



Fall 2017

Stream Guardian

Great Smoky Mountains National Park

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Banded Sculpin (*Cottus carolinae*) eating Redline Darter (*Etheostoma rufilineatum*)
(Photo credit: Aaron Coons)



From the Top...

Greg Bushey & Jason R. Brown

Welcome to the Great Smoky Mountains National Park Fisheries Department's periodic newsletter! Throughout this newsletter and others that follow, we will feature a variety of the park's aquatic inhabitants, such as our only native trout species, the Brook Trout (*Salvelinus fontinalis*), and the park's efforts to preserve and restore other fish species. In addition, we will highlight the methods and techniques used by the fisheries department, such as electro-fishing and creel surveys, to monitor the aquatic communities of the park. Various on-going projects involving the park or its staff will also be presented and updated progressively as noteworthy events take place. We hope that each newsletter will leave readers more educated and informed about the activities and actions being conducted within the park that we all know and love. Enjoy!

Public Service Announcement: Creel Surveys

Jason R. Brown

It is estimated that approximately 400,000 individual anglers visit the roughly 750 miles of fishable waterways of Great Smoky Mountains National Park each year. Such large visitation would make anyone, park staff and visitors alike, interested in where these activities are being focused. It was shown in a National Park Service study, which can be found at <https://www.nps.gov/grsm/learn/nature/upload/fishing-study.pdf>, that the pressures of angling by the general public do not affect long-term fish population abundance. But how can the park quantify the levels of angling frequency on specific waters?

A creel survey contains basic information about any fishing trip, no matter the duration or success, including elapsed time, location, number of fish caught, and whether they were kept or released. These data are then analyzed to determine the amount of pressure a particular waterway typically experiences and the level of success anglers can expect during a visit to their chosen fishing site.

Knowledge gained from this information can then be used by park staff and anglers themselves to ensure that every visitor to the park has an enjoyable experience, whether they are seeking a social environment, peace and quiet, or simply want to know where the most productive fishing sites are located. For example, creel survey data tracking from 1958 to today have shown, on average across the park, anglers that live near the park and frequent the local waters can expect catch rates of 2.4 fish per hour, while those visiting from outside of a 50-mile range around the park typically catch closer to 1.3 fish per hour. So if you're on a mission to catch high numbers of fish during a vacation visit to the Smokies, some local fishing friends may be just what you need!

Other interesting information can be drawn from these data as well, such as the fact that harvest rates with local anglers are more than 60% higher than with out-of-town visitors to the park (0.5 fish per hour and 0.3 fish per hour, respectively). This suggests that vacationing anglers are more prone to fishing for entertainment purposes and less likely to be in pursuit of a fish dinner than area locals. This trend has been seen to be on the rise at destinations across the nation.



(Photo Credit: Ian and Charity Rutter)

By filling out a simple survey, now available online at <https://www.nps.gov/grsm/planyourvisit/creel-survey.htm>, anglers can assist the park staff in understanding the needs of the anglers, the fish they pursue, and other visitors to the park in general.

Some Fish You May Have Missed...

Cass Garrigus

The Smoky Madtom (*Noturus baileyi*) is a federally endangered catfish that is only found in two creeks in the world, both of which are in South-eastern Tennessee. These small catfish can be found in Citico Creek within the Cherokee National Forest as well as lower Abrams Creek in Great Smoky Mountains National Park. Smoky Madtoms were thought to be extinct after an application of the piscicide rotenone was applied to Abrams Creek in an effort to create a trophy Rainbow Trout (*Oncorhynchus mykiss*) stream in 1957. They were reintroduced to Abrams Creek in 1987 and have since established viable populations.

Smoky Madtoms are a skittish, nocturnal species that can reach a maximum length of 3 inches (73 mm). They usually occupy riffle and run portions of the stream from summer to fall and gentle runs and pools in winter through spring. They can be found in gravel and cobble substrate with small boulders. During the spring, females will lay eggs under these boulders and leave the male to protect the eggs. Similar to other species, they may abandon the nest if it is disturbed, such as by rock dam or channel construction by people.



Smoky Madtom (*Noturus baileyi*)
(Photo Credit: Conservation Fisheries, Inc.)



Above: Central Stoneroller (*Campostoma anomalum*)
Below: *C. anomalum* breeding male
(Photo Credits: Etnier/Starnes 1993)

The Central Stoneroller (*Campostoma anomalum*) is abundant in both small streams and large rivers in Tennessee. The males can reach a length of 12 inches (30 cm). Their preferred habitat is gravel bottomed streams, where males will build a nest for spawning by rolling stones with his mouth. These large mounds of stones can be seen in early summer as other, often more colorful, fishes gather on them to also spawn or feed on the eggs. Some anglers have dubbed them “Hornyheads” in reference to tubercles on a sexually mature male’s head, which resemble little horns. The tubercles are used to defend their nest from other males, although the Stoneroller will allow the nest to be used by other fish species.

Crayfish Species of the Smokies

Parker Hildreth

Crayfish of the Smokies are known to thrive in a range of ecological niches from elevations of 1,200 feet to over 5,000 feet and in every aquatic environment. The diversity of crayfish in the Great Smoky Mountains National Park is currently at 11 species, with the protected park environment serving as the perfect catalyst for new scientific discovery.

As the name implies, the Common Crayfish (*Cambarus bartonii bartonii*) is the most often encountered species. The range of this species spans the entire park and is the only species to be found in the lowest elevation streams such as the Pigeon River or Little River, all the way into the park's headwater streams.



Common Crayfish
Cambarus bartonii bartonii
(Photo Credit: Parker Hildreth)



Red Burrowing Crayfish (*Cambarus carolinus*) "castle"

The Red Burrowing Crayfish (*Cambarus carolinus*) is another example of crayfish diversity in the park. One of the park's more brilliantly-colored burrowing crayfish, they live their entire lives beneath a small tower of mud on streambanks called a "Crayfish Castle," where they perform all of life's functions below the waterline. Burrowing crayfish use the small pocket of water at the base of their burrows to keep their gills moist, which allows them to survive in the subterranean environment. Burrowing crayfish will even use mud from their excavation to seal off the entrance of the burrow to prevent desiccation during times of drought.



Reticulated Crayfish
Orconectes erichsonianus
(Photo Credit: Parker Hildreth)

The Reticulated Crayfish (*Orconectes erichsonianus*) is a species that resides primarily in the warmer waters of Abrams Creek. This species lives along the shoreline, using the nutrient-rich waters blanketed by siltation as feeding grounds and housing. Like all crayfish, the Reticulated Crayfish is primarily a scavenger. Unlike other crayfish, this species has a uniquely voracious appetite and feeds on a variety of available food sources within its preferred habitat.

Underappreciated Inverts

Emily Bush

The Great Smoky Mountains National Park is known for its rich biodiversity. However, many living species in the park often go unseen. Not because people aren't looking, but because these species are hidden. Freshwater mussels are a great example of this phenomenon.

These small creatures vary in population sizes due to several factors such as stream depth, velocity, temperature, alkalinity, and substrate composition. Freshwater mussels filter feed, which means they consume small particles floating in the water. This makes them one of the only animals that actually improve water quality. However, it also means they are highly susceptible to contaminants in the water, such as pollution and sedimentation. This fact makes freshwater mussels a great species to examine for stream health. The less pollution and sedimentation a stream has, the more mussels it can contain.

The life history of freshwater mussels is unique. After fertilization, the female will attach her eggs to the gills of fish by either releasing the eggs in the water as a dense cloud or waving her mantle flap to provoke fish to attack her and spraying the dense egg cloud into the fish's gills. Once the mussel larvae, or glochidia, reach a certain size, they drop off and burrow into the streambed to start their life cycle.



Freshwater mussel displaying mantle flap
in Abrams Creek.



Wavy-rayed Lampmussel (*Lampsilis fasciola*)
in Abrams Creek
(Photo Credit: Eric Malone)

Of the 133 species of freshwater mussels historically found in Tennessee, at least 45 have been designated as Endangered under the Endangered Species Act and at least 16 species are believed to be extinct. These losses are mainly due to competition with invasive species, overharvesting, habitat degradation or loss, sedimentation, and poor water quality. Surveys conducted in 2016 and 2017 documented 5 different species in Abrams Creek at and near the impounded section of Chilhowee Reservoir with the most common species observed being the Rainbow Mussel (*Villosa iris*) and the Cumberland Moccasinshell (*Medionidus conradicus*).

Currently, steps are being taken within the Smokies to promote the success of native freshwater mussel populations. Notably, the reintroduction of various host fish species to Abrams Creek began in 2017. See the article "Native Fish Restoration: Abrams Creek" of this newsletter for more information about this project. It is hoped that the reintroduction of native host fish will promote population expansion of the native mussel fauna.

Fighting for Brook Trout

Grant Woodard

The Southern Appalachian Brook Trout (*Salvelinus fontinalis*) is an iconic native species found in Great Smoky Mountains National Park (GRSM) and is the only trout species native to this region. While once distributed throughout the majority of the park's streams, habitat degradation from logging and competition from non-native species, like Rainbow Trout (*Oncorhynchus mykiss*) and Brown Trout (*Salmo trutta*), reduced the current distribution of Brook Trout by 75% since the early 1900s. In order to preserve this species, the National Park Service has been restoring streams around the park to regain portions of the native Brook Trout range.

GRSM uses two methods to restore Brook Trout streams: Electrofishing and piscicide application. Electrofishing involves the use of backpack electrofishing units which send electricity into the water to stun the fish. Through electrofishing, fisheries employees systematically work through sections of a restoration site, manually shocking and removing non-native Rainbow Trout. Once the non-native fish are removed, native Brook Trout can then be reintroduced to the area, thus completing the restoration. During the summer of 2016, a restoration effort on 2.1 miles (3.4 km) of Anthony Creek involved the removal of 2,384 individual Rainbow Trout through electroshocking. In the following year, fisheries employees removed remaining Rainbow Trout and 269 Brook Trout were reintroduced to Anthony Creek as of the fall of 2017.

The second method used by GRSM to restore Brook Trout is piscicide application, which uses EPA-approved pesticides that target fish. This method was used to restore Little Cataloochee Creek during the summer of 2017. Prior to treatment, crews used electrofishing to survey the distribution of Rainbow Trout and retain any native Brook Trout found in the treatment zone for reintroduction following the treatment. Once the piscicide was applied and all non-native Rainbow Trout were effectively removed from the treatment zone, Brook Trout were reintroduced to the site.

These restoration efforts added 4.0 miles (6.4 km) of stream to the Brook Trout's current range in the park. These efforts will provide additional opportunities for anglers to target these beautiful species in the GRSM. Thus, the Brook Trout restoration projects of 2016 and 2017 enable the NPS to embody its mission of preserving and protecting native species, while providing additional opportunities for the public to enjoy the native trout of the Smokies.



Brook Trout (*Salvelinus fontinalis*)

(Photo Credit: Grant Woodard)

Native Fish Restoration: Abrams Creek

Eric Malone

In 1957, a fish piscicide, rotenone, was added to lower Abrams Creek to remove the many different smaller species of fish that at the time were considered to be pests in an attempt to create a trophy fishery for non-native Rainbow Trout (*Oncorhynchus mykiss*). This reclamation effort eliminated over 30 species of native fishes, but the trout fishery was never established. Starting in 1986, the National Park Service (NPS), Conservation Fisheries, Inc., U.S. Fish & Wildlife Service and Tennessee Wildlife Resources Agency began restoring lower Abrams Creek by reintroducing the federally-listed Citico Darter (*Etheostoma sitikuense*), Smoky Madtom (*Noturus baileyi*), and Yellowfin Madtom (*Noturus flavipinnis*). However, many other ecologically-important fish species are still not present and require assisted reintroductions to restore.



A Banded Sculpin (*Cottus carolinae*) is well camouflaged against a rocky stream bottom.

(Photo Credit: Aaron Coons)



Several common mussel species found in 2017 snorkel surveys of Abrams Creek.

(Photo Credit: Eric Malone)

Recent efforts have focused on reintroducing Greenside Darters (*Etheostoma blennioides*) and Banded Sculpins (*Cottus carolinae*). These species were selected because they serve as essential hosts to the larvae of some native freshwater mussels. Currently, researchers at Tennessee Technological University and NPS fisheries biologists have identified, collected, and reintroduced 120 Greenside Darters and 509 Banded Sculpins from suitable genetic sources in the Little River to Abrams Creek. It may take several years of translocations for the fish to become established throughout their former range, but partners like the Tennessee Wildlife Resource Agency are committed to assisting with the effort to ensure its success. Once these populations are reestablished, biologists can start mussel restoration efforts since their valuable host species will be in place. It is very easy to harm an ecosystem, but difficult to restore one; however, these efforts are helping lower Abrams Creek slowly recover to its former biodiverse ecosystem.

Park Safety: Mercury Studies

Aaron Coons

As part of the National Park Service's mission to "preserve unimpaired" the natural resources entrusted to it, the Great Smoky Mountains National Park (GRSM) fisheries crew collaborated with U.S. Geological Survey (USGS) research ecologists on a 2015-2016 study to determine levels of toxic mercury in fishes within GRSM and across parks in the eastern U.S.

Because of mercury's status as one of the most widespread environmental contaminants and its potency as a neurotoxin, the presence of this metal in a resource that is commonly consumed by the populace is of great concern, especially in areas of the country that are championed as pristine wildlife habitats. A common pathway for mercury of anthropogenic origins to be delivered to an ecosystem is through atmospheric deposition. This makes mercury analysis in GRSM of special interest, given its correlation with other non-point source atmospheric pollutants, such as acid deposition.

GRSM's contribution to this national study was the collection of 344 fish from 17 sites in 2015 and 2016. Collection sites were chosen across watersheds and elevations to be as representative of the park as possible. Smallmouth Bass (*Micropterus dolomieu*), Blacknose Dace (*Rhinichthys atratulus*), Rainbow Trout (*Oncorhynchus mykiss*), Brown Trout (*Salmo trutta*), and Brook Trout (*Salvelinus fontinalis*) were collected from sites across the park via backpack electrofishing units, seines, and block nets.



Left to right: GRSM fisheries staff electroshocks a stream to collect fish samples. GRSM fisheries staff label and record samples to be processed and analyzed by USGS personnel.

Game fish were the focus of this study in GRSM partly because they generally are top predators in stream food webs. This trophic placement makes them the endpoint for the bioaccumulation of toxins such as mercury. Game fish are also the species most likely to be consumed by humans, making them of particular interest in regards to human health concerns associated with mercury. If this study determines mercury levels exceed human health standards, consumption advisories will be placed upon these species and locations. Results from western U.S. parks have already been reported and are available at:

Western Parks Report: <https://pubs.usgs.gov/of/2014/1051/pdf/ofr2014-1051.pdf>

As of this time, all samples have been collected, preserved, and analyzed by USGS in Corvallis, Oregon. An eastern parks report should be available in spring 2018.

Get Involved!

Volunteers and non-profit organizations are an essential part of the workforce behind the efforts being performed at Great Smoky Mountains National Park. Without their support, the accomplishments mentioned within this newsletter, and many more to come, would never be possible. The Great Smoky Mountains National Park Fisheries Department would like to thank the following organizations for their contributions:



Great Smoky Mountains Association
<https://www.smokiesinformation.org/>



Tennessee Wildlife Resource Agency
<https://tn.gov/twra/>



Friends of the Smokies
<https://friendsofthesmokies.org/>



North Carolina Wildlife Resource Commission
<http://www.ncwildlife.org/>



Trout Unlimited
<https://www.tu.org/>



Tennessee Valley Authority
<https://www.tva.gov/>

If you or someone you know would like to volunteer with the Great Smoky Mountains National Park Fisheries Department, please contact:

TN Volunteer Coordinator –

Charlie Chmielewski at cell: (865)661-7325 or email: charlieflyfish@gmail.com

NC Volunteer Coordinator –

Mike Kesselring at cell: (828)736-6929 or email: mikessel59@gmail.com

About The Authors



Jason R. Brown: Seasonal Fisheries Technician

Jason R. Brown lives in Sevierville, Tennessee. He is currently a senior at the University of Tennessee, where he is majoring in Environmental Science with a minor in Watershed Management. He intends to pursue a career in native aquatic habitat restoration.



Emily Bush: Fisheries Intern

Emily Bush is from Lower Alabama. She is currently in her senior year at Rochester Institute of Technology, majoring in Environmental Science. She plans to work with the restoration of endangered species.



Greg Bushey: Seasonal Fisheries Technician

Greg Bushey is from Huntsville, Alabama. He is a senior at the University of Tennessee in the Wildlife & Fisheries program with a goal of working in Hawaii with invasive species control.



Aaron Coons: Seasonal Fisheries Technician

Aaron Coons is from Versailles, Ohio and came to the Smokies after completing a BS in Wildlife Conservation Biology from Ohio University. Aaron now resides in Knoxville, Tennessee with his fiancé, Mallory Barga.



Cas Garrigus: Seasonal Fisheries Technician

Cass Garrigus is originally from Dunsmuir, California. He now resides in Stillwater, Oklahoma and is a senior at Oklahoma State University studying Natural Resource and Ecology Management with an emphasis on Fisheries and Aquatic Ecology.



Parker Hildreth: Fisheries Intern

Parker Hildreth is from Smithville, Tennessee. A sophomore at Motlow State Community College, he is currently pursuing an AS in Biology with plans to continue to a 4-year institution after graduation. He has a strong interest in crayfish and intends to develop a career in aquatic research.



Eric Malone: Seasonal Fisheries Technician

Eric Malone is a California native who currently lives in Cookeville, Tennessee. He has completed a BS in Fisheries and Aquaculture at State University of New York at Cobleskill and is now a graduate student at Tennessee Tech University. His thesis work has focused on reintroducing non-game fishes to Abrams Creek.



Grant Woodard: Fisheries Intern

Grant Woodard is from Cleveland, Ohio and will be entering his sophomore year at Michigan State University where he is a Fisheries and Wildlife undergraduate student. He has a passion for the conservation of native salmonids and plans to work on native salmonid restoration projects.