BLUE RIDGE PARKWAY FISH SURVEY, 2007

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In 2004 I was offered a contract to survey fishes along the Blue Ridge Parkway for the National Park Service Inventory and Monitoring Program. I was euphoric at the prospect of sampling streams along the 469 miles of scenic highway through the Blue Ridge mountains of North Carolina and Virginia. Imagine the privilege of visiting this beautiful national park and being able to pull over and sample fishes in those clear, inviting, gorgeous streams—as a paying job!

From north to south, the Blue Ridge Parkway crosses streams of 6 major river drainages: James, Roanoke, New, Yadkin, Catawba, and Tennessee. Having worked 25 years as a fisheries biologist for the Tennessee Valley Authority (TVA), I was very familiar with the fishes of the Tennessee River drainage and excited to sample fishes of the more distant drainages with which I had only limited experience. During winter break in 1973, I and two other undergraduate students from the University of Tennessee, Knoxville, obtained a Virginia scientific collecting permit and advice from Dr. Robert E. Jenkins, Roanoke College, and made a coldwater blitz of streams in the James, Roanoke, and New drainages using only chest waders and a seine. I'll never forget those shivering nights spent along US 11 in a pickup camper! Years later, in 1995, I had a contract with the National Resource Conservation Service (NRCS) to do Index of Biotic Integrity (IBI) fish surveys of the Chestnut Creek watershed in the New River drainage near Galax, VA.

Conservation Fisheries, Inc. (CFI) was also involved in the recent Blue Ridge Parkway fish inventory contract. CFI's Jamie Parris and I were the primary researchers and were able to sample smaller streams with a backpack shocker, dip nets, and seines. For boat electrofishing larger waters, such as the James and Roanoke rivers, we were joined by Pat Rakes and J. R. Shute. Park Service employees Patrick Flaherty, Nora Murdock, Robert Emmott, Bob Cherry, and Jim Hughes frequently pitched in to collect fishes. Dr. Jenkins was very helpful in identifying fish from the James and Roanoke rivers. John Copeland (VA Dept. of Game and Inland Fisheries) brought another electrofishing boat to

Blue Ridge Parkway fish sampling crew, Linville River, May 16, 2005. L–R: Jim Hughes, Ed Scott, Nora Murdock, Patrick Flaherty, Bob Cherry, Meryl Scott DeBord. (Photo by Robert Emmott, NPS)

Sampling Linville River with backpack electroshocker, seine, and dipnets. (Photos by Bob Cherry, NPS)

help with sampling the James River.

Between 2004 and 2007, we conducted 50 collections and caught nearly 7,000 fishes of 82 species in streams, rivers, and small impoundments along the Blue Ridge Parkway (Table 1, page 5).

The vast majority of fish were released, but occasionally fish were preserved for documentation and are being curated by Dr. Wayne C. Starnes at the North Carolina Museum of Natural Sciences (NCMNS) in Raleigh. Basic identifications were documented by digital photography.

I had no previous experience with fishes of the Catawba River (Atlantic drainage), so I eagerly anticipated collecting species I had never seen. To help prepare for field identification of new-to-me species I studied *The Freshwater Fishes of North Carolina* by Edward F. Menhinick and a checklist of NC fish species by drainage, provided by NCMNS. There were a dozen or so "new" species I hoped to find in the Catawba drainage streams along the parkway, including the Linville River.

TEASERS

1. What species occurred most frequently? (***Hint:*** Don't be a fool.)

2. What was the most abundant species in the survey? (***Hint:*** Bait bucket.)

For our initial sampling of the Linville River, Jamie and I recruited NPS seasonal employee Alex Rose at the Linville Falls visitor center. The three of us were able to sample small Linville River tributaries adequately with the backpack shocker and dip nets, but the main river was beyond our capabilities. Limited by deep water, we shocked along the banks. Of the fish we were able to collect, *I was shocked* to see Warpaint Shiner (*Luxilus coccogenis*), an unmistakable minnow species of the upper Tennessee River system. We also caught Whitetail Shiner (*Cyprinella galactura*), Mirror Shiner (*Notropis spectrunculus*), and Saffron Shiner (*Notropis rubricroceus*), all of which are indicative of the Tennessee River. We caught Redlip Shiner (*Notropis chiliticus*), though, which is not a Tennessee drainage species, as well as several other species that are known from both the Tennessee and Catawba drainages. We collected several immature *Nocomis* chubs, which I believed to be Bluehead Chubs (*Nocomis leptocephalus*), as indicated in Menhinick's book and the NCMNS checklist. Needless to say, I was disappointed that we failed to collect any of the hoped-for Catawba drainage species.

All that winter I pondered our Linville River collections. I was bothered by the apparent abundance of Tennessee drainage species and the lack of Catawba drainage species. Therefore, our first Blue Ridge Parkway fish survey of the 2006 season was directed at the Linville River, above the falls. We had a crew of six—including my daughter, Meryl—and a backpack shocker, dip nets, and a 20-foot seine. As our sampling began with seine hauls in backwater areas, again we encountered the same mix of minnow species seen in the 2005 effort, including more immature chubs, which we recorded as Blueheads. Later, backpack shocking into an outstretched seine in flowing water, we were rewarded with the capture of a huge, mature, highly tubeculate male chub. Uh, another Bluehead Chub, like all the immature chubs I had "identified" up until then? This adult male was as pink as a petunia! Bob Cherry (NPS) said it didn't have a "blue head." As the on-site ichthyologic authority, I squirmed in my waders. The two NC references I had studied indicated only Bluehead Chubs

Is this a Bluehead Chub? (Photo by Bob Cherry, NPS)

in the Linville River. We reluctantly recorded the big fish as a Bluehead Chub on our field sheet, but I took a very good photograph of the fish before releasing it. (The NPS preferred photo specimens whenever possible.) We finished sampling the Linville River site and continued our week's work further north on the parkway toward Roanoke, VA.

From my office in Knoxville the following week, I emailed the photo of the rosy, pink-headed Bluehead Chub and capture circumstances to several prominent ichthyologists, including Dr. Jenkins, Dr. David Etnier, Dr. Wayne Starnes, NANFA's Fritz Rohde, and Bryn Tracy. Almost immediately, came responses of *River Chub*, not Bluehead Chub! Dr. Jenkins responded, saying something like, "You got another one! Where's the specimen?"

Uh, another one? Uh, specimen?

He said there is a reference to a River Chub in the Linville River indicated in the NC fishes book. I hurried to reread the text, but found no mention of River Chubs in the Linville River. I looked again at the distribution map for NC River Chubs and noticed a bar across the Linville River below the falls. What did that mean? Locations of NC River Chub collections were shown by dots on the distribution map, as is usual for fish publications. I wondered if the bar indicated a small dam or some sort of boundary, but when I read the introductory pages of *Freshwater Fishes of North Carolina,* I found that the bar was actually a dash, and a dash was the author's way of indicating an unconfirmed record of a species on the distribution map, meaning that there was no specimen, and that the author was not fully confident of the occurrence.

Oh, heck!

We had collected the second-ever River Chub (*Nocomis micropogon*) from the Linville River, but didn't keep the documenting specimen. We had had it in our bucket and in our hands, and we let it go! The ichthyologists I'd contacted would shun me for not realizing the significance of a River Chub from the Linville River and failing to keep the specimen. I would have to return to the Linville River in hopes of finding that one, big, male River Chub to save my reputation. But instead of returning with a backpack shocker, seine, and a large crew, I decided to search for the fish in a less labor-intensive manner.

Since it was still early summer and all worthy male River Chubs would be guarding their spawning mounds, all we would have to do was to find piles of rocks in the river and watch for the mounds' owners, hoping one of them would be our fugitive petunia pink River Chub. I invited my good friend, Snorkelmeister Casper Cox, the NANFA representative for Tennessee, to help me search for and—hopefully—capture that particular fish.

Casper and I returned to the NPS campground on the Linville River above the falls and entered the river with masks, snorkels, and small aquarium dip nets. We expected to find the chub mounds easily, but finding the one male River Chub amongst a river full of Bluehead Chubs could be a frightful challenge. It didn't take long to find the first chub mound. It was attended by Warpaint Shiners, Saffron Shiners, a few Whitetail Shiners, and immature or female chubs. Where was the male chub? From out of nowhere, the male chub appeared. And it was a River Chub! Casper skillfully captured it in his dip net, and the trip was a success! That fish was headed for a jar on a shelf at the NC museum in Raleigh!

We wondered what the odds were of finding a male River Chub in a river supposedly populated with Bluehead Chubs. We continued to search for additional chub mounds, expecting to find only male Bluehead Chubs guarding them. Instead, all we could find were more River Chubs! We caught five of them. Now, that was curious!

We explored a stretch of river upstream, and Casper was looking for more chub mounds while snorkeling beneath a high bridge. From downstream I looked up as a large hatchery truck stopped in the center of the bridge and began bombing Casper with stocker Rainbow Trout. Fish falling from the sky, a NANFA dream.

Still questioning the occurrence of Bluehead Chubs in the Linville River above the falls, Casper and I returned a few weeks later to assist T. R. Russ, a biologist with NCWRC, in sampling fish at the NC Forestry Training Center (the site of NANFA's 2014 annual con-

Table 1. List of fish species found and numbers observed in major river drainages of the Blue Ridge Parkway, 2004–07. Q denotes qualitative data, indicating that a species was observed (e.g., while snorkeling) but specimens were not collected or counted.

Common name	Scientific name	James	Roanoke	New	Tennessee	Yadkin	Catawba
American Eel	*Anguilla rostrata*	2					
Gizzard Shad	*Dorosoma cepedianem*		16				
Central Stoneroller	*Campostoma anomalum*				56		118
undescribed stoneroller	*Campostoma* sp. cf. *anomalum*	32	6	10			
Rosyside Dace	*Clinostomus funduloides*			342	31	62	1
Satinfin Shiner	*Cyprinella analostana*		72				
Whitetail Shiner	*Cyprinella galactura*				25		Q
Spotfin Shiner	*Cyprinella spiloptera*		121				
Common Carp	*Cyprinus carpio*	11	55				
Highback Chub	*Hybopsis hypsinotus*					3	
White Shiner	*Luxilus albeolus*		37				
Crescent Shiner	*Luxilus cerasinus*		1	5			
Warpaint Shiner	*Luxilus coccogenis*				5		159
Common Shiner	*Luxilus cornutus*	26					
Rosefin Shiner	*Lythrurus ardens*	44	73	1			
Bluehead Chub*	*Nocomis leptocephalus*	32	58	206		21	
River Chub*	*Nocomis micropogon*				53		129
Bull Chub	*Nocomis raneyi*	20					
Nocomis spp.	*Nocomis* spp.		5				
Golden Shiner	*Notemigonus crysoleucas*	1	200		1229		2
Comely Shiner	*Notropis amoenus*	8	29				
Redlip Shiner	*Notropis chiliticus*			91		30	24
Spottail Shiner	*Notropis hudsonius*		33				
Tennessee Shiner	*Notropis leuciodus*			Q			
Swallowtail Shiner	*Notropis procne*	13	25				
"Rosyface Shiner"	*Notropis* sp. cf. *rubellus*	2		3			
Saffron Shiner	*Notropis rubricroceus*				20		8
Mirror Shiner	*Notropis spectrunculus*				6		184
Telescope Shiner	*Notropis telescopus*	68					
Mimic Shiner	*Notropis volucellus*	31		4			
Kanawha Minnow	*Phenacobius teretulus*			7			
Mountain Redbelly Dace	*Phoxinus oreas*		5	372			
Bluntnose Minnow	*Pimephales notatus*	77	3				
Fathead Minnow	*Pimephales promelas*				2		
Eastern Blacknose Dace	*Rhinichthys atratulus*	1	4				
Longnose Dace	*Rhinichthys cataractae*			1	2		38
Western Blacknose Dace	*Rhinichthys obtusus*		98	125	30	22	
Creek Chub	*Semotilus atromaculatus*			65	34	39	9
Fallfish	*Semotilus corporalis*	7					
Quillback	*Carpiodes cyprinus*		41				
White Sucker	*Catostomus commersoni*	2	9	46	23	4	8
Northern Hog Sucker	*Hypentelium nigricans*	14	2	Q	6		29
Roanoke Hog Sucker	*Hypentelium roanokense*		2				
Black Jumprock	*Moxostoma cervinum*		36				
Notchlip Redhorse	*Moxostoma collapsum*		17				
Golden Redhorse	*Moxostoma erythrurum*	4	3				
Shorthead Redhorse	*Moxostoma macrolepidotum*		15				
V-Lip Redhorse	*Moxostoma pappillosum*		8				
Striped Jumprock	*Moxostoma rupiscartes*					2	
Torrent Sucker	*Thoburnia rhothoeca*	12					
Black Bullhead	*Ameiurus melas*			30	2		
Yellow Bullhead	*Ameiurus natalis*		1				
Brown Bullhead	*Ameiurus nebulosus*		15				
Flat Bullhead	*Ameiurus platycephalus*				19	1	
Channel Catfish	*Ictalurus punctatus*	1	2				
Margined Madtom	*Noturus insignis*	13	2			7	
Flathead Catfish	*Pylodictis olivaris*	3					
Muskellunge	*Esox masquinongy*	1					
Rainbow Trout	*Oncorhynchus mykiss*		57	2	5	37	1
Brown Trout	*Salmo trutta*		6	1	35	Q	81
Brook Trout	*Salvelinus fontinalis*	12	7	2	156		6
Mottled Sculpin	*Cottus bairdi*	14	34	126			
White Perch	*Morone americana*		3				
Striped Bass	*Morone saxatilis*		3				
Rock Bass	*Ambloplites rupestris*	39	11	10			14
Redbreast Sunfish	*Lepomis auritus*	10	15	3	182	3	Q
Green Sunfish	*Lepomis cyanellus*	4	3				1
Pumpkinseed	*Lepomis gibbosus*			1	1		
Bluegill	*Lepomis macrochirus*	35	126	1	1		58
Hybrid Sunfish	*Lepomis* hybrid	8					
Smallmouth Bass	*Micropterus dolomieu*	62	15			2	Q
Largemouth Bass	*Micropterus salmoides*	37	3	1	145		63
Fantail Darter	*Etheostoma flabellare*	14	54	79		16	
Kanawha Darter	*Etheostoma kanawhae*			7			
Longfin Darter	*Etheostoma longimanum*	1					
Johnny Darter	*Etheostoma nigrum*	6	10				
Tesselated Darter	*Etheostoma olmstedi*					1	
Riverweed Darter	*Etheostoma podostemone*		33				
Redline Darter	*Etheostoma rufilineatum*				28		
Swannanoa Darter	*Etheostoma swannanoa*				4		
Yellow Perch	*Perca flavescens*		2				
Appalachia Darter	*Percina gymnocephala*			3			
Stripeback Darter	*Percina notogramma*	2					
Roanoke Darter	*Percina roanoka*	4	8				
	Total # of samples	5	9	10	13	5	8
	Total # of species	37	47	29	25	16	22
	Total # of fish	673	1384	1544	2100	250	933

*For photos of the River and Bluehead chubs, see page 18.

vention) near Crossnore. We sampled using backpack shockers, seines, and dip nets for 3 or 4 hours, above and below the bridge to the forestry center. The only male chubs observed in this stretch of Linville River were all River Chubs. Still searching for Bluehead Chubs, I preserved 13 immature specimens for dissection in order to identify them according to their intestinal formation. All of these fish were River Chubs, too.

Months later, I was writing the report for the Blue Ridge Parkway fish inventory. The Linville River was still troubling me, like a fish bone caught in my throat. The Linville River species list is enigmatic: it's a Catawba River tributary, flowing into the Atlantic Ocean, with River Chubs, Warpaint Shiners, Mirror Shiners, Saffron Shiners, and Whitetail Shiners, all species found in streams in the Tennessee River drainage. Redlip Shiner was the only non-Tennessee River system species we found in the Linville River!

Noodling for an explanation, I asked Google about "Linville River stream capture." References to the subject popped up instantly, relating to salamander and Bog Turtle distributions. I leaped from my desk and drove to the University of Tennessee Agricultural Library to find the journals containing those publications. My search also turned up a document published in 1971 describing the geologic drainage history of the Linville River. It stated that the headwaters of the ancestral Linville River captured approximately 35 miles of the North Toe River (Nolichucky-Tennessee River drainage) at the crest of the Blue Ridge. From that point, the fortified Linville River eroded the stream bed (back cut) several miles to the northwest, causing Linville Falls to retreat to its present location (Ross 1971, see Figures 1–2). The stream capture event is believed to have occurred during the Pleistocene Epoch, which ended about 10,000 years ago. I hadn't known that until then! I felt like I was the *last* person to find out, and only because of that pink petunia River Chub!

It finally became obvious why all those Tennessee River drainage species were found in "Linville River." Perhaps a better name for the river above Linville Falls would be "Severed Toe" or "Lost Toe" River. Its fish assemblage may not have changed much in the 10,000 years since it was connected with the Tennessee River system. The one foreigner (barring stocked trout), Redlip Shiner, is most likely an introduction to that river segment.

Given the current capabilities of genetic analyses, it would be interesting to study species shared between the present North Toe River, the Linville River above the falls, and the Catawba River, such as Central Stoneroller (*Campostoma anomalum*), White Sucker (*Catostomus commersonii*), Northern Hog Sucker (*Hypentelium nigricans*), Rock Bass (*Ambloplites rupestris*), and Smallmouth Bass (*Micropterus dolomieu*). Genetic analyses could add evidence of the Tennessee River drainage origins of fishes inhabiting Linville River above the falls.

Table 2. Fish species in the Catawba River system that are also found in the Tennessee River system, according to Fritz Rohde, as indicated in *The Freshwater Fishes of North Carolina*. ***Rohde questions the origins of these species.**

Common name	Scientific name
Central Stoneroller*	*Campostoma anomalum*
Whitetail Shiner	*Cyprinella galactura*
Warpaint Shiner	*Luxilus coccogenis*
River Chub	*Nocomis micropogon*
Tennessee Shiner	*Notropis leuciodus*
Saffron Shiner	*Notropis rubricroceus*
Mirror Shiner	*Notropis spectrunculus*
Telescope Shiner	*Notropis telescopus*
Western Blacknose Dace*	*Rhinichthys obtusus*
Longnose Dace*	*Rhinichthys cataractae*
Northern Hog Sucker*	*Hypentelium nigricans*
Rock Bass*	*Ambloplites rupestris*

Fritz Rohde also has reservations about the origins of certain species shared between the Tennessee and Catawba systems (Table 2, those asterisked). Genetic analyses of these species should be able to determine their historical origins.

If you are fortunate enough to attend this year's NANFA convention on the Linville River near Crossnore, NC, spend a little time reflecting on the river's geologic history. Visit Linville Falls and tour Linville Gorge. Ponder the power of 35 miles of river flow over 10,000 years. Consider how fish communities in that 35 mile segment would change over that much time. See if you, too, can find a river chub. But if you happen upon an actual Bluehead Chub in the Linville River above the

Teaser answers: The most frequently occurring species in the Blue Ridge Parkway fish inventory was the White Sucker, which was found in 18 of the 50 samples. The most abundant species was…wait for it…shouldn't even be there, but it is… Golden Shiner (*Notemigonus crysoleucas*). The Golden Shiner is almost certainly a bait-bucket introduction gone wild, especially in Price Lake, where boat shocking collected over a thousand individual Golden Shiners, but not a single Largemouth Bass. Large, adult Golden Shiners had become the "apex predator" of the small impoundment, able to suppress reproduction of bass and other sunfish.

falls, by all means, document the finding with photographs and witnesses. Credible witnesses!

LEARN MORE:

Just for fun, while Casper and I were snorkeling the Linville River in June, 2007, we went to a nearby Catawba River tributary, Steele Creek, to search for chub mounds. Steele Creek is the stream that is most accessible and closest to the Linville River (just east of Linville River). It was again easy to find the mounds, but in this stream the mounds were attended by actual Bluehead Chubs. We found no River Chubs, although we saw numerous Warpaint Shiners (Tennessee River origin) alongside Fieryblack Shiners (*Cyprinella pyrrhomelas*) (Catawba River native). If we had had more time, it would have been interesting to identify all the fish we saw and determine their origins as either Tennessee or Catawba systems.

Lack of Tennessee drainage species found above the falls but not below might indicate those species' inability to compete with native Catawba drainage species. On the other hand, Tennessee drainage species found both above and below the falls may indicate that they either out-competed native Catawba species or developed a niche compatible with native Catawba species, allowing them to cohabit Linville River below the falls and elsewhere in the Catawba drainage.

Besides Steele Creek, there is access to the Linville River below the falls, just upstream from Lake James near Nebo, on NC 126. Snorkeling and/or seining there could reveal an intriguing mix of species from the two drainages and provide fuel for long nights of heated discussion.

Source:

Ross, R. D. 1971. The drainage history of the Tennessee River. *In:* Holt, P. C. (Ed.), Distributional History of the Biota of the Southern Appalachians. Part III: Vertebrates, Research Division Monograph 4, Virginia Polytechnic Institute and State University, Blacksburg, VA, pp. 11–42.

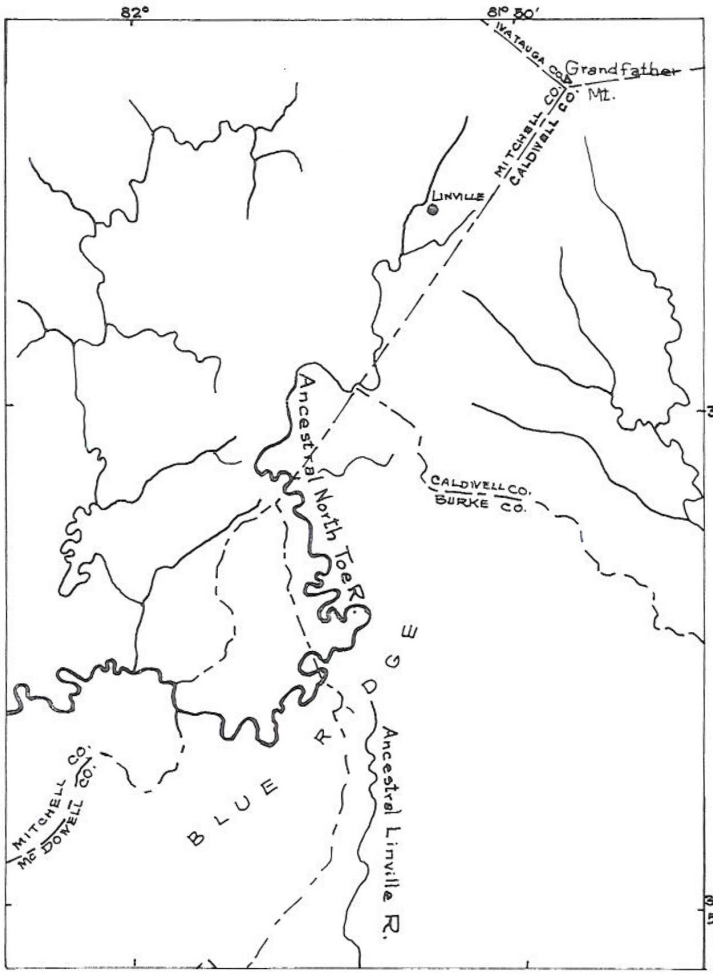


Figure 1. The course of the ancestral North Toe River (Tennessee River system) as it may have once drained the southwestern flank of Grandfather Mountain, NC. The ancestral Linville River is attacking the Blue Ridge (from Ross 1971).

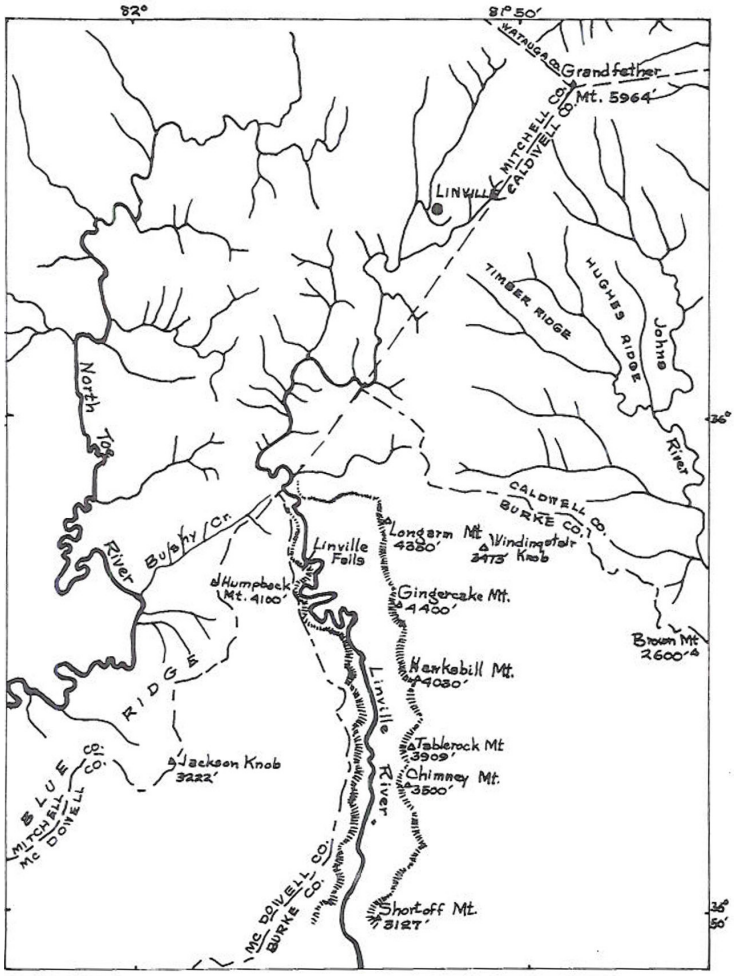
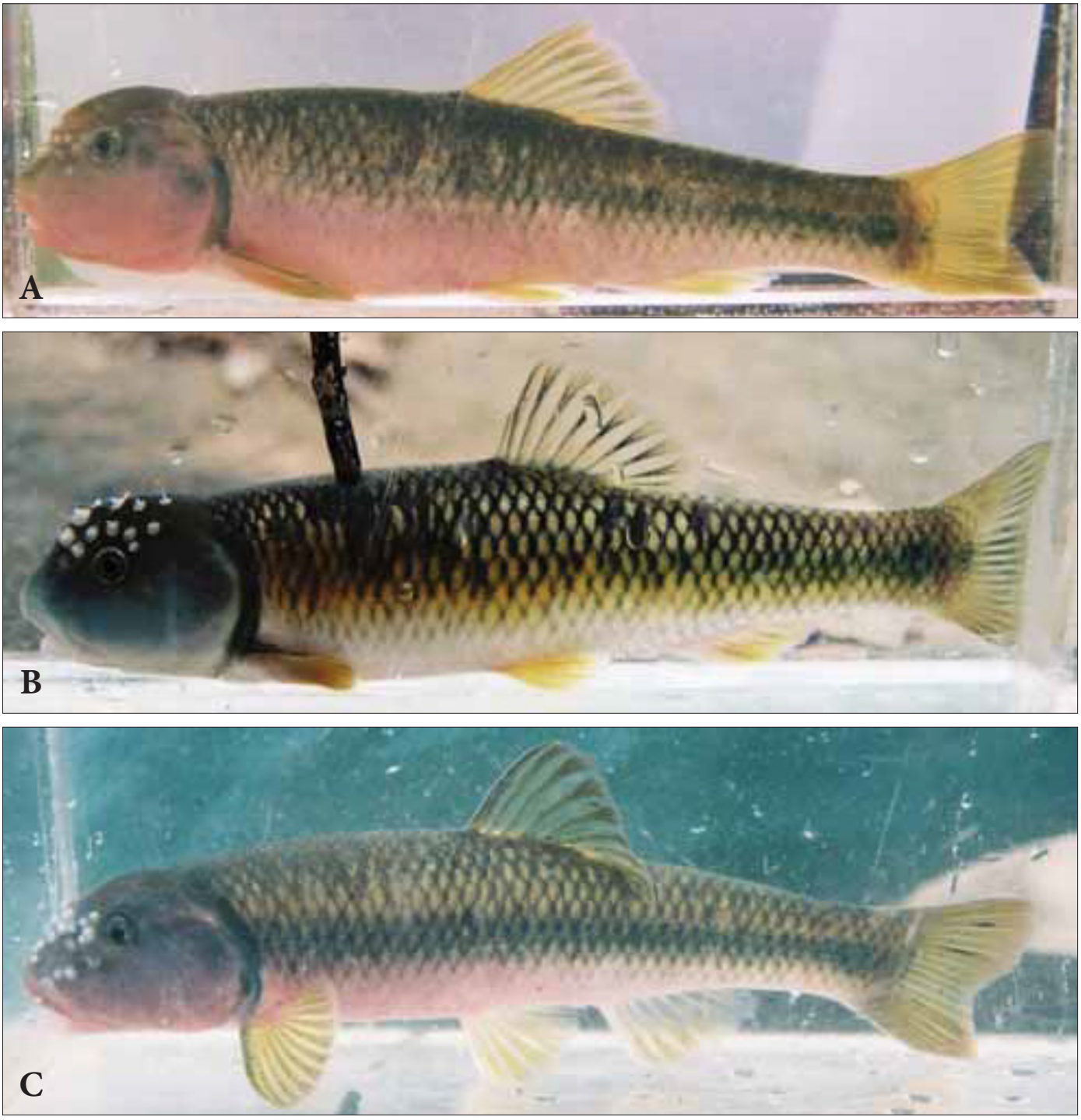


Figure 2. The present drainage of the Linville River on the southwestern flank of Grandfather Mountain, NC. The Linville River has captured the North Toe River and diverted it to the Santee drainage of the Atlantic coast.



Three Blue Ridge Parkway chubs: The "original" Linville River River Chub (A), a typical Bluehead Chub (B), and a snorkel-caught Linville River River Chub (C). (Photos by Ed Scott)