The Great Smoky Mountains National Park
Fisheries Division Presents:

The Stream Guardian

VOL. 2 Fall 2018

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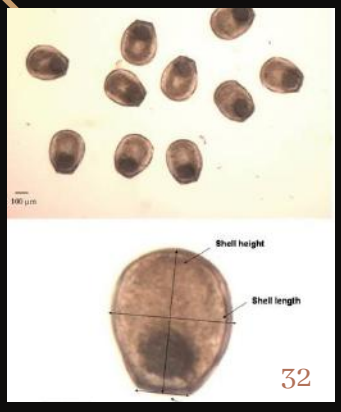
VAMPIRES

of the Stream

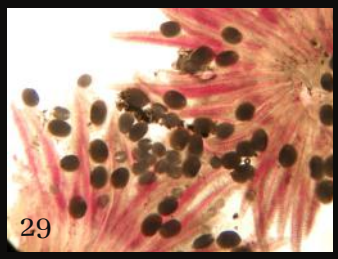
You may have thought that tales of blood sucking villains were just stories to scare children, but often the natural world can be just as fascinating and unbelievable as any tall tale. In Great Smoky Mountains National Park, there are actually quite a few species of “vampire," though may not look like the Count Dracula of lore. You may assume that it would be a bat or some spooky animal who hunts in the night, but the vampires of the Smokies are actually the larval form of freshwater mollusks, who begin their journey as blood thirsty glochidia, no bigger than the period at the end of this sentence.

If you happen to be snorkeling in Abrams Creek during the summer you might just come across the ugliest little fish you have ever seen. This fish will flail and seize, jerk and thrash, but it will not swim away if you approach. Upon further inspection you'll find that you aren't looking at a fish at all, but the mantle of a female Wavy-rayed Lampmussel (*Lampsilis fasciola*). Through trial and error by natural selection this species (which has no eyes to see any of the things it is mimicking) has evolved a variety of patterns that look just like the prey of the fish species they target.

The mussel uses these lures just like a fisherman, dangling an irresistible morsel in front of the fish, tempting them to bite. Just as the fish strikes its prey it finds itself clamped in "jaws" of the mussel's shell.

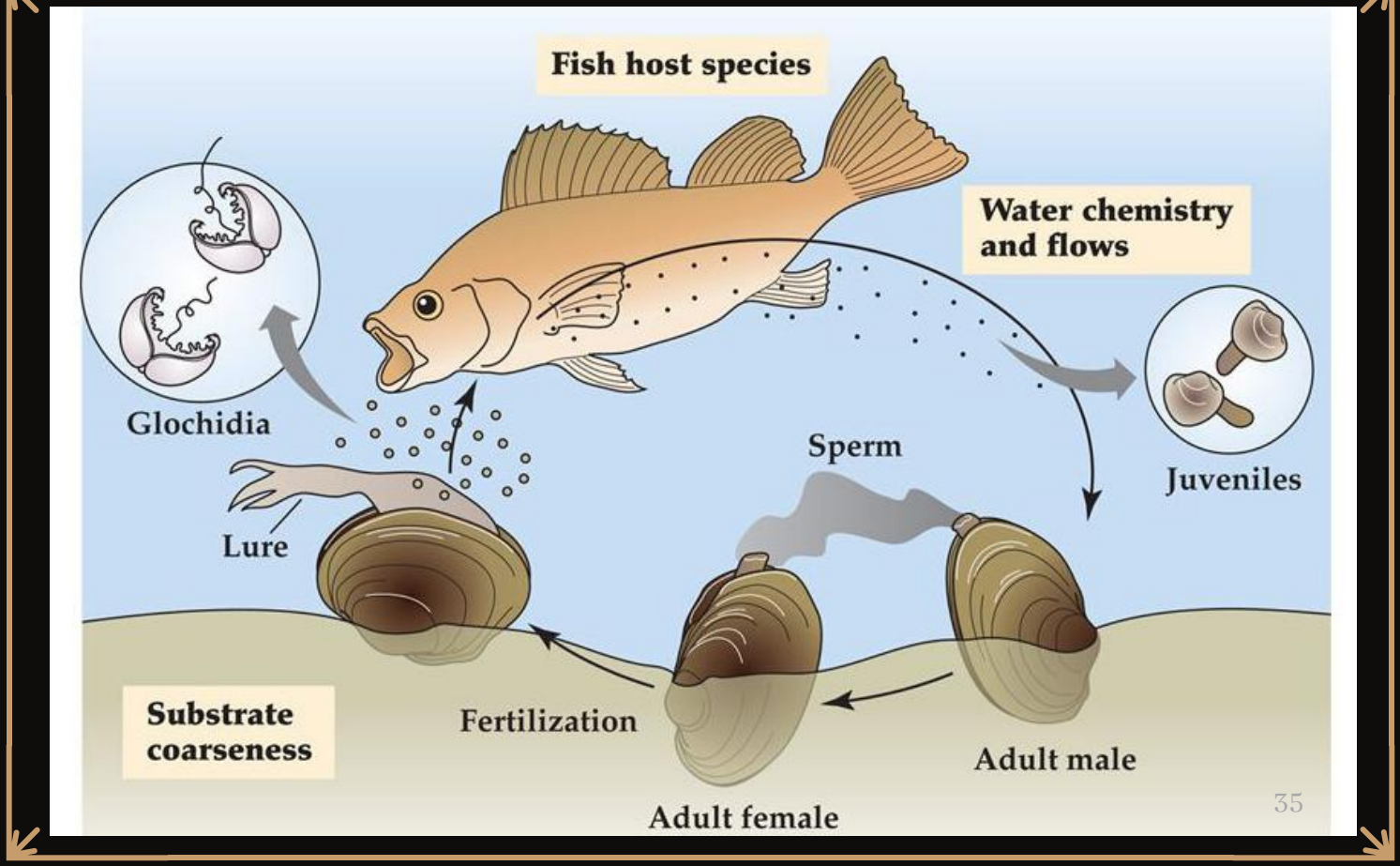


Left: Wavy-rayed Lampmussel glochidia
Right: Glochidia of other species



Pictured above: An example of the mantle display used by female L. fasciola, a mussel clamping on a fish, and glochidia attached to the gill tissue.

While the mussel has the fish immobilized, she pumps thousands of parasitic larvae, called glochidia, into the fish's gills. The tiny glochidia may not look as menacing as the vampires of lore, but nonetheless, they will attach themselves to the fish's gills and feed on it's blood for several weeks until they metamorphose into juveniles and release themselves from the gills. This transition marks the beginning the rest of their sessile lives planted in the substrate below. During their juvenile stage, the larvae stay burrowed beneath the substrate, filtering detritus, algae, and bacteria. Upon reaching sexual maturity (3-4 yrs) the adult mussels will emerge to the surface of the substrate to reproduce.



Wavy-rayed lampmussels are dioeceus, meaning individuals are either male or female and they rely solely on sexual reproduction. Mussels begin spawning in the summer. During this time, males will come to the surface to release sperm and females will siphon the sperm into a specialized chamber called the marsupia. In their marsupia, the sperm fertilizes eggs the female has laid, and over the course of the fall, winter, and spring these eggs will develop into larvae that will be released into unsuspecting fish the following summer.

This strategy is not unique to the Wavy-rayed Lampmussel; many bivalves in the families Unionidae and Margaritiferidae share a similar life history. And while there are rarer and flashier bivalves in the Smokies, the Wavy-rayed Lampmussel has a few tricks up its mantle not often seen in other species.

According to Dr. Gerald Dinkins, curator of malacology at University of Tennessee, Wavy-rayed Lampmussels has several variants of its mantle display. Individuals will only have one display, but the lures can vary widely between individuals across their range. While the most common is the “ugly fish," individuals have been seen with mantles resembling worms, crayfish, hellgrammites, and even caterpillars.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There are several mantle display types seen in female Wavyrayed lampmussels, among them are: a worm mimic, a hellgramite mimic, and a fish mimic.

While one can only surmise what the display is intended to mimic, we know that different displays are seen in different regions. Dr. Dinkins has observed that here in the more southern range of its distribution there are a greater variety of displays than you might find up north, supposedly because there is higher biodiversity and more prey items to mimic in the southeastern U.S.

While the vampire-like glochidia do rely on the blood of fish to survive, they rarely impact the survival of their fish hosts, as the death of the fish would not benefit them in the least. Because adult mussels are largely bound to the same patch of substrate for the majority of their lives, the larval stage they spend mounted to fish is the only chance most mussels have to expand their range. This carefully planned lifecycle is therefore entirely reliant on the health and stability of the host fish population. Any factors that threaten the habitat or health of the host fish, like Smallmouth Bass, will in turn impact the Wavy-rayed Lampmussel.


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Threats such as habitat fragmentation and sedimentation impact fish as well as the mussels that rely on them.

Author: Josh Cary & Briana Cairco

Restoring the Brookies:

The Power of a Positive *Troutlook*

Once upon a time the Brook Trout (*Salvelinus fontinalis*) was abundant and widely distributed within eastern North America. These fish thrived in the cold, clean streams where they reigned as the only native salmonid in Appalachia. These incredible fish were perfectly adapted for life in these waters… until the very waters they were built to survive in began to change.

As timber companies and settlers changed the land around them by logging and farming, the loose soil once held by roots was washed into the streams, and the cool waters once shaded by the trees became too warm without the dense canopy to protect them. In addition, logging companies and the National Park Service (NPS) stocked over 1.4 million non-native rainbow trout (*Oncorhynchus mykiss*) into park streams, which outcompeted and further displaced native Brook Trout populations. Since the 1900s, the Brook Trout, which were once abundant, declined by 75% in Great Smoky Mountain National Park (GRSM) due to logging practices performed before the creation of the park in 1934.

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Even as the the forests began to grow back, the sky above became polluted from the gas released from factories, cars, and power plants. The rain that once brought relief to the drying earth below, now brought an assault of acid that altered the chemistry of the soil and the streams making them inhospitable to Brook Trout.

The hardships that came with the changes to their habitat were only compounded by the introduction and expansion of non-native Rainbow Trout from the West. With their habitat altered by humans and new competitors dominating their territory, Brook Trout populations continued to decline through the mid-1900s.

The NPS sought to restore the Brook Trout not just because they are native to the local streams and rivers where they have dwelled for millennia, but because these fish are intertwined with southern Appalachian heritage. These Brook Trout are the descendants of those who saw the first European settlers arrive in Tennessee, the same lineage as those who supported Native American settlements for centuries, and of the same blood as those who knew these waters when they were fed by the glaciers covering North America.

Anthony Creek


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2016 In 2016, the NPS began efforts to restore Anthony Creek by dividing the stream above a barrier mill dam into 34, 100-meter sections and removing non–native rainbow trout using the 3-Pass Depletion method and backpack electrofishing units. Backpack electrofishing units send 600-700 volts of electricity into the water, which stuns the fish, and allows backup netters to net and capture the non-native Rainbow Trout. Each section is worked through three times to ensure a high capture rate. Using this method 2,284 Rainbow Trout, or 99.3 percent of the trout population, were removed in 2016.


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2017 In 2017, the NPS conducted a second effort to remove Rainbow Trout from the area, which resulted in the capture of an additional 52 Rainbow Trout. Following the removal of all non-native Rainbow Trout, the NPS began the reintroduction of Brook Trout from local source streams. The first reintroduction collected 269 Brook Trout from Bunches Creek and relocated the fish to Anthony Creek in hopes of establishing the Brook Trout population. Bunches Creek, located near Balsam Mountain, NC, was selected for the source stock as the stream lies within the same Little Tennessee River watershed as Anthony Creek and the Brook Trout were known to be genetically pure Little Tennessee drainage fish.


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2018 In 2018, the NPS continued reintroduction efforts by capturing approximately 230 Brook Trout from Deep Creek and Sahlee Creek within the Deep Creek watershed (also a genetically pure Little Tennessee tributary). With the help of our friends from the NPS trails crew and their trusty mules, the fisheries crew were able to haul the trout safely up the mountain trail, and from there transport them to Anthony Creek. If all goes as planned, these new recruits will disperse, multiply, and reach carrying capacity within 3 years.

For more about out adventure with the mules visit: https://friendsofthesmokies.org/blog/have-you-ever-been-fishing-with-a-mule/

Little Cataloochee

2017 The restoration of Little Cataloochee Creek began in 2017. Due to the large size of the stream, holes over 3-4 feet deep, and the generally complex habitat in Little Cataloochee a different removal method was necessary. Instead of backpack electrofishing, the EPA approved piscicide Antimycin A, was utilized to remove Rainbow Trout from a 3-mile section of stream.

Antimycin A acts by inhibiting cellular respiration of fish, including Rainbow Trout. One 8-hour treatment of Antimycin A depleted all Rainbow Trout within the restored section of Little Cataloochee Creek. Below the barrier waterfall at the lower end of the treatment zone, the antimycin was neutralized using potassium permanganate ($KMnO_4$); once neutralized, the antimycin becomes ineffective and no fish are killed downstream of the barrier falls.

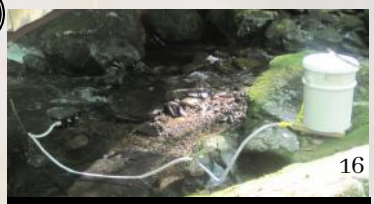
Given Little Cataloochee Creek included both Rainbow and Brook Trout, prior to Antimycin A application, a significant effort was made to remove all Brook Trout from the treatment sections with backpack electrofishing and hold them in a large tank or untreated headwater areas until treatment was complete. Once treatment was complete, the captive Brook Trout were redistributed to the newly reclaimed stream segments.

2018 In 2018, the stream was monitored to evaluate the condition of the reintroduced Brook Trout. An additional 151 Brook Trout were captured from Correll Branch and transported to Little Cataloochee Creek to augment the existing population. The 2018 Brook Trout population surveys indicate Little Cataloochee Creek is recovering very nicely and should be back to carrying capacity within three years.

The successful restoration of Little Cataloochee Creek brings the total number of Brook Trout streams restored within GRSM to 13 and includes 30.5 miles of stream habitat.

1. 

Native fish are removed from the stream and held in a inflatable tank

2. 

Antimycin is applied to the water

3. 

The antimycin infiltrates the water treating as it flows downstream.

4. 

Exposed fish are killed

5. 

At the end of the treatment area, the antimycin is neutralized to make it safe for fish downstream

6. 

Brook trout are reintroduced to the treated stream

Author: Hailey Goyette

The Dirty Work

The Fisheries Department of Great Smoky Mountains National Park (GRSM) doesn't just manage the health of the parks nearly 70 species of fish, but is also responsible for monitoring water quality throughout the park. Maintaining good water quality is important not only to protect the parks natural resources, but also to protect human health. One way GRSM staff assesses water quality to protect human health is to collect water samples in and around the park's four horse concessions (riding stables) to monitor *Escherichia coli (E. coli)* levels.

Why study *E. coli* levels in water?

E. coli is a digestive system bacteria commonly found in feces of horses, human and other mammals. Although *E. coli* is safe for our lower digestive system, if ingested orally into our stomach, it can be harmful to human health. If *E. coli* levels in the waters exceed EPA human health standards, there is concern that people could become sick if they ingest the bacteria laden water where they're swimming, tubing, or playing in the water.

Currently, there are 4 concession-operated horse riding stables within GRSM and an additional 16 commercial riding stables outside of the park within 15 miles of the park boundary. A single GRSM riding stable can average 15,000-20,000 rides over the 8-month season. With such a high amount of horse traffic on a limited number of GRSM trails in proximity to park streams, there is potential to affect human health. Many of the trails used by the riding stables cross a stream multiple times in a single ride. A higher density of horses on a single trail also means greater potential for horse feces to be washed into park streams that are frequently crossed by the horses and riders.

In order to test for *E. coli* in the water, water samples are taken weekly in multiple streams upstream and downstream of the horse riding stable trails. Samples are taken back to a NPS lab where they are tested for *E. coli.*

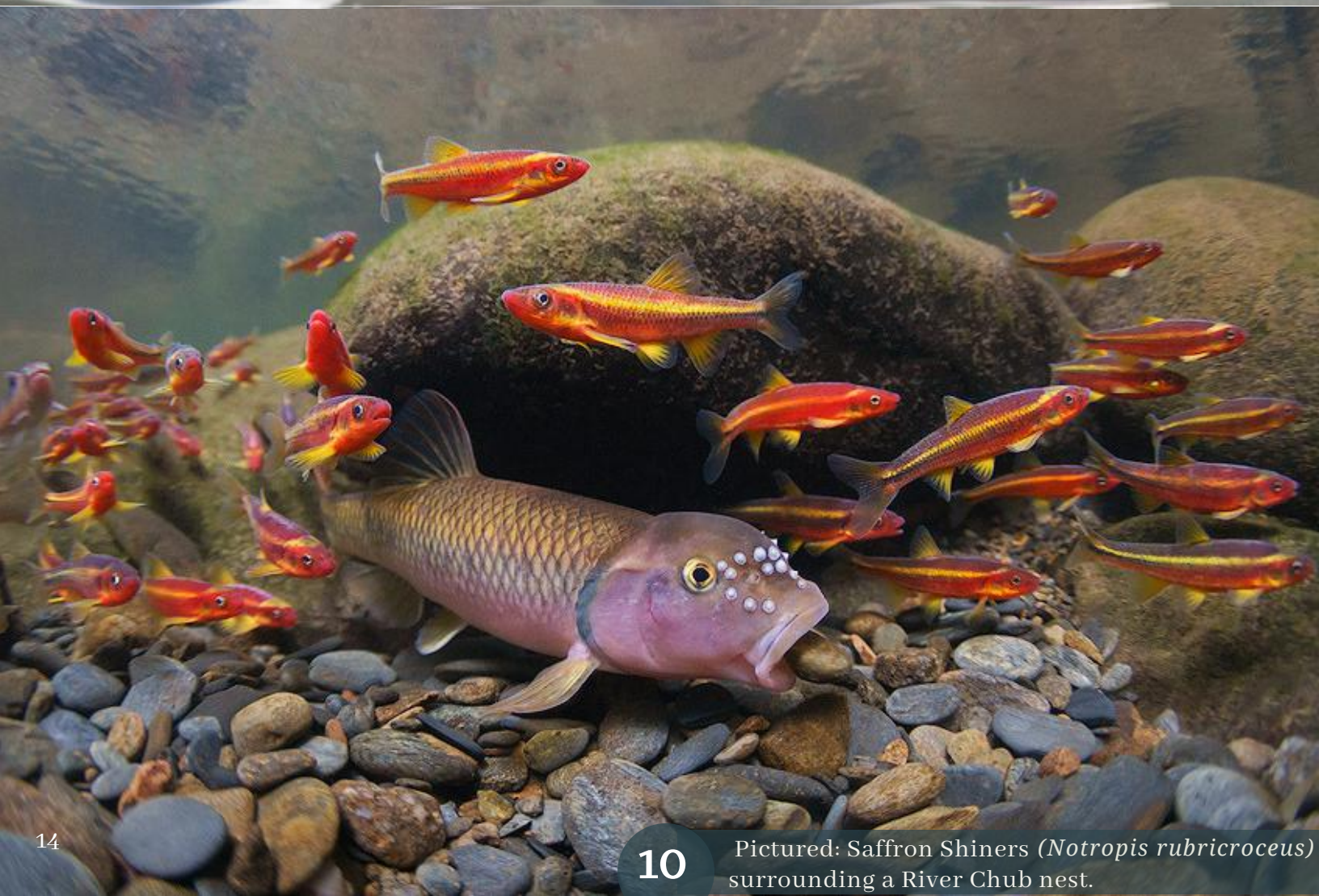
The levels of bacteria typically increase during the summer months due to warmer water temperatures and lower water levels, which aid in the reproduction and growth of the bacteria resulting in higher concentrations. During the June to September months, levels of *E. coli* in some streams near the riding stables may exceed human health standards set by the EPA. In these areas, visitors should be cautious particularly if they choose to enter the water.

The National Park Service recognizes water quality as a primary concern and is currently working to mitigate *E. coli* issues at the riding stables. Once the results are complete, GRSM will use these data to guide management decisions and implement potential mitigation techniques in order to protect human health and ecosystem health.

Author: Nathan Bolick

Beneath The Blue

Below the surface of the rivers across the eastern United States a great spectacle occurs every spring. What may appear as a grouping of red aquatic plants at first glance is actually a gathering of red fish called Tennessee Shiners (*Notropis leuciodus*). The number of these fish can range in the thousands. This curious event is in response to the reproductive behaviors of a variety of fish species, and at the center of it all is the River Chub (*Nocomis micropogon*).



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Pictured: Saffron Shiners *(Notropis rubricroceus)* surrounding a River Chub nest.

The River Chub

is part of the minnow family, and it is a common species found in large streams and rivers in the eastern United States as far north as Michigan and as far south as northern Georgia. River Chubs are large minnows typically reaching 5-9 inches at maturity. During the breeding season male River Chubs develop a pinkish-purple hue and grow keratinous nodules on their head called tubercles.

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A lone warpaint shiner swims above a chub nest which was abandoned after breeding season.

In the spring and early summer the male begins to construct a circular mound out of thousands of similar-sized stones until the nest is 2-3 feet across and 8-12 inches high. This undertaking is done over the course of a few days. Once his nest is built he creates a shallow depression on the top where the female will lay her eggs. After the male and a gravid female have copulated, the male will cover the eggs are with gravel and begin aggressively defending the nest against other males.

However, other species see this defensive behavior and protected nest as an opportunity to lay their own eggs. These species, known as nest associates, can include: the Tennessee Shiner (*Notropis leuciodus*), Saffron Shiner (*Notropis rubricroceus*), Warpaint Shiner (*Luxilus coccogenis*), and the Central Stoneroller (*Campostoma anomalum*) among many others.

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Tennessee Shiners

2

Saffron Shiner

2

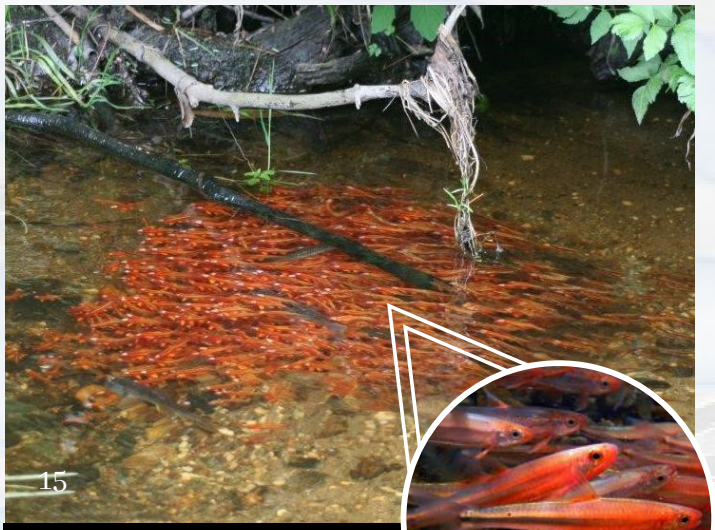
Central Stoneroller

2

Warpaint Shiner

The nest associates will gather around as the nest is being built, waiting to spawn simultaneously with the host fish. This gathering of shiners in their breeding coloration creates the mass of red visible through the water.

With the protection from predators provided by the male River Chub, the hatch rate of all the eggs found in the nest increases. While the freeloading nest associates may not appear to be helping the hardworking chub, the addition of other species eggs to the mound means that his eggs are less likely to be preyed upon, and have a greater chance of survival. In the end, all the species can benefit from this shared nesting, and so this spectacle continues, year after year.



Tennessee Shiners and Saffron Shiners often form the conspicuous orange masses around River Chub nests found in the Smokies.

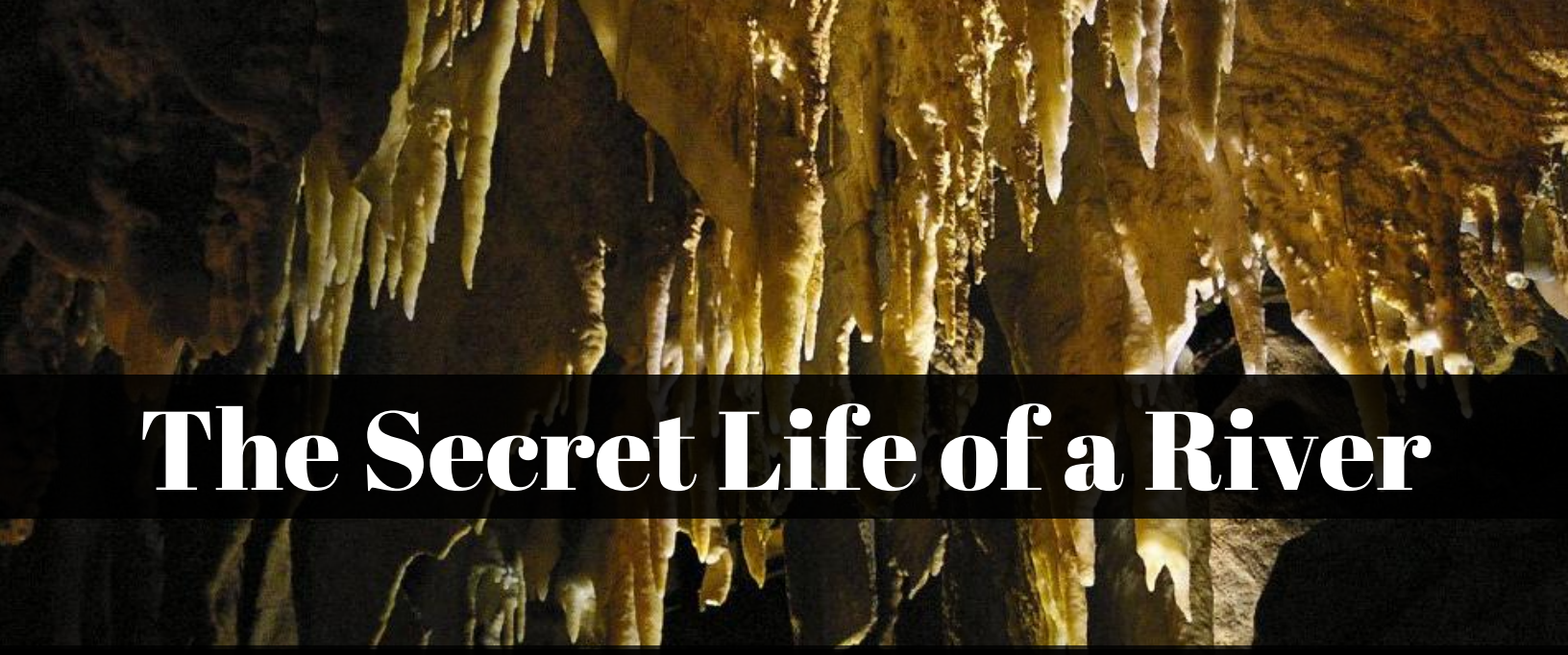
For more information and a cool video check out the resources below!

https://www.youtube.com/watch?v=YBY3k12R2MM

http://tennesseeaquarium.blogspot.com/2013/01/minnow-mystery-unmasked.html

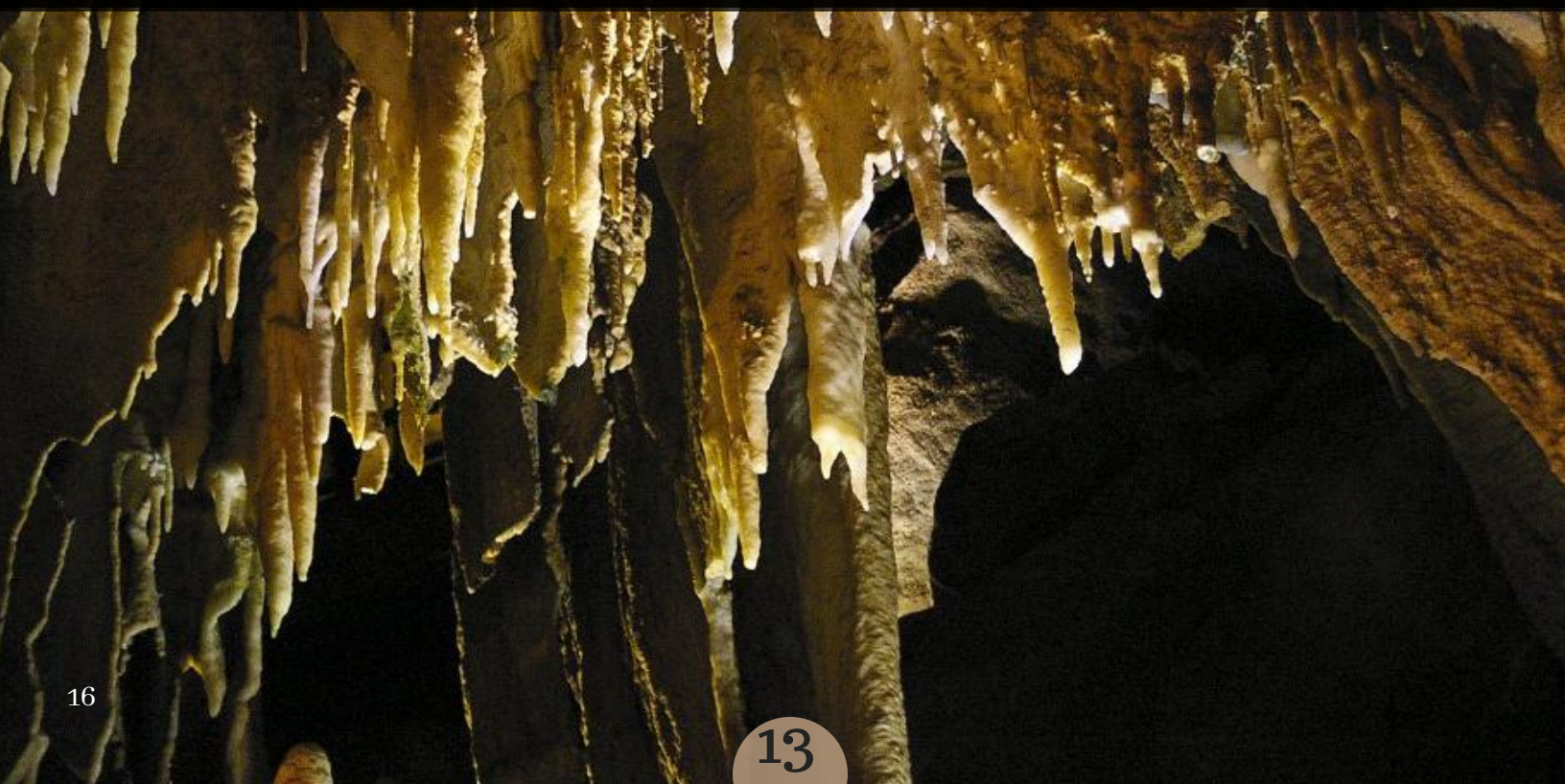
http://wildlife.ohiodnr.gov/species-and-habitats/species-guide-index/fish/river-chub

Author: Caitlin Livingston



The Secret Life of a River

The question of "what goes on beneath the surface?" takes on a new meaning for rivers in karst systems. These bodies of water can travel through a labyrinth of caverns below ground before emerging on the earth's surface. Because the complex routes these waters travel underground, there are many questions about the rivers that still remain unanswered. Several projects are underway within the western Great Smoky Mountains to discover where these waters flow and how these systems work.



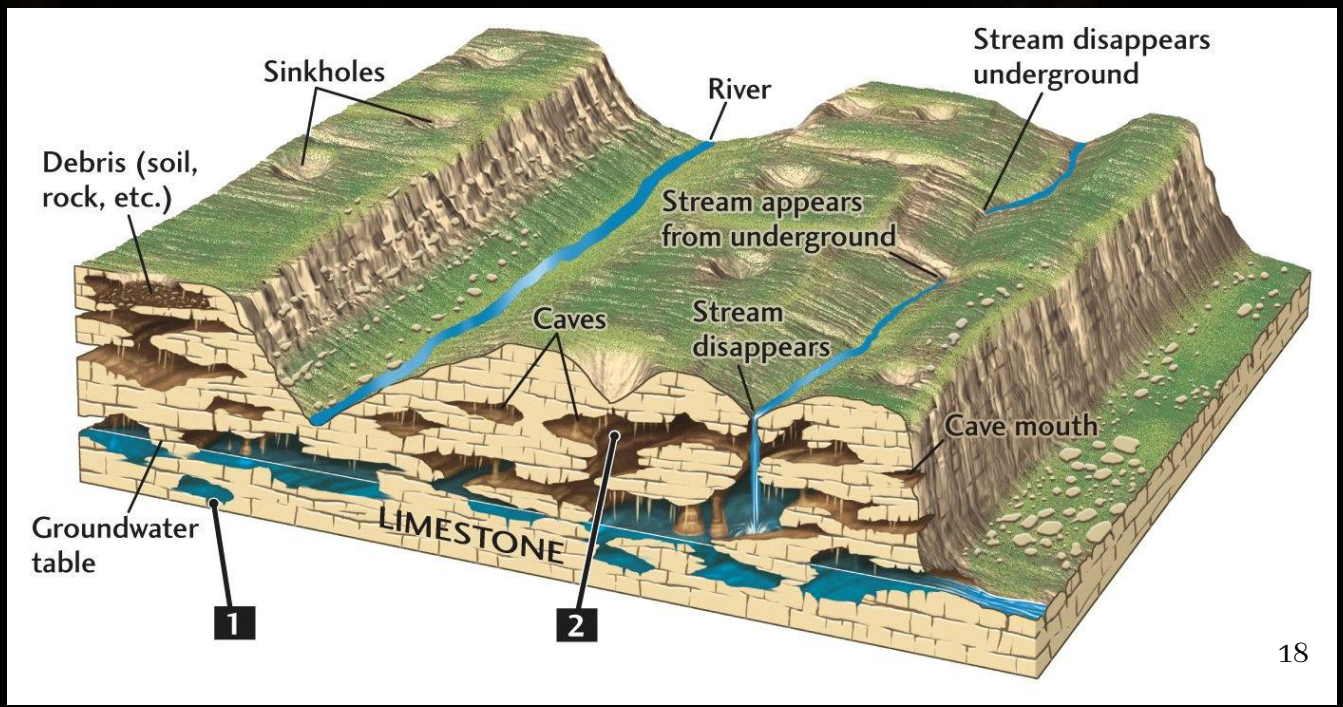
What is Karst Topography?

Karst topography is a type of topography commonly occurring in areas underlain by soluble carbonate bedrock, commonly characterized by sinkholes, caves, and underground drainage systems. What allows for the development of these karst formations lies in the characteristic bedrock of karst systems.

This image shows a sinkhole, formed as a result of the karst system underground.

How do Karst Systems Form?

Carbonate rocks such as limestone and dolostone are relatively easily dissolved by naturally occurring weakly acidic water. Flowing through cracks and pores in the bedrock, this water continually dissolves the rock and gradually enlarges the openings and pathways through the carbonate rock layers. Such formations as Mammoth Cave in Kentucky and Bull Cave and White Oak Sink in Great Smoky Mountains National Park were formed by processes such as this over the millennia. Sinkholes are created when a cave, cavern, or other hollow underground collapses, causing the ground above to "sink". Karst systems can be relatively dynamic and are significant hydrologically, as water frequently and sometimes continuously flows through them.



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Karst in the Park

Recently, the United States Geological Survey (USGS), Tallassee Fund, Tennessee Wildlife Resources Agency (TWRA), and the National Park Service (NPS) cooperated to begin a study of the karst hydrology of the western Great Smoky Mountains. The goals of this study are to characterize the hydrology and geology of the karst areas of Great Smoky Mountain National Park, to understand the hydrologic behavior of the cave stream and groundwater features of the caves located to the north of Cades Cove, and to better define the hydrologic understanding needed to evaluate threats to the karst resources in these areas. These goals are being accomplished through the installation of stream gages and data loggers both in surface water in Abrams Creek and in underground water resources in Bull Cave and White Oak blowhole Cave, as well as through dye tracing and seepage runs conducted in various locations in that area of the park. The gages and data loggers installed allow for collection of stage, temperature, and conductivity data in these areas, which tells USGS researchers how much water is running through these systems, how they react to precipitation events, and their general behavior.

A dye trace is a method used to determine where water flows and how fast it gets there. Dye, such as rhodamine wt, is injected into a stream or other water system, where it will flow downstream. Downstream areas are monitored for resurgence of the dye. Knowing where the dye ends up and how long it took for it to get there allows for researchers to determine the path of travel and the velocity at which it moved. Resulting from a series of dye traces conducted in four cave systems found along Rich Mountain and Scott Mountain, researchers have identified the resurgence point and travel velocity for water in each of the systems and the existence of at least four distinct spring basins in Tuckaleechee Cove.

Dye trace injection in progress.

A seepage run is a method where multiple discharge measurements are made along a stream to establish whether the stream is gaining (groundwater is flowing into the stream) or losing (stream water is sinking into the groundwater system) in any particular section. This allows researchers to better understand the dynamics of the system and better understand the risks to ground and surface water in certain areas. USGS hydrographers and hydrologists conducted a seepage run on the Abrams Creek system in Cades Cove and found that the stream is gaining in stretches up in the surrounding hills but begins losing as soon as it reaches the cove floor, actually drying up completely mid-valley at Hyatt Lane before being fed by springs and seeps near the confluence with Feezell Branch. The sections that lost the most water coincided with the inflection point of the steeper surrounding slopes with the flatter, more gently sloping cove floor, which happens to be underlain by soluble limestone, potentially explaining the loss of surface water to the groundwater system.

The data gained from this study will help the park to properly identify and manage risks to the ecosystem in that area. Understanding the hydrology of the area allows us to predict the damage a chemical spill may cause, better understand threats to the ecosystem, or locate vulnerable areas that may need special attention or protection. The study is still underway, with more sampling projects and data collection planned, hopefully ultimately leading to a complete, thorough comprehension of the karst hydrology in that area, helping the park to preserve unimpaired the natural resources of this area for this generation and generations to come.

Author: Joe Rector

Rising *From the* Ashes

In November 2016, the Chimney Tops 2 Fire burned roughly 11,410 acres of park land and impacted 55 linear miles of streams, including Baskins Creek, Leconte Creek, Twomile Branch, Road Prong, Roaring Fork and the West Prong of the Little Pigeon River. These cold-cool streams listed are home to 17 species of native fish, including Brook Trout, Longnose Dace, Stonerollers and Greenside Darter.


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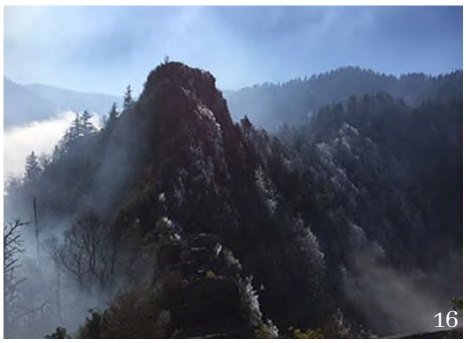
These species are just a part of what Franklin Roosevelt was referring to in his dedication speech for Great Smoky Mountains National Park in that they are “for the permanent enjoyment of the people."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After a major fire event, many factors determine the severity of the impact on the aquatic biota in the short term as well as the long term. These factors include the severity of the burned area around the streams and drainage pathways, habitat connectivity in terms of refuge sites, and sedimentation. The main short term threat is sediment loading to streams, which can inhibit gill function and suffocate eggs of fish and aquatic insects. The suffocation of eggs impacts the recruitment of young of year fish into the stream population, which lowers the amount of fish to be viewed or harvested in the long term. Additionally, the sediment increases stream turbidity, which can raise the temperature of the streams due to solar absorption. This is important for the game fish such as trout who need the cold water to spawn and survive.

Although these environmental issues can occur as a result of fire, observations from water quality monitoring are within the normal range to date. Even after a storm event, turbidity levels in the West Prong of the Little Pigeon River is tracked to pre-fire levels (Figure 1). Additionally, pre- vs. post-fire mean turbidity after storm events indicated no significant differences and the peaks of storms were very similar.

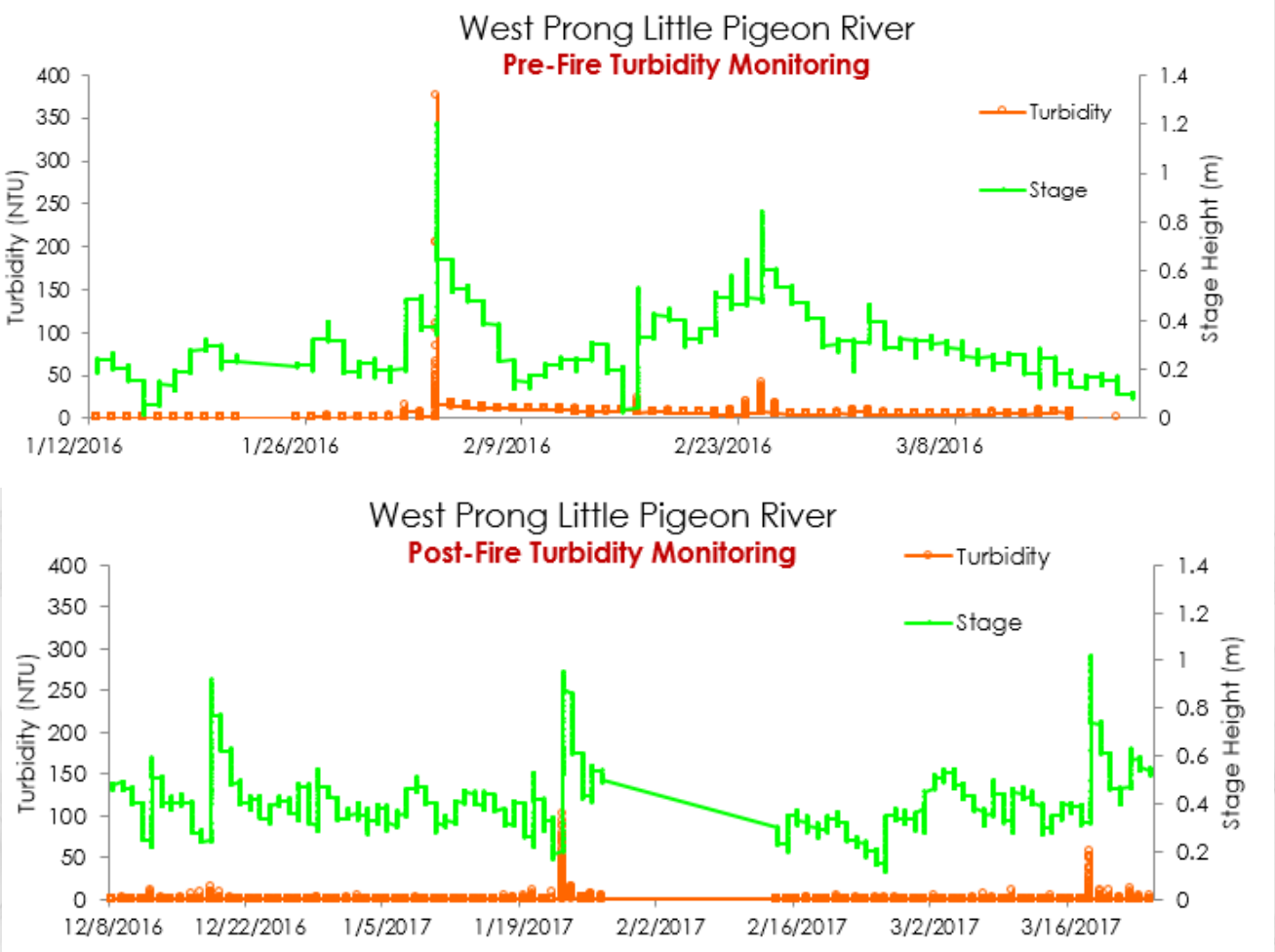


Figure 1. Turbidity of the West Prong of the Little Pigeon River pre- vs. post-fire after a similarly sized storm event were studied and results indicate pre- versus post- fire turbidity levels were very similar.

In terms of water chemistry, Leconte Creek, which includes 1.6 miles of restored brook trout water, had no significant differences in pre- vs. post-fire water chemistry (Figure 2). However, in the West Prong of the Little Pigeon River there were statistically significant lower nitrate, sulfate, calcium and ANC levels. The conductivity and pH of the West Prong of the Little Pigeon River had no significant differences in the pre- vs. post-fire water chemistry.

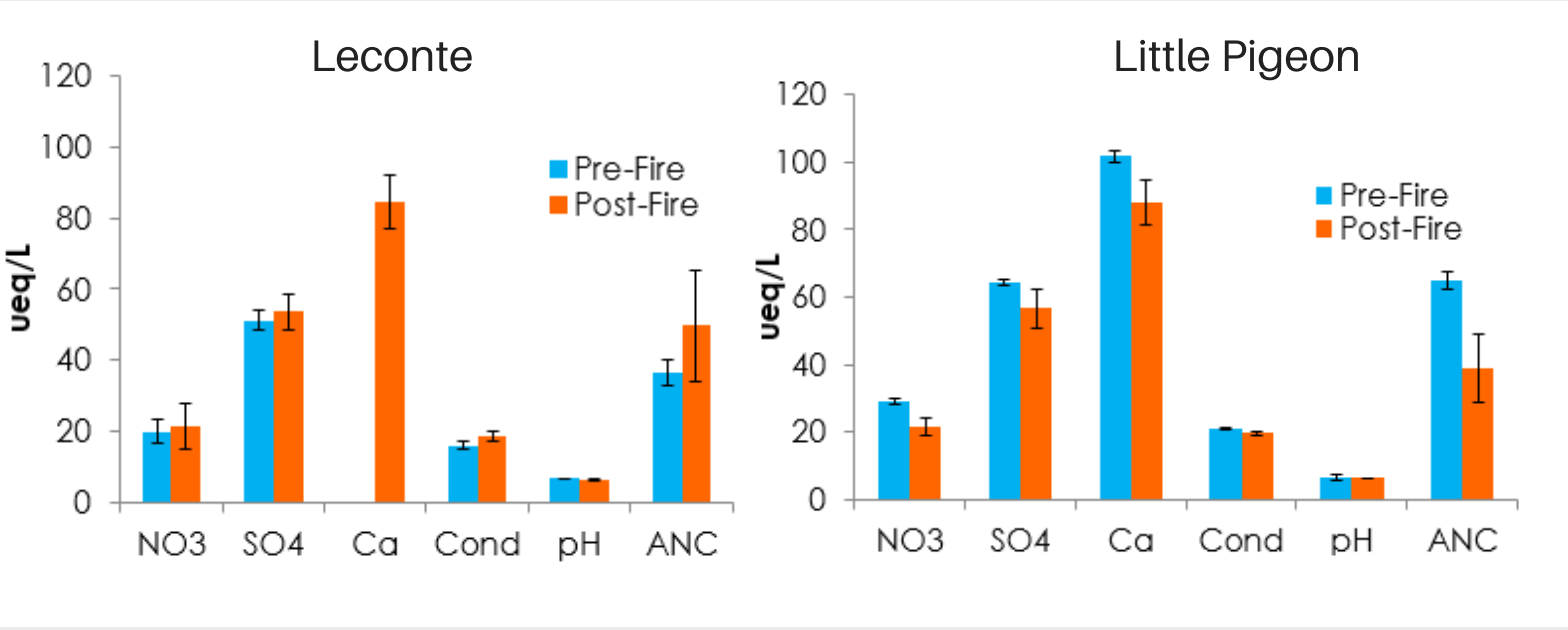


Figure 2. Water chemistry results for pre and post-fire of streams in the impacted zone. Pre-fire levels are in blue and in the orange are post-fire levels. There were no biologically significant differences in pre- versus post-fire water chemistry in any of the study sites.

Despite some minor changes in water chemistry in West Prong Little Pigeon river (Figure 2), the biomass of a burned area vs. a site above the burned area indicated no biological differences in salmonids or non- game fish (Figure 3). Overall in 2017, the stream biomass declined park wide due to the low summer/fall stream flows from the drought in 2016. The drought impacted the productivity of the streams and the adult recruitment. However, the populations usually recover in 1-2 years to carrying capacity.

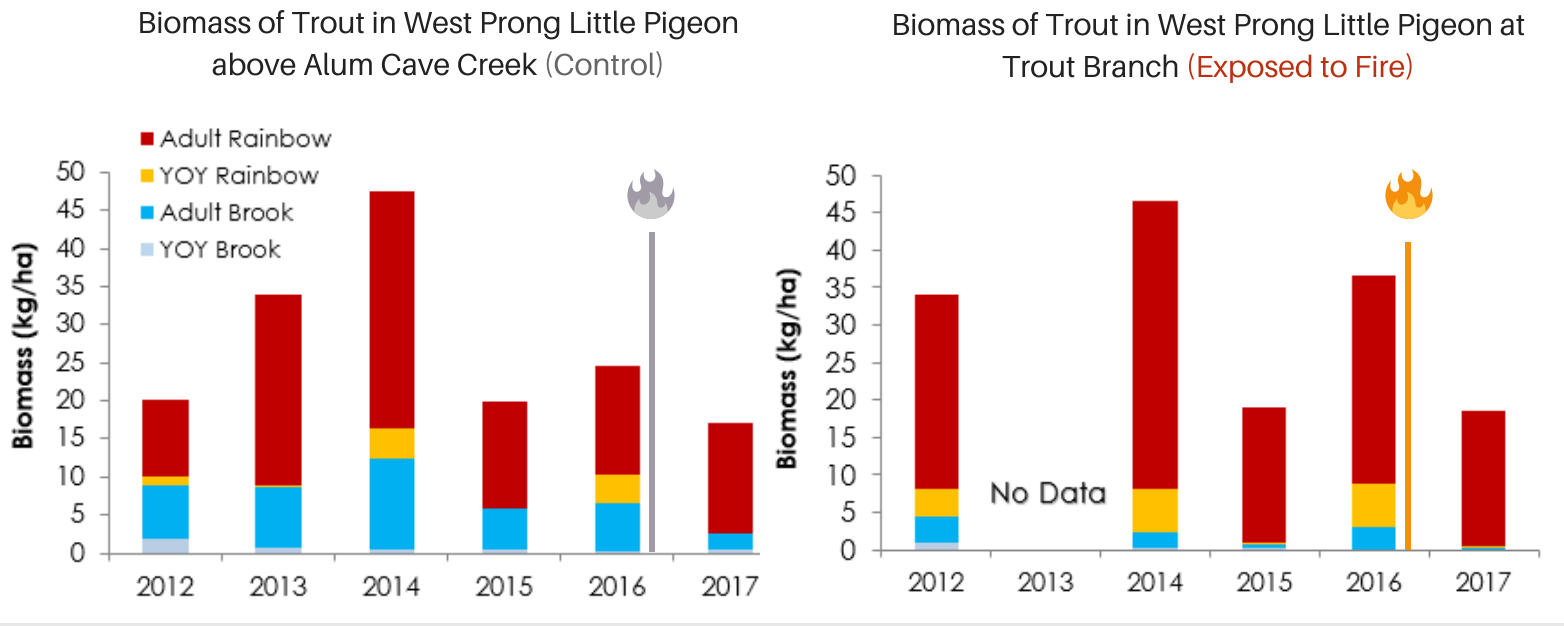


Figure 3. A control site versus a burned area site in terms of game fish assemblage and biomass. There was no biological differences in biomass noted between pre- versus post-fire results.

Overall the fire effects were short-lived, with the water chemistry having negligible differences or not any observed differences. There was no significant difference observed in turbidity from the pre- vs. post-fire sites and storm event peak sediment levels were very similar for similarly sized stream flows. The majority of the park burn area received a low to moderate burn with very limited severe burns within the park. The duff layer was still intact through most of the burn area, so minimal runoff was observed and primary succession was very strong.

The stream health was observed to have no significant difference in fish or water quality. These results indicate the water remains healthy and affected streams are still full of harvestable game fish and non-game fish for observation.

Brook Trout are found in the fire impacted zone.

Author: Randy Fink

Fish of the Smokies

Built to win from head to fin!

Western Mosquitofish

Gambusia affinis

1

Total length:1-2.5 inches at maturity
Life Span: ~1 Year

The Western Mosquitofish is a common North American fish, however it has only been documented within the park at Tabcat creek. The Western Mosquitofish typically lives in shallow, lentic (slow moving) waters where it preys on insects that fall on the water surface, including mosquito larvae, hence their name "Mosquitofish." Mosquitofish are live bearers, meaning the males fertilize the female's eggs internally, and the female will carry the eggs until they hatch inside her. This strategy ensures greater protection of her eggs and a much higher hatch rate than fish that lay their eggs in the gravel.

Redline Darter

Etheostoma rufilineatum

2

Total Length:1.5-2.5 inches at maturity
Life Span: 3-4 Years

Redline darters occur only in the Tennessee and Cumberland river drainages. These fish prefer riffles, but can also be found in runs and pools depending upon the season. They primarily feed on swimming mayfly nymphs and blackfly larvae. Males exhibit brilliant colors, especially during breeding season (May-August). Redline Darters are in the genus Etheostoma, which has more species than any other genus of freshwater fish in North America.

River Redhorse

Moxostoma carinatum

3

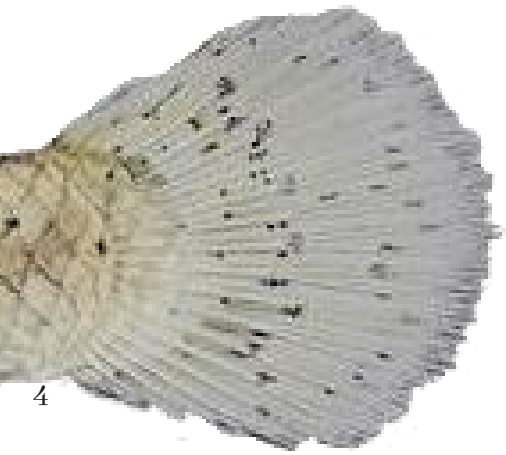
Total length: 16-29 inches at maturity
Life Span: 8-12 Years

River Redhorses are uncommon within the Great Smoky Mountains, and although they have been recorded in both Abrams creek and Little Tennessee River systems they likely only occupy those waters part time, as they generally prefer larger, deeper rivers than those found in the park. Unfortunately, these fish are in decline due to dams that fragment their natural distribution and keep fish from traveling their historic routes. River Redhorses are also threatened by sedimentation from development and agriculture, which can cover the gravel which they nest in and smother their eggs.

Author: Briana Cairco

What's in a fin?

The caudal fin, or "tail" fin, of a fish can tell you a lot about the habitat preference of a species. There are 3 caudal fin shapes seen most frequently in freshwater fishes and each shape is suited for different swimming actions.



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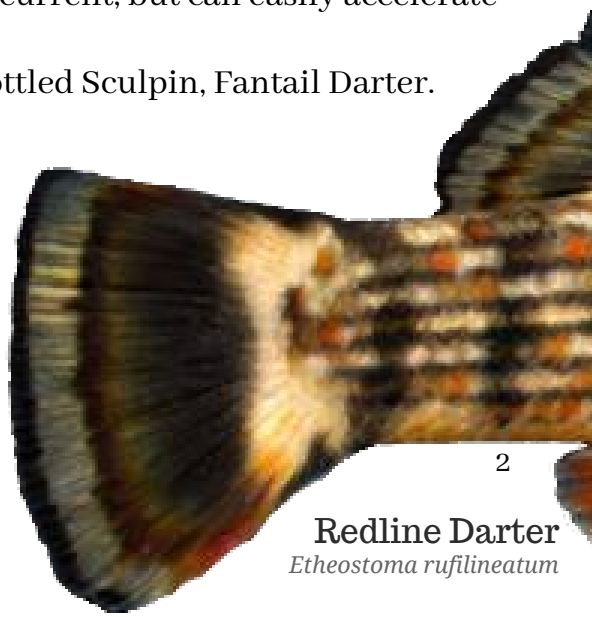
Western Mosquitofish

Gambusia affinis

Mosquitofish have rounded caudal fins. Rounded fins have the most surface area, allowing the fish to accelerate quickly, maneuver around obstacles, and avoid predators. Rounded fins also generate the most drag, causing fish to tire quickly after accelerating. Fish with this type of caudal fin are best adapted for slow or still water where they don't have to fight the current, but can easily accelerate in short small bursts.

Other examples in the park: Mottled Sculpin, Fantail Darter.



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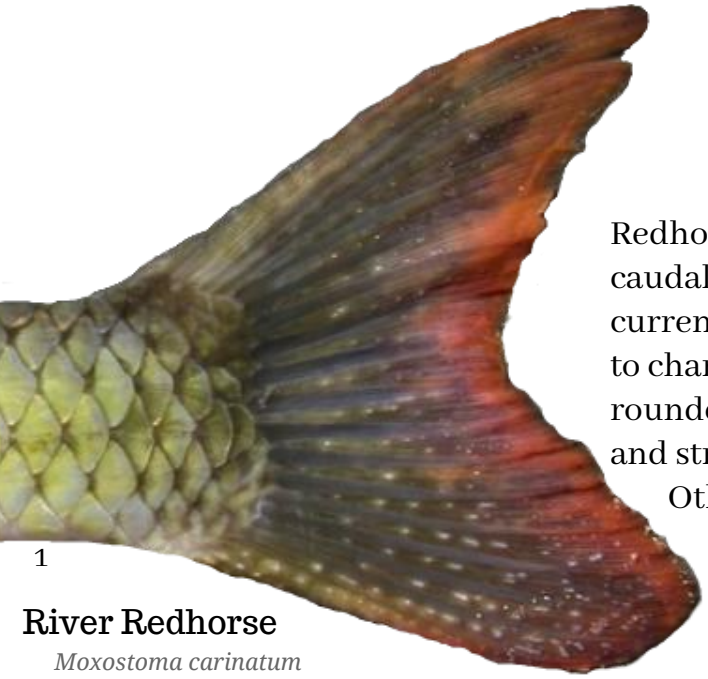
Redline Darter

Etheostoma rufilineatum

Many darter species within the park, including the Redline Darter, have truncate caudal fins. This shape is more streamlined than round fins, allowing fish to swim in currents without tiring as quickly. Truncate fins still have plenty of surface area for easy maneuvering. Truncate fins are a happy medium for fish that need to maneuver between obstacles to hide from predators, but may also need to swim quickly or fight currents.

Other examples in the park: Yellow Bullhead, Greenfin Darter.



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River Redhorse

Moxostoma carinatum

Redhorses are among the fastest fishes in the park. Their forked caudal fins eliminate drag and allow them to fight the swift currents in the runs where they live. While they may not be able to change directions as quickly or turn as sharply as fish with rounded or truncate fins, few fish can compete with the speed and strength of the River Redhorse.

Other examples in the park: Brook Trout, Whitetail Shiner.

Author: Briana Cairco

COMING SOON TO A THEATER NEAR YOU...

LIPS

Read My Lips

Though fish can't talk, their mouths and lips can speak volumes about them. The orientation of a fish's mouth gives clues about where they live in the water column and what they might eat. In certain groups of fishes the easiest way to tell species apart is by comparing the shapes of their lips.

Superior

Western Mosquitofish

Gambusia affinis

The Western Mosquitofish has a superior mouth, this means their mouths are oriented to the top of their head. Fish with superior mouths usually wait for prey to come to them before they strike. Anglerfish and Betta fish also have this mouth type.

-Mosquitofish use their superior mouths to feed on insects on the waters' surface, and to take in air, which they can uniquely breathe through their mouth instead of their gills, if necessary.

Terminal

Redline Darter

Etheostoma rufilineatum

Redline Darters have mouths that point forward and are centered on their head, this type of mouth is called a terminal mouth. Fish with terminal mouths usually feed in the middle of the water column. Terminal mouths are versatile, allowing fish to pursue prey, filter feed, or pick insects off of rocks.
Many fish such as Brook trout and Northern Pike have terminal mouths as well.

Inferior

River Redhorse

Moxostoma carinatum

River Redhorses are in the family Catostomidae, or the "sucker fish." Appropriately named, these fish all have inferior mouths used for "sucking" up food on the substrate below. River Redhorses differ from other species of red horse in having molariform teeth which they use to crush clams and other mollusks, the primary component of their diet. River Redhorse are known to eat the invasive clam *Corbicula*, which is good news for keeping the invaders at bay and offers a plentiful food source for the River Redhorses.
Plecos, Catfish, and Longnose Dace, are other examples of fish with inferior mouths.

Author: Briana Cairco

About the Authors

Briana Cairco: Seasonal Fisheries Technician

Briana graduated from Clemson University with a BS in Wildlife & Fisheries, and a minor in Entomology. She grew up catching bugs and playing in the creeks of Fort Mill, South Carolina. Briana has also worked in New River Gorge National River in West Virginia as both an aquatics intern and a forest health protection intern. In the future, she plans to work in resource education.

Josh Cary: Seasonal Fisheries Technician

Joshua Cary is a graduate of Clemson University where he earned a BS in Conservation Biology. Clemson is also where he found his passion; working with stream fish. Immediately after college, Josh took a job in his home state of Maryland completing stream and wetland restoration projects and continuing the study of stream fish. He plans to pursue a Master's degree in fisheries biology and continue working with stream fish.

Hailey Goyette: Seasonal Fisheries Technician

Hailey "Hailstorm" Goyette is from Flagstaff, Arizona and came to work in the Smokies after completing a BS in Forestry and minor in Biology at Northern Arizona University. Her previous internships with Arizona Game and Fish Department consisted of working on restoration projects involving the native Apache Trout, which set her on a path into fisheries work. She hopes to pursue a permanent fisheries position in the future.

Nathan Bolick: Seasonal Fisheries Technician

Nathan Bolick earned his Bachelors degree in Ecology, Evolution, and Environmental Biology from Appalachian State University in December 2017. Nathan comes from Blowing Rock, NC where he spends his time bear hunting, training dogs, and fishing. When he is not preparing for hunting season he enjoys skydiving, traveling, and dancing. Nate would like to continue working in natural resources as an educator or interpretive ranger.

Caitlin Livingston: Southeastern Conservation Corps Intern

Caitlin was born and raised in Knoxville, Tennessee and earned a BS in Wildlife & Fisheries Science from University of Tennessee. Caitlin enjoys deer hunting, fishing, and spending time outside. Before working at GRSM, she worked in Indiana conducting electrofishing surveys. Caitlin is interested in many aspects of natural resources and would like to explore careers in wildlife for her next job.

Joe Rector: Southeastern Conservation Corps Intern

Joe "Slim" Rector hails from Aurora, Indiana. He graduated from Hanover College in May 2018 with a double major in Geology and Biology, and joined the fisheries crew shortly after. Joe would like to continue working in the fisheries field, and eventually return to school for a Master's degree in Fisheries Biology. Joe is also an avid birder, rock enthusiast, and has shown great potential for a career in competitive eating.

Randy Fink: Seasonal Fisheries Technician

Randy joined the seasonal fisheries crew by the way of Coastal Carolina University where he studied marine science. He was involved in fisheries monitoring while at CCU and helped with a NOAA groundfish trawl sampling cruise. He was inspired by the conservation and restoration work done in the Great Smoky Mountains National Park. He is hoping to become a full time fishery biologist in the future.

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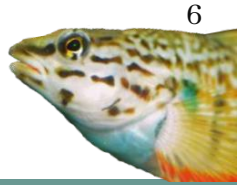

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