

Eddies

Reflections on Fisheries Conservation



Eddies

Vol. 5, No. 1

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

John Bryan	Jarrad Kosa
Terri Edwards	Mark Lisac
Ron Essig	Abigail Lynch
Kyle Flanery	Alexa Marcigliano
Kay Hively	Randi Sue Smith
Karen R. Hollingsworth	E. Peter Steenstra
Meghan Kearney	Denise Wagner

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, 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 87102

Design

Blue Heron
Communications

On the Cover:

Striped bass school
offshore in the Atlantic
Ocean. See page 20 to
learn more. Doug Stamm
photo.



<i>Departments</i>	Headwaters	3	American Fishes	10
	Watermarks	4	Meanders	30
	Pioneers	8		

Features



**Of Red Knots and
Horseshoe Crabs–12**
Alexa Marcigliano



**Restoration of
Atlantic Migratory
Striped Bass–20**
John Bryan



**A Dinosaur Fish Swims
on through Deep
Time–16**
Abigail Lynch



**Swimming into the
Future–24**
Meghan Kearney



**Drumming up a Great
Partnership–26**
Kay Hively



Paul A. Lang/USFWS

A dinosaur fish swims southern waters. See page 16.

*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

Dajao on my Mind

By Bryan Arroyo



Hazel Arroyo

The Tallaboa River tumbles out of the hills of southern Puerto Rico, and pours out into the Caribbean Sea. The river transforms as it goes along, but always keeping its nature of a quaint life-giving stream, cutting a swath through a valley of the same name. At its mouth attracted by the current, dajao, as the aboriginal Taino people of Puerto Rico called the fish, swim upriver. In English, it's the mountain mullet. It's a silvery fish that has left a memory shining in my mind.

My father used to tell me his stories about fishing for dajao from when he was a young boy on the Tallaboa River. He told me about how abundant this fish was and he only kept what was needed to help feed his family. I've caught dajao myself, fishing at the base of a dam. My dad's stories turned into lamentations. Dajao were decimated in the waters of his youth. You see, dajao need open waterways to migrate and to breed. This fish is catadromous, meaning it lives in both fresh and salt water, and moves out to sea to spawn. In Puerto Rico, most of the dajao populations have been cut off from the sea by dams. Free-flowing rivers have been segmented by concrete and steel edifices.

Dajao are like other storied fish species: American eel, white sturgeon, Yukon River Chinook salmon. They are all capable of moving monumental distances—and in fact, need to do so as to produce young of the next generation. The Chinook move some 1,700 miles to breed and die. Massive-sized white sturgeon used to swim from the Pacific Ocean well into Idaho. American eel could go from the Sargasso Sea to South Dakota. Like with these fishes, dajao swim through interjurisdictional boundaries and run headlong into obstructions.

Place-based strategies are not well suited for the conservation of these species. It is only through collaboration and partnership approaches that meaningful conservation actions can be implemented. That is how we achieve the conservation goals for these wide-ranging species. This is one of the crucial roles that our Fish and Wildlife Conservation Offices and National Fish Hatcheries fulfill day in and day out to conserve interjurisdictional species across the country. Our staff achieve these goals by developing and using leading-edge fisheries science and having long-standing and effective collaborative efforts.

The collaborative effort underway for striped bass is one item you will read about in this issue of *Eddies*. The story by writer John Bryan explains the conservation issue, and what our people and our partners are doing for the benefit of the fish – and the people and economies that rely upon the fisheries.

My friend, the writer Kay Hively tells us about the red drum fishery, one that extends from the Carolinas to Texas and beyond, underscoring the large collaborative approach needed for fisheries of this magnitude. She writes about a conservation partnership with Bears Bluff National Fish Hatchery, youth groups, and the South Carolina Department of Natural Resources.

Our “American Fishes” installment this time around is about the Dolly Varden by biologist Mark Lisac of Togiak National Wildlife Refuge in Alaska. Lisac probably knows more about the oddly named cherry-colored fish than anyone. You'll know a whole lot more, too, after you read his story.

The issue closes out with a “Meanders” by Richard Christian, musing about his red drum experiences.

Last spring I had the chance to fish in the Nation's River Bass Tournament with FLW Outdoors. The young man who I shared a boat with caught his first, second, and third striped bass. He couldn't wait to tell others at the dock. They were “his dajao.” I'm eager to tell you that these sorts of experiences are made possible by dedicated conservationists, and I challenge you to do your part for conservation.

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

Clean-up continues at Vermont hatchery flooded by Tropical Storm Irene



USFWS

Mud slugged through White River National Fish Hatchery in Vermont, causing extensive damage.

The White River National Fish Hatchery was mostly under water after Tropical Storm Irene swept over Vermont last year. The White River flooded much of the hatchery. When it receded, it left behind mud eight feet deep in some places. The flood compromised the hatchery's wells and mechanical and electrical systems. Buildings, fish pools and equipment were damaged or destroyed.

The clean-up continues. To lend a much-needed helping hand in the weeks immediately following the storm, heavy equipment operators drove machinery from national wildlife refuges in Maine, New Hampshire, Massachusetts and New Jersey to help move mud and debris.

Nearly a third of the hatchery's total population of fish was either killed or escaped into the White River during the flood. The facility produces eggs as part of the Atlantic salmon restoration program, lake trout to support recreational fishing in the Great Lakes, and native brook trout, a favorite of Vermont anglers.

To prevent the spread of disease and aquatic invasive species, such as didymo or "rock snot" known to occur in the White River, the remaining fish will be removed and the hatchery decontaminated. Some fish may be released into waters where didymo is already confirmed. As didymo does not have any human health risk, some fish may be donated to Native American tribes for traditional ceremonies. For more information, visit www.fws.gov/whiterivernfh/irene.html. ♦ Terri Edwards

Stretching out a dollar

Jordan River National Fish Hatchery stretched the value of a dollar, parlaying a \$60,000 Visitor Facility Enhancement grant into a hatchery-wide education project. Located on 116 acres that includes streams and wetlands, the property is loaded with educational opportunities for the visiting public—an outdoor classroom just waiting to happen. The grant facilitated new nature trails with resting benches and informational signs at habitat zones, a four-season shelter for school kids, and a 15,000-square-foot pollinator garden composed of native plants of northern Michigan. These projects employed Youth Conservation Corps interns. With their labor and the dedication of volunteers, Jordan River's outdoor classroom is now a reality. ♦ Denise Wagner



USFWS

Members of the Youth Conservation Corps build a trail at Jordan River National Fish Hatchery in Michigan.

Wildlife Forever “Fish Make You Smarter” national essay award

“...not judged by length, but by what you say” is at the heart of criteria for a new National Award in Wildlife Forever’s annual State-Fish Art Contest sponsored by the U.S. Fish and Wildlife Service’s Division of Fisheries and Aquatic Resource Conservation.

For the first time in the Contest’s 14 years, in addition to winning artists, a child’s written words will be selected and honored in each grade category. Karen Hollingsworth, State-Fish Art Manager explains, “We are looking for a spark of personal connection to their chosen fish and its watery world, how a fish lives and what it needs to be healthy.”

“I am so excited to have Fisheries as a partner!” exclaimed Hollingsworth. “Their judging of our top Grade 10-12 essays and personally awarding the winner emphasizes the science-side of our Program—educating our youth about fish and aquatic conservation issues.”

Click on “new in 2012” at www.statefishart.org. ♦ Karen R. Hollingsworth



FEATURED FACILITY Nashua National Fish Hatchery

Where: Nashua, New Hampshire

When: Established 1898

Then: An 1898 U.S. Fish Commission report described a site near the Nashua River as possessing “in greater degree than any others examined in the State the requisites for a fish hatchery. The property is well suited for a favorable arrangement of buildings and ponds.” And so it came to be. A federal fisheries facility soon raised rainbow, brook and brown trout for New England waters and beyond. Eggs from its broodstock shipped around the country, primarily by railroad.

Now: Today, Nashua National Fish Hatchery is fully immersed in Atlantic salmon and American shad conservation for fisheries in the Merrimack River and other New England waters. The hatchery is a refuge for threatened brook floater mussel. Excess broodstock for the largest directed Atlantic salmon fishery in New England provides economic benefits of about \$300,000 annually, also yielding valuable data on fish movement and habitat preference.



Kyle Flanery/USFWS

Nashua National Fish Hatchery biologist Claudia Ostaudelafont (l), and volunteer Stacy Flanery prepare recently fertilized and certified disease-free Atlantic salmon eggs for incubation stacks behind them. The eggs incubate five months before release into the Merrimack River watershed.

In 2011, over 400 Atlantic salmon returned to the Merrimack River; the highest number since the restoration program’s inception. The hatchery in 2011 produced almost 6 million shad larvae, the highest production yet for the facility. www.fws.gov/nashua ♦ Kyle Flanery

Sport Fish Restoration supports state hatcheries



Under the rainbow, New York's 148-year-old Caledonia Fish Hatchery benefits from Sport Fish Restoration funding derived from angler expenditures.

The Dingell-Johnson Sport Fish Restoration (SFR) program has a 61-year tradition of funding state hatchery programs. One early SFR grant of \$6,375 helped develop disease-resistant strains of trout in New York. According to data from the

past 20 years, \$1.1 billion (24 percent) of national SFR funds have been spent by states on fish production and stocking. This 24 percent for hatcheries combined with 33 percent for fisheries research and surveys, and 21 percent for boating and fishing

Fish in the Classroom

One Fish, Two Fish, Red Fish, Blue Fish . . . remember that Dr. Seuss classic from kindergarten or elementary school? Grade school kids are getting to know more about fish, and not just from books. Thanks to the work of the U.S. Fish and Wildlife Service, fish – real fish – are in classrooms for hands-on learning.

“Shad in the Classroom” and “Chub in the Classroom” are two such examples used by many U.S. Fish and Wildlife Service Fisheries field stations to educate and engage youth, basically bringing real-life fisheries management experiences up close and personal. Participating classrooms set up an aquarium and receive eggs or juvenile fish

from a National Fish Hatchery. Students are then responsible for feeding the fish daily and monitoring water temperature and water quality. Students learn about food webs, watershed management and conservation, study fish anatomy, and gain knowledge of what makes a Fisheries field station work. The students gain an understanding of a fish species and its importance within an ecosystem and the valuable role the children play as future stewards of fish and wildlife.

The Raleigh Ecological Services Field Office, North Carolina, as well as several National Fish Hatcheries in the Southeast have worked with schools to raise fish in the classroom.

access, all told represents over three-fourths of SFR funding to state fish and game agencies. SFR dollars come from federal excise taxes on fishing equipment and federal gas taxes attributable to motorboats.

Eighty-seven percent of national SFR hatchery funding during the past 20 years was used for operations and maintenance. Caledonia Hatchery in New York which was built in 1864 and is the oldest hatchery in the western hemisphere, currently producing 170,000 pounds of catchable brown trout each year, partially supported by SFR. While large hatcheries are familiar images, SFR also supports small-scale hatcheries. The Nanticoke Shad Hatchery in Delaware, has a series of spawning, culture and egg collection tanks and egg incubation jars within a single 24-foot by 30-foot pole building. Each year this hatchery produces about 600,000 Atlantic shad fry that are stocked in the Nanticoke River, Delaware's only major tributary of Chesapeake Bay.

◆ Ron Essig

The Arizona Fish and Wildlife Conservation Office recently started its own Chub in the Classroom.

These programs are based on Trout in the Classroom developed by Trout Unlimited and curricula has been modified to fit each station's specific needs.

The programs encompass not only science, but many other curriculum areas including language arts, mathematics, social studies, ecology, and art. You can learn more at www.troutintheclassroom.com.

◆ Denise Wagner

New book on Bob Hines a must-read

Bob Hines was a man at one with his art. His subjects—fishes, birds, fur-bearers, big game, and people—two-dimensional as they are on canvas, are filled with the life that they possessed. Hines' artworks overflow with vitality and a new biography on the man is filled with a similar energy.

Author John D. Juriga, a practicing pediatrician in Upstate New York, published *Bob Hines: National Wildlife Artist* (Beaver's Pond Press) in time to celebrate the centennial of Hines' birth later this year. Hines was a self-taught artist who found his muse during the Great Depression in northern Ohio. He worked as an artist for the Ohio Department of Conservation and Natural Resources before joining the U.S. Fish and Wildlife Service in 1948.

"*Bob Hines* is a fabulous book that should be read by those who appreciate the Federal Duck Stamp Program, and the history of conservation," said Carlos R. Martinez, Director of the D.C. Booth Historic National Fish Hatchery and Archives in Spearfish, South Dakota. "The man's contribution to art and conservation has flown under the radar. Prior to Juriga's work, I did not fully appreciate the 22 Bob Hines originals preserved in our archives."

Among those held at the historic National Fish Hatchery is the highly regarded painting, *The Symbol of Our Nation*, a bald eagle taking flight from a tree snag. That's just one of many images you'll see in Juriga's richly illustrated book. Hines' work has been in galleries, books, pamphlets, and in *Eddies*. ♦ Craig Springer



Beaver's Pond Press

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

There is something about a three-dimensional cast-metal fish that makes you go "WOW." Inch for inch, metal fish are heavier than the real thing and surprisingly delicate. Trying to move a heavy, yet fragile item requires some thought. Why were these beasts created?

In the early days of the National Fish Hatchery System, metal fish signs were indicators of the species propagated. Signs were mostly made of wood and metal. Although plastic was made decades ago, early plastics were not durable. Colorful signs of plastic for outdoor use were not available until the 1960s.

One of these cast fish was recently donated to the Archives. A note signed by fisheries conservation pioneer, the late Robert W. Thoesen (see *Eddies*, Spring 2008) says it came from the Cohutta National Fish Hatchery, Georgia. Old photos confirm that such a fish was found there. Apparently by the mid-1960s, our metal sign was gone. A 1967 Cohutta information brochure has an image of a large wood entrance sign



Randi Sue Smith/USFWS

Metal three-dimensional fish signs are stout yet fragile. with a blue fish logo and a metal Bureau of Sport Fisheries and Wildlife shield. The shield was used from around 1956 to 1974.

Putting it all together, my guess is that the metal fish were used until around 1960, but by mid-decade had been phased out in favor of the wood sign with the flat metal shield.

One wonders what happened to the other metal fish that graced signs across the country. If you have information or photos of signs, or other items of interest, we want to hear from you. Email randi_smith@fws.gov or call (605) 642-7730 x215. ♦ Randi Sue Smith

By E. Peter Steenstra

Charles Grandison Atkins



Charles Atkins snapped the shutter on hatchery worker Charles Gibbs as he tediously picked dead Atlantic salmon eggs from incubation trays using double-loop tweezers.

Fisheries biologist Charles Atkins was truly a visionary who left his tracks in published literature and in black-and-white photos. Atkins followed a life-long calling in the science of fish culturing. Over his 80-year life span, his career would take him to Europe, across the continental United States, and by invitation to Japan in his interest to educate others in what he knew.

Like his contemporary Dr. Livingston Stone, (see *Eddies*, Spring 2011) Charles Atkins was a New Englander. He was born in New Sharon, Maine, on January 19, 1841. He attended Bowdoin College, and upon graduation accepted a teaching position at Green Bay, Wisconsin. Within a few years his interest in

fisheries conservation, as well as declining fish populations in our eastern rivers, undoubtedly caused him to return to his native Maine where he began a career in fish culture and research.

Indeed, concurrent with Atkins' early years, fisheries scientists were becoming increasingly alarmed by the decline of migratory fish species in the northeastern United States. In answer, the states of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, New Jersey, New York, and Michigan formed a consortium to address the issues. A year later Maine formed its own Fish Commission, and hired Charles Atkins and Nathan Foster as its first commissioners. The Commission's first report in January 1868 cited, "The salmon is suffering from neglect and persecution. So peculiarly is it exposed to the attacks of man, so greedy and relentless has been the pursuit, and so regardless of their necessities has been the management of the waters, that in many rivers, both in Europe and America, it has become utterly extinct, and in very few of the remainder does it yield anything like the number that it was wont."

The U.S. Congress followed the states' lead, creating the U.S. Commission on Fish and Fisheries on February 9, 1871—the forerunner of the U.S. Fish and Wildlife Service. Spencer F. Baird was appointed its first Commissioner, and among his first directives were to conduct studies on the decline of coastal and inland food fishes and methods of fish culture (see *Eddies*, Special Issue 2009). Baird turned to the noted Charles Atkins, and directed him to locate a

suitable site in Maine to raise Atlantic salmon. The site Atkins selected was a vacant mill located at the mouth of Craig Brook on Alamoosook Lake in mid-coast Maine.

Thus began Charles Atkins' 48-year career as a fisheries biologist in the employ of the U.S. Fish Commission, and the U.S. Bureau of Fisheries. In the absence of fish culture training in America, he traveled to Berlin, Germany, where he received an education, earning his diploma in 1880. Upon his return to the United States, Charles Atkins had already developed his meticulous style in scientific methodology, his accurate data recording and retrieval techniques, and the production of his own skillful illustrations dealing with external morphology and embryological development of various fish species. And there was the lens. Atkins made exquisite use of photography in scientific documentation. With his camera, Atkins recorded and left us a visual window upon his world, not a small vignette—but a “*Saturday Evening Post*” if you will—of his life’s work. He produced hundreds of photographs which illustrate well the process and product of fish culturing in its infancy. All told, they comprise a tremendous photographic record.

Charles Atkins is known primarily for his work with diadromous Atlantic salmon, but he also conducted in-depth research with several other species such as cod, flounder, lobster, smelt, American shad, white perch, and striped bass. Atkins’ accomplishments won him considerable acclaim, as he published over 100 papers and another 100

more that were written but went unpublished. His extensive work and high-quality photographic images, coupled with his insatiable desire for scientific detail and accuracy, earned him induction to the American Fisheries Society’s Fish Culture Hall of Fame located at D.C. Booth Historic National Fish Hatchery and Archives in Spearfish, South Dakota in 1996.

Charles Atkins was truly an exemplary biologist as well as a model for responsibility in stewardship for wildlife and their habitats. ♦

E. Peter Steenstra is an Outreach and Education Specialist at the Maine Fisheries Program Complex at Craig Brook and Green Lake National Fish Hatcheries. His story, “S.H.A.R.E. Partnership in Downeast Maine,” appeared in *Eddies*, winter 2008.



Charles Atkins transfers an adult Atlantic salmon at the Dead Brook holding facility. The fish were artificially spawned here each November, and the eggs transferred to Craig Brook hatchery two miles away on the east shore of Alamoosook Lake where the eggs incubated for five months.

USFWS



Charles Atkins with net in hand collects Atlantic salmon broodstock fish off a weir at Verona Island in Penobscot Bay. The salmon were ferried in covered and half-submerged “salmon cars” to the lock in Orland by the Steamer Agnes, and then sluggishly rowed by hand two more miles to the Dead Brook holding pens for spawning.

USFWS

Dolly Varden

By Mark Lisac



Ora Schlei/USFWS

A small piece of fin tissue taken from this vividly colored Dolly Varden will tell geneticists its river of origin. The fish's unusual name comes from a character bedecked in cherry-colored clothes in a Charles Dickens story.

The Dolly Varden has a colorful history. It was first described for science by German physician-naturalist Johann Walbaum in 1792, the same doctor who discovered that gloves used in surgery reduced infection. The fish he named *Salvelinus malma* was commonly called “Malma trout” after a native name in the Kamchatka region of the Russian Far East.

The fish's present common name was borrowed from a character in

Charles Dickens' novel, *Barnaby Rudge*. Dolly Varden was a flirtatious young British lady in the story who wore cherry-colored clothes and ribbons, and set off a fashion fad in the 1870s. Ladies began to mimick Dolly's manner of dress. Pop culture at the time went further and applied the name to songs, poems, boats, dry goods stores, water bodies, mines, and mountains. It takes no leap of imagination to see how a fish was given this name when you see a colorful spawning Dolly Varden.

David Starr Jordan, the preeminent fisheries scientist of his day wrote in a 1905 report to the California Fish Commission, that Spencer F. Baird, the founder of the U.S. Fish Commission, suggested the fish be called the “Dolly Varden trout” in 1878.

The Dolly Varden is no more a trout than is its close kin, the brook trout (see *Eddies*, Spring 2009). Both are members of the char group in the salmon family which includes salmon,

trout, whitefish, and grayling. Char are distinguished from others in this family by having lighter markings on a dark background. To make matters murkier, the Dolly Varden placement in the picture with other char species has been confusing. What are now three species, Dolly Varden, Arctic char (*Salvelinus arcticus*) and bull trout (*Salvelinus confluentus*), were until the 1970s considered the same fish. The Dolly Varden ranges widely from eastern Asia through Alaska and northern Canada, and south along Pacific Coast streams to northern California.

The Dolly Varden is still sometimes confused with Arctic char, but the two can be distinguished by their color and shape. The Dolly Varden's tail fin is less forked with a thicker base, and it usually has black in the mouth. Arctic char have fewer light-colored spots, with the largest spots being bigger than the pupil. Come spawning time, these differences are more pronounced. Both sexes of the anadromous Dolly Varden in Alaska change from their almost chrome sides with faint spots and dark greenish backs. Their reddening fins with a bright white leading edge and flame-red or pink spots portray the color of its namesake's coat. Spawning males are much more striking with a red belly, and black head with a hooked lower jaw called a kype.

Because this species changes appearance throughout the year, the Native people of southwest Alaska have three names for Dolly Varden based on looks, where they are caught, and the fat content or parasites found in the meat. Interviewing local people using photographs have confirmed that these are all indeed the same species.

Due to the early "char confusion" Dolly Varden were targeted along with Arctic char for eradication. When Bristol Bay sockeye salmon numbers declined in the early 1900s, commercial fisherman and fisheries managers blamed char for eating too many juvenile salmon. From 1928 to 1940, the federal government put a bounty of \$0.05 per tail on char, paying as much as \$30,000 a year to boost wild sockeye salmon production. In the 1970s the bounty ended, but the State of Alaska tried to pen up char at river mouths until after the sockeye smolt had migrated out to sea. Later it was discovered that although they may eat some juvenile salmon, the primary food of Dolly Varden are salmon eggs that didn't get buried in the gravel and likely would not have survived anyway.

Substantial research to clear up the "char confusion" has discovered interesting life histories, like populations of land-locked dwarf Dolly Varden and populations in rivers connected to the ocean that never leave their home waters. But the majority of Dolly Varden in Alaska spend a portion of their life at sea.

Dolly Varden mature at three to six years old and spawn from August to October in gravelly areas in flowing water. The female digs a nest called a "redd" and buries the fertilized eggs so that oxygen-rich water can percolate around them. The eggs hatch as fry in late winter to early spring. The young Dolly Varden that will move out to sea do so in one to three years. A proportion of the spawners die, especially the males due to their violent defense of the female, but a good number survive and can spawn multiple times in their up to 12-year-long life.

Mature fish almost exclusively return to their home rivers to spawn and usually enter the rivers first, followed by immature fish that return to overwinter in freshwater. They return by the tens of thousands in late July and August to feed and to spend the winter. It's then that anglers catch an estimated 40,000 Dolly Varden from Togiak National Wildlife Refuge waters alone. Only an estimated 2,000 of these fish are harvested. Some anglers love Dolly Varden for their ease of catching and their sheer numbers, not to mention their beauty and taste. Others detest them and treat them as a trash fish because they get in the way of catching salmon and rainbow trout.

Come spring time the Dolly Varden head out to sea shortly after the ice breaks up in the rivers. Once at sea these fish feed on marine fishes and invertebrates, and can travel great distances. Several fish tagged in Togiak National Wildlife Refuge rivers have been caught up to 500 miles away. One of the farthest documented distances traveled by a Dolly Varden is that of a fish that was captured while overwintering in the Wulik River in northwest Alaska. It was recaptured 60 days after entering the ocean—2,600 miles away on the spawning grounds in the Anadyr River in Russia.

So whether you love them or hate them you have to give the Dolly its due for its unique and colorful history. ♦

Mark Lisac is the Fisheries Biologist on the Togiak National Wildlife Refuge based out of Dillingham, Alaska. He has spent half of his 28-year career involved in research on Dolly Varden in southwest Alaska.

By Alexa Marcigliano

Of Red Knots and Horseshoe Crabs

The horseshoe crab is as enigmatic as it is odd-looking. It's a key element in medical research, a major resource for the bait industry, and an essential food source for migrating shorebirds. It presents a management challenge for fisheries along the Atlantic Coast.

Though important to modern medicine and research in many ways, the horseshoe crab is an ancient species that has remained relatively unchanged in appearance for 350 million years. Its blood contains primitive large cells called amoebocytes from which a clotting agent, Limulus amoebocyte lysate (LAL), is derived. LAL clots when it comes in contact with bacterial toxins, making it invaluable when testing the sterility of vaccines, drugs, prosthetics, and other medical devices. There is currently no FDA-approved synthetic substitute for LAL.

Additionally, a large amount of our knowledge regarding human vision and the function of human eyes results from research using cells found in horseshoe crab eyes. The researchers who conducted these studies were awarded the 1967 Nobel Prize in Medicine.

Also important to the bait industry, horseshoe crabs are often harvested for conch and American eel fisheries along the Atlantic Coast. In the late 1800s and early 1900s, nearly four million crabs were harvested annually for fertilizer and animal food.

With all of the ways in which people depend on the horseshoe crab, it becomes increasingly important that we acknowledge and assist the other species that rely on the crab



for survival. The red knot, a small, migratory shorebird that breeds in the Arctic tundra and winters as far south as South America, relies heavily on a supply of horseshoe crab

No sooner do horseshoe crabs lay eggs, do red knots eat them. The nutritious eggs needed from the shallows sustain the birds as they move along on their migration. Photo courtesy of USFWS.



USFWS

eggs to survive its annual journey northward in the spring.

Horseshoe crabs arrive at Atlantic Coast beaches in late spring through early summer to lay their eggs.

The safe, sandy beaches of the Delaware Bay are the prime location for horseshoe crab spawning, with thousands of crabs converging to lay their eggs in late May and early June. A horseshoe crab egg cluster can

contain 4,000 eggs, and a female may lay multiple nests in a night. Over the course of several days she can lay up to 100,000 eggs.



USFWS

Horseshoe crabs spawn en masse on the Atlantic Coast.

Many eggs are uncovered by crashing waves or the digging of other horseshoe crabs, making the perfect meal for migrating shorebirds. The Delaware Bay hosts the second largest population of migrating shorebirds in North America and more than half of the total flyway population of red knot. The mid-Atlantic coast is one of the few areas the birds stop on their journey from South America to the Arctic, making this meal critical to their survival.

The birds spend up to two weeks feeding before continuing their

migration north. Each red knot can double its weight by eating thousands of the nutrient-rich horseshoe crab eggs, preparing for the rest of its journey across the hemisphere.

Because of the human demand on horseshoe crabs throughout history, and more recently a large harvest increase in the 1990s, red knots have had a difficult time finding the food they need to sustain their migration. Because of this and other stressors, the red knot is currently a candidate species for the federal Threatened and Endangered Species List.

The intersection of human and wildlife needs concerning a third species has resulted in biologists collaborating in a new way—interjurisdictional species management. Fisheries and migratory bird specialists together created strategies and plans best suited to both horseshoe crabs and red knots.

From this need for collaboration and regulation, the Atlantic States Marine Fisheries Commission (ASMFC) developed the Interstate Fishery Management Plan for

Horseshoe Crab in 1998. This plan and subsequent addendums assigned mandatory state-by-state harvest quotas and created the 1,500 square-mile Carl N. Shuster Jr. Horseshoe Crab Sanctuary off the mouth of the Delaware Bay.

A working group of the ASMFC, known as the Adaptive Resource Management work group, comprised of both horseshoe crab and shorebird experts, creates models to project potential outcomes of different horseshoe crab harvest management decisions. The ASMFC's Horseshoe Crab and Delaware Bay Ecosystem Technical Committees review the models and then make recommendations to the Horseshoe Crab Management Board of the ASMFC.

Mike Millard, Ph.D, a member of the technical committee and director of the U.S. Fish and Wildlife Service's (Service) Northeast Fishery Center in Lamar, Pennsylvania, speaks of the initial difficulties resulting from cross-jurisdiction collaboration. "The challenge was that we're no longer just managing for a sustainable fishery, but also taking into account the trophic needs of a shorebird. It's a new way of thinking for fishery managers. It's really a groundbreaking approach."

Through this partnership, however difficult, successful models have been created, and the thought process behind horseshoe crab management has evolved. According to Millard, "In the old days when data were unavailable, we would just cut the harvest by some amount and see what happened." Now, he says, they use the suite of scientific models to predict the "optimal management scenario for the growth and sustainability of both species."

Despite the new regulations in horseshoe crab harvest, shorebird biologists are still seeing steady decline in the red knot population. With reduced red knot numbers, the species is now more vulnerable to other threats throughout its range such as human disturbance, loss of habitat from coastal development and sea level rise, red tide events, and oil spills. While an estimated 67,500 red knot were observed in the wintering grounds of Tierra del Fuego in the mid-1980s, only around 16,200 were counted in 2010, according to Annette Scherer, senior endangered species biologist at the Service's New Jersey Field Office and member of the ASMFC Delaware Bay Ecosystem Technical Committee.

Scherer cites the lengthy juvenile stage of horseshoe crabs, nine years or more, as a contributing factor in slowing recovery of red knots. The policies have been put in place

to provide sufficient food for the migrating red knot, now we need to wait for the horseshoe crabs to mature and spawn, she explained.

Realizing the importance of conserving one species to save another has been a cooperative and innovative process resulting in years of tagging, tracking and strategizing among fisheries professionals. Hopefully through maintaining this collaboration, red knot populations will begin to rise in the coming years. ♦

Alexa Marcigliano is a Social Media Specialist with the U.S. Fish and Wildlife Service in New York City. She's also a stuntwoman and has appeared in two films, *The Woman* and *Knight & Day*.



Large waves of horseshoe crabs leave behind masses of eggs, some of which are consumed by red knots and other shorebirds.

By Abigail Lynch



A Dinosaur Fish Swims on through Deep Time

In the misty morning U.S. Fish and Wildlife Service biologists Frank Parauka, Greg Landry and Meghan Landry are on the Choctawahatchee River, Florida.

Out on the Yellow River along the Florida panhandle, you might not expect to see a dinosaur. But, that's exactly what Frank Parauka, fishery biologist with the U.S. Fish and Wildlife Service's Panama City Fish and Wildlife Conservation Office, is on the hunt for, Gulf sturgeon. This fish is a "living dinosaur."

Gulf sturgeon appear in the fossil record early—before the reign of the dinosaurs—about 225 million years ago and have changed remarkably little since. The fish now faces extinction because of overfishing and habitat degradation. Parauka's job, along with numerous other fisheries professionals and volunteers, is to ensure that restoration, not



Angley attempt netting Gulf sturgeon in the

USFWS

enough, imagine one jumping up next to your 15-foot fishing boat. In Florida's Suwannee River, there were 10 collisions between Gulf sturgeon and boaters in 2011. These sturgeon are famous for jumping, but scientists have yet to discover why. Some researchers reason that jumping is a form of sturgeon-to-sturgeon communication because the act has a characteristic sound pattern. "There are too many questions to answer about these fun fish," says Parauka. "They sure keep you guessing."

The most southern of the sturgeons, Gulf sturgeon are a subspecies of Atlantic sturgeon that were separated by the Florida peninsula about 350,000 years ago. They've since adapted to the warmer waters of the Gulf. Historically, Gulf sturgeon ranged from the Mississippi River to Tampa Bay. The present range extends from Lake Pontchartrain, Louisiana and the Pearl River system of the Mississippi, east to the Suwannee River, Florida. They migrate between fresh and marine waters and feed in estuaries during the winter, rarely straying more than a few miles from the coast. Gulf sturgeon possess a very strong homing instinct and generally return to their own natal rivers in the spring to spawn. They spend the rest of the summer and fall months in freshwater where they fast, not eating for eight or nine months.

Initially, Gulf sturgeon supported a profitable fishery with the harvest of their eggs for caviar, their flesh for smoked fillets, and their swim bladders for isinglass, a semi-transparent gelatin used in jellies, wine and beer clarification, and special cements and glues. Because of their long life, slow growth, late maturity (females at 12-15 years and males at 7-10 years), and infrequent

reproduction (females spawn every 3-5 years), Gulf sturgeon were easily overfished by the mid-twentieth century. Concurrent with overfishing, habitat degradation also precipitated this decline. Dams limited migration to historical spawning grounds; groundwater extraction decreased flow into streams and restricted cool-water summer refuges; point and non-point pollution caused bioaccumulation of heavy metals and other toxicants; and dredging destroyed river-bottom feeding areas.

Management of Gulf sturgeon is challenging, foremost because they readily migrate across interjurisdictional boundaries. Because these fish travel long distances, place-based conservation measures do not provide adequate protection. Therefore, management across state and federal jurisdictions is necessary.

The Gulf sturgeon was listed as a threatened subspecies in 1991 and a recovery plan was implemented in 1995. The U.S. Fish and Wildlife Service, National Marine Fisheries Service, and Gulf States Marine Fisheries Commission were signatories to the plan with the joint objectives to prevent further reduction of wild populations and eventual delisting.

Karen Herrington of the Panama City Ecological Services Office is the recovery lead for the U.S. Fish and Wildlife Service. She and her National Marine Fisheries Service counterpart are currently guiding the update of the recovery plan. "Since we've listed the species," says Herrington, "we've funded a lot of research and come a long way in what we know about the species. We can greatly improve upon the

extinction, is the future for this majestic fish.

Gulf sturgeon grow to over 8 feet, weigh over 200 pounds, and live at least 30 years. They have a large snout with a vacuum-like mouth, and their bodies are covered in five rows of bony scutes that act as a body armor. And, if that is not intimidating



Paul A. Lang/USFWS

Old fish are heavy fish. Greg Landry (l), Frank Parauka, and Meghan Langley haul a Gulf Sturgeon from Florida's Black River onto their boat where it will be weighed, measured, tagged and released.

current plan because we have a better idea of how to achieve recovery.”

Currently, seven rivers support four genetically distinct reproducing populations of Gulf sturgeon. The largest population in the Suwannee River may contain as many as 14,000 fish. Parauka has led annual gill net surveys on the Escambia, Yellow, Choctawhatchee, and Apalachicola rivers of the Florida Panhandle since the mid 1980s. The surveys yield important data on length and weight, and the movement patterns of fish previously

tagged. Close to 300 Gulf sturgeon now have acoustic transmitters. Some 140 receivers, from the mouth of the Suwannee River to the Louisiana coast, positioned 15 miles apart record when the fish leave the rivers and where they go. Gulf sturgeon movement is still quite a mystery. “We don’t know what they’re going to do half the time,” says Parauka.

Even with interjurisdictional management at its best, Gulf sturgeon restoration is never simple. Though everyone has common restoration goals, wrangling geographically dispersed partners can be difficult. “Little things can be big challenges,” according to Herrington. “Permitting and getting

all the partners to use the same conservation measures can be tough.” But, the returns from working together are even greater. “To see these charismatic fish recover,” says Herrington, “what a reward!” ♦

Abigail Lynch faced a white sturgeon at the end of a rod, tagged Atlantic sturgeon in Chesapeake Bay, but has yet to encounter a jumping Gulf sturgeon. She’s a Ph.D. student in the Department of Fisheries and Wildlife at Michigan State University, and a SCEP employee with the U.S. Fish and Wildlife Service’s Division of Fisheries and Aquatic Resources Conservation.



Paul A. Lang/USFWS

This Gulf sturgeon's exposure to air is minimized as Meghan Langley measures the fish's length at the base of its tail fin. Frank Parauka holds the fish and tape measure steady.

By John Bryan

Restoration of Atlantic Migratory Striped Bass



Wilson Laney/USFWS

Commander Jerry Adams of the NOAA R/V Oregon II, holds a large, freshly tagged Atlantic Ocean striped bass prior to release.

It's early Monday morning in the fall of 2011. The ring of Steve Minkkinen's telephone heralds a stunning report. "She was pretty excited," he recalls.

Minkkinen supervises the Maryland Fisheries Resources Office which was created in 1986 to help restore the Atlantic striped bass—a remarkably successful restoration that involved massive cooperative effort.

"Everyone pulled the wagon for the common cause," says Jaime Geiger, Assistant Director for the U.S. Fish and Wildlife Service's Northeast Regional Office, "universities, two federal agencies, power companies, recreational fishermen, commercial fishermen, and on and on."

Native to the Atlantic coast and its tributaries, striped bass have been important since Colonial days—and at one time were so numerous that they were used to fertilize fields. But as the human population grew and fishing techniques became extremely effective—especially in the 1970s—the striped bass population became highly vulnerable. Commercially caught stripers totaled 14.7 million pounds in 1973, and during the following 10 years the annual total dropped to 1.7 million pounds, including a loss of 7,000 jobs and \$220 million in revenues. "THE money fish along the Atlantic coast," says Geiger.

Today's caller tells Minkkinen about the striper she caught yesterday—a

tagged 30-incher. The enthusiasm in the caller's voice is unusually fervent.

There is nothing unusual about a call reporting a tagged striper. Prior to today there have been more than 90,000 such reports. The tagging programs of the Fish and Wildlife Service and other agencies have resulted in 501,800 tagged fish registered at the Maryland Fisheries Resources Office—a coordinated database that has been an important tool in striped bass research and restoration. "There were 37 tagging agencies involved when the database was established," says Ian Park, fish biologist at the Maryland Fisheries Resources Office. "Fish have been

recaptured as many as five times and as long as 8,000 days after tagging.”

Today’s phone call causes Minkkinen to remember the year 1985 when his career began, the year the state of Maryland closed striper fishing. Today the population is officially restored, but back then the future was bleak.

“Striper management was somewhat fragmented,” says Park, “and the federal authorities had no real strength to tell the states what to do.” In 1979 Congress authorized the Emergency Striped Bass Study to determine the size of the migratory population, initiate research on the reasons for the crash, assess the economic impact, and eventually make recommendations for recovery. One of the results was the preparation of an Atlantic Coastal Management Plan that put in place strict regulations regarding harvest. In 1984 Congress passed the Atlantic Striped Bass Conservation Act which enabled the Secretary of Commerce to impose a moratorium on striped bass fishing in any state that did not comply with the management plan. The U.S. Fish and Wildlife Service was charged with taking the lead in determining the cause of the fishery’s decline.

These federal actions were possible because of the cooperation of recreational and commercial fishermen and the advocacy and influence of members of Congress such as Senator John Chafee (RI) and Representative Silvio O. Conte (MA).

“The fisheries management organizations had a clear choice: cooperative restoration or mandatory recovery,” says Geiger. “They decided on cooperative restoration,

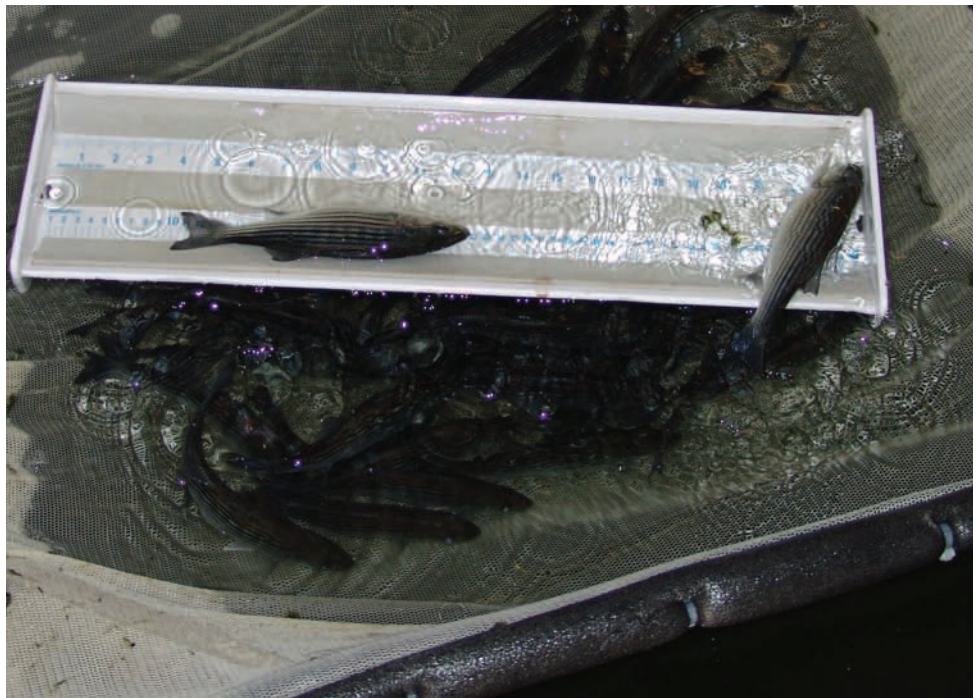
and this was enhanced by strong congressional support.”

In 1979 there was no solid research to determine the cause of striped bass depletion. There were several key hypotheses, among them: contaminants, over-harvest, excessive larval predation, climatic events, water use practices, disease, and of course habitat degradation. The decline could have been due to any or all.

Because it is anadromous, the striped bass requires a multi-menu of multi-water conditions to nurture its life cycle. “The fish has to do some complex things: show up at the right time, release eggs under the right conditions, move down into the estuaries, and so forth,” says Minkkinen.

The Atlantic striped bass spawns in fresh water, and the eggs need to be buoyant enough to suspend for two or three days until they hatch. For the next five days while the larval fish receive nutrients from a retained yolk sack, they are susceptible to predation, starvation, and poor water quality. They move out into the ocean after three years, the females going earlier than the males. Females reach sexual maturity at five to seven years and return to spawn, and the eggs are fertilized by males as young as three years. Protecting this entire life cycle was of course crucial to the restoration.

While listening to the amazing report on this morning’s telephone call, Minkkinen recalls the years of work that preceded the restoration. This call is a glowing celebration of the success.



Striped bass get weighed, measured, and tagged at Edenton National Fish Hatchery, helping biologists better understand the fish population in the wild.

Stephen Jackson/USFWS

Overharvest, especially of spawners, was identified as a major reason for the decline, and strict limitations were put in place including the National Marine Fisheries Service's prohibition of all harvest within the Exclusive Economic Zone—waters from 3 to 200 miles off the Atlantic Coast. Simultaneously facilities in the National Fish Hatchery System went to work hatching, raising, and stocking young striped bass to supplement depleted year classes. And, expansive tagging programs were put in place to help evaluate the results.

Commercial and recreational anglers became proactive. "They were actively cooperating in the restoration of striped bass," says Geiger. "They wanted to be a part of the solution—not seen as the problem." A broad range of other agencies had major involvements. "The U.S. Fish and Wildlife Service was a really good partner," recalls Allan Brown, Fisheries Program Supervisor for Warmwater Hatcheries at the Southeast Regional Office in Atlanta. "We often go out of our way NOT to be the lead organization so it doesn't appear that the federal government is dictating what's being done."

The efforts paid off, the annual Juvenile Index numbers went up, and in January 1995 the Atlantic States Marine Fisheries Commission (ASMFC) declared the striped bass restored. Since then continued management, habitat restoration, selective stocking, and diverse research have been accompanied by growth in the population.

"Obviously it's a really important fish recreationally and commercially to a lot of people," says Minkinen. "The population will be watched and managed as carefully as possible."



Biologists at Edenton National Fish Hatchery, North Carolina, collect young striped bass for eventual stocking in the wild.

USFWS

Minkinen listens to today's caller as she provides astonishing indication of the size of today's striper population.

There are of course challenges for the future—including the apparent depletion of river herring and other menu items for stripers. "Striped bass had a lot of appeal," says Mike Odom, supervisor of Harrison Lake National Fish Hatchery in Virginia. "There was a lot of push to restore a top predator when a lot of its forage was depressed. I'd like to have seen some of the prey species rebuilt first."

"Our focus on striped bass caused us to not take as aggressive a management stance on the forage side of the equation," confirms Wilson Laney, Coordinator for the South Atlantic Fish & Wildlife Conservation Office.

Another potential challenge is mycobacteriosis, a progressive and multi-symptom disease now prevalent among Chesapeake Bay striped bass. "There is suggestion that this disease attacks high-density populations," says Laney. But new research by John Hoenig of the Virginia Institute of Marine Science indicates that although a significant number of fish are affected, the disease takes so long to mature that the mortality rate may be minor.

Over the last decade additional important research has taken place, such as a study of striped bass mortality associated with catch-and-release angling in the Hudson River. "The in-river fisheries are happening right on the spawning grounds and this can be problematic," says Mike Millard, Director of the U.S. Fish and Wildlife Service's Northeast Fishery Center and one of the

study's principal investigators. "You can hook a bunch of fish because they're congregated right there: big reproducing adults." But Millard's research confirmed that the catch-and-release mortality is relatively insignificant.

And there is an increasing amount of genetics-based research, including a new project to help determine the strength of river fidelity. "This coming spring we'll take fin clips for genetic analysis," says Edenton's Jackson. Genetic coding will confirm each fish's native river system. "We'll be able to run those clips without lethal sampling."

Prior to today's phone call Minkinen had seen a Montauk striper photo in the new issue of *Field & Stream*: a room-size group of shoulder-to-shoulder surface-feeding stripers. But now his eyebrows rise as he listens to today's caller speak about the surface-feeding Montauk stripers that she saw: "ACRES OF THEM," she exudes, "SO THICK IT WAS ALMOST LIKE YOU COULD WALK ACROSS THEIR BACKS."

From depletion in 1979 to restoration in 1995 to acres for back-walking in 2011: a miracle restoration for sure. But experts recognize many cautions for the future, especially the

need for system-wide approaches to fisheries. "The ASMFC is trying to move toward eco-system-based management," says Laney, "as opposed to single-species. We need to know what biomass is needed to support all of those species."

"It would be nice to see more studies on who's eating what and where," says Minkinen. "But the ocean is a big plate." ♦

John Bryan edited the book, *Take Me Fishing*, working with such writers as Tom McGuane, John McPhee, Dave Barry, and President Jimmy Carter. This is his fifth story to appear in *Eddies*.



USFWS

It may be the end product for the work of hatchery biologists, but after striped bass are stocked in the wild, a multitude of scientists from several state and federal agencies will monitor their populations in the wild.

By Meghan Kearney

Swimming to the Future

Interjurisdictional fisheries management is a “complex” affair



USFWS

Chinook and coho salmon are raised at Dworshak National Fish Hatchery in Idaho.

Dworshak National Fish Hatchery is an impressive place this early morning. And the proof is in the numbers, the amount of fish coming from this federal fisheries facility in Ahsahka, Idaho. Out in the raceways, a combined 5.2 million young steelhead, Chinook, and coho salmon swim anxiously with hungry bellies as their breakfast is showered across the surface of their waters. As fish that migrate to the ocean as juveniles and as adults return to

freshwater to spawn one to four years later, they will be released into the Clearwater River not far from where Lewis and Clark encamped for 10 days in 1805. Upon release, hatchery salmon and steelhead will begin their own remarkable journey, a 500-mile swim to the Pacific Ocean. The fish will negotiate eight lower Snake and Columbia river dams and face a variety of avian and aquatic predators along the way.

Suddenly, lights throughout the hatchery flicker out and the sound of water alarms startle workers. A power failure sends the hatchery's buildings into darkness and pumps stop delivering water to raceways. The back-up generator kicks in with a flip of a switch. Electrician Ben Green makes a manual transfer to the main water pump, ensuring the hatchery is restored to life. The chatter of voices sharing instructions and plans can be heard clearly on hand-held radios, the teams' primary communication source until power returns. Workers monitor water levels, making adjustments and updating one another. A total of 57 burrow ponds and 30 Chinook and coho raceways are kept up until the power returns 45 minutes later. The teamwork showcased during the power outage is characteristic of day-to-day operations at Dworshak, which is organized as a unified “complex” of four interconnected U.S. Fish and Wildlife Service facilities.

Rewind to 1966. The North Fork Clearwater River is about to welcome a new tenant. Dworshak Dam is under construction. The Clearwater River Basin will see both benefits and detriments. After the dam's completion, below the surface of the river's deep blue ripples, salmon and steelhead will be turned away from their natal streams after a

treacherous homeward journey. Fish populations above the dam will struggle. It won't be until 1968, that the first brick of Dworshak National Fish Hatchery will be laid, offering a glimmer of hope for future fish runs and tribal harvest on the Clearwater River.

The hatchery is built to offset the loss and likely extirpation of the North Fork Clearwater steelhead from this new dam and other Snake River and Columbia River Basin hydroelectric projects. Over the next four decades, Dworshak becomes a cornerstone within a larger network of 24 hatcheries that contribute to naturally spawning populations and sustain economically and culturally important fisheries in the Pacific Northwest—important to Tribes, the commercial fishing industry, and recreational anglers.

In the 40-plus years since the hatchery was built, a larger complex of fisheries facilities has evolved into a prime example of collaborative interjurisdictional fisheries management. This is more than a group of co-located field stations, it's an institution where several fisheries professionals have a hand in managing interjurisdictional fisheries, day-to-day and in the long-term. This complex includes of course Dworshak National Fish Hatchery, but also the Idaho Fish Health Center, the Idaho Fishery Resource Office and also the nearby Kooskia National Fish Hatchery. The Nez Perce Tribe co-manages the two hatcheries (see *Eddies*, Spring 2009).

Dworshak's spring-migrating Chinook program is funded by the Bonneville Power Association's Lower Snake River Compensation Plan (LSRCP), intended to return salmon and steelhead to the Snake River Basin lost to construction of the four Lower Snake River dams. The Idaho Department of Fish and Game oversees fish harvest, along with the states of Oregon and Washington. These three state fishery

management agencies use data derived from fish tagged in the U.S. Fish and Wildlife Service's mass-marking programs. Idaho Fishery Resource Office biologists and Idaho Fish Health Center veterinarians help ensure hatchery operations meet state and federal environmental regulations, and policies on aquatic animal health.

The synergy resulting from partner contributions in managing interjurisdictional fisheries is especially evident in working with the Nez Perce Tribe. Ed Larson, Nez Perce Tribal Coordinator, highlights some shared successes: restoring Clearwater River coho populations, fish health services available to the Tribe, and cooperative management of tribal harvest. "When unity occurs, it empowers the team of the Service and the Tribe to accomplish more than either might alone," said Larson.

Coho salmon were declared extirpated in the Clearwater River in 1986. Restoration didn't occur until 1994 when the Nez Perce Tribe incubated and reared coho from surplus eggs from state and federal hatcheries. "We have come a long way since," says Mike Bisbee, Coho Project Leader for the Nez Perce. "Now, 850,000 coho smolts are released into the Clearwater River each year, and adult-return numbers continue to progress."

While returning coho to the Clearwater River represents a significant feat, so too is ensuring that spring Chinook production meets LSRCP mitigation harvest goals and fulfills treaty trust obligations to other tribes.

"A lot of changes in production strategies were made to identify the most efficient methods of spring Chinook salmon production," says Ray Jones, who evaluates Dworshak National Fish Hatchery operations. "The best time of release, rearing densities, and the optimum size at release have been addressed, to

mention only a few." Today, Chinook production has "an overall efficiency of about 80 to 85 percent survival from egg to smolt," Jones shares. "We have an obligation to help develop and maintain sufficient runs of spring Chinook salmon," says Jones, "so that Tribal members can exercise their treaty rights to harvest fish relative to their culture and religion."

Further upriver from Dworshak on the Nez Perce Reservation, Kooskia National Fish Hatchery contributes valuable spring Chinook salmon to the Clearwater River Basin. Hatchery manager and Nez Perce Tribe employee, Kent Hills, says more Chinook and coho are resulting from the work at Kooskia.

Marilyn "Guppy" Blair, DVM, leads the Idaho Fish Health Center (see *Eddies*, Summer 2008). Dr. Blair comments that she has witnessed substantial changes at Dworshak in the last 10 years. "We have decreased the presence of a parasite called *Ichthyophthirius* as well as Bacterial Kidney Disease (BKD) in both adults and juveniles," noted Blair. Dworshak was the first hatchery to create a BKD management plan, one since adopted by state and federal hatcheries across the Pacific Northwest.

As the workday winds down at Dworshak this day, activity lessens and a quiet comes to blanket the hatchery grounds. The Clearwater River runs wide and silent by the hatchery. This year marks Dworshak Dam's 40th anniversary. In all that time the Dworshak National Fish Hatchery has produced healthy fish and helped sustain fisheries for commercial harvest and recreational angling, and so that tribal members can preserve their way of life.

Through—or perhaps because of—its role in interjurisdictional management, the hatchery has grown in countless ways in the past four decades. ♦

By Kay Hively

Drumming up a Great Partnership

Cooperative work on red drum yields valuable data

The red drum has all the qualities that sportsmen admire in a fish. They grow big, are easily found, and they put up a nasty fight. They're tasty, too. So, of course, they are highly sought after both as a sport fish and for eating.

The heavy demand for these fish is one of the reasons the U.S. Fish and Wildlife Service has partnered with the South Carolina Department of Natural Resources, to assure there will always be red drum for the fishing public. Red drum, also called "redfish," are one of the most popular sport fish in South Carolina, not to mention along the Atlantic seaboard, around Florida and past the tip of Texas.

The red drum research partnership is headed by Dr. Mike Denson with the South Carolina Department of Natural Resources, and Kent Ware, manager of Bears Bluff National Fish Hatchery. Denson says the red drum is an estuarine-dependent species; it completes most of its early life stage in coastal estuaries and marshes. The fish lives in both near-shore brackish estuaries and further off-shore in deeper seawater. It's within reach of all types of anglers fishing from beaches, piers, or out of boats.

This fish was thrust into the national spotlight in the 1980s when Paul Prudhomme, a renowned New Orleans chef, began serving "blackened fish," using red drum as his specialty. It was an instant hit, placing the heretofore-unsung red drum on most everyone's list of favorite seafood dishes.

With the popularity of the red drum on menus throughout the South, fishing boats began scouring the Gulf waters off Louisiana to supply the demand. This pressure on the red drum caused it to be overfished, so the state of Louisiana regulated red drum harvest in the 1980s.

That's when the South Carolina Department of Natural Resources, fearful of overfishing, took a proactive approach in red drum management. The fish was declared a sport fish, and shortly after began stock enhancement research that continues today. The Atlantic States Marine Fisheries Commission categorized the Atlantic Coast red drum stock as "overfished" in 1994.

To help conserve the red drum, South Carolina turned to the staff at the Bears Bluff National Fish Hatchery located on Wadmalaw Island near Charleston, South Carolina. In 2002, they formed a partnership to assist with red drum stock enhancement research. The timing was great because ponds at the hatchery had just been restored after being damaged by a number of storms.

The state provided the hatchery with newly hatched fry, and Bears Bluff raised them to fingerling size in their restored ponds. This growth, to one inch, took about 30 days. The red drum were released at high tide in the flooded marshes of the North Edisto River estuary, near Wadmalaw Island.

But the project has had its ups and downs. It takes a lot of care

and dedication in the restoration process. Since the Department of Natural Resources has been working to rebuild the red drum population, Denson described the work as a series of questions the staff has tried to answer.

"Of course, each time we answer one question, we find we have three or four more," Denson said. "The questions we ask have been about such things as the best season to release them, what is the best size to release to get the best results, and what is the most cost-effective method of rearing."

According to hatchery manager, Kent Ware, the fingerlings that are released are very much the same as those that were hatched and have lived only in the wild. "Since we use only wild-caught broodfish, we maintain the genetic integrity of the wild population. When you catch these hatchery fish in the wild, they are exactly like their brothers who were born there."

When the work at Bears Bluff began, fingerlings were released when they reached one inch in length. Now research shows that the fish do better when they are released a half-inch longer, and that takes another two weeks in the hatchery.

New broodstock are collected every two to three years from offshore spawning congregations. Bears Bluff biologists now complete some of the brood



Roman Crumpton/USFWS

A South Carolinian youngster measures a freshly caught redfish before cutting off a tiny portion of its fin. The fin clip will be used by geneticists and fishery managers to determine redfish conservation strategies.



Dave Balaha

When not working at Bears Bluff National Fish Hatchery, biologist Roman Crumpton can be found floating over shallow flooded marsh grass and throwing flies at redfish. Redfish feed in the shallows on crabs, shrimp, and fish.

spawning on site. All broodfish are genetically identified so that stocked fingerlings can be easily distinguished from wild fingerlings. This allows different estuaries to be stocked with separate family groups. Genetic analysis allows biologists to measure the success of each stocking event on an annual basis.

Now Denson and Ware have formed a third partnership with area citizens. When the red drum are about a

year old, local guides and anglers participate in a fin-clipping project. They catch red drum up to 15 inches long and take a small fin clip which is returned to the hatchery to analyze the drum's background. Geneticists with the South Carolina Department of Natural Resources determine if the fish were hatched in the wild or released from the hatchery. Collecting this information allows biologists to answer many questions and measure the relative success of

each year's stocking. Fishermen turn in an average of 300 fin clips from the North Edisto each fall and about 100 of these are analyzed for each year-class stocked.

This year, students in the Angling Club at Wando High School will participate in the fin clipping process. James Henne, assistant manager at Bears Bluff, has worked with the students, training them to collect samples. Students were given sample kits and, if all goes well, they will get to provide some real help to conserve the red drum population.

This partnership between Bears Bluff and the South Carolina Department of Natural Resources has been very successful. Mike Denson says, "We have a long relationship with Bears

Bluff and the use of their lab is important to us."

Kent Ware agrees with Denson, "We work well together. We have enjoyed working with them for years. Even through years of tough budgets and personnel change, we get along just fine, and we're doing good work for the fish and fishing."

And there's no doubt that the fishermen of South Carolina, and blackened fish lovers as well, appreciate all the efforts of this special partnership. ♦

Kay Hively served on the board of the National Fisheries Friends Partnership, and writes from Neosho, Missouri.



James Henne/USFWS

Small redfish grow into big redfish, reaching about 11 inches long in their first year of life. They grow much bigger; the heaviest known fish weighing 94 pounds.

Meanders

By Richard Christian

Rednecks and Red Drum

Morning stillness held the fetor of decaying marine life intertwined among the sargassum weed that lay on the sand at high tide. As I pulled the match from the box, I puzzled over the diatribe triggered by this fish in front of me. Oxygen sucked violently from the air nanoseconds before the explosion. Nostrils flared in an attempt to re-inflate my lungs. Charred stubbles now highlighted the area where eyebrows had been. The immediate adrenalin rush enhanced the smell of the mesquite that quickly crackled to a blaze. Mesquite is known for the heat that it produces. I had brought some back from my last trip home just for such occasions. In reflection, the white gas from my Coleman lantern, I sensed, had not been a good idea as a fire starter. But, I needed a fire, and a hot one to try my hand at the “Cajun Craze” of blackened redfish.

The skillet that would receive the fillet properly seasoned with a medley of Cajun spices held together with enough butter to grease the axel on my truck, needed to be white hot. As I anticipated the first bite, Jimmy Buffet playing on the cassette in the background reminded me, “Nothing like this out in West Texas; Galveston Bay is a whole other world.” The smoking-hot

skillet would soon provide a metaphor for the debate that this “Cajun Craze” would help fuel, and would soon add a whole other meaning to those lyrics in a world far from the prickly pear parched earth of West Texas where I grew up.

Redfish, or red drum, had been a point of contention between sport and commercial fishermen for more than 100 years leading into the late 1970s and mid-1980s. But, when famous New Orleans chef, Paul Prudhomme, introduced blackened redfish in 1986, the entire scene of managing fish that migrate between multiple state and federal jurisdictions changed dramatically.


Demand went up and supply sharply went down. The market price soared over night from 30 cents to a buck-thirty per pound. Commercial landings of red drum in state and federal waters rose from 2.7 million pounds in 1980 to 8.3 million pounds during the first half of 1986.

The Cajun Craze had arrived. Red drum, a fish that had previous merited identity only as “catch of the day” became haute cuisine in restaurants from New Orleans to New York. The craze was credited with forcing a ban on commercial fishing in the Gulf during the following year. Red drum had become the bellwether for other coastal fisheries susceptible to similar exploitation.

Two years prior to this culinary revolution, a group of avid sport fisherman, concerned about the future of red drum in the Gulf of Mexico formed the Gulf Coast Conservation Association (GCCA). That same year, the world-record red drum was landed off of Cape Hatteras Island, North Carolina. It weighed in at just over a record-setting 94 pounds. The fish caught by federal fisheries biologist, David Duel, measured 59 inches in length and had a girth 38 inches. A 10-pound redfish can take up to 15 minutes to land. This monster greatly extended the fight. Red drum can live to be 60 years old and are commonly found to be 40 years old. These are the fish that the GCCA set out to protect. In the ensuing years, the Houston-based GCCA expanded from its original chapter to include chapters in 17 coastal states along the Gulf, Pacific, and Atlantic Seaboards, and changed its name accordingly to the Coastal Conservation Association. The CCA has expanded its breadth, taking on conservation issues beyond red drum.

Parasailing behind a pickup truck on a dry reservoir bed swept by the unpredictable West Texas winds provided early learning experiences about unpredictable outcomes. The only things that could be predicted was that sometime during the day it would get hot, the wind would blow, and something was going to get dirty.

It did. I got dirty.



The remnant of a prickly pear spine still floats unencumbered under my scalp as a reminder of yet another lesson learned: parasailing over water may have been a better choice. Leaving the dry, cactus-rich climes of my childhood, I headed for the wettest place that I could find: the Gulf of Mexico—that beautiful expanse of turbulent, aqueous mystery bounded only by a blue-sky imagination locked in the clouds. There, I found red drum. With undergraduate degree in hand, I launched a career track in fisheries management at the National Marine Fisheries Service laboratory on Galveston Island. Tagging shrimp in the northern Gulf of Mexico, I became intensely curious about the fate of the red drum that regularly appeared in our nets as bycatch—and graced our grills at the end of each cruise. This curiosity led me down an unforeseen path of roiling state and federal politics, a graduate degree focused on red drum and eventually to the nation’s capital city where the burning question of how politics influences fisheries management has played out in a career rife with experiences beyond the imagination of my youth.

In route to my current office at the U.S. Fish and Wildlife Service in Arlington, Virginia, a whiff of diesel exhaust from a passing bus stimulates memories of life and labor aboard federal research vessels tagging shrimp, puzzling over the fate of our red drum bycatch.

Onshore, I linger between cruises in my memory as the diesel turns into a pungent breath of sulphur rising from the anoxic mud of the wetlands stirred by a light breeze off the Gulf on an ebbing tide. In these surroundings, I would often sit on the rock jetties at the entrance to the Houston Ship Channel and mull over the remonstrations of laughing gulls among the flotsam and jetsam of the tidal flat where a dispute over a decaying bit of fish flesh had erupted into intense vocalizations and bobbing heads. I remember the fight for red drum that led to similar remonstrations among fisheries managers from adjacent jurisdictions. Those on the Atlantic Coast where I have landed, relate more closely with striped bass. But for me red drum brought the battles over allocation and overfishing from the federal jurisdictional waters of the Exclusive Economic Zone into multiple state territorial waters where this coastal migratory species crosses the jurisdictions from Texas to Massachusetts. As witness and participant in the process, images of these gulls are replaced by the faces of my cohorts as they argue over the fish entrusted to their thoughtful consideration in development of wise management decisions.

From gulls to Chef Prudhomme, the way to our conscience actions may well be through our stomachs. As I rub the prickly pear spine under my scalp, I realize that there is nothing like this out in West Texas. Galveston

Bay, and interjurisdictional fisheries I found there are a “whole other world.” Perhaps in that world we will find a better way to manage than to fight like laughing gulls on a tidal flat. ♦

Richard Christian is Chief of the Branch of Communications and Partnerships for the Fisheries Program in Washington, DC. Prior to coming to the U.S. Fish and Wildlife Service, he worked for the Atlantic States Marine Fisheries Commission as their Recreational Fisheries Coordinator and liaison to the three Atlantic Marine Fisheries Management Councils.

Eddies

Reflections on Fisheries Conservation

U.S. Fish and Wildlife Service
Fisheries RM 9100D
500 Gold Ave. SW
Albuquerque, NM 87102

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>

Spring 2012



Shad Talk

American shad provide great fun to anglers on any tackle. The rare trophy exceeds nine pounds of muscular flesh. Those muscular shad swim hundreds of miles up free-flowing rivers along the Atlantic Coast to spawn, fashioning unparalleled fishing far inland from saltier haunts.

Even though American shad are the most abundant anadromous fish in the East, populations are at historic lows. They move across many political boundaries throughout life. Interjurisdictional fisheries management requires cooperation. The U.S. Fish and Wildlife Service's Fisheries Program coordinates American shad conservation with the Atlantic States Marine Fisheries Commission. The Fisheries Program restores shad through Strategic Habitat Conservation, using diverse management tools for the betterment of fisheries through habitat improvements, fish passage installations, aquaculture, and placing spawning stocks in newly restored habitats.



Joe Millmoe/USFWS

Popular shad flies used in the mid-Atlantic region. American shad can reach nine pounds.

and the U.S. Geological Survey provide invaluable insights to the causes of shad declines. And there are glimmers of hope for this most American of fish, as returns of spawning shad improve in the Susquehanna, Delaware and Connecticut rivers. ♦ Jarrad Kosa



Just as in fishing, the key to success lies in a better understanding of the fish. Recent science partnerships between the Fisheries Program