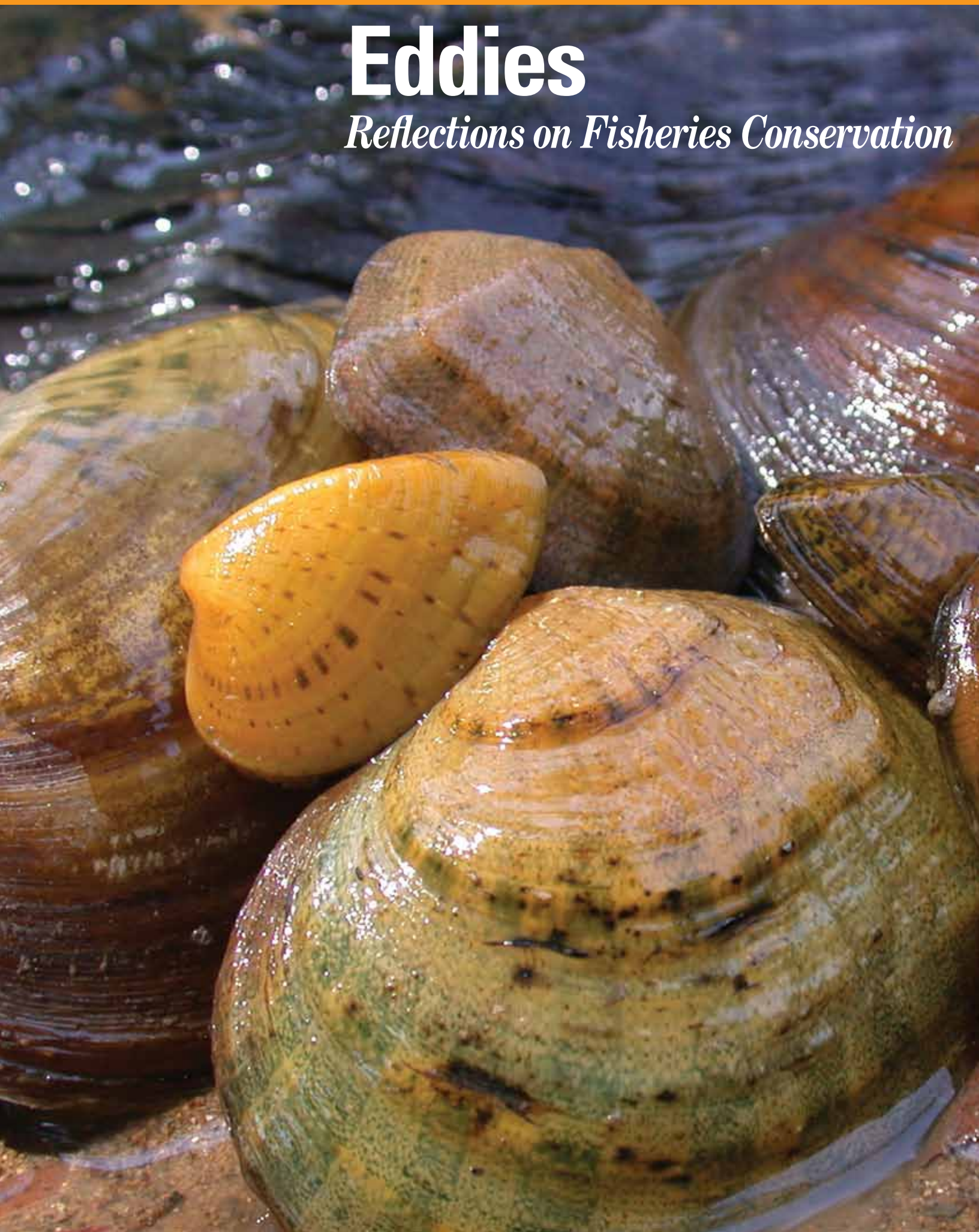
Eddies

Reflections on Fisheries Conservation



Eddies

Vol. 6, No. 2

Publisher
David Hoskins, Assistant Director
U.S. Fish and Wildlife Service
Fish and Aquatic Conservation

Executive Editor
Mike Weimer

Deputy Editor
Richard Christian

Editor
Craig Springer

Contributing Editor
Abigail Lynch

Contributing Writers
Jim Bowker
John Bryan
Stephanie Byers
Roman Crumpton
Jeff Finley
Joanna Gilkeson
Kerry Graves
Gregory Landry
Katrina Mueller, Ph.D.
Dane Shuman
Randi Sue Smith

Editorial Advisors
Mark Brouder, U.S. Fish and Wildlife Service
Dave Erdahl, Ph.D., U.S. Fish and Wildlife Service
Stuart Leon, Ph.D., Chair, U.S. Fish and Wildlife Service (ret.)
Ryck Lydecker, Boat Owners Assoc. of The United States
Mark Maskill, U.S. Fish and Wildlife Service
Tom Sadler, Outdoor Writers Assoc. of America
Bill Taylor, Ph.D. Michigan State University

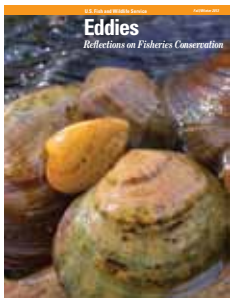
Assistant Regional Directors – Fisheries
Michael Carrier, Pacific Region
Dan Castleberry, Pacific Southwest Region
Tom Sinclair (acting), Southeast Region
Stewart Jacks, Southwest Region
Tim Jennings, Alaska Region
Sharon Rose, Mountain–Prairie Region
Sherry White, Northeast Region
Todd Turner, Midwest Region

Subscription Service
Mike DeRosa
USFWS Fisheries RM 700
4401 N. Fairfax Dr.
Arlington, VA 22203
(703) 358-1792
michael_derosa@fws.gov
www.fws.gov/eddies

Editorial
Craig Springer
USFWS Fisheries RM 9100D
500 Gold Ave SW
Albuquerque, NM 87102
(505) 248-6867
craig_springer@fws.gov

Design
Blue Heron
Communications

On the Cover
Freshwater mussels are integral parts of stream fisheries. Chris Barnhart/ Missouri State University



Departments

Features

Chris Barnhart/Missouri State University

Biologist Jeff Finley muses about mussels, minnows, and memories on page 26.

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

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

In Six Months' Time

By David Hoskins

USFWS

Six months ago, I was very pleased and honored to join the U.S. Fish and Wildlife Service in my new capacity as Assistant Director for Fish and Aquatic Conservation. I look forward to working with my colleagues and our partners to implement the Service's mission to conserve, protect, and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people.

Within the Service, the fish program has a long and proud history. In 1871, Congress established the U.S. Fish Commission. Shortly thereafter, President Grant appointed the first Commissioner of Fish and Fisheries. The Fish and Aquatic Conservation Program's staff has worked nationwide for over 140 years with our partners to conduct high quality research, develop new technologies to rear and manage fish, conserve and protect aquatic species, and restore their habitats.

The threats confronting our fish and aquatic resources today, although different than when the U.S. Fish Commission was first established in 1871, are every bit as challenging. In addition to the need to maintain water quality, ensure adequate in-stream flows, and protect and restore habitats on which these species depend, many native freshwater species are now at risk of extinction. As a result, the program is increasingly focused on the conservation of imperiled native fish and mussel species. This includes working to prevent the introduction, establishment, and spread of aquatic invasive species, such as the zebra mussel and Asian carp, which not only threaten native species but also cost the nation billions of dollars each year.

During my first six months on the job I have met with the program's staff in Washington D.C. and across the country to learn firsthand about these problems and the tools at our disposal to conserve and protect aquatic species. I have toured fish health and technology centers, visited several of our national fish hatcheries, and been out in the field to see fish passage projects. I also testified in September before Congress in support of a Service proposal to expedite the listing of injurious wildlife under the Lacey Act to help prevent the introduction and spread of invasive species. In this issue of *Eddies*, you'll read a smattering of such work going on around the country.

Needless to say, it has been a busy six months. Although we face a number of challenges, including significant financial ones, I have been truly and uniformly impressed with the expertise, dedication and commitment of our staff. Working together, I am confident that we can continue to build on the long-standing and proud history of the program to address today's conservation challenges.

But our success in addressing these challenges and accomplishing the Service's mission will require more than federal dollars and a hard working and talented staff. It also depends on our ability to reach out to and work with tribes, state fish and wildlife agencies, local governments, universities, industry, non-profit outdoor recreation and conservation organizations and, of course, the American people.

This summer, the Sport Fishing and Boating Partnership Council completed work on its comprehensive assessment and strategic vision for the Fish and Aquatic Conservation Program. I hope that the report will serve as a springboard for our own internal strategic planning process, informed by the input and perspectives of a wide range of other partners and constituents with whom I also will be meeting in the coming weeks and months. I look forward to working with each of you to construct and realize that shared vision for our fish and aquatic resources. ✦

David Hoskins is the Assistant Director for Fish and Aquatic Conservation in Washington, D.C.

In Memoriam

Mark Gocke/Wyoming Game and Fish Department

Maegan Spindler, 1988 – 2013

Dr. Robert Klumb and Maegan Spindler will be forever missed by family, friends, and colleagues. Klumb was the Project Leader and Spindler a biological technician for the Great Plains Fish and Wildlife Conservation Office in Pierre, South Dakota. The two were tragically killed on July 8, 2013.

Maegan Spindler was born February 28, 1988 in Cazenovia, New York. She earned her Bachelor of Science in Wildlife Science from State University of New York - College of Environmental Science and Forestry in Syracuse, New York in 2010. She continued her education receiving a technical certificate in Fisheries and Aquaculture from Vancouver Island University in Nanaimo, British Columbia, Canada, in 2011. Prior to arriving in Pierre, South Dakota, Spindler worked for two summers with the Wyoming Game and Fish Department on native trout research near Pinedale, Wyoming. She planned to continue her education in fisheries, with an interest in native fish conservation.

Klumb was born May 27, 1967 in Milwaukee, Wisconsin. He received Bachelor of Science degrees in both Biology and Biological Aspects of Conservation at the University of Wisconsin-Milwaukee in 1990. In 1997, he earned his Master of Science in Natural Resources—Fisheries from the University of Wisconsin-Stevens Point. Klumb completed his education with a Doctor of Philosophy in Natural Resources-Fisheries from Cornell University in 2003. His dissertation was titled *The role of embayments and nearshore habitats of Lake Ontario as nursery grounds for young-of-the-year alewives,* Alosa pseudoharengus, *and other species.*

Klumb was always a mentor to his students, staff, and colleagues and demonstrated a sincere passion for fisheries management and research. His expertise enabled him to author or co-author 21 peer-reviewed scientific journal articles, 34 reports and non-refereed articles, 74 oral presentations, 10 invited presentations, and 17 posters. He served as a reviewer for 30 scientific journal articles written by other scientists. Along with leadership positions in professional societies, Klumb was an Assistant Professor and later an Associate Professor at South Dakota State University in Brookings from 2004 until the time of his death; he advised six Master of Science students and three Doctoral candidates.

The two scientists shared many traits: they were both avid gardeners, humanitarians, compassionate toward the creatures they encountered, and passionate about the natural resources they were proudly protecting. Their passions and their ideals were infectious; they will be forever missed. ✦ Dane Shuman

Dane Shuman/USFWS

Dr. Robert Klumb, 1967 – 2013

Initial approval for immediate-release sedative getting closer

If a fisheries professional wants to sedate a fish and release it back into the wild, one must hold the treated fish in captivity for at least 21 days. That's required by the U.S. Food and Drug Administration (FDA). The U.S. Fish and Wildlife Service's Aquatic Animal Drug Approval Partnership Program (AADAP) has worked for the last five years with others to obtain an initial approval by the FDA to legally allow use of an immediate-release sedative for fish, AQUI-S20E. This drug will make field sedations much easier for fishery biologists who will be able to release the fish directly back into the wild. The Federal Food, Drug, and Cosmetic Act requires that drugs used on food-producing animals, including fish, be approved by FDA to ensure that the drug is safe and effective when used according to the label and that fish treated with a drug that are harvested for human consumption are safe for people to eat. The approval process usually takes 10 to 15 years and can cost up to $20 million dollars. However, due to efforts by the drug sponsor (AQUI-S New Zealand, Ltd.), AADAP, the U. S. Geological Survey's Upper Midwest Environmental Sciences Center, and others, an initial approval for AQUI-S20E could be obtained from FDA within seven years and at a much lower cost due to collaborative efforts to prove that this drug is safe and effective. AADAP is proud to be involved in an effort that will benefit fishery biologists throughout the country. ✦ Jim Bowker

AADAP

FEATURED FACILITY

Tishomingo National Fish Hatchery

Where: Tishomingo, Oklahoma

When: Established 1928

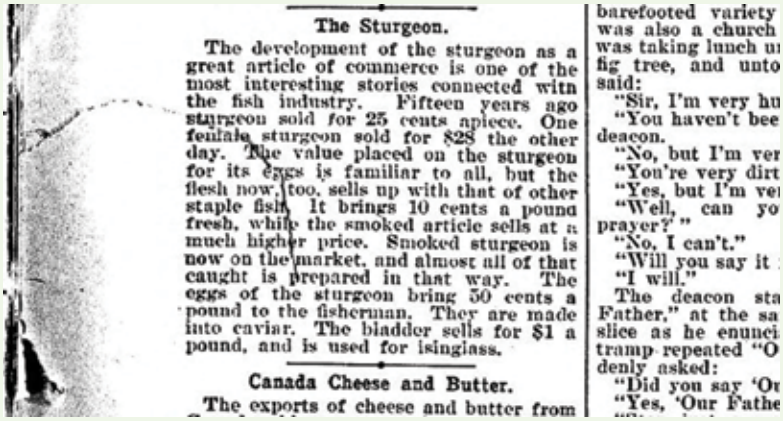
Then: The hatchery was originally established as an "Auxiliary Fish Cultural Station to Neosho, Missouri," for the purpose of propagating food fish indigenous to the region—primarily bass species.

Now: Tishomingo National Fish Hatchery focuses on imperiled aquatic species such as Arkansas River shiner, a threatened species; paddlefish, a species of special concern; alligator snapping turtle, which has been petitioned for listing under the Endangered Species Act; and alligator gar—generally accepted as imperiled throughout its native range. Hatchery biologists investigate life histories and develop captive propagation techniques for these species, and re-introduce them into the wild to re-establish self-sustaining populations. Success stories include development of captive spawning techniques for Arkansas River shiners; re-establishment of naturally reproducing paddlefish populations above four impoundments in Oklahoma; and re-introductions of captive-reared alligator snapping turtles in two states. ✦ Kerry Graves

USFWS

Tishomingo National Fish Hatchery works to re-establish naturally reproducing populations of paddlefish, a species of special concern.

Historic newspapers reveal important data



The Sturgeon.

The development of the sturgeon as a great article of commerce is one of the most interesting stories connected with the fish industry. Fifteen years ago sturgeon sold for 25 cents apiece. One female sturgeon sold for $28 the other day. The value placed on the sturgeon for its eggs is familiar to all, but the flesh now, too, sells up with that of other staple fish. It brings 10 cents a pound fresh, while the smoked article sells at a much higher price. Smoked sturgeon is now on the market, and almost all of that caught is prepared in that way. The eggs of the sturgeon bring 50 cents a pound to the fisherman. They are made into caviar. The bladder sells for $1 a pound, and is used for isinglass.

Canada Cheese and Butter.

The exports of cheese and butter from

barefooted variety was also a church was taking lunch u fig tree, and unto said:

"Sir, I'm very hu

"You haven't bee deacon.

"No, but I'm ver

"You're very dirt

"Yes, but I'm ve

"Well, can yo prayer?"

"No, I can't."

"Will you say it

"I will."

The deacon sta Father," at the sa slice as he enunci tramp repeated "O denly asked:

"Did you say 'Ou

"Yes, 'Our Fathe

Virginian Enterprise

Historic newspaper articles help researchers understand the conditions of fish populations from years past.

Old newspapers have their use, and it may not be what you first think. One person's "fish wrapper" is another's treasure trove of historic records.

Two fisheries researchers in Wisconsin, with the assistance of several student helpers from Saint Norbert College and Saint Mary's University, waded chin-deep into the microfiche. What they netted were historic accounts of lake sturgeon reported in the news of yesteryear. What they found and how they found it was published in the peer-reviewed journal *Archives in Natural History* published by The Society for the History of Natural History in London, England. The lake sturgeon is a large-growing, long-lived fish that has decreased in abundance throughout its range in the U.S., including the Great Lakes.

Dr. Philip Cochran, a biology professor at Saint Mary's University and Robert Elliot, a fish biologist in the Green Bay Fish and Wildlife Conservation Office, delved into the historic newspaper reports of lake sturgeon caught by anglers and commercial fishers as part of an attempt to identify the original distribution and former abundance of the species in Lake Michigan. They surveyed several newspapers from De Pere and Green Bay, Wisconsin, but relied primarily on accounts published in De Pere, roughly from 1871 to 1915, when sturgeon harvest was outlawed.

They learned that the various newspapers reported such items inconsistently between titles. The researchers noticed that the nature of the historic newspaper accounts changed over time and showed "that sturgeon declined from a profitable commodity to a curiosity, symbolic of the good old days." They found that accounts in one newspaper told a story on small scale that mirrored the decline of sturgeon at a national scale. Moreover, their techniques proved useful and may help other researchers in their own similar inquiries.

On a national scale, several U.S. Fish and Wildlife Service field stations conduct lake sturgeon conservation projects—from the Warm Springs Fisheries Center in Georgia, to Genoa National Fish Hatchery in Wisconsin. ✦ Craig Springer

Learning with Lahontans

The Lahontan National Fish Hatchery Complex, in Nevada, participates in a variety of youth based education and outreach programs that inspire awe, awareness, and pride in a big fish—the Lahontan cutthroat trout. It is the largest of 13 cutthroat subspecies. The programs bring young people into the world of their local, native trout. They learn about the trout's habitat needs, how they use the lakes and rivers, and the fun and enjoyment of fishing for this fish that grows really big: 60-plus pounds. Raising awareness of this native fish through education and outreach has increased support and appreciation for its conservation and recovery.

Interactive games and hands-on activities teach children the basic biology and habitat needed for "their" fish to grow, survive and thrive. Just as important as educating the future biologists of tomorrow is strengthening partnerships through outreach activities for a more coordinated and diverse approach to restoring this native, lake-dwelling Lahontan cutthroat trout. ✦ Stephanie Byers

Tim Loux/USFWS

Children get hands-on experience learning about conservation with staff from the Lahontan National Fish Hatchery.

Fish hatchery a premier birding site

What do you think of when you hear the words National Fish Hatchery? Fish, naturally. In contrast, Sherry Bixler, a member of the Friends of Inks Dam National Fish Hatchery, a Texas Master Naturalist, and active with the Highland Lakes Birding and Wildflower Society, thinks of something else: birds. She and several other birders began surveying the environs around Inks Dam National Fish Hatchery in March 2013. In just three months they documented about 100 different bird species that they have seen or heard. Bixler expects the list of documented birds to surge upwards to 200 different species after the winter birds come through.

Why so many birds? It's habitat. The hatchery is set on about 100 acres of central Texas Hill Country land, with only 30 acres used for fish culture. The remaining diverse acreage is attractive to birds, and three species commonly found on the hatchery, according to Bixler, are on the Audubon Society's Watchlist: the Painted Bunting, Northern Bobwhite quail, and the Bell's Vireo. These birds have been sighted frequently by birders, and given their apparent affinities to the hatchery, the facility will be seeking designation as an Important Bird Area by the Audubon Society. ✦ Gregory Landry

USFWS

Aptly named, the Painted Bunting brings color to the grounds of Inks Dam National Fish Hatchery.

FROM THE ATTIC

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

In these energy conscious times, we evaluate materials used for recyclability, durability, and ease of use. Plastic pipes are common on hatcheries today. It's easy to use. Many of the choices in the past were more difficult to use—soldering copper pipe, cutting and threading iron pipe, moving lengths of heavy metal, even bending and riveting, or welding heavy sheet metal into pipe sections. But, imagine pipe made of wood.

Craig Springer/USFWS

Wooden pipes in the stave style are preserved in the U.S. Fish and Wildlife Service's archives at D.C. Booth.

Hatcheries commonly used wooden pipe. It worked well. Available in sizes from two inches to several feet in diameter, wood could transport water for most all hatchery needs. Smaller sizes, up to a few feet in diameter, were shipped in from the manufacturer. The very large pipe could be built on site. Most piping was stave style, somewhat like a barrel construction. Edge cuts notched together as the long boards were assembled into lengths of pipe. Wire or flat metal wraps kept the sections tight. Ends could be tapered or hollowed out, fitting together, sometimes with a collar to hold the joints together. Ten-foot lengths were common. Another type of pipe was bored out from a solid section of wood.

Wooden pipe lasted well in use. Out of use, and buried, it usually returned to the soil. The wire banding takes longer to disappear by rusting, and can make a large snarl when encountered by a backhoe. Wooden pipes fell out of favor in mid-1900s, and today are an interesting artifact of the plumbing past. ✦ Randi Sue Smith

Pioneers

By Craig Springer

Edwin "Phil" Pister

Greg Boyer/OneHorseStudio.com

At 84, Edwin "Phil" Pister, is still engaged in fisheries conservation as the Executive Secretary of the Desert Fishes Council.

The man has no booming voice, nor is he domineering in his demeanor. He is affable and unassuming and yet commanding through natural favor. Edwin "Phil" Pister has a presence about him that draws one in. His career started with the U.S. Fish and Wildlife Service, post-Korean War, and today he continues in conservation as the Executive Secretary of the Desert Fishes Council. His work has led him to the highest of mountains, below sea level, and to the United States Supreme Court. At age 84, there's no visible sign the man is slowing down.

Pister owns a California heritage. His ancestors settled in the San Francisco area in the 1850s, and acquired a large swath of land near Stockton brokered by a former general of the U.S. Army, William T. Sherman. What was thousands of acres has been divvied down to about 12 acres still in the Pister name. It's there that Pister came of age in hard economic times.

"I was born on January 15, 1929, the same day as Martin Luther King—perhaps this was a good day for rebels," quipped Pister. "I've never been sure of whether I caused the Great Depression or was the result of it. My main recollection was that since dad was a schoolteacher, we always had bread on the table. Many of my classmates in a rough area of Stockton were not so lucky. Dad made $200 per month in those days, a small fortune to those less fortunate."

Steady income and summers off were fortuitous, allowing the Pister family to make frequent outings to fish and camp. Pister recalled that Yosemite was a second home, "Dad loved the back country, and loved to fish and always took us boys along."

Did these experiences prove directional for the young man? "Unquestionably, but this didn't become focused in my mind until I was a Berkeley undergrad," said Pister. "My brother was a grad student in the late forties and he suggested I talk to 'Starker Leopold over in Life Sciences.' He had just been thumbing through the new UCB catalog and spotted the wildlife conservation offering. I had been in pre-med and Starker was just putting together his first class. I never intended to become an M.D., but at least those folks were interested in living things. I shifted my major and never looked back."

Pister remembers the passion he had for fish as a student—and one that he still possesses. "Strawberry Creek runs through the Berkeley campus, and when walking along I could in my mind's eye see a trout under every rock. These feelings all came together at that time, after having lurked beneath the surface since my childhood outdoor experiences."

Pister was an ROTC student and that landed him a commission in the U.S. Army in an anti-aircraft division just in time for the Korean War, though he never saw combat given the enemy didn't have aircraft. "Many from my graduating class, with little or no need for anti-aircraft officers, were handed a rifle and put in charge of infantry platoons," said Pister in an earnest tone. "Nearly half of my Berkeley classmates were killed in action."

Back in civilian life, Pister followed his muse to high country of the Sierra Nevada where he worked for the U.S. Fish and Wildlife Service conducting trout research in lakes around Convict Creek. The gig didn't last. He was laid off and took a summer job with the California Fish and Game Department. That morphed into permanent work, and there he remained until 1990, working on California's state fish, the golden trout, and rare desert-dwelling pupfishes throughout his career.

In 1959, Pister started his golden trout work. The interest in the well-being of the fish started from the top. "We took Governor Pat Brown into the golden trout country. He had a deep intellectual interest in such things and asked me if the fish were safe," recalled Pister. "A few passes with a shocker [to catch fish] showed that we were in big trouble. Non-native brown trout outnumbered goldens in some locations more than 100:1. Our state fish was nearly gone." Pister learned early that it's much easier to plant a foreign fish species than it is to remove it. His love for the fish was manifest in his ardent efforts to create the Golden Trout Wilderness.

The term "bucket biologist" has a negative connotation, but in Pister's case, not so. In 1969, he literally saved the last population of Owens pupfish—moving 800 fish in 2 buckets—away from certain destruction. The rare fish were scooped out of a shoe-deep slough sure to dry, and moved into safer water.

Pister saw his first pupfish species, the White Sands pupfish, in 1949 while training for combat in the southern New Mexico desert. Twenty-some years later he helped fight another battle, this one to protect the habitat of the Devils Hole pupfish in his California bailiwick, a fight that went to the U.S. Supreme Court. The fish lived in a 10 by 50-foot window into the aquifer below Death Valley. Clearly, Pister still has ownership in protecting fishes that he believes hold inherent, intrinsic value. In remembering a phone call he got in 1976, informing him that the court ruled for the pupfish, it brought him to tears.

Today, from his home in Bishop, California, Pister helps steer the Desert Fishes Council, a ship that he helped build 45 years ago, all with a mind to conserve fishes that perhaps have the most dire need yet today. ✦

Courtesy image

Family fishing trips to the Sierra Nevada made lasting impressions on a young man who would make conservation his career.

Chinook Salmon

By Katrina Mueller, Ph.D.

Andy Wink

Chinook salmon grow to great sizes and are highly sought by anglers. Paul Dicarlo caught this Chinook salmon near Juneau, Alaska.

American author and journalist Tim Egan famously described the Pacific Northwest as "any place salmon can get to." In the same breath he captured the iconic status of a genus and underscored the gravity of very real extirpations and declines. For him and others, Pacific salmon—especially Chinook salmon—and the character of North America's west coast are inextricably linked. Recognized as the state fish of Alaska and Oregon, Chinook are part of the fabric of human life throughout their range, supporting long-valued traditions and economies associated with subsistence, personal use, commercial, and recreational fisheries.

The Chinook is the largest of the Pacific salmon, with adults commonly exceeding 30 pounds, and, in rare cases, 100 pounds. It becomes quickly apparent why they are called "Kings." A Kenai River King salmon that topped the scales at 97.25 pounds currently holds the sport fishing world record. The largest commercially caught fish weighed 126 pounds.

Besides King, other monikers—spring salmon, June hog, blackmouth—describe the timing of spawning migrations or distinguishing physical characteristics. In fact, the genus *Oncorhynchus* is derived from the Greek onkos (hook) and rynchos (nose), in reference to the pronounced kype or snout on spawning males. The species name, *tshawytscha* can be traced back to the native people of Kamchatka, Russia.

In North America, Chinook once ranged from Point Hope, Alaska, to the Ventura River in southern California. They were introduced to the Great Lakes in 1967 and have since catalyzed a robust sport fishery there.

Like other Pacific salmon, Chinook typically return to their river of origin, and possibly to the same local area, to spawn. Alevin emerge in

spring from the gravel—specifically from a redd (nest) dug deep enough by the powerful tail of a spawning female to protect incubating eggs from scouring spring flows. The act of redd construction cleans the gravel of silt, ensuring that buried eggs are bathed in cold, well-oxygenated water throughout winter.

"Stream-type" Chinook—like those originating from Alaska's Yukon River—spend a significant portion of their life cycle in the headwater streams of large river systems and tend to have a longer freshwater residency and migrations compared to their "ocean–type" counterparts. This makes them particularly vulnerable to freshwater habitat fragmentation and loss, or the drying, thawing, and rising water temperatures associated with changing climatic conditions in the Arctic.

Before smolts migrate to sea, they make their living among a wide variety of freshwater habitat types including main-stem rivers, side channel braids, headwater streams, and lower gradient streams with pools and wood for cover. A Yukon River Chinook may move hundreds of miles from their natal stream and travel among these different habitat types to find what it needs to survive the different seasons and environmental conditions typical of Interior Alaska. A barrier caused by a seemingly mundane culvert placed where a gravel road crosses a stream and not designed to pass fish can prevent or delay juveniles from reaching overwintering grounds or some other key resources needed for survival.

For a Yukon River Chinook, completing each life stage requires avoiding different sets of predators and contending with the dynamic nature of one of the last largely uncontrolled large rivers in the world (save for a dam at Whitehorse, Yukon). That includes ice and a dynamic environment shaped by the millions of tons of sediment moving towards the sea, and a discharge that exceeds a hundred thousand cubic feet of water per second.

Destined for the rich waters of the Bering Sea, and perhaps, ultimately, the North Pacific, juvenile Yukon River Chinook make their way downriver one or more years after hatching (after spring thaw) and transform from parr into smolts for the transition into saltwater. At sea, they'll acquire the strength and size needed to swim thousands of miles up the Yukon where the beginning of a new cohort's life cycle will mark the end of theirs—but not typically before spending several years pursuing and growing fat off the ocean's smorgasbord of prey—like herring, sandlance, and squid.

Just as juveniles are camouflaged with parr marks to break up form and avoid predation in freshwater, smolts and adults wear a color phase more suited for pelagic environments. If you were to fly over Chinook swimming near the surface at sea, you would see the blue-green-purple hues of their backs, speckled with black spots; from the side, chrome; and from below looking up, white, to match the lighter sky above.

Worldwide, less than two dozen rivers are longer than the Yukon, and Yukon River Chinook migrations are likewise some of the longest of any salmon in the world. Originating in the Canadian Province of British Columbia, this river flows through the Yukon Territory before crossing the U.S.-Canada border. Flowing east to west across the entirety of Alaska, it finally fans out across the Yukon-Kuskokwim Delta (roughly the size of Oregon) before draining into the Bering Sea. The amount of energy needed to migrate upriver makes Yukon kings highly prized for their oily flesh. Yukon River Chinook are the preferred food source for Alaska Natives that have co-existed with and subsisted on Chinook and other Pacific salmon species since time immemorial.

Today, Chinook populations south of northern California's Sacramento River have been extirpated, and a number of other populations outside Alaska are considered Endangered, Threatened, Candidates for Listing, or Species of Concern. These declines are largely the result of human activities having significantly reduced access to inland habitats and the quality and quantity of those remaining. Even in Alaska, Chinook populations are showing signs of stress: 11 are currently considered Stocks of Management or Yield Concern and statewide returns are down.

Maintaining broad diversity of river-specific, thus genetically distinct, populations of Chinook salmon throughout their range is key to the resiliency and stability of the species as a whole and associated fisheries. Broad genetic diversity is undoubtedly linked to the varying habitats and stream conditions within and among rivers to which they are adapted. Because Chinook migrations cross state and international boundaries, many stakeholders are involved with their conservation and management—as well as understanding and addressing declines. Keeping people connected to rivers and the fish is incredibly important in maintaining the relevance of this species. ✦

Katrina Mueller, Ph.D., is an outreach specialist for the U.S. Fish and Wildlife Service, stationed in Anchorage, Alaska.

By John Bryan

Seven Divers—One Mission

Conservation happens underwater

Larry Lockard, stationed at Creston National Fish Hatchery in Montana, spends a great deal of his diving time monitoring and assessing the distribution of the invasive quagga mussel. Lockard and others recently surveyed boats in marinas at Lake Powell for the unwanted mussel.

USFWS

"We were in the Aleutians running transects to confirm benthic critters with cameras," recalls Mitch Osborne, Fish Biologist with the Fairbanks Fish and Wildlife Field Office. "Out of the corner of my eye I saw it, a sunflower seastar— like a starfish—rolling downslope. And then came an anemone. They were being impacted by water pressure caused by Steller sea lions—the size of a mini-pickup—dive-bombing us. We went to another area five miles away, but those same three sea lions were back on us; the video confirmed their spots."

Osborne is one of several dozen divers who conduct conservation work on plants, fish, mussels, and other aquatic species for the U.S. Fish and Wildlife Service. Their personalities share important traits.

"You have to be calm under pressure," says Kevin Foster, Marine Ecologist for the Service in the Pacific Islands. "You have to be able to recognize a problem and work through it clinically and not be emotional."

"You have to be flexible and adaptable and willing to do a hard day's work," says Patricia Caccavale, Southwest Region Dive Officer at the San Marcos Aquatic Resource Center in Texas, "and have a very good sense of humor."

"Calm under stressful conditions," says Scott Yess of the La Crosse Fish and Wildlife Conservation Office in Onalaska, Wisconsin. "You want to be relaxed, slow-moving, and able to control your tendency to panic."

"Selfless people. Not big egos," says Patty Morrison, Northeast Region Dive Officer at the Ohio River Islands National Wildlife Refuge in Williamstown, West Virginia. Morrison grew up on the Hudson

River near Nyack, New York. She has a biology degree from MIT and an Environmental Law degree from West Virginia University. She helps restore mussel populations to the Ohio River.

"Mussels filter and cycle nutrients," she says. "They make the river cleaner and healthier for people to enjoy. A primary thing we do is inventory, another is monitoring, and another is collecting brood stock. We might go into an area that has 25 species and look for 3. When mussel diving you're only going to see what's one or two feet in front of you. The Ohio River is mostly cobble, rubble and sand—so mussels are well camouflaged. You have to stay within arm's reach of your dive buddy.

"Our most unusual find was a safe," Morrison recalls. The state police identified it as having been stolen three years earlier from a hotel in St. Cloud and supposedly containing $18,000. "Hindsight's always twenty-twenty," she responds jokingly to the common question about a finders-keepers policy.

Tony Brady's mussel diving began in graduate school at Tennessee Tech when one of his professors who was conducting mussel research asked, "Want to be a scuba diver, Tony? If so, we're paying for it." Today, Brady is a Mussel Propagation Biologist at the Natchitoches National Fish Hatchery in Louisiana. "You get trotlines in the river—entanglement issues. Sunken logs that you don't see until you hit them. Currents can be problematical. We're diving in zero visibility—not crawling around and looking, but digging around in the mud. Last week on the Pearl

USFWS

Patricia Caccavale is a biologist at the San Marcos Aquatic Resource Center. She surveys waters in the Edwards Aquifer of Central Texas for imperiled darters and salamanders, and removes invasive plants destructive to habitat of the endangered Texas Wild Rice, a plant found only in the upper two miles of the San Marcos River.

River there were alligator tracks next to where we launched the boat."

Divers in the Service have to demonstrate extensive physical abilities on an annual basis—including a 400-yard free swim, an 800-yard kick swim, a 200-yard diver distress tow, and 15 minutes of treading water including hands out of the water for the last 2 minutes. Divers are required to have a dozen or more dives each season and never have a gap longer than 6 months between dives.

"The coldest I've ever been? It was while placing mussel cages on the St. Croix River with chunks of ice floating by," Yess recalls. They are 3x2x2-foot wire cages with wood board bottoms and four 12-inch legs. The cages contain live fish whose gills have been inoculated with glochidia—mussel larvae—that eventually fall off and land on the platform. "We were in dry suits, but our faces were exposed. It's like little needles until your face numbs up, and then you don't feel it. Your hands and feet are the first to get cold—even with gloves and booties. When your hands get numb and you no longer have dexterity, it's time to get out."

Larry Lockard is a Fish and Wildlife Biologist at the Creston National Fish Hatchery in Kalispell, Montana. Part of his work is containing and eradicating invasive quagga mussels that were discovered in Lake Powell in 2012 at two marinas near the dam. "Lake Mead is downstream and is the epicenter for quagga mussels," Lockard explains. "They've only been in Mead since 2007, but it happens fast when they arrive. They're covering boats, motors, docks, water intakes, even the cooling system at the dam. They are a threat to municipal water and power supplies and could even blacken Los Angeles."

In June 2013, he helped examine 1,100 houseboats moored at the two Lake Powell marinas. A two-man team looked at each boat, each diver going down one side of the boat, meeting at the motor, and then going down the center. "We looked especially in the through-hull holes; they thrive on current, so any water intakes on outboards are targets. Our job was to remove every mussel and put them in little plastic vials. They range from microscopic to an inch. We found fewer than 300 on the 1,100 boats, mostly singles, and only 23 groups that were close to reproducing. Infestation is right at the beginning, and you have to contain it at those two marinas."

USFWS

Before Mitch Osborne with Fairbanks Fish and Wildlife Field Office in Alaska can dive in cold Arctic waters, he first has to get through the ice. Osborne surveys habitats in fresh water and under the sea.

Kevin Foster grew up in New England where he was on a swim team throughout school

USFWS

Kevin Foster, with clipboard in hand, dives in a coral reef off the Hawaiian shores. Foster's work takes him to other islands in the Pacific to assess fisheries habitats.

and dived constantly with his dad who was an instructor for the National Association of Underwater Instructors. Foster joined the Peace Corps right out of college and was assigned to a 900-resident, no-electricity village on a Pacific island where his primary job was aquaculture—raising giant clams.

Today, Foster's work includes marine bio-assessment for harbors and channels that are scheduled for expansion by the U.S. Army Corps of Engineers. The dive work includes counting reef fish, corals, plants, and macroinvertebrates, and documenting spawning periods, behavior, life stages—all of which helps determine the best schedule for Corps projects.

Patricia Caccavale also grew up around water; her parents owned a boat yard in Staten Island. Caccavale's current work includes monitoring the upper San Marcos River in the Texas Hill Country to remove an invasive water trumpet native to Sri Lanka, a popular aquarium plant that "grows like crazy" and took over that section of the river a decade ago.

Caccavale's team first waves the sediment and soil away from the base, and then gradually removes the whole plant. In some areas they have to tie themselves with rope because of fast current. The eradication process began with dredging, and followed with divers who pulled out 1,200 plants the first year. In the fall of 2012, they found only two.

Although Service divers share a set of safety-first personality traits, they also share an ongoing awareness of, and exposure to, hazards.

"Turbid water, debris, lots of sunken logs, fishing line, hooks, barbed wire," says Caccavale. "We've come up wrapped in fishing line and had to cut each other out."

"We were doing a deep dive in perfect weather in the Marshall Islands," recalls Foster. "When we surfaced we were in three-to-five-foot swells with an approaching squall and visibility reducing to just feet. The wind was blowing our boat away from us and we were swimming with 80 pounds of gear. We grabbed the back of the boat just as the rain hit."

Together, these seven divers have logged many thousands of dives during which they have never been injured by an animal—including

sharks and alligators—and don't know any divers who have.

And they haven't found sunken doubloons. They have found arrowheads, sunglasses, shoes, hats, bottles, occasional antique anchors, unspent military shells, and wallets filled with mud. And, of course, "There isn't a body of water—no matter where you go—that doesn't have a golf ball in it," confirms Osborne.

"Seventy percent of the planet is under water," says Osborne, "and, for the most part, we have no clue what's under there. Once someone reads and understands a report, they take ownership and start caring."

Osborne, like all the Service divers, takes ownership in the work, learning and discovering, and in the end, conserving fisheries. ✦

USFWS

Tony Brady is a mussel propagation biologist at the Natchitoches National Fish Hatchery in Louisiana, where he leads the captive rearing of imperiled freshwater mussels. His work also takes him to the field to assess mussels in the wild.

By Joanna Gilkeson

Form Follows Function

Research reveals habitat needs of sauger and sturgeon

"We identified studies to fill the gaps in fish swimming capabilities to improve the test design and ultimately the building of fish passages."

Form follows function, and that holds true for fish. Knowing how a fish's shape and size affects its ability to swim in various currents is essential to managing fish populations, and in particular, designing passage structures for streams. Gaining that essential knowledge is underway at the Bozeman Fish Technology Center in Montana, with the help of some very capable hired hands.

Streams most everywhere have been altered and fish populations have been segmented by culverts, dams, and diversions—and fish numbers have suffered for it. Toward a remedy, cutting-edge fish passage research at the Fish Technology Center is plowing forward in a partnership with the Western Transportation Institute at Montana State University.

The research outcomes on two fronts may have important implications for imperiled species. One study is assessing the swimming abilities of sauger, a species of concern in Montana, and the longnose dace, a small minnow also native to the state. The second study is evaluating spawning conditions needed by shovelnose sturgeon. Those findings could offer clues about habitat conditions needed by the pallid sturgeon, a federally endangered species formerly found throughout the Missouri and Mississippi rivers.

Kevin Kappenmann/USFWS

Captive shovelnose sturgeon are used as surrogates of the endangered pallid sturgeon so as to learn spawning habitat preferences.

"The goal of the swimming capability research is to improve fish passage and landscape connectivity for native and sensitive species. Some of the ground work for this study has been done, but nothing to this extent," said David Dockery, a graduate student at Montana State University pursuing a master's degree in fisheries and wildlife. Dockery is native to Montana, which inspires his dedication to this project, "I love Montana, and I've been here my whole life. I'm very invested in Montana and restoring this area's aquatic populations."

Under the direction of Fish Technology Center biologist Kevin Kappenman, Dockery works as a Pathways Intern where he develops studies to improve the understanding of native fish species. Leading this research in collaboration with Kappenman are Montana State University professors Thomas E. McMahon and Matt Blank. McMahon teaches fisheries science and Blank, civil engineering.

According to Kappenman, studying the various fish body forms and sizes yields a greater understanding to accommodate a spectrum of native fish and meet their needs as they move through the water. "Each of these fish swims differently and prefers different conditions," said Kappenman, "and in evaluating several sizes of fish and various river sizes and scales, we can get a better feel for what kind of fish passages are needed across the board."

USFWS

Biological Technician, Chris Forrest, is at home around water. The former U.S. Navy Seal fully immersed himself in sturgeon and sauger research at the Bozeman Fish Technology Center.

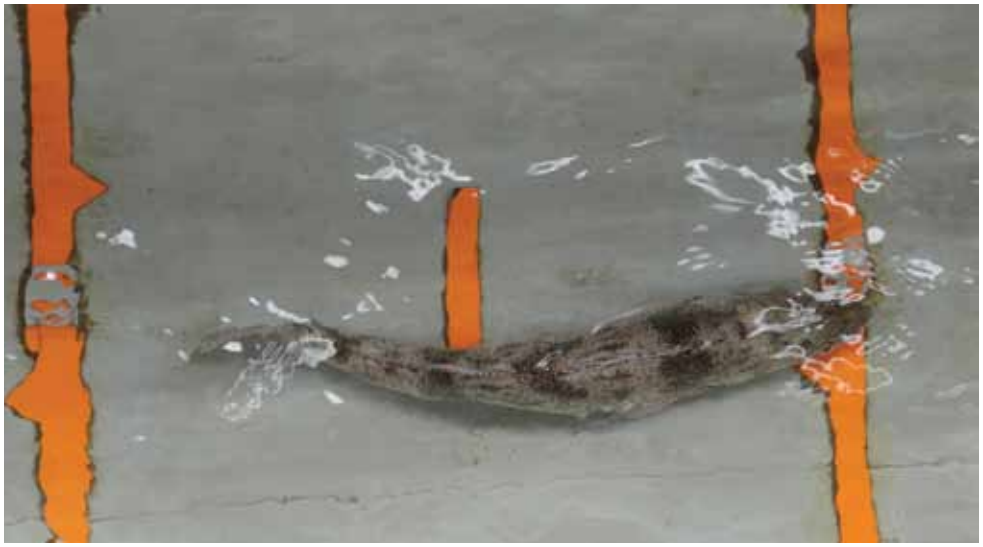
In the 2012 field season, Dockery focused on the swimming abilities of sauger. The sauger represents larger-bodied fish swimming in bigger rivers. This year he's concentrated on the longnose dace. The minnow represents small-bodied fishes that live in smaller rivers, and he's learning along with McMahon.

"Professor McMahon has been essential in developing the ideas behind this research because he specializes in fish habitat and fragmentation," Dockery said. "We identified studies to fill the gaps in fish swimming capabilities to improve the test design and ultimately the building of fish passages."

Two additional interns worked alongside Kappenman and Dockery in 2012, each with a unique perspective on fisheries and wildlife conservation. Chris Forrest and Michael Stein were armed services veterans. One defended our country in the air, the other, on the water. Forrest was a U.S. Navy Seal for seven years

Kevin Kappenmann/USFWS

Pathways Intern and Montana State University graduate student, David Dockery, times a sauger's swimming speeds through a flume.



David Dockery/USFWS

Brindled and barred, a sauger performs in a controlled-velocity flume. How fish perform at known velocities helps scientists and engineers design fish ways, bridges, and culverts.

while Stein piloted a Black Hawk helicopter in the U.S. Army for 10 years. After their service, both men dramatically shifted their careers to conservation.

Forrest, now a biological technician, assisted Dockery with his research. After his time in the Navy, Forrest decided to reconnect with his love of fishing and interest in the aquatic world. "Having the opportunity to go back to school and study fish and wildlife management and work with the U.S. Fish and Wildlife Service has been rewarding. I'm part of the solution to protecting land and water for future generations and minimizing anthropogenic effects that we have upon the land," Forrest said. "This is cutting edge science and it's exciting to be on a project with a management and stewardship goal."

Stein assisted Kappenman with spawning shovelnose sturgeon in an artificial stream. Stein had been interested in fish his whole life: "I've always had two passions in life, flying and fishing." He conquered the first while in the Army, but after 10 years was ready to pursue his other passion, fishing. Stein is now a student in the Fish and Wildlife Management Program at Montana State University. "Working on broader issues like this is a no brainer. I've always been environmentally aware and have moved all over and experienced a broader sense of how connected everything is," said Stein.

The shovelnose sturgeon project Stein worked on takes place in an artificial river at the Fish Technology Center. The stream mimics natural conditions, and conditions can be manipulated to evoke responses from the fish.

"I hope that observing the shovelnose sturgeon sparks further research. There is a huge potential

for this to have a broad impact on sturgeon, in particular assisting with the management of the pallid sturgeon," Stein said. The Missouri and Mississippi rivers where pallid sturgeon naturally occurred have been turned into a series of lakes, very much affecting the fish. The rivers are deep uniform channels which are unfavorable for the species. In addition, downstream dams have altered the river's timing of flow, temperature, and sediment load. Observing shovelnose sturgeon as a surrogate to pallid sturgeon may tell biologists what's needed to promote spawning and recruitment.

The spawning study has made some promising headway, "we are getting a good idea of what kind of stream velocity sturgeon prefer and the type of stream bottom they like to spawn on," Kappenman said.

Form follows function, and what good form it is to have energetic people with bright minds focused on finding the function that all the vagaries of streamflow can have on fishes of such high ecological importance. ✦

Kevin Kappenmann/USFWS

The sauger, a very close kin to walleye, is a species of concern in Montana. Here, a sauger awaits being transferred to the open-channel flume.

Joanna Gilkeson is a public affairs specialist in Minneapolis, Minnesota who supports the Wildlife and Sport Fish Restoration and the Sea Lamprey Control Programs.

Project Research is supported by:

U.S. Fish and Wildlife Service - National Fish Passage Program

U.S. Geological Survey - Science Support Partnership

The Plains and Prairie Potholes Landscape Conservation Cooperative

Montana State University - Department of Civil Engineering, Western Transportation Institute

Montana State University - Department of Ecology, Fish and Wildlife Management

By Roman Crumpton

Oyster Feasts and Reefs

Shell recycling builds fish habitat, protects property

Roman Crumpton/USFWS

In South Carolina, oyster reefs thrive in the intertidal zone providing habitat, wave breaks, sediment traps, and cleaner water.

On almost any cool fall night in coastal South Carolina, a unique scent permeates the air, as if someone has filled a hot tub with sea water and set it on high. The scent causes some to respond like a bloodhound on the hunt. It is oyster season again.

Oyster feasts have been popular social events in coastal South Carolina since the first people populated the Atlantic shores. Native American settlements have been located by the shell rings left behind. These rings date to 4,500 years old, and the significance of the shell rings is thought to be ceremonial. Archaeological evidence of early Europeans harvesting oysters is also apparent. Shell is often found in dumps, or middens, along with other items including glass and ceramics. Beyond ceremonial use, oyster shell was also used in projects such as dike building, as well as a binding element of mortar, the evidence of which can readily be seen in the foundations of many historical buildings in coastal South Carolina. But perhaps most significantly, spent oyster shell was rarely returned back to the water from whence it came.

The eastern oyster is found on both the Atlantic and Gulf coasts of North America. In South Carolina, mature oysters spawn in water temperatures that exceed 68 degrees. A free-swimming larval oyster is formed and progresses through several life stages which only takes a few weeks. This part is essential: the larval oyster seeks out other oyster shell and attaches as a "spat," or the juvenile form of a sessile oyster. As a result, oysters build upon themselves into oyster reefs, and as the years pass they become extremely complex in their architecture. These reefs are beneficial in many aspects: they provide essential habitat for a

variety of aquatic organisms beyond themselves, and since oysters filter water to find their food, they clean the sea through the filtering process. Moreover, the oyster reefs reduce shoreline erosion by dissipating storm and wave energy. Less shoreline sediment in the water means better fisheries.

Over the years, a substantial commercial and recreational fishery existed for the eastern oyster. Until recently there has been no concerted effort to return shell to the water. Bears Bluff National Fish Hatchery on South Carolina's Wadmalaw Island partnered with the South Carolina Oyster Restoration Enhancement (SCORE) program to do just that—get shell back where it's needed—in the tidewaters. The SCORE program has operated since 2001 as an entity of the South Carolina Department of Natural Resources.

Acquiring oyster shell continues to be the challenge. Bears Bluff National Fish Hatchery has established an oyster shell drop-off site where the public can bring their shells following a roast. The site employs an informational kiosk used to educate the public about the oyster restoration program, and why shell is needed. The SCORE program has drop-off sites at many state-maintained boat ramps throughout coastal South Carolina. Partnering with local caterers and restaurants has proven to be a reliable source of shell. Oyster shell can be purchased as well; however, the costs can be limiting.

After the shell is collected, it cannot be returned to the estuary for at least six months. This is called the "curing" time. Curing the shell is necessary to protect local oyster beds from diseases that may have infected oysters from other areas of the country or even other local estuaries. Disease is a major threat to existing reefs. Cured shell is then bagged in

Roman Crumpton/USFWS

A stack of bagged shells sits at a public drop off site at Bears Bluff National Fish Hatchery. The kiosk informs the public about the importance of conservation.

Roman Crumpton/USFWS

Boy Scouts volunteer frequently to bag shells for future oyster reef projects.

Roman Crumpton/USFWS

A freshly built oyster reef will soon flourish into a rich fish habitat and wave break.

mesh sacks and stacked, waiting then to be arrayed in the water. Bagging is often done by volunteers from naturalist groups, youth summer camps, and school groups.

In 2012, Bears Bluff National Fish Hatchery and the Charleston Ecological Service's Coastal Program started building oyster reefs for landowners who are experiencing erosion near their waterfront homes. The process requires an initial site visit at low tide to determine feasibility and an approach to reef-building. Factors include: ability to increase fish habitat, sea bottom type, exposure to erosion, and accessibility. A plan is devised and permission is then sought through the South Carolina Department of Health

Roman Crumpton/USFWS

Four years later, a rebuilt oyster reef is robust and well established.

and Environmental Control. Upon acknowledgement of compliance to South Carolina's coastal zone management program, reef building commences in the intertidal zone.

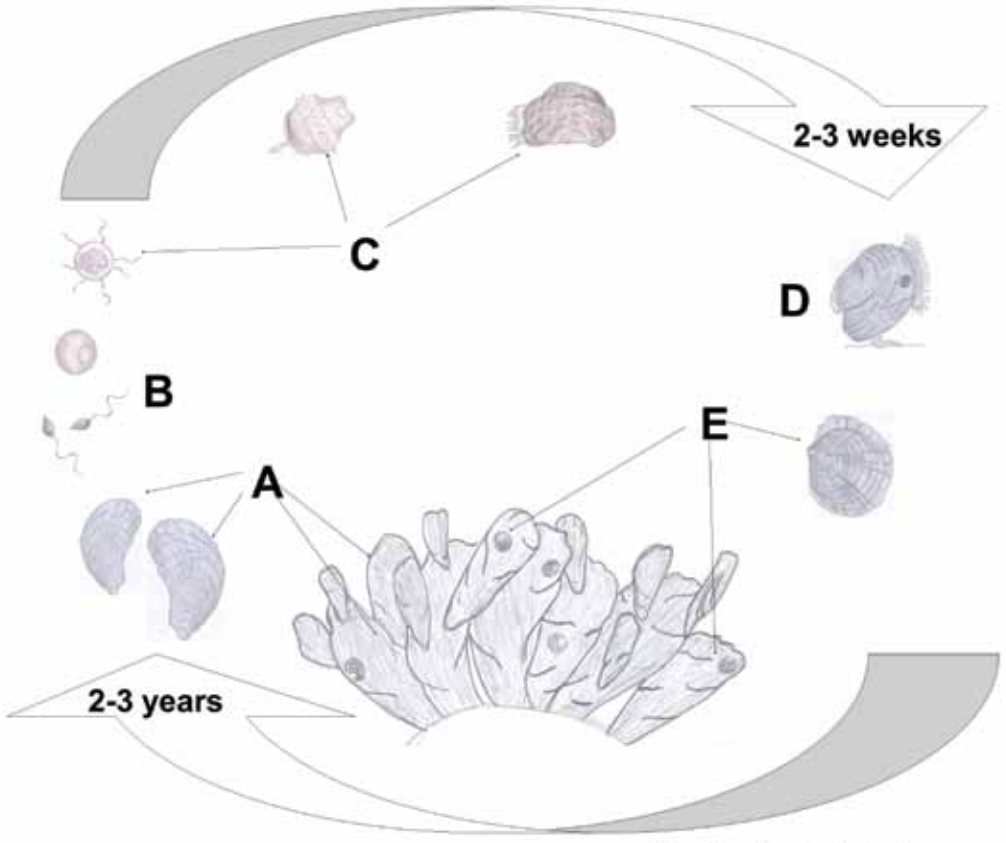
Here's how it's done in the water. Bagged shells rest on top of wooden pallets. The pallets are dropped on the sea floor. Steel rebar stakes driven through the reef and pallets secure it in place. Biologists with the Bears Bluff National Fish Hatchery and the Coastal Program make follow-up visits to check on the condition of the reefs as well as monitor sediment deposit behind the reefs—a byproduct of wave energy dissipation by the new reef. In these areas behind the reefs there is a significant increase in marsh plants, mainly smooth cord grass, which is nursery habitat for fish.

Oyster reefs enhance fish habitat, clean the water, reduce erosion, and restore marsh habitat. Increasing marsh habitat buffers the effects of energy storms and waves carry. The new marshes trap pollutants and provide essential habitat for other species of aquatic organisms including crabs, birds, fish, and you guessed it—oysters. And that's all good for people, too. ✦

Roman Crumpton is a fish biologist at Bears Bluff National Fish Hatchery on Wadmalaw Island, South Carolina.

Biology of the Eastern Oyster
Crassostrea virginica

When the water warms to 68 degrees in South Carolina, roughly from May to October, adult oysters (A) begin reproducing. Eggs and sperm are released into the water (B) and, upon fertilization, a free-swimming larval oyster is formed (C). Larval oysters float with the tide and need cultch on which to attach. After about three weeks in the larval stage the oyster develops a foot (D), settles to the bottom, and searches for suitable cultch. Adult oysters, and even the shells of dead oysters, emit chemicals that attract these larval oysters. Once attached, the oysters are called "spat" (E). At this stage the oysters are immobile and will grow into adults. Oysters grow on top of one another, therefore, each oyster provides a place of attachment for future spat. As years pass and the cycle is repeated, oyster reefs grow in height and complexity, thus providing ideal habitat for a variety of fish, invertebrates, and plants.



Meanders

By Jeff Finley

Devil's Horn and the Baptism Pool

Were it not for the rope swing, stone campfire ring and fresh footprints in the sand, I would have thought I was the first person to ever see this place. Nestled deep in the Ozark Hills of rural Carter County, Missouri, off a sparsely populated patch-paved county road and a couple miles down a two-track gravel lane and past a sun-grayed wooden church sits one of the prettiest places I've ever visited: Big Barren Creek Natural Area in Mark Twain National Forest. Lilly pads dot a postcard picturesque pool that teem with schools of minnows. This large pool of clear water rests at the base of the Devil's Horn bluff.

Local folks searching for relief from the summer heat can be found cooling themselves in the "swimmin' hole." There aren't many visitors to this remote spot so they are eager to share stories about this unique place they take such pride in. We were told that on special Sundays the church congregation used to amble up the gravel road to witness a full-immersion baptism, by coincidence, in the pool at the foot of Devil's Horn bluff. They pointed out where wagons crossed when the area was settled, where the moonshiners set stills during prohibition, and they helped us discover the remains of a spring box once used to gather drinking water for a nearby home. A vine-covered chimney standing in solitude is all that remains. They enlightened us with recollections of big fish, fist fights, marriage proposals, and which families' children had stacked the rocks in a makeshift dam to deepen the pool. No matter the tale, they were all threaded with a deep respect and sense of pride in this special place.

Since being designated a Natural Area in 1989, this portion of Big Barren Creek has been under special management by the U.S. Forest Service. The dolomitic bluffs and fine-grained chert forests have remained relatively untouched for decades. The creek is a gaining portion of a losing stream; that is, numerous springs bubbling from the porous limestone fill several cool, clear, permanent pools of water joined by shallow silver riffles. Downstream of these bluff pools, Big Barren Creek goes barren and soaks into a dry and rocky creek bed. It is lost underground for several miles before it is reborn near Twin Springs and its confluence with the Current River.

Few fisheries workers have cataloged the species that dwell in these pools. Aside from a few seine net hauls from the years 1941, 1971, and 1994, only 20 species of fish were known to reside here. Our task was to look deeper and determine habitat quality and fish species composition of Big Barren Creek, and to identify species which may require special management considerations for Mark Twain National Forest. Our study revealed that 45 fish species inhabit these waters, several of conservation concern, including the Ozark shiner and pugnose minnow.

But we learned about more than just fish. We discovered several Arkansas brokenray mussel shells in the shallows. These mussels are in the *Lampsilis* genus which is composed of several extremely rare and endangered species. To our knowledge, a mussel survey of the area had never been completed and the discovery of the brokenrays subsequently prompted one. Freshwater mussels are not typically found in small headwater streams of the Ozarks, but we discovered at least 8 different genera with as many as 10 different species. The identity of two of those potential species is being examined. Finding such mussel diversity and densities of rare species was all the more proof that this is a very unique place. Even the colorful names of mussels—the Slippershell, Creeper, Rainbow, Purple Lilliput, Ouachita Kidneyshell—they speak to the same. Most of the mussels were found around the massive old spadderdock roots and in the gravel beds below riffles. The roots were as large as my forearms and dense risers to the lilly pads were reminiscent of diving through a miniature kelp forest in the Pacific Ocean. SCUBA diving the deep clear pools reminded me of a tropical reef in the Atlantic, only without the taste of salt. The pinkish leaves at the bases of the spadderdock looked like fan coral-—the brilliant orange and teal of the several species of sunfish, blood-red and iridescent blues found on various minnows and shiners were all similar to salty cousins in tropical waters. What's more, three different species of crayfish skittered about and peeking ever so warily from their rocky hideaways. Never in my 20 years of diving, have I experienced such a beautiful dive in fresh water.

They enlightened us with recollections of big fish, fist fights, marriage proposals, and which families' children had stacked the rocks in a makeshift dam to deepen the pool. No matter the tale, they were all threaded with a deep respect and sense of pride in this special place.

Mussels, minnows, and memories weren't the only thing we discovered. While looking for mussels around the chunky rubbles littering the bedrock in a deep pool below a bluff, I found an old fishing lure wedged in a crevice between two large stones. The hooks had long rusted away. The rear propeller dissolved into a puff of rusty dust when I pulled it from its snag. One glass eye was missing but the balsa body still had its raspberry spots on a honeydew body, still vibrant after being shielded from the sun's fading rays. The best I can find, this old wooden Heddon Dowagiac Minnow was manufactured prior to 1920. My imagination prompted a sepia vision of an angler in woolen trousers and waxed mustache cursing as his cotton line snapped.

As much as I'd like to think I was the first to discover this pristine Ozark paradise, I am far from it. These special little places, adored by locals and occasionally visited by passers-through, are a fresh reminder of the wonders we are so blessed to experience and charged with protecting. I shall return some day to enjoy the sights, the cool refreshing water, and perhaps even hear another story or two about the Baptism Pool below the Devil's Horn bluff. ✦

Jeff Finley, a frequent contributor to *Eddies* is a Fish Biologist for the Columbia Fish and Wildlife Conservation Office in Missouri, whose work often takes him underwater with SCUBA gear. He and his wife Anna have been together 21 years and have three children. The oldest is currently serving in the U.S. Army in South Korea.

Eddies

Reflections on Fisheries Conservation

U.S. Fish and Wildlife Service
Div. of Fish and Aquatic Conservation
MS ARLSQ 700
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 2013

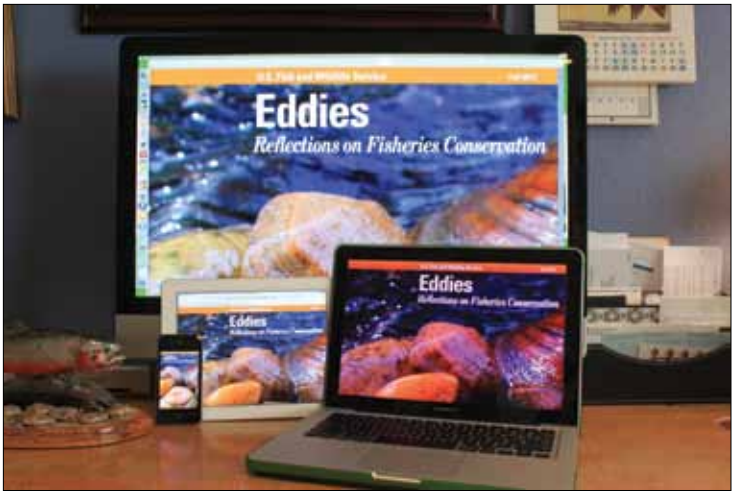
Change in all Things is Sweet

Aristotle wrote that "Change in all things is sweet." We're changing the way we deliver *Eddies*. You'll still get all the same news, departments, and feature stories, the quality writing and quality photos, but not in paper and ink. We're going entirely digital and you can read it on any device.

Do you want to get a notice when a new issue is online? Signing up is short and sweet. Visit the magazine's homepage, www.fws.gov/eddies, and click the Subscribe button then tell us what email address to use.

If you have any questions or concerns see the masthead on the inside cover for our contact information. We love hearing from our readers.

Thanks for your continued interest in *Eddies* and fisheries conservation. ✦ The Editors



Craig Springer/USFWS

Tablet, smartphone, desktop or laptop, Eddies *is readable on any device.*