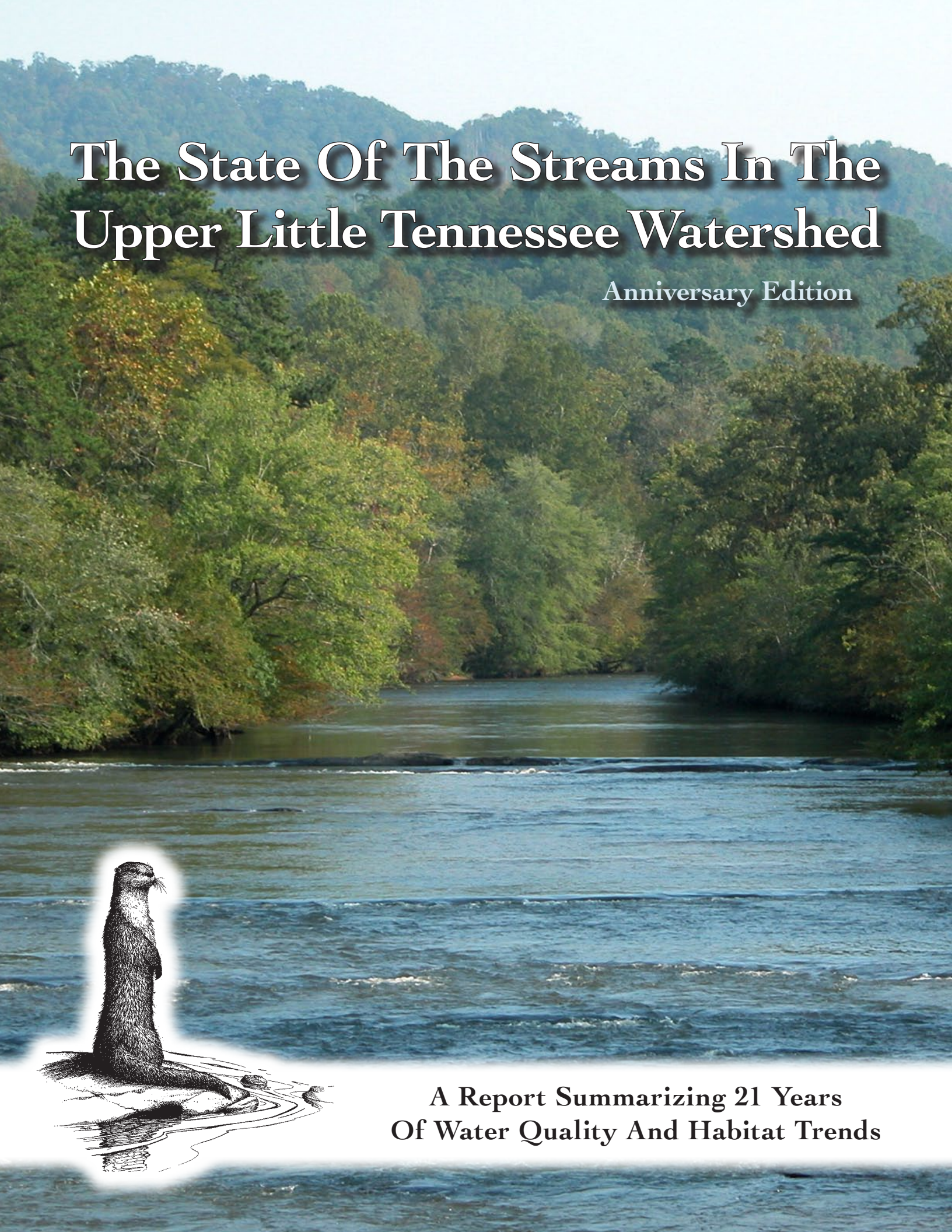
The State Of The Streams In The Upper Little Tennessee Watershed

Anniversary Edition



A Report Summarizing 21 Years Of Water Quality And Habitat Trends

Preface

The idea to produce this updated report came about shortly after I started working at the Little Tennessee Watershed Association in 2007. We were in the midst of a transition and trying to revive our membership. Many of the people I spoke with at events and festivals really wanted to know more about the health of our streams, and several had been volunteers with Dr. McLarney in the past. The demand for information was so high that we quickly exhausted our reserved stash of extra reports, even though by then it was five years old.

The State of the Streams Report is important to our community because as we learn more about the fantastic recreational opportunities that Little Tennessee has to offer, the more we want to know about the history, uniqueness and health of our beautiful river. What types of species live here? What are the major threats to this gem? How did the Cherokee live? Where is it safe for my family to play?

This report summarizes the last 21 years of biological monitoring data collected by Dr. Bill McLarney and the thousands of volunteers that have volunteered with him in this time. It contains details on the changes that have been recorded since the first State of the Streams was produced in 2002. It is meant to provide information so that we, as a community, can make better informed decisions. We also hope to inspire others to become ambassadors for clean water and healthy habitat in the Little Tennessee so that future generations have the same opportunities to enjoy this invaluable resource.

I am grateful to have had the opportunity to work on this project, and indebted to many volunteers who contributed time and technical assistance to make it happen. As a principal author in this report and the creator of the Biomonitoring Program, I should point out that none of us would be here if it were not for the unending dedication of Dr. Bill McLarney and his insatiable quest to impart an appreciation for biodiversity and water quality to the masses. We are fortunate to have someone like him looking out for our river.

Onward,

Jenny Sanders, Executive Director

Front cover by Ralph Preston

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Highlights

An Introduction to the Upper Little Tennessee River Watershed

What is a watershed?

A watershed can be visualized as a leaf with small veins (creeks and streams) feeding the main vein (large river). When it rains, or as snow melts, the watershed acts as a funnel by collecting all the water within the area covered by the basin and channeling it into soils, groundwater, creeks, and streams, making its way to larger rivers and eventually the sea.

Just as nations, states, and counties have boundaries, so do watersheds. Within a watershed is the land that contributes water to a given site, whether on a local-scale, or a much larger scale.

Unifying the landscape

Water is a universal solvent, affected by all that it comes in contact with: both the land it traverses and the soils through which it travels. How clean a river is depends on how the land that drains to it is managed. This is especially true of the land closest to our streams and rivers, the riparian zone.

Riparian areas are important components of watersheds because they help buffer the river from activities on the land nearby. A healthy riparian zone ideally consists of a native mix of grasses, shrubs and trees. Trees and shrubs are excellent riparian plants because they filter pollutants carried by rainwater before it reaches the stream. Additionally, roots from the plants help to keep the banks from washing into the river. Above all, the important thing to remember is that land use affects water quality for all communities living downstream.

Watersheds Focus Action

Using watershed boundaries rather than political boundaries is a very effective framework for dealing with water quality issues. Watershed management can bring together people from different towns, counties, and even states to focus on a single river system. Using watershed lines as a boundary, all the sources of pollution for a river can be identified and used to give communities a realistic avenue for addressing problems affecting an entire river.

More importantly, the watershed approach allows communities to come together around a vision for the future of their watershed. Many times, political boundaries often follow watershed boundaries (ridgelines) or have equal share of a resource by using the river channel as the dividing line; this is especially true here in the mountains and aids in the management of resources. However there are exceptions. For example, the Georgia/ North Carolina boundary is defined by specific latitude.

Where is the Little Tennessee?

With headwaters in Rabun County, Georgia at the confluence of Billy and Keener creeks, the Little Tennessee River flows north and northwest for 55 miles, unimpeded for its entire length except for Porters Bend Dam, which forms the relatively tiny (250 acre) Lake Emory in the town of Franklin. Before reaching Lake Emory, the river makes its way through a flat, wide valley, dropping less than 50 feet of elevation in more than 10 miles of channel length. Here, the valley is defined by the Nantahala Mountains to the west and the Fishhawk Mountains and Blue Ridge Escarpment to the east.

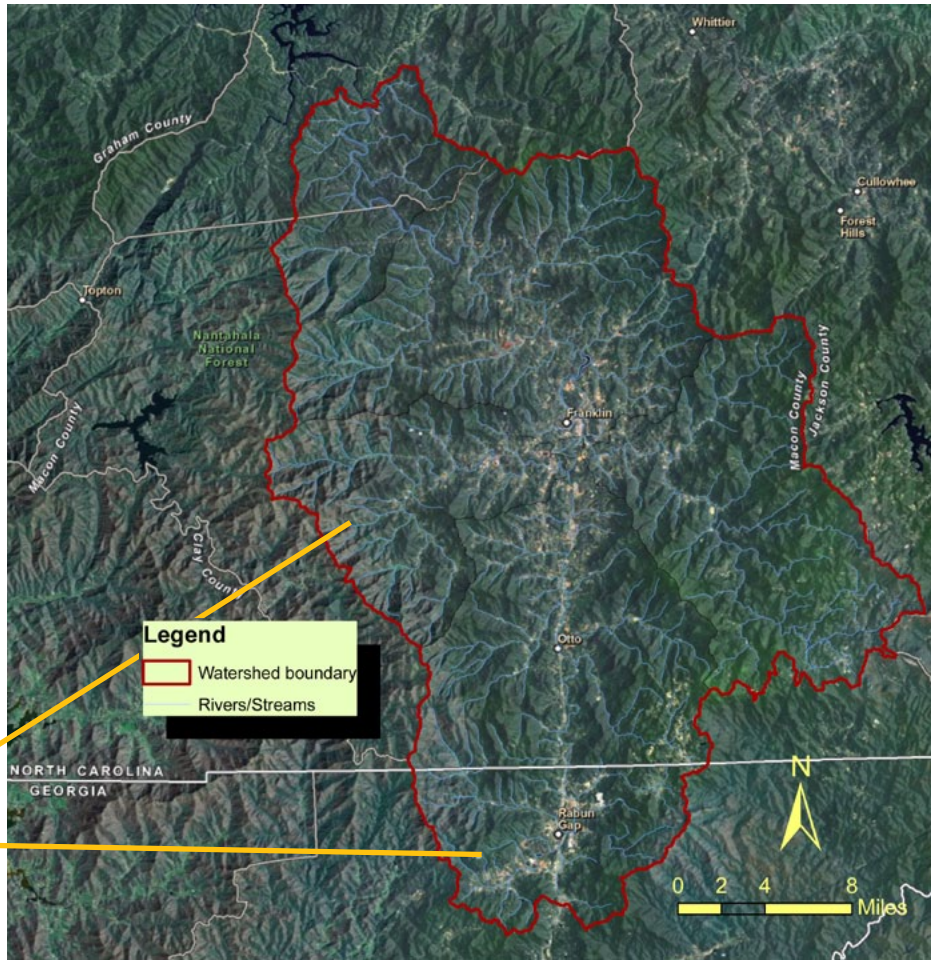
As the river leaves the impoundment of Lake Emory, conditions change greatly. Somewhat surprisingly, the river improves in quality as it flows downstream. The river becomes swifter as it is constricted between the Nantahala and Cowee mountains.

The stretch of the river between Lake Emory and Fontana Reservoir is one of the highest quality rivers in the Southern Appalachians, making it unique among the Blue Ridge Rivers to have escaped much of the industrial pollution that has degraded so many other rivers in the region. The Little Tennessee is by any measure the healthiest major river in the Blue Ridge, and probably the only one with anything approaching a complete, intact biota.

The importance of our river in the big picture is greater than we often realize. Starting at the "high pool" level of Fontana Reservoir, just downstream of the mouth of Sawmill Creek in Swain County, the Little Tennessee has been converted to a single string of reservoir lakes all the way for 80 miles to its juncture with the Tennessee River at Lenoir City, Tennessee.

From there on for 601 miles to where it becomes the largest tributary to the Ohio River at Paducah, Kentucky, the "big" Tennessee is almost as completely impounded, with only short stretches of free-flowing river.

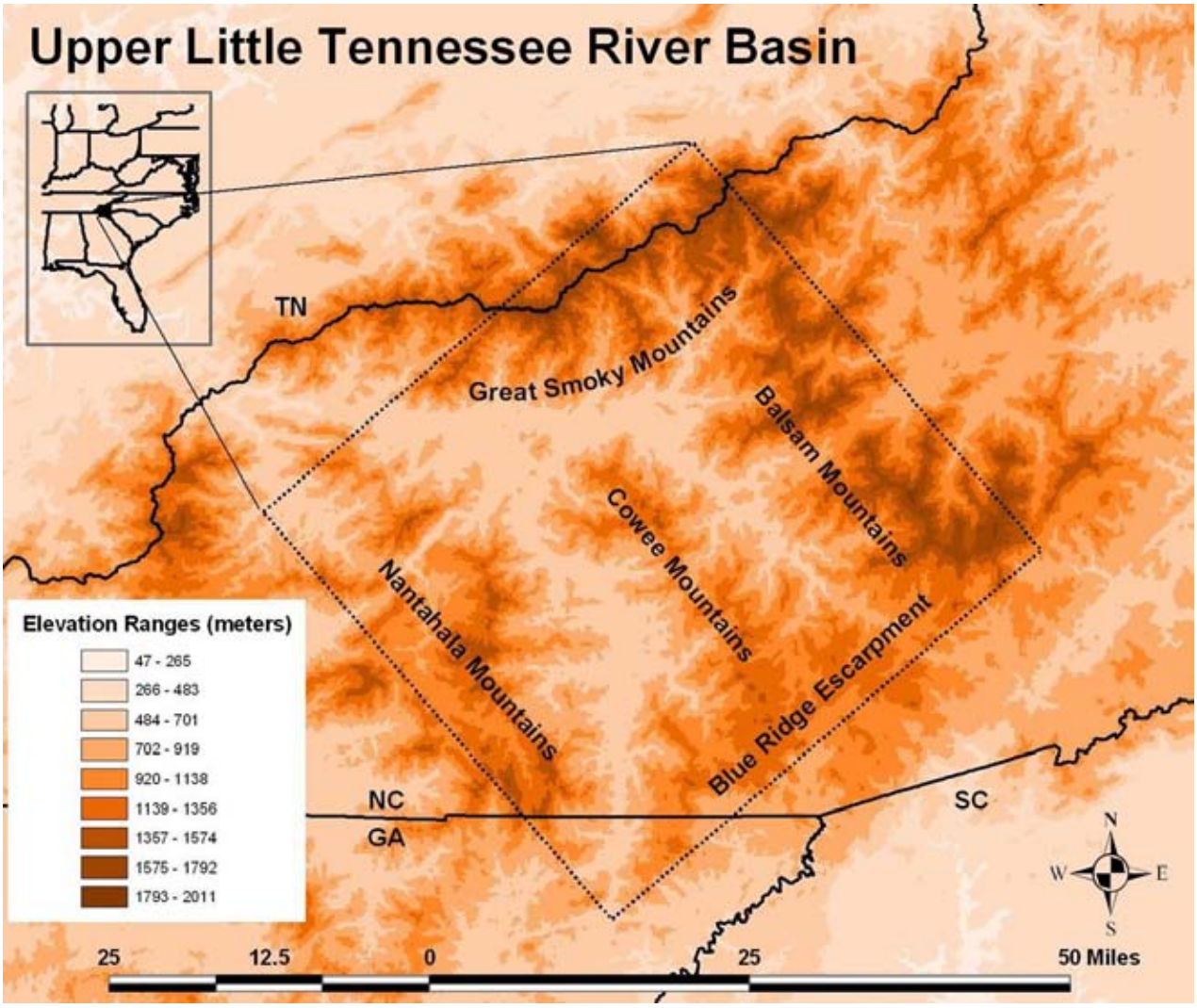
Impeded though it is by dams, the water continues to flow, continuing 46 miles downstream, and the Ohio River becomes the



largest tributary by volume to the Mississippi River in Cairo, Illinois. From Cairo, the Mississippi travels another 980 miles down to the Gulf of Mexico.

As you can see, all water originating at the headwaters of the Little Tennessee Watershed must travel over 1,750 miles downstream, passing through at least 65 cities and towns before reaching the Gulf of Mexico. Millions of people - from boaters on Fontana to urban residents of New Orleans - use “our” water as a drinking supply, and to support industry, agriculture, fisheries, recreation, and sewage disposal. We have a responsibility to make sure we pass on the healthiest water possible.

Great as our responsibility to downstream users may be, we have an equal responsibility to our place and ourselves. The 53 miles from Rabun Gap to Fontana are all that remain of the Little Tennessee as a free flowing river. Whatever is lost here will not be found somewhere else, and will not be replaced. Protecting water quality for people downstream and protecting our own unique biodiversity, cultural heritage, drinking water, esthetics and recreational resources are just two aspects of the same job – the one to which the LTWA is dedicated.



created by Carla Norwood

Why is the Valley Special?

Biodiversity

The Upper Little Tennessee watershed covers 450 square miles of forests, fields, towns and communities in the heart of the Southern Appalachians. From its headwaters in Rabun County, Georgia, through Macon and Swain counties in North Carolina to the headwaters of Fontana Reservoir on the edge of the Great Smoky Mountains National Park, the watershed is home to a diverse population of aquatic life, unique forest types, and long-standing human communities.

Maribel Mafla

Little Tennessee River Crayfish
ᏥᏩᏯᏍᏙ Tsi·stv·na

While the Little Tennessee River continues to Lenoir City, Tennessee where it joins the Tennessee River, all of the area from Fontana down becomes an unbroken string of reservoirs, or lakes. It is up to the people of Macon, Swain, Jackson and Graham counties in western North Carolina to preserve what is left of the free-flowing Little Tennessee River, and since 1990 there have been organized local efforts underway to protect, maintain and restore this special place.

Terrestrial Diversity

Much of the terrestrial diversity of the watershed persists in the Park and elsewhere, from Fontana down to the Tennessee River itself. The forests of the Little Tennessee watershed provide a strong complement to the rich aquatic life. These forests harbor the southernmost representatives of “northern” communities such as the Spruce Fir Forests, while also providing habitat for the typical plants and animals of the southeast. According to the North Carolina Natural Heritage Program, the upper Little Tennessee watershed is “home to excellent examples of rock outcrop natural communities, including one of the best

What is Endemism?

Biologists use the word “endemic” to describe those plants and animals which are found only in a particular place. Everywhere is important, but areas with high endemism are particularly important to conserve. In addition to the endemic fishes mentioned in the text, the Little Tennessee boasts an endemic crayfish (appropriately called the Little Tennessee River crayfish). A number of other species, including such colorful and conspicuous fish as greenfin darter, warpaint shiner and southern brook trout, are endemic to the southern Appalachians. Taken together these unique species, and their landscape, are part of what defines us; they should be a source of pride for every resident of the upper Little Tennessee watershed.

Tuckaseigee darter
ᏚᏚᏘᏍᏙ Du·ga·lv·na

Smoky dace
ᏫᏙᏓᏍ U·ta·lu·ga

Maribel Mafla

LTWA

Sicklefin redhorse

examples of Montane Red Cedar-Hardwood Woodland in the nation" (Schwartzman, 2010). These unusual communities typically contain small cliffs and boulder outcrops mixed with glade-like openings on gentle slopes. Rare plants and butterflies are known to inhabit these important communities. Similarly, the Needmore Game Lands contain Montane Oak-Hickory Forest, Acidic Cove Forest, and Montane Alluvial Forest, the latter of which is considered to be rare. The examples along the Little Tennessee River are considered to be some of the best examples in the state, if not the nation. This riverine forest has a hardwood canopy with sycamore (*Plantanus occidentalis*), black walnut (*Juglans nigra*) and other hardwoods (Schwartzman, 2010).

The upper Little Tennessee river also contains a highly significant wetland system, the Nantahala River Bogs, which are recognized as one of the best known Southern Appalachian Bogs. Studies by geomorphologists indicate that the bogs may be quite old, and sediments from one of the wetlands dates back approximately 13,000 years. A number of noteworthy reptiles, amphibians and plants are found in these bogs, including the federally threatened bog turtle (*Glyptemys muhlenbergii*) (Schwartzman, 2010).

Aquatic Diversity

The upper Little Tennessee valley is the most ecologically intact portion of the seven-state Tennessee River system, which itself is the most species-rich aquatic system in the temperate world. The river contains approximately 47 species of native fish and approximately 10 native freshwater mussel species.

Comprising just 2% of the greater Tennessee drainage, the free-flowing Little Tennessee

Hellbenders

Another rare species of particular interest which is found in relatively healthy populations in the Little Tennessee River watershed is the hellbender (*Cryptobranchus alleganiensis*). The hellbender is a giant salamander, North America's largest, that reaches a maximum length of 29 inches. It is sometimes called a "mudpuppy" locally, but that is in fact a distinctly different species. The hellbender inhabits rocky, fast flowing streams in the Appalachians and is an indicator of good water quality. Populations are thought to be diminishing due to pollution, sedimentation, habitat disturbance, and chytrid fungus.

Fabiana Silva

is home to fully one-fourth of the native fish species of the entire Tennessee system. This is one of a only few, isolated river reaches that collectively support what remains of the exceptional aquatic biodiversity of the Southeastern United States. The Little Tennessee River has been identified by the World Wildlife Fund as one of 19 most important biological 'hotspots' worldwide, it is home to two UNESCO Biosphere Reserves and is a Biogem of the Natural Resources Defense Council.

Many native species are adapted to the clean, cool conditions traditionally found in mountain streams, and cannot tolerate degraded habitats caused by sedimentation or increases in temperature. Taken together these species comprise some of the most imperiled of the southeast's aquatic wildlife, including the Federally Threatened spotfin chub and sicklefin redhorse, the Federally Endangered Appalachian elktoe mussel, littlewing pearlymussel and endemic species such as the Tuckaseigee darter and smoky dace. These species represent a unique assemblage which can never be replaced if it is lost.

Recreation

Opportunities abound in this region for anyone who is eager to get outside. The water as well as the land holds many offerings of fun and memorable experiences. Watersports include paddling, tubing, and fishing. While most of the river can be navigated by kayak or canoe (except the extreme headwaters) and launch sites are located both above and below Lake Emory, the more popular location for tubing is the lower reaches. Fishing is exceptional throughout the basin. Trout inhabit many of the tributaries and even a few headwater reaches still contain native brook trout populations. In the warmer reaches, smallmouth and rock bass, sunfish, and flathead catfish are the common target for many anglers.


Ralph Preston

A number of recreational activities are available through the watershed's vast public land opportunities. Birding is a popular past time as this region is along a migration route for many neo-tropical songbirds. Tessentee Bottomland Preserve is one of many locations for bird enthusiasts to view these beautiful migrants. Hiking trails meander within our watershed, including the famed Appalachian Trail and Bartram's Trail. Additional trails as well as public hunting opportunities within our basin can be found in the Needmore Game Lands, Nantahala National Forest, and a small section of the Chattahoochee National Forest in the extreme upper headwaters of Georgia.

Whatever your pleasure, the Little Tennessee River basin is unique to offer so much within a relatively short distance that many of the mentioned activities can be done on the same day. There is plenty of public land and waters available, thanks to state and federal resources as well as locally owned conservation land. It is now up to you to get outside and enjoy what the region has to offer.

Economic Value

Communities have traditionally developed around water resources because water allows for growth. The rural mountain regions of Western North Carolina, East Tennessee and Northeast Georgia are no different. The abundant water supplies in the region have historically drawn industry and, more recently, recreational tourism opportunities as well as second home development.

Over the years, these communities have witnessed the exodus of factory jobs to countries with much lower wages or, in many cases, companies have simply gone out of business entirely. As a result, communities in the rural Little Tennessee valley have become heavily dependent on tourism and vacation home construction as the economic driver of the region.

The economic impact of the recreation industry in rural communities across North Carolina and Georgia is significant. In 2009, a report on the economic impact of mountain trout fishing compiled by the NC Wildlife Resources Commission (NCWRC) stated "[In 2008] Mountain trout anglers…fished for 1.42 million days…spent $146 million and had a total economic output of $174 million when indirect economic effects are factored in." (NCWRC, 2009) Trout fishing's annual impact in Georgia is estimated to "exceed $172 million annually."

Similarly, agricultural wine operations in Northeast Georgia depend on clean, abundant water supplies. Estimates from the Agricultural Extension Service estimate the wine industry's economic impact in Georgia to be around $15 million. Additionally, a report completed by Western Carolina University found that the Nantahala Gorge contributes $85 million annually to the local economy, and is the primary reason first time visitors elect to come to North Carolina (Newsome, 2009).

Clearly, the presence of a healthy and intact river system has afforded these communities the opportunity to offer unique experiences and beauty that draw substantial investment to the watershed.

Ralph Preston

Culture and History in the Upper Little Tennessee River Valley

Ralph Preston

Fish weir on the Little Tennessee River

The Little Tennessee River and the Appalachian Summit Area

By: Lamar Marshall

The Little Tennessee River originates from tens of thousands of springs that emanate from the many mountain chains that comprise the western North Carolina area of the Appalachian Summit. When the glaciers retreated northward, rich coves along the headwaters of the river provided a unique diversity of plants, animals and fish that eventually enticed nomadic hunters and gatherers to build permanent settlements along floodplains.

The prehistory of western North Carolina is divided into four basic time periods: Paleo, Archaic, Woodland and Mississippian. They span a time from about 9,000 B.C. with the arrival of the Paleo-Indians, until the arrival of Europeans around 1500 A.D. Through these millennia, the nomadic lifestyle that included the hunting of mastodons and mammoths was lost to changing climatic conditions and the extinction of those megafauna. Although the Pleistocene animals are believed to have vanished by 8,500 B.C., it was another 7,000 years before permanent or semi-permanent villages became widespread. Over time, the wandering bands of hunters grew larger and embraced the introduction of plant propagation around permanent camps and villages.

About 1,000 B.C., the widespread use of pottery marked the beginning of the Woodland Period and a continuing increase in the practice of horticulture. As distinct tribes emerged in various regions, farming and the hunting of resident bear, elk, bison, deer and turkey led to the eventual territorial claims of the Cherokees as well as other bands of Indians. Cherokees propagated native plants and began growing imports like corn and maypops (*Passiflora incarnata*) from Mexico. An extensive aboriginal trade evolved between tribes of the Americas became an important part of their local economies.

To support trade, travel, hunting and warfare, a complex continental-wide Indian trail system evolved. Trails in western North Carolina and the Little Tennessee River watershed closely followed the river and its hundreds of tributaries, tying settlements by crossing

mountain gaps. Seasonal or permanent camps have been found in the uplands and gaps of the mountains that predate the migration to the flood plains. Mountain gaps were natural travel ways for big game and early hunters laid in wait for nature's provisions. Before 1725, a Cherokee told a trader that the buffalo were their cows, the deer their sheep and the bear their hogs.

Native American fishing weirs are found along most southeastern rivers and numerous fish weirs are preserved in the Little Tennessee to serve as historic landmarks where fish harvesting and processing camps were located. Thirteen weirs have been identified in one seven mile section of the Little Tennessee between Iotla Creek and the McCoy Bridge. Archaeologists have found that camps were usually located nearby where drying racks were set up. The fish were smoked and dried using fire-heated rocks. After a quantity was processed, it was taken to nearby towns where it was stored and eaten. Red horse was a principle migratory fish targeted during spring spawning runs.

River Cane

By: David Cozzo

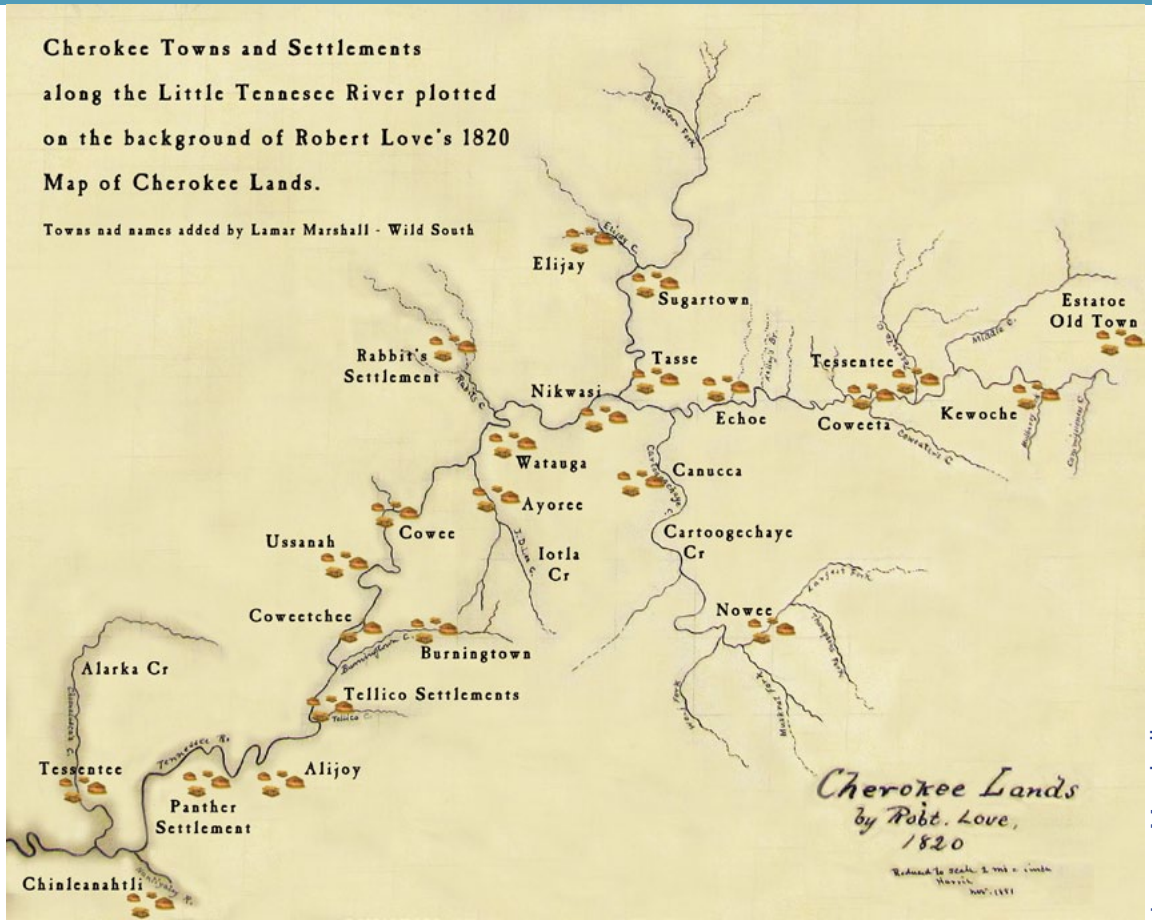
River cane (Arundinaria gigantea) is the largest native species of bamboo in North America. Historical accounts suggest the tallest cane reached heights of nearly 40 feet and canebrakes ran for miles along southeastern river valleys. While much underappreciated today, it was once an indicator of valuable rangeland for cattle and a sign of high-quality agricultural soils. Its value also led to its decline as foraging destroyed canebrakes and agriculture pushed it to the margins. Today, it is estimated that less than 2% of the original cane still exists.

Sunny Himes

River cane serves a dual ecological function in the health of our streams and for wildlife habitat. Recent studies have indicated that 10 meters of cane can filter out more sediment and nutrient runoff than a 10 meter forest buffer. The thick rhizomes and fibrous roots also protect stream banks from erosion during flood events. The dense canebrakes provided a thermal inversion layer that protected wildlife from harsh weather and the young culms and foliage provided a nutritious feast for animals large and small. Several species of butterflies are also thought to be canebrake specialists.

River cane also played a prominent role in the lives of the Southeastern Indians. It was once used in nearly every aspect of village life, including housing, ceremonial objects, musical instruments, sitting and sleeping mats, funeral shrouds, hunting equipment, fish traps, and, of course, baskets. River cane baskets were so tightly woven that they were used to haul water. The grain produced when river cane goes to seed provided a high quality food at a time of year when resources were scarce and the young shoots could be cooked and eaten like other bamboo shoots.

Today, the shortage of river cane is of great concern to Native American groups throughout the Southeast, especially our local Cherokee artists. Cultural preservation efforts have trained many new basket makers and increased the demand for this limited resource. It is only through partnerships with conservation groups and educational efforts about the benefits of river cane that this wonderful resource will thrive as a tool of both environmental and cultural preservation.



Lamar Marshall

About nineteen Cherokee towns or settlements were located between the headwaters of the Little Tennessee River near Rabun Gap, GA, to its junction with the Tuckasegee River. Some of the more important towns were located near Dillard, GA, and Otto, Franklin, Iotla and Cowee Community in North Carolina. Twenty eight Cherokee Citizen Reservations were located on the Little Tennessee and tributaries. Yellow Bear, Trout, Little Deer, Beaver Toter, Whippoorwill, and Six Killer were among those who took reserves in 1819. With over a hundred houses, Cowee Town was one of the most prominent Cherokee Middle Towns up to and after the American Revolution. The Council House was located on Cowee Mound on the west side of the Little Tennessee River just downstream from the influx of Cowee Creek. The town itself lay on both sides of the river. A smaller yet prominent mound is located on the east bank on private property at the junction of Cowee Creek and the river. There are dozens if not hundreds of cupules or mortar holes in numerous rocks on both sides of the river.

Pottery shards are found in fields on both sides of the river upstream and downstream of the mound. In addition, pottery shards have been found far up the Cowee Valley on the bottomlands of Matlock, Rickman, Cowee, Shepherd, and Mica City Creeks. Archaeological sites have been found along Burningtown, Tellico, Iotla and dozens of other feeder streams.

Tradition tells us that many waterfalls such as Burningtown Falls were sacred places to the Cherokees. Alexander Long, an English trader who lived with and knew the Cherokees well, wrote a journal in 1725. He noted that the Cherokees purged themselves in a ritual associated with the ripening of their corn in late summer. Long describes how they fasted and took herbal physics before their holy man led the people to the river to wash off their pollutions.

Iotla Town was situated where the modern Macon County Airport is now located. The original Cherokee name was Ayoree or Jore

Ralph Preston

LTWA

Cowee (top) and Nikwasi (bottom) Indian Mounds

Town. A great trading path that originated in Charles Town, South Carolina passed through Nikwasi, modern Franklin and Ayoree, and crossed the Nantahala Mountains to the Valley towns and Overhill towns of the Cherokees. It was called the Iona Canara Road in 1761. Important archaeological discoveries were made at Iotla in April of 2009 when archaeologists surveying a proposed runway expansion at the airport found two palisaded villages dating to about 1100 A.D. Some artifacts on the site dated as early as 2000 B.C. but most of what was found dated back to the Woodland Period, 500 A.D. This included structures, storage and cooking pits. The excavations also turned up artifacts and the remains of structures and pits dating as late as 1600-1750 A.D. which may have coincided with the burning of Ayoree town by the British General James Grant in 1761.

The Little Tennessee River

Two centuries of use, abuse and restoration

By: Barbara McRae

When William Bartram traveled through the region in 1775, he noted the lovely meadows and grasslands along portions of the Little Tennessee River. The trail he followed as he visited the Cherokee towns meandered through these grassy areas and at times plunged into deep woods. For ages, the Cherokee had lived in small villages surrounded by communal agricultural lands and connected to one another by trails. This settlement pattern changed when the Cherokee departed and new settlers moved into the valley.

The newcomers preferred to live on large parcels of land, in scattered homesteads rather than towns. Some of the best property was located along the Little Tennessee and its major tributaries, where the bottomland was rich and flat. This land was snatched up when the state began offering grants in 1820. For most of the county's history, the main uses of the bottomlands were agricultural.

Settlement proceeded rapidly in the beginning, but plateaued when the population reached 5,000 because of the lure of new territories to the west. As time passed, farming intensified, especially in the valleys, and road-building increased, but for several decades the overall effect on the river was not much greater than in the Cherokee era.

Macon County's early residents included a number of people with entrepreneurial expectations. Some purchased huge tracts of mountain land, hoping to find mineral wealth or a way to harvest the timber. However, obstacles stood in the way of progress, chief among them the difficult terrain and the inaccessibility to markets. No one could do anything about the terrain, but, beginning in 1850, local leaders tried to bring in a rail line to improve market access. The Civil War ended their efforts.

Exploitation of resources

Portable sawmills came into widespread use in this era, allowing companies to set up temporary camps anywhere. A rush began to harvest the huge stands of virgin forest. Timber production became a large-scale industry, gaining steam in 1906, when the Tallulah Falls Railroad was extended to Depot Street in Franklin. In 1911, spurred by public opinion, Congress passed the Weeks Act, which permitted the government to purchase land to safeguard the headwaters of streams. The U.S. Forest Service began buying and protecting critical tracts in the Southern Mountains. This was the beginning of the Nantahala National Forest. However, companies could still log private land as they wished, and they did so for as long as the timber held out. By 1925, more than 90 percent of the county's virgin forest was gone.

Timber wasn't the only resource made marketable by the railroads. This new transportation option also encouraged mining throughout the mountains. Mica production intensified in the 1920s to keep up with industrial demand. Three large, mechanized processing plants were located on the Little Tennessee River which added large loads of sediment to the river.

Poor agricultural practices in the early 20th century further burdened the river and streams with silt. In 1922, an anonymous writer commented in The Franklin Press that "some of our farmers are cultivating fields which produce cornstalks hardly bigger around than a man's little finger. Why not let timber grow on these poorest and roughest fields so that our grandchildren can inherit something besides red gullies?"

Education proved the key to improving agriculture. The first county agent began work in Macon County in 1913. His efforts were resisted at first, but people eventually came

Macon County Historical Society

A logging team along Main Street in Franklin, NC during the early 1900's

to understand the benefits of better farming methods. In the early 1930s, the county agent organized the Macon County Soil Conservation and Water Control Association, a precursor to the committee-governed Soil Conservation Service, which was established in 1949.

Industry

Macon County never became an industrial center, despite many attempts by progressive leaders to lure manufacturers, whose repeated failures helped ensure the health of the Little Tennessee. The 1860 census reported six tanneries, four sawmills and three saddleries in the county. Their environmental impact was localized and limited. Sawmills were stationary, depending on water power, and the output of the tanneries was relatively small. Even by the early 20th century, other than the three mineral plants, manufacturing remained at a modest level. The biggest industrial impact on the river seems to have been the carpet mill in Rabun County, Georgia. A Tennessee Valley Authority (TVA) study of the watershed in 1968 determined that the mill, which was then known as James Lees & Sons, released treated waste dye into a small branch of the Little Tennessee.

The development of paved highways in the 1920s fueled anticipation that this area could become a major resort center — an idea that made people much more aware of values such as scenic beauty and clean water. In 1925, the Lake Emory project became reality. People were confident that the municipal hydroelectric plant would give the momentum for industrial development. The 225-acre reservoir was envisioned as the center of a major resort, with an 18-hole golf course, a modern inn and beautiful homes on its borders. Its waters would provide pleasure boating and splendid fishing opportunities.

The town was on a roll. In 1926, the Great Smoky Mountain Park was established and Franklin found itself on the route of the scenic, newly paved Asheville-to-Atlanta highway. The boom attracted out-of-town developers and speculators who purchased enormous tracts of property. However, the Great Depression put everything on hold. Lake Emory was built, but failed to live up to its hype. The hydroelectric plant proved an economic drain on the town, which began desperately looking for a buyer in just three years. Furthermore, in spite of enormous improvements in agriculture, forestry and road-building techniques, erosion and siltation continued. The dam at Lake Emory stopped the silt that previously had flowed downstream which benefited the lower reach of the river, but quickly made “lake” an oxymoron and devalued it for recreational use as population began to decline in the region. Following the mid-1960s Americans began an unprecedented movement away from the cities, back to the countryside. Suddenly, the mountains and particularly Macon County began to boom. Drawn by the beauty and climate, people were looking for places to retire or spend the summer. They brought prosperity and launched a new kind of development: Large resort complexes, gated communities, golf courses, new roads on mountainsides and houses on steep sites where few people had ever before chosen to live. The result was a new source of soil disturbance and stream siltation.

Nearly two centuries have now passed since the Cherokees left their Middle Towns and new settlers moved in. In that time the region has gone from an area of enormous virgin forest, with unspoiled streams and rich, wet bottomlands, to the ravaged hillsides and muddy streams of the age of exploitation, and back to productive forests and much improved environmental conditions.

The valley today is a long way from the “natural” state of 1819, but it is also a long way from the degraded state of 1913. Two centuries of land use have taught many hard and valuable lessons, including the importance of clean water and healthy streams, and what it takes to conserve these critical resources.

Challenges to Protecting Water Quality and Quantity

Pollution

Point source

Point source pollution is pollution that enters a waterbody via a pipe or some other direct source that can be traced. It is typically associated with industrial processes and wastewater treatment plants, and is often the first type of water quality problem which occurs to the average citizen. Fortunately, the Little Tennessee River watershed has not suffered as much from toxic point sources as many, including some neighboring watersheds like the Tuckasegee and the French Broad. But neither are we exempt from point sources.

The most significant development in that area was the closing in 2006 of the Fruit of the Loom plant in Rabun Gap, Georgia, which accounted for over 95% of the total permitted industrial discharges to the entire watershed. We are already seeing benefits in the downstream ecosystem, for example recovery of riverweed (*Podostemum*), the characteristic aquatic plant of the Little Tennessee. Of course what is good news if you are a fish, was bad news for the local economy – the plant was Rabun County's largest employer with 30% of its employees hailing from Macon County.

The other significant point source category in our watershed is municipal waste water treatment plants. In Highlands, macroinvertebrate data from Mill Creek show a slowed but continual recovery following the shutdown of an old, inadequate municipal plant in the late 90's. The initially controversial new Highlands plant, which discharges directly to the Cullasaja River below Sequoyah Reservoir, has produced no measurable negative effects in the lower reaches of the river, though this may be partly due to the function of Dry Falls and Cullasaja Falls as natural tertiary treatment facilities.

The biggest change, though, may be yet to come; as an inevitable consequence of population growth, all three municipal facilities in the watershed (Highlands, Franklin and Dillard) are approaching capacity. Rabun County also recently purchased an idle factory in Rabun Gap and successfully converted the pollution discharge permit to allow both industrial and municipal wastewater to be treated and released from this facility.

Typical treatment of waste involves using

Rabun County Chamber

Fruit of the Loom plant in DIllard, GA

chlorine to kill any remaining bacteria before entering the river. However, chlorine is detrimental to aquatic organisms, and often creates a void of many species immediately downstream of the discharge area. In this context, the Town of Highlands and Rabun County have switched to UV treatment of waste because it has no harmful effect on aquatic species.

Non-point source

Sewage treatment plants are one source of organic pollution, but most organic pollution comes in the form of “nutrients” from non-point sources, including inefficient septic tanks, livestock in and near streams, and agricultural fertilizers. In this category, the overall trend is positive, largely as a result of efforts by landowners, government agencies and organizations like the LTWA to help reduce access to streams by livestock.

photo by LTWA flight by Southwings

Improperly placed roads are sources for sediment

As row crop agriculture has declined, so has the incidence of non-point source chemical pollution. One happy event during the time period covered by this report was a voluntary change of practice by a major agricultural operation on Cat Creek. While the change is too recent to be reflected in our biomonitoring results, we hope for improvement in that beleaguered stream, which has always rated Poor.

Sedimentation

Growth brings soil disturbance and, nearly always an increase in erosion and sedimentation. Probably the most spectacular recent example from our watershed is that provided by Caler Fork, downstream of the ill-fated Wildflower development. There a “perfect storm” compounded of extensive road building and grading, followed by sustained extreme flows in the winter and spring of 2005-2006 was quickly followed by the crash of the housing sector of the local economy. Virtual non-maintenance of the property led to rates of sedimentation downstream which produced the most spectacular decline in stream quality we have recorded in 21 years of monitoring. In the lapse of one year, Caler Fork went from an IBI score of 50 (in the middle of the “Good”range) to 33 (Poor).

There are other examples of mistreatment and neglect of land in the course of development, some of them visible to the casual observer from the main highways, but growth-related negative trends have been to a significant degree offset by active and passive stream restoration, better regulatory enforcement and a much greater level of awareness on the part of builders and grading contractors.

Interbasin Transfers

For the past decade Atlanta has faced periods of severe drought. Though the drought has been broken for the time being, recent legal rulings in what is known as the “tri-state water war” has renewed the water shortage crisis for Atlanta. The city has become increasingly motivated to find any means of acquiring

Ralph Preston

Sediment is a major threat to the region.

access to alternative drinking supply sources, and the Little Tennessee will not be overlooked.

An interbasin transfer occurs when water is permanently removed from one river basin and deposited into another river basin. This often occurs when water from the “donor” basin is used as municipal water and then sent, via pipes, to another river basin to be treated and discharged as wastewater. The result is a net loss of water in one basin and a net gain in the other.

Interbasin transfers (or IBT’s), are problematic because they can leave the donor river with low flows. When a river stays consistently low, it begins to attract ground water to keep a minimum base flow in the river bed, and this can cause nearby wells and ponds to dry up. Sustained low flow also creates problems for recreation and aquatic animals that need a healthy, abundant supply of water to survive. Furthermore, industries that rely on water for production can suffer if it is not consistently available. Conversely, the receiving river has higher flows, thus potentially altering the flood stage and flow dynamics.

In 2009, after years of fighting with neighboring states for water from Lake Lanier, a federal judge ruled that the City of Atlanta had been illegally tapping drinking water from Lake Lanier and they were given until July 17th, 2012 to apply for a legal permit or find an alternative source. Recommendations made by a governor-appointed task force included creating new reservoirs, transferring water from tributaries of the Tennessee River (all along Georgia’s northern border) and withdrawals from Lakes Burton and Rabun in Northeast Georgia among possible solutions.

In 2007, Rabun County Commissioners purchased the idle Fruit of the Loom factory along the Little Tennessee River in Rabun Gap, Georgia, and successfully converted the wastewater discharge permit from industrial use to both municipal and industrial uses. The new permit will allow the County to begin importing sewage from other areas of the county (including parts that are in the Savannah River Basin) to this plant to be treated and discharged into the Little Tennessee.

At that time, it was anticipated that the next step would be to convert the industrial water withdraw permit into a municipal withdraw permit, so that the “excess capacity” of the Little Tennessee could be made available for drinking water in other areas of the county. The Little Tennessee Watershed Association is especially concerned that with Atlanta’s deadline fast approaching, it would be appealing to the Rabun County Commissioners to sell this water out of county. However, through the efforts of LTWA and many other partners in Rabun County, the Rabun County Board of Commissioners have decided to take a stand against unwanted water grabs from Atlanta. On February 22nd, 2011, they unanimously voted to approve a resolution that urges the Georgia General Assembly to pass enforceable interbasin transfer regulations.

This action was immediately reciprocated by both the Town of Franklin and Macon County Commissioners, who passed a resolution in support of Rabun's actions.

This is a big step forward and the result of many years of work to educate the citizens all over our watershed. We applaud each of these boards for taking the issue of IBT's so seriously and for taking action to protect our water.

However, the work is not yet done. In order to establish lasting protection for the Little Tennessee and to open the lines of communication to prevent future multi-state water wars from beginning, the Little Tennessee Watershed Association supports the idea of the creation of a "Little Tennessee River Advisory Commission". This Commission is designed to bring basin stakeholders from industry, agriculture, non-profits, tribal entities and local governments together periodically to review proposals and make recommendations when issues around water quality or quantity in the Little Tennessee arise, but it would have no authority to make rules or regulations. For the Little Tennessee River Advisory Commission to be established, all three states (GA, FL and TN) need to pass legislation creating the entity.

Invasive Species

Exotic species

While we like to brag on our watershed's aquatic animal diversity, it is important to note that the Little Tennessee is also home to a number of species that nature never intended us to have. Some, like the brown trout (native to Europe), rainbow trout (from the Pacific coast) and redbreast sunfish (from the piedmont and coastal plain) are by now permanent parts of our fauna; we may as well learn to live with and enjoy them.

But this is no excuse for further accidental

Yellowfin Shiner

The yellowfin shiner, *Notropis lutipinnis,* is a small minnow native to watersheds that drain into the Atlantic Ocean. Its presence in the Little Tennessee River was first recognized in 1988 in Commissioners Creek, just 0.2 mi. downstream of the Georgia state line. By 1990, the yellowfin shiner was present, and often abundant in Commissioners Creek, Mud Creek, and at several sites on the Little Tennessee mainstem. Between 1990 and 1995 we confirmed its presence at most low elevation stream sites in Georgia all the way back to Keener Creek which joins with Billy Creek to form the Little Tennessee, and as far downstream as Cartoogechaye Creek.

In 1991, a specimen was recorded at Ellijay Creek. This individual had progressed 6 miles upstream from the mouth of the Cullasaja River. To move downstream beyond the Cullasaja, a fish must pass through 4 mi. of slack water (Lake Emory) formed by Porters Bend Dam. In 1993 we collected the first individual from Rabbit Creek, a tributary to Lake Emory not far above the dam.

By 1997 yellowfin shiners had passed over Porters Bend Dam and began a downstream invasion, appearing in Watauga Creek and later in Iotla Creek (1998), Burningtown Creek (2000), and in Tellico Creek (2006). We have no records of yellowfins from the mainstem of the Little Tennessee below Lake Emory (probably due to lack of suitable habitat) but based on records from tributaries, it has invaded 44 of the 53 free flowing miles of the Little Tennessee, lacking only 9 mi. to reach Fontana Reservoir.

Maribel Mafla

Maribel Mafla

or irresponsible introductions. To cite a few examples, since 2002:

• The Asian clam Corbicula, first discovered in the Little Tennessee in the 1990's, remained rare until recently. By 2009 their abundance had skyrocketed by over 2000% on average with densities up to 640 per square meter. These exotic invaders are more tolerant of sediment, water pollution, and other impacts to habitat than are our native mussels. It's not clear if there's a causal relationship between their increase and the decline of native mussels, but their abundance could inhibit recovery of native populations.

• The yellow perch, which has been present in the Lake Emory area since at least 1993, has in the last few years spread all the way down to Fontana and up to Betty Creek in Georgia, where it competes with both bass and trout.

• More recently, anglers have started catching spotted bass at scattered locations from Fontana to Dillard. This smaller cousin of our native smallmouth and largemouth bass is capable of competing with both.

• The most recent exotic species observation is of an aquatic plant, Elodea, in much of the river below Franklin. Elodea has the potential to behave like kudzu and Japanese honeysuckle do in the terrestrial environment.

Perhaps we should not even mention the Highlands Plateau, where the native fish fauna largely disappeared years ago – of 18 fish species we have recorded from that area, only 3 are native. But the trend continues, with new species popping up as recently as this year. We mention this to demonstrate that unauthorized stocking, or just dumping, of fish is an ongoing problem which needs to be curbed.

Native Invasion

With the help of distribution maps, recognizing non-native species is relatively easy, similar to noticing kudzu along the roadway. However, what happens when a native species is found in a location it otherwise would not be in? This is referred to as a "native invasion" discussed by Scott and Helfman (2001).

A classic example is that of two native fish species: "Headwater" species prefers streams with cold water and a clean, rocky substrate, usually found in the upper reaches of the watershed; whereas "river" species can tolerate a wider range of temperatures and substrates, but generally is found farther downstream where water temperatures are warmer.

Due to the removal of riparian vegetation and the construction of roads in the headwater region, small streams begin to have higher water temperatures, increased sediment deposition and elevated nutrient levels and result in conditions physically and chemically similar to those which naturally occur in larger streams. This facilitates the establishment of "river" species not naturally present in these small streams and subsequently deteriorate habitat conditions for "headwater" species.

A more subtle "invasion" does not require an invasion at all. Habitat change caused by anthropogenic modifications may simply shift the proportion of one species to another. Often, this involves a dominant organism which is specialized to the conditions of that particular

Maribel Mafla

Corbicula shells along the Little Tennessee River

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Central stoneroller
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region and sensitive to environmental changes becoming rare while other species become more abundant. One term biologists use to describe these invaders are “weedy” species. Under normal conditions, their population is suppressed by the established specialized species. However, like weeds, following a disturbance the “weedy” species are quick to occupy the recently vacated habitat.

One example of a “weedy” species is the central stoneroller (Campostoma anomalum), found throughout the streams of the Little Tennessee River. This species is adapted to feed on algae that grows on rocks, and therefore is typically most abundant in larger streams and rivers where sunlight can penetrate to the stream. However, due to increased sunlight through the reduction of riparian areas, and increased nutrient levels (fertilizer and manure run-off), algal growth is becoming more common in headwater streams. As a result the central stoneroller has been detected in extraordinarily high abundance (100’s) in small streams where the species would typically be represented by less than 10 individuals.

A common problem in biomonitoring is how to handle cases when native invasion seems to have occurred. The difficulty is that native invaders are likely to be overlooked because they naturally occur in the watershed to begin with, although they misrepresent their normal range. This is particularly complex when factoring in natural events (e.g. drought, flood) as explanations for shifts in species distribution.

Furthermore, native invasions may lead to no change in diversity or perhaps, to an increase in diversity, leading to a false sense of stream improvement. Nevertheless, when species are discovered in an area or in numbers that they generally do not occur in, native or not, this indicates a disruption to the natural state and should be perceived as degradation of stream health.

Mussel Decline

By: Stephen Fraley

Before the invention of modern gas detection equipment, coal miners paid close attention to the health of caged canaries that accompanied them into the mines. The canaries were more sensitive to poisonous gases and when they became sick or died, it was a warning to take action or suffer a similar fate. Freshwater mussels are often compared to canaries in the coal mines. They are among the most sensitive organisms to pollution and habitat changes in our rivers. Their fate can be a harbinger of things to come for other organisms that rely on clean water— including us.

Over the past few years, two rare mussel species have declined dramatically in the Little Tennessee River between Franklin and Fontana Reservoir. Surveys conducted since 2004 show loss of over 90% of the federally endangered Appalachian elktoe and the state endangered Slippershell populations. Between 2004 and

NCWRC

Appalachian elktoe mussel
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2006 these species alone declined; however, surveys conducted this fall show that other mussel species are declining, too.

The Appalachian elktoe is found only in a few rivers in western North Carolina and eastern Tennessee. Until recently, the most abundant population was in the Little Tennessee, which was designated by the U.S. Fish and Wildlife Service (USFWS) as Critical Habitat for the species in 2002. Prior to 2004, they could be found at densities up to 40 per square meter of river bottom.

Results from surveys conducted in 2009 were drastically different. Appalachian elktoe and Slippershells had dwindled to less than 10% of their former abundance. At the same monitoring site where the highest densities were seen historically (near Needmore swinging bridge), only 3 Appalachian elktoe and no Slippershells were found in 8 hours of searching.


NCWRC

Slippershell mussel
JEO Da·gv·na

Results were similar near the McCoy Bridge monitoring site, about half-way between Franklin and Fontana. However, declines were not as bad just below Emory (Franklin) Dam, where Appalachian elktoe and Slippershells were found at roughly half their former densities. Unfortunately, no young of either species were found at the site and declines are likely to continue as older mussels die.

Most native mussel species have declined in abundance, while some remain relatively unchanged, and one species appears to have increased substantially in abundance at one location. The Tennessee clubshell, listed as endangered in the state, has declined by over 80% since 2006. The Rainbow mussel (NC Species of Concern) appears to have declined by about half, while the Spike, also an NC Species of Concern, showed no clear trend.

The Wavy-rayed lampmussel (another NC Species of Concern) has declined slightly at our upper monitoring sites, but has nearly doubled in abundance at the Needmore area.

The cause for these drastic changes remains unclear. Sediment deposition and the frequency of muddy water, which are detrimental to sensitive mussels, appear to have increased with the increase in development in the watershed and water pollution may be on the rise with increasing human population. However, water sampling and assessments by NC Division of Water Quality (NCDWQ), the Little Tennessee Watershed Association, and Tennessee Valley Authority show no clear problems.

Asian clams are likely a factor, but the specifics are unclear. Since 2004, the Little Tennessee has experienced record floods and droughts which have surely exacerbated other problems. The NCWRC and USFWS are working with partners at NC State University, NCDWQ, US Geological Survey, and Coweeta Hydrologic Laboratory to conduct and coordinate research to determine causes that will hopefully lead to successfully addressing this problem. In any event, it's clear that our "canaries in the coal mine" are sounding an alarm.


USFWS

Freshwater mussel samples are often conducted by snorkeling

Biomonitoring: 21 Years of Documenting Stream Health

Summary

As we are fond of saying to volunteers prior to undertaking a biomonitoring sample, “The real experts are the fish – we just have to learn to interpret what they are telling us.” So, what are the trends in our watershed during 2002-2010 according to the real experts?

Two worrisome trends that stand out are: 1) Monitoring of threatened and endangered species in the mainstem below Franklin suggests that fluctuations in the abundance of the spotfin chub may (or may not) be cyclical, but the decline of our diverse mussel fauna, including two endangered species, looks like a long term phenomenon. In addition, 2) another of our sensitive fishes, the wounded darter, has almost disappeared from the Cullasaja River, though it remains moderately common in the lower Little Tennessee. The likeliest explanation is increased sedimentation of the lower reaches of the Cullasaja, where wounded darters spend their first months of life.

Had this report been written around 2005, we might have identified more trends, but many apparent trends were interrupted or altered by the extreme flows and water levels of 2005-2006. While we tend to see floods and extreme storm events as destructive, that is not altogether true on the level of natural systems. Although the health of our most unstable streams declined after 2005, on a watershed-wide level the extreme weather seemed to function as a “reset” system, flushing sediments while moving fish species proportions back toward a more “natural” mix. On the one hand, this reinforces the notion of the resilience of our mountain streams. On the other, noting that previously healthy streams returned to a good condition more rapidly than those which are historically polluted, channelized, full of cattle, etc. should incline us toward better stewardship.

Probably the single best barometer of watershed health is the condition of the mainstem at the lower extreme of our

Maribel Mafla

Bob Scott

watershed, in the Needmore area. While we note with concern the decline of the mussel assemblage, and the continued proliferation of new non-native species, overall the condition of the river at Needmore suggests that positive actions – not the least being the creation of the river corridor through creation of the Needmore Game Lands in 1999 – have at least counterbalanced the negative trends. Annual IBI scores at Needmore over the years 1990-2002 ran between 54 and 60 (Excellent or high Good ratings); during 2002-2010 the range was 53-58.

It is difficult to describe a single trend for the rest of the watershed, since each tributary watershed reflects the sum result of all the improvements and new stresses taking place. The reader can detect some of these trends by comparing the color-coded map in this edition of State of the Streams with its predecessor from 2002. However, we decided to clean the windshield a bit by looking carefully at all those sites for which we have biomonitoring data from 3 to 9 occasions between 2002 and 2010. We found 30 such sites, of which 20, covering a full range of Bioclass Ratings from Very Poor to Excellent, showed no significant change over this period. For some important watersheds (for example Coweeta Creek) we don't have enough data over this time to make a statement, but among the "stable" watershed areas are Needmore, Brush Creek (Swain County), Burningtown, Cowee Creek, Watauga, Holly Springs, Crawford Branch, the lower and middle Cullasaja, Ellijay, Mill Creek (Highlands),lower Cartoogechaye Creek, Mill Creek (Cartoogechaye watershed), Wayah, Tessentee, Middle Creek, the mainstem in Dillard and lower Betty Creek.

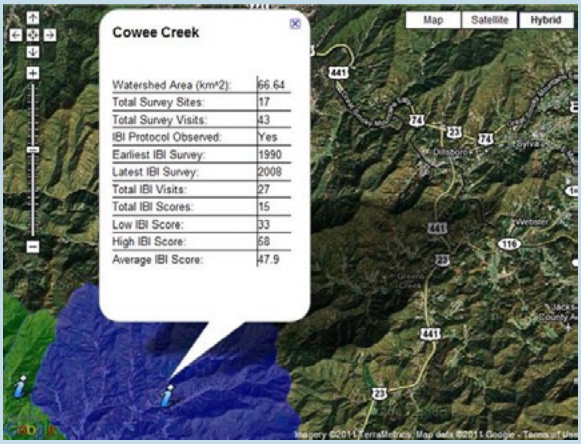
We found 5 sites which show symptoms of decline, and 4 which showed improvement.

Declining sites

1. Possibly the hardest to understand, is the reach of the Little Tennessee River at and just above the state line. This area is extremely important, not only because of the change in jurisdiction at the state line, but because it is just downstream of a major concentration of stresses, including the former Fruit of

Biomonitoring Database Website

In 2011, the Little Tennessee Watershed Association and its partners at Coweeta LTER launched a website that makes available the full 21 year span of Biomonitoring data in an easily accessible website available to the public. With the help of thousands of volunteers, Dr. Bill McLarney has provided a record of stream health for the upper Little Tennessee River and its tributaries since 1988. In compiling the database, we learned that Dr. McLarney and his volunteers have sampled, identified, and counted over 196,000 fish, making this database is one of the largest of its kind! Each year, LTWA uses these data to issue reports that provide community leaders with feedback on water quality and general ecosystem health, and to advocate for changed behavior to improve water quality and habitat.



LTWA

In 2008, Dr. McLarney approached the Coweeta LTER Program for help. Recognizing both the long-term value of the data and the fact that others might be able to mine the data more effectively, the Coweeta LTER helped organize the extensive Biomonitoring data set. Once this work was completed, we were able to launch the new website, which now presents the fish species and IBI score data in a searchable framework. The information made available through the massive reorganization of LTWA's data set provided justification to North Carolina Natural Heritage Program to greatly expand several existing Significant Natural Heritage Area by adding several previously unlisted tributary streams. These are identified as important aquatic habitats and are using in defining conservation priorities.

As time goes on, LTWA is increasingly complementing the fish work with macroinvertebrate monitoring and habitat assessment, and the database will be updated on an annual basis. The development of this database and website is the first collaborative effort among the Little Tennessee Watershed Association and the Coweeta Long Term Ecological Research Program. Researchers at both institutions view this effort as merely the beginning of a long-term collaboration that will enhance awareness of biodiversity locally while increasingly involving students and the general public in the setting and implementation of conservation priorities.

To access the database please visit www.coweeta.uga.edu/ltwa/

the Loom Plant, the Dillard municipal waste water treatment plant and, most recently, the expansion of US 441 between Clayton and the state line. In 2007 we moved our “state line” fixed station from a site which was actually on the state line to a point just above GA Highway 246 (the Dillard-Scaly-Highlands road). This was done because of the difficulty associated with the extremely unstable river bed at the state line.

We anticipated a healthier biota and gradual improvement due to the elimination of a major point source with the closure of the Fruit of the Loom plant. While the macroinvertebrate community is definitely healthier at the new site, with its rock substrate, the fish data are less than clear; generally producing a Bioclass Rating of Fair. What is more discouraging, they show a slight decline in the last two years.

2. Perhaps more disturbing is the decline, since about 2008, from Fair to Poor in the mainstem river at the upper end of impoundment of Lake Emory, between the mouths of the Cullasaja River and Cartoogechaye Creek. This reach of river, one of the strongholds of the state listed olive darter, has been subject to heavy development pressure in recent years, and will suffer even more with pending construction of the Siler Rd. Extension bridge.

3. Middle Creek, which rated Good from 1992 through 2002, has since oscillated between Fair and Good, with an apparent slight overall negative trend, related to development in the upper watershed. This “yo-yo” behavior is typical of streams suffering constant but intermittent inputs of sediment.

4. Caler Fork, which declined drastically in 2006 (Good to Poor), then recovered to Good for a while, declined to Fair in 2010, reflecting the effect of sediment bleeding off roads and house sites on the failed and largely abandoned Wildflower development. It would not be surprising in the near future for Caler Fork to oscillate like Middle Creek.

5. The clearest example of cause and effect among our declining streams is offered by Tellico Creek, which dropped from Good into the lower reaches of the Fair category, apparently as a consequence of severe organic pollution from a trout farming operation.

Improving sites

1. The lower reaches of Iotla Creek improved from Poor to Fair after 2002, possibly reflecting improvements in management at the Macon County Airport. However, with airport expansion and school construction expected in the near future, this trend could reverse.

2. Two sites on Skeenah Creek, one at the NC Welcome Center on US 441 and one about 0.8 mi. upstream, both improved from Poor to Fair over the period 2002-2010. In the case of the lower site, this may be due to stabilization after heavy disturbance during the construction of the new Union School. However, the upstream site is located above the school site. Improvement could be a byproduct of recovering populations of some species downstream, but we must also admit to the possibility of other positive changes in the watershed of which we are unaware.

3. Upper Betty Creek clearly improved from Fair to Good concurrent with the elimination of a presumed source of agricultural fertilizers and pesticides just upstream. This is corroborated by a reduction in benthic algae at the site.

4. The positive change (Poor to Fair) on the mainstem in the Wolf Fork Valley, while welcome, is probably not as significant as we would like. It appears to be a very local effect resulting from the initiative of a landowner at our monitoring site to place rocks along the shoreline of this heavily sedimented site, thus greatly increasing habitat for several species. It does, however, suggest the potential of simple forms of habitat restoration.

Understanding IBI Scores and Bioclass Ratings

The Index of Biotic Integrity (IBI) is a 'scale' to calculate the health of the stream sampled. IBI integrates scores for several indicators of ecosystem health. The IBI criteria is adjusted by stream size, for instance, one would expect to catch a greater number of fish in a larger water body and there would be a slight shift in the composition of species compared to a small stream. However, in general, the criteria used evaluate each stream sample are:

	Good Stream	Degraded Stream
Diversity	Many different types of native fishes (e.g. darters, shiners, suckers)	Dominated by only a few species
Position on the food chain	A distributed mix of omnivores, herbivores, piscivores, but dominated by insectivores	Dominated heavily by ominvores and herbivores
Fish health	Little or no disease or parasites	Many fish observed with disease or parasites
Pollution tolerance	Dominated by specialized, pollution intolerant fish	Consists mostly or solely of tolerant fish
Catch rate	Many fish, high catch rate	Very few fish, low catch rate

Bioclasses (assessed based on the numerical IBI value)

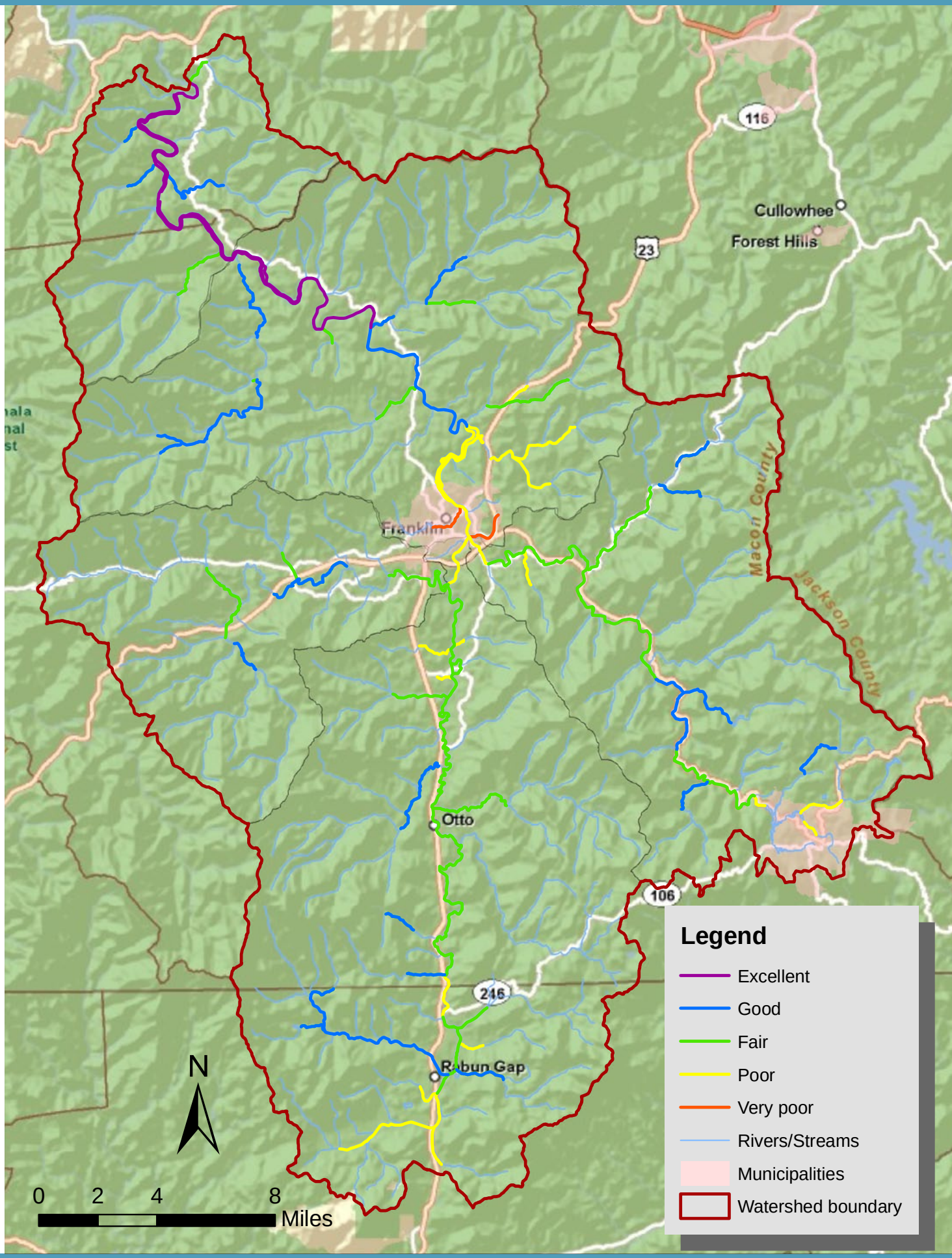
EXCELLENT (58 - 60) Comparable to the best situations with no detectable human influence; all regionally expected species for the habitat and stream size, including the species most intolerant of disturbance, are present with a full array of age and sex classes; balanced trophic structure.

GOOD (48 - 52) Species richness somewhat below expectation, especially due to loss of most intolerant forms; some species with less than optimal abundance or size distribution; trophic structure shows signs of stress.

FAIR (39 - 44) Signs of additional deterioration include fewer intolerant forms, more skewed trophic structure (e.g. increasing frequency of omnivores); older age classes of top carnivores may be rare.

POOR (28 - 35) Dominated by omnivores, pollution tolerant forms and habitat generalists; few top carnivores; growth rates and condition factors commonly depressed; hybrids and diseased fish often present.

VERY POOR (12 - 35) Few fish present, mostly introduced or very tolerant forms; hybrids may be common and diseases, parasites, fin damage and other anomalies regular.


116
Cullowhee
Forest Hills
23
Franklin
Macon County
Jackson County
Otto
106
216
Rabun Gap
N
0 2 4 8
Miles
Legend
Excellent
Good
Fair
Poor
Very poor
Rivers/Streams
Municipalities
Watershed boundary

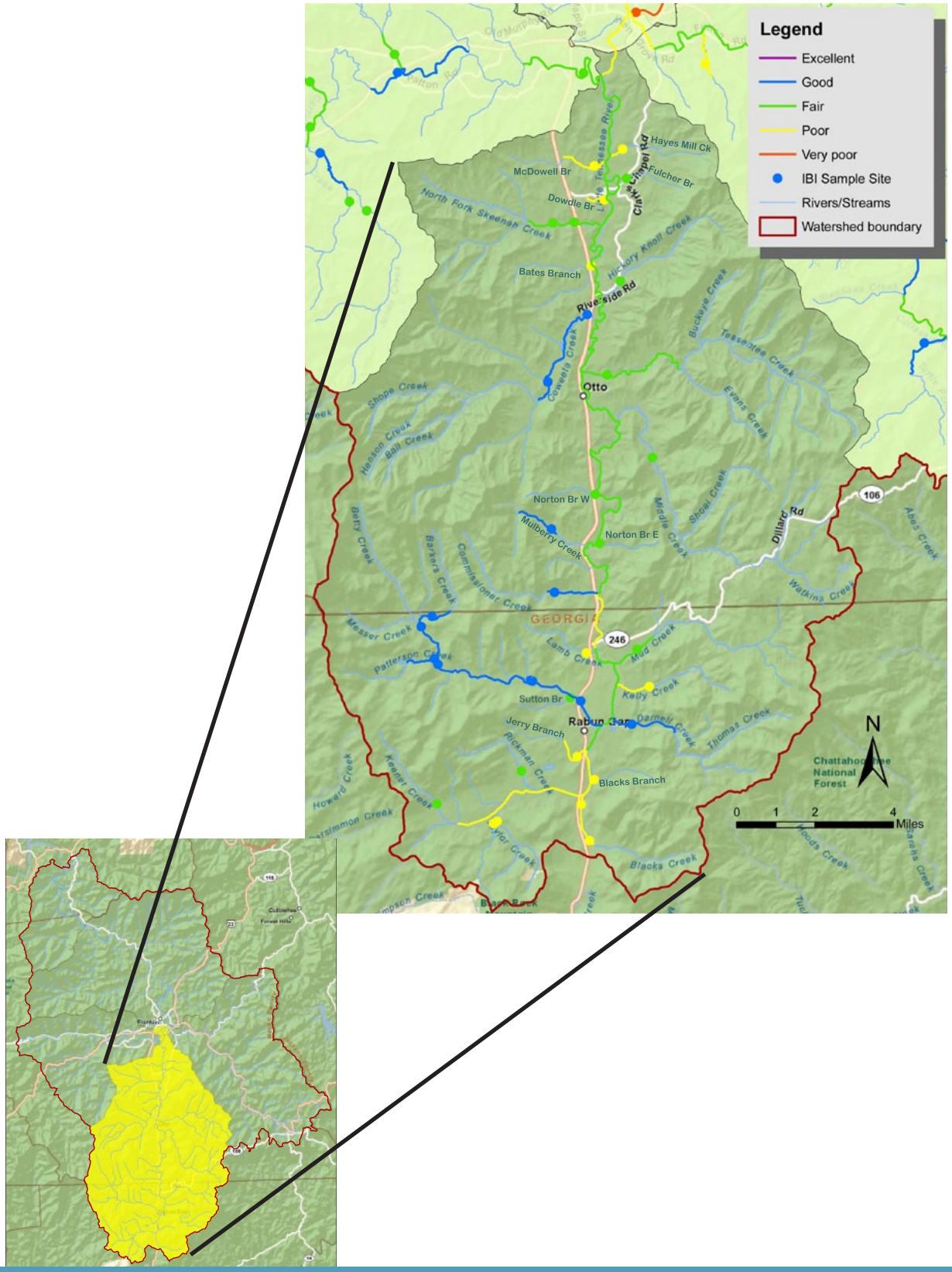
Index of Monitored Streams

Stream (page)	Most Recent Sample	Bioclass Rating
Allison Creek (44)	2007	FAIR
Barkers Creek (34)	2010	FAIR
Bates Branch (36)	2003	POOR
Betty Creek (34)	2008	GOOD
Blacks Creek (34)	2010	FAIR
Bradley Creek (58)	2010	FAIR
Brush Creek (53)	2008	FAIR
Buck Creek (41)	2005	FAIR
Burningtown Creek (49)		
Left Prong	2009	GOOD
upper	2009	GOOD
middle-lower	2008	GOOD
Caler Fork (50)	2010	FAIR
Cartoogechaye Creek (44)	2007/2010	F-G-F-G
Cat Creek (48)	2010	POOR
Commissioners Creek (35)	1995	GOOD
Coon Creek (51)	2005	POOR
Cowee Creek (50)	2010	GOOD
Coweeta Creek (36)	2008	GOOD
Crawford Branch (48)		
upper	2010	POOR
lower	2009	V. POOR
Cullasaja River (38)	2008/2010	P-F-G-F-P
Dalton Creek (50)	2008	GOOD
Darnell Creek (34)	2005	GOOD
Ellijay Creek (38)		
upper	2005	GOOD
North Prong	2005	GOOD
lower	2009	FAIR
Fulcher Branch (36)	1995	POOR
Hayes Mill Creek (36)	1995	POOR
Hickory Knoll Creek (36)	2007	FAIR
Iotla Creek (51)	2004	FAIR
Jerry Branch (34)	2002	POOR
Jones Creek (44)	2007	FAIR
K-Mart Branch (44)	2009	V. POOR
Keener Creek (34)	1995	FAIR
Kelly Creek (34)	1995	POOR
Lamb Creek (34)	2002	POOR

Stream (page)	Most Recent Sample	Bioclass Rating
Licklog Creek (53)	2006	GOOD
Little Tennessee River (34, 35, 47, 49, 53)		
headwaters - Lake Emory	2007/2009/ 2010	P-F-P-F-P
Lake Emory	2006	POOR
Dean Island	2009	GOOD
Needmore	2010	EXCELLENT
Matlock Creek (50)	2008	GOOD
McDowell Branch (36)	2005	POOR
Middle Creek (36)	2010	GOOD
Mill Creek (Cartoogechaye) (44)	2009	FAIR
Mill Creek (Cullasaja) (41)	2010	POOR
Mud Creek (34)	2007	FAIR
Mulberry Creek (35)	1995	GOOD
Norton Branch East (35)	2002	FAIR
Norton Branch West (35)	2002	FAIR
Peeks Creek (39)	2010	GOOD
Pitt Branch (34)	1995	POOR
Poplar Cove Creek (44)	2007	FAIR
Rabbit Creek (48)	2010	POOR
Rickman Creek (34)	1996	FAIR
Rocky Branch (*)	2010	FAIR
Rose Creek (51)	2004	FAIR
Salali Branch (49)	2003	V. POOR
Sawmill Creek (*)	2002	FAIR
Skeenah Creek (36)	2010	FAIR
Sutton Branch (34)	2004	FAIR
Taylor Creek (34)	1995	POOR
Tellico Creek (53)	2010	FAIR
Tessentee Creek (36)	2010	FAIR
Tippet Branch (51)	2009	POOR
Turtle Pond Creek (41)	2009	GOOD
Walnut Creek (38)	2008	GOOD
Watauga Creek (51, 58)	2010	FAIR
Wayah Creek (44)	2010	FAIR
Wiggins Creek (*)	2010	GOOD
Younce Creek (50)	2009	FAIR

* no write-up, on map only

The Headwaters



Rabun County, Georgia

Most of the headwater area of the Little Tennessee (55 sq. mi.) is located in Rabun County, Georgia, with the source at the junction of Keener and Billy Creeks. The river flows through an agricultural area of long standing, with many channelized reaches, sporadic riparian cover, and heavily sedimented.

The river is small enough here that local effects may be reflected in the IBI. For example, IBI in the reach immediately above and below Wolf Fork Church Rd. dropped from 48 (GOOD) in 1994 to 33 (POOR) in 2005, presumably in response to re-channelization. Just downstream, a landowners' initiative in reestablishing shade and placing rocks along the bank led to an improvement from an IBI of 31 (POOR) in 2001 to 39 (FAIR) in 2006.

Near Dillard, the volume of the river is almost doubled when it receives input from Betty Creek. From this point to near the state line water and habitat quality as measured by IBI are in the FAIR to GOOD range (IBI's around 47). However, as it passes through Dillard, the river is subjected to a number of stresses. Most obvious are two point sources – the Dillard municipal waste water treatment plant and an industrial facility, locally known as the "Rabun Mills" plant.

A sudden disappearance of fish within the mainstem, from Dillard to around the mouth of Coweeta Creek, in 1994 appears to have been related to a malfunction at the Dillard Waste Water Treatment Plant. However, most of the concern has historically centered around the Rabun Mills plant, which has historically accounted for around 95% of the total volume of permitted industrial wastewater discharges above Fontana Reservoir. At the time the federal Clean Water Act was enacted in 1972, the Little Tennessee in Georgia was horrifically polluted. Regulatory success in the ensuing years was further enhanced by the efforts of the Biomonitoring Program (at that time under the aegis of the Western North Carolina Alliance) and the U.S. Fish and Wildlife Service. As a consequence of state and federal regulation, biotic integrity has risen from what was certainly a VERY POOR condition in the 60's and 70's, to POOR at the time IBI monitoring was initiated, to a series of mostly FAIR-GOOD ratings beginning in 1992.

There are 12 tributaries to the Little Tennessee River in Georgia with watershed areas of > 1 sq. mi. Although at least 4 streams support native brook trout in their upper reaches, in general they are in bad shape in their lower reaches, having been channelized, deforested and subjected to agricultural impacts. The most recent damage was to **Lamb Creek**, much of which was a GOOD quality stream until 1995 when it was stripped of riparian cover for development. Of these 12 streams 6 (**Lamb Cr., Kelly Cr., Jerry Br., Blacks Br., Taylor Cr.** and **Pitt Br.**) rated POOR the last time they were monitored; four (**Blacks Cr., Mud Cr., Rickman Cr.** and **Keener Cr.**) rated FAIR.

The exceptions are 2 of the 3 largest tributaries - **Darnell Creek**, which has improved from an IBI of 45 (FAIR) in 2001 to 53 (GOOD) in 2005, presumably as a result of elimination of cabbage fields and attention to erosion issues.

Although the smaller tributaries in Georgia are, on the average, in worse condition than those in North Carolina, **Betty Creek**, the largest Georgia tributary, may probably be the healthiest major tributary to the upper Little Tennessee in both states. All eight sites along Betty Creek have showed almost universally GOOD quality (IBI's of 47-55). **Barkers Creek** is of particular importance as part of the watershed of Betty Creek, generally considered to be the healthiest tributary of the upper Little Tennessee. Also, Barkers Creek serves as an important trout nursery area. However, we have noticed a reduction in available pool habitat in Barkers Creek, and the effect is apparent in our fish data. IBI scores for the past two samples are respectively 40.5 (FAIR -2006) and 46.5 (FAIR-2010).

Mention should be made of one small Betty Creek tributary. The entire watershed of **Sutton Branch** (1.0 sq. mi.) is located on

the property of the Rabun Gap-Nacoochee School. For many years it had been trampled by cattle and otherwise abused when Rabun Gap biology teacher Terry Seehorn decided to involve his students in a restoration experiment. Over the period 1998-2003 fencing, rock placement, reestablishment of natural riparian vegetation and control of invasive plants clearly had a positive effect on the physical environment and in 2004 there was a suggestion of biological improvement with the first FAIR IBI score (41) in the lower reaches. Unfortunately, with Mr. Seehorn's departure from the school, the project was abandoned.


LTWA

Little Tennessee River in Otto, NC

Probably historically the most severe impact on this reach of the mainstem Little Tennessee River has been from channelization during construction of the short-lived Tallulah Falls Railroad. The damage was partially mitigated by placement of large rocks along the bank, which maintains populations of some species, most notably the hellbender salamander. Nevertheless, this has historically been the poorest reach of the Little Tennessee, with an unstable substrate of shifting sand due to deforested streambanks.

Some aspects of the river have improved remarkably. Cattle are now largely absent from the river channel and many stretches of bank have been stabilized, with reestablishment of riparian vegetation. Anyone who floated the river above Franklin around 1999 and again recently would note more shade, more wildlife and general esthetic improvement.

Southern Macon County, North Carolina

We have perhaps been negligent in monitoring this part of the river since 2002. The 4 samples we have carried out – one site not far below the state line, and 3 on conservation easements and riparian restoration sites by the Land Trust for the Little Tennessee (one near Norton, and the other two at Tessentee Farm) have not shown much difference from earlier years, with FAIR Bioclass Ratings (IBI scores 36-41).

We will pay more attention to the river between Franklin and Georgia in the years to come, but do not expect to document strong biological improvement. We are looking at 80 years of sediment accumulation; even though the rate of accumulation of new sediment may be declining, this will not be flushed out quickly. Meanwhile we can be proud of a more attractive river, with less potential for damage when it floods.

Continuing downstream into North Carolina, there are 9 tributaries to this reach of the Little Tennessee with watershed areas in the range of 1-4 sq. mi., and 5 (not including Cartoogechaye Creek) with drainage areas greater than 4 sq. mi. All of the 9 smaller tributaries were monitored in 1995 as part of a unified effort to document small tributaries.

• The two streams nearest the Georgia line (**Commissioners Creek** and **Mulberry Creek**) both scored 46 and received GOOD Bioclass ratings.

• The two **Norton Branches** (one on each

bank of the river) were rated FAIR (IBI's of 45 and 42).

• Closer to town, **Bates Branch, Fulcher Branch, McDowell Branch** and **Hayes Mill Creek** all rated POOR (IBI range 24-35) except for Fulcher Branch which rated FAIR with an IBI of 40.

We have not returned to most of these streams since then, in part because we have not perceived major changes in their watersheds. This gradient suggests greater historic agricultural use where tributary streams cross the wider floodplain nearer to town. Certainly the most severe stresses affecting these streams have been from agricultural use, cattle access and channelization where they cross river bottom lands.

Of the larger tributaries, **Coweeta Creek** normally receives a GOOD Bioclass Rating at all sites monitored, which appears to be due in part to the forested condition of the entire upper watershed as part of the Forest Service Coweeta Hydrologic Lab facility, while **Tessentee** and **Hickory Knoll Creeks** consistently rate FAIR (IBI's of 41-45). The two remaining larger tributaries, **Middle Creek** and **Skeenah Creek**, provide more interesting story lines:

In our previous State of the Streams report we have cited **Middle Creek** as a success story. Up through the 1980's, the upper watershed of Middle Creek, on Scaly Mountain, was an agricultural disaster area; documented rates of soil loss there were the highest ever recorded in the United States east of the Mississippi River. Through the efforts of the Macon Soil and Water Conservation District, the US Soil Conservation Service and cooperating farmers, sheet and gully erosion was largely eliminated.

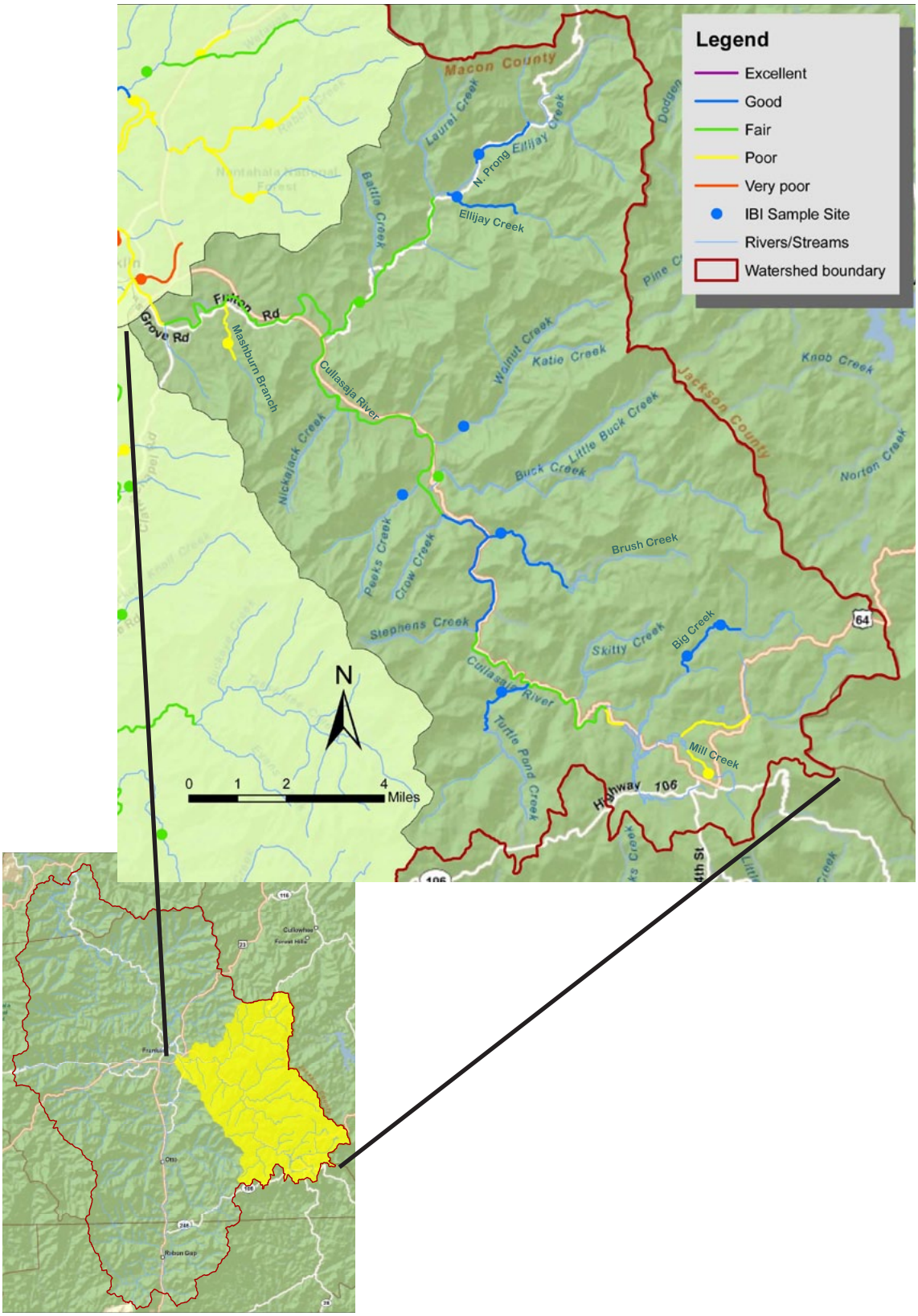
The first time we monitored our Middle Creek Fixed Station in 1990, the effects of the soil conservation effort were just kicking in, and an IBI of 36 (Bioclass Rating POOR) was recorded. By 1992, sediment accumulation was less and IBI increased to 50 for a GOOD Bioclass Rating. For 11 consecutive years we assigned a GOOD rating to the fixed station site (IBI range 47-52). Among the most apparent changes was the recovery of the stream's function as a trout nursery area.

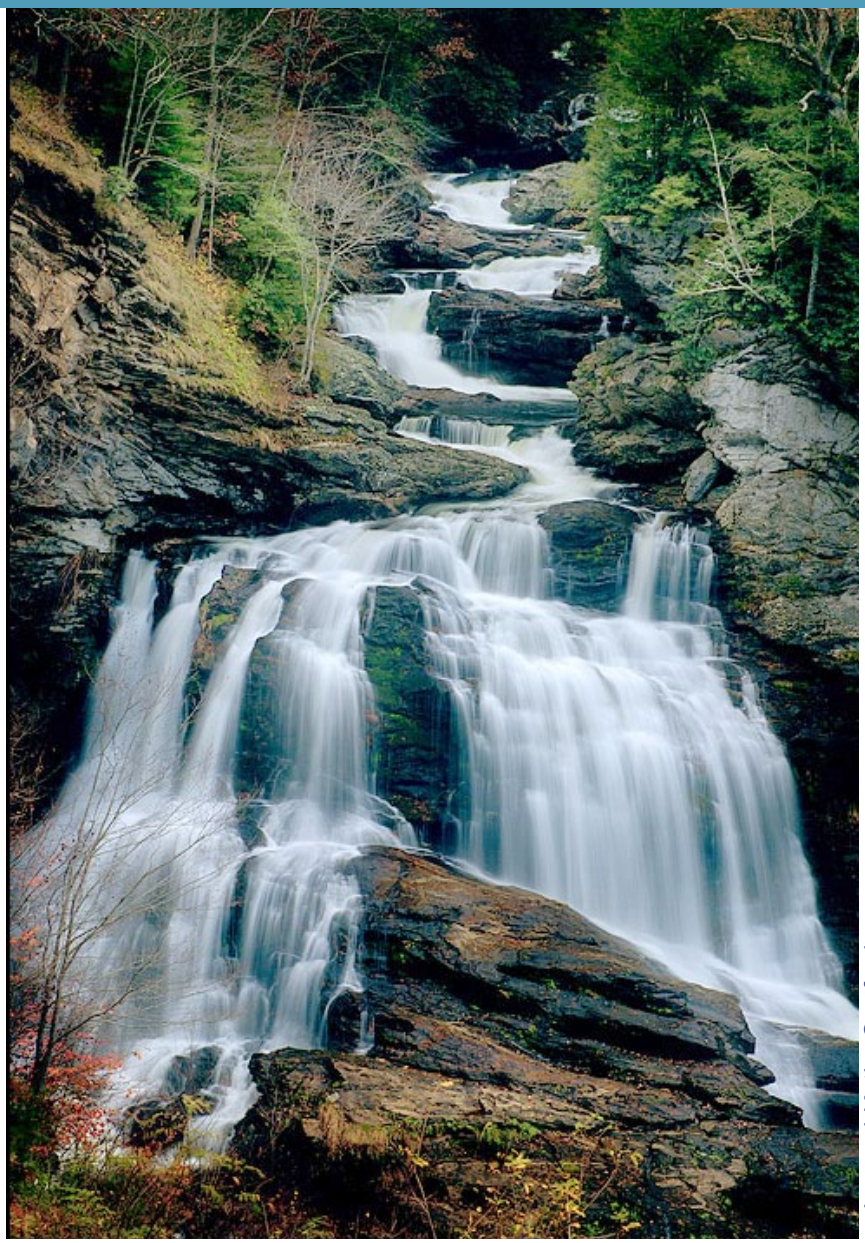
However, in the ensuing years, residential development began to displace agriculture in the upper Middle Creek watershed. While nothing disastrous has occurred, we note a moderate increase of sediment, particularly in shoreline areas. During 2003-2010, Middle Creek has rated GOOD on 3 occasions and FAIR on 5 (IBI range 39-50).

Skeenah Creek at the NC Welcome Center has only once rated better than FAIR (48 in 1995) but has showed a clear development-related trend within the POOR-FAIR range. With the exception of the odd 1995 number, Skeenah Creek was consistently rated FAIR (IBI range 36-39) over the course of 5 monitoring events between 1994 and 2000. Seven monitoring events during 2001-2007 produced POOR ratings (IBI range 27-36). In each of the 3 years beginning in 2008 the site has once again achieved a FAIR rating (IBI range 39-42). The variation observed corresponds to the construction, not far upstream, of the new South Macon School, with a consequent increase in sediment loads. During the 2 years of active construction. the IBI dropped to a record low of 27, but has been inching upward since. A monitoring site located not far above the construction site scored 36-42 (FAIR) during this period.

The oscillations in biotic integrity shown by Middle and Skeenah Creeks are typical of streams under moderate but chronic stress. The recovery of Skeenah Creek should not necessarily be interpreted to say that these impacts are always reversible. Just as is the case with human health, long term chronic stress can predispose the system to further damage.

The Cullasaja Watershed





Joe and Kathy Sanford

Cullasaja River Gorge

The following paragraph, adapted from our 2002 State of the Streams report, still fairly describes the Cullasaja River watershed:

"The Cullasaja is the largest tributary of the Little Tennessee and is somewhat unique in that it has an urban area (Highlands) at its headwaters. This is reflected in its bioclass rating, which goes from POOR above Highlands and its lakes, to FAIR between Sequoyah Dam and Cullasaja Falls and GOOD in the swiftly flowing reach in and below the Gorge. Over the last few miles before the Cullasaja reaches the Little Tennessee at Franklin, it declines to FAIR and then POOR."

The only change which must be noted is that, after 2003, the bioclass rating of our lowermost monitoring station, located near Macon Middle School, improved to FAIR. However, due to deepening of the channel, we have not been able to carry out fish samples in the lower Cullasaja since 2007.

Again with one worrisome exception, the health of Cullasaja tributaries has also remained stable. That exception is **Ellijay Creek**, by far the Cullasaja's largest tributary, which rated GOOD when monitored in 1991 and 1998 (IBI's of 47 and 52, respectively), has rated only FAIR (IBI 39 to 47) on the past four occasions since 2003. This would appear to reflect development pressure in the upper reaches, including channelization of a significant stretch. The main headwater tributary of Ellijay Creek, known as the **North Prong**, and **Ellijay Creek above the North Prong** both scored IBI's of 53 (GOOD), which accurately reflects the condition of the upper watershed.

The only Cullasaja tributaries located below Cullasaja Falls and the Highlands Plateau for which we have IBI results since 2002 are the other two largest ones (Walnut Creek and Buck Creek) and the much smaller Peeks Creek, which has achieved an unwelcome degree of fame since our last State of the Streams report.

Although **Walnut Creek** is subject to development pressure in the watershed, and suffered the effects of a small dam blowout, it has continued to rate GOOD (IBI of 53 in 1999 and again in 2009). While considerable quantities of new sediment were evident in pools, apparently the unusually high gradient of Walnut Creek provides enough flushing to maintain healthy rainbow trout and sculpin populations, and a diverse macroinvertebrate assemblage. On the other hand, lower **Buck**

Peeks Creek

In September, 2004 a slope failure in the headwater area of Peeks Creek, on National Forest lands, unleashed a mudslide which destroyed 15 homes, killing 5 people and injuring more than 24 others.

Along with repairs to Peeks Creek Road, which parallels the creek, and clean-up and salvage efforts to properties along the creek, a modest effort was made to stabilize the stream, through placement of rock (principally in areas where the creek flows close to the road) and hydroseeding.

An ambitious and expensive restoration proposal came to naught, which presented us with the opportunity to document the natural recovery of Peeks Creek, beginning with the 2005 season. The only fish present that year were fingerling rainbow trout, which typically disperse into small streams seeking nursery habitat. With time we have seen steady improvement in several areas:

- The amount of loose sand in the stream is visibly diminished,
- Natural vegetation is beginning to provide some shade as well as nutrients.
- Over the years, size distribution of rainbow trout has improved. As of 2010, our monitoring site in the lower reaches contains a few “catchable” size individuals (up to 10 inches long).
- The macroinvertebrate assemblage has improved, as more sensitive species find suitable habitat.

Unfortunately, our pre-2005 fish inventory data for Peeks Creek is incomplete, but we have observed a heartening increase in fish diversity since that year. In 2007 we observed the first “new” species (longnose dace, formerly a dominant species). Discounting isolated individuals, we consider that 2 more species were reestablished by 2008, another one in 2009 and in 2010 – with the return of the mottled sculpin and fingerling brown trout– there appears to be a complete pre-flood fish assemblage. In 2010 Peeks Creek received it’s first GOOD bioclass rating (IBI 51).

We confess we felt a twinge of guilt going into the Peeks Creek disaster area in 2005 to evaluate biodiversity and ecosystem health, when the residents were still traumatized by loss of life and property, and busy dealing with the aftermath. Since the beginning, however, our annual monitoring has drawn positive attention. Nowhere else in the upper Little Tennessee watershed do we receive so many spontaneous visits from people offering encouragement and hoping for good news. For us, Peeks Creek has come to symbolize resilience – of our southern Appalachian streams, but also of our people.

USGS

Peeks Creek

Mill Creek

Mill Creek (not to be confused with Mill Creek in the Cartoogechaye Creek watershed), arises within the urban boundaries of the Town of Highlands and is impacted by many stresses typical of an urban stream.

We first monitored Mill Creek in 1991 for macroinvertebrates only, at a site located not far downstream of Highlands Waste Water Treatment Plant. The appearance of the site was deceiving. While not far upstream, above Maple St., the riparian area of Mill Creek is intensely urbanized, here it flows through a wooded gorge, with picturesque cascades over intermittent bedrock ledges.

Even prior to taking the sample, any illusions were shattered by the odor. The macroinvertebrate sample was dominated by a tiny crustacean known as a scud (*Crangonyx*) and a variety of Chironomid midges. Both are strong negative water quality indicators, considered to be among the most pollution-resistant aquatic organisms. (This is the only site in the upper Little Tennessee watershed where we have ever seen *Crangonyx*). At the time we also took a macroinvertebrate sample above the plant. While the results were POOR, reflecting urban impacts, the stream was clearly healthier above the plant.

We finally carried out a combined fish/ macroinvertebrate IBI in 1999, soon after the Mill Creek WWTP was mothballed. Crangonyx was nearly gone and had disappeared by the time of the following sample, in 2005. Since then we have revisited the site 3 times. In 2005 IBI was up to 30 and in 2009 it scored 35 (still POOR). A 2010 fish sample suggests still further improvement. We are particularly impressed by the steady decline in the proportion of pollution tolerant fish in the sample.

LTWA

Mill Creek in Highlands

Clearly, Mill Creek remains in a process of recovery. Our optimism about Mill Creek is tempered by one observation not directly related to pollution issues: In 1999, we discovered populations of two exotic species, rosyside dace and bluehead chub, both native to Atlantic drainages, in Mill Creek. These 2 species have comprised over 2/3 of the fish sample in every year we have monitored. While we have no indication that rosyside dace have made it through Mirror Lake to spread beyond Mill Creek, we now routinely record bluehead chubs in the Cullasaja as far down as the top of Cullasaja Falls. Both species are a threat to hybridize with native species.

In 2005, we discovered an established population of the mottled sculpin in Mill Creek. While sculpins are native, and often dominant, in streams in the rest of the watershed, this was our first record of sculpins on the Highlands Plateau. This indicates that intentional or accidental introductions of potentially invasive exotic fishes continue to occur on the Plateau, to the probable detriment of our native fauna.

LTWA

Cullasaja River downstream of the gorge at Peaceful Cove Road.

Creek continues to surprise by maintaining only a FAIR bioclass rating (IBI of 42 in 2005.).

The only negative note from the middle Cullasaja itself is that the wounded darter, a highly sensitive, regional endemic fish species, continues to barely hang on at our fixed station site at Peaceful Cove. Otherwise, the middle Cullasaja continues to be a bright spot, with GOOD bioclass ratings in 6 of the last 7 years (IBI range 45-54). While this rating undoubtedly reflects on riparian and watershed conditions between Franklin and the Cullasaja Gorge, the health of and prospects for the Cullasaja River cannot be discussed intelligently without factoring in the complex situation above Cullasaja Falls, on the Highlands Plateau.

The Cullasaja River itself, between Sequoyah Dam in Highlands and the Gorge is so atypical as to resist rating – there is virtually no other river of this size, at this elevation above barrier falls, to which it can be compared. Moreover, the fish assemblage in the Cullasaja watershed above Cullasaja Falls bears almost no resemblance to the natural condition. The maximum number of fish species native to the Highlands Plateau would appear to be 4, and we have secure documentation for only one (brook trout). However, since 1990 we have documented the presence of many additional, non-native species. Occasional fish and macroinvertebrate sampling at a station not far above Dry Falls and another just above Cullasaja Falls suggest FAIR to GOOD conditions, with improvement as the river moves downstream, picking up water from high quality tributaries. Except for **Mill Creek**, the only one of these streams we have monitored since 2002 is **Turtle Pond Creek**, which maintains a GOOD bioclass rating, with IBI's of 47-48, despite increasing development pressure in its watershed.

An important positive factor on the Plateau is the high proportion of National Forest and other protected lands. An often overlooked negative factor is the abundance of artificial lakes and ponds, ranging from Sequoyah Reservoir to tiny golf course ponds. In addition to blocking up and downstream movement by migratory fauna, each of these dams increases evaporation loss and functions as a solar water heater. The result is elevated temperatures

in the Cullasaja below Highlands, particularly in the reach above Dry Falls, which does not support trout on a year-round basis.

However, undoubtedly the most unique aspect of the Cullasaja watershed is the presence of an urban area (Highlands) at the very top of the watershed, a fact which inevitably impacts everything downstream. While Highlands differs from most urban areas in having producing very little industrial pollution, this is perhaps offset by the unusually large area devoted to golf courses. Apart from these differences, Highlands is totally typical in its production of human waste and in the large area of impervious surface which comes with urbanization.

The question of human waste disposal was a hot-button issue in Highlands during the 90's, when it stimulated a controversy which was, in our view, notable for a lack of consistent attention to facts on all sides. Since the problem has been successfully resolved, it may be time to retell the story, in the hope that it can contribute to rational discussion of future waste water treatment issues which are sure to arise somewhere in the watershed.

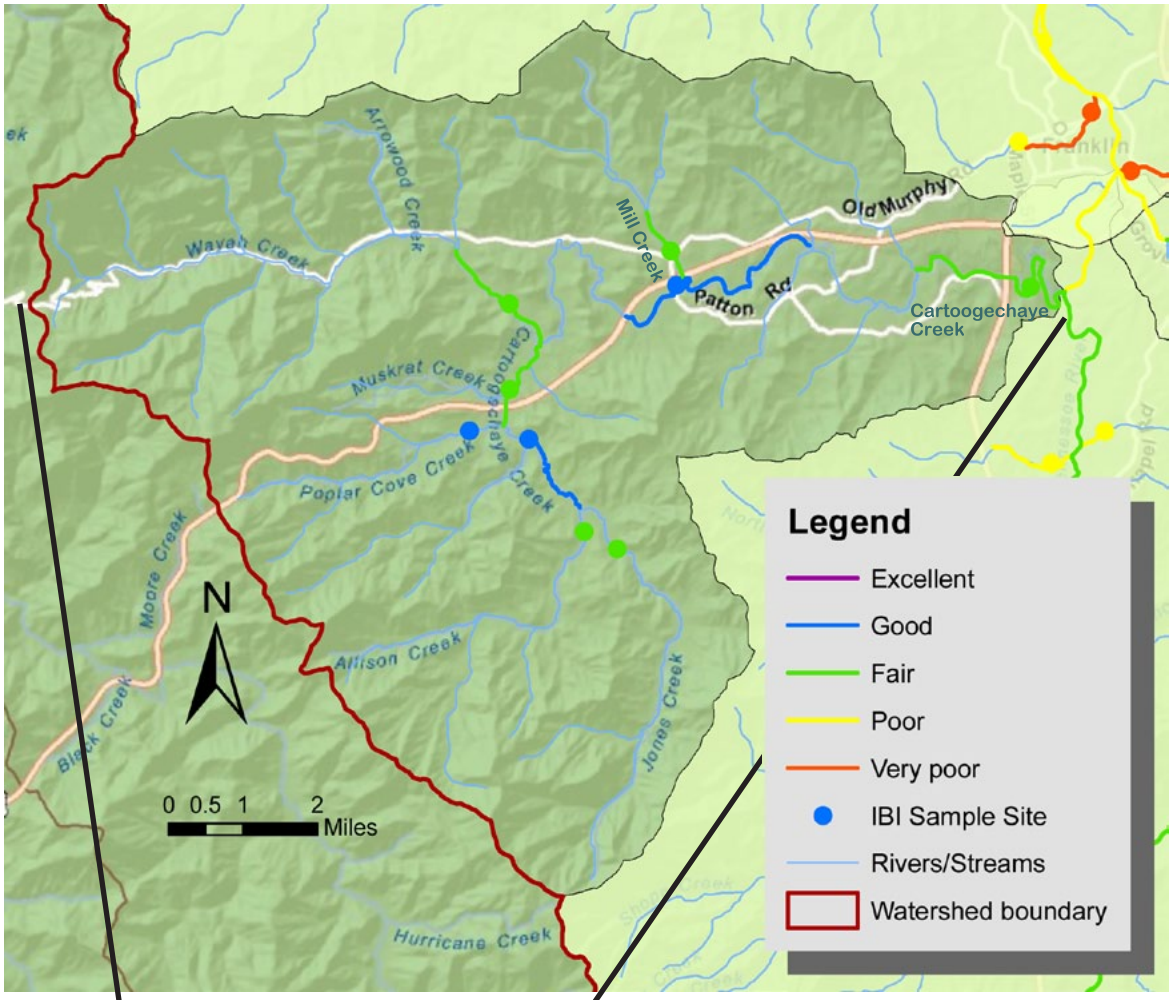
Prior to 1995, Highlands' municipal waste water treatment plant (WWTP) discharged into Mill Creek in town, just above Mirror Lake. The biological consequences were disastrous, since the receiving stream was far too small to assimilate the amount of waste produced by the town. The Cullasaja River downstream was buffered by the presence of Mirror Lake and, below it, Sequoyah Reservoir, both of which served the unintended purpose of providing another level of treatment for effluent from the WWTP. This was understandably not a popular idea with property owners along the two impoundments.

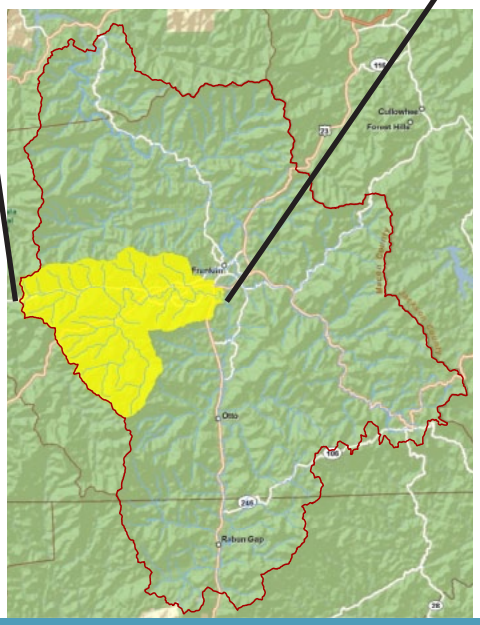
The proposed solution was to build a new treatment plant, to discharge directly to the Cullasaja River just below Sequoyah Dam. The overheated controversy which ensued quickly degenerated into a round of mutual recriminations between Highlands and the State on one hand, and the downstream neighbor, Franklin, aided by conservation advocacy groups, on the other. The reasonable concerns of both sides went right over most people's heads and the plant was built, going online in 1995. The old WWTP on Mill Creek was phased out.

While there was a minor dip in IBI at the downstream Peaceful Cove site during 2000-2004 (while still maintaining a GOOD bioclass rating) there is no way to know if this has any relation to the new WWTP and/or the growth of the Highlands urban area during that time. What the data do suggest is that the tertiary treatment function formerly provided by the lakes was now being supplied through aeration as the Cullasaja passes over the extremely turbulent reach, with 2 major waterfalls, between Highlands and the Cullasaja Gorge.

More recently, the Town of Highlands, to its credit, switched to a non-chlorine based disinfection system at the new WWTP. The present situation is as good as can be hoped for under present regulations and available technology. The effects on rivers of urban areas, and their waste water treatment plants, are always a concern, and that concern will not go away in the case of the major biodiversity, recreational and esthetic resource that is the Cullasaja River. However, our data taken as a whole, and the story just recounted suggest that the people of the upper Little Tennessee watershed will continue to be capable of finding ways to alleviate that concern.

The Cartoogechaye Watershed





Cartoogechaye Creek is the second largest tributary to the Little Tennessee above Fontana (watershed area 58 sq. mi.) and the source of the Town of Franklin's drinking water. Biotic Integrity trends over the period 1990-2010 show what appears to be a slight downward trend almost throughout. The clearest example is provided by IBI results from our Fixed Station at the Veterans Memorial Park in Franklin. With a single exception in 1998 IBI at the Park during 1990-2000 was in the range of 45-50, with 8 GOOD and 2 FAIR Bioclass Ratings. But from 2001-2009 all 9 monitoring events yielded FAIR Bioclass Ratings (scores of 36-47).

This result could perhaps be ascribed to the long term effects of urbanization. In a four mile stretch past the Franklin drinking water treatment, Cartoogechaye Creek passes through the Macon Country Industrial Park, by a quarry, through areas of suburban population density, followed by an area dominated by parking lots and under a 4 lane highway, receiving effluent from at least one package waste water treatment plant along the way.

However, trends at 2 sites above the water treatment plant are similar, with a gradual drift from GOOD Bioclass Ratings (IBI's of 50-52) to FAIR (45-47). The Killian Farm results are particularly discouraging since it was the site, during 1995-1996 of a major restoration effort, which resulted in improved bank stability and increased habitat for trout, but no measurable effect on biotic integrity.

We detect what appears to be an opposite trend at our uppermost Cartoogechaye Creek site, located at Cartoogechaye Baptist Church. This site, which rated FAIR (IBI range 41-44) on 3 occasions during 1991-2001, scored 47 (GOOD) when monitored in 2007. This may reflect decreased use of the riparian zone by cattle and an increase in riparian vegetative cover. This trend is the opposite of that observed over most of the rest of the watershed.

Allison and **Jones Creeks**, which join to form Cartoogechaye Creek, both oscillate unpredictably between FAIR and GOOD (IBI range 39-48). Both rated FAIR when last monitored in 2007. Both streams suffer from cattle access in their lower reaches.

Similarly, **Mill Creek** (not to be confused with Mill Creek in Highlands) has oscillated between 33 (POOR) and 39 (FAIR) during 5 monitoring events between 1999 and 2009. One of the factors historically contributing to low biotic integrity in Mill Creek has been the Mill Creek Club, which accounts for 272 acres of the upper watershed, including a golf course and related facilities and several ponds. The Mill Creek Club has recently come under new management; the new owner professes an interest in enhancing the quality of the creek, on and below the property, through means such as restoration of riparian vegetation and better pond management.

Poplar Cove Creek remains perched on the margin between FAIR and GOOD (IBIs of 45-46).

LTWA

An example of blackspot.

Wayah Creek consistently scores FAIR, contrary to what was expected when the LBJ Job Corps Waste Water Treatment Plant went off line in 1999. Since then several pollution-sensitive species of fish have returned to the lower reaches, which has very good physical habitat. However, the trophic structure of the fish assemblage remains more like that of a polluted stream.

The stream to which we refer to as **K-Mart Branch** surfaces on the Franklin Golf Course, is then piped under the 4-lane US 64 and into the Westgate shopping center, where it is

LTWA

Cartoogechaye Creek at Veterans Memorial Park just before entering the Little Tennessee River

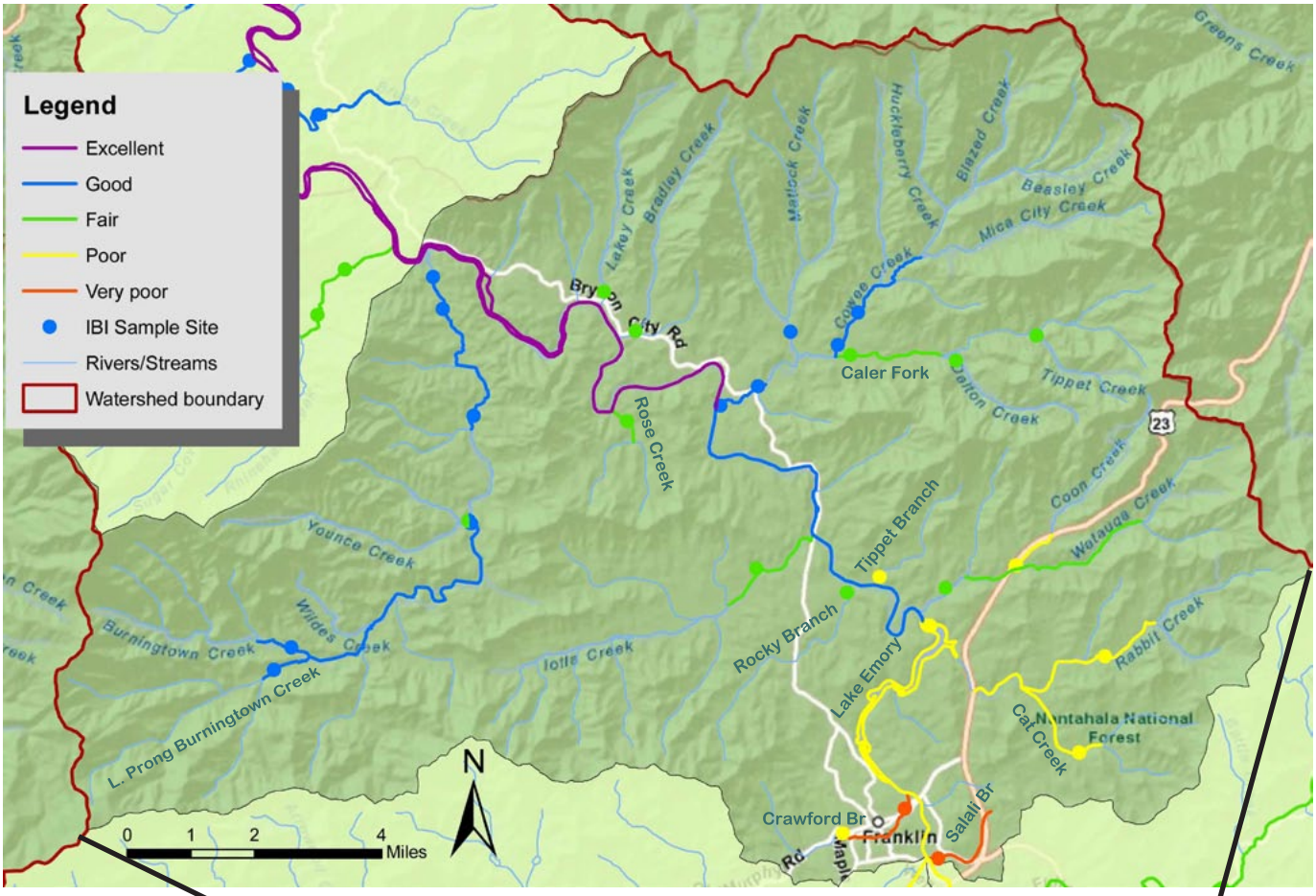
barely recognizable as part of a settling pond designed to filter pollutants from the huge surrounding paved area. K-mart Branch yielded 12 species of fish. Over half of the fish were of non-native and/or pollution-tolerant species. This is in some respects worse than our most notorious urban stream, Crawford Branch in downtown Franklin, and fully merits a bioclass rating of Very Poor. K-Mart Branch and Crawford Branch are just two among several examples of what are called “urban streams” – streams overwhelmed by pavement, culverts, channelization, pollution, trash , and neglect.

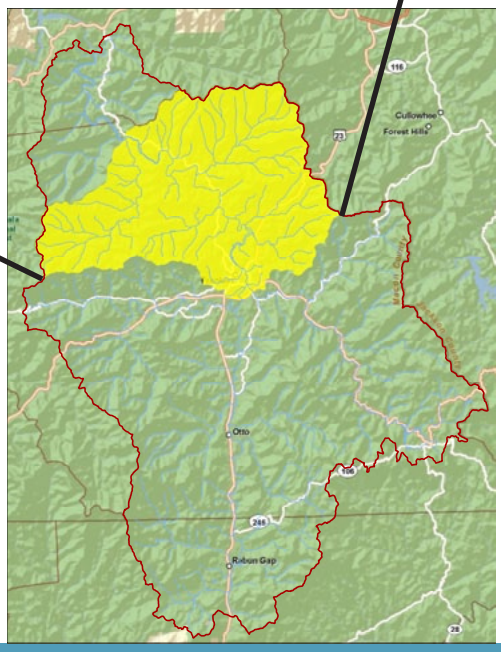
One factor lowering IBI scores in the Cartoogechaye Creek watershed generally is a consistently high incidence of disease and parasites in fish – sometimes more than 10% of our sample. The 2009 season saw a resurgence in Cartoogechaye Creek of a form of blackspot parasite we had observed before, but which had largely disappeared after 2003. While normal blackspot takes the form of small, flat round black cysts, this form (which we have not seen in any other part of the Little Tennessee watershed) are larger, swollen and irregularly shaped.

The reader interested in more detail on the Cartoogechaye Creek watershed is referred to the “Cartoogechaye Creek Municipal Watershed Assessment” published by the Little Tennessee Watershed Association in 2008 for presentation to the Town of Franklin. It offers maps and detailed analysis of not only biomonitoring results, but land use, riparian buffer condition, livestock access and special problems along the mainstem of Cartoogechaye Creek and the lower reaches of its major tributaries in the Municipal Watershed upstream of the Franklin Water Treatment Plant.

While acknowledging that water quality from the point of view of potable water supply is not the same thing as good water and habitat quality for the maintenance of biological integrity and biodiversity, there are broad overlaps. Our results suggest that the Franklin Municipal Watershed is not adequately protected.

Franklin to Burningtown





Lake Emory and Urban Streams

Although the sign on the Henson Bridge in downtown Franklin says “Little Tennessee River”, and it is indeed the waters of the Little Tennessee which pass beneath it, this reach, paralleled by the Franklin Greenway, cannot be considered as part of the “natural” Little Tennessee River. A dam dating to 1925, located about 3 miles downstream, and variously known as the Porters Bend, Franklin or Emory Dam, causes widening of the river for less than a mile upstream, but backs the river up, obliterating the natural shoals, for more than 4 miles, to a point not far above the mouth of the Cullasaja River. From a biological perspective, all of this reach should be known as Lake Emory. Loss of shoal habitat, combined with 85 years’ accumulation of sediment from the upper watershed, plus pollution originating in the Franklin urban area combine to make this biologically the poorest portion of the mainstem. When last monitored, in 2005, it received a POOR rating (IBI 30), which actually suggests a moderate improvement over pre-2003 results.

Lake Emory Dam

In recent years, the future of Lake Emory has been questioned, and the possibility of dam removal (as was done with the nearby Dillsboro Dam on the Tuckaseigee River) has been raised. Lake Emory is a portion of the Little Tennessee which both biologists and recreational users like to ignore. However it has the potential to play a pivotal role in determining the future of our river.

Arguments in favor:

- The amount of electrical power generated is insignificant by its present owner (Duke Energy).
- Despite limited value as a fishery resource for some, it is also considered an eyesore and mosquito breeding ground by many.
- Removal of the dam would restore over 4 miles of natural river habitat, reestablishing biological connectivity from Fontana Reservoir to the headwaters 53 miles upstream in Rabun Gap, Georgia.

There are also arguments against dam removal:

- In the past Lake Emory has served to trap excess sediments originating in southern Macon and northern Rabun Counties, thus protecting the river downstream.
- Lake Emory presently serves as an unintentional treatment facility for the Franklin Waste Water Treatment Plant, which discharges directly to the reservoir.
- Perhaps of greatest concern, we do not know what lies buried in deep sediments in Lake Emory. We do know that prior to enactment of the Federal Clean Water Act in 1972, industrial pollution was severe in the vicinity of Rabun Gap-Dillard, Georgia. The possibility exists that draining of Lake Emory, or dredging prior to draining, would release toxic substances to the detriment of the river downstream.

LTWA

Looking at the dam below Lake Emory.

Putative improvement is offset by an unexpected drop in the condition of the river just above the upper limit of impoundment of Lake Emory, between the mouths of Cartoogechaye Creek and the Cullasaja River. This site which had rated consistently FAIR (IBI's of 38-42) from 1997 through 2007, took a sudden drop to 34 (POOR) in 2008 and 32 in 2010. This is presumably due to erosive activity causing the loss of the only riffle in this reach of the river. At present, the upstream reach seems to be improving while biotic integrity downstream of Franklin remains high. A tentative positive trend over the last 2 years is an unanticipated drop in the invasive exotic yellowfin shiner abundance.

The condition of Lake Emory is not improved by any of three tributaries we have monitored:

The largest Lake Emory tributary, **Rabbit Creek**, lies outside of the Franklin urban area and drains the Holly Springs Community. Bioclass ratings at a fixed station we have maintained for 21 years on Rabbit Creek have generally been POOR, with a brief rise into the FAIR range during 1997-2000. Three other less frequently visited stations on Rabbit Creek within the settled area, have given similar results; a site near the upper end of Holly Springs proper scored 36 (POOR) in 2004. Holly Springs has one of the longest histories of development of any watershed area in Macon County, beginning as an agricultural center. Its history, recounted in our 2002 report, is one of barely beginning recovery from one set of impacts when it is hit by another.

An early impact, which we may never be able to evaluate, was the construction of Lake Emory, which impounds the lower half mile of its course. Rabbit Creek is the only tributary with a watershed area of greater than 7 sq. mi. where we have never taken any species of darter. Our hypothesis is that they may have been wiped out by an early extreme sedimentation episode and, lacking access to the free flowing portion of the river, were never able to repopulate.

The most recent changes to Rabbit Creek include the replacement, in 2009, of a bridge on Rabbit Creek Road by channelizing and entubing the stream at the old bridge site, and changing agriculture practices of an 85 acre farm along the lowermost reaches of Cat Creek, Rabbit Creek's main tributary.

LTWA

Stream alteration along Rabbit Creek

The history of **Cat Creek** parallels that of Rabbit Creek, and it has received similar POOR ratings (IBI 33) as recently as 2009 at a monitoring station on the lower reaches. An 85 acre farm which extends along both banks of Cat Creek maintains no riparian buffer beyond grass, and replaces an unfenced pasture area where the same condition held true. Until late 2009, this farm was dedicated to chemical-intensive production of tomatoes, but has now switched to blackberries, a much less chemically demanding crop.

Cat Creek is presently the site of two restoration projects, one with a wetland component immediately above the tomato farm, and the other not far upstream on a private farm where historic channelization and cattle access have been problems. IBI (33.0) and bioclass rating (POOR) are identical for the last 3 years of monitoring at this site (2008-2010) as are scores for all individual fish metrics.

Crawford Branch, Franklin's quintessential urban stream, has been monitored on 21 occasions, at 4 different sites during 1995-

2010. The most frequently monitored site, between the 2 lanes of Main Street in downtown Franklin, has consistently scored VERY POOR (IBI range 12-24). The other 3 sites have occasionally achieved a POOR rating, but are also characteristically VERY POOR. A small improvement in Crawford Branch may have occurred in 2009, when a previously diverted, underground section was daylighted. However, development still persists near the Frogtown area, adding more stressors to the stream. This reach of Crawford Branch is notoriously "flashy" and causes occasional flooding episodes in downtown Franklin.

In 2003, we monitored another urban stream, **Salali Branch**. Originating near US Highway 441, Salali Branch crosses Highlands Rd. and receives the run-off from a major shopping center before entering Lake Emory, at the Salali Greenway access. Compared to Crawford Branch, it is more difficult to conceive of a partial restoration strategy for Salali Branch, which received an IBI of 21 (VERY POOR).

Below Lake Emory

The character of the river changes dramatically below Lake Emory, where it develops a higher gradient, wider channel and lower human population density. This is the point at which it becomes the Little Tennessee River famed for high biotic integrity, scenic beauty and smallmouth bass fishing. While this reach lacks the wilderness character of the downstream "Needmore Tract" reach it has the same high species diversity and populations of sensitive and protected species such as the spotfin chub, sicklefin redhorse, olive darter and Appalachian elktoe mussel. Both reaches have very nearly a full complement of all the native fish species which "should" be there. And it also continues to produce IBI scores in the GOOD to EXCELLENT range (54 at Iotla Bridge and 58 at Dean Island in 2009).

This reach receives the waters of the 3rd and 4th largest tributaries to the upper Little Tennessee. Burningtown Creek (watershed area 27 sq. mi.) defines the upstream boundary of the Needmore Game Lands (see following section) and drains a rural area which is still relatively lightly populated. Cowee Creek drains a more populated valley. Both of these streams have historically rated higher than smaller tributaries to this reach of the river, possibly due to the high percentage of National Forest in their upper watersheds, and that trend continued after 2002.

We monitored **Burningtown Creek** on 7 occasions at 5 sites spread over about 9 miles of stream during 2003-2009, and it always rated at least GOOD (IBI range 47-58), as did its principal tributary, known as **Left Prong Burningtown** (IBI 54). One other tributary,

Ralph Preston

Burningtown Creek

Younce Creek, rated only FAIR (IBI 42), but in general we can state that the Burningtown Creek watershed is outstandingly healthy as compared to normal expectations for a watershed of its size.

During the period 2003-2009 **Cowee Creek**, at its mouth, consistently rated GOOD (IBI range 50-55), with one EXCELLENT score (58) in 2004. These results continue to seem exaggeratedly high to us, but this condition has held since 1997. Cowee Creek above its largest tributary, Caler Fork, scored 47 (GOOD) in 2010, and the second largest tributary, ***Matlock Creek***, also rated 51 (GOOD) that same year. These results are in line with what we have generally found throughout the Cowee Creek watershed, with an apparent trend toward improvement after 2002. However, beginning in 2005-2006, the Caler Fork subwatershed became a dramatic exception to the trend.

LTWA

Cowee Creek at the West's Mill District.

Caler Fork has historically been the home of the Cowee Valley gem mining industry. This tourist-oriented activity has historically produced exaggerated sediment loads. However, since the mid-1990's, most of the mines have closed, and Caler Fork was undergoing a process of self-restoration until the fall of 2005, when construction began on Wildflower, a planned 1,200 acre megadevelopment on steep slopes in the upper watershed of Caler Fork and its tributaries Dalton Creek and Tippet Creek. As of 2010, Wildflower may be classified as a failure, with one occupied house and a slowly failing road system.

Between 2005 and 2006, Caler Fork registered the single largest one year drop in IBI that we have ever recorded – from 50 (GOOD) in 2005 to 33 (POOR) in 2006. The cause was clear – massive sedimentation due to road and house site development on the Wildflower property. On June 29, when we stepped into Caler Fork to execute the 2006 IBI sample, the stream was so turbid we could not see bottom in knee deep water, although it had not rained recently.

New sediment deposition was also evident in Dalton and Tippet Creeks. At Tippet Creek there were heavy sand deposits in the wooded riparian area at up to 20 ft. from the creek. In **Dalton Creek** almost all pool habitat had been at least temporarily lost to sedimentation but rated GOOD in 2008. Fish inventories showed that rainbow trout had been virtually eliminated from Tippet Creek and at both sites all fish species were represented almost exclusively by large adults, suggesting reproductive failure. Caler Fork above the mouth of Tippet Creek at that time lay outside the Wildflower construction area, and none of these effects were noted there.

In 2007 and 2008, Caler Fork returned to its former GOOD condition (IBI's of 47 and 50) but with an altered fish assemblage. On the positive side, this demonstrates the resilience of our mountain streams, which appear to be adapted to process occasional heavy sediment loads generated by extreme storm events. Apparently, the Wildflower-associated event mimicked a severe storm in some respects. The bad news is that the untended road network and vacant house sites in Wildflower continue to bleed sediment into the Caler Fork system as we saw when the 2010 sample yielded a FAIR condition. Experience shows (see Iotla Creek below) that chronic small sediment inputs have permanent negative effects on streams over time.

LTWA flight provided by Southwings.

Poor planning and development practices in Wildflower have resulted in sedimentation in nearby streams and landslides.

Medium and small size tributaries to the Little Tennessee between Lake Emory and Burningtown Creek show more effects of human impacts:

• **Tippet Branch** (not to be confused with Tippet Creek, which forms part of the Cowee Creek watershed) scored 33 (POOR) when monitored in 2009, similar to earlier results. However, it should be noted that efforts by a single landowner to improve riparian conditions have contributed to development of better pool habitat, and we are observing changes in species composition which may presage a significant improvement in ecosystem health.

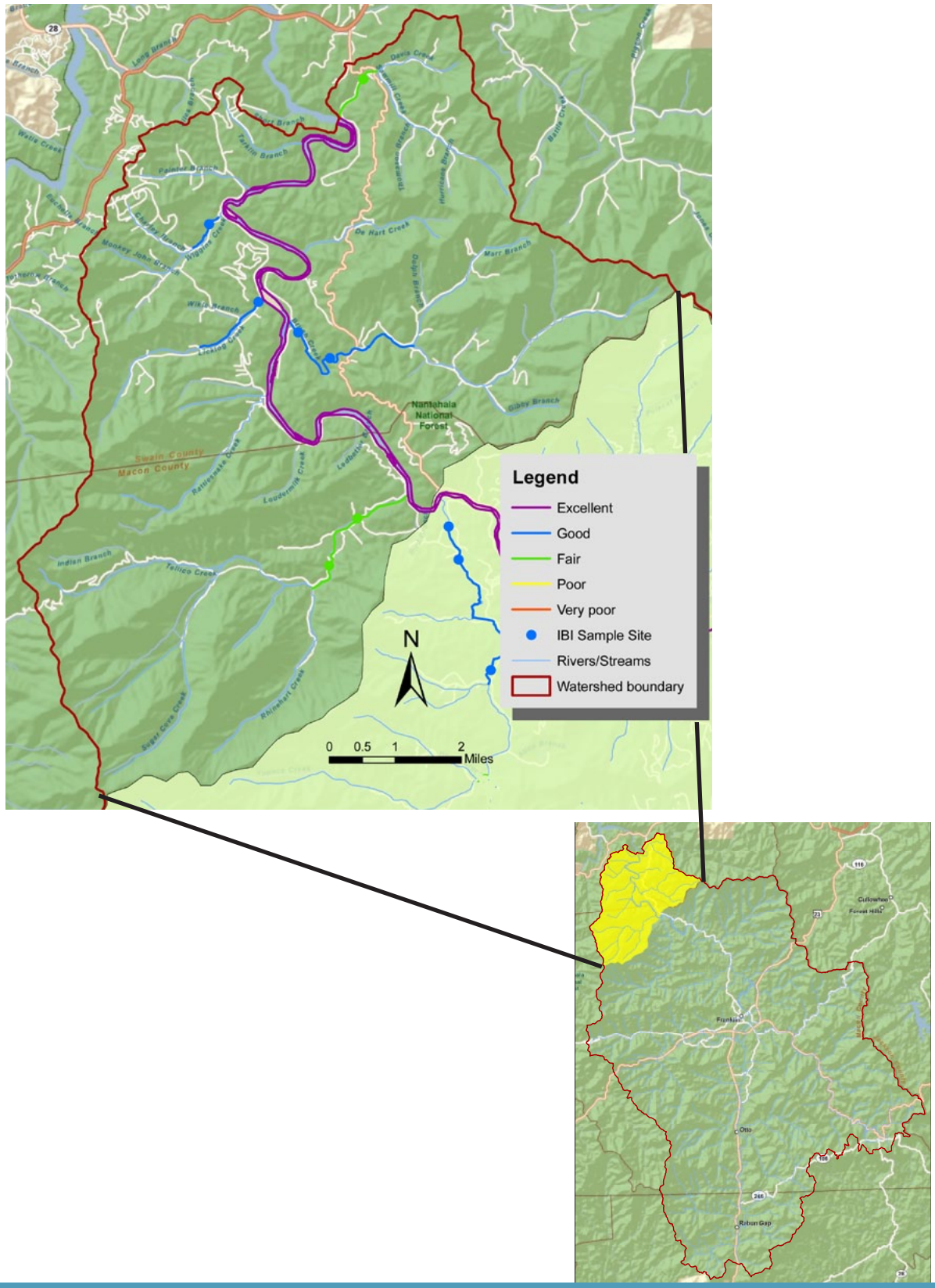
• Another small tributary, **Rose Creek**, located in a more rural area, received an IBI of 47(FAIR).

• **Iotla Creek** serves to demonstrate the cumulative effect of chronic sedimentation. The Iotla Valley has the longest history of settlement of any portion of Macon County, and is also the site of the Macon County Airport. In our previous report we cited VERY POOR and POOR conditions in Iotla Creek. Based on a cautious interpretation of two monitoring results from the present report period (IBI of 39 in 2004 and 47 in 2006 -both considered FAIR), there may be continuing improvement.

Without a doubt the most interesting small to medium sized tributary to the river between Lake Emory and Burningtown during this report period was **Watauga Creek**.

IBI scores and bioclass ratings (FAIR, with IBI's of 41-47 along the mainstem, and 38 – POOR in its heavily impacted tributary **Coon Creek**) do not tell the story. See Restoration box in Progress Section.

Needmore


Legend
Excellent
Good
Fair
Poor
Very poor
IBI Sample Site
Rivers/Streams
Watershed boundary
N
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Miles
Nantahala National Forest
Swain County
Macon County
Long Branch
Davis Creek
Wallis Creek
Tessie Branch
Palmer Branch
Monkey John Branch
Wilkie Branch
Licklog Creek
De Hart Creek
Marr Branch
Gibby Branch
Rattlesnake Creek
Laurelmill Creek
Indian Branch
Tellico Creek
Rhinehart Creek
Sugar Cove Creek
Franklin
Otto
Robbinsville

Since 2002, what was formerly known as the Needmore Tract, along 13 miles of the Little Tennessee mainstem from the mouth of Burningtown Creek to Fontana Reservoir, has come fully under the management of the NC Wildlife Resources Commission, and is formally known as the Needmore Game Lands. As a consequence of a perhaps unfortunate but necessary prohibition on camping, the trash and garbage problem along the reaches of Needmore Road which parallel the river has gone from enormous to minuscule. On the other hand, protection brings attention and the Needmore area now receives much heavier recreational use, including fishing pressure.

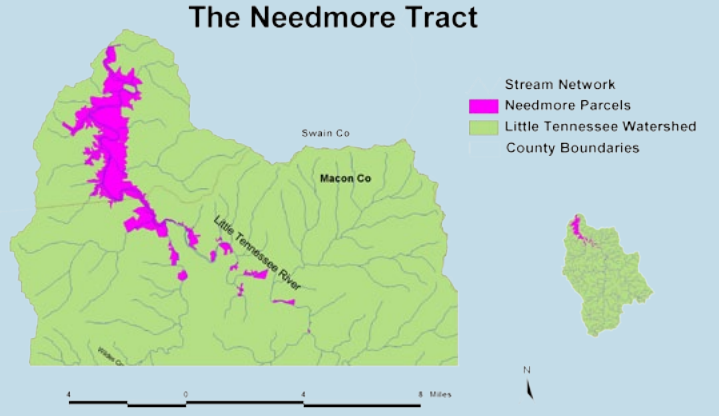
Nevertheless, although IBI on the mainstem at Needmore showed a slight dip between 2002 and 2006, it rebounded after the extreme weather of 2005-2006 and once again rates as EXCELLENT. Of three tributaries to the river in the Needmore Reach, **Licklog Creek** rated GOOD (IBI 49) in 1995, dipped to FAIR (IBI 45) in 2005, but recovered to GOOD (50) in 2006. **Brush Creek** also dipped into the FAIR range (IBI 44) in 2005, but bounced back to 47 after the big storm.

However, **Tellico Creek**, the largest tributary to the Needmore Reach is of great concern. During 1990-2002 IBI at several sites along Tellico Creek ranged between 52 and 55 (GOOD). Like the other two tributaries cited its biotic integrity declined in 2004 (IBI 47, FAIR-GOOD) but recovered to 55 (GOOD) in 2006. However, the next time we visited Tellico Creek, in 2010, IBI had dropped catastrophically, to 39, on the low side of the FAIR bioclass category. Effects observed included:

- A low total number of fish, with absence or extreme scarcity of young individuals of most species.

- A huge reduction in number of sculpins, normally the most abundant fish in our rocky streams. (We had noticed this trend as early as 2004, but failed to connect it to the larger picture).

The Needmore Game Lands



created by Carla Norwood

- Decline in abundance of darters, with disappearance of the endemic Tuckasegee darter.

- Scarcity of shiners in the pools.

- Replacement of insectivores by more adaptable omnivorous fish.

- Decline in numbers of 3 pollution-sensitive species (smoky dace, telescope shiner and gilt darter).

- An unusual amount of filamentous green algae for such a heavily shaded stream.

The source of the problem was suggested later in the year when a crew from the NC Department of Natural Resources, in response to our results, carried out water quality and macroinvertebrate samples below a trout farm which discharges to the creek. Not only did they document severe impacts to the stream, they happened to be present when a large quantity of water contaminated with fish remains, feces and food waste was discharged. We trust that these findings will lead to corrective action.

So far the problems of Tellico Creek do not seem to have affected the two high profile sensitive species which inhabit the mainstem in the Needmore area:

The Threatened spotfin chub maintains the strongest of a handful of existing populations in

Ralph Preston

The swinging bridge on the Little Tennessee River in the Needmore Game Lands

the Little Tennessee below Franklin, principally in the Needmore area. In 2007, around the time the NC Wildlife Resources Commission commenced annual population monitoring of this species, it was considered to be undergoing an alarming decline, a conclusion supported by unusually low numbers observed ascending tributary streams in the fall of 2006. However, the population bounced back in 2008 and 2009, with a strong cohort of younger fish.

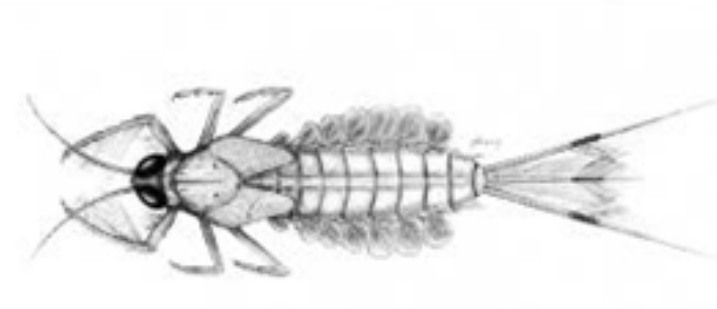
Over the same period, the Endangered Appalachian elktoe mussel has undergone a severe decline at a monitoring site in the Needmore area below Tellico Creek, but also at 2 sites further upstream. At the same time, elktoe populations in the neighboring Tuckaseigee River appear to be increasing.

The most recent development potentially affecting the river in the Needmore area is promotion, by the North Carolina DOT of conversion of the Needmore Road, which parallels the river over much of its length in Needmore, to a wide, two-lane, paved highway. Realization of this plan would be detrimental to the river ecosystem and its recreational and esthetic values. In keeping with our mission, the LTWA, along with numerous local organizations, is heavily involved in arguing for alternative approaches to addressing legitimate safety and citizen access concerns along the Needmore Road.

Apart from the esthetic and recreational value of the Needmore area, we can still claim that the river on and above the Needmore Game Lands is unique in the Blue Ridge. Few other large rivers in the upland South can match it for biotic integrity or as a wildlands experience.

Benthic Macroinvertebrates

By: Dave Penrose



Mayfly nymph reprinted from Berner and Pescador (1988).

Benthic macroinvertebrates, predominantly aquatic insects, comprise a large group of organisms that live at least part of their life cycles in or on the bottom of the stream (Klemm et al. 1990). These organisms vary in size with some forms requiring a microscope to be viewed while other individuals are large enough to see with the naked eye. Another definition is that benthic macroinvertebrates are those organisms that can be retained by a U.S. Standard No. 30 sieve. Many benthic macroinvertebrates are immature forms of insects that will emerge to the land and air for a short time to deposit their eggs back to aquatic systems. Aquatic insects are key players in stream ecology because they are important in the diets of many fish species. A very common benthic macroinvertebrate, the mayfly nymph *Isonychia*, is illustrated.

Benthic macroinvertebrates are effective indicators of water quality (Plafkin et al. 1989). Various types of aquatic organisms are found in all aquatic habitats including very small streams and ditches that may contain few, if any, fish. Even the most polluted stream generally has a community of tolerant insects. Benthic macroinvertebrates are also easily and inexpensively collected. Perhaps most importantly is the way these communities react to environmental changes. Sensitive species respond quickly to stress, while community shifts are generally more long-term. In addition, benthic macroinvertebrate communities respond to the various types of water pollution in predictable fashions (Hocutt 1975). Unstressed streams will support greater diversity and biological integrity than polluted streams, and as water pollution is introduced into a stream system, intolerant taxa (e.g., mayflies, stoneflies and some caddisflies) disappear and are replaced by tolerant species.

LTWA

Macroinvertebrate sampling

There are numerous approaches to collection of benthic macroinvertebrates, including dip netting, kick seining, Surber sampling, and artificial substrates. All of these methods strive to collect a representative sample of organisms living in the stream. The collection method used by the LTWA volunteers for this program was selected to mimic collection methods used by the NC Division of Water Quality (NCDEHNR 1997). At each site volunteers used a variety of sampling methods including kick nets, sweep nets, and sorting through leaf packs found in the stream. All specimens were then “picked” for debris and preserved in the field, and sent to an expert for identification.

Progress and Accomplishments

Conservation Efforts Since Work Began

A strong commitment to river health has emerged throughout the watershed, based on conventional concepts of natural resource conservation but also on pride in the uniqueness of our biological heritage. For example, in 1999, there were no properties along the Little Tennessee mainstem that were protected for conservation. Today, thanks to the efforts of landowners, and local conservation organizations, and with the support of elected leaders, more than one-third of the entire river corridor is on its way to being managed for conservation.

It would be nice to say that all of the changes over these years have been positive and that the Little Tennessee Watershed Association played a role in all of them. Neither, of course, is true. So what this section hopes to do is partially describe a time period in a dynamic mix of human and natural systems, and place the watershed association's efforts within that context. The appropriate question here is "How well have we (not just the LTWA, but the citizens of our watershed) done over the past 8-9 years in meeting that challenge?" The clearest way to approach answering that question may be by looking separately at various categories of environmental areas of concern from a watershed perspective.

Riparian areas

While discussion continues to swirl around the issue of maintenance and restoration of riparian vegetative buffers and whether they should be mandatory, we are pleased to report that, at least on the Little Tennessee mainstem, the trend is positive. It is easy to overlook change when it comes gradually, but for the long time resident of the area a slow drive along US 441 between Prentiss and the state

Why Riparian Buffers?

Riparian buffers, or streamside vegetation, are critical to maintaining and improving water quality. As we have seen throughout this report, streams with healthy riparian zones are often our cleanest and most vibrant streams. Here are a few ways streams benefit from buffers:

-- Filter pollutants originating on adjacent land
-- Stabilize banks
  • prevent erosion of land
  • prevent sedimentation to the stream
-- Reduce the velocity of flood waters
-- Control temperature through shade
-- Roots, branches, etc. provide important habitat for aquatic animals.
-- Leaf drop drives the food chain
-- Insects falling off overhanging vegetation are another important food source for fish.
-- Provide migration corridors for terrestrial wildlife
-- Esthetic benefits

If you own land along a creek or river, planting trees and deep rooting shrubs along the waterway is one of the most important things you can do for your waterway.

LTWA

A shrub and tree buffer between the road (upper-right) and Caler Fork Creek

line, where the river parallels the road can be both instructive and encouraging. Formerly the view was dominated by high, raw, eroding banks with little vegetation beyond pasture grass and with the river completely exposed to the sun. Today the river is largely obscured from view by a border of trees and shrubs. This reflects the combination of several trends, some of which the LTWA is proud to have had a hand in promoting or executing.

- Stream bank restoration projects carried out principally by the Macon Soil and Water Conservation District.

- Acquisition of conservation easements and properties by the Land Trust for the Little Tennessee. (This effect is particularly evident between Franklin and Burningtown.)

- Tree planting by conservation-minded landowners.

- Natural revegetation reflecting the reversion of pasture and agricultural fields to other uses. We would venture to say that enhancement of riparian buffers is the single most important area of improvement In our watershed during 2002-2010 and represents the most fertile area for continued improvement in the near future.

LTWA

Riparian buffer of river cane along the Little Tennessee

Growth

Looking away from the river for the moment, any outside observer would say that the most visible change in the upper Little Tennessee watershed has been continued growth of population and infrastructure. To ask whether the kinds and amounts of growth we have experienced are good or bad, in social, economic or esthetic terms opens the door to all manner of discussion. This sort of discussion is urgently needed, but way beyond the scope of this publication. What we can say without the slightest fear of contradiction is that anthropogenic change, which more often than not means growth, complicates the task of trying to maintain or even improve ecosystem health and biological integrity.

Restoration

Apart from the bank restoration and stabilization efforts carried out by Soil and Water Conservation Districts, stream restoration was almost unknown in our watershed before 2002. Today, while it has still achieved only a tiny proportion of its potential, stream restoration is an accepted concept, and one in which the Little Tennessee Watershed Association is an active participant, together with government agencies, local contractors and landowners. Completed and ongoing projects on Bradley, Cat and Watauga Creeks, all involving practical benefits to landowners as well as conservation benefits, are clearly visible examples suggesting what we expect will be a major theme of the next edition of this report.

Stream Restoration

In 2009, the Little Tennessee Watershed Association was awarded U.S. Fish and Wildlife Service funds through the Partners for Fish and Wildlife grant program to complete a series of restoration activities on projects designed to improve fish passage on tributary streams in the Little Tennessee River watershed. Some of this money came from the American Recovery and Restoration Act, also known as the “stimulus” bill. Through our biomonitoring activities, we identified three sites where we could make the most efficient use of our funds. The first site is on Watauga Creek, the second is on Bradley Creek and the third is on Tellico Creek, but awaiting landowner approval. Where projects have been completed, migrating fish can now move freely between these streams and the river, habitat has been improved, and sedimentation and erosion have been greatly reduced. Not only have we corrected a significant problems on these streams, but we have also benefitted the local economy by employing local firms and buying local products, and prevented a potentially costly and damaging problem for the landowners.

Watauga Creek

The first project was completed on December 30th, 2009 on property owned by Mr. John Brown on Watauga Creek. Contracting with two local construction companies, Macon Grading and Penland Construction, a damaged culvert and abandoned dam was removed, and the culvert was replaced with a free-spanning bridge. A small engineering firm out of Asheville with significant streambank restoration experience to oversee the design and permitting process was contracted to design and manage the restoration activities.

This project was identified and made possible through the Little Tennessee Watershed Association Biomonitoring Program. As Dr. McLarney completes IBI surveys on water quality year after year, he establishes good working relationships with landowners. Dr. McLarney’s work also helped identify the crumpled culvert as the barrier that was keeping certain species of small fish from moving upstream and was used to justify funding for restoration. This project was also prioritized first because the area around the culvert was eroding badly, and a catastrophic blowout was eminent.

Bradley Creek

On January 7th, 2011 the second such restoration project was completed on property owned by Mr. and Mrs. Charles Henson on Bradley Creek. Contracting with a local construction company, Macon Grading, two undersized, damaged culverts were removed because they were causing flooding problems and were at risk of failing.

The culverts were replaced with a free-spanning bridge, designed by CETech Engineering in Franklin. Confluence Engineering was also contracted for stream bank restoration and project management assistance to ensure project success and safe, stable stream banks.

This project was prioritized based on its proximity, in the lower reaches of Bradley Creek, to a bed of endangered Appalachian elktoe mussels in the Little Tennessee River. The culverts were not sufficient during high flow events, scouring out around the embankment and flushing excess sediment into the river. Upon removal, we found that the entire bottom of one culvert had corroded away. In a short time the culvert would have failed, flushing a huge pulse of sediment into the river and leaving the landowners without a driveway.

Watauga Creek

Before

After

Clockwise from bottom left: 1) Old dam remnants above the culvert. 2) Upstream of culvert showing signs of severe damage and erosion. 3) After removal of dam and culvert, banks were stabilized and a new free-span bridge was erected. Photos by LTWA.

Bradley Creek

Before

After

Clockwise from bottom left: 1) Corroded bottom of culvert after removal. 2) Heavy erosion around the culvert on the upstream end. 3) Vegetation growing along stabilized banks where the old culvert was removed with the new free-span bridge in the background. Photos by LTWA.

Ordinance Changes

Since the last State of the Streams report, there have been several positive developments in county ordinances that protect water quality:

• The Floodplain Protection Ordinance was revised after the county received updated floodplain maps from FEMA in 2008. Additions include the prohibition of new building in the floodway (or areas of high velocity water during a flood event), the requirement of no-rise studies for building in the floodplain, and the prohibition of fill in the floodplain.

• The Subdivision Ordinance was passed in 2008. It provides standards for road construction, requiring the phasing of subdivision development to limit the amount of land disturbed at one time. Also, the ordinance provides standards and incentives for conservation subdivisions including the restriction of impervious surfaces, the preservation of natural drainage patterns, and the preservation or establishment of riparian zones along streams.

• The Sedimentation and Erosion Control ordinance was updated in 2008 to follow the state model. Between 2009-2010, the Watershed Council worked on another update to this ordinance, which is currently awaiting review and approval by the County Commissioners.

• The Planning Board is currently developing a Safe Slope Development ordinance.

With forethought and leadership, this valley will continue to be a living library of a healthy river system. Information is only as important as the positive actions that it catalyzes, and we hope that this report will help individuals and communities make the right decisions to protect and restore our watershed.

Partner Involvement

Given the size of the area and the various aspects of conservation and enhancement within the watershed, the duties involved are too many for a single organization. Partnerships are a crucial component to ensure adequate protection of the entire watershed. The Little Tennessee Watershed Association along with other non-profit organizations, tribal, local, state, and federal agencies have been working together and sharing the load to strengthen our community, preserve our heritage, and promote a healthy watershed.

<u>Cherokee Fisheries and Wildlife Management</u>
By: Mike LaVoie, Wildlife Biologist

Expanding efforts to comprehensively manage and sustain aquatic ecosystems is an important objective for the Eastern Band of Cherokee Indians (EBCI). With approximately 180 miles of streams on the Qualla Boundary, non-point source pollution is a major concern for the EBCI's Office of Environment and Natural Resources. The EBCI's Watershed Protection Program has developed management plans for priority sub-watersheds to identify current and potential threats to water quality and highlight opportunities for restoration and best management practices. Clean Water Act funds have been utilized to address causes of non-point source pollution and protect riparian corridors in the upper Oconaluftee River watershed. One success story involves the completion of the Goose Creek Watershed Restoration project, which enhanced 5,400 linear feet of stream and repaired 6,800 linear feet of stormwater drainage. The Cherokee department of Fisheries and Wildlife management is also in the process of implementing activities to conserve aquatic biodiversity in the upper Oconaluftee River watershed. Fisheries management activities involving IBI monitoring, southern Appalachian brook trout conservation and sicklefin redhorse restoration are continuing priorities for the Tribe.

Coweeta Long Term Ecological Research
By: Jason Love, Coweeta LTER Site Manager

The Coweeta Long Term Ecological Research (LTER) Program is one of 26 LTER stations established by the National Science Foundation to study long-term natural phenomena in the United States and abroad. Its current research, “Southern Appalachia On the Edge – Exurbanization and Climate Interaction in the Southeast,” examines the projected consequences that climate change and changing land use practices will have on southern Appalachia. The project involves 28 scientists from a range of disciplines, from historical anthropologists to stream ecologists. Though the program is centered at the University of Georgia, there are researchers from eight other universities involved in the program, as well as scientists from the Coweeta Hydrologic Laboratory. The program’s current study area is the upper Little Tennessee River basin. Since the southern Appalachian region is both a ‘water tower,’ supplying freshwater to the Southeast, and is among the most biodiverse temperate regions in the world, this research will provide crucial knowledge to scientists, policy makers, and the public.

Coweeta LTER has an outreach component, the Coweeta LTER Schoolyard Program, which reaches out to area schools to engage students in real and relevant science. The Schoolyard Program has partnered with LTWA and local teacher Adrian Holt to produce the “Little Tennessee Watershed Curriculum”. This curriculum is included with the Stream Study Box, one of six Science Study Boxes which local educators can check out for free from the Coweeta LTER.

NC Ecosystem Enhancement Program
By: Andrea Leslie, Western Watershed Planner

The Ecosystem Enhancement Program (EEP) is a partner in watershed planning and restoration in the Little Tennessee watershed. EEP, which is a program within the NC Department of Natural Resources, implements stream and wetland restoration and protection projects identified through its watershed planning process. In the upper Little Tennessee River basin, EEP is leading a local watershed plan for a 154 square mile area, called the Franklin to Fontana watershed. This plan involves water quality, habitat, and biological community monitoring and GIS analysis to identify key stressors for area streams. A comprehensive watershed management plan will be developed that names strategies to address stream degradation and will include an atlas of specific stream restoration, buffer planting, land preservation, and stormwater best management practice projects.

EEP is prioritizing the Franklin to Fontana watershed for its stream restoration and preservation activities. In 2009, it worked on 8,640 feet of Cat Creek, re-meandering sections of the stream which were once straightened and entrenched, enhancing pool and riffle habitats, protecting well-buffered and stable sections of stream, and restoring riparian wetlands along the creek.

The Land Trust for the Little Tennessee

Since 1998, the Land Trust for the Little Tennessee (LTLT) has been dedicated to conserving the waters, forests, farms, and heritage of the Upper Little Tennessee River Valley and more recently, the Hiwassee River Valley. In partnership with private landowners, public agencies, and others, LTLT works to insure that the natural beauty, ecological integrity, and rural character of our region are preserved for generations to come.

With nearly 35 riverfront miles conserved since 1999, the Little Tennessee River corridor remains the flagship of LTLT conservation successes. As of September 2009, LTLT has directly protected or partnered to conserve over 12,000 acres in its project area. Within the Little Tennessee River watershed, this includes conservation of the 4,500-acre NC Needmore Game Lands with 13 miles of Little Tennessee River frontage and 4,400 acres in other projects that protects 22 miles of River frontage and its tributaries.

Little Tennessee River projects include securing Cowee Mound and the surrounding 70 acres an area of great historic significance. The most recent conservation project conserved a 45-acre parcel on the Macon-Swain County line which includes the first-order Loudermilk Creek and is surrounded by National Forest System lands and Needmore Game Lands.

LTLT believes that protecting farmland and floodplain in this area is the best way to maintain the biological wealth and historic landscape found along this exceptional reach of river.

Macon Soil and Water Conservation District
By: Doug Johnson, Biologist

The Macon Soil and Water Conservation District (MSWCD) has for more than ten years been promoting the Little Tennessee Stream and Riparian Restoration Program within the Little Tennessee Watershed in Macon County. MSWCD has been able to provide money on a cost-share basis to landowners interested in restoring degraded streams and/or establishing riparian buffers on their property. To date, nearly four miles of degraded stream has been stabilized or restored and some fifteen miles of viable riparian buffer has been established.

Natural Heritage Program
By: Angie Rodgers, Freshwater Ecologist, Western Region

The North Carolina Natural Heritage Program (NHP) inventories, catalogues, and supports conservation of the most outstanding elements of the natural diversity of our state (including plants, animals, and natural communities). The NHP serves as the state's repository for rare species and natural community data and then disseminates this information to the conservation community to help prioritize habitats for protection.

In 2010, NHP finalizes the Macon County Natural Area Inventory which will include updated information on the natural diversity of Macon County. This inventory is the result of an intensive two-year focus on the county's natural areas and can be used to aid in prioritization of habitats for conservation efforts. Macon County is an important area for the biodiversity of North Carolina and the Southern Appalachians. A total of 78 Significant Natural Heritage Areas and Aquatic Habitats have been

documented in the county. All of these contain important elements of the state's natural heritage. Of the 78 sites, 10 are nationally-significant and 25 are significant at the state level. The Little Tennessee River Aquatic Habitat is renowned for its highly significant assemblage of rare freshwater mussels and fish species. The lower slopes of the Little Tennessee River valley and its tributaries also support some of the best known examples of the rare Montane Red Cedar-Hardwood Woodland natural community. The Highlands Plateau and Blue Ridge Escarpment in the southeastern corner of the county contain High Elevation Granitic Domes such as Blackrock Mountain/Granite City, The Fodderstacks, and Satulah Mountain. The area also harbors two rocky river gorges along the Chattooga and Cullasaja Rivers that contain some of the best known Spray Cliff natural communities in western North Carolina. An extensive forested landscape characterizes the Nantahala Mountains and Cowee Mountains, the county's two principal mountain ranges.

The Little Tennessee River Basin is a priority aquatic area for the Natural Heritage Program due to the numerous rare aquatic species and habitats present within its waters. Additionally, NHP works with various conservation partners in the basin to implement conservation measures for the protection of these valuable resources. NHP coordinates the Partners for the Little Tennessee, an informal group of state, federal, and local agencies, academic institutions, and nonprofit organizations with a focus on water quality and habitat protection of the Little Tennessee River Basin, in addition to providing assistance on specific watershed-related projects.

U.S. Fish and Wildlife Service
By: Gary Peeples, Outreach Specialist

Home to a concentration of imperiled species, the Little Tennessee River has long been a focus of the U.S. Fish & Wildlife Service, keeper of the federal endangered species list. Efforts to improve habitat and recover the endangered Appalachian elktoe mussel and threatened spotfin chub, a tiny fish, have precipitated a great deal of Service involvement in efforts to improve the health and well-being of area streams. The Service supports local efforts to plant native trees and shrubs and control invasive plants along streams, and develop alternatives to watering livestock in the river. The Service is working extensively with the Little Tennessee Watershed Association and other partners to improve the ability of aquatic life to move up-and down-stream, movement which can be blocked by culverts or bridges that were poorly installed or are in need of repair. The Service is also involved in the efforts of partner organizations to gain a big-picture perspective of the health of the Little Tennessee River basin and ways to improve it.

The Service is involved in numerous species-specific projects. Working with rare fish experts at Conservation Fisheries, Inc., biologists occasionally collect individual spotfin chubs to use in captive propagation for stocking efforts in other regional streams. The Service works with the N.C. Wildlife Resources Commission to monitor the well-being of both the spotfin chub and Appalachian elktoe mussel. Once home to the healthiest remaining Appalachian elktoe population, the river's population has undergone an estimated 90% decline. The Service, in cooperation with the N.C. Wildlife

Resources Commission, US Geological Survey, Western Carolina University, North Carolina State University, and other partners, is studying factors that may be the cause or contributing to the die-off. The Service is also working with the U.S. Geological Survey, Western Carolina University, Eastern Band of Cherokee Indians, North Carolina Wildlife Resources Commission, and Duke Energy Carolinas on studies to learn more about the sicklefin redhorse, a recently discovered rare fish found only in a handful of Southern Appalachian streams, including the Little Tennessee.

"To preserve, protect and enhance North Carolina's water..."

NC Division of Water Quality
By: Cathy Tyndall, Environmental Specialist

The Watershed Assessment Team (WAT), which is part of the North Carolina Division of Water Quality, conducts water quality assessments in watersheds throughout the state. Since spring 2008, WAT has been working in the Franklin to Fontana watershed and has conducted extensive nutrient and fecal coliform sampling in approximately nineteen streams to characterize pollution sources, stressors and to determine whether North Carolina's water quality standards for fecal coliform are being met. In addition, WAT has coordinated macroinvertebrate sampling to characterize water quality as demonstrated by the aquatic community. WAT has recently expanded the scope of its projects to include water quality monitoring of restoration and enhancement projects, the assessment of land use, stream habitat conditions, and identifying sediment impacts to the Little Tennessee River and its tributaries.

Raplh Preston

Resources

Information

Building Permits and Flood Plain maps:

Rabun County Planning Commission 706-782-1579
Macon County Dept. of Planning, Permitting, and Development 828-349-2073
Swain County Inspections Department 828-488-9134
ncfloodmaps.com/links
georgiadfirm.com/publicdocs

Erosion/Sediment Control:

Region 1 Georgia Soil and Water Conservation Commission 706-295-6131
Macon County Soil and Water Conservation District 828-524-3311 ext 101
Swain County Soil and Water Conservation District 828-488-8803 ext 3

Riparian Buffers and Stream Restoration:

Region 1 Georgia Soil and Water Conservation Commission 706-295-6131
Macon County Soil and Water Conservation District 828-524-3311 ext 101
Swain County Soil and Water Conservation District 828-488-8803 ext 3

Agricultural Lands: Natural Resources Conservation Service

Rabun County 706-782-3319
Macon County 828-524-3311 ext 3
Swain County 828-488-3785 ext 3
ga.nrcs.usda.gov
nc.nrcs.usda.gov

Local Information:

The Little Tennessee Watershed Association ltwa.org
The Land Trust for the Little Tennessee ltlt.org
The Little Tennessee River Greenway littletennessee.org
Partners for the Little Tennessee littletbasin.org

Data:

USGS nc.water.usgs.gov/realtime/real_time_little_tennessee.html
Coweeta Long Term Ecological Research Program coweeta.uga.edu/

Resources

Enforcement

Waste water / storm water discharge:
- Georgia Environmental Protection Division 404-675-6240
- NC Division of Water Quality 828-296-4500

Debris Disposal:
- GA EPD Land Protection Branch 404-362-2537
- NC Division of Solid Waste 828-296-4500

Ground Water Pollution:
- GA EPD Watershed Protection Branch 404-675-6236
- NC Ground Water Section 828-296-4500

Septic System Permits or Repairs:
- District 2 Public Health (Georgia) 770-535-5743
- Macon County Health Department 828-349-2490
- Swain County Health Department 828-488-3792

In and around Trout Waters:
- GADNR Region II Fisheries Management 770-535-5498
- NC Wildlife Resources Commission 828-452-0422

Erosion/Sediment Control or Land Disturbance activity:
- Rabun County Planning and Zoning 706-782-1579
- Macon County Planning Office 828-349-2073
- Swain County Inspections Department 828-488-9134
- Georgia Environmental Protection Division 404-675-6240
- NC hotline 866-STOPMUD

Wildlife Violations:
- GA Department of Natural Resources Region II 770-535-5499
- NC Wildlife Resources Commission 800-662-7137

Wetlands: US Army Corps of Engineers
- Georgia 800-448-2402
- North Carolina 828-271-7980

Cost Share Programs

By: Doug Johnson

Utilizing grants from North Carolina Clean Water Management Trust Fund as well as those from U.S. Fish and Wildlife's Partners Program and EPA's 319 Program, Macon Soil and Water Conservation District (MSWCD) has been able to provide money on a cost-share basis to landowners interested in restoring degraded streams and/or establishing riparian buffers on their property.

In addition to its stream and riparian program, MSWCD administers the NC Agricultural Cost-Share Program (NCACSP) and the Community Conservation Assistance Program (CCAP). The Agricultural Cost-Share Program works with interested farm owners and operators by providing financial and technical assistance to address water quality concerns. Installation of various best management practices (BMPs) such as fencing, alternate watering sources, heavy-use areas, etc can be designed and paid for using this program. CCAP funds can be used to address water quality problems on non-agricultural lands. Some of the BMPs which can be installed using CCAP include cisterns, rain gardens, and backyard wetlands.

Co-located with MSWCD within the Macon County Agricultural Services Building, the Natural Resources Conservation Service (NRCS) is a division of the United States Department of Agriculture (USDA). NRCS administers several federal cost-share and technical assistance programs such as the Environmental Quality Incentives Program (EQIP) and the Wildlife Habitat Improvement Program (WHIP).

Nationwide

Partners for Fish and Wildlife: U.S. Fish and Wildlife Service
www.fws.gov/partners

Environmental Quality Incentives Program: Natural Resources Conservation Service
nrcs.usda.gov/programs/eqip

Wildlife Habitat Improvement Program: Natural Resources Conservation Service
nrcs.usda.gov/programs/whip

North Carolina

NC Agriculture Cost-Share Program: NC Dept. of Environment and Natural Resources
enr.state.nc.us/dswc/pages/agcostshareprogram.html

Community Conservation Assistance Program: NC Dept. of Environment and Natural Resources
enr.state.nc.us/dswc/pages/ccap_program.html

Georgia

Forest Land Enhancement Cost-Share Program: Georgia Forestry Commission
gfc.state.ga.us/ForestManagement/FLEP.cfm (Georgia)

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Each year, the Biomonitoring program relies on partners and volunteers to help conduct the field research that is the basis for this report. Two of our main partners that have been immensely supportive and generous with staff time, equipment and funding have been the Tennessee Valley Authority (TVA) and the North Carolina Wildlife Resources Commission (NCWRC). The collaboration of TVA (Dave Matthews and Charlie Saylor) is indispensable; without the use of the boat shocker, monitoring of several of our mainstem sites would not be feasible. Steve Fraley at the WRC has also been a long time supporter of this work, and his assistance with technical collaboration, permitting and funding has been critical.

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Local graphic designer Kristin Murphy deserves our utmost appreciation for donating her talent and services on very short notice to help us produce this report.

Perhaps the most noteworthy contribution to this report came from the newest addition to the Little Tennessee Watershed Association's team - Jason Meador. Although much of the material for this report had been collected, it was not organized, edited or laid out in a format that made any sense when he arrived on the scene. Jason immediately took the lead on this project; following up on or simply researching and writing missing sections as needed. He also created new maps and visuals to accompany the information. He took the initiative to make a good project great and we are lucky to have him working with us. Also special thanks should be made to Brad and Shelli Stanback, who helped us add Jason's position with a generous contribution to the Biomonitoring Program in 2010.

Little Tennessee Watershed Association

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828.369.6402 • www.ltwa.org

Mission:

The mission of the Little Tennessee Watershed Association is to protect and restore the health of the waters of the Little Tennessee River and its tributaries upstream of the Fontana reservoir through monitoring, education, habitat restoration and citizen action.

Our Vision:

Our vision is that the water quality of the beautiful and biologically intact upper Little Tennessee River is protected and restored. Children and adults are able to swim and fish in its abundant waters, and our community and economy is sustained through its clean, plentiful and healthy condition. Our community and elected officials are aware of its multiple values and consistently work to protect and enhance them. We are an active member in a network of river organizations sharing community based science for the benefit of all, and in a landscape in which all river ecosystems retain their intact natural flows in their historic condition. Above all, through education, leadership and cooperative efforts that foster a strong ethic of stewardship and sustainability, we work to protect and restore the upper Little Tennessee watershed.