWS

ON THE COVER: The “net worth” of the Gila trout is measured in myriad ways—by scientists, anglers, and economists. This fish was an endangered species, closed to angling for over 50 years. Dedicated conservationists brought it back from the brink in 2006. Once staring into the dark abyss of extinction, the fish is now sought by a following of anglers. Through conservation, the Gila trout now contributes to the economy, generating time on the water, and the spending associated with it, in Arizona and New Mexico.



Ranger Boats

AMERICA'S AQUATIC GOODS AND SERVICES

By Bryan Arroyo

Since 1871, the Fisheries Program of the U.S. Fish and Wildlife Service has been a leader in managing species, conserving habitat and sustaining the biological health of America’s aquatic resources. These resources—the richest and most diverse on Earth—are inextricably tied to the health and wealth of our Nation. Benefits include ecological, scientific, aesthetic, recreational, commercial, subsistence, social, cultural—and economic.

This report highlights \$3.6 billion in annual contributions to the U.S. economy by the Fisheries Program and many partners: states, tribes, NGOs and private organizations.

How big is \$3.6 billion?

A company with \$3.6 billion in annual profits would rank No. 41 on the Fortune 500 List of America’s Most Profitable Corporations. That’s just behind retailer CVS Pharmacies and

Verizon, but ahead of the grocery brand Kraft.

Conservation stimulates commerce. Money changing hands translates to industry; \$903 million in industrial output results from angling for fish originating in the National Fish Hatchery System. Habitat and fisheries conservation create more than 68,000 jobs in a multitude of businesses. Money invested today pays dividends tomorrow. That is the essence of

conservation, looking out on the long-horizon. This economic report lends a well-documented perspective that conservation is a commodity good for fish and for people.

Think about it—the Total Economic Contribution of the National Fisheries Program: \$3.6 billion annually. That’s \$70 million a week—\$10 million a day.

The return on investment is tremendous.

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



Imagine a business investment that annually returns 28 times its initial investment.



GAS

FOOD

LODGING

America's National Fisheries Program does.

MAJOR PAYOFFS

Each taxpayer dollar budgeted for the program generates \$28 in economic returns.

The revenue generated can be seen at sporting goods stores, marinas, boat dealerships, guides and outfitter services; bait shops, gas stations, cafes, hotels, wildlife watching tour businesses and many other enterprises that exist for, or benefit from, the National Fisheries Program and its many partners.



USFWS



Ranger Boats

Supporting 68,000 Jobs

A total of 68,000 American jobs are attributable to the economic contribution of the National Fisheries Program. If all 68,000 of these jobs were part of a single company, its workforce numbers would closely match that of these large U.S. companies: Merck; State Farm Insurance; Whirlpool; Comcast; and Boeing.



Ranger Boats

Recreational Angling Resulting from National Fish Hatchery Stocking Programs Generates:

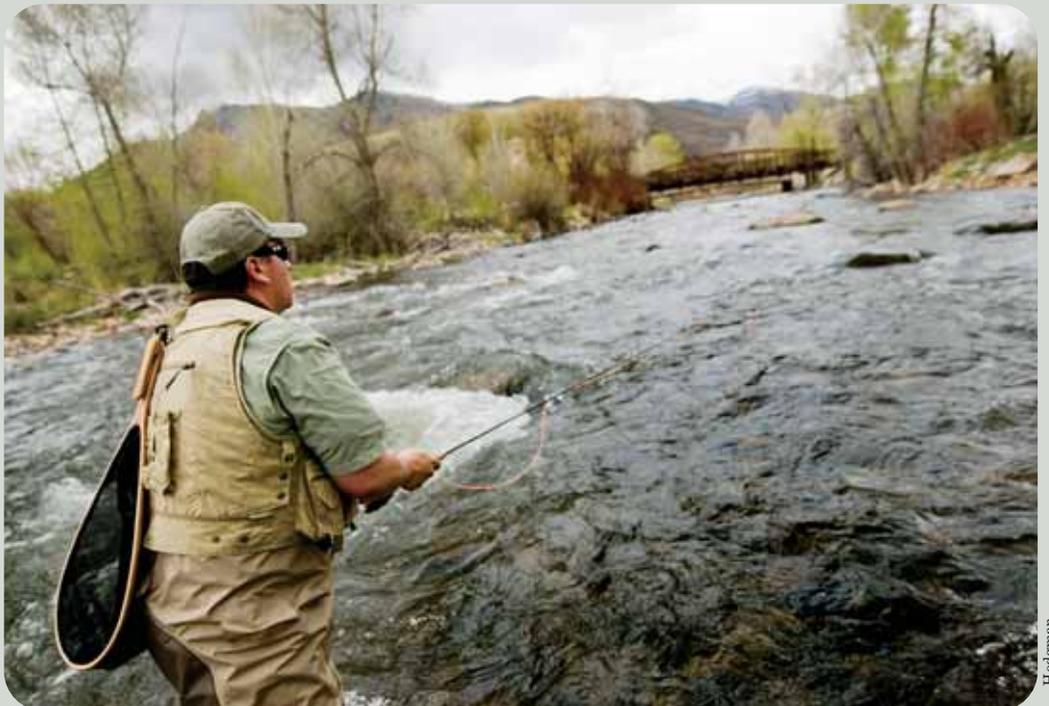
- 13.5 million angler-days
- \$554 million in retail sales
- \$903 million in industrial output
- 8,000 jobs
- \$256 million in wages/salaries
- \$37 million in federal tax revenues
- \$35 million in local tax revenues



Henry Quinlan



Henry Quinlan



Hodgman



USFWS

MAKING IT HAPPEN

Fisheries Program professionals, facilities and partners work together in five core areas:

Habitat Conservation

Types of Projects: Restore, enhance and protect habitat; restore in-stream flows and fish migration, monitor habitat quality.

Example: Worked with Eglin Air Force Base in Florida to remove dams and other barriers to restore critical passage for the Okaloosa darter. Fisheries Program dollars were matched almost 5:1 with funding from partners.

Species Conservation

Types of Projects: Recover threatened and endangered species, develop and implement fishery management plans, restore native species, control nuisance species.

Example: Worked with state, federal and Tribal resource agencies to recover once-endangered Apache trout in Arizona. The species is now abundant enough to support recreational fishing.

Cooperation with States

Types of Projects: Develop recreational fishing opportunities, mitigation of federal water developments,

stocking fish in conjunction with state DNRs.

Example: Stocked 9 million rainbow trout; each taxpayer dollar spent generated \$32.20 in angler retail sales.

Cooperation with Tribes

Types of Projects: Provide technical assistance, training, job opportunities for Tribal members and fish for stocking on Tribal lands.

Example: Restore coho salmon in the Waatch River for subsistence fishing on the Makah Reservation in Washington. Nationally, fish populations managed for subsistence have a minimum replacement value of \$301 million.

Science and Technology

Types of Projects: Conduct Wild Fish Health Surveys, lead advancements in diagnostics, nutrition, genetics, propagation and marking.

Example: Work with aquaculture industry and agencies to monitor, manage and contain pathogens that could have detrimental impacts on fish populations and associated economic benefits.

Species in Peril

Despite efforts to conserve fish and other aquatic resources, a growing number of species are declining. The Endangered Species List includes 139 fish, 70 mussel, 25 amphibian and 22 crustacean species. Here's a sample of relevant Fisheries Program initiatives:

Maintaining broodstock populations of imperiled species at national fish hatcheries. Rare species held in refugia are valued by the public at \$456 million.



Propagating and restocking the razorback sucker to indigenous rivers in Colorado, New Mexico, Arizona and Utah.



Assessing non-point source pollution that threatens six rare mussel populations in the Chipola River Basin in Florida.



Restoring fish passage for pallid sturgeon migrating between critical secondary channels and the navigation channel of the lower Mississippi River.



Healthy Habitat, Healthy Economy

Restoring or enhancing habitat is an essential function of the Fisheries Program. Healthy habitats ensure good fishing, and protect homes, businesses, and roads from damaging floods. The National Fish Passage Program and National Fish Habitat Action Plan are key components in habitat management.

Working with partners, an annual average of 890 miles of river habitat re-opened to fish passage has a value of \$483 million when in full productivity, and with it an estimated 11,000 jobs. That exceeds a value of \$542,000 per stream mile.

MAKING AN IMPACT

The Fisheries Program generates major economic benefits nationally and in your backyard.

Alaska

Removed passage barriers to conserve habitat and help sustain salmon runs in south-central **Alaska**. Local anglers spent \$989 million and generated \$91 million in state and local taxes.

Central U.S.

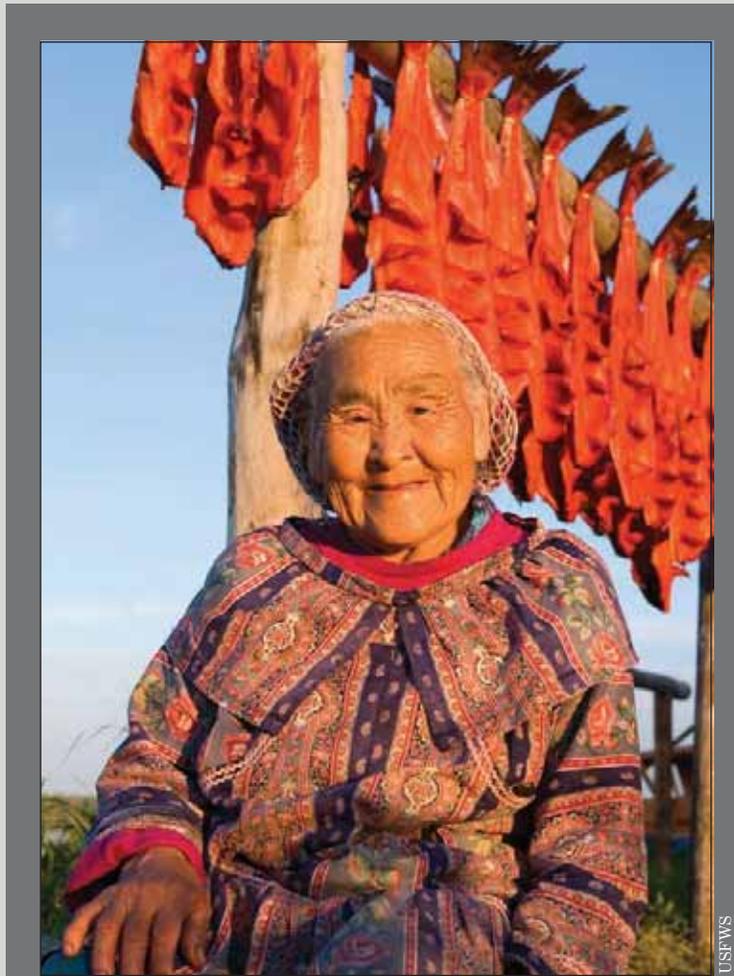
Provided public fishing access at Desoto National Wildlife Refuge. Desoto Lake receives 26,000 angling visits per year, generating \$1.3 million in annual economic benefit for western **Iowa** and eastern **Nebraska**.

New England

Helped restore recreational angling for Atlantic salmon and other species by removing a dam and restoring fish passage in Souhegan River in **New Hampshire**.

Southeast

Utilized national fish hatcheries in **Arkansas, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee** and **Louisiana** to rear and release 22.3 million sport fish in 12 southeastern states. Anglers responded with 3.2 million days of fishing, generating \$239 million in economic output and supporting 3,100 jobs.



USFWS

Hometown Benefits

Aside from its \$3.6 billion total economic impact and associated 68,000 jobs on a national scale, the Fisheries Program brings direct benefits to Main Street, America.

With dozens of conservation offices, hatcheries, labs, health, and technology centers -- and more that 800 dedicated professionals -- the program's facilities and its employees are a significant economic force themselves, where they live and work. The Fisheries Program's local economic impact translates to 5,692 jobs that stem from wages, supplies, and services rendered at Fisheries facilities, making a difference in hometowns across the country.

Hold in refugia a unique strain of Lahontan cutthroat trout extirpated from Lake Tahoe in the 1930s. This trout will be the centerpiece of a reintroduction program in several fisheries in **Nevada**.

Reared and released Gulf Coast striped bass to help restore a commercial and recreational fishery in **Louisiana**. This effort generated 3,000 angler days and \$425,000 in local economic benefits.

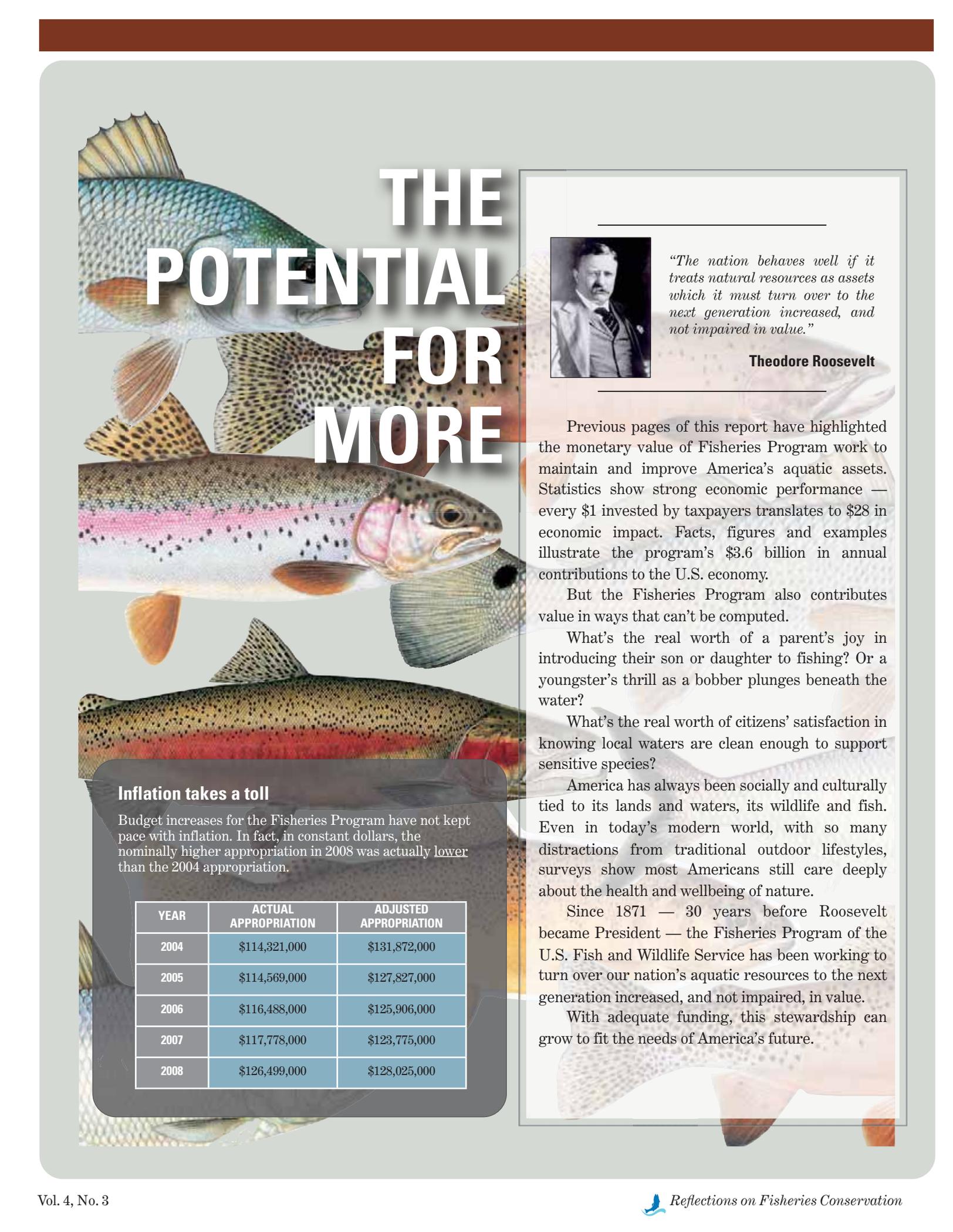
Great Lakes

Controlled non-native sea lamprey populations to help minimize impacts on sport species. This effort provided economic contributions of \$556 million and 13,200 jobs.

Improved spawning habitat for lake sturgeon, walleye and other sportfish by providing fish passage to reconnect habitats on both sides of Heiberg Dam in **Minnesota**.

Western U.S.

Reared and released 12 million Chinook salmon to support commercial and recreational fisheries in northern **California**. In the Sacramento River alone, salmon fishing is valued at over \$100 million annually.



THE POTENTIAL FOR MORE



“The nation behaves well if it treats natural resources as assets which it must turn over to the next generation increased, and not impaired in value.”

Theodore Roosevelt

Previous pages of this report have highlighted the monetary value of Fisheries Program work to maintain and improve America’s aquatic assets. Statistics show strong economic performance — every \$1 invested by taxpayers translates to \$28 in economic impact. Facts, figures and examples illustrate the program’s \$3.6 billion in annual contributions to the U.S. economy.

But the Fisheries Program also contributes value in ways that can’t be computed.

What’s the real worth of a parent’s joy in introducing their son or daughter to fishing? Or a youngster’s thrill as a bobber plunges beneath the water?

What’s the real worth of citizens’ satisfaction in knowing local waters are clean enough to support sensitive species?

America has always been socially and culturally tied to its lands and waters, its wildlife and fish. Even in today’s modern world, with so many distractions from traditional outdoor lifestyles, surveys show most Americans still care deeply about the health and wellbeing of nature.

Since 1871 — 30 years before Roosevelt became President — the Fisheries Program of the U.S. Fish and Wildlife Service has been working to turn over our nation’s aquatic resources to the next generation increased, and not impaired, in value.

With adequate funding, this stewardship can grow to fit the needs of America’s future.

Inflation takes a toll

Budget increases for the Fisheries Program have not kept pace with inflation. In fact, in constant dollars, the nominally higher appropriation in 2008 was actually lower than the 2004 appropriation.

YEAR	ACTUAL APPROPRIATION	ADJUSTED APPROPRIATION
2004	\$114,321,000	\$131,872,000
2005	\$114,569,000	\$127,827,000
2006	\$116,488,000	\$125,906,000
2007	\$117,778,000	\$123,775,000
2008	\$126,499,000	\$128,025,000



68,000

**AMERICAN JOBS ATTRIBUTABLE TO
THE ECONOMIC CONTRIBUTION OF
THE NATIONAL FISHERIES PROGRAM**

\$3.6B

**TOTAL ECONOMIC IMPACT OF TAX
DOLLARS INVESTED INTO NATIONAL
FISHERIES PROGRAM**

\$28:\$1

**ECONOMIC RETURNS GENERATED PER
TAX DOLLAR INVESTED INTO**

DEFINITION

re•turn on in•vest•ment (ri-turn awn in-vest-muh-nt) *noun*

1. A performance measure used to evaluate the efficiency of an investment or to compare the efficiency of a number of different investments. To calculate ROI, the benefit (return) of an investment is divided by the cost of the investment; the result is expressed as a percentage or a ratio.

By Mike Oetker and Nicole Osborn

Living with Drought and Fire



Jeremy Voeltz/USFWS

The damage done, a rainbow arcs over burnt-out woods in the Apache Sitgreaves National Forest. The Wallow fire was the largest fire to ever burn in Arizona.

Here in the Southwest, the havoc that prolonged drought can cause to both people and wildlife can be catastrophic. Add uncontrolled fires to the mix, and things really get out of hand. The summer of 2011 will long be remembered as the year of droughts and fires—massive wildfires. Few people did not hear about the fires that swept across Arizona, New Mexico, Texas, and Oklahoma in 2011; they caused devastating damage as they burned. For the people who live right here in the Southwest, the problem was literally right outside our doors.

Standing on our front porches, we could smell the smoke sometimes coming from hundreds of miles away, but as if it was right in our own backyards. Ash billowed more than 20,000 feet into the sky, looking more like thunderheads than smoke.

It started in Texas. The spring of 2011 was the driest on record. More than 1.6 million acres burned in Texas this year. As summer progressed, wildfires broke out in New Mexico and Arizona. The single largest wildfires recorded in Arizona and New Mexico history occurred this

year. Arizona's Wallow fire that crept into New Mexico reached nearly 540,000 acres. The Los Conchas fire reached more than 156,000 acres. This year alone, wildfires burned more than four million acres in four states.

As the problem of drought magnified with every new fire, many wondered what would happen to the fish and wildlife—especially those that have been labeled as threatened or endangered by the U.S. Fish and Wildlife Service because of their already dwindled populations.



Shauna Hedwall/USFWS

The Little Colorado spinedace is listed as “threatened” under the Endangered Species Act. This fish was pulled from Rudd Creek in east central Arizona.

The task at hand can seem so daunting. Luckily for anglers and conservationists who care about fish, we were already in action. Biologists plan and train for management situations involving drought and fire; we are well equipped to handle these adversities. The dangers for threatened and endangered fish are no doubt daunting, but for the dedicated men and women working in conservation, what to do in an emergency is almost second-nature.

Case in point: the Mimbres River. The Mimbres rises in the pine-studded Black Range and Mogollon Mountains of southwestern New

Mexico. It’s a place naturally arid. Throw drought in the mix, and the native fish suffer. The Mimbres is home to Chihuahua chub, a deep-bodied minnow that lives nowhere else in the U.S. With the Mimbres River drying, the Fisheries Program biologists along with the U.S. Forest Service and the New Mexico Department of Game and Fish staff collected Chihuahua chub and moved them to the Dexter National Fish Hatchery and Technology Center in Dexter, New Mexico. Biologists found chubs within two boulder-outcrop pools, in water less than three feet and evaporating fast. The chubs are doing well since their arrival at Dexter. There they will remain in

quarantine until the drought is over or they may be added to the refuge population at the hatchery to boost the genetics of captive fish already held there.

Wildfires can impact aquatic species in several ways, but the most severe impacts are after the fire is contained and snuffed out. Rain and wind push ash into the streams smothering fish and aquatic insects. The summer monsoon rains in Arizona and New Mexico can be a blessing or a curse. The much needed rain, if light, can help sprout seedlings and suppress fires. Heavy downpours devastate fish habitat with churning slugs of ash slurry pouring down stream beds.

Such was the case with New Mexico's Las Conchas fire, and Arizona's Wallow fire.

In times like these, excellent working relationships become very crucial to getting work done. Biologists from state, tribal, and federal agencies have been cooperating at all levels to protect a number of sensitive species and ensure their survival. After the Wallow fire in Arizona, biologists rescued the threatened Apache trout, loach minnow, and the Little Colorado spinedace. Roundtail chub, Three Forks Springsnail, bluehead sucker, Little Colorado sucker, and California floater mussel—all rare species—were salvaged from the wild. The threatened Chiricahua leopard frog was also a rescue priority, but none were found.

In New Mexico, several endangered species were rescued from the distress of drought including the endangered Pecos bluntnose shiner, the Rio Grande silvery minnow, and of course, Chihuahua chub. The Rio Grande cutthroat trout, a candidate for listing under the Endangered Species Act, will also likely be salvaged from the affects of the Las Conchas and Pacheco wildfires. Because roads do not always go to the lakes and rivers where these native fish dwell, especially in wilderness areas, some fish have had to be carried out on mules, or sometimes even helicopter to National Fish Hatcheries that would become their temporary homes. This was the case for the threatened Gila chub and the headwater chub, a candidate for threatened status. Biologists took mules into the Gila Wilderness to collect these rare species.

The National Fish Hatchery and Technology Center in San Marcos, Texas has recently provided a refuge for seven threatened or endangered species: the Texas blind salamander; San Marcos salamander; fountain darter; Texas wild-rice; Comal Springs riffle beetle; Comal Springs dryopid beetle; and Peck's cave

amphipod, all to ensure the species' survival under the most dramatic drought conditions recorded. The Edwards Aquifer is one of the most productive artesian aquifers in the world. Located on Edwards Plateau, it flows through 180 miles of porous limestone and discharges about 900,000 acre-feet of water a year. It is the primary source of drinking water for more than two million people, including the seventh largest city in the nation, San Antonio. It serves the domestic, agricultural, industrial, and recreational needs of the area. The Edwards Aquifer is also the source of the two largest springs remaining in Texas: Comal and San Marcos springs. These waters provide habitat for listed species and provide fresh water inflows to the rivers that support the bays and estuaries on the Gulf Coast, including the wintering grounds for the last remaining wild flock of whooping cranes, found at the Aransas National Wildlife Refuge.

In Texas and Oklahoma, state and federal agency biologists have rescued peppered chub, Arkansas River shiner, and sharpnose shiner

from drying rivers. Because of past droughts and natural or man-made disasters, we already hold a number of species in captivity—just in case. The Big Bend gambusia lives only in one location in the wild, Big Bend National Park, but we keep it at Dexter National Fish Hatchery, too. The Clear Creek gambusia lives only in one privately owned pond, and we keep it in captivity at Inks Dam National Fish Hatchery.

Let us all hope that we do not have another year like this one, with both drought and incredible fire danger. But if we ever find ourselves in this situation again, we have the benefit of experience and know-how behind us. ♦

Mike Oetker is the Assistant Regional Director-Fisheries, and Nicole Osborn is a writer, both stationed in the Southwest Regional Office of the U.S. Fish and Wildlife Service in Albuquerque, NM.



U.S. Fish and Wildlife Service biologists take threatened Little Colorado spinedace from Arizona's Rudd Creek in the face of wildfire.

Shaula Hedwall/USFWS

By Dale Bast

Thirty Years Young: Iron River National Fish Hatchery



USFWS

Biologists from Iron River National Fish Hatchery and the Minnesota Department of Natural Resources work together to stock lake trout into Lake Superior.

At thirty-something years old, Iron River National Fish Hatchery is one of the youngest facilities within the 141-year-old National Fish Hatchery

System. Like with many hatcheries, we are nestled in the forest, high up in a watershed, and a few miles from nowhere. We carry on a fisheries

conservation mission that benefits fish and people.

The hatchery is located where it is for one very good reason—water. Springs gush out 3,500 gallons of water each minute that flow freely through pipelines, tanks, treatment ponds, and back again to the original stream bed with only the pull of gravity.

To protect this small watershed, the U.S. Fish and Wildlife Service purchased 1,200 acres of land that encompasses all the springs and it adjoins the Chequamegon-Nicolet National Forest Service or Bayfield County Forest property. With this amount of land, Iron River National Fish Hatchery affords an uncommon amount of opportunity for outdoor education. More than three miles of trails for hiking, snowshoeing, and cross-country skiing are marked and maintained here. We are open to public hunting and fishing, and have a snowmobile/ATV trail that crosses the property. We cooperatively manage historic hayfields with the aid of local farmers, and offer public firewood gathering permits; with fewer dead trees there is less of a fire hazard.

Wildlife species are numerous and often viewed unexpectedly near our facility. Predators such as bears, bobcats, wolves, coyotes, and fishers have pressured the white-tailed deer to have their fawns near the roads and fields adjacent to the hatchery office. Each year we get to see newborn fawns nursed from the office windows. One spring a fawn tried to follow a co-worker to the office while it was still wet and unable to walk on its still-wobbly legs. Its mother returned after a few hours and reclaimed her young one. Nature is a rough place to make a living; this

year we spotted a bald eagle feeding on a fawn that did not survive.

Each morning, I arrive early and pause in the parking lot to look and listen for wildlife. It's common for me to hear the yelp of a coyote or the buttery whistle of a whip-poor-will in the crepuscular light of dawn. We have a long list of songbirds that greet the summer morning sun. Some days, as it is in life, it rains, and yes some days it is windy, snowing, and cold. Iron River National Fish Hatchery can be a place of extremes: the snow can pile three feet high in one helping and the mercury dips to minus-40 degrees. Regardless, each morning I tell myself that I am a lucky man.

The staff will soon arrive, and there are a couple of million hungry fish to care for. This hatchery was not built because of the wildlife and natural beauty—and we have an abundance of both—but instead this place was put into public service for the ability to produce large numbers of fish.

Iron River National Fish Hatchery was designed and built to produce lake trout in order to help restore the species in the Great Lakes where the fish once swam in great quantities. By the 1950s, over-fishing and invasive sea lampreys had almost wiped out the lake trout in all of the Great Lakes. By the 1960s, techniques were developed to control the parasitic sea lamprey (see *Eddies*, Winter 2010). Remnant populations of lake trout were gathered as broodstocks, and hatcheries were built to produce millions of fish. Pendills Creek, Sullivan Creek, and Jordan River National Fish Hatcheries were in full production before Iron River got started. State and Provincial Canadian hatcheries, and tribal biologists were all working to restore lake trout. This restoration is no small task. Lake Superior alone holds one-fifth of the world's fresh water, Lake Michigan is even larger in surface area, and Lake Huron carries

almost all the water leaving these two mammoth lakes.

Management of all this water and its fish is shared by many governments that work under the guidance of the Great Lakes Fishery Commission, an international group that coordinates fisheries conservation. This effort went forward without many of today's laws. There was no Endangered Species Act or Clean Water Act to help. Consequently some stocks went extinct, and the waters flowing into Lake Erie were so polluted it supported almost no fish. So the commission had a few challenges—and it led to greater determination.

That determination has led to accomplishments. By 1995, the number of lake trout naturally hatched in Lake Superior far outnumbered those originating from a hatchery. Many of these wild fish were offspring of hatchery stocks released as early as the 1960s. Some of these stocked fish reached the age of 30 to 40 years and spawned many times. With the high number of wild and hatchery adults reproducing, there was no longer a need to stock the majority of Lake Superior. So we moved on to Lake Michigan, but our progress has been limited by the impact of the overwhelming list of non-native fishes that have invaded or were introduced into that system over the years. Through stocking adult fish, the population has rebounded and is poised to reproduce soon.

Lake Huron was severely impacted by the sea lamprey populations until the 1990s. Once the lampreys were controlled, lake trout began to reach maturity and reproduce. In recent years, scientists, commercial fishermen, and anglers have all been capturing numerous mature adult lake trout. In many areas, 40 to 50 percent of the large fish were naturally hatched in the wild. This lake may be rapidly moving toward restoration.

So where does this leave Iron River National Fish Hatchery when lake trout are restored? Well, we have not stayed idle. Since 1995, we have been working to restore the coaster brook trout, a species of trout that makes a home along the near-shore habitats of the Great Lakes. Then there's the lake sturgeon too—a swimming dinosaur. In the face of all of the fisheries conservation challenges, there will be more work ahead with other species as well and the folks at this still-young Iron River National Fish Hatchery will be up to the task. ♦

Dale Bast is the manager of Iron River National Fish Hatchery, located a few miles from nowhere, 10 miles south of Lake Superior and nearer still to Iron River, WI.



Millions of lake trout fry every year get their start at the Iron River National Fish Hatchery.

By Craig Springer

Reading Between the Lines

Historic memo proves prophetic

Fort Apache Indian Agency,
Whiteriver, Arizona,
February 15, 1935.

Commissioner of Indian Affairs:

We, the Council of the White Mountain Apache Indians, after having thoroughly explained to us your letter of February 8, 1935, and the Bill introduced by Carl Hayden, Senator from this State, recommending the appropriation for the purpose of establishing a Federal Fish Hatchery on Williams Creek, on this Reservation, hereby lend our support and approval of the location of a Fish Hatchery, as we feel that it would be a benefit to the reservation.

We are favorable to granting for an indefinite period the use of the location desired by the Federal Bureau of Fisheries on condition that a reasonable effort will be made to keep all streams on the reservation well stocked with mountain trout; that insofar as possible Indians of this reservation be favored with such labor as they can perform at commercial wages; that in the purchase of worthless ponies the Hatchery give Indians preference in supplying the same.

We will gladly donate sufficient pasture wherein this Federal Hatchery may keep a supply of ponies on hand, requesting only that the government pay us the prevailing price for these ponies.

With the above mentioned consideration we feel that the proposed Federal Fish Hatchery will be a benefit to the reservation as well as the surrounding community, and we wish to go on record as favoring and cooperating with the Federal Government in establishing this proposed Hatchery where designated on this reservation.

Baha, Head Chief, His Mark	<i>Floyd & Togg</i> Chief, Eastfork District
John Ethelbah, His Mark Chief, Carrizo District	<i>Jack Keyes</i> Chief, Eastfork District
Charley Shinn, His Mark Chief, Canyon Day District	John Taylay, His Mark Chief, Cibicous District
Yahit Kane, His Mark Chief, Cedar Creek District	Will Lupe, His Mark Chief, Oak Creek District.
Bigelow John, His Mark	
Isaac Gass, His Mark Chief, Turkey Creek District.	

You don't have to read between the lines of a 1935 memo from the White Mountain Apache Tribe to the Commissioner of Indian Affairs in Washington, D.C., to understand the Tribe's desire. It's all there in the kerned words strung along through four short, tilted paragraphs. They wanted the U.S. Bureau of Fisheries to build a hatchery on their land for the purpose of employment. The tribal council understood the potential economic outcomes, maybe not in the modern metrics that economists measure things today, but intuitively they understood that fisheries conservation work and improved fishing close to home translated into jobs.

Consider the context of time; America was in the throes of the Great Depression, six years into it when the missive was drafted. The Apaches asked that they supply the labor force to produce trout for what is arguably still today a tremendous place to intersect with nature—the high country of eastern Arizona. Forget the iconic saguaro cactus associated with the Grand Canyon State, this place is populated by ponderosa pine, blue spruce, and white fir atop tall mountains that capture soppy winter snows. Trout do best in pretty places, and the White Mountain Apache Tribe's land is just that.

Then there's the odd clause in the memo about supplying "worthless ponies." Feral horses were harvested and reduced to cuts of meat, allowed to rot and become a base whereby flies could lay eggs. Eggs became maggots, and maggots fish food. With science and its offspring, technology, diets for fish in hatcheries have improved greatly since then (see *Eddies*, Fall 2008).

This 1935 letter from the White Mountain Apache Tribe to the Commissioner of Indian Affairs states the Tribe's desires to support fisheries conservation on their land.

USFWS



Craig Springer/USFWS

Bradley Clarkson, a fish biologist and member of the White Mountain Apache Tribe, has had his hands in Apache trout conservation for the last 16 years.

And look at the signatories, the names of the Apache chiefs of the tribal council. Sadly only two of them were literate—all the others signed the memo with a thumb print. But the tribe succeeded in their quest. Construction of Williams Creek National Fish Hatchery commenced four years later, largely built by a product of the Depression, young men in the Civilian Conservation Corps. In June 1941, rainbow trout eggs arrived by rail from Eagle Nest, New Mexico, and Yellowstone

cutthroat trout from the national park. Also that same year, hatchery biologists took a stab at culturing the “Arizona native trout,” what we have since come to recognize as the Apache trout. It’s a threatened species, and like the White Mountain Apache people, its association with this place is steeped in time. You’ll find the yellowish, black-flecked trout nowhere else in the world but here.

In fish biologist Bradley Clarkson is the embodiment of what his tribal

ancestors desired. Clarkson is a 16-year veteran employee of the U.S. Fish and Wildlife Service. He holds a bachelor’s degree in Fisheries Science from the University of Arizona. He’s a family man, married, a father of three and granddad to one. Clarkson grew up hunting and fishing and playing baseball and still does a little of all that. He’s a right fielder for the all-Apache team, the *Turkey Creek Expos*. They travel to Phoenix and Tucson and to other Indian reservations to play the game. On



Craig Springer/USFWS

Apache trout naturally occur only in the White Mountains of eastern Arizona. Given species recognition by science in 1972, this unique trout had been known to the Apaches and interlopers a century before. U.S. Army Lt. Britton Davis wrote that streams near his 1885 camp “were alive with mountain trout. There were literally thousands of them for every mile or two of creek.”

The Arizona Fish and Wildlife Conservation Office is the lead field station for recovery of Apache trout. Working with the State, Tribe, and Forest Service, we improve Apache trout populations through construction and maintenance of artificial barriers used to isolate Apache trout from nonnative fishes; remove nonnative fishes from within recovery populations; restore stream and riparian habitats; and provide angling opportunities in lakes and streams for Apache trout produced by Williams Creek NFH. ♦ Jeremy Voeltz

the job, for the last decade and a half he’s worked where early Williams Creek biologists couldn’t get traction: Apache trout culture.

Bob David, a now-retired fish biologist, mastered Apache trout culture in captivity in 1984, at the request of the Apache Trout Recovery Team. The team is a body of fisheries professionals that direct conservation work on the fish with the single focus of getting the animal off the list of threatened species.

Clarkson carries on. The broodstock of Apache trout now at the hatchery is well developed. It’s customary that Clarkson and others at the hatchery are spawning Apache trout in December. Williams Creek

Spring makes this all the more easy; it gurgles out of the ground under a pitched-roof protective cover at a constant 52 degrees. The water mixes with air through aluminum baffles, gets injected with oxygen, and lastly disinfected by ultraviolet in place of harsh chemicals by passing through pipes lit up with special light bulbs. The spring water still only a few feet downhill from its natal rocky fissure, passes over Apache trout of a variety of sizes residing in concrete raceways.

According to Clarkson, the spring was a traditional Apache site for drinking water and for bathing. The water is in a peculiar way still a source of vitality for the people, but in a larger sense. The Apache trout produced from the spring

at Williams Creek National Fish Hatchery don't go far, being stocked out in waters managed by the White Mountain Apache Tribe, the U.S. Forest Service, or the Arizona Game and Fish Department. The native fish have a following of anglers. But they are not the only fish raised there. Rainbow trout, brown trout, and brook trout still come from the hatchery, but to a far less degree since Apache trout rose in prominence.

The nearby and much newer Alchey National Fish Hatchery also raises trout for much the same purpose, the rainbows, browns, and brookies going to Indian reservations in the Four Corners states. All told, these trout support a tremendous sport fishery with measureable economic outcomes. Here is one such measure: in 2006, economist Dr. James Caudill with the U.S. Fish and Wildlife Service learned that for every taxpayer buck spent on trout at these two hatcheries, it generated some \$19 in retail sales, and that implies jobs.

Looking over that 1935 memo with the thumb prints, and reading the direct nature of the message saying essentially, 'a hatchery will stimulate the economy,' it appears that the tribal council got what it was after.

The ponies are gone. Trout eat food created by Ph.D. nutritionists, and fisheries management has moved away from art towards science. Clarkson has the enviable position of doing something he loves, something the men a couple of generations ahead of him wanted him to do. It's poignant that men who could not read, stamped in ink their unique thumb prints, in a way giving a seal of approval ahead of the fact. ♦



A large tank truck distributes Apache trout from Williams Creek National Fish Hatchery to points nearby.



Water percolates over rainbow trout eggs as they incubate indoors. These eggs arrived by post from White Sulphur Springs National Fish Hatchery in West Virginia, underscoring that the 71 National Fish Hatcheries operate as a "system."

By Kari Duncan

Peering Under the Hood



After 50 years of service, a pipeline at Alchey National Fish Hatchery in Arizona had to be replaced. Now, 10,000 gallons of water per minute pours through this new pipe, ensuring economically important trout are delivered to Indian tribes in the Four Corners states.

National Fish Hatcheries have been around a long time. Fish hatcheries served as the origin of the U.S. Fish and Wildlife Service as we know it today. As of September 1, 2011, 68 of the 71 National Fish Hatcheries are over 30 years old and 12 of those are over 100 years old. But don't let age fool you. Our hatcheries may be old and they certainly have maintenance needs, but it doesn't mean they're behind the times or falling apart.

The National Fish Hatchery System (NFHS) rears or holds in refugia 81 species of fish, 38 of which are threatened or endangered; 31 species of mussels, 14 of which are threatened or endangered; 4 threatened or endangered species of invertebrates; 4 species of plants; and 10 species of other vertebrates, 8 of which are threatened or endangered. It takes a lot of working parts to move water for all of those animals and plants, and it takes dedicated employees and a significant amount of maintenance funding to keep it working properly. We have maintenance challenges, successes, and lessons learned.

Neosho NFH in Missouri provides an example of a maintenance success. It's the oldest continuously operating hatchery in the NFHS, and it boasts the newest renewable energy technology in the system. The 9,500-square-foot visitor center achieved a gold rating under the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) program and includes photovoltaic solar panels, energy efficient building systems, geothermal wells, and was built using environmentally friendly, natural materials including fiber cement siding, wood framing, metal roofing, stained concrete and marmoleum flooring. It's the first building in

Craig Springer/USFWS

the U.S. Fish and Wildlife Service to achieve a LEED gold rating and we're proud of this achievement.

Leadville NFH, in Colorado, will celebrate its 125th anniversary in 2014. It is home to a highly complex water treatment system that filters disease-causing pathogens, such as whirling disease. Clean water ensures healthy Snake River cutthroat trout, rainbow trout and greenback cutthroat trout come out of the hatchery. The water treatment system, built in 2004 for \$1.8 million requires about \$60,000 in annual operations and maintenance. The design is innovative and is critical to keeping this "old" hatchery operational, but it requires a significant financial investment.

One of the lessons learned occurred at Jackson NFH in Wyoming in June 2011 when the hatchery lost power. A transfer switch for the electrical system had been ordered but not installed so the emergency generator could not supply power to keep water circulating in the raceways. As a result, 150,000 Snake River cutthroat trout were lost, including broodstock being held for future production. Because of this loss, other hatcheries are reviewing their backup power systems to ensure this doesn't occur elsewhere. The Grand Valley Propagation Facility, which rears endangered razorback sucker for the Colorado River, identified this same deficiency following the loss in Wyoming.

A prime example of challenges and successes occurred at Alchesay NFH in Arizona. Alchesay NFH supplies rainbow trout to 19 tribes and pueblos in Arizona and New Mexico, which in turn through angler expenditures generate \$20 million in economic



Ed Stege/USFWS

Water at the Leadville National Fish Hatchery in Colorado passes over this rotating drum pre-filter; removing debris as small as 80 microns. The water then moves to a 10-micron filter to remove tams, the organism that causes whirling disease in trout.

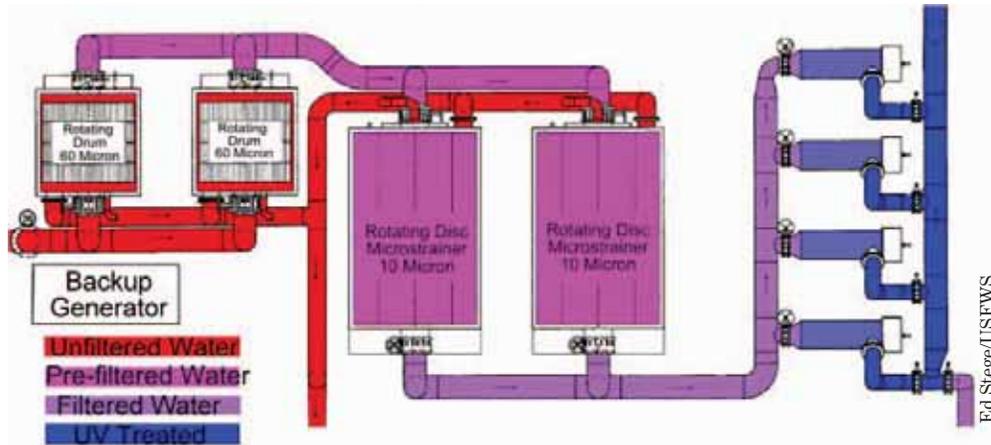
output, returning \$1 million in tax revenue. The hatchery's 1,400-foot water supply pipeline that ruptured in May 2009 has been replaced and is supplying the hatchery with 10,000 gallons of water per minute. Alchesay NFH was only out of production during the seven-month construction phase. In preparation for the replacement, all of the fish from Alchesay NFH were stocked at smaller sizes in May 2011. Rainbow trout that are stocked in the summer months support a very important recreational fishery for the White Mountain Apache Tribe, and are the driver of a significant economic engine for the surrounding White Mountain communities of eastern Arizona. To minimize impacts to the tribal communities, Hotchkiss NFH in Colorado provided catchable sized rainbow trout throughout the

summer. This project is a tremendous example of excellent planning and coordination across hatcheries to meet the needs of surrounding communities, really underscoring

that the hatcheries operate as a “system.”

The ability of the NFHS to accomplish its mission is largely

determined by the condition of key, mission-critical assets associated with water delivery, aquatic species culture, and effluent management. These mission-critical water management assets, which constitute over two-thirds of the nearly 4,000 constructed assets within the NFHS, include those that directly deliver and treat the water delivered to, and discharged from, the hatchery, and regulate the actual rearing or holding environment of fish and other aquatic species. Properly managed, preventive maintenance is the most logical and cost-effective way to resolve maintenance issues as they occur. Funding for maintenance has averaged just over \$8 million per year in the past several years, and the NFHS can plan recurring maintenance to enable more proactive



This simple schematic diagrams the complex water treatment system built in 2004 at Leadville National Fish Hatchery, installed for the express purpose of preventing whirling disease in greenback cutthroat trout, rainbow trout, and Snake River cutthroat trout.



Each of these three large cartridges house 24 ultra-violet light bulbs. A fourth cartridge is not pictured. Water pours past the intense light inside, killing bacteria and fungus, ensuring the water used to raise trout is of the highest quality at Leadville National Fish Hatchery.

asset management, reduce maintenance needs from becoming costly deficiencies, foster safe, successful operations, and deliver our mission.

Deferred Maintenance funding, which is also approximately \$8 million per year, is directed at the repair, rehabilitation, or replacement of constructed assets that have already been delayed beyond their scheduled maintenance or replacement date. After critical health and safety projects are addressed, the bulk of remaining funds are applied to those mission-critical assets required for aquatic species conservation.

Ensuring hatcheries are kept fully functional is key to the NFHS's ability to conserve significant fish and other aquatic species. Current funding of \$8 million for Annual Maintenance and \$8 million for Deferred Maintenance does not keep pace with inflation and an aging infrastructure, but given the success and variety of propagation and refugia programs within the NFHS, we've proven that we can make a little funding go a long way. ♦

Kari Duncan is chief of the Branch of Hatchery Operations and Maintenance in the headquarters office of the U.S. Fish and Wildlife Service in Arlington, VA.



Pumps and filters require reliable electricity. This backup generator keeps alarm systems running and the water flowing in rare times of need at Leadville National Fish Hatchery. It exercises itself for 15 minutes every Tuesday to make sure all is in order.

Ed Stege/USFWS

By Stuart Leon, Ph.D.

Hatchery in the Heartland



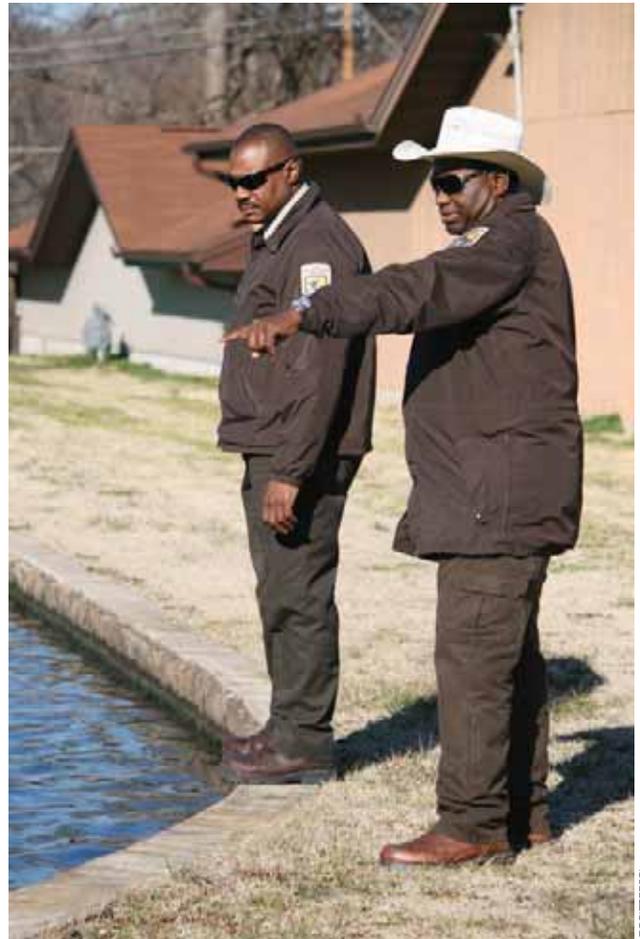
Artist W. Jeffery Jones commissioned by First Community Bank captured on canvas Neosho National Fish Hatchery manager; David Hendrix, while a crew pulls a net in front of a newly built visitor's center. The building is the first in the U.S. Fish and Wildlife Service to earn a LEED Gold rating. Jones is active in the Friends of Neosho National Fish Hatchery.



W. Jeffery Jones

Satisfying is the simple fact that the heart of America is far from today's Wall Street. Folks in the Nation's heartland wag their heads in quiet disbelief at the goings-on in DC's beltway. Here, a steadfast affinity to family values, church, your neighbors, and your home town is deeply rooted in one's psyche. Local high school football games on Friday nights are fodder for a week's worth of conversations at diners and gathering places throughout history-laden main streets and town squares. Where you come from and what brought you here define you as a person. The tie to the past provides the inner strength needed for meeting the challenges the future will bring. This is the visceral vigor and beauty of our heartland.

Nowhere is the value of history, family, and home town more exemplified in the heartland than in the "City of Springs," Neosho, Missouri. As sure as the springs bubble forth from mother earth, the residents of Neosho are rightfully prideful in the role their ancestors played in defining this great country. In October 1861, Neosho played host to Governor Claiborne Scott Jackson and several elected members of the Missouri state government who met in the town square to vote for secession from the Union. Only two other Confederate states, Virginia and Tennessee, were to see more battles on their soil as did Missouri. And so, this is a glimpse of Neosho, a mining heritage, and townsfolk closely associated with the bounty of



USFWS

Skilled leadership. *Roderick May, assistant hatchery manager (l) and David Hendrix, manager, plot the course for future fish production at Neosho National Fish Hatchery in Missouri.*



David Hendrix/USFWS

An endangered species, the pallid sturgeon gets a hand from biologists at Neosho National Fish Hatchery. The facility also raises rainbow trout and eyeless Ozark cavefish.

wildlife. Subsistence through hunting and fishing—a relationship with the land—enabled Neosho to endure. Located on the western flank of the pastoral, breathtaking Ozarks, the town is just an hour west of the larger city of Springfield—home to the contemporary entrepreneurial iconic symbol of citizen conservation, Bass Pro Shops.

In February 1889, William F. Page arrived in Neosho to be Superintendent of the then new Neosho National Fish Hatchery (NFH), located only three short blocks from the historic town square. Situated near bountiful and pure springs for which it is named, and the

confluence of three major railroads, Neosho NFH is the Nation's oldest continuously operating federal fish hatchery. And it is much more. The hatchery is indistinguishable from the historic trappings of this town and southwest Missouri. Its place in Neosho's social and cultural fabric is palpable, and is no doubt a primary reason this community remains proud and vibrant.

Cradled within the town's eastside neighborhoods, Neosho NFH is a destination place for conservation enthusiasts. If by chance you are planning a vacation to Branson, or to Bass Pro Shops prior to your long-awaited fishing trip to Lake

Taneycomo, be sure to work this special place of American history and genuine hospitality into your route. Each year, over 45,000 visitors make their way to the hatchery to enjoy the beautiful park-like environment and the tours offered by the informed and dedicated employees.

Neosho NFH has several ongoing fishery programs that include providing rainbow trout for purposes of mitigating the effects of large federal water projects; participation in recovery efforts through captive propagation and grow-out of federally endangered pallid sturgeon; refugia and protection of the federally threatened Ozark cavefish; and

restoration and recovery work for the benefit of imperiled native mussels. The four beautiful springs that flow to the hatchery allow biologists to produce over 100,000 pounds of rainbow trout each year. Neosho's trout generate more than 160,000 angling-days that in turn drive nearly \$6 million in retail expenditures and a total economic output of \$11 million. The hatchery's high-quality spring water is essential for maintaining a disease-free environment. Enigmatic hatchery manager, David Hendrix, says it plainly: "The thing that is so special about Neosho from a production standpoint is its ability to manipulate its water temperature to produce anything freshwater; be it cool-, cold-, or warm-water organisms. It's a perfect place for successful fish culture."

Recovery of the endangered pallid sturgeon throughout the highly modified Missouri River is no small undertaking (see "Romancing the River," *Eddies*, Summer 2008). Neosho's primary role is to apply best science practices to increase successful captive propagation and grow-out, with an eye towards releasing 15,000 genetically appropriate and disease-free pallid sturgeon, 15 inches long, into the Missouri River each year.

Aside from fish culture, there are myriad other special things about Neosho NFH. It begins with the hatchery's exceptional employees. The recipe for success: a vastly talented group of people that love what they do, and dare to make a difference each and every day. These are employees who understand the importance of nurturing relationships with their community and their Partners. "We understand that when we team up with others who share our mindset about caring for our Nation and its bountiful aquatic resources,

great things can happen, and the public and its precious resources will benefit," says Hendrix.

Consider the mindset shared. The Neosho NFH Friends Group is one that represents an amazing cross section of the community. Lawyers, bankers, farmers, merchants, retired school teachers, and many more all come together to support the hatchery. These committed volunteers provide thousands of hours each year that enable hatchery staff to better serve the community. The beautiful park-like hatchery grounds serve as the perfect gathering place for weddings, class reunions, annual fishing events for youth and the elderly, scouting activities, picnics, and much more. With the completion and dedication of the new Visitor and Educational Center in December 2010, visitation is expected to exceed 100,000 folks each year.

"It's a very special place and a wonderful asset for our community, the Fish and Wildlife Service, and our Nation," says Hendrix. ♦

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



USFWS

Growing up in Neosho, Heather Thorne, Administrative Officer for the hatchery, never dreamed she would one day work there. "For years I lived just two blocks from here. As a youth, I walked and biked the hatchery grounds almost daily. I love this place, my job, and the people I work with."

History in the Making

Atlantic salmon conservation at Craig Brook National Fish Hatchery



E. Peter Steenstra/USFWS

An Atlantic salmon male showing the “kype,” the battering ram he uses to do battle with rival males for the right to spawn.

Today, the mission of Craig Brook National Fish Hatchery in Maine is the same as it was when it was founded over a century ago – to restore Atlantic salmon to the rivers of the northeast.

Migrating Atlantic salmon were plentiful for centuries in the northeast United States until over-fishing, pollution, dams and loss of habitat took their toll. Populations declined dramatically. By the late 1940s, they

had altogether disappeared from the Penobscot River north of Bangor. The population headed towards extinction.

In a report issued to the Maine state legislature in 1868, Charles G. Atkins, the newly appointed fish commissioner from Maine, recognized the problems plaguing the species. He began experimenting with raising fish in captivity in order to help restore wild stocks, and

focused his research on Atlantic salmon life history, culturing methods, and fish behavior to help address the declining fishery.

Atkins saw the economic value of having a fish hatchery for breeding salmon and established a multi-state facility in 1871 on Craig Pond, just above the current hatchery location. In 1872, Atkins came to work for the U.S. Fish Commission, the predecessor to the U.S. Fish and Wildlife Service. His fish husbandry work ceased in 1876, because the cooperating states and the U.S. Fish Commissioner suspended operations until the results of previous efforts were evaluated. In 1879, Atkins was instructed to once again commence Atlantic salmon egg production. As a consequence, the Fish Commission had its first Atlantic salmon hatchery in Orland, Maine, predecessor to today's Craig Brook National Fish Hatchery, and Atkins became recognized as the father of Atlantic salmon culture.

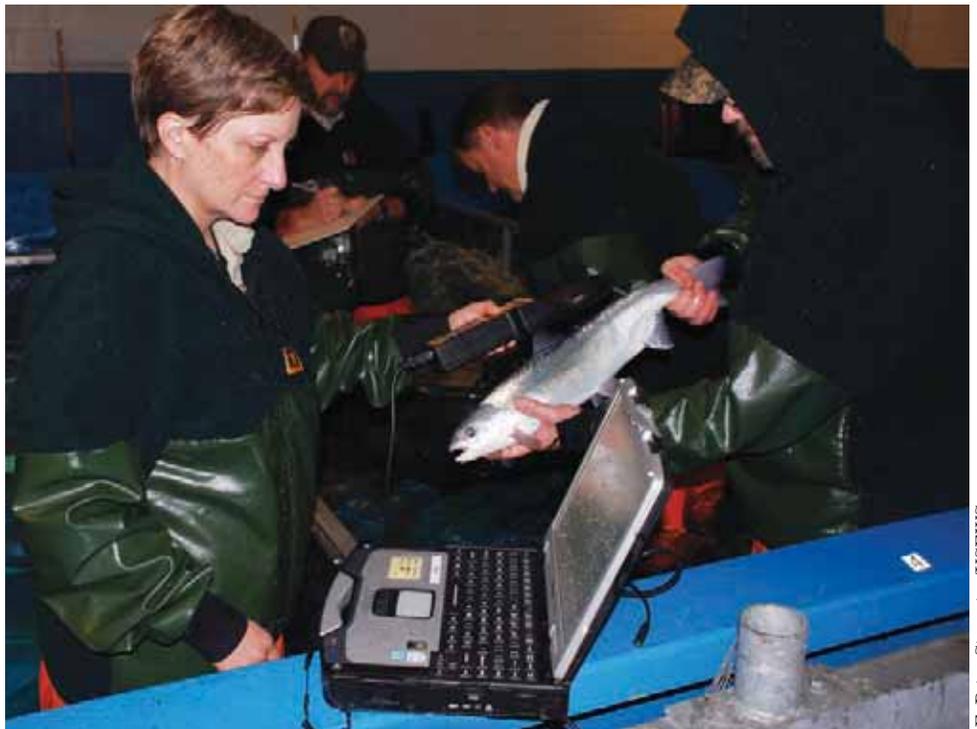
In 1889, Congress appropriated funds for the purchase of 135 acres of land, construction of buildings and ponds, and the purchase of equipment of the fish hatchery and rearing stations that included Craig Brook. In 1890, the decision was made to concentrate on raising Atlantic salmon to restore Maine's wild salmon population—and the first year alone produced 1.9 million eggs.

Fast forward to the mid-1990s. U.S. Fish and Wildlife Service fish biologists were still playing a significant role in restoration of Atlantic salmon at the Craig Brook National Fish Hatchery. At the time, the Fisheries Program anticipated that the species would need protection under the Endangered Species Act. As a result, the hatchery

was reinvented using a modern, scientific conservation hatchery design.

And in fact, it was in 2000, that the U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration's Fisheries Service listed the Atlantic salmon as endangered in eight Maine rivers: the Dennys, East Machias, Machias, Pleasant, Narraguagus, Cove Brook, Ducktrap and Sheepscot. Then in 2009, both agencies extended Endangered Species Act protection to Atlantic salmon in the Penobscot, Kennebec, and Androscoggin rivers and their watersheds.

“Craig Brook National Fish Hatchery has been instrumental at preventing extinction of Atlantic salmon in



E. Peter Steenstra/USFWS

U.S. Fish and Wildlife Service biologist Denise Buckley scans for a female Atlantic salmon's PIT tag to determine its genetic compatibility with a male fish from the Sheepscot River population. Biologist Coley Powers holds the female for scanning.



E. Peter Steenstra/USFWS

Craig Brook National Fish Hatchery, East Orland, Maine.

the United States,” said Dr. Jaime Geiger, U.S. Fish and Wildlife Service Assistant Regional Director of the Fisheries Program in the Northeast Region. “It was designed to recover salmon but, as we look to the future, it’s also flexible enough to accommodate restoration of the full suite of aquatic species important to Maine’s healthy and productive ecosystems.”

In 2011, after decades of decline, wild adult salmon returns to the Penobscot and Narraguagus rivers were the best since program peaks in the 1980s. “We are encouraged by the improved returns and the possible stabilization of North American salmon stocks,” said Geiger. He added, “We have been working hard with other state and federal agencies and non-government groups, including international fishery management groups, to ensure that

impacts on Atlantic salmon from other fisheries are reduced. We have been using the best technology and genetic methods to produce and release resilient fry and smolts. And, we have done everything in our power to ensure that suitable habitat is available, degraded habitat is improved, and river connectivity is restored.”

Nevertheless, the U.S. Fish and Wildlife Service is proceeding with great caution to continue to build on the river-specific remnant stocks of Atlantic salmon. Ambitious plans are in place to remove three large dams on the Penobscot River. And, the Craig Brook hatchery in East Orland is continuing its mission, spearheading the recovery of Atlantic salmon in Maine with assistance from the Green Lake National Fish Hatchery in Ellsworth, a sister

station under the Maine Fisheries Program Office Complex.

“This places the Maine Fisheries Program at the forefront of endangered species recovery,” said Geiger. “Like Charlie Atkins before us, we are concentrating on bringing the citizens of Maine healthy fish in a healthy environment, using management tools which include hatcheries like Craig Brook.” ♦

Jan Rowan is a fish biologist stationed in the U.S. Fish and Wildlife Service’s Northeast Regional Office in Hadley, MA.

Valerie Fellows is a public affairs specialist based in the headquarters office of the U.S. Fish and Wildlife Service in Arlington, VA.



E. Peter Steenstra/USFWS

The Friends of Craig Brook NFH organization maintains the Atlantic Salmon Museum during the summer months. The museum, established in 1995, uses the facility’s 110-year-old building as its venue. True to its name, the ice house was used to store ice cut from adjacent Alamoosook Lake. It was the source of the hatchery’s ice all summer long.



E. Peter Steenstra/USFWS

Atlantic salmon have long been the concern of Craig Brook National Fish Hatchery in Maine. Science determines how biologists pair mates to raise fish for the future. Salmon eggs in these dishes have been fertilized and will incubate under watchful eyes.

Meanders

By Buddy Jensen

Willows over the Water

Black willow leaves hanging close by trembled slightly in the autumn breeze. Some broke loose and gently spiraled to the water's surface below. There were fish there, not big ones, but fish nevertheless. In the reclusive shadows a bent straight-pin delicately pierced a wriggling worm. Attached to a cotton string safely secured to a small willow pole, a budding fisherman sought his elusive quarry. As the worm broke through the surface of the water, it was voraciously attacked by the throng of small fish living in the pool of clear water along the banks of the Gila River. Only 200 yards from the house, a passion for things aquatic imprinted on the mind of a young farm boy taking a welcome respite from the fall harvest in the farm fields. After numerous misses, persistence eventually paid off and a silvery three-inch minnow flopped among the golden leaves covering the riverbank.

Reflecting back on those frequent excursions by this then pre-school lad, the elusive target was most likely a longfin dace, one of the more common fishes native to the upper Gila River in southwest New Mexico. It was the early fifties and an enticing world lay just beyond the trees lining the serene home place. It wasn't just the river close to home, I was fortunate to have a father who rarely went anywhere in the

outdoors without his sons in tow, even at an early age.

Fishing the headwaters of the Gila River throughout my formative years exposed me to unique native fishes that captured my imagination. Memories of the aggressive strike and explosive jump of a roundtail chub fooled by a silver Mepps spinner; and the powerful surge of a large Sonora sucker ripping line from my reel still paint brilliant scenes in my mind. Like the ripples of a stone delicately tossed into still water, the memories still roll onto the shores of my childhood reflections.

The Gila River and its high mountain tributaries also yielded to my enticements an impressive array of table fare comprised of non-native sport species introduced to support angling. Channel catfish, smallmouth bass, rainbow, brook, and brown trout, frequently graced the glowing embers of a streamside fire and Mom's kitchen table back home.

Few things bring peace, contentment, and relaxation to me like the soothing music of a stream cascading over bug-laden boulders underneath aromatic ponderosa pines, sycamores, and Arizona alders. Herbert Hoover mused "To go fishing is the chance to wash one's soul with pure air, with the rush of the brook, or with the shimmer of sun on blue water." And Izaak Walton wrote "Rivers and the inhabitants of the watery elements are made for wise men to contemplate

and for fools to pass by without consideration."

I consider them now, maybe more than ever before. I didn't understand in those early years the delicate balance of the aquatic ecosystem that I found so alluring. Ecosystem, habitat components, fish community structure, niche, and inter-species competition were ecological concepts yet to be learned. Jack Carlson managed the state fish hatchery in Glenwood, New Mexico, near the banks of Whitewater Creek, and was a close friend of my father. Mr. Carlson would take time to show and patiently explain to me about eyed eggs, fry, and fingerling trout that one day would be destined for a favorite stream as catchable rainbow trout. My early exposures to the art and science of fish culture set me on a course; the thoughts began to form that somehow, someday, I have to be a 'fish culturist' too. So began the journey that became my life: a fishing fanatic, a Bachelor's Degree in Fish and Wildlife Management, a Master's Degree in Fishery Science, and a career as a Fishery Biologist with the U.S. Fish and Wildlife Service.

An avid angler still, I often ponder the road traveled, the camaraderie and commitment of dedicated colleagues, and the challenges yet ahead for those currently employed in conservation. I know that they too are captivated by the enormity and diversity of our nation's rich aquatic resources and economically important



recreational fisheries, and for their season of opportunity to contribute to and preserve the same.

Finding the balance between native fish and non-native fisheries conservation has always been a challenge, but one that U.S. Fish and Wildlife Service professionals have consistently met. Since its founding in 1871, the ever-changing role of the National Fish Hatchery System is a tribute to the dedication and adaptability of its employees in response to emerging national aquatic conservation issues. Hatchery workers have always risen to, and nearly always met, the challenging assignments placed in their trust. Not every endeavor has succeeded at first, but most have, and the results of patient persistence have been a milestone in the conservation of imperiled aquatic species of this great nation.

Conserving America's fisheries has been the mission of the National Fish Hatchery System now for 140 years, and its employees have been on the cutting edge of fishery science from the beginning. New culture protocols for previously uncultured species now seem to be written annually by scientists at National Fish Hatcheries. Whether it was commercial fish food stocks in the early years; farm pond programs through the Great Depression; Pacific salmon and steelhead on the West coast; striped bass and American shad on the East coast; paddlefish, alligator gar and pallid sturgeon in

the heartland; lake trout and coaster brook trout for the Great Lakes; Apache and Gila trout, bonytail, and razorback sucker in the Southwest; toads in Wyoming; blind salamanders and wild rice in Texas; or imperiled mussels in the Midwest – the National Fish Hatchery System has always responded to conservation needs of the time.

Working with important stakeholders that include Native American tribes, other federal agencies, state agencies, and the private sector, the National Fish Hatchery System remains uniquely positioned to meet its statutory responsibilities to recreational fishing for Tribal Trust programs and federal water project mitigation. But equally important, it is deeply engaged in native fish recovery programs—with many of those also filling unique niches in the sport fishing arena. The National Fish Hatchery System always has and will continue to respond to emerging issues, or to natural or man-caused disasters that affect fisheries. National Fish Hatcheries are typically situated on valuable water supplies. That has enabled the U.S. Fish and Wildlife Service to maintain rare or imperiled species of fish and amphibians until their natural habitats recuperate. National Fish Hatchery System facilities offer a place to keep rare fishes and their gene pool in captivity to ensure long-term survival. And here is an added benefit: National Fish Hatcheries offer places to conduct conservation education—a place

where visitors heighten their awareness of nature, witness conservation at work and come to better understand the economic contributions of America's 40 million anglers.

At 141 years old, the National Fish Hatchery System remains an American institution. To those who have been fortunate to be a part of those experiences, a sense of pride accompanies the memories of dedicated colleagues. Then as now, fish culturists wouldn't be there if they didn't love their work. And that, if nothing else, bodes well for the future of fisheries conservation. ♦

Buddy Jensen is a retired fish biologist who was employed in the U.S. Fish and Wildlife Service's Fisheries Program for 34 years. He writes from the family farm in the Gila River Valley of southwest New Mexico where he angled a memorable longfin dace sixty-some years ago.

Eddies

Reflections on Fisheries Conservation

U.S. Fish and Wildlife Service— Fisheries
MS ARLSQ 720
4401 North Fairfax Drive
Arlington, VA 22203

STANDARD PRESORT
POSTAGE AND FEES

PAID

U.S. DEPARTMENT
OF THE INTERIOR
PERMIT G-77

U.S. Fish and Wildlife Service
<http://www.fws.gov/eddies>



Fall/Winter 2011

Dedicated Workforce

The epitaph speaks to a mother's anguish. Carl Anderson died in the prime of manhood, leaving behind his widowed mother who'd already lost her two younger boys. This stone stands at Oakland Cemetery, Manchester, IA.

His obit speaks to his notable devotion to conservation. Anderson died from a 10-month-long "insidious disease...peculiar and bafflingly." He worked at Manchester National Fish Hatchery and on the *Curlew*, a steamer on the upper Mississippi River where he collected game fishes. It was grueling work in the Midwest summers.

What is striking is that the obit articulates traits that Anderson possessed are the same traits owned by people who work in conservation today. He was "a man of exceptional energy, ability, and pertinacity of purpose," the obituary reads. "Socially and officially he was held in the highest esteem by those with whom he associated, and by his death the Bureau [of Fisheries] has lost a superior man and his coworkers a never failing friend." Anderson established a "noteworthy record ... of industry and integrity," the sorrows relieved knowing he "lived a true, unselfish and helpful life."

He is gone, but not forgotten. Nor should it be forgotten that those who work in conserving America's fisheries today, do so resolute in purpose for the benefit of the American people. ♦ Stuart Leon, Ph.D., Executive Editor



Courtesy Wes Orr

A memorial in Manchester, IA, serves as respectful remembrance of a dedicated National Fish Hatchery employee and conservationist.