American Currents

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The North American Native Fishes Association

Est. 1972 — John Bondhus, founder

Mission: The North American Native Fishes Association (NANFA) is dedicated to the appreciation, study and conservation of the continent's native fishes. NANFA is a not-for-profit, tax-exempt corporation chartered in the State of Maryland. The purposes of the organization are: • to increase and disseminate knowledge about native North American fishes; • to promote practical programs for their conservation and the protection/restoration of their natural habitats; • to advance the educational, scientific and conservation benefits of captive maintenance and husbandry; • to encourage the legal, environmentally responsible collection of native fishes for private aquaria as a valid use of a natural resource; and • to provide a forum for fellowship and camaraderie among its members.

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FRONT COVER: Oregon Chub from the Ankeny National Wildlife refuge near Salem. (Photo by Rick Brown) **BACK COVER:** Fleeing for deep water. Nothing says spring like the White Bass run. April, 2012, Vermillion River, LaSalle Co., IL. (Photo by Olaf Nelson)

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2014 CONVENTION SCHEDULE: JUNE 5–8

FINAL NOTICE!

NANFA President Fritz Rohde will be the host. We will convene at the North Carolina Forest Service Training Center in Crossnore, near Linville Falls State Park and about 30 minutes south of Boone, NC. Unlike previous conventions, there will be no speakers. While the event runs from 5–8 June, arrangements will be made for those who wish to stay on the 4th and depart on the 9th. For those arriving on Thursday, we hope to meet that afternoon with WRC biologists and their electrofishing boat on the French Broad River for boat shocking and seining. Friday will feature collecting and snorkeling in nearby watersheds, possibly more electrofishing, with arrival back at the facility in time to enjoy the cookout and auction.

Linville Falls (Photo by Fritz Rohde)

At least 90 species of fish occur within an hour's drive of Crossnore. On Saturday and Sunday, attendees will have a choice of collecting trips depending on their species of interest: **(1)** ***Catawba River Drainage*** (Rosyside Dace, Fieryblack Shiner, Thicklip Chub, Whitefin Shiner, Santee Chub, Bluehead Chub, Greenhead Shiner, Margined Madtom, Seagreen Darter); **(2)** ***New River Drainage*** (Rosyside Dace, Tonguetied Minnow, Bigmouth Chub, Redlip Shiner, Highland Shiner, Kanawha Minnow, Mountain Redbelly Dace, Kanawha Darter, Appalachia Darter); and **(3)** ***Nolichucky River Drainage*** (Blotched Chub, River Chub, Whitetail Shiner, Warpaint Shiner, Tennessee Shiner, Saffron Shiner, Fatlips Minnow, Greenfin Darter, Swannanoa Darter, Tangerine Darter, Gilt Darter).

On Saturday there will be a collecting challenge between two teams who will visit the same 4 sites, in reverse order—all catch and release. Team sizes are limited, so if you wish to compete, be prepared to register. An extra fee ($10) for the challenge will cover the cost of t-shirts for the winning team.

Collecting and snorkeling can continue on Sunday, with groups heading home and others staying in the area. Depending on the direction attendees will be heading home, collecting trips may be offered in other drainages. We will try to get trip leaders under the scientific collecting permit of the host so no other licenses will be needed unless you decide to collect before or after the convention.

Lodging, Costs, and Registration: Five dormitories, with 45 rooms and 88 beds, are available, **BUT** only 55 beds are available Wed. and Thurs. nights. **Late registrants may have to stay at nearby motels.** Most rooms have 2 single beds and a sink. Buildings A and B are closest to the dining facility; each has 1 single and 14 double rooms, all with sinks. Building A will be our primary gathering place and the location of registration and the auction. It has separate men's and women's restrooms and showers. Single women and couples will most likely stay in this building. Building B has one unisex shower/restroom. Both have microwaves, refrigerators, and TV. There is a large fire pit outside these buildings for gatherings.

The Mountain Lodge sleeps 11 (one single) and has a unisex shower/restroom and a full kitchen. The River Lodge is the newest and sleeps 9 (one room has 3 beds). There are no sinks in these rooms. There are two shower/rest rooms in this building so couples and single females could stay here also. Large, gathering room upstairs. The Helitack Building is about one-quarter mile away and sleeps ten, no sinks in the rooms. It has a full kitchen with two bathrooms. Check out the following link for more details: http://ncforestservice.gov/education/corpening_facility.asp.

Costs are very reasonable. If you come in on Thursday and leave Sunday, room and meals will be $154,

(Continued on page 14)

BLUE RIDGE PARKWAY FISH SURVEY, 2007

Ed Scott

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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.

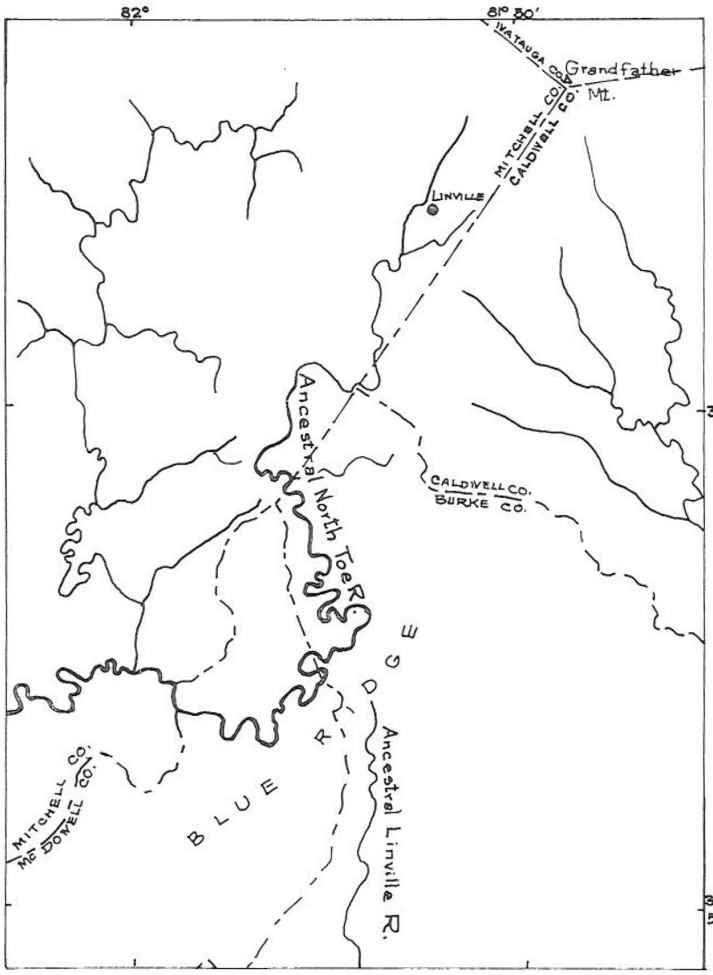

Figure 1. The course of the ancestral North Toe River (Tennessee River system) as it may have once drained the southwestern flank of Grandfather Mountain, NC. The ancestral Linville River is attacking the Blue Ridge (from Ross 1971).

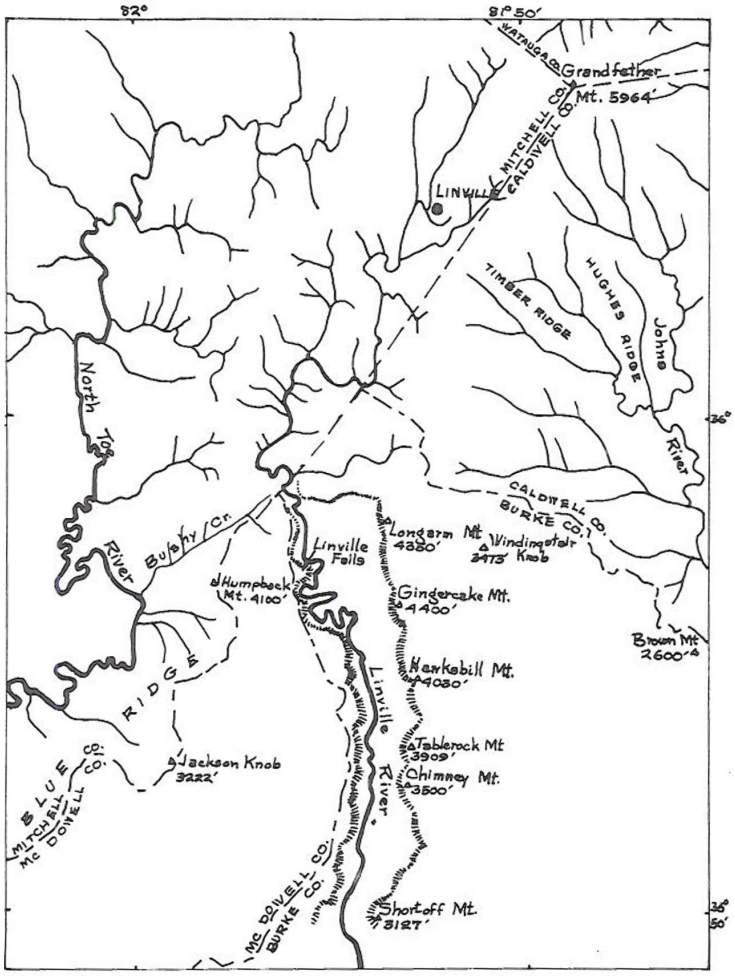

Figure 2. The present drainage of the Linville River on the southwestern flank of Grandfather Mountain, NC. The Linville River has captured the North Toe River and diverted it to the Santee drainage of the Atlantic coast.

NANFA News

MEMBERS, EVENTS, ACCOMPLISHMENTS AND ADMINISTRIVIA

2014 NANFA CONSERVATION RESEARCH GRANT AWARDED

This year's NANFA Conservation Research Grant (CRG) proposal review committee—Bruce Stallsmith, Derek Wheaton, and Michael Wolfe—received 7 proposals, 3 of which they felt addressed issues consistent with the stated aims of the CRG. The proposal judged best, for having the most immediate impact, with NANFA's financial support being integral to the proposed work, was the submission by Michael Moore of Virginia Tech (excerpted below). The Clinch Dace is an extremely vulnerable species, only recently known to science. It has the misfortune to have a range restricted to the north side of the Clinch River in Virginia. This puts it in coal mining territory, never a good thing for sensitive fish species. Michael will receive a grant of $1000 from NANFA to support his research.

Michael Moore, Virginia Tech.

Occupancy modeling for the Clinch Dace (*Chrosomus* sp. cf. *saylori*) in the Upper Clinch River System, Virginia, using minnow trapping, backpack electrofishing, and eDNA sampling.

Although the Clinch Dace is not currently listed under the Endangered Species Act, it is classified as "endangered" by Jelks and is considered to be one of the rarest fish species in the United States. In Virginia, Clinch Dace are known from headwater streams in two counties. Populations are small and separated by large distances of unfavorable habitat. The occupancy status of Clinch Dace remains unknown at many sites throughout the proposed range.

Questions to be investigated: Our research questions for Clinch Dace are threefold. 1. What is the species' current distribution? 2. Which sampling gear is best to monitor and survey for populations and are habitat conditions correlated to site occupancy? 3. Is eDNA sampling feasible for Clinch Dace?

Research Objectives: In response, we propose the following objectives. 1. Survey streams using minnow traps, visual observation, and backpack electrofishing. 2. Analyze presence/absence data using occupancy models accounting for gears type and habitat features as covariates. 3. Develop primers to detect *Chrosomus* DNA in water samples collected at a subset of sites. 4. Collect water samples downstream of identified populations to understand spatial distributions of DNA in a lotic system.

Description of Work: We will survey ~70 sites twice during 2014 and 2015 using minnow traps, and once each using visual observation and backpack electrofishing. Sites will be randomly selected south-flowing tributaries to the Clinch River in Russell and Tazewell Counties Virginia.

Benefits: Monitoring allows biologists to observe population trends and adjust management accordingly. Specific benefits include updated distributional records, determination of optimal survey effort, identification of habitat requirements to address in habitat restoration, and occupancy prediction at unsampled sites. EDNA protocols and primers we develop could provide a minimally invasive, low effort, high sensitivity approach to monitor *Chrosomus* dace.

TO ACCESS THE DIGITAL VERSION OF THIS ISSUE

1. Go to **http://nanfa.org/ac.shtml** and click the link for Volume 39, Number 2, Spring 2014 (featuring Oregon Chub on the cover)
2. The PDF will start to open, but will ask for a password.
3. This issue's password is "oregonchub" (without the quotation marks).

RECOVERY OF OREGON CHUB HELPS MARK THE 40TH ANNIVERSARY OF THE ENDANGERED SPECIES ACT

Paul Scheerer

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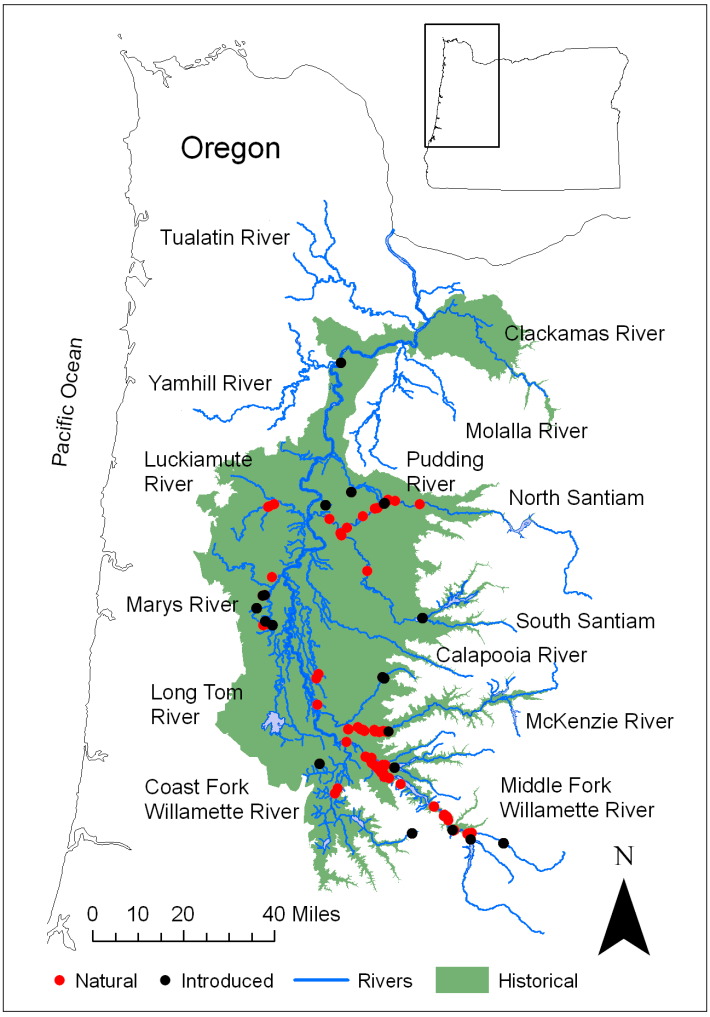
An inconspicuous minnow that inhabits the backwaters of the Willamette Valley will soon gain national prominence when it becomes the first fish in the United States to be taken off the federal Endangered Species list due to conservation efforts. The collective effort by a very strong public-private partnership in the Willamette Valley clearly demonstrates that listed species can be recovered and delisted in a highly populated, working landscape, a testament to the resilience of the species and the innovation of Oregon Department of Fish and Wildlife (ODFW) biologists. This is one of the rare success stories for the Endangered Species Act (ESA), which turned 40 years old just last month. The law made it the official policy of the United States not to let any species go extinct. It sets a high standard in that it not only prevents extinction, but also mandates recovery to a more sustainable state.

A pair of Oregon Chub from a McKenzie River slough. (Photo by Dave Herasimtschuk, Freshwaters Illustrated)

The Oregon Chub (*Oregonichthys crameri*) is a small minnow that lives in sloughs, swamps, beaver ponds, and low-gradient tributaries. These off-channel habitats were dramatically reduced by the construction of Willamette River flood-control dams, channelization of the river for navigation, and the draining of wetlands for agriculture and development, and are prime habitats for nonnative game fish, such as bass and Bluegill, which prey on the species. Due to these threats, this fish was listed as endangered in 1993, when only eight populations totaling fewer than 1000 fish were known to exist. Now, 21 years later, there are over 80 populations and more than 150,000 fish.

This success is a remarkable story of cooperation between landowners, nonprofit organizations, and state and federal agencies that got behind the effort decades ago to ensure the species would not become extinct. This partnership includes ODFW, the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, the U.S. Forest Service, Oregon State Parks, Oregon Department of Transportation, local municipalities, numerous private landowners, watershed councils, the McKenzie River trust, and others. In contrast to high-profile species, such as the Pacific salmon or the Grey Wolf, most of the recovery activities have occurred under the radar with little impact on local communities.

ODFW biologist Paul Scheerer has devoted 22 years of his professional life to recovering Oregon Chub populations in the Willamette Valley. He was joined in 2005 by Brian Bangs, who has enthusiastically led on-the-ground efforts for the past six years. This team of biologists has led the charge by conducting research and monitoring, promoting habitat protection and improvements, and conducting reintroductions of the fish into unoccupied habitats. Specific examples included



Historical distribution of the Oregon Chub

working closely with the U.S. Army Corps of Engineers to manage flows and temperatures to benefit native fish including the Oregon Chub, coordinating with the McKenzie River trust to identify high quality habitats for land acquisition, working with the Middle Fork Willamette, Santiam, and Long Tom Watershed councils to identify private landowners who were willing to enhance and protect chub habitats, and coordinating with the U.S. Fish and Wildlife Service, U.S. Forest Service, Oregon Parks and Recreation and Oregon Department of Transportation to protect, enhance, and create habitat on lands that they manage.

Through extensive surveys at over 1,000 locations in the basin, this team has discovered many previously undocumented populations. Historical records of the species' occurrence were rare, as no targeted surveys occurred until the 1980s. This effort was, at times, like finding a needle in a haystack, but persistence has its rewards. In addition, recovery has benefitted from the introduction of the Oregon Chub into suitable, unoccupied habitats. There have been 21 introductions to date. These help reduce the threat of extinction by expanding the species range and providing backup populations that can be used in the event of loss of local populations. Many of the introductions have occurred on private lands. Coordinated efforts with U.S. Fish and Wildlife Service's and ODFW's private lands biologists have helped to identify properties and willing landowners and to acquire funding under various Farm Bill programs, like the Wetland Reserve Program, to re-create high quality habitat that has been lost over the years.

Recovery is the goal of the ESA. Success has been rare, but progress is being made. The Oregon Chub has benefitted from the protections afforded by the Act, as have countless other species of fish, birds, amphibians, and mammals that also depend on these off-channel habitats. However, the status of this species and others like it depends on a concerted community effort to understand, protect, and restore the natural river processes that these species require for continued survival. This community effort is what made recovery of the Oregon Chub possible.

Oregon Chub from the Ankeny National Wildlife refuge near Salem. (Photo by Rick Brown)

HISTORY OF CHANGES IN THE WILLAMETTE RIVER AND EFFECTS ON OREGON CHUB

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Nearly two centuries ago, Euro-American settlement of the Willamette Valley began with the opening of the Oregon Trail around 1830. The Willamette River of 1830 was a vastly different river from what it is today. A federal land survey conducted in the 1850s described the southern two-thirds of the valley as a complex of open prairie and woodland with a broad riparian corridor. A dense deciduous forest covered the floodplains of the Willamette and its tributaries with thick underbrush and large cottonwood trees. This floodplain was estimated to be 1–2 miles wide and up to seven miles wide at tributary junctions. The river consisted of multiple braided channels and was choked with logs and log jams. During floods, which were frequent, new channels were opened and old ones closed, sloughs became the main channel while the latter became sloughs, and the formation of islands and bars was a constant process. Large downed trees and piles of wood contributed to the formation and movement of Willamette River channels.

In the lazy off-channel sloughs lived a small speckled minnow, now known as the Oregon Chub, which was found exclusively in the Willamette River. This small minnow thrived in off-channel habitats that were also home to countless beavers, herons, deer, mink, otters, amphibians, turtles, waterfowl, and young salmon and trout. However, as settlement progressed, this small speckled minnow struggled to survive in a world that was rapidly changing. Starting around 1880, for a period of 60 years, the Army Corps of Engineers removed nearly 70 thousand downed trees or snags, many up to six feet in diameter. These downed trees and wood jams created diverse off-channel habitat and played an important ecological role through the creation and movement of secondary channels and the formation of floodplain islands. During this same time period, the Corps began building a series of revetments to contain the main river channel and stabilize its banks. These revetments were primarily constructed along the outside banks of river bends, locations where the channel was most active in lateral cutting and movement. This also had ecological consequences by reducing channel migration, the creation of off-channel habitats and gravel bars for cottonwoods, and the delivery of large wood to the channel from the banks.

Historically, the Willamette River experienced frequent large floods, with water extending up to two miles across the valley. These floods were devastating to towns and settlements along the river, with many being destroyed completely. Ecologically, flooding provided linkages and interactions between the channel, the floodplain, and the watershed, including nutrient and sediment cycling. The floods formed new channels, gravel bars, and deep pools, and redistributed large wood, creating a diverse habitat for fish and other aquatic organisms. Beginning in the 1940s, the Corps constructed 13 flood control dams, which reduced the frequency and magnitude (and associated ecological processes) of these flood events, such that an event with a pre-dam 10 year occurrence interval now occurs at a 100-year interval. Flood control led to increased agricultural and municipal development along the river corridor and with this development additional wetlands were drained. The combination of snag removal, construction of revetments and flood control dams, and drainage of wetlands for bottom land agriculture resulted in the elimination of up to 70 percent of the historical channel, depending on the

Oregon Chub habitat in the North Santiam (top) and McKenzie (bottom) basins (Brian Banks, photos)

location within the watershed. In addition, the water quality in the Willamette declined dramatically as cannery and sawmill waste were dumped into the river to the point where in the 1940s certain river sections had such low oxygen concentrations that they no longer supported aquatic life.

The Willamette River floodplain was partially shaped by the American beaver, nature's hydrologic engineer. Beavers dam small rivers and side channels to escape predators and in doing so create habitat for other plants and animals. Behind the dams, they create shallow wetlands and pools that support otters, turtles, amphibians, birds, and fishes. Beaver ponds are one of the Oregon Chub's preferred habitats. The abundance of beavers attracted trappers into the Willamette Valley in the 1700s, when beaver pelts were in high demand in Europe for hats. From 1810 through 1840, beavers were harvested in very large numbers, nearly to extinction.

Combined, these changes to the Willamette River severely altered the habitat for the Oregon Chub. To make matters worse, their neighborhood (fish community) was also changing in a negative way. New settlers and management agencies introduced fish from the eastern and Midwestern U.S. that were foreign to the river. These fish, typically warmwater game fish, expanded rapidly in the same habitats used by the Oregon Chub. They not only competed for food but also preyed upon the tiny minnows, which are only 2–3 inches long. The chub hid and held on until the late 1980s, when biologists recognized the species' plight and started taking action to help it out. The Oregon chub was listed as endangered in 1993 under the Endangered Species Act.

For 22 years teams of biologists and managers, led by the Oregon Department of Fish and Wildlife, worked to understand the needs of the fish, created and protected off-channel habitats, introduced chub back into suitable, predator-free sites, and worked to understand the floodplain processes and factors that can allow the species to co-occur with, but not be decimated by, nonnative fishes. This remarkable teamwork by state and federal agencies, NGOs, private landowners, watershed councils, and tribes resulted in a rare success story. In 2012 and 2013, the Oregon Chub met all of the recovery criteria as outlined in their recovery plan. In 2014 the Oregon Chub will be the first fish to be recovered and removed from the endangered species list, which coincides with the 40th anniversary of the Endangered Species Act.

OBSERVATIONS ON SPAWNING BY CAPTIVE SAND SHINERS (*NOTROPIS STRAMINEUS*) FROM MINNESOTA

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INTRODUCTION

Little information is available on the spawning behavior of the Sand Shiner *(Notropis stramineus)* (Becker, 1983). For example, it was not included in Johnston and Page's (1992) listing of 95 North American minnow species for which reproductive strategies had been reported. More recently, Platania and Altenbach (1998) stated that Sand Shiners were broadcast spawners that laid demersal, adhesive eggs. They observed a captive female being chased by a male, but did not observe the actual spawning event. The purpose of this note is to report additional observations of spawning by captive Sand Shiners.

METHODS

The observations reported herein did not result from a planned, controlled study. The Sand Shiners were originally captured in the Root River, Fillmore County, Minnesota in 2011. They were held in an aquarium by the original collectors until May 2012, when they were transferred to my possession. I put three Sand Shiners in a hexagonal glass aquarium (side panels: 59 cm tall × 29 cm wide; horizontal distance between panels: 50 cm) with a juvenile Common Shiner (*Luxilus cornutus*) from the Root River, five Southern Redbelly Dace (*Chrosomus erythrogaster*) from the Upper Iowa River in Mower County, Minnesota, two small bichirs (*Polypterus* sp.), two green *Corydoras* sp., and a Sailfin Pleco (*Pterygoplichthys gibbiceps*). The tank was provided with a gravel bottom, partly covered by a dolostone slab, a piece of driftwood, and sparse java moss (*Taxiphyllum barbieri*). Only a single strand of *Elodea* extended farther than 24 cm above the gravel surface. The tank was equipped with an undergravel filter with two lift tubes, an internal power filter, and an overhead light that was left on 24 hours per day. The fish were fed commercial flake food and frozen bloodworms (*Chironomus* sp.) daily, but the Sand Shiners were not observed to feed on the latter. Water temperature varied with in the temperature of the room where the tank was kept and was 20°C on the date that spawning was observed.

RESULTS

On the evening of 14 November 2012, I noticed that the Sand Shiners seemed more silvery than usual,

Sand Shiners (*Notropis stramineus*), Kankakee River, IL. (Photos by Uland Thomas)

reflecting light like flashes from a mirror, and that they were very active, "chasing" back and forth in the upper half of the water column. I realized then that they might be displaying reproductive behavior. It appeared as if one fish was chasing another, but when the trailing fish suddenly reversed, the other did too. I could not discern breeding tubercles or distinguish between sexes. However, within approximately five minutes I witnessed three spawning events, two involving all three Sand Shiners and one involving two. In each case the fish suddenly turned up in a vertical direction in the central portion of the tank as the eggs were released. As the eggs fell through the water, they were rapidly consumed by the other minnows in the tank.

DISCUSSION

Compared to many species, the Sand Shiner has an extended spawning season. Becker (1983) reported that it spawns in Wisconsin from late May until mid-August. It seems possible that reproduction by a species with an extended spawning season would be less tied to specific temperatures, daylengths, or other environmental cues, and hence, more likely to occur in captivity at an atypical time of year.

The observations reported here lend support to those of Platania and Altenbach (1998). It seems safe to conclude that the Sand Shiner is indeed a broadcast spawner with demersal eggs. However, both cases involved captive specimens observed in small numbers (3–4). It would be desirable to observe how larger spawning groups behave in unconfined situations with a choice of substrates.

Acknowledgments

I thank my students Clinton Nienhaus, Collin Nienhaus, and Tom Walker, who originally collected the Sand Shiners observed spawning during this study and cared for them during their first months in captivity.

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Platania, S.P. and C.S. Altenbach. 1998. Reproductive strategies and egg types of seven Rio Grande Basin cyprinids. Copeia 1998: 559–569.

Sand Shiner, Macon County, IL. (Photo by Lance Merry)

2014 Convention (Continued from page 1)

plus registration. Registration is $75 for members, $105 for non-members (including a 1-year membership), $35 for students, and $15 for non-collecting spouses coming to the banquet. Registration includes a cook-out on Friday.

So the Forest Service knows how much food to buy, **FINAL PAYMENTS MUST BE RECEIVED BY MAY 9TH.** Latecomers may be able to stay at the facility, but keep in mind that numbers are limited and they **DO NOT** take credit cards. To register and pay online, go to **http://www.nanfa.org/convention/2014.shtml** and scroll down to the registration and payment link (just above the Rosyside Dace). If you don't want to use Paypal, send a check, payable to NANFA, along with the information requested on the registration form (**http://www.nanfa.org/cgi-bin/2014convention.pl**), to Tom Watson at the address below the NANFA logo on the back cover of this issue.

There are a number of campgrounds in the area, including one operated by the National Park Service at Linville Falls, only 6 miles away. There are two motels in Linville Falls and one in Pineola, both about five miles away. Nearby Linville Falls, Crossnore, and Newland have several good restaurants. The nearest airport is in Asheville, some 70 miles (90 minutes) away.

Though there will not be any formal presentations, bring videos, underwater photos, or powerpoint presentations for informal get-togethers in the evenings.

BLUEBREAST DARTER REMOVED FROM OHIO'S LIST OF ENDANGERED AND THREATENED FISHES

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The range expansion of the Bluebreast Darter (*Etheostoma camurum*) and several other rare or protected species of fish in Ohio's waters is likely the result of dramatically improved water quality since the beginning of the Clean Water Act of 1972, which began to regulate point source pollution including industries and municipal water treatment facilities. The Ohio EPA began to use fish populations to monitor water quality in the late 1970s, leading to a robust program that is still monitoring water quality in Ohio surface waters today. Other factors have also contributed to this and other species' range expansions. Better conservation of flood plains and riparian corridors and improvements in agricultural practices to reduce the amount of soil being washed from fields into streams and rivers have undoubtedly played a role. This shows that we, as a society, have good reason to continue to improve how we care for our waterways and other parts of our environment so more species can enjoy such a dramatic recovery as the Ohio population of Bluebreast Darter.

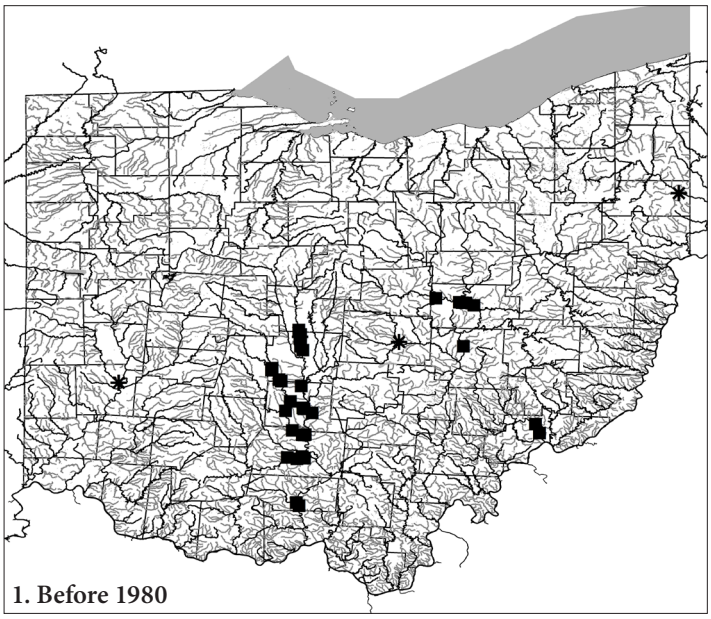
Between 1900 and 1980 (Map 1), the Bluebreast Darter was known to occur in several streams in the Scioto River drainage and limited portions of the Muskingum drainage. There are also three pre-1900 (Map 1) records of this species occurring in the Great Miami, Licking, and Mahoning River drainages. Many of the known populations were rather small as of 1980, and only a few individuals could be found at any given location.

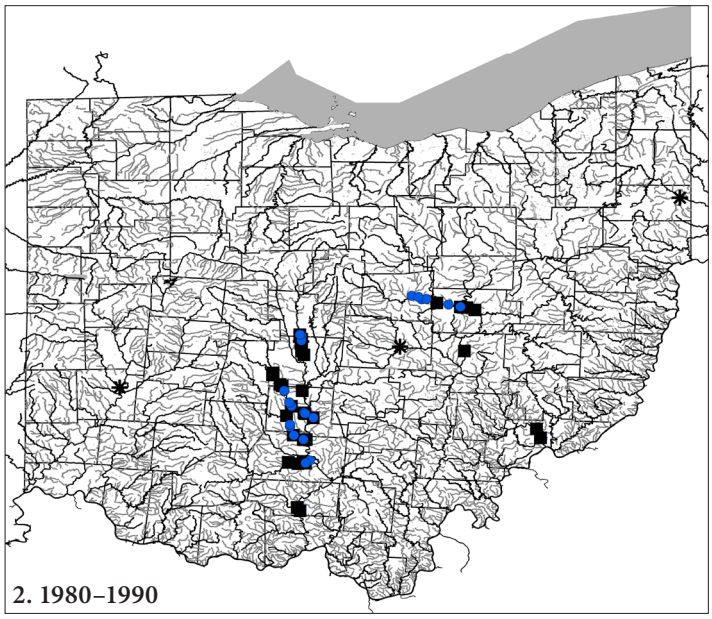
By 1990 (Map 2), some expansion of the Bluebreast Darter's distribution could be seen. In the Scioto River drainage the species has become more abundant and widespread in Big Darby and Deer Creeks. It has expanded slightly in the Muskingum drainage, becoming more abundant in the Walhonding River, and has been found further upstream in the lower Kokosing River, one of two rivers that form the Walhonding River.

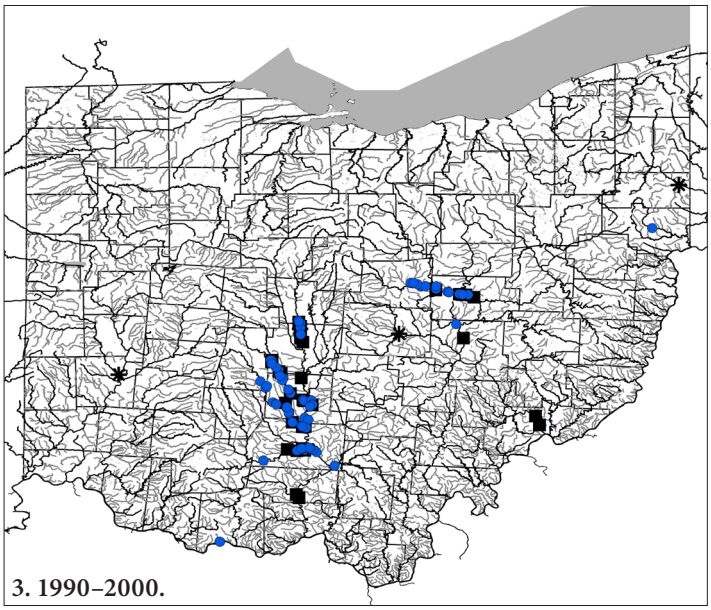
By the year 2000 (Map 3), the Bluebreast Darter's expansion was even more apparent, as they were found in a good portion of the main-stem Scioto River and several of its tributaries. The species was found in one location in the main-stem Muskingum River and one in the Ohio River proper, and in 1998 was found for the first time in Little Beaver Creek, a direct tributary to the upper Ohio River on the eastern side of the state.

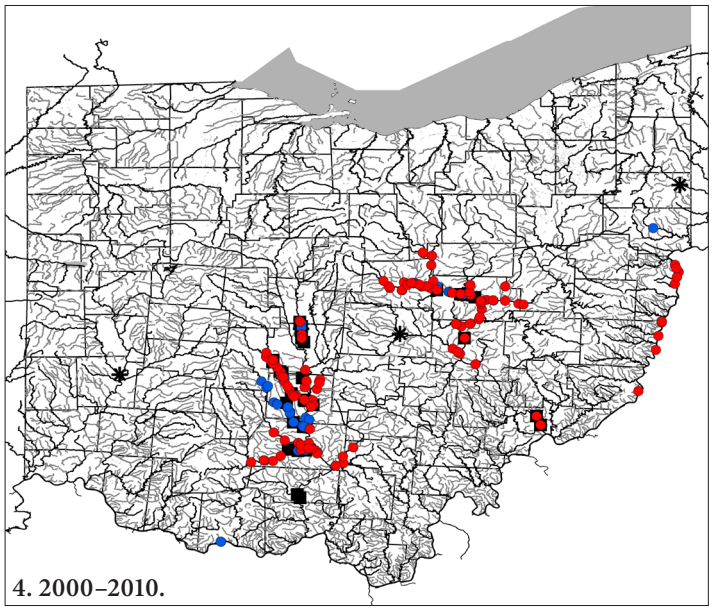
By 2010 (Map 4), the species had dramatically increased its known distribution in Ohio. It was now found in almost every major tributary to the Scioto River from Columbus downstream to the Ohio River, including a significant portion of the main-stem of the Scioto. In the Muskingum drainage a similar expansion had occurred and it could now be found by the hundreds at some locations, including sites on the upper main-stem of this system. Most impressive is its expansion along the eastern border of Ohio, where it was first found by ORSANCO, which had contracted some benthic trawling in the upper Ohio River. Further, the Ohio EPA found the species in the lower end of several direct tributaries to the Ohio River in the same area. I found them to be abundant below the Pike Island Lock and Dam on the Ohio River in 2009.

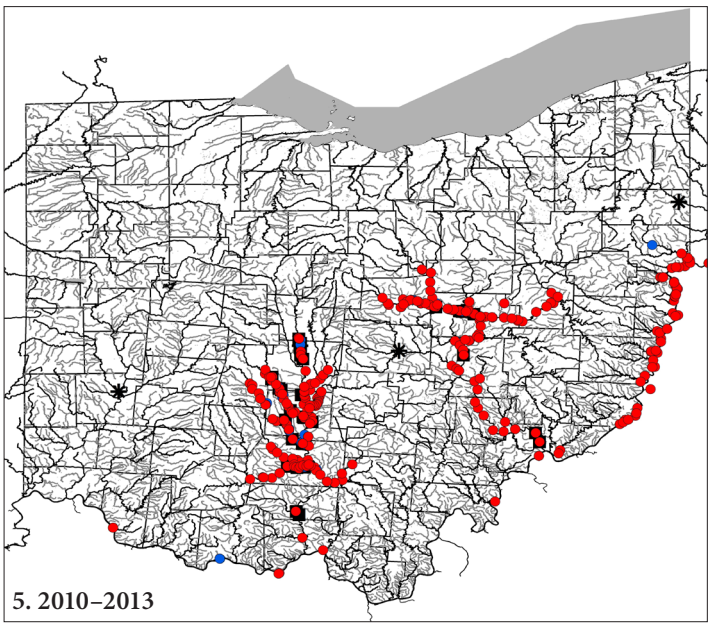
The species has continued to expand even in the last four years, from 2010–2013 (Map 5), and I am sure new


1. Before 1980


2. 1980–1990


3. 1990–2000.


4. 2000–2010.


5. 2010–2013

* = Before 1900
■ = Between 1900 and 1980.
● = 1980s and 1990s.
● = 2000s and 2010s.

records will be added in 2014 as well. In 2011 I began a new project with the intent to build new distribution maps for every species of fish found in Ohio. The eventual goal is a new *Fishes of Ohio* book. The project is being funded by the Ohio Division of Wildlife through the Ohio State University (OSU). One of the main data gaps we discovered is a lack of up-to-date distribution data for large river benthic species including the Blue-breast Darter. In the past several years we have done a significant amount of field sampling in Ohio's large rivers, which has led to our current picture of the Blue-breast Darter's distribution. We have found it in the lower 2–5 miles of nearly every major tributary to the

Ohio River along the eastern side of the state. It is now present in some abundance 10 miles or more up Little Beaver Creek (the largest eastern Ohio tributary to the Ohio River). We have occasionally found specimens much further down the Ohio River proper, including one not far from the Cincinnati area. They are found in the tailwaters of every dam on the Muskingum River. Additionally, they have expanded to the east in the upper Muskingum basin well up the Tuscarawas River, one of the two rivers that form the Muskingum River. We will be sampling the lower Scioto River in the upcoming summer 2014 field season and expect to find them there as well. I anticipate that the map will show a rather continuous distribution in that system all the way downstream to the Ohio River, as it already does for its distribution in the Muskingum River.

In the second year of the Fishes of Ohio Inventory and Distribution project, the Ohio Division of Wildlife conducted a 5-year review of the status of fish species in the state. Based on our (myself and others working on the project at OSU) experience and the data we already had in hand at that time, we recommended that the Bluebreast Darter be removed from the state Endangered and Threatened list. The Division of Wildlife took our recommendation and the Bluebreast Darter was officially delisted as of July 1, 2012.

The Division of Wildlife lists 20 species of fish as endangered, 13 as threatened, and 9 as being of special concern. Hopefully some of these species will, with continued improvement of water quality in the state, expand their ranges to the point that protection is no longer warranted.

SPAWNING MY MILWAUKEE RIVER SPOTFIN SHINERS, LEGALLY!!!

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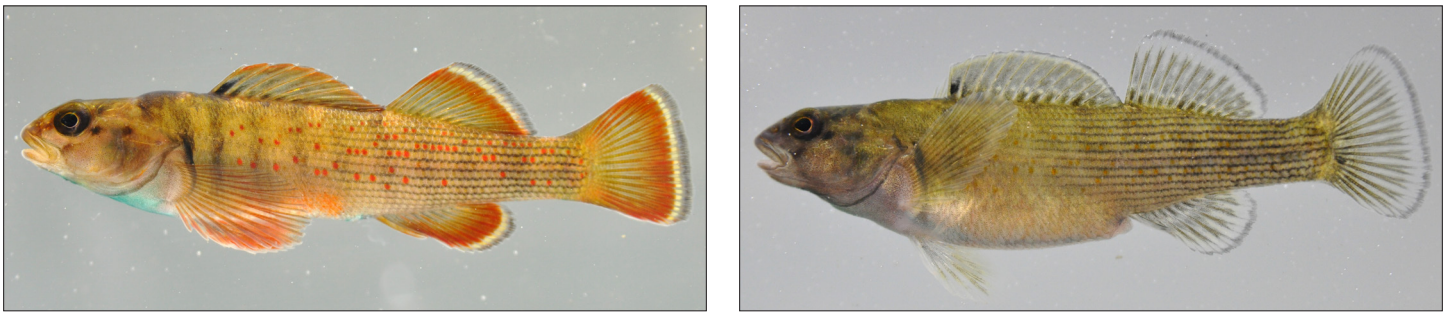
For those of you that don't know, I have a Letter of Permission (LOP) issued by the state of Wisconsin's Department of Natural Resources (DNR) to capture, keep, breed, and sell native "minnows" of Wisconsin. I put the word "minnows" in quotes because the state definition includes some other fish that don't normally fall under the definition of minnows. Such fish are: suckers, mudminnows, madtoms, stonecats, killifish, topminnows, silversides, sticklebacks, trout-perch, darters, sculpin, and all species in the minnow family, except goldfish and carp. I have had this LOP for many years and enjoy using my LOP to provide people and institutions with native fish though my hobby-business, BT-Darters. I see and catch a lot of fish that many people don't know about. One of the more beautiful fish that I catch in southeastern Wisconsin is the Spotfin Shiner (*Cyprinella spiloptera*.) During the breeding season, May to September, males collected in the river are an absolute stunning steel blue with scales edged in purple and fins of orange with white tips! They rival most tropical fish any day! Now I do have to mention that non-spawning males and females are simply silver in color, though they do possess the species' interesting body shape. To me, Spotfin Shiners look like little salmon. Anyway, I love these fish!

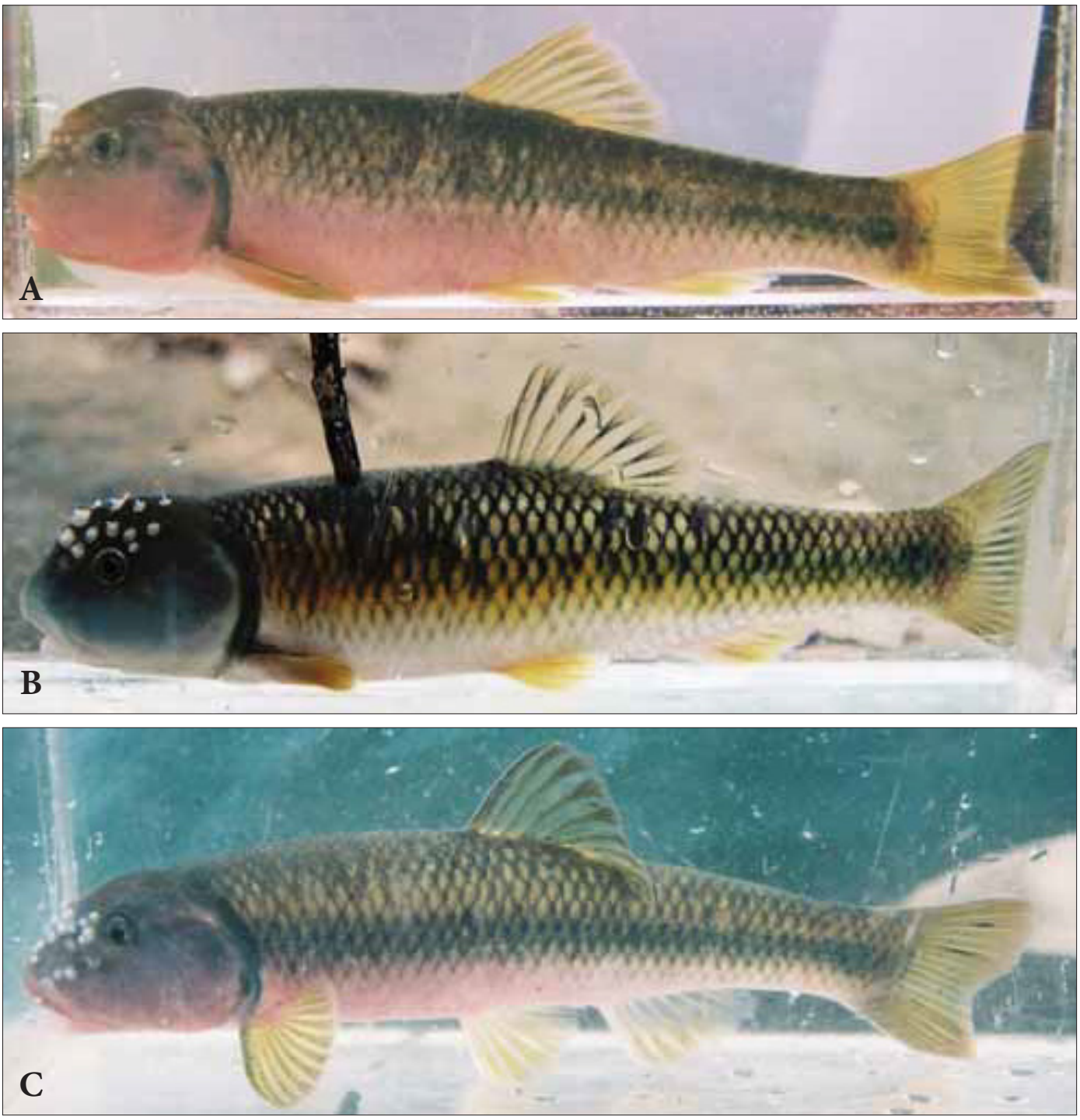
This year, in the month of June, I collected several breeding-condition male and female Spotfins out of the Milwaukee River. Now, you may think that the Milwaukee River might be a complete environmental "mess," but it has actually improved dramatically in water qual-

(Continued on page 24)

Author's Note: This article was originally written for the Milwaukee Aquarium Society Breeder's Award Program. Some things mentioned in the article may be obvious to the reader, but were included as it was intended for an audience with limited knowledge of my operations. Reprinted with permission from *Splash*, the official publication of the Milwaukee Aquarium Society.



Bluebreast darter: male (left), Wakatomika Creek, OH; female (right), Big Darby Creek, OH. (Photos by Brian Zimmerman)



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)

Tangerine Darter (*Percina aurantiaca*), Little River, TN. (Photo by Dustin Smith)

Banded Darter (*Etheostoma zonale*), Cane River, NC. (Photo by Fritz Rohde)

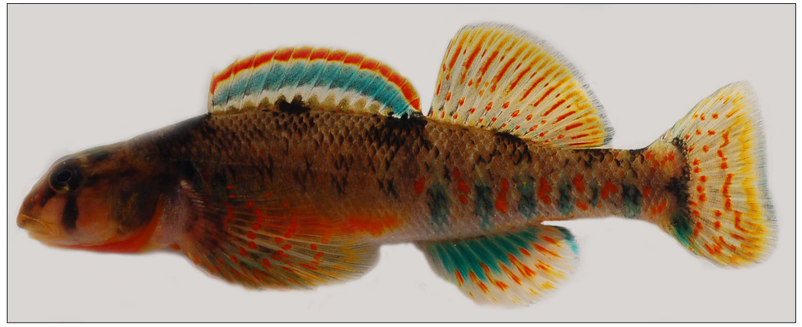
Kanawha minnow (*Phenacobius teretulus*), Big Laurel Creek, NC. (Photo by Fritz Rohde)

Warpaint Shiner (*Luxilus coccogenis*), Price Creek, NC. (Photo by Dustin Smith)

Kanawha Highlands Shiner (*Notropis* sp. cf. *rubellus*), Big Laurel Creek, NC. (Photo by Fritz Rohde)

Saffron Shiner (*Notropis rubricroceus*), Price Creek, NC. (Photo by Fritz Rohde)

Fieryblack Shiner (*Cyprinella pyrrhomelas*), Middle Saluda River, SC. (Photo by Fritz Rohde)



Kanawha Darter (male) (*Etheostoma kanawhae*), Big Laurel Creek, NC. (Photo by Fritz Rohde)

Greenfin Darter (*Etheostoma chlorobranchium*), Cullasaja River, NC. (Photo by Dustin Smith)

Greenfin Shiner (*Cyprinella chlorisita*), Mountain Creek, NC. (Photo by Dustin Smith)

A FEW OF THE SPECIES LIKELY TO BE SEEN DURING THE 2014 NANFA CONVENTION

To get your hands on these species—and many more—grab your waders and camera and make your way to Crossnore, NC, June 5–8. For more information, see the article on page 1 of this issue.

Multiple species caught in Cranberry Creek, New River drainage, NC. (Photo by Fritz Rohde)

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4

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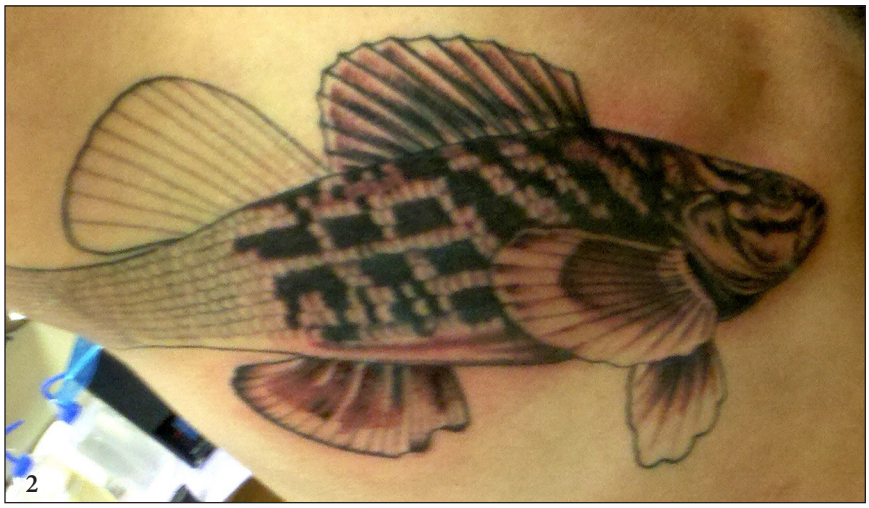

2

DARTERS ON THE BRAIN:
INSIGHTS AND OBSERVATIONS OF A REDLINE FANATIC

Nick Little

National Aquarium
Washington, D.C.

ORIENTATION

Like many, my fascination with fish began long ago with the vibrant colors and social interactions of South American tetras, African cichlids, and various reef fish. Evenings were spent "playing in the fishroom" with my father, Alan, a fellow fish enthusiast, as we routinely spent 2–4 hours a night maintaining the approximately 40 fish tanks and vivariums in our basement. Tank sizes ranged from 2 to 225 gallons and held nearly every species of tropical fish that could be found for sale. We had success breeding and rearing the young of many species. Most were traded away at local fish clubs we were associated with. Growing up in the Piedmont region of northern Virginia, I spent many afternoons mucking around local creeks after school attempting to capture the local wildlife. Rarely did the idea creep into my head to actually try to keep any species I managed to net. At that point in my life, they—fish in particular—were just drab, boringcreek fare. They paled in comparison to the "exotics" and weren't worth the tank space.

Little did I know at that time that many years down the road I would fall head-over-heels for natives, from working exclusively with them in a professional setting to permanently altering my body in the form of a large tattoo.

CAREER

My professional career in the zoo and aquarium industry began at the Virginia Living Museum (VLM) in Newport News, VA. The VLM boasts a wonderful array of native flora and fauna that can be found across the state in every geographical region and habitat. Their collection includes native birds, mammals, herps, fish, invertebrates, and plants. For the first three years, I was a herpetology assistant and helped maintain the large collection of display and education animals. After that, I moved over to the Aquarium Department where I became a full time Aquarist under curator Chris Crippen, who still holds the position today. In the year I worked with him, Chris taught me everything about native freshwater and marine species of fish and aquatic invertebrates. From Chesapeake Bay species 101 to Stream Inhabitants 404—I learned it all. This is where my passion for natives, and stream fish in particular, really developed. We made many collecting trips to various parts of the state in order to obtain species we needed for the exhibit. Among these were trips up and down the Blue Ridge Mountains along Interstate 81 to find stream inhabitants. While I was familiar with the types of fish that could be found in a stream environment, from my youth, I had never experienced anything like mountain streams and the secrets they keep. Chris opened my eyes to the mind-blowing world of darters. I've been hooked ever since.

In early 2009, I moved back to northern Virginia and took a position as an aquarist at the National Aquarium in Washington, D.C. The vacancy just happened to be for the "Native Freshwater Ecosystems" gallery. The displays are based on the ichthyofauna that can be found in ponds, lakes, rivers, streams, and swamps across the continental United States. Over the last five years, the Curator (Jay Bradley) and I have traveled across most of the eastern states collecting species for display. Jay helped nurture my passion for natives by allowing me to redesign, renovate, and repopulate each exhibit as I saw fit. The collection now includes over 60 native species, of which 10 are darters. One species in particular quickly became a favorite and has—quite literally—left its mark!

OBSESSION

The first time I collected a batch of Redline Darters (*Etheostoma rufilineatum*) was on a trip to eastern Tennessee in the fall of 2009. A few aquarists from the Tennessee Aquarium led us on an expedition to the outskirts of Chattanooga and the eastern portion of the state to begin our collecting. In addition to Redlines, we also scooped up a few Tennessee Snubnose (*E. simoterum*), Striped (*E. virgatum*), and Rainbow (*E. caeruleum*) darters. Most of the males retained decent coloration, considering it was early October. It was not the Redlines' handsome mix of red, black, yellow, tan, and a dash of blue of that first caught my attention, however, but their outgoing personality. I vividly recall having to poke the Redlines into the dip net as they blatantly refused to move from behind whatever rock they were using as shelter from the current. As a 6-foot, 200-pound man, I would expect to be seen as a formidable threat by any stream inhabitant, especially a two-inch darter. Yet all of them—every single one I caught—held their ground while other species fled immediately. I was impressed.

Even once our new captives arrived in D.C., their antics never ceased. Males and females alike chase each other around but rarely cause any damage. They all jockey for the best spot in the exhibit, sitting directly in the outflow of the powerheads. Despite their gallant efforts, even the most robust female loses her spot to the larger, dominant males. And what a sight those males are! Tucked in and amongst the river rock that lines the floor of their Appalachian Stream exhibit, you can always see several Redlines playing tag and finding new hiding places behind or under rocks. Though there are over 250 species of darters, I knew right away that the Redline had "that special something" that would make them my favorite.

All the while, another bug had been giving me an itch and it was the infamous 'second tattoo' bug. Those of you who only have one tattoo will know exactly what I'm talking about. Though over four years had passed since getting my first, there was never any doubt that I would end up with another. I knew I wanted it to be some sort of animal, and several herp species were at the top of the list. By the time I was finally able to afford my next tattoo, I had spent years working with native fish and the herps were being pushed further down the list.

WHY A REDLINE TATTOO?

Most stream fish I have captured over the years tend to lose the vivid colors that they express in the wild. At best, their colors return only occasionally, under the right conditions, and last for a very short time. Male Redlines retain quite a bit of color throughout the year, making them an impressive display animal. Like that of all darters, they have that elongated, unique profile of a bottom-dwelling perciform that defies the classic fish-shape most of us expect.

Being a "think outside of the box" type of guy, I wanted a tattoo that no one else had. On top of that, it had to have a prominent location. Eureka!....the rib cage! Though some readers may cringe at the thought of spending many hours in a chair being tickled on the ribs by thousands of needle pricks, I happily sat through three 4-hour sessions while reading my Kindle. The first stage was the outlining the fish and its fins and scales (Figure 1). After 2 weeks, I returned to get the shading done (Figure 2). The red you see is my body's reaction to the initial trauma, not coloring.

Finally, after a several month hiatus due to scheduling conflicts, I returned to the parlor to have the tattoo finished (Figure 3). Believe it or not, NO red ink was used on the final product. We decided that using a true red would contrast too much, so we went with a deep orange instead. I initially had a hard time swallowing the idea that my REDline darter tattoo was orange, but a year later I'm very happy with the results. In hindsight, one could argue that certain populations of Redlines are slightly more orange than red (at least I tell myself that to help fall asleep at night!). The actual size of the tattoo ended up having to be roughly 12" x 5" (Figure 4) in order to include all of the fine detail.

FINAL THOUGHTS

Redlines remain one of my all-time favorite fish, even when exotics are considered. The fact that I don't have to leave the country (or even the state, for that matter) to see them makes them even more appealing. Watching them in the wild never gets old, which is why Chris and I usually take a couple of trips a year to the western side of the state to go 'dartering'. I switch on my "Redline Radar" and can home in on their exact location. My fellow darter enthusiasts will know that I'm talking about riffles. This species prefers very strong current and is able to navigate it with ease. In the right spots, I can capture

two or three on each attempt with a dip net. I seem to have good luck as most of the time it is a male and one or two females. This holds true even outside of the breeding season. In captivity, the Redline Darter does quite well. Despite their preference for cool waters, I have had them in tanks that reached an ambient temperature of 75 degrees. To my initial surprise, they did quite well at this elevated temperature for an extended duration. I made sure to add extra aeration to these tanks to help increase the dissolved oxygen, as warm water holds less.

Though breeding behaviors have been seen and spawing has likely occurred, no attempts have been made to harvest any eggs. Other fish in the tanks likely make short work of the unguarded eggs and/or fry. I still intend to successfully breed and rear this species in the future. I am currently in the process of setting up a 125-gallon stream display at my new house. It will have (surprise, surprise!) Redline Darters as its main feature. Finding a place to hide the 10- and 20-gallon rearing tanks from the wife will be my next trick!

Milwaukee Spotfins (Continued from page 17)

ity over the last 10 years. At one particular location where I collect the Spotfins, the water has several feet of visibility, even after heavy rain events. And, this may sound bad, but the river has no odor. I mention that because in years past, for example, the 1990s, I remember the river having a distinct, rancid smell. Now, no odor and many fish! Good times!

After collecting the fish, I got them home, acclimated them, and got them on a heavy Captain Bob's flake food and live blackworm diet. After about a month in captivity, they started laying eggs. Now, Spotfins are crevice spawners, so I had to make special egg "traps" for them. What I did was I threaded some small clay pots through a piece of airline tubing and put spacers between the nested pots. The spacers were made out of airline tubing, too. That made a gap of about 3/16 of an inch between each pot. I placed the "pot array" in the adult's tank and just waited for them to start laying eggs. I checked the pots every few days until I found eggs. On July 26th, the fish laid eggs. I removed the spawning apparatus with the eggs and put them in a seasoned 2.5-gallon tank with a sponge filter and a heater. Now, I probably don't need a heater in there, but I wanted to get the fry to grow as quickly as I could. I really wanted those Breeder Award Points (BAP)! The adults spawned again three days later, and after several days, I had 50–100 fry from the two spawnings. The fry didn't seem to have much of a yolk sac when they hatched and looked like tiny little slivers of glass. I immediately started them on a microworm and vinegar eel diet and performed 50% water changes once daily. The fry seemed to acclimate to the live foods and water change schedule well. After about a week, I began adding live baby brine shrimp, Captain Bob's Top Secret Fry Food, and Captain Bob's Nori "45" Fry Food to their diet. They did very well on this and have been growing well.

At the time of writing this article, the fry are a couple of months old and are doing very well. I estimate that I still have about 50 fry and the largest ones are 1 and ¼ inches long. I am going to have a limited number of fry available for purchase. The DNR regulations regarding my selling of captive-spawned fish are a little bit less strict than my selling of wild-collected fish. For my wild-collected fish, the people who purchase them from me are required to register with me, providing name, mailing address and phone number. This is because the DNR wants me to have that information on file in the event that the fish disease Viral Hemorrhagic Septicemia (VHS) is found at any of my collecting sites. If it is, the owners of fish from that location(s) can be notified. This has not happened since VHS was found in Wisconsin, and I only collect from VHS-free waters, but it is a precautionary measure.

For my captive-spawned fish, no registration is required, though I do provide a proof-of-purchase to indicate that you legally purchased the fish from me. Simple stuff!

Well, if you like what you've read here, please head over to my website: www.btdarters.com. If you want to purchase some Spotfin fry, I am selling them for four fry for $15.00. Please contact me through any of the means on my "Contact Us" page on my website. Thanks for reading my article!

Other Links of Interest:

Captain Bob's Fish Food:
www.captainbobsfishtales.com
California Blackworm Company:
www.aquaticfoods.com

OCCURRENCE OF LEAST KILLIFISH AT THE NORTHERN LIMIT OF ITS RANGE IN SOUTH AND NORTH CAROLINA

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INTRODUCTION

The Least Killifish (*Heterandria formosa*), is a small, live-bearing poeciliid native to the southeastern United States. *Heterandria* is the smallest freshwater fish in North America and one of the smallest in the world, growing to an average adult size of approximately 2.0 cm (0.8 in). Common habitat includes shallow, vegetated ditches and ponds, with some populations occasionally venturing into brackish water (Rohde et al., 2009). Females give birth to up to 8 young at intervals of about 10 days. Least Killifish are diurnal feeders on small arthropods, snails, algae, plants, and detritus and have a lifespan of about 2 years (Menhinick and Braswell, 1997). They are found on the coastal plain from Louisiana to Wilmington, North Carolina, including Florida, and have been found as far as 161 km (100 miles) inland (Chaney and Bechler, 2006). The Least Killifish is an easily overlooked species because of its small size, occurrence in heavily vegetated habitat, and similarity to more widespread species such as the Eastern Mosquitofish (*Gambusia holbrooki*).

Spotty records of *Heterandria* exist in Horry County, South Carolina, but no records of which we are aware exist between this region and collections of *H. formosa* near Wilmington, North Carolina, a distance of approximately 64 km (40 miles) between the closest verified occurrences (Menhinick and Braswell, 1997; Hogue and Raine, 2006; Rohde et al. 2009). Genetic evidence indicates that a historically recent range expansion of *H. formosa* into the Carolinas has not achieved Hardy-Weinberg equilibrium. Populations of *Heterandria* are in flux, and there is evidence that populations in the Carolinas have been established more recently than populations further south (Baer, 1998). Anecdotal observations suggest that Least Killifish are more common now in Horry County than they were in previous decades (R.H. Moore, pers. comm.). Stream capture under low flow conditions may function as a conduit for establishing new natural populations over time (Chaney and Bechler, 2006), but an isolated population indicates the likelihood that specimens caught in the lower Cape Fear River drainage around Wilmington are introduced, possibly from the stocking of larger game fish or through bait-bucket transfer.

Bait-bucket transfer can occur when bait sold by a retailer is released. *H. formosa* is unlikely to be used for bait due to its diminutive size, however store-sold bait often contains non-bait species, or bait being sold may not be the species advertised. Bait may also be transported between basins by stores receiving shipments of bait stock containing *H. formosa* or from fishermen transporting bait personally. There is the potential for non-native species to be introduced to a new environment when fishermen release their bait or when bait escapes. The combination of these factors creates a high likelihood that species are frequently introduced to new environments through bait-bucket transfer (Ludwig and Leitch, 1996).

Least Killifish (*Heterandria formosa*), Waccamaw River tributary, SC. (Photo by Fritz Rohde)

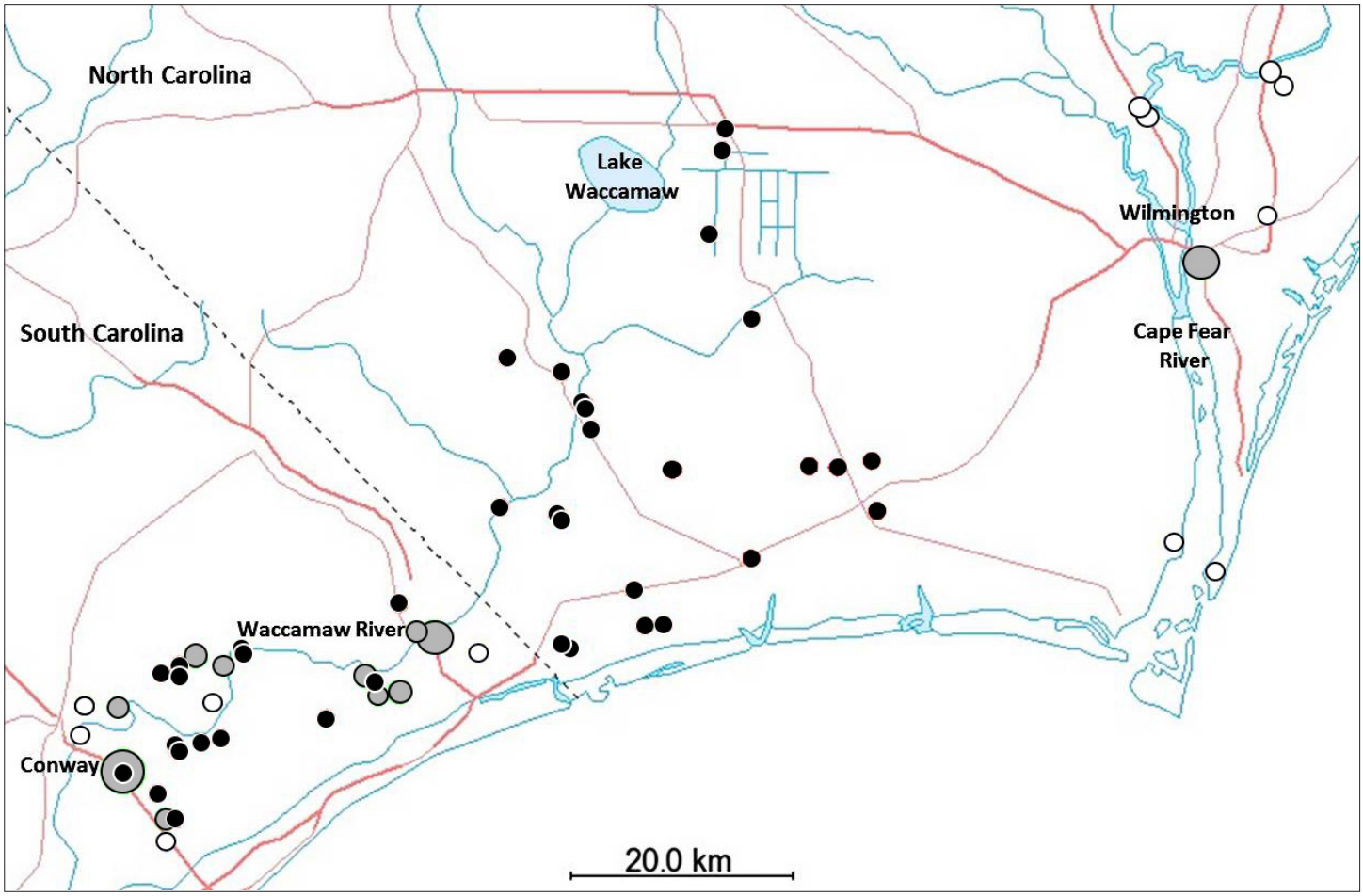

Figure 1. Map of localities sampled for the presence of *Heterandria formosa* in 2012 (n = 61). Gray circles indicate the presence of *Heterandria* (n = 14) and the size indicates the population density (smallest = 1, largest = 37). Black circles indicate sites where fish were caught, but *Heterandria* were not. White circles mark past catches of *H. formosa* (see Rohde et al. 2009, http://people.clemson.edu/~jwfoltz/scfish/search.htm, http://collections.naturalsciences.org/searchFishes.aspx). See also an interactive Google Map (http://goo.gl/maps/9MDZM) containing collection information, representative photographs of habitat, and locations.

Such a small species of fish is understandably highly affected by the environment in which it lives. Other small poeciliids known to prey on *Heterandria*, such as *G. holbrooki*, may influence the size and sex distribution of populations of *Heterandria* by skewing the population towards large-bodied females (Belk and Lydeard, 1994; Schaefer et al., 1994). The density of *Heterandria* in communities containing few predators seems to fluctuate significantly between monthly censuses while there is greater stability of populations of *H. formosa* in communities with strong predator presence (Richardson et al. 2006). The type of environment, whether creek, river, or lake, can affect the average size of *Heterandria* due to differences in vegetation and depth (Leips and Travis, 1999). Average size may also correlate positively with brood size and negatively with life expectancy of mothers (Henrich, 1988).

The purpose of this study was to resolve the uncertainty regarding the occurrences of *H. formosa* at the northern limit of its range. A lack of continuity in the occurrence of *H. formosa* between South Carolina collections and those around Wilmington, North Carolina, would strengthen the contention that disjunct populations are the result of introduction events in the Wilmington area. Confirmation of a disjunct distribution presents opportunities for research on ecological, behavioral, and genetic variation within the species.

FIELD SAMPLING

To investigate the northern limit of the range of *H. formosa*, sampling of 61 sites was done in Horry County, South Carolina, and Brunswick, Columbus, and New Hanover counties, North Carolina. Sampling sites were preselected using Google Maps based on apparent accessibility and proximity to visible water sources. Several sites that historically had populations of *H. formosa* were also sampled (Hogue and Raine, 2006; Rohde et al., 2009). Sites were also visited opportunistically dur-

Figure 2. Typical *Heterandria formosa* habitat.

ing sampling trips if they were visible from the road and had apparent characteristics of *H. formosa* habitat (e.g., shallow, vegetated water). Sampling took place between March and November, 2012, and focused on the region east of Conway and north of Myrtle Beach, South Carolina in the Waccamaw and Carolina Coastal-Sampit watersheds. Routes that were sampled included South Carolina highways 90, 905, and 9, as well as North Carolina highways 904, 130, 179, and 211. Several localities in Wilmington, North Carolina, part of the lower Cape Fear watershed, were also sampled to confirm the persistence of *H. formosa* in North Carolina.

At each site, a digital photograph and GPS coordinates were recorded and the water was sampled using a long sweep of a fully submerged 40 x 24 cm dip net with a 109 cm handle. Sampling occurred in water with moderate vegetation, if any was present. If fish were present in initial sweeps, four additional sweeps of the net were performed to obtain data on population density. If Least Killifish were caught, a solution of tricaine methanesulfonate was used to sedate the fish at an optimal dosage between 60 and 100 mg/L (Carter et al. 2010). Length and sex of the first 20 specimens were recorded to the nearest 0.1 mm using calipers. After measurements, fish were revived and released. *Heterandria* caught in Wilmington were preserved in 100% ethanol for use in future population genetic studies. To obtain data on associated fish species, individuals were field identified and released for easily recognizable types, while unfamiliar specimens were preserved in 10% neutral buffered formalin, and identified using a dissecting scope and dichotomous keys (Rohde et al., 2009). Sampling was conducted under South Carolina Department of Natural Resources permit F-12-05 and North Carolina Wildlife Resources Commission permit 12-SFC00086 issued to Erin Burge.

DATA ANALYSIS

Google Maps (https://maps.google.com) and GPS Visualizer (http://www.gpsvisualizer.com) were used to map all sample sites and display relative density data for *Heterandria* (Figure 1). Previous occurrences of *H. formosa* in South Carolina and North Carolina were also obtained from publicly available databases and included on maps (South Carolina, JW Foltz: http://people.clemson.edu/~jwfoltz/scfish/search.htm; North Carolina, North Carolina Museum of Natural Sciences http://collections.naturalsciences.org/searchFishes.aspx). The map was used to infer the distribution of *H. formosa* at the northern reported limit of its range and to determine how the range correlated with specific drainage basins.

RESULTS

Occurrences of *H. formosa* were found primarily in South Carolina, with the northeasternmost population found along Highway 9 at the Waccamaw River. No *H. formosa* were found in North Carolina except for isolated occurrences in Wilmington (Figure 1, Table 1). Distances between the northeasternmost South Carolina site containing *Heterandria* (33° 54' 30.70" N, 78° 41' 50.22" W) and the closest historical locations in Wilmington were 67.3 km (33° 59' 4.92" N, 77° 58' 22.44" W), 77.2 km (34° 12' 42.80" N, 77° 56' 42.40" W), and 79.7 km (34° 19' 50.16" N, 77° 59' 53.88" W). Localities with *Heterandria* were usually shallow roadside ditches with heavy vegetation, and rarely lakes, ponds, or natural streams (Figure 2). All but one site containing *H. formosa* also contained *G. holbrooki*. See Table 1 for additional species associated with collections of *H. formosa*, and an interactive Google Map containing collection information, representative photographs of habitat, and locations (http://goo.gl/maps/9MDZM).

DISCUSSION

Field sampling data (n = 61 sites) indicated that the population of *H. formosa* in Wilmington, North Carolina is geographically disjunct from South Carolina localities. To our knowledge, no *H. formosa* have been collected in Brunswick or Columbus counties, North Carolina, prior to and including this study, but isolated occurrences reported in Menhinick and Braswell (1997) in Wilmington, part of New Hanover County, were confirmed by these collections. In South Carolina, the northeasternmost easily accessible point of the normal range of Least Killifish is along Highway 9 in the Waccamaw River drainage. Wilmington, North Carolina,

lies within a different drainage basin—the Cape Fear River—and the absence of *H. formosa* in collections between South Carolina localities and established populations in North Carolina strengthen the likelihood that the Wilmington population was introduced and is separate from the species' natural range.

It is possible that the Wilmington area was once within the species' natural range. At some point in recent geological history the population may have been cut off by some barrier to migration, resulting in a relict population of *H. formosa*. Similar relict, rare, or endemic fishes, such as the Bluefin Killifish (*Lucania goodei*), and the endemic Waccamaw Killifish (*Fundulus waccamensis*), are also present in southeastern North Carolina (Menhinick and Braswell, 1997). This division, possibly by shifting watersheds or development, would have created vicariance, isolating the population. As a result, a population of Least Killifish within the main range may have a similar genetic fingerprint to the isolated population in Wilmington. Similar processes modifying the distribution and isolating populations of Central American species, including other poecilids, has been studied previously (Costa and Schlupp, 2010; Lee and Johnson, 2009; Smith and Bermingham, 2005).

Acknowledgements

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CORCORAN EDUCATION GRANT REPORT

EXPERIENTIAL EDUCATION AND NATIVE FISH

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In 2012 Avon Grove Charter School (AGCS) was fortunate enough to receive a Corcoran Education Grant from NANFA. As a result, we were able to launch a project which would greatly improve our students' ability to study native fishes, stream ecology, and the surrounding watershed. Since our school's inception in 2002, AGCS students have conducted stream studies across the region, participated in riparian planting initiatives, managed tiny "trout hatcheries" in their classrooms (through the national "Trout in the Classroom" program), and raised American Shad (*Alosa sapidissima)* for reintroduction into local waterways. Projects involving freshwater ecosystems are a logical fit for our school for two important reasons:

1) We are located at the center of the White Clay Creek Watershed, which the federal government has designated a "National Wild and Scenic River System."

2) Our school's founding charter challenges us to provide experiential instruction for our students. This means that, whenever possible, we must endeavor to engage students through high-interest, hands-on, and project-based learning activities. Over the years, the streams that make up our watershed have been our school's "outdoor classroom."

ESTABLISHING A PLAN

Our school has been a member of NANFA for three years, and we have learned a great deal from reading the organization's publication, *American Currents*. Occasionally, we have come across articles which describe the care of native fish within large stock tanks. In some cases, these tanks were densely planted, and included both aquatic and terrestrial components. For a school like ours, the idea of an "indoor stream" was particularly appealing, and it was exciting to see that a number of NANFA articles offered some concrete suggestions for bringing highly naturalistic freshwater environments to life.

The NANFA website also includes a number of intriguing articles, such as Jeff Fullerton's "Striking Gold: The Eastern Starhead Topminnow, *Fundulus escambiae,*" which describes the author's experience with keeping fish in outdoor ponds and stock tanks, and Christopher Scharpf's online series of "Captive Care Notes" which meticulously describe larger-scale fish keeping/breeding practices and the importance of fast-flowing raceways for stream-dwelling fish.

The more we read, the more we wanted to find a way to apply some of these ideas to an educational setting.

The first stage of work on the Corcoran Aquatics Lab, with the tanks, plants, and aeration system in place and shelving, benches and workstations to follow.

For many years, our students have responded extremely well to stream studies, and building a functioning indoor stream could extend our students' exposure to freshwater fish species into the winter months, when local stream banks can be extremely treacherous.

We understood, on a very basic level, that regulating the movement of water might be complicated and did some additional reading in aquaculture journals on raceways (Heard and Martin, 1979), which are essentially channels of fast-moving water that enable fish accustomed to fast-moving stream environments to live in artificial conditions.

Our concepts seemed simple enough: we planned to begin with a 350-gallon Rubbermaid stock tank which would serve as the outer container for our indoor habitat. We would then use natural materials to channel the current created from a 750-gph recirculating pump to form a spiral-shaped channel or circular raceway. We hypothesized that this raceway, in addition to an elevated and heavily planted section of the tank, with a rocky substrate, would allow for natural filtration. When the Corcoran Grant Review team made the decision to fund our project, we were eager to set about building the system according to this plan.

THE BUILDING PROCESS

We started our project in the fall of 2012 by clearing a 20' x 20' space in our school's greenhouse and laying out our materials. Not surprisingly, we soon discovered that creating a simulated stream in a round stock tank was going to be somewhat more challenging than we had expected. The first problem we encountered related to natural materials. We initially had planned to avoid synthetic raw material in our system. However, we quickly learned that raceways and planting beds made from even the most carefully positioned stones were very difficult to keep in place and always prone to collapse.

We solved this initial problem by recycling dozens of plastic planting flats and large plastic pots. We also used large terracotta pots (turned upside down and sometimes stacked) to support our spiraling raceway channel. Later, the terra cotta pots would also prove ideal as hiding places for juvenile fishes. Our second challenge related to current. Based on what we had read, it seemed that a 750-gph pump would have sufficient power to push water through our spiraling raceway. This was definitely not the case. In reality, our pump was only able to produce enough of a current to move water half way around our spiral.

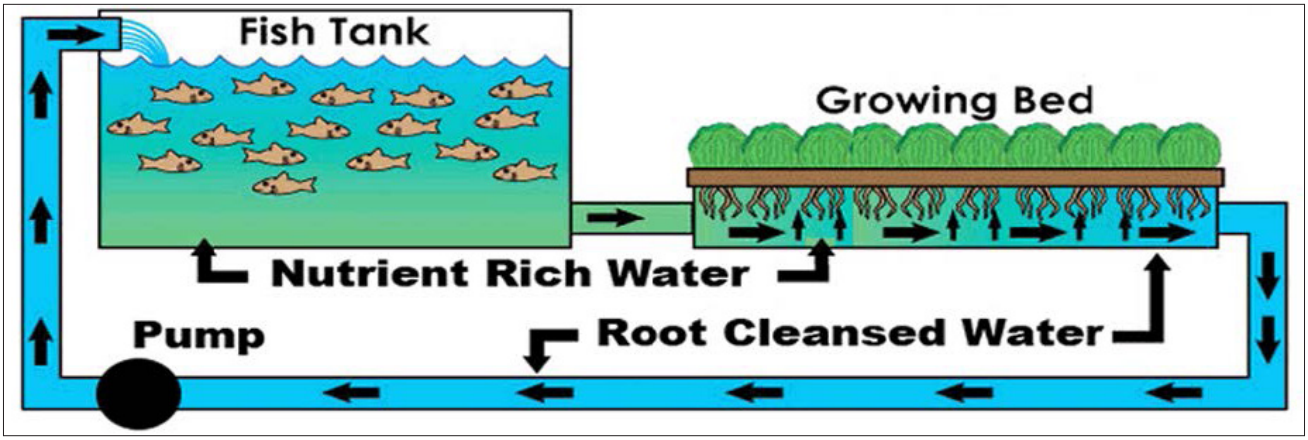
Students adjusting the wooden covering above one of the three pumps within the Freshwater Aquatic Lab.

We attempted to remedy this problem by creating deflectors to bounce moving water in a way that would extend our flow. Though this technique produced some very modest positive outcomes, it did not solve the problem.

After a great deal of experimentation and the addition of a few feet of PVC pipe, we managed to engineer a solution. We added another 750-gph pump precisely at the section of the raceway where our current went slack. The addition of the second pump immediately solved the problem, and within seconds, we had what we had hoped for: a swiftly-moving indoor stream!

We lined the raceway and the base of the tank with stones which were chemically neutral or which (like the limestone substrate of our watershed) mildly raised the pH of the system. Before placing these stones, we added a commercial substrate which would enable submerged plants to take root. For about two weeks, the pH of the tank fluctuated. At one point, our measurements were in the 6.5 range and a few days later, they spiked to 7.2. Our pH finally stabilized at 7.1, which is comparable to average readings in our local watershed (North, 2007).

We planted a variety of emergent plants along the perimeter of the tank including Pickerel Rush (*Pontederia cordata*) and Common Cattail (*Typha latifolia).* Both of these species immediately began to thrive. A little later, we added a tiny sprig of Watercress (*Nasturtium officinale)* and some colorful garden-variety Nasturtiums *(Tropaeolum majus).* These two species would grow at an almost unreal rate, and throughout the coldest winter months, students would harvest massive bunches of Watercress and Nasturtium flowers



A traditional aquaponics system.

on a weekly basis. We eventually managed to sell Watercress to local restaurants which helped defray some of the costs associated with operating the aquatics lab.

We also added a number of oxygenating plants to the edges of the raceway and within the plunge pool at the center of the tank. We took a systematic approach to adding water to the system. We slowly filled the system with a mix of aged tap water and gleanings from an established outdoor pond on our property. As a result, we imported a number of micro- and macro-invertebrates, which provided a baseline food source for the fish we would eventually introduce.

When the pond was filled with water, the pumps were running properly, and our plants were in place, we turned our attention to regulating temperature. Luckily, our school had purchased a chiller for the previous classroom trout-hatchery project many years before, and it was still in excellent working order. This ¼-horsepower machine and an accompanying 400-gph pump kept our system at a fairly constant stream temperature between 55 and 63 degrees.

After about a week of tinkering, we allowed the tank to cycle for about 10 days, regularly checking ammonia, pH, and nitrate/nitrite levels.

NATIVE FISHES

One of our goals was to populate the Corcoran Freshwater Aquatics Lab with fish from our watershed. We managed to accomplish this goal with some help from the researchers at the Stroud Water Research Center. Our friends at Stroud provided some very healthy aquarium-raised fish, and we supplemented their contribution with fish from our outdoor pond and an online aquaculture supplier. By the spring of 2013, our collection included most of the fishes present in White Clay Creek, and a few species from the neighboring Delaware and Susquehanna watersheds. I have included our complete list of represented species (at right).

A UNIQUE TEACHING TOOL

Our students responded to the introduction of the Corcoran Freshwater Aquatics Lab with a tremendous amount of enthusiasm. During the course of the year, elementary, middle, and secondary students marveled at the sight of tiny fish leaping at the water's surface and colorful and determined darters working their way "upstream."

Although the tank contained a very healthy and self-sustaining culture of tiny insects and freshwater

Table. Species represented in the Corcoran Aquatics Lab

Species from White Clay watershed	
Common name	**Scientific name**
White Sucker	*Catostomus commersoni*
Rosyside Dace	*Clinostomus funduloides*
Tessellated Darter	*Etheostoma olmstedi*
Cutlips Minnow	*Exoglossum maxillingua*
Common Shiner	*Luxilus cornutus*
Spottail Shiner	*Notropis hudsonius*
Swallowtail Shiner	*Notropis procne*
Spotfin Shiner	*Cyprinella spiloptera*
Margined Madtom	*Noturus insignis*
Fathead Minnow	*Pimephales promelas*
Blacknose Dace	*Rhinichthys atratulus*
Longnose Dace	*Rhinichthys cataractae*
Creek Chub	*Semotilus atromaculatus*
Species from other regional watersheds	
Common name	**Scientific name**
Bluespotted Sunfish	*Enneacanthus gloriosus*
Chesapeake Logperch	*Percina bimaculata*
Green Darter	*Etheostoma blennioides*
Pirate Perch	*Aphredoderus sayanus*

plankton, the number of fish in the system made regular feeding necessary. Feeding time was particularly exciting for our students because many of the fish in the aquatics lab were captive-raised and fearless; they literally jumped for fish flakes and frozen bloodworms.

Our teachers immediately began finding ways to integrate the Corcoran Aquatics Lab into daily instruction. Bonnie Dickson, our school's middle school Environmental Science teacher, devised a number of activities that enabled students to identify native fish species on sight, and used our indoor stream to better illustrate the relationship between native fishes and other life forms within our watershed. Kathleen Logullo, our elementary-level Environmental Science Teacher, used the aquatics lab to engage the imaginations of our school's youngest students, who subsequently produced some truly stellar scientific and artistic work celebrating native fishes.

One of the most challenging and entertaining elements of the project was the introduction of a fish cam—essentially a 3 inch by ½ inch submersible video camera—which, through a small array of LED lights, enabled students to see what was happening underwater. Ms. Dickson and her students became very adept at using the camera to observe fish behavior. Although the quality of the short video clips captured by the students was never crystal clear, the fish cam was useful enough to get students up close and personal with their underwater subjects.

At Avon Grove Charter, we are lucky to have tremendously creative environmental educators like Ms. Dickson and Ms. Logullo, who see the unique potential of an instructional resource like the Corcoran Aquatics Lab and who, through experimentation and ingenuity, continually find new ways of integrating our indoor stream into their instruction.

As time passes, the Corcoran Aquatics Lab will continue to engage students, inspire teachers, and remind all of the members of our school community of the splendor and diversity of our native fish species.

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WELCOME, NEW MEMBERS!

Jack Agliata, Davidson, NC
Lori Anton, Dixon, IL
Owain Berry, Saskatoon, SK
Tim Daniel, Columbus, OH
Erik Donofrio, Athens, GA
Jessica East, Lubbock, TX
Jack Fetters, Hamilton, OH
Pamela Hart, Auburn, AL
Brajaan Hayes, Richmond, KY
Kat Hentsch, Sumner, WA
Joseph Lachawiec, Waretown, NJ
Chris Lehenbauer, Worcester, NY
Otto Lorenz, Americus, GA
David MacNeill, Oswego, NY
Donald Mohney, North Kingsville, OH
Michael Moore, Blacksburg, VA
Heather Neptune, Derry, NH
Danielle Pitt, Moreno Valley, CA
Todd Radek, Spring Grove, IL
Roberta Reynolds, Abbeville, SC
Thomas Ruf, Amelia, OH
Paul Skvorc, Wasilla, AK
Ben Stenger, Hixson, TN
William Thorne, Richmond, VA
Thai Tran, Westminster, CA
Denis Vardaro, Staten Island, NY
Paul Westlund, Columbia Heights, MN

CORCORAN EDUCATION GRANT REPORT
A LIFE-SIZE STURGEON EDUCATIONAL DISPLAY FOR FREE INTERAGENCY LOAN

Thomas E. Brooking

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Sturgeon are the keystone species of native, freshwater fishes. Once abundant throughout New York and the Great Lakes drainage, sturgeon have been reduced in numbers or extirpated from many watersheds. Most species of sturgeon are now listed as Threatened or Endangered throughout much of their historical range, and have been listed as species of primary restoration concern by the USGS Great Lakes Restoration Initiative, The Great Lakes Fisheries Commission, and most states surrounding the Great Lakes basin. Sturgeon were once abundant in many parts of New York, including the Great Lakes tributaries, St. Lawrence River, Hudson River, and others. They were an important part of Native American culture, and were once so abundant that commercial fishermen complained of all the large sturgeon tearing up their nets. However, the prized caviar of the sturgeon soon turned them into a highly sought after species. They were netted and caught in large numbers, with little regard to overharvest. At the same time, many streams were dammed to provide power to fuel the Industrial Revolution, inadvertently blocking access to many sturgeon spawning streams. Also, sturgeon are a long-lived species (>100 years) so it takes females 15–20 years to reach spawning age. Many were getting caught before they were even able to spawn. The combination of these factors, along with pollution, led to the collapse of nearly all sturgeon populations in New York and many other areas. Human actions led to their decline, and thus we bear the responsibility to restore them.

The New York Chapter of Sturgeon For Tomorrow (see links below) was recently formed to promote the re-establishment of sturgeon throughout New York to levels such that all species of sturgeon found in New York are able to be removed from the Threatened or Endangered Species lists, and ultimately produce self-sustaining populations capable of supporting sport fisheries. Sturgeon For Tomorrow groups were originally started in some Midwest states, such as Michigan (http://www.sturgeonfortomorrow.org/) and Wisconsin (http://www.sturgeonfortomorrow.net/Chapters.html). About two years ago, a chapter was organized here in New York. It is still a fledgling group with practically no funding. From my fisheries job with Cornell University, I knew lots of folks who did sturgeon research, and had many fishermen reporting sturgeon catches to us, so it seemed natural to make a connection and capture everyone's enthusiasm to restore sturgeon in New York.

Public education and support play an integral role in encouraging state and federal management agencies to commit ever-shrinking resources towards re-establishment of sturgeon. We applied for and were very fortunate to receive an educational grant from the North American Native Fishes Association through their Gerald C. Corcoran Education Grant Program, to purchase a life-size, realistic sturgeon replica to jump-start our public educational displays. This amazingly realistic sturgeon mount was specially constructed for us by American Fish Taxidermy in TN (http://www.americanfishtaxidermy.com/). The sturgeon mount is the centerpiece of our educational displays, and truly captures the awe-inspiring magnitude of a real-life, swimming fish that can surpass seven

Contact New York Sturgeon for Tomorrow by email using the link above. The mailing address is 111 Russet Lane, Solvay, NY 13209. Phone: (315) 663-5422

http://www.nysturgeonfortomorrow.org
http://www.facebook.com/pages/NY-Sturgeon-For-Tomorrow/221935594534480

feet in length and weigh over 230 lbs in freshwater lakes and rivers. It is truly a remarkable, eye-catching piece that would not have been possible without the Corcoran Education Grant. In addition to the sturgeon mount, we have rounded out the display with several sturgeon posters, a scientific poster on sturgeon research, informational brochures and signs, videos, sturgeon baseball cards, sturgeon coloring sheets and stickers for the kids, and even live baby sturgeon on display.

An added benefit is that the model was purchased with the intent of being available for short-term loan to environmental groups, angler associations, universities, researchers, fish hatcheries, state and federal agencies, public and private schools, local zoos, and other pertinent groups. By making it available for loan, we save them from having to spend resources on separate displays, something that would be impossible for most of them to do individually. By loaning out the sturgeon replica, we can reach many thousands more people than if our group alone tried to promote sturgeon. The replica mount is housed at the Cornell University Biological Field Station in Syracuse, and loans are coordinated by the author, who is employed at that location as a Fisheries Research Support Specialist.

DISPLAY USAGE

Since receiving the sturgeon model in the fall of 2012, we have done 15 educational displays. An overview of these is given in the table below, which also gives an idea of what types of agencies and groups have borrowed the display. Two of the largest events were the Syracuse and Rochester Sportsman's Shows, which are 3-day events that attract thousands of people. Other notable events include a display at the annual sturgeon stocking event; several elementary and college classroom displays; a display at the hatchery during spring spawning; and two fish and wildlife festivals. We've attempted to estimate attendance at each of these events, and believe that so far we have reached somewhere close to 17,500 people, a return on investment of approximately $0.06/person. Eight of the 15 events so far have been loans of the model to borrowing agencies, and we are elated that folks have been able to take advantage of this great resource for their fish and wildlife related events! We have actually had to decline four requests for usage because the display was already reserved for that weekend or time slot.

The sturgeon mount, which has been fondly dubbed "Stella the Sturgeon," is an absolute magnet for the

(Photo by Thomas E. Brooking)

public at these public displays, and Stella attracts people from far off with sometimes humorous reactions. Some people excitedly run up to the booth and can't wait to relate to you that they or their fishing buddies recently caught a huge sturgeon. Others are in awe at the sheer size of the fish, and some are even frightened that such a huge creature could be swimming around in the lake they swim in! Many are fascinated and enlightened to learn about such prehistoric creatures and their fascinating life history. Particularly rewarding are the children who come up, wide-eyed, dragging mom or dad to look at the huge fish that they can't wait to catch someday! I believe this truly exemplifies the heart and soul of the Gerald C. Corcoran Education Grant Program.

Stella's work is far from done, however. As of this writing, we have seven more events scheduled between July and September of 2013. We are also trying to make arrangements for Stella to be on display for the New York State Fair in Syracuse at the end of August with a potential attendance of >1 million people over 12 days.

SUMMARY

Sturgeon are truly the "Bald Eagle of fish," a remarkable and awe-inspiring fish, the likely source of many

Stella. (Scott Schlueter, NANFA rep for central NY, third from left.) (Photo by Thomas E. Brooking)

legends and mythical beasts. They are an important part of Native American culture and European history. Sturgeon have the potential to provide a significant trophy fishery, and would be the catch of a lifetime for many anglers. An important facet of angling lore is the perpetual hope to catch a Moby Dick, the freshwater version of Hemingway's "The Old Man and the Sea." Even today, as sturgeon populations are being restored, we see that excitement in anglers' faces as they relate their catches to us. This species survived unchanged for millions of years, but was decimated by humans in less than one sturgeon lifespan. It is only with public education and support that our under-funded environmental resource agencies can devote the needed funds and personnel to reverse these trends, and the generous donation from the Gerald C. Corcoran Education Grant Program has substantially advanced our sturgeon education program in NY. The future is bright for sturgeon in New York and many other Great Lakes areas, where restoration programs have seen encouraging success in recent times. NY Sturgeon For Tomorrow is very grateful for the help provided by the North American Native Fishes Association and the Corcoran Education Grant Program, and we encourage others to take advantage of this wonderful opportunity for education funding!

Acknowledgements

I would like to thank everyone who helped make this possible, especially the folks who make time in to serve on the Gerald C. Corcoran Education Grant Program Selection Committee. Also, many thanks to Scott Schlueter of the USFWS, whose help and encouragement were invaluable in making this a reality, and to Dawn Dittman (USGS) and Michael J. Lucas (NANFA Regional Representative) for writing letters in support of the grant application. Artist Gary R. Fitch did an amazing job volunteering to design a professional logo for us, and many volunteers gave up their weekends to help out at shows, including Scott Schlueter, Dawn Dittman, Emily Waldt, Mark Chalupnicki and others. Last, thanks to my wife and family for their support and putting up with all my hare-brained ideas!

Table. Summary of sturgeon educational displays.

Loan Date	Return Date	Affiliation	Attendance	Event Description
10/30/2012	10/30/2012	Cornell University	20	Group from Cazenovia College
11/6/2012	11/9/2012	NYSDEC Region 6	30	Stocking sturgeon at Salmon River
11/14/2012	11/14/2012	NYSDEC Region 6	40	Salmon River Central school
11/14/2012	11/30/2012	New York Power Authority	180	NYPA Visitors Center
11/30/2012	11/31/12	NYSDEC Region 6	40	Massena Elementary School
1/11/2013	1/13/2013	NY Sturgeon For Tomorrow	2000	OCC NY Sportsman's Show
1/25/2013	1/27/2013	NY Sturgeon For Tomorrow	8000	NY Fairgrounds Sportsman's Expo
3/1/2013	3/3/2013	NY Sturgeon For Tomorrow	5000	Rochester Sportsmen's Expo
4/3/2013	4/16/2013	Oneida Fish Hatchery	1200	walleye spawning run
4/6/2013	4/6/2013	Fat Nancy's Tackle Shop	declined	Spring Fishing Extravaganza
4/4/2013	4/7/2013	United Taxidermists of NY	declined	convention at Carrier Circle
4/1/2013	4/13/2013	Boy Scout group	declined	Saratoga County Trout Stocking
4/20/2013	4/20/2013	NYSDEC Region 6	300	Earth Day Event, Watertown State Office Bldg.
4/27/2013	4/27/2013	USGS	150	Tunison Lab Fishing Festival
4/27/2013	4/27/2013	SUNY Cobleskill	declined	Fish and Wildlife Festival
4/29/2013	4/29/2013	Cornell University	300	Oneida Lake Assoc. Annual Meeting
6/6/2013	6/6/2013	Cornell University	200	Bridgeport Elem. School Community Celebration
6/15/2013	6/15/2013	FWS Region 9	300	Dunkirk Fish and Wildlife Festival
6/25/2013	6/25/2013	Cornell University	50	Cornell Biological Field Station Open House
7/3/2013	7/3/2013	Cornell University	no data	Oswego County Fair
7/9/2013	7/9/2013	Cornell University	no data	Verona Beach Nature Festival
7/23/2013	7/23/2013	Cornell University	no data	Cornell Education Initiative Teacher Training Day
8/6/2013	8/18/2013	FWS Region 9	no data	Erie County Fair
8/22/2013	9/2/2013	NY Sturgeon For Tomorrow	no data	NY State Fair
9/7/2013	9/7/2013	FWS Region 9	no data	Buffalo 5k Run Fish and Wildlife Festival
9/7/2013	9/7/2013	Onondaga County	no data	Onondaga County Open House
9/20/2013	9/22/2013	NYS Conservation Council	no data	NYS Conservation Council fall convention
unknown	unknown	Cayuga Nature Center	no data	Nature Center display; not sure what dates
unknown	unknown	Sterling Nature Center	no data	Nature Center display; flexible dates

2013 NANFA CONVENTION SUMMARY

Josh Blaylock

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The 2013 edition of the annual NANFA Convention was held at Cumberland Falls State Park in Kentucky, and was hosted by Kentucky and Ohio Regional Representatives Josh Blaylock and Matt De La Vega. From May 2nd through the 5th, NANFA members were treated to some of the best that Kentucky has to offer. Cumberland Falls is one of the most beautiful places in the state of Kentucky. Geologists estimate that the rock over which the Cumberland River plunges is about 250 million years old. Often called the Niagara of the South, Cumberland Falls is the only place in the Northern Hemisphere where a Moonbow (a rainbow by moonlight) can be seen. The only other location on Earth is Victoria Falls in Africa. The State Park and Dupont Lodge gave NANFA members a great location and wonderful facilities, offering everything they needed, a rustic feel, and, of course, the delicious southern food provided by Riverview Restaurant.

The convention kicked off on Thursday, May 2nd, as guests arrived. Between their arrival and the first planned events, many people relaxed and explored Cumberland Falls and the surrounding area. That evening, Uland Thomas led a photo tank building workshop. Those who attended learned how to build photo tanks by actually building tanks that were auctioned off on Friday, with proceeds going to support NANFA.

On Friday, May 3rd, NANFA was treated to a variety of wonderful speakers. We were honored to have such a fine lineup of guests, including Kathlina Alford (Tennessee Aquarium Conservation Institute), Matt Thomas (Kentucky Department of Fish and Wildlife Resources), Brooke Washburn, (Morehead State University), J.R. Shute, (Conservation Fisheries, Inc.) Michael Hensley (The Nature Conservancy), David Cravens (Kentucky Center for Mollusk Conservation), Brian Zimmerman (NANFA), and a park ranger from Cumberland Falls. See below for a summary of each talk.

That evening we enjoyed a wonderful southern dinner from Riverview Restaurant, followed by the annual auction. This was likely the largest auction to date for a NANFA convention. Donations poured in from large corporations, small companies, and many NANFA members. Books, live fish, fishy folk art, and aquariums were just a few of the many items sold. Some of the more notable items were custom aquarium backgrounds donated by Designs by Nature, the NANFA-built photo tanks, Mike Lucas's handmade fish ornaments, and even a few cases of the 2013 convention's unofficial drink, Kentucky's original Ale-8-One. This year's auction was record breaking in both size and income.

Saturday, May 4th, was a big day in Kentucky as it marked the 139th running of the Kentucky Derby. It was also a big day for NANFA. Despite the weather—it was, I'm told, the first time it has rained on the field collection day of a NANFA convention—NANFA members came together to explore one of the most diverse areas in the United States. We arranged for three separate trips. Trip 1, led by host Matt DeLaVega, went to the Kentucky River drainage. Heading east, they had dry conditions for most of the day. As an added bonus, Matt Thomas from the KDFWR took them to a location where they could find Kentucky Arrow Darters. This site is frequently used by CFI for their work with the Arrow Darter. Though the group was limited to one river drainage, they caught an impressive number of species.

Trip 2 headed west and was led by Uland Thomas. Though they encountered rain at their first location, that didn't stop them. They headed back east and sampled some locations in the Middle Cumberland River drainage.

Trip 3, led by host Josh Blaylock, sampled locations in the Middle Cumberland River and upper Green River. This was a unique trip as there were multiple locations within the area that allowed us to sample very different habitats. This group also witnessed some spawning action of Longnose Gar. One member even got in on the action with a Golden Redhorse, but we'll leave it at that. Due to the drainages and locations, this trip yielded the highest number of species.

The heavy rain continued on Sunday, May 5th. Three trips were planned but had to be cancelled due

ACTION SHOTS FROM THE 2013 NANFA CONVENTION, KENTUCKY














Photos by Jenny Kruckenberg (*) and Fritz Rohde.

to the weather. Though most people began their trips home, one group stayed behind to brave the rain and find more species. We traveled north to locations in the Rockcastle River and Dix River. In the Rockcastle drainage we sampled Crooked Creek, which yielded plenty of the Kentucky endemic Striped Darter. We also seined in a unique cave-fed creek that holds an unusual looking Orangethroat Darter. We ended our day in the Dix River, where we caught the Sheltowee Darter.

Even with the poor weather on the collecting days, the convention was a great success. In the end, everyone had a great time. This convention didn't happen just through the efforts of Matt and I. I would like to take a few lines to thank a few deserving people. Casper Cox and his son, Cobalt, did an amazing job on the artwork for the convention logo and t-shirts. Dave Neely's illustration of the Kentucky Arrow Darter was spot on. I'm still blown away when I look at the overall work of the shirts and logos. Thanks to Michael Wolfe for all his work on the website and making sure it all worked; he really made us look good. Thanks to Tom Watson for handling the registration. Both Tom and Michael did a ton of work on the auction and without them it would not have been as successful as it was. Thanks also to Phil Nixon for once again stirring up the auction bids. Speaking of the auction, a HUGE thank you to all the NANFA members who donated and participated. Many people helped in some way, and I want to thank each of you, even if not by name. Finally, another big thank you to our speakers and to Cumberland Falls State Park. This year's convention was, in my opinion, a success. It brought in a record income for NANFA. Moving forward, I hope to have another convention in Kentucky soon, perhaps in the western part of the Commonwealth for a totally new experience.

PRESENTATIONS

Kathlina Alford: *Southern Brook Trout Propagation Program at the Tennessee Aquarium Conservation Institute*

The ever-humorous Kathlina spoke about her work at the Tennessee Aquarium. The Brook Trout (a char, not a trout) is the only native trout in the eastern United States and is a fall spawner. Northern and southern strains are genetically distinct. Northern fish reach 28 inches; southern fish are generally less than 8 inches. In 2011/12, 2,482 eggs were stripped, but as the males weren't up to the task and little milt was recovered, only 189 fry hatched. Of these, 101 juveniles were marked with visible elassomer tags and released into the stream; 8 of these were found in 2013 sampling. In 2012/13 the broodstock was kept in a recirculating system where the fry were raised up to 3–4 inches before release in August. The fertilization rate was 46% and the hatching rate was 88%. Some 1,098 eggs were obtained, of which 451 hatched and 320 were still alive. The fry grew too fast at 55° so the temperature was lowered to 47°. Some of the lessons learned so far: cold water cycles slowly; issues with ammonia; water changes in a cold system are difficult; spawning condition turns off with increased temperatures; juveniles are picky eaters; and they are growing too fast for an August release!

Matt Thomas: *Diversity and Distribution of Fishes in Kentucky*

Matt is the state ichthyologist. Kentucky has three regional watersheds: the Ohio River, the Tennessee River, and the lower Mississippi River. There are 12 major basins with 248 native fishes and 18 introduced species. The Cumberland basin has 171 species and the Green possesses 154. Some 68 species are in need of some action. Habitat and historical events shape distributions as does human activity. Several species display glacial vicariance with species in the Ozarks: the two arrow darters with the Niangua Darter, and the Frecklebelly Darter with the Bluestripe Darter. After this overview, Matt narrowed his presentation to discuss a recent survey of the Buck Creek system in the Cumberland drainage. Five species of concern are present in the lower reach, which is impounded. In earlier surveys, 73 species in 13 families were documented within the system. A recent re-survey at 47 localities caught 68 species in 16 families. New records were Mountain Brook Lamprey, Lake Sturgeon, Southern Cavefish and Redlips Darter. Combined with the earlier surveys, 81 species (9 introduced) have been documented in the Buck Creek system.

Cumberland Falls Park Ranger

The ranger provided an informative history of the park, the second established in Kentucky. The falls are unique in having a moonbow when a full moon's light is refracted through the mist.

J.R. Shute: *Propagation and Monitoring of the Rare Kentucky Arrow Darter and the Cumberland Darter*

J.R. spoke about the work that Conservation Fisheries Inc. has done for the past 20 years. At their facility, which houses 600 tanks holding 25,000 gallons, they have bred over 50 species and successfully re-introduced a number of protected species back into their historic streams. The Kentucky Arrow Darter (*Etheostoma sa-*

gitta) lives in small streams which can be easily impacted by coal mining, gas extraction, and siltation. CFI's goal is to develop propagation protocols so this species can be restored to its native streams. This species burns out more quickly in warmer water so CFI uses a chiller. Two lighting systems are used: one simulating daylight and the other to represent dawn and dusk. These fish are intolerant of one another when not spawning. During spawning, the female dives into the substrate and the male mounts her; they vibrate and bury themselves further in the sand. The eggs develop in the sand, and the fry hatch, swim up, and become pelagic. CFI captures larvae and places them in rearing tubs where they are fed rotifers, daphnia, and other small creatures. At about six months, visible elastomer tags are inserted. At 8 months females are gravid and males are colored up. CFI has re-captured 50 released fish, which is quite good considering the species' solitary nature. The Cumberland Darter (*E. susanae*) lays its eggs on the undersides of slab rocks and sticks. The male guards the eggs, which may have come from four or five females. CFI uses ceramic tiles and incubates eggs in shoe boxes. The larvae are not pelagic and grow quickly.

Brook Washburn: *Dispersal Ability of the Frecklebelly Darter (Percina stictogaster)*

Brook, a sophomore at Morehead State College, gave an impressive presentation. She and colleagues studied movements of this intolerant species—which has a pelagic lifestyle—and compared it to semi-pelagic darters and two benthic darters. Some 748 fish were tagged with visible elastomer implants; 10 died. Thirty-six individuals were recaptured (4.8%). No movement was observed in the benthic species. One *Percina sciera* (semi-pelagic) moved 767 meters. Two *P. stictogaster* were observed to travel 206 meters; one accomplished this overnight. Areas of concern included tagging mortality, tag retention and visibility, large rivers with obstructions to seining, increased predation (unlikely), and migration out of the study area.

Michael Hensley: *The Tennessee Nature Conservancy Green River Project*

Michael discussed the high diversity in the Green River drainage (which includes Mammoth Cave): 71 species of mussels, 152 fishes (7 endemic), and 42 troglodytes. Many are imperiled. The river is experiencing a lot of high bank erosion and TNC is partnering with Natural Resources Conservation Service to conduct a high bank erosion study. The Green River Lake Dam is one of four Army Corps of Engineers (ACOE) dams built in the Green River basin for flood control and recreation. The ACOE has agreed to change their method of draw down in the fall which will allow for increased mussel reproduction.

David Cravens: *Kentucky Center for Mollusk Conservation*

At one time Kentucky was home to 104 species of mussels. The number is now down to 84 and 27 of these are federally endangered. The Center is a flow-through facility and 54 species have been cultured with a number being released back into the wild. David showed some cool photos and videos of mussel lures, including a snuffbox snaring a Logperch.

Brian Zimmerman: *Captive Propagation*

Brian provided a very interesting and informative overview of his propagation of a number of different species in his outside ponds.

NANFA 2013 Financial Summary

SUBMITTED BY TOM WATSON, TREASURER

Beginning Balance:	**36,693.39** (as published in the October, 2013, *AC*)		
Membership Dues	8,185.32	**Debits and Disbursements**	
T-shirt/hat sales	1,827.12	AC Printing, Shipping	-9,983.60
AC CD Sales	156.26	Conservation Research Grants	-1,000.00
Card Sales	93.63	Corcoran Grant	-640.00
Convention	6,584.95	Website	-474.86
Donations	225.00	Miscellaneous Expense	-628.17
Misc. Income	73.82	Convention Expense	-1,239.78
Tate's Hell	2,099.72	Tate's Hell	-1,299.72
Total Income	**19,245.82**	**Total Debits**	**-15,266.13**
		Year End Balance	**40,673.08**

THE NORTH AMERICAN NATIVE FISHES ASSOCIATION

DEDICATED TO THE APPRECIATION, STUDY AND CONSERVATION OF THE CONTINENT'S NATIVE FISHES

AN INVITATION TO JOIN OR RENEW.

The North American Native Fishes Association is a not-for-profit, tax-exempt corporation that serves to bring together professional and amateur aquarists, anglers, fisheries biologists, ichthyologists, fish and wildlife officials, educators, and naturalists who share an interest in the conservation, study, and captive husbandry of North America's native fishes. A portion of each member's dues helps support two important initiatives: NANFA's Conservation Research Grant Program, which funds research on the biology and conservation of North America's most neglected and imperiled fishes; and the Gerald C. Corcoran Education Grant, which funds educational outreach programs aimed at children and the general public.

MEMBER BENEFITS

- *AMERICAN CURRENTS,* a quarterly publication featuring articles and news items on collecting, keeping, observing, conserving, and breeding North American fishes.
- **REGIONAL NANFA CHAPTERS.** State and regional aquarium groups where members may get together to collect and discuss native fishes, remove exotics, and perform conservation and stream restoration work.
- **NEW MEMBER PACKET.** An 8-page newsletter that's sent to new NANFA members introducing them to NANFA, and to the fascinating world of collecting, keeping and conserving North America's native fishes.
- **ANNUAL CONVENTION.** Where NANFA members from around the country meet for lectures, collecting trips, auctions, fun and finship. The 2014 meeting will be held in North Carolina (June 5th to 8th).
- **GRANT FUNDING.** Only NANFA members can apply for NANFA's Conservation Research Grant and Gerald C. Corcoran Education Grant programs. For details, see NANFA's website (www.nanfa.org), or contact Dr. Bruce Stallsmith, Conservation Grant Chair, 256-890-6992, fundulus@hotmail.com, or Scott Schlueter, Education Grant Chair, scott_schlueter@fws.gov.

DUES: USA, $30/year ◆ CANADA and MÉXICO, $35/year ◆ ALL OTHER COUNTRIES, $44/year (All amounts in US$)

Please renew or begin my NANFA membership, or send a gift membership to the person named below.

Enclosed are dues in the amount of $_____ for _____ year(s). In addition to my dues, I would like to make an additional tax-deductible contribution in the amount of $_____ to help fund NANFA's education and conservation programs.

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City _____ State/Prov. _____ Zip Code _____

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E-mail address _____

Upon request, we send a membership directory to NANFA members. This is a way for members to meet each other.

May we include your address in this directory? YES NO May we include your phone number? YES NO

If this is a gift membership, please say it is from: _____

Feel free to photocopy this page and share it with other native fish enthusiasts.

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