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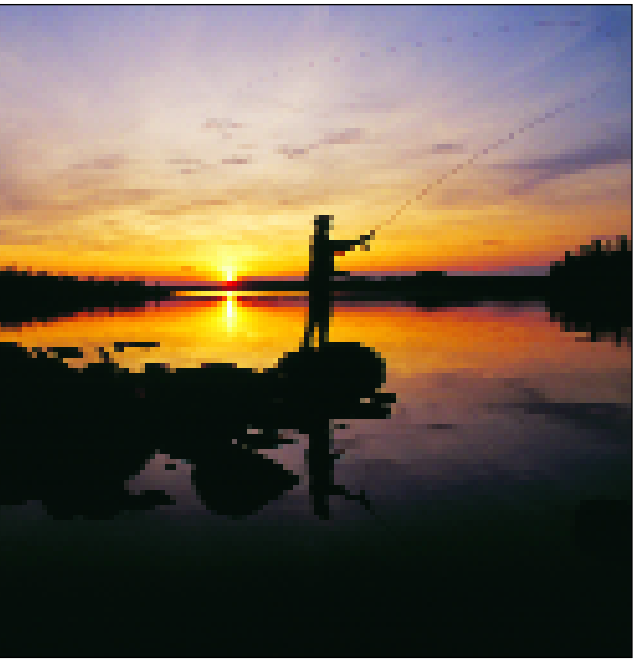
The Southeast: Biodiversity Center of North America

Christine Olsenius
Executive Director
Southeast Watershed Forum

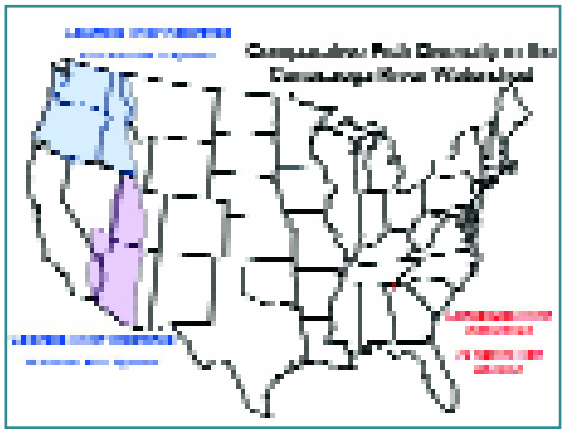
According to studies by The Nature Conservancy and World Wildlife Fund, the Tennessee and Cumberland River Basins have the highest number of fish, mussels and crayfish species and the highest number of endemic species in North America. Endemic means that they have adapted to a unique environment and are found no where else on earth. Together with the Mobile River Basin, these freshwater resources are among the most species-rich, temperate ecosystems in the world! They are to the temperate regions, what the rain forest is to the tropics. Using just one southeastern river as comparison, the chart below illustrates the number of native fish in the Conasauga River of Georgia, versus other major river basins in the country.

Richard Olsenius



Water resources are one of the region's greatest economic assets.

Given the economic value of fishing and water-based recreational activity, protecting and promoting the rivers of the Southeast should be a priority of every state. But what is widely known to aquatic scientists and watershed associations, is relatively unknown to others. This lack of awareness combined, with poor land use planning in the face of growth and development pressures, almost ensures that loss of native fish and aquatic life will continue.



Paul Johnson

Unparalleled Waters in Peril

Currently, 34 percent of North American fish species listed as endangered, threatened or of special concern are found in the Southeast. And 90 percent of the native mussel species designated as endangered, threatened or of special concern are found in the Southeast. Their survival is interdependent. Mussels filter water providing a healthier habitat for fish (and humans).

Without proper land use practices, new and expanding communities will further stress water supplies and place increased threats to fish and aquatic habitat, especially in the small creeks that serve as nurseries to over 50 percent of aquatic species. And if the creeks are lost, so will the rivers, lakes, and coastal estuaries.

Return of the Natives

Return of the Natives celebrates the diverse partnerships forming across the region to stem the tide of species loss, and to build a foundation for future species recovery. While under-funded, these efforts are NOT under-appreciated. Dollar for dollar they provide a disproportionate amount of value to the local outdoor economy and quality of life. It is hoped that these successful case studies will inspire other cooperative community initiatives and provide a template for replication. Restoration and reintroduction efforts can be difficult and costly, and they remind us how much more efficient it would be to prevent the losses and preserve the habitat in the first place. We hope that the case studies in this report will:

- Provide a blueprint for local efforts to restore native fish and aquatic species
- Encourage communities to implement land use practices that will protect the habitat and water quality essential to biological diversity
- Highlight the importance of public-private partnerships to achieve habitat protection
- Build regional awareness, pride and value in having some of the most biologically diverse watersheds in the world.

Return of the Natives is a prophesy of hope that a vibrant freshwater resource may be sustained, if we are willing to implement watershed-friendly land use practices and join in collaborative efforts to protect the creeks, rivers and coastal estuaries that serve as vital habitat for fish and aquatic life. This publication offers a guide to an alternative future; one that balances growth and development with the world-class resources that make this region the special place we call home.

To develop initiatives in your community, contact one or more of the agencies and organizations listed on the inside back cover.

Return of the Natives: A Global Perspective

Those of us living in the American Southeast are blessed with an abundance of rivers and streams. Picturesque names like Talking Rock Creek, Hanging Dog Creek and Mama's Creek blend with the languages of the Cherokee, Choctaw, Chickasaw and Creek Indian Nations in names like Hiawassee, Tellico, Coosa, Tallapoosa, Cahaba and Conasauga. The mighty Tennessee River was known by the Cherokee as Wahatchee meaning "great river" and the state of Tennessee's name evolved from the Cherokee, Tanasi – meaning, "meeting place".

These rivers and streams abound with a diversity of aquatic life second only to the Amazon Basin. More than 250 species of crayfish, nearly 300 species of mussels, and over half of all freshwater fish species in the United States are found in the waters of the Southeast. Many native species are found in just one stream or watershed here and nowhere else on Earth.

Why is this place so special?

Escaping the steamroller of glaciation during the Ice Age helped. The killer cold that froze out species in more northern climes, didn't hit here as hard. Still the cold temperatures forced species to adapt to very specific places (known by us as endemics). From the mountain streams of the Cumberland Plateau to the fertile piedmont and coastal plains of the Gulf of Mexico, the varied geography – knobs and ridges, valleys and swamps – of the region and the climate along these rivers and streams have created a unique range of habitats.

World Wildlife Fund's Role

World Wildlife Fund (WWF) believes that to preserve the diversity of life; the systems upon which life depends – forests, deserts, rivers, wetlands, mangroves and coral reefs – must also be preserved. Because many of these places are rapidly disappearing, and because limited resources are available to protect them, WWF set priority areas. An essential goal is saving representative examples of each of the many distinct expressions of life here on earth — a kind of modern day Noah's Ark.

To guide the work, WWF scientists identified more than 200 outstanding terrestrial, freshwater and marine habitats – places that we must protect if we are to preserve the web of life. These places are known as the Global 200 Ecoregions. WWF focuses its effort on conserving a subset of these ecoregions, one of which is the Southeast Rivers and Streams.

We work with partners and stakeholders throughout the region to encourage a vision for this place, a vision that will ensure that its unique natural resources survive for future generations.

We envision a region of healthy rivers and streams, where distinctive species like the Smoky Madtom, Paddlefish and Tennessee Heelsplitter populations thrive, and where people can safely fish and swim in the waters near their homes, whether they live in the country or the city. This region will be filled with rivers where lake sturgeon can thrive and mussel populations are healthy and with people who recognize that whatever happens on the land affects the rivers, and who work to protect their stream and riverside landscapes to ensure clean freshwater resources.

We envision communities where human needs are balanced with those of nature, where people recognize that part of what makes the region rich, both now and in the future, is its natural capital –its freshwater resources. We envision communities where people understand and celebrate the role that nature plays in their lives, a region where conserving natural resources is an integral part of business and political practices, and where people take pride in their role as stewards of the land and water.

We have an ambitious vision, some would say naïve, but I believe that all change starts with a conversation. The threats to our aquatic resources are the result of human activities such as suburban development and agricultural, forestry and mining practices. We all have a hand in creating these threats and a role in protecting and restoring our aquatic resources, if for no other reason than ensuring clean water for our communities. It takes money to make these changes, but in my mind it really isn't about money as much as it is about the willingness to think and plan differently. As Albert Einstein said, "We cannot solve the problems that we have created with the same thinking that created them." It's evident from the successful reintroduction work we see in this book that this is already occurring.

Wendy Smith
Director
World Wildlife Fund's Southeast River & Streams Program

A "good luck" smooch given to a young lake sturgeon by Wendy Smith, Director of the World Wildlife Fund's Southeast Rivers Program and Charles Saylor, Aquatic Biologist for the Tennessee Valley Authority prior to release in the French Broad River.

"I started out thinking of America as highways and state lines. As I got to know it better, I began to think of it as rivers. Most of what I love about the country is the gift of rivers. America is a great story, and there's a river on every page."

Charles Kuralt

Return of the Natives: A Regional Perspective

SAM HAMILTON
Southeast Regional Director
U.S. Fish & Wildlife Service

The U.S. Fish and Wildlife Service's fisheries program has played a vital role in conserving and managing fish and other aquatic resources since 1871. Today we partner with states, tribes, other government and Service programs, private organizations, public institutions and interested citizens in a larger effort to conserve these important resources.

The southeastern United States is a region that has more freshwater aquatic species than any other — 62 percent of our nation's freshwater fishes and 75 percent of its freshwater mussels.

Our region comes by this great natural resource, because we have the highest aquatic diversity in the nation, more than 70 major river basins, and 26,000 miles of coastal shoreline. The variety of aquatic habitats includes cold-water mountain streams and lakes, large reservoirs, estuaries, major river basins, wetlands and near-shore coastal areas.

There's a truism that says, the more you have, the more you have to lose. Truisms often have a way of coming close to hitting the mark, and in this instance this one certainly does, because more than one-third of all North American fish species, and 90 percent of all mussel species, listed either as endangered, threatened, or of special concern, occur in the Southeast.

Across the board, these losses can be attributed primarily to loss of habitat, over harvesting, and introduction of non-native species. For instance:

- Some 144 major dams and reservoirs have been constructed on southeastern streams and rivers, dramatically altering habitat, disrupting fish migration, water flows and impacting water quality.
- A recent report published by The Nature Conservancy identified five watershed hot spots in the Southeast, where freshwater species biodiversity was considered to be especially threatened.
- Human populations in the South Atlantic and Gulf states are projected to grow by 73 and 46 percent, respectively, by 2020.
- About 100 non-native species have been introduced into the southeastern United States.

These daunting statistics may seem irreversible and impossible for us to address, but I believe they are not. Conserving and restoring our Southeast aquatic resources requires that we all - federal, state, industry, private organizations, and individual members of the general public - become involved. We must first recognize that no one agency, group, or individual has all the knowledge, resources, and authority to accomplish this alone. It is only by working together through partnerships that we will make a difference.

Collaborative efforts such as the Southeast Watershed Forum and the Southeast Aquatic Resources Partnership will be essential to our success. The development of this restoration guide book will give us an invaluable tool, allowing us to gain a better understanding of the aquatic resources issues we are facing in our region. More importantly, it will guide us in identifying and implementing necessary corrective actions.

We in the Service are strongly committed to working with all of our partners and stakeholders to conserve our fisheries and aquatic resources for the continuing benefit, use, and enjoyment of the American people.

SOUTHEAST AQUATIC RESOURCES PARTNERSHIP

The Southeast Aquatic Resources Partnership (SARP) was initiated in 2001 to address the myriad issues related to the management of aquatic resources in the southeast region. SARP is comprised of representatives from 14 southeastern states (Alabama, Mississippi, Louisiana, South Carolina, Oklahoma, North Carolina, Florida, Georgia, Kentucky, Tennessee, Missouri, Virginia, Texas. and Arkansas), the U.S. Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), Gulf States Marine Fisheries Commission (GSMFC), and the South Atlantic Fishery Management Council (SAFMC). All Southeastern Association of Fish and Wildlife Agencies (SEAFWA) states are invited to participate. SARP focuses on six key issue areas of greatest concern and interest to the Southeast: 1) Public Use, 2) Fishery Mitigation, 3) Imperiled Fish and Aquatic Species Recovery, 4) Inter-jurisdictional Fisheries, 5) Aquatic Habitat Conservation, and 6) Aquatic Nuisance Species.

This partnership envisions a southeastern United States with healthy and diverse aquatic ecosystems that support sustainable public use. SARP was formed under the realization that the individual members lack sufficient resources to effectively achieve their missions and must therefore work cooperatively to design a process that will attain the desired common goals. The intent of SARP is to develop State and Federal partnerships that will extend beyond the traditional boundaries of fishery resource management agencies and will establish a commitment to truly work together for the benefit of the resource. It will shift the focus beyond what are individual Federal and State responsibilities to what are our joint responsibilities to the resource. Long term success of this partnership will require that we move to a higher level of coordination built upon mutual trust that will focus on making things happen at the ground level.

Return of the Natives: A State Perspective

GARY MYERS
EXECUTIVE DIRECTOR
Tennessee Wildlife Resources Agency

The southeast United States is blessed with more aquatic freshwater species than any other region in the nation. We have 505 (62%) of our nation's freshwater fish species and 222 (75%) of our country's mussel species. The source of this species diversity is our great variety of landforms and resulting habitats.

People find this landscape diversity attractive and useful. As our human population expands, the pressures on aquatic resources have increased at an alarming rate. Urban sprawl is having a major effect in the Southeast by reducing wetlands, water quality and stream flows. Five of the top ten most sprawling U.S. metropolitan areas of at least 1 million people are in the Southeast. Additionally, 9 of the top 17 states losing the most open space and farmland to urban sprawl are in the Southeast. Man's activities to control rivers and streams with at least 144 major dams and reservoirs has altered or eliminated aquatic habitat. These dams provide recreation, electric power, navigation and flood control, which we all enjoy. But they also have disrupted fish migration, water flows, and have impacted water quality. Demand for recreational use of aquatic resources continues to increase. Currently the Southeast has more licensed anglers than any other region with highest economic return on recreational fishing ($17 billion annually).

Thirteen state resources agencies, the U.S. Fish & Wildlife Service, the National Marine Fisheries Service, coastal fisheries commissions and councils and private resource groups have created a partnership to address these complex issues. The Southeast Aquatic Resources Partnership or SARP envisions a southeastern United States with healthy and diverse aquatic ecosystems that support sustainable public use. Members realize that individually they lack the resources to achieve their missions and must work cooperatively to achieve common goals. The partnership recognizes that aquatic resources are rapidly approaching a crisis point. Nationally, a third of our freshwater fish species are at risk of extinction, 72% of our mussels are imperiled, and almost 400 aquatic species are in trouble in some portion of their range. The Southeast is responsible for 34% of the fish species that are in trouble nationwide and 90% of the mussels. SARP is aware of the problems, recognizes the urgency for action, and is doing its best to make a difference for aquatic resources across our landscape. I think it will be difficult, but I know they will succeed.

"Demand for recreational use of aquatic resources continues to increase. Currently the Southeast has more licensed anglers than any other region with highest economic return on recreational fishing."

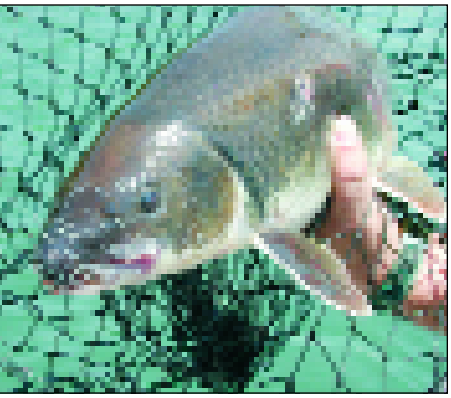
Eric Long, Florida Fish and Wildlife Commission

A future fisherman's first catch.

Recovering the Robust Redhorse

Jimmy Evans
Senior Fisheries Biologist
Georgia Department of Natural Resources

Jimmy Evans, Georgia Department of Natural Resources



John Crutchfield, Carolina Power and Light Company

Top photo was taken from a bluff in the immediate vicinity of a major robust redhorse spawning area located on the Oconee River between Toomsboro and Milledgeville, Georgia.

Bottom photo: The robust redhorse may reach lengths of almost 30 inches and weights of over 15 pounds.

The robust redhorse (Moxostoma robustum) is a large redhorse sucker originally native to Atlantic slope rivers from the Pee Dee River in North and South Carolina to the Altamaha River Basin in Georgia. First described in 1870 by the famous naturalist Edward Cope, the species was lost to science until 1991 when it was "rediscovered" by Georgia Department of Natural Resources (GADNR) biologists in the Oconee River of central Georgia. Subsequent surveys have located additional isolated populations in the Ocmulgee River in Georgia, the Savannah River of Georgia and South Carolina, and the Pee Dee River in North and South Carolina.

The robust redhorse may reach lengths of almost 30 inches and weights of over 15 pounds. Preferred habitat is Piedmont and upper Coastal Plain sections of larger Atlantic slope rivers containing suitable gravel spawning substrate. Spawning occurs over shallow gravel deposits from late April to early June at temperatures between 65 and 75°F. Adult robust redhorse feed primarily on small mussels and clams that are crushed with large pharyngeal teeth. With the decline of native mussel populations, the exotic Asiatic clam (Corbicula sp.) has become the only abundant food source.

The robust redhorse has disappeared from most of its historic range, due probably to increased erosion and sedimentation caused by deforestation, poor agricultural practices, and urban development. Erosion harms robust redhorse populations by introducing large amounts of sediment into rivers, destroying both the clean gravel required for spawning and native mussels that are a major food source. Other factors contributing to species decline include the construction of dams that have destroyed habitat and interrupted migration patterns, and more recently the introduction of non-native predators such as blue and flathead catfish. The robust redhorse is currently classified as endangered by the Georgia Department of Natural Resources.

Soon after its discovery it became obvious that the limited geographic range, low population sizes, and generally low recruitment rates represented serious threats to the continued survival of the robust redhorse. Recovery efforts were initiated in 1994 and the recovery strategy soon shifted from a federal listing under the Endangered Species Act (ESA) to a cooperative, stakeholder approach organized under a memorandum of understanding (MOU). This approach is encouraged under provisions of the ESA and is designed to foster more rapid, efficient, and less confrontational implementation of recovery activities.

The Robust Redhorse Conservation Committee (RRCC) was established in 1995 through an MOU among state and federal agencies, conservation groups, and the private sector. Currently with 13 signatories, the RRCC is tasked to develop an understanding of the status and biology of the species, protect and enhance existing populations, and reestablish additional reproducing populations. A Conservation Strategy was developed by the RRCC to promote voluntary conservation initiatives and stakeholder partnerships. Examples of recovery initiatives include a Candidate Conservation Agreement to expedite reintroductions into the Ocmulgee River, an Oconee River Flow Advisory Team to evaluate the effectiveness of conservation releases from Sinclair Dam, and the development of comprehensive policies that guide most recovery activities.

Recovery successes include: 1) the development of culture techniques, 2) improved understanding of the species' distribution, abundance, life history, and genetics, 3) habitat restoration initiatives, and 4) the establishment of introduced populations in the Ocmulgee, Ogeechee, and Broad rivers of Georgia. This progress demonstrates that stakeholder partnerships can effectively manage imperiled species through a process of cooperation, rather than the confrontation that often characterizes recovery efforts.

The 13 signatories to the MOU that created the Robust Redhorse Conservation Committee (RRCC) are:
1. United States Fish and Wildlife Service
2. United States Army Corps of Engineers
3. United States Geological Survey Biological Resources Division
4. United States Forest Service
5. Georgia Department of Natural Resources
6. South Carolina Department of Natural Resources
7. North Carolina Wildlife Resources Commission
8. Georgia Power/Southern Company
9. Duke Power/Energy Company
10. Carolina Power and Light Company
11. South Carolina Electric and Gas Company
12. Georgia Wildlife Federation
13. South Carolina Aquarium

There are two cooperator members to the RRCC (but not signatories to the MOU): North Carolina Museum of Natural History and Georgia River Network

Restoring the River Filters

DON HUBBS
Tennessee Wildlife Resources Agency

STEVE AHLSTEDT
United States Geological Survey

Freshwater mussels are a renewable resource that provides important ecological and economical benefits for all aquatic species, animals, and humans. Sedentary by nature, freshwater mussel colonies known as "beds" require a stable bottom environment of cobble, gravel, and sand. Mussels are living biological water pumps that filter water to extract food in the form of algae, detritus (decaying leaves and woody debris), bacteria, and sediments 24 hours a day 7 days a week over the course of their entire life. The filtering action of water provided by some mussels that can live for more than 100 years could be measured in tons of material that are processed every day in our rivers. Important food products generated as waste by the filtering action of mussels are expelled into the water. The waste product is in the form of a pellet that serves as a basic food source for other aquatic species that live at the bottom of the food chain. Aquatic insects, snails, and crayfish utilize this food source and in turn are fed upon by larger predators higher up the food chain (bream, catfish, and bass).

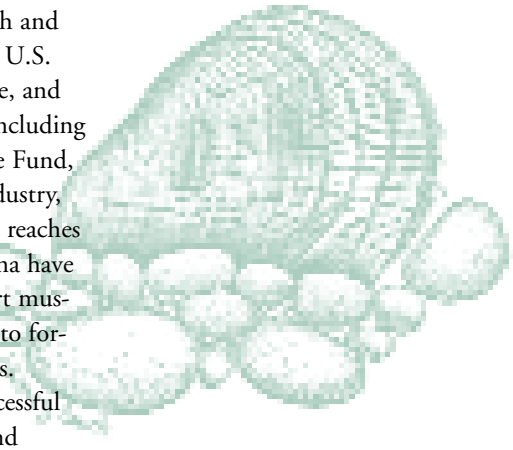
Mussels are the best indicators of water quality because they are filter feeders. They cannot survive exposure to toxic chemicals and excessive amounts of fine sediment that clogs their gills and interferes with feeding and reproduction. Most mussel species depend on a fish that serves as a host for tiny mussels called glochidium that attach as babies (a parasite) on the fish's gills or fins for a brief period of time. Fish are important for mussels in their reproductive life cycle because the baby mussel feeds on the blood nutrients of the host fish. Some mussels require certain host fish in order to complete their life cycle and if that particular fish were destroyed the mussel could not reproduce and would perish. Mussels also depend on fish to disperse their offspring (hitching a ride) to other parts of a river. An abundant and diverse mussel bed is indicative of a high quality freshwater ecosystem. There is a strong correlation that exists between mussels as living sentinels or indicators of water quality and the distribution, occurrence, and quality of both fish and other aquatic species in rivers. Mussels are a silent witness to the destruction of much of our fisheries resources across the nation. Ignoring our freshwater mussel fauna as indicators of the quality of water and what lives in them will only accelerate the continued destruction of our natural resources.

The Southeastern United States is the center of species diversity for freshwater mussels. Approximately 90 percent of the nearly 300 species found in North America occurs in this region. However, because of their declining populations resulting from pollution and habitat loss in our river systems, dam and reservoir construction for instance, nearly 70 percent of this fauna are extinct, federally listed as endangered, or in need of special protection. Many more mussel species are awaiting evaluation for possible listing. No other native faunal group in North America approaches this level of imperilment. Despite repeated efforts by local, state, and federal resource agencies and non-governmental conservation groups to educate the public and government in the form of workshops, symposiums, National Fish and Wildlife Society meetings including the formation of a Freshwater Mollusk Conservation Society and development of a National Strategy for mussel conservation, our molluscan fauna (mussels and snails) hasn't received the attention or a fraction of the money that is needed for faunal recovery or that is allocated to more charismatic species.

In spite of this neglect, efforts to save this resource in the Southeast are centered in the States of Alabama, Kentucky, Virginia, and Tennessee. Over the last 20 years, basic research on mussel life history, host fish identifications, food habits, toxicity testing, and culture and propagation research resulted in endangered and non-endangered species being reared in captivity and released into the wild. This is a culmination of partnerships and pooling of scant resources from state resource agencies, the U.S. Fish and Wildlife Service, U.S. Geological Survey, U.S. National Park Service, U.S. Forest Service, and non-governmental conservation groups including The Nature Conservancy, World Wildlife Fund, Tennessee Aquatic Research Institute, industry, and municipalities. Some rivers and river reaches that once supported a diverse mussel fauna have been restored sufficiently to again support mussels. Joint efforts are currently underway to formalize a recovery plan for mollusk species.

Several case studies that highlight successful recovery efforts in Alabama, Kentucky and Tennessee, have been included in this guide.

"Mussels are the best indicators of water quality because they are filter feeders."



Project in Works to Restore Mussels in Big South Fork

Morgan Simmons
Knoxville News Sentinel

They are Tennessee's version of the California condor or the cactus pygmy owl, only not as charismatic or cute. Freshwater mussels are the most threatened and rapidly declining faunal group in the United States, and Tennessee lies at the epicenter of their range. Of the 297 mussels known to occur in U.S. waters, over 90 percent live in the Southeast.

Currently, nearly 25 percent of the Southeast's mussels are federally listed as threatened or endangered, and about 12 percent already are extinct. Steve Ahlstedt, aquatic biologist with the U.S. Geological Survey in Knoxville, said no other group of animals approaches this level of imperilment.

Scientists inventory mussels on the Big South Fork of the Cumberland River.

"You don't see mussels unless you look for them, but they're tied to an intricate web of water quality," Ahlstedt said. "They're indicator species. They tell us when things are fairly good and when something is wrong."

One of the most important freshwater mussel sanctuaries in the region is the Big South Fork National River and Recreation Area. Located on the northern Cumberland Plateau in Tennessee and Kentucky, the park protects 90 miles of the Big South Fork of the Cumberland River and its tributaries, and harbors more federally listed endangered aquatic species than any national park in the United States.

State and federal wildlife officials are about to embark on a groundbreaking project to restore the park's mussel population. With help from a mussel hatchery at Virginia Tech, biologists will soon be raising and releasing freshwater mussels that have either declined in the Big South Fork or completely disappeared.

Currently, 26 mussel species occur in the Big South Fork, and six of those are federally protected. Those six are the Cumberland elktoe, Cumberlandian combshell, Cumberland bean pearlymussel, oyster mussel, tan riffleshell, and the little-wing pearlymussel.

Ahlstedt said the project's ultimate goal is to get the park's mussels off the endangered species list."Historically, Big South Fork had as many as 70 mussel species," he said.

"If we could even come close to restoring that many, I'd be tickled to death. But that's probably two lifetimes worth of work."

Biologists spent two years testing the techniques that will be used to propagate and release rare mussels in the Big South Fork.

An environmental study was reworked so park managers could better address the concerns of the oil and gas industry, which opposed the project, as well as horseback riding groups.

Park biologist Steve Bakaletz said mussels in the Big South Fork already receive protection under existing state and federal water pollution laws. "In essence, we argued it was wrong for polluters to wipe out the mussels in the first place and that bringing them back does not put any more of a regulatory burden on them than already exists under the Clean Water Act," Bakaletz said.

While the mussel decline in the Big South Fork has been considerable, recent surveys indicate the river is slowly recovering from past pollution sources such as coal mining and timber harvesting. Nowadays the main impact on park waters is from sediment washed from dirt roads outside the park. Oil and gas wells — most of which are in the New River watershed — also are a major concern.

Biologists hope to release a round of juvenile mussels into the Big South Fork as early as this summer. One of the main goals is to expand the mussels' range throughout the park so the population as a whole is less vulnerable.

With 380 miles of horse trails, the Big South Fork attracts more horseback riders than any national park in the country. Three years ago the park service placed flags across the main river crossings at Station Camp and Big Island to keep horses from walking across the mussel beds.

Bakaletz said the damage done to mussels by horseback riders is minor compared to outside pollution threats.

"Yes, horses may crush some mussels, but they're not interfering with reproduction," Bakaletz said. "Recreation is part of our business, and it's our job to do it right. We can be the No. 1 destination for horseback riders. We just have to make sure the environment doesn't get harmed."

NOTE:
To secure much-needed financial support, the Big South Fork National River and Recreation Area needs 1000 people to sign up for their new license plate.
Go to www.info@friendsofbigsouthfork.com.

Interrupted Rocksnail Reintroduction to the Coosa River

The small aquatic snail that you see here may not look like much, but it is a member of a very elite group of mollusks. The interrupted rocksnail (Leptoxis foremani) was considered extinct until 1997 when a U.S. Geological Survey (USGS) biologist re-discovered a single individual in the Oostanaula River located in northwest Georgia. Determined by an extensive survey done by the Tennessee Aquarium Research Institute (TNARI), the distribution of the interrupted rocksnail is currently limited to a section of the Oostanaula in Gordon and Floyd counties, Georgia. Currently a "candidate" species for federal listing by the U.S. Fish and Wildlife Service (USFWS) under the Endangered Species Act (ESA), it has been eliminated from over 99% of its historic range within the Coosa River system.

Coosa River Basin existing populations of the interrupted snail disappeared over time due to habitat modifications through construction of dams, siltation, and water pollution. In addition to the interrupted rocksnail, 36 other snail species are known to have disappeared from the Coosa River. All of these are riverine species that have life cycles adapted to flowing water. In addition to the loss of water flow, dams also facilitate siltation (deposition of sediments). Behind the dams, sediments cover the rocks on the bottom of the river, which snails and other organisms inhabit.

Parties Involved

The interrupted rocksnail reintroduction is a project of the Alabama Division of Wildlife and Freshwater Fishes. Other cooperators are the Tennessee Aquarium Research Institute, U.S. Fish and Wildlife Service, The Nature Conservancy, Alabama Department of Conservation and Natural Resources, and the U.S. Geological Survey.

Captive Rearing of Rocksnails

Once the snail was re-discovered, the U.S. Fish and Wildlife Service contacted TNARI to locate more of the snails in the Oostanaula and begin an artificial propagation program. Scientists located more snails and brought them back to the lab to attempt to reproduce them in captivity for release into the wild. In this way, the natural population would be augmented with more individuals through captive rearing of snails. The interrupted rocksnail occurs in low numbers and the species cannot be translocated without endangering the host population. The first year of artificial propagation, a limited number of juveniles were produced. The following year, holding tank modifications were completed and 800-1000 snails were produced. In 2003, captive brood stock hatched and reared in captivity reproduced and about 2000 snails were produced.

Release into the Coosa River

In December 2003, the interrupted rocksnail was reintroduced into the Coosa River after being extirpated (totally eliminated) for about 80 years from the mainstem of the river. More than 3,000 snails were released by the Alabama Department of Conservation and Natural Resources two miles below Jordan Dam near Wetumpka. In 1990, Alabama Power Company began minimum water flow releases of 2,000 cubic feet per second below Jordan Dam. By putting more water flow into this section of the Coosa River, it has improved the habitat for aquatic life such as the rocksnail. According to Jeff Gardner, a biologist with the Division of Wildlife and Freshwater Fishes, this stretch of river has become one of the best examples of free-flowing large-river habitat left in the southeastern U.S.

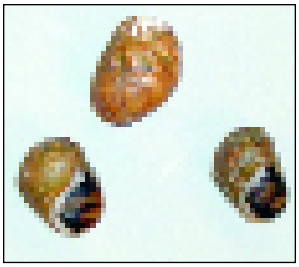
The interrupted rocksnail project is the first reintroduction within the Coosa River system, and paves the way for possible other imperiled species reintroductions down the road.

For information about this project, contact Jeff Gardner at 256-767-7673.

Sabrina F. Novak
Research Coordinator
Tennessee Aquarium Research Institute

> *"In addition to the interrupted rocksnail, 36 other snail species are known to have disappeared from the Coosa River."*

Photo below top: Leptoxis foremani adult shell. They are called "interrupted "because of the ridges that interrupt their otherwise smooth shells.
Photo belowright: Juvenile three month old interrupted rocksnail as seen through a microscope.
Photo below left: Interrupted rocksnails settling into their new home in the Coosa River below Jordan Dam.



Paul Johnson

Sabrina Novak

Paul Johnson

Restoring Imperiled Fish to Abrams Creek, Great Smoky Mo

Patrick L. Rakes
Conservation Fisheries, Inc.

SCOPE: lowermost free-flowing 10.4 miles of Abrams Creek below Abrams Falls from Little Bottoms to Chilhowee Lake reservoir embayment.

COST: currently funded through Section 6 funds from Tennessee Wildlife Resources Agency (TWRA) @ ~$25,000/yr; initiated in 1986 @ <$5,000/yr. This does not include substantial in kind contributions (>25% match) from volunteers and Conservation Fisheries, Inc staff.

LOCATION: Abrams Creek, tributary to Little Tennessee River (Chilhowee Lake), Great Smoky Mountains National Park (GSMNP), south of Maryville, Blount County, Tennessee.

PERMITS: Scientific Collections Permits from TWRA and North Carolina Wildlife Resources Commission (NCWRC); NCWRC Endangered Species Permit; U.S. Fish & Wildlife Service (FWS) Region 4 Federal Fish and Wildlife Permit (all with highly specific conditions and authorizations for each species).

CONTACT: Patrick L. Rakes, Conservation Fisheries, Inc. (CFI); 865-521-6665; xenisma@aol.com

"Successfully restoring sensitive fish species is a long slow process, requiring many years or even decades of effort."

Project Description

Previously thought to be extinct, the smoky madtom (Noturus baileyi), and yellowfin madtom (N. flavipinnis), have been rediscovered in Citico Creek near Knoxville, Tennessee. They were the objects of a Master's thesis by University of Tennessee-Knoxville (UTK) grad students Gerry Dinkins and Peggy Shute, under the guidance of Dr. David Etnier. At. that time the idea arose to use the Citico Creek populations to restore the lost Abrams Creek populations. Propagation would be required since these species exist in low densities and are too difficult to collect for translocations to be feasible. The Tennessee Wildlife Resources Agency has continuously funded the project over the years. The duskytail darter (Etheostoma percnurum) and spotfin chub (Erimonax monachus) were added to the effort in the mid 1990s. The Cherokee National Forest (CNF) has continuously funded monitoring to ensure the status of the source populations in Citico Creek. The North Carolina Wildlife Resources Commission has granted permission to collect spotfin chubs from the Little Tennessee River in North Carolina for captive propagation. The nonprofit Friends of The Smokies and Trout Unlimited have assisted Great Smoky Mountain National Park and the Tennessee Valley Authority (TVA) in riparian restoration efforts along Abrams Creek in Cades Cove, a beautiful setting within the park.

The Abrams Creek restoration project began in 1986 with a Memorandum of Understanding (MOU) between Tennessee Wildlife Resources Agency, U.S. Fish & Wildlife Service, USDA Forest Service Cherokee National Forest (CNF), the National Park, and the University of Tennessee, Knoxville.

Male tangerine

Barriers Overcome

It is notable that substantial survivorship and wild reproduction of reintroduced fish were not observed until the mid-1990s and that such pioneering restoration efforts may require significant time intervals for success. Also, the true costs of the effort are much greater than the actual funding levels suggest, due to substantial in kind contributions by Conservation Fisheries, Inc, graduate students, government agency personnel, and other volunteers. While it now appears that viable populations of both madtoms and the duskytail darter are established in Abrams Creek,

the spotfin chub has not been established. Many more years of effort will likely be required to monitor, protect, and manage the reintroduced populations and to determine whether the spotfin chub can be successfully reintroduced. Ironically, even though the watershed of Abrams Creek is entirely within federally protected lands, its water and habitat quality have been negatively impacted by land use practices above the reintroduction reaches in Cades Cove and by the unknowing activities of National Park visitors. Identifying and correcting activities harmful to these sensitive fish species has been an ongoing process in both Citico and Abrams Creeks—one that would be much more difficult to implement on private lands! Even on public lands, today an MOU between interested parties would not likely be implemented to initiate the restoration of endangered species. The more involved process of designation and review of a Nonessential Experimental Population (NEP) would be required, with public hearings and draft and final publications in the Federal Record.

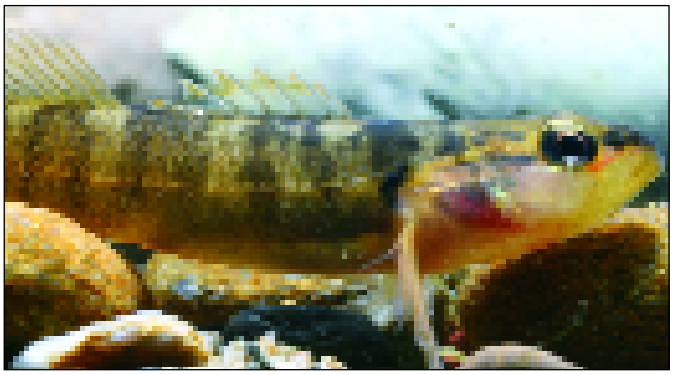
Restoration Techniques (or more barriers to overcome)

As noted above, restoration of these federally listed fish species required captive propagation and reintroductions, primarily to minimize impacts on the only remaining (and fragile) source populations. Because of the small size of these fish, as well as financial limitations, all husbandry, propagation, and rearing techniques were developed in closed system aquaria, based on techniques known for the most similar species in the aquarium trade or through previous graduate student experience with related but common native species. Many years were required to innovate and refine protocols at all points in the process, from egg and larval collection techniques (snorkeling with hand nets and turkey basters), through egg incubation and rearing of the fish (in complex multi-aquarium systems), to safely monitoring restored populations (snorkeling, often at night, with blacklights to illuminate fluorescent-tagged fish). Besides collection of wild-spawned nests, the fish are also induced to captively spawn, by manipulating temperature and light to mimic natural seasonal variation. Standard hatchery techniques for stripping eggs and milt from game fish are impossible with such small fish that produce few eggs, exhibit parental care, have specialized spawning sites and complicated courtships, and/or release a few eggs at a time over a prolonged period of time.

Lessons Learned

Patience. Successfully restoring sensitive fish species is a long slow process, requiring many years or even decades of effort. The cooperative effort of many diverse partners is required. Background research and/or experience with the organisms and their life history and habitat requirements are essential. Innovative approaches may be required, because every organism and every restoration effort has unique and unforeseeable characteristics.

Photos from top to bottom: duskytail darter, smokey madtom, yellowfin madtom.



Photos: Brad Bingham, U.S. Fish & Wildlife Service

Long Live the King: Lake Sturgeon Reintroduction to the Upp

ROB TODD
Rivers Coordinator, Tennessee Wildlife Resources Agency

SABRINA F. NOVAK
Research Coordinator
TN Aquarium Research Institute

The lake sturgeon belongs to an ancient family of fishes that date back 350 million years. They were once fairly abundant throughout their range of the upper and middle Mississippi River basin, the Great Lakes and Hudson Bay drainages, and the upper Coosa River system. Habitat destruction, water quality degradation, and commercial over-harvest, especially during the late 1800's and early 1900's, contributed to their depletion. Few self-sustaining populations exist in the United States. Although not federally listed, it is state-listed as either threatened or endangered in 19 of the 21 states where lake sturgeon are found. In the southeastern U.S., lake sturgeon are rarely collected during sampling activities, and may be extirpated from most waters in their southern historic range.

Currently several states are engaging in enhancement or restoration programs to reduce the trend of dwindling populations nationwide. In the Southeast, lake sturgeon restoration programs are underway in Georgia, Missouri and Tennessee.

Lake sturgeon were extirpated (eliminated) from east Tennessee for over 50 years primarily due to dam construction and harvest of the remaining adult population. Improvements to the water quality (and quantity in some cases) below Tennessee Valley Authority (TVA) hydroelectric dams in east Tennessee began about 10 years ago. Benthic fauna and fish populations responded to these improvements with dramatic increases in diversity and numbers. The French Broad River below Douglas Dam was one of these sites. The TVA installed a water retention weir below the dam and oxygen injectors above the dam restoring minimum flows and improving oxygen levels to the river. The improvements in the fish and benthic communities downstream suggested the opportunity to restore lake sturgeon to the upper Tennessee River system.

A lake sturgeon recovery team was formed in 1995, named the Tennessee Lake Sturgeon Reintroduction Working Group (TLSRWG). It included most of the aquatic resources agencies/organizations in the region (U. S. Fish & Wildlife Agency, Tennessee Wildlife Resources Agency, TVA, U. S. Geological Survey, The Tennessee Aquarium Research Institute, University of Tennessee, Tennessee Technological University, Conservation Fisheries Inc, Tennessee Clean Water Network, and the World Wildlife Fund). A draft recovery plan was developed that same year with input from all the partners of the team. The goal of the program is to establish self-sustaining populations that allow removal of the state endangered status for the species and eventually provide a future recreational fishery.

A recovery project proposal was sent to Wisconsin Department of Natural Resources in December of 1998 in hopes of obtaining 10,000 lake sturgeon eggs for rearing purposes. Wisconsin approved the proposal and by 1999, Warm Springs National Fish Hatchery in Georgia and Cohutta Fish Hatchery (operated by the Tennessee Aquarium Research Institute) were rearing fish from eggs collected from adult Wolf River lake sturgeon. The following year 1,441 lake sturgeon, approximately 18-24 inches long, were released into the French Broad River at three locations. Since that time, another 21,000 lake sturgeon have been reintroduced into the French Broad River.

Lake sturgeon touch tank at the Tennessee Aquarium in Chattanooga, Tennessee. As people touch these fish, docents explain the biology of the fish and the reintroduction program

Todd Stailey, Tennessee Aquarium

er Tennessee River

Karen Estes, Tennessee Aquarium

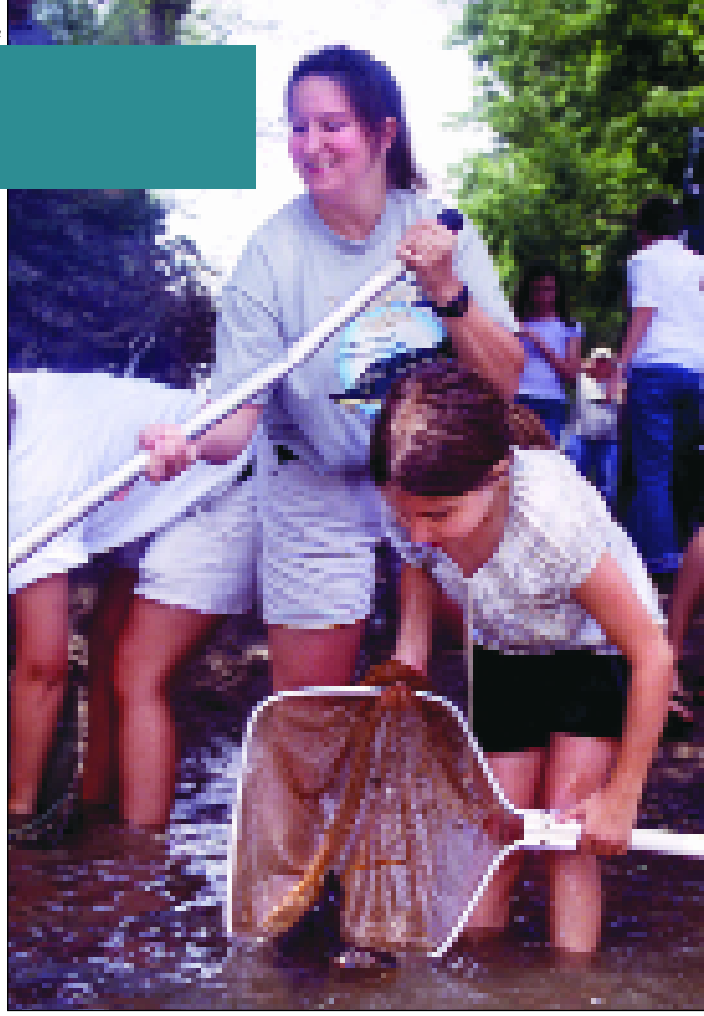


Photo above: Lake sturgeon are released into the French Broad River by 9-year old Alexandria Fisher and her mother, Natalie Fisher.

Photo below: Radio tag being implanted into a 2-year old lake sturgeon.

George Benz

Prior to release into the wild the fish are marked with a tag or unique mark to identify that the fish came from the reintroduction efforts. Marking the fish also allows biologists to identify what year the fish were hatched if they become recaptured after release. Some fish have been recaptured by monitoring done by field biologists and fishermen have reported catching and releasing lake sturgeon.

As they grow larger and sampling techniques are refined, they will be easier to capture. Sport fishers continue to report catches and releases to the recovery team partners. Even a snorkeler, searching for freshwater mussels, has reported observing a lake sturgeon.

This recovery effort is an extremely long-term project that requires a considerable commitment by the participating agencies and organizations. Lake sturgeon releases will continue for several more years until the team determines whether recovery efforts have been successful or not. Lake sturgeon are a long lived species that require 20 or more years to mature so monitoring will have to continue far into the future to document any spawning success.

The lake sturgeon recovery project has received support and praise from political entities, conservation groups, state and federal natural resource agencies, educational institutions, and local landowners. The Vice-Mayor of Knoxville, a local City Councilman, and the League of Women Voters have voiced support for the project. Students of Gap Creek Elementary have participated in the releases. The public has been kept aware by a keenly interested news media. Two local stations have televised releases of lake sturgeon since 2000. The *Knoxville News Sentinel* newspaper has written two articles on the project and National Public Radio has aired a segment. Crowds of interested citizens, usually between 25 to 60 people have been present at the release events.

What to do if you catch a lake sturgeon in TN

The lake sturgeon is listed within the State of Tennessee as endangered within Tennessee waters, so keeping it is illegal. If you catch a lake sturgeon, please put it back into the river and then call the TWRA Region 4 office at (423) 587-7037 or 1-800-332-0900 to report where the fish was caught, its approximate size, and how it was caught. These reports greatly help program biologists by tracking where fish are within the river system and that they are healthy.

Monitoring efforts are being continued by the partnership in conjunction with graduate students from the University of Tennessee at Knoxville (UTK). Dr. Larry Wilson, a professor at UTK, will be starting a 2-year radio-telemetry study with 2.5-foot and 1-foot lake sturgeon to track where the fish go once they are released into the river. This will allow the partners to determine what part of the river the fish "prefer" and this will assist in recapture efforts for monitoring purposes. Other monitoring efforts to be done in May 2004 include: electroshocking, trot lining, gill netting, otter trawling, haul seining, and scuba diving to gather more information on sturgeon occurrence within the river.

To further strengthen the lake sturgeon program or any other long-term conservation program in general, support and participation from local volunteers, grass-roots organizations and school groups is important. Private landowners along the French Broad and Holston rivers have approached the Tennessee Lake Sturgeon Group to show support of the work being done to bring the sturgeon back to the river. In areas ideal for release of fish, some landowners have even had small releases of sturgeon from their shoreline property, becoming part of the reintroduction effort to bring this "King of Fishes" back to the river.

If you would like to be contacted about fish releases to bring out your family to witness the event please send your e-mail address and request to Sabrina Novak at snovak@tnari.org.

Restoring the Endangered Shortnose Sturgeon: The Ogeechee

THOMAS D. BRYCE
Chief of Fisheries
Fort Stewart/Hunter AAF

SCOPE: 120 miles-plus of the Ogeechee River (to include it's smaller tributary, the Canoochee River)

PRICE: Projected cost in excess of $250,000

LOCATION: The Ogeechee River watershed covers a 5,540 square mile area, emptying into the Atlantic near Savannah, Georgia

PERMITS: Endangered Species Collection Permit (National Marine Fisheries Service)

CONTACT: Thomas D. Bryce, Chief of Fisheries, Fish and Wildlife Branch, Fort Stewart/Hunter AAF, Georgia - 912-767-5477 - brycet@stewart.army.mil

"It must be emphasized again that restoration actions for the shortnose sturgeon must include restoration initiatives for the Ogeechee River."

Project Description

The Ogeechee and Canoochee Rivers are two of southeast Georgia's most beautiful "blackwater" rivers. Originating in the lower piedmont, these warmwater, tannic acid systems meander across the flat lower coastal plain through wide bottomland hardwood forests. Both rivers are unique among Atlantic coast drainages in that they are unimpounded and the lower 58 km of the Canoochee River flows though an ecologically diverse 280,000-acre military installation, Fort Stewart. The principal focus of this restoration project is the endangered shortnose sturgeon, a semi-anadromous fish whose population size has been determined to be less than 300 adults with little evidence of reproductive success.

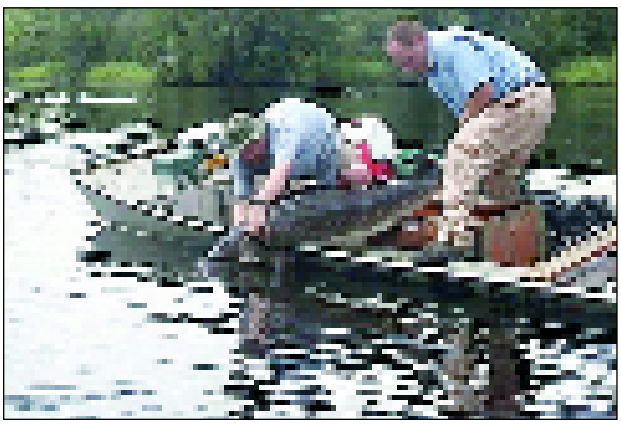
In keeping with the mandates of the Endangered Species Act, Fort Stewart and Hunter Army Airfield's Fish and Wildlife Branch has been monitoring the shortnose sturgeon population since the 1990's, however several questions still elude the installation biologists: location and condition of spawning and rearing habitat, impact of contaminants on fish health, as well as effects of low dissolved oxygen and high salinity on juvenile fish. As a result, Fort Stewart initiated the formation of a multi-agency, cooperative team to more effectively assess the shortnose sturgeon population, identify habitat limitations, and collaborate to achieve recovery of the Ogeechee River system population. The Ogeechee River Shortnose Sturgeon Working Group (ORSSWG) is the first river-basin specific team organized to recover any population of shortnose sturgeon and is comprised of 14 partners consisting of federal and state government agencies, non-government conservation organizations, and local citizenry. This working group is currently building partnerships within the watershed with local stakeholder groups such as the Friends of the Ogeechee River, Ogeechee Audubon Society, and Georgia Chapter of the Sierra Club, to assist in monitoring the river using Georgia's Adopt-A-Stream methodologies.

The ORSSWG believes that the shortnose sturgeon will be instrumental in focusing restoration attention on the Ogeechee River and could serve as the "poster child" for improved water quality and water conservation within the watershed. Key environmental stressors for the Ogeechee River basin, as identified by the Georgia's Environmental Protection Division (EPD), include fecal coliform bacteria, nutrient loading, and methylmercury contamination of fish tissue. Like the proverbial "canary in the coal mine", the shortnose sturgeon is serving as a bio-indicator of the health of the Ogeechee River system. Consequently, by initiating sturgeon recovery actions in the Ogeechee River system, water quality and habitat issues will be addressed, benefiting both the river's biotic communities as well as the watershed residents.

Barriers Overcome

The initial challenge faced by the Army (Fort Stewart/Hunter Army Airfield) in managing and recovering this fish was identifying sturgeon conservation stakeholders within the Ogeechee River basin and then assembling a comprehensive team to more effectively restore this population. The Army realized that monitoring and recovery is best accomplished through a collaborative effort, however shortnose sturgeon conservation has been somewhat fragmented and minimized in the past, especially among Southeast populations. The National Marine Fisheries Service (NMFS) administers recovery of the shortnose sturgeon,

A 6' Atlantic sturgeon being released after capture by Fort Stewart Biologists Larry Carlile (left) and Joel Fleming (right).



Tom Bryce

River Cooperative Initiative

Water quality monitoring: Georgia Southern University's Dr. Jim Reichard and Fort Stewart Biologist, Kathryn Sukkestad

however the U. S. Fish and Wildlife Service (USFWS) has historically taken the lead in developing propagation and culture techniques. In addition, the Georgia Department of Natural Resources (DNR) had been faced with both a decade of budget shortfalls and the challenge of which Division could best oversee the management of this fish. The installation, along with the support of the NMFS and USFWS hosted the first range-wide shortnose sturgeon recovery conference in 2003 to gather the leading shortnose specialists from Florida to Canada.

This successful gathering of state and federal agencies helped to unify and focus the effort of many agencies and as a result, the ORSSWG was spawned. The working group's key federal members, the U. S. Army Corps of Engineers, Georgia's Environmental Protection Division, the University System of Georgia, the Canoochee Riverkeeper, and the Georgia Aquarium have joined in this cooperative initiative. Once organized, the challenge of the ORSSWG was to develop a recovery strategy, coordinate responsibility roles, and secure the necessary funding. To date, all members have demonstrated commitment and enthusiasm. Additionally, DNR was instrumental in creating an Anadromous Fish Biologist position and reassign, all anadromous fish management responsibilities to the Wildlife Resources Division office located within the Ogeechee River basin.

Restoration Techniques

It must be emphasized again that restoration actions for the shortnose sturgeon must include restoration initiatives for the Ogeechee River. Half of the recovery work must focus on the fish, its biology and life history, while the second half must focus on the fish's habitat. Consequently, fish restoration techniques proposed include (1) the use of radio-tagged "sentinel" fish to help locate spawning sites, (2) cryo-preservation of Ogeechee River shortnose sturgeon sperm for maintaining a gamete source with a genetic pool specific to this river basin population, (3) capture of wild Ogeechee River shortnose sturgeon brood stock for spawning, (4) rearing of the cultured progeny, and (5) developing a source of Ogeechee River hatchery-reared shortnose sturgeon that could be used to either conduct experimental releases so as to evaluate constriction points in the life history of the fish or supplement the natural population until the limiting factors can be corrected and a self-sustaining population can be established.

Concurrent with the fish work, habitat assessment and restoration will proceed that will include (1) development of a water quality model for evaluating the riverine interrelationships of temperature, dissolved oxygen and salinity, (2) long-term monitoring of water quality through biological and chemical stream assessment using volunteers throughout the watershed, (3) identification and characterization of underwater artesian seeps and assess their role in influencing sturgeon behavior and survival, (4) identification of spawning and rearing habitat and assessment of habitat condition, (5) contaminant assessment of critical habitat sites, (6) work with the Georgia Environmental Protection Department to mitigate identified water quality and contaminant impacts, and (7) work with EPD to mitigate identified impacts to underwater artesian seeps stemming from increasing aquifer withdrawals. These last two action items will present our biggest restoration challenge due to the environmental complexity of correcting point and non-point discharges and influencing aquifer withdrawal policies and practices in the coastal plain of Georgia.

Lessons Learned

Due to the complexity of recovering an endangered species and mitigating environmental impacts, a single stakeholder cannot be very effective even when that stakeholder is a major federal entity and the resource to be restored is a local one. A collaborative approach through the partnering of multiple stakeholders is the only cost-effective means of tackling such a complex problem. Sensitivity, wise leadership, and a strong cooperative spirit are necessary to bring together diverse stakeholders. Information exchange and mutual education among the stakeholders and the community are crucial for strong and effective team building. Round table, face-to-face communication at the local and regional levels helps to bridge institutional differences and builds mutual trust and understanding. And lastly, it is very important to bring the resource regulators as well as the public (local citizenry and community conservation groups) into the planning process early and include them on the team.

"Due to the complexity of recovering an endangered species and mitigating environmental impacts, a single stakeholder cannot be very effective even when that stakeholder is a major federal entity and the resource to be restored is a local one."

The Mighty Duck

Paul D. Johnson
Director
Tennessee Aquarium Research Institute

"Although just 262 miles in length, south-central Tennessee's Duck River, likely supports the highest biological diversity of any tributary system in North America. Cooperative efforts among private conservationists, state and federal wildlife officials, and public utilities agencies are racing to secure this national treasure."

Paul D. Johnson
Director, Tennessee Aquarium Research Institute

About one hour's drive south of Nashville lies the Duck River basin in south-central Tennessee. The 262 mile-long river crosses seven counties before joining the Tennessee River at Kentucky Lake, making it the longest river contained within the state of Tennessee. Over 30 tributaries are present in the basin, but the majority of the river's discharge is groundwater supplied through the limestone rich Karst topography in the central portion of the basin. There are four large cities located on the banks of the Duck River, Manchester in the Coffee County headwaters, Shelbyville and Columbia, in the middle portion of the drainage and finally the town of Centerville, in the lower end of the basin. There are also two state parks (Old Fort and Henry Horton) within the basin. The Duck River is joined by the Buffalo River just before it meets the Tennessee River in Hickman County.

Problematic Past

Water quality problems have plagued the Duck River throughout most of the 20th century. Phosphate mining and heavy clear cutting devastated much of the river and its watershed. The naturally thin soils were not well suited for crop production and horse and cattle are the main agricultural products. Fortunately, the majority of point source impacts were located in Columbia, Tennessee located about mid-basin. In 1971 the Tennessee Valley Authority (TVA) damned the upper Duck River, and completed Normandy Dam up river of Shelbyville, Tennessee. Seasonably variable water releases and low dissolved oxygen concentrations in waters released by the dam, affected the river for the next 115 miles to Columbia, where point source releases impacted the basin's lower half.

In 1973 TVA began turning its attention to the construction of a new dam just above Columbia. The 35-mile long pool of the Columbia Dam project would be much larger than the just completed Normandy. In fact, the dam's completion would have inundated the best remaining riverine habitat in the basin. It also would have placed the only remaining habitat for two federally listed mussels (birdwing pearlymussel, Lemiox rimosus and the Cumberland monkeyface, Quadrula intermedia) directly under the new pool. This would have resulted in certain extirpation for both species.

With the completion of the dam looming in 1977, the U.S. Fish & Wildlife Service issued a Biological Opinion condemning the dam's completion. In 1979 TVA placed the completion of Columbia Dam on hold and in 1995 determined the project could not be completed.

A New Day

With the implementation of the Clean Water Act, point source discharges were gradually eliminated from the river during the 1980's. Problems with a wastewater treatment plant in Shelbyville were corrected and chlorine emissions substantially reduced. Lands purchased for the now defunct Columbia Dam project lay fallow. One final ingredient remained for recovery: addressing the irregular seasonal flows and low dissolved oxygen problems experienced with discharges from Normandy Dam.

In 1991 the TVA implemented the Reservoir Release Improvements (RRI) program at Normandy Dam. The RRI program was designed to deal with water quality problems common to dam tailwaters. TVA placed over two miles of soaker hoses in the pool of Normandy dam to oxygenate the water before it was released from the reservoir. Additionally, seasonal adjustments in discharge levels were made to shift more water back into the river during the spring and summer seasons. In 1999 The Nature Conservancy opened an office in Columbia to support conservation efforts in the Duck River watershed and TVA removed the last physical vestiges of Columbia Dam. In 2001 TVA donated lands acquired for the dam project to the Tennessee Wildlife Resources Agency (TWRA).

Mussels in hand, Quadrula intermedia, Cumberland monkeyface.

A Stunning Comeback

With all recovery elements in place, the last element needed was time. Ten years after TVA initiated the RRI program, a new mollusk inventory of the basin was commissioned by The Nature Conservancy and TWRA to determine how well this most sensitive fauna had responded to recovery efforts. Freshwater mollusks are the most imperiled group of animals on the planet, and the rivers of the Southeast are the global epicenter of freshwater mollusk species diversity. Scientists from the United States Geological Survey (USGS) and the Tennessee Aquarium Research Institute (TNARI) were contacted to lead the survey project. Now nearing completion, this study has shown a remarkable turnaround in the molluscan resources of the Duck River. The river basin contains 54 species of freshwater mussels and 22 species of freshwater snails. Mussel densities have increased between 2-6 fold since 1988, and the range and numbers of endangered species have increased exponentially. Mussel diversity was greatest in the town of Columbia where 33 species of freshwater mussels now reside in an area that was too toxic for most of these species a generation ago. Additionally, a small fish survey of the lower Duck River found 97 species of fish residing in a half-mile section of river. "This is THE river recovery story in the nation, but nobody knows about it outside this state" states Leslie Colley with The Nature Conservancy's Duck River Office. "We've recovered a river system to the point that it supports healthy populations of the most sensitive of species". With the mollusk fauna already gone or rapidly disappearing from most southeastern rivers, the Duck River stands in stark contrast to the degradation in the region.

The upper Duck River Utility has also assisted recovery efforts through extensive planning of water needs in the basin. Based upon extensive flow modeling, the utility has estimated they can meet water supply needs in the basin for the next 50 years. With some minor adjustments in the operation of Normandy Dam, the utility authority can meet the water supply needs of the basin for years to come.

Uncertain Future

Even with this remarkable partnership between state, federal and private agencies, all of this may not be enough to maintain the success that has been achieved. Explosive growth around Nashville will degrade the watershed without better planning. The long term prognosis is not good if sound environmental planning within the basin is not achieved. But with proper planning, the Duck River can remain a biological treasure not only for Tennessee, but the nation.

Recovery Project Partners:
The Nature Conservancy – Duck River Office
Tennessee Wildlife Resources Agency
Tennessee Aquarium Research Institute
Tennessee Valley Authority
Upper Duck River Utility Cooperative
U.S. Fish and Wildlife Service
U.S. Geological Survey

DUCK RIVER BIODIVERSITY COUNT

Source: TVA Heritage, United States Geological Survey, and Tennessee Aquarium Research Institute

Taxa	Species
Periphyton and algae	87
Zooplankton	45
Flatworms and Oligochaete	32
Non-insect arthropods	25
Freshwater Insects	225
Freshwater snails	22
Freshwater mussels	5
Fishes	147
Frogs and Turtles	15
Total Species Count	> 652 species

Photo below left:
Steve Ahlstedt USGS - WRD - Knoxville, TN and Richard G. Biggins USFWS - Asheville, NC (retired) working with mussels collected in the Duck River below Carpenters Bridge, Maury Co., TN.

Photo below right:
Duck River Hoopers Island

Paul Johnson

Paul Johnson

Striped Bass Restoration in the Southeast

Edited by
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Office of Fisheries
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"After five years of strict enforcement of striped bass harvest limits, along with managed river flows during the spawning season, the signs of recovery were evident."

Striped bass populations along the South Atlantic and Gulf Coasts experienced dramatic declines beginning in the 1950s and continuing through the 1980s. This period of decline was coincidental with increased urbanization, pollution, groundwater extraction, over harvest, and water development projects creating reservoirs in striped bass watersheds. These factors collectively acted to degrade water quality and cool water refuge areas (refugia), change water discharge quantity, and block access to traditional spawning grounds.

Beginning in the late 1980s, Federal and State fisheries management agencies began extensive efforts to counteract these declines. Three major efforts within the Apalachicola, Roanoke, and Savannah River Basins are indicative of the cooperative effort needed to restore southeastern striped bass populations.

Apalachicola River Basin

By 1980, the Apalachicola-Chattahoochee-Flint (ACF) river system, in Florida, Georgia, and Alabama, harbored the only known reproducing Gulf race population within its historic range.

Dams in the ACF blocked striped bass migration to spawning grounds and coolwater thermal refuges. Egg and young-of–the-year surveys conducted in 1985 demonstrated that successful natural reproduction in the ACF was limited and probably confined to the Flint River. As a result, a cooperative agreement was forged between the conservation agency directors of Florida, Georgia, and Alabama, and the Regional Director of the U. S. Fish and Wildlife Service to formalize restoration of native striped bass within the ACF.

Initial attempts to capture and propagate Gulf race broodfish from the Apalachicola River were successful, and hatchery production quickly increased. Since 1980, a total of 8.7 million Phase I and 832,000 Phase II (6-12 inch) fingerlings have been stocked into Lake Seminole and the Apalachicola River. Progeny of Gulf race broodfish from the ACF have been released into other reservoirs of the Flint and Chattahoochee rivers, as well as other Gulf Coast river and reservoir systems.

Angler catches in the upper Apalachicola River during springtime creel surveys increased tenfold as a result of the stockings. The ACF striped bass fishery has become an exceedingly popular opportunity to catch a trophy fish that may exceed 40 pounds.

Protection, rehabilitation, and enhancement of critical coolwater habitat have been important to restoration efforts. Florida Fish and Wildlife Conservation Commission (FFWCC) biologists have worked closely with the U. S. Army Corps of Engineers (COE) to re-establish connections with springs and creeks during hot summer months. They also cooperated to remove the Dead Lakes Dam on the Chipola River, which re-opened approximately 50 miles of coolwater habitat in the upper reaches of this tributary. Georgia Department of Natural Resources (DNR) acquired and enhanced Radium Springs, a large thermal refuge on the Flint River. Known thermal refuge springs in Lake Seminole and the Flint River were closed to fishing from May to November while adult striped bass occupy them.

There are many challenges to continued success of striped bass restoration in the ACF. Lake Seminole, the primary nursery for young striped bass, has an abundance of aquatic plants (hydrilla), which can impact primary productivity and reduce the forage base for young and adult striped bass. Rapid urbanization in the upper ACF watershed has placed increased demand for water withdrawals, and increased point source and non-point source pollution. High groundwater demand for irrigating farmlands may also reduce or reverse flows from coolwater springs, further diminishing important habitat that is already limiting.

Coolwater thermal refuges are important for bass habitat.

Mike Spelman, FWC

Roanoke River Basin

In 1986, Federal and State resource agencies, the U.S. Army Corps of Engineers, Virginia Electric Power Company (now Dominion Generation), municipalities, and members of private industries formed an ad hoc committee to examine changes in water release patterns in the Roanoke River since the construction of dams. At the same time, Federal and State agencies with regulatory authority over striped bass management and harvest began examining past and current characteristics of the striped bass stock and associated fisheries. These examinations identified a link between water releases and striped bass productivity.

As a result, a normalized flow regime for the Roanoke River was implemented during the striped bass spawning season. Virginia Electric and Power Company agreed to suspend hydropower peaking operations during a 76-day period determined to be most important for striped bass spawning. The U.S. Army Corps of Engineers, whose upstream reservoir releases dictate overall flows, agreed to hold river discharge within brackets close to historical median flows unless extreme flooding or drought conditions were present. State resource agencies also curtailed striped bass harvest by 80% of historical averages.

After five years of strict enforcement of striped bass harvest limits, along with managed river flows during the spawning season, the signs of recovery were evident. Annual estimates of reproductive success, based on catches of young-of-the-year, reached all time highs. By 1995, three strong year classes had been naturally produced. In 1997, the Atlantic States Marine Fisheries Commission declared that the Roanoke River/Albemarle Sound striped bass stock was restored. After that time, harvest restrictions were eased and recreational and commercial fishermen began reaping the benefits of restoration process.

Savannah River Basin

The Savannah River once supported the largest naturally occurring population of striped bass in Georgia, and was the source of broodfish for the state's stocking program. During the 1980's, the striped bass population declined precipitously as a direct result of habitat degradation associated with operation of a tide gate and its attendant channel modifications. In response to the decreasing striped bass population, the Georgia Department of Natural Resources (GADNR) adopted a striped bass harvest moratorium for the Savannah River in 1988. The South Carolina Department of Natural Resources (SCDNR) followed suit in 1991. GADNR, with assistance from the U.S. Fish and Wildlife Service, also initiated an intensive stocking program in 1989 with the goal of reestablishing a self-sustaining population. Restoration of degraded spawning areas began in 1991 with the removal of the tide gate from operation and continued through 1992 with filling of the associated diversion canal.

Since 1995, GADNR's annual strategy has been to stock approximately 40,000 (8-10 inch) striped bass into the lower Savannah River. The stocking program has been very successful in increasing the number of striped bass in the lower river, and current levels are approaching historic highs. Anglers have noticed a resurgence in the striped bass population over the last several years, and a popular catch and release fishery has developed.

Although GADNR has been successful in increasing the number of adult striped bass in the river, the goal of restoring a self-sustaining population has not yet been achieved, as the majority of the fish are hatchery reared. Natural recruitment of striped bass remains well below historic levels, and GADNR continues to address issues concerning natural recruitment and potential impacts of future harbor development projects.

Michael Hill, FWD

Fisherman with a 42-pound bass caught on the Apalachicola River.

Bass fishing along the Apalachicola River in the tailrace of Jim Woodruff Lock & Dam near the Florida-Georgia state line.

Michael Hill, FWD

Working with Private Landowners to Protect Habitat: The Barrens Topminnow Case Study

Brad Bingham
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The barrens topminnow (Fundulus julisia) once ranged across six Tennessee counties, all situated on the Highland Rim in the central part of the state, northwest of Chattanooga. Habitat loss and modification, however, have resulted in a drastic decline of their numbers over the past 15 years. As of today, only three viable populations remain in the wild. The three remaining sites are all privately owned and located in Coffee and Cannon Counties, Tennessee. All sites provide suitable habitat for the barrens topminnow, but the small sizes, locations, and private ownership pose potential problems for the fish in the near future.

"... the goal of the Fish and Wildlife Service is not only to protect and enhance existing habitat, but to reestablish the barrens topminnow throughout its historic range."

Developing Trust

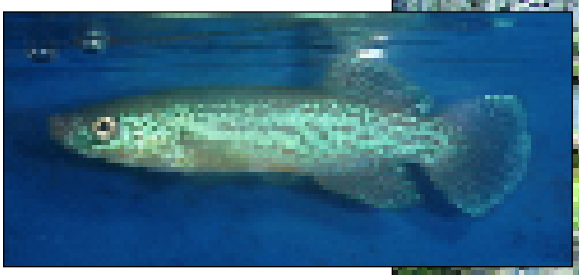
An outreach effort to develop a level of trust between the U.S. Fish and Wildlife Service (Service) and local landowners was launched in 1997. This effort included contacting and developing a working relationship with the local Natural Resource Conservation Service District Conservationist for each county. Their valuable knowledge of the local agricultural community and problems related to it was an absolute necessity in developing successful landowner relationships. Problems encountered by the agricultural community and how they related to the problems contributing to the decline of the barrens topminnow populations were identified. For example, degraded water quality was identified as a major cause in the decline of suitable habitat, a problem associated with livestock production in the area.

Improving Water Quality

Utilizing the Partners for Fish and Wildlife Program as a funding source, practices including fencing of livestock from riparian areas, hardened stream crossings and accesses, hardened feeding areas, sediment removal from springs, and alternative watering sources (tanks) have been installed to reduce livestock impacts on springs and their associated runs. These practices, targeted to improve water quality, have been installed at 18 sites since 1997. In addition, the barrens topminnow has been returned to eight of the 18 sites, all of which occur within its historic home range.

Ultimate Goal

Ultimately, the goal of the Fish and Wildlife Service is not only to protect and enhance existing habitat, but to reestablish the barrens topminnow throughout its historic range. By restoring habitat and establishing additional populations of F. julisia, the need to list the species under the Endangered Species Act should be precluded. Therefore, by working with private landowners, not only can we achieve the Service's goal, we can also assist landowners in their daily efforts to make a living producing livestock in a more environmentally-friendly manner.



Hoover Hancock's spring in Grundy County, Tennessee is one of the restoration sites for the barrens topminnow shown in photo above.

Bard Bingham, U.S. Fish & Wildlife Service