

River Ecosystems



What are River Ecosystems?

Rivers are more than just the water flowing between their banks. The health of the land surrounding rivers directly affects the water quality and the life that exists in and around them. Tennessee's rivers are home to a rich and diverse natural heritage and support a wealth of cultural history, with important archaeological and historical sites. There are more than 15,000 miles of tremendously diverse rivers that flow across the state.

Why are River Ecosystems Important?

An extraordinary variety of aquatic creatures, largely unseen and unfamiliar to most people, is hidden beneath the shimmering surface of Tennessee's rivers. Though many people are devoted to the beauty and recreational values of streams, creeks, and rivers, few of us know that Tennessee's stream life is exceptional on a global level, even when compared with the Tropics. This remarkable freshwater diversity should be a great source of pride for Tennesseans.

Tennessee not only has the greatest diversity of freshwater fish species in the country, but it also supports an abundance of crayfish, mollusks, and some aquatic insects. There are over 300 fish species in Tennessee, 71 crayfish, 129 freshwater mussels, and 96 freshwater snails. In fact, the Ohio River basin, which encompasses most of Tennessee, contains the world's richest diversity of freshwater mussels. The Nature Conservancy, in their report entitled *Rivers of Life*, found that the center for aquatic biodiversity is largely concentrated in the Tennessee, Cumberland, Ohio, and Mobile River basins, of which sizeable portions of each flow through Tennessee (Figure 1). They identified numerous Tennessee River watersheds that are treasure-troves of biological diversity in critical need of protection. In addition, they identified the Clinch River, in northeastern Tennessee and southwestern Virginia, as the most biologically diverse river in the United States. In fact, the Clinch and Powell Rivers are home to the most endemic federally listed species of freshwater mussels remaining in the world.

Rare and Unique Plants and Animals

Generally disregarded and unknown, non-game freshwater aquatic species are part of the web of life that supports the game species we enjoy fishing for and eating and the wildlife we enjoy watching. Non-game fish species represent an important food source for fishes, birds, and mammals. Freshwater mussels are filter feeders, acting like miniature water purifiers. They capture and remove large quantities of tiny algae and plankton that most other aquatic animals cannot eat. They, in turn, become food for river otters, muskrats, fishes, and other wildlife species. Crayfish are the scavengers of the underwater world, feeding on dead and decaying animals and plants. They recycle decaying material into food for themselves and then become food for larger animals. Abundant and diverse aquatic insect populations often indicate that thriving populations of sport fishes, birds, and mammals are also present.

Freshwater mussels, non-game fishes, and aquatic insects are sensitive to environmental and



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chemical changes in our rivers and are excellent indicators of water quality. Where there is a high diversity of aquatic species, there is also clean water for wildlife and people. Where diversity and numbers of aquatic species has declined, there is generally trouble in the river and, thus, trouble for the wildlife and people that use the river.

Rivers also have significant, but often overlooked, economic values. Tennesseans consider rivers and their surrounding landscapes among the state's most scenic areas. In fact, the beauty of a river can greatly affect the appeal and value of the surrounding land. We use rivers not only for their life supporting values, like drinking water and crop irrigation, but also for recreation. The 1996 Survey of Fishing, Hunting, and Wildlife Associated Recreation found that Tennesseans and visitors spent 475 million dollars on fishing and other recreational activities related to

waterways. Rivers also provide a highway to transport our goods and generate electricity. Finally, common species of freshwater mussels from the Tennessee, Cumberland, and Ohio Rivers are at the center of a multi-million-dollar freshwater cultured pearl industry. Freshwater mussel shells are used as the nucleus for cultured pearls.

Threats to River Ecosystems

Although Native Americans used mussels for food and fashioned mussel shells for tools and adornments, they had little impact on the freshwater aquatic life of Tennessee's rivers. However, as European settlers moved into the area, river ecosystems were dramatically altered, and the diverse river life that once flourished began to decline. River ecosystems are dynamic systems that include all living plants and animals and their interactions with the nonliving parts, such as the soil, climate, minerals, and water. These systems are flexible and

can absorb some stresses but not on a continuing and increasing basis. What we gain in the short term from altering rivers to serve our needs may come at the long-term expense of river health and aquatic life.

Overall, species that depend on clean water are in trouble. In fact, of all the animal groups in the United States, mollusks, non-game fishes, crayfish, and amphibians, are the most imperiled. This far exceeds the loss of birds, mammals, reptiles, and insects. Tennessee has the second highest number of freshwater species (66) considered to be threatened or endangered in the United States.

To understand why aquatic species are declining so sharply, we must step back and look at the big picture the landscape. When we refer to *rivers and the surrounding land they drain*, we call it a **watershed**. The watershed is an easy concept to understand if we just remember that

You Can Help

Establish and maintain stream-side buffers of trees, shrubs, and grasses. Several federal, state and private programs are available to assist landowners, both technically and financially, with restoring and protecting stream-side buffers and eroding riverbanks. Implement and maintain measures for controlling erosion and storm water during and after land-clearing and disturbance activities. Be careful with the use and disposal of fertilizers, pesticides, and other chemicals. Remember, what you put on your land or dump down the drain may eventually end up in nearby waters. Support local, state, and national clean water legislation. Report illegal dumping activities and erosion problems. Recycle as much as you can, eliminating the need for new landfills. Get involved with a local water conservation group and participate in a stream or river cleanup. Volunteer to monitor water quality in local rivers for your county water authority.

water flows downhill and empties into common points —rivers. Think of the rain flowing off your roof, down your gutter, down the street drain, into a small creek, into a stream, and, finally, into a river. Now think of this same concept on a much larger scale, including agricultural land, forests, parks, shopping malls, and communities, all in the same drainage area and all draining into the same river. The area of land that collects this run-off is the watershed, or natural drainage basin. Because water runs downhill, changes in water flow, temperature, and chemistry can be passed throughout the watershed, negatively impacting miles and miles of a river and gallons and gallons of water. Therefore, human activities directly up slope or upstream may affect stream life and water quality for the neighbors downstream.

What are the human activities that are adversely affecting our rivers and river life? They are varied and come from many activities, like non-point source pollution, which includes residential, construction, municipal, and commercial storm-water run-off and agricultural run-off (containing sediment, pesticides, herbicides, and fertilizers); impoundments; deforestation of river banks; channel alterations; and the invasion of nonnative species. These threats directly and indirectly affect our natural and cultural heritage, and, ultimately, public health and our quality of life.

Ten percent of Tennessee's rivers are of such poor quality that they do not meet their designated uses, and 110 miles are actually posted to warn against any human contact. Twenty percent of the Tennessee River system has been impounded, and most of the rivers of west Tennessee have been turned into straight-line drainage ditches. Both of these activities have resulted in

enormous habitat loss and decline of species, and channelization has caused the loss of recreational opportunities. Impoundments have also permanently flooded important historical and ecological resources. The loss of forested riverbanks has caused property loss from stream banks that have eroded into rivers and habitat loss from eroding soil that has turned gravel riverbeds into mud beds. Eroding soil enters our rivers, suffocating aquatic life and hindering their reproduction. Moreover, more pollutants go directly into the river because there is no buffer of trees and grass to filter them out. The nonnative zebra mussel is invading our rivers, clogging water intake pipes, and suffocating and out-competing native aquatic life for food and space.

When rivers are polluted, everyone is affected. Pollution from a pipe or sediment from an eroding riverbank causes obvious problems for people living downstream and for everyone else. This results in higher maintenance costs that water treatment plants charge for cleaning dirty, polluted water. Polluting a watershed is like trashing a neighborhood—it's unsightly and costly!

What is Being Done to Protect These Rare Places?

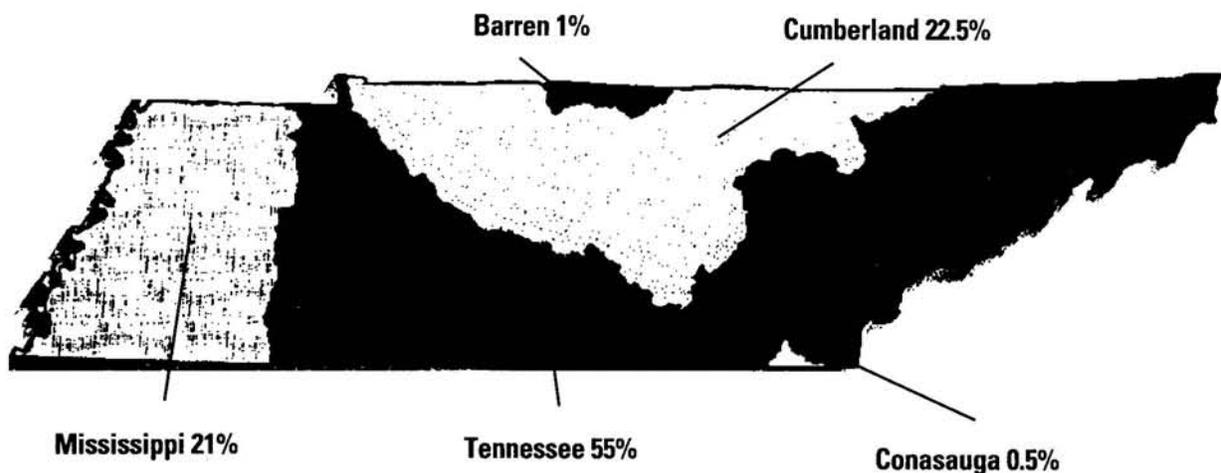
Communities are banding together with public and private agencies to protect and restore rivers in their watershed. Working together, communities are able to support and make greater improvements on the ground. Livestock owners are helping to reduce the amount of soil that enters our rivers by fencing stream banks, which prevents livestock from trampling streambeds and shorelines. In many cases these actions can improve the health and productivity of the land. Many crop farmers and gardeners are helping by using the best management practices recommended by the state when

applying fertilizers and by maintaining wide vegetated buffer strips along rivers. Many home builders and others involved in construction are helping to stabilize soils exposed during building activities so that the amount of soil washing into the river is minimized. City planners are helping when they implement ways to slow storm-water run-off into natural waterways. Homeowners and managers of recreational land are pitching in to protect water quality by maintaining native plants along the river and by reducing the amount of fertilizers and pesticides used on their lawns. By working together we can improve our rivers and maintain our rich cultural and natural heritage for our use and enjoyment today and tomorrow.

Seeing is Believing!

Tennessee is lucky to have an abundance of rivers. Take some time to check out a river near you!

Tennessee Watershed Map (Figure 1)



Prepared by the Tennessee Rivers Assessment Project

In Tennessee, watersheds are grouped into five large drainage basins. Basins are simply a way of grouping watersheds together based upon the water's destination. Most of the water in Tennessee empties into the Tennessee (55%), Cumberland (22.5%), and Mississippi (21%) River basins. A small amount of water also empties into the Ohio river basin by way of the Barren River in Kentucky and the Mobile River basin by way of the Conasauga River in Georgia. Which watershed do you live in and which river basin does your watershed empty into?

Pallid Sturgeon

(*Scaphirhynchus albus*)

You Can Help!

Remember, what we put on the land may eventually enter the streams! Tell a friend about the pallid sturgeon. Reduce water consumption. Protect water quality. Participate in a local river cleanup. Use biodegradable soaps. Control erosion on your property, and report erosion sources. Watch for and report illegal dumping along streams and rivers. Plant or maintain native vegetation along streams. Take pride in Tennessee's wildlife!

Status

The pallid sturgeon was listed as endangered on September 6, 1990.

Description

The pallid sturgeon is a large, long-lived freshwater fish. It has a flattened, shovel-shaped snout and five rows of bony plates along the body. The pallid sturgeon is lighter in color and grows larger than most other sturgeons. It has a toothless mouth on the underside of its head. It is one of the largest freshwater fish species in North America; adults can weigh up to 65 pounds.

Habitat

Pallid sturgeons live in large, turbid, free-flowing riverine ecosystems. They are usually found near the bottoms of streams or lakes in sand flats or gravel bars. The pallid sturgeon is almost entirely restricted to the Missouri and lower Mississippi Rivers.

Life History

The pallid sturgeon feeds on small fishes, aquatic insect larvae, and mollusks. Spawning takes place in spring or summer. Little else is known about the life of the pallid sturgeon.

Role in the Ecosystem

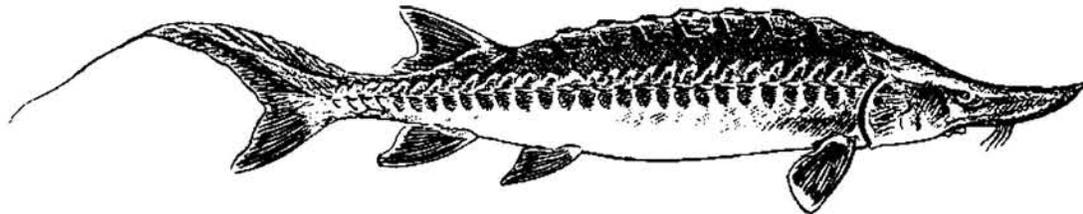
All species of sturgeon are an integral part of the aquatic food web. People in particular enjoy caviar (sturgeon eggs) and eating sturgeon meat of the more common sturgeon species.

Threats

The channelization of rivers and construction of reservoirs have drastically altered nearly 80 percent of the pallid sturgeon's range. The remaining habitat occurs below dams and is affected by decreased water temperatures, reduced silt loads, and altered water run-off patterns. These factors also prevent the fish from swimming to their spawning grounds. High levels of pollutants and over-harvesting have also affected the pallid sturgeon.

Recovery

Eleven states within the pallid sturgeon's range have some regulations that prohibit taking the fish. Commercial fishing has been discontinued or restricted in many areas on the Mississippi and Missouri Rivers.



Cumberland Monkeyface Pearlymussel

(*Quadrula intermedia*)

You Can Help!

Remember, what we put on the land may eventually enter the streams! Tell a friend about the Cumberland monkeyface pearlymussel. Reduce water consumption. Protect water quality. Prevent nonpoint source pollution. Participate in a local stream or river cleanup. Use biodegradable soaps. Control erosion on your property, and report erosion sources. Watch for and report illegal dumping along springs and streams. Plant or maintain native vegetation alongside streams. Take pride in Tennessee's wildlife!

Status

The Cumberland monkeyface pearlymussel was listed as endangered on June 14, 1976.

Description

The Cumberland monkeyface pearlymussel is a medium-sized (3 to 4 - inches) mussel. It has two bowl-shaped shells joined together by a fleshy hinge. The surface of the shell is covered with small bumps. The shell color is brownish-yellow with triangular green markings. The inside of the shell varies in color from salmon to pearly white.

Habitat

The Cumberland monkeyface pearlymussel is typically found living in clean, fast-flowing streams with gravel and sandy bottom habitats. This species occurs within only three rivers in Tennessee – the Duck, Powell, and Elk. It also occurs in Virginia and Alabama.

Life History

Fertilized mussel eggs develop into larvae, called glochidia. One female may produce hundreds of thousands of glochidia. These tiny, bean-shaped glochidia attach themselves to the gills of fishes and cling there for a time while they develop into adults. Once this change is completed, the tiny mussels drop to the stream bottom. Adult mussels are filter feeders; they consume tiny creatures by pumping and filtering water through their gills. Using their single "foot," they can move short distances along the streambed. Freshwater mussels can live as long as 50 years.

Role in the Ecosystem

The presence of the Cumberland monkeyface pearlymussel and other freshwater mussels indicates good water quality. Mussels help remove

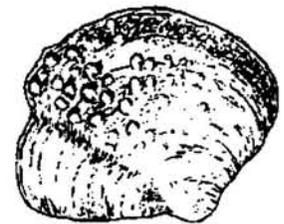
silt from the water and serve as a food source for fishes, otters, raccoons, turtles, and muskrats.

Threats

Cumberland monkeyface pearlymussels are threatened primarily by the alteration and destruction of their stream habitats. The construction of dams, gravel dredging, strip mining, and pollution have all contributed to the decline of this species. Pollution from coal mining and other sources of nonpoint source pollution kill freshwater mussels. Silt from erosion and poor land-use practices clogs the mussels' gills and smothers them. The spread of exotic species, such as the zebra mussel and the Asian clam, is also a threat to freshwater mussels; they use up valuable space in freshwater mussel habitat. Zebra mussels also attach themselves to the shells of native mussels, covering and eventually suffocating them.

Recovery

Recovery goals include the reduction of factors that have contributed to the decline of freshwater mussels. Research is needed to determine the biological needs of the Cumberland monkeyface pearlymussel.

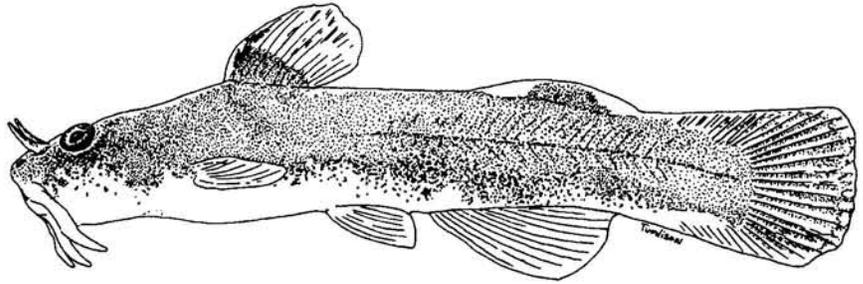


Smoky Madtom

(*Noturus baileyi*)

You Can Help!

Remember, what we put on the land may eventually enter the streams! Tell a friend about the smoky madtom. Avoid disturbing stream rocks along Citico and Abrams Creeks; a smoky madtom may be hiding underneath! Protect water quality. Participate in a local stream cleanup. Use biodegradable soaps. Plant or maintain native vegetation along springs and streams. Reduce water consumption. Take pride in Tennessee's wildlife!



Status

The smoky madtom was listed as endangered on October 26, 1984.

Description

The smoky madtom is a light brown catfish that grows to be about 3 inches long. It has a relatively large, rounded head and small eyes. Four dark, saddlelike markings cross its back. Like other catfish species, the smoky madtom has “whiskers.”

Habitat and Biology

The smoky madtom is restricted to only about 6 miles of Citico Creek in the Cherokee National Forest in Tennessee. This secretive fish lives in shallow riffles underneath palm-sized slab rocks. During colder months the fish moves to shallow pools but still spends most of its time under small slab rocks. The smoky madtom eats small insect larvae and may feed by picking up food items from the stream bottom. The smoky madtom spawns in late spring and early summer. There are 30 to 40 eggs in a cluster, which are deposited under large flat rocks. Male smoky madtoms remain at the nest site to guard the eggs and newly hatched young.

Role in the Ecosystem

Nongame fish species like the smoky madtom are a critical ecological link in the food chain. They feed on insects

and are prey for sport fishes, birds, and other wildlife. They are also important indicators of water quality and ecosystem health.

Threats

The limited distribution of the smoky madtom makes it very vulnerable to extinction. Logging, mining, road and bridge construction and maintenance, mineral exploration, and other projects within the watershed are all potential threats to this species and its habitat. It is thought that much of the smoky madtom's historical range was destroyed by dam and reservoir construction on the Little Tennessee River; poor forestry practices were also a contributing factor.

Recovery

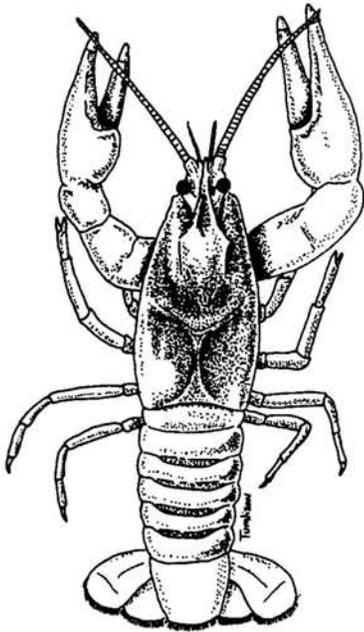
Smoky madtom recovery efforts are underway. Researchers collect smoky madtom eggs and young from Citico Creek each spring and rear the young in captivity. Each fall they are returned to Citico Creek to help increase that population. They are also placed into Abrams Creek within the Great Smoky Mountains National Park, where the smoky madtom once lived. For some good news about the smoky madtom, see the success story—*Abram's Creek: Reintroduction of Four Listed Fishes*—found in this guide.

Nashville Crayfish

(*Orconectes shoupi*)

You Can Help!

Remember, what we put on the land may eventually enter the streams! Tell a friend about the Nashville crayfish. Avoid disturbing covered, vegetated areas along Mill Creek. Protect water quality. Participate in a local stream cleanup. Use biodegradable soaps. Plant or maintain native vegetation alongside springs and streams. Reduce water consumption. Take pride in Tennessee's wildlife!



Status

The Nashville crayfish was listed as endangered on October 24, 1986.

Description

The Nashville crayfish can grow to a length of 7 inches and has large claws with orange and black tips. The body color of this crayfish is variable, with light saddlelike markings over the back and down the sides.

Habitat

The Nashville crayfish lives only in Mill Creek, partly in a highly urbanized area of the city of Nashville. It lives in a wide variety of stream habitats from pools to riffles in areas where stream-bank vegetation has not been removed. The Nashville crayfish spends the day hiding, usually under rocks and vegetation. Crayfish are opportunistic eaters and feed on a wide variety of both plant and animal material. Little is known about the life history of this rare species.

Role in the Ecosystem

Crayfish serve as important links in the food chain, feeding on plants, invertebrates, and dead fishes, while serving as food for sport fishes, birds, and other wildlife species. They are also indicators of environmental quality and health, flourishing in clean water and perishing in polluted water. Did you know that in the Southeast nearly 75,000 tons of crayfish, with an estimated value of \$50 million, are farmed in ponds or trapped from wetlands to be sold as gourmet food!

Threats

The Nashville crayfish is a hardy species. It has survived stream channelization, stream-side vegetation removal, trash along the banks of Mill Creek, soil erosion and siltation, and toxic chemical spills. No species can endure such treatment forever; thus, this species is now endangered. Should habitat quality continue to decrease, the species' chances of survival are slim.

Recovery

Recovery goals include limiting further siltation and pollution in the Mill Creek watershed. More research is needed to determine the biological needs and life history of the Nashville crayfish.